2020 MAGELLAN CLINICAL GUIDELINES
FOR
MEDICAL NECESSITY REVIEW

ADVANCED IMAGING GUIDELINES

SELECT HEALTH OF SOUTH CAROLINA

Effective: January 1, 2020

Guidelines for Clinical Review Determination

Preamble

Magellan is committed to the philosophy of supporting safe and effective treatment for patients. The medical necessity criteria that follow are guidelines for the provision of diagnostic imaging. These criteria are designed to guide both providers and reviewers to the most appropriate diagnostic tests based on a patient's unique circumstances. In all cases, clinical judgment consistent with the standards of good medical practice will be used when applying the guidelines. *Determinations are made based on both the guideline and clinical information provided at the time of the request.* It is expected that medical necessity decisions may change as new *evidence-based* information is provided or based on unique aspects of the patient's condition. The treating clinician has final authority and responsibility for treatment decisions regarding the care of the patient.

Guideline Development Process

These medical necessity criteria were developed by Magellan Healthcare for the purpose of making clinical review determinations for requests for therapies and diagnostic procedures. The developers of the criteria sets included representatives from the disciplines of radiology, internal medicine, nursing, cardiology, and other specialty groups. *Magellan's guidelines are reviewed yearly and modified when necessary following a literature search of pertinent and established clinical guidelines and accepted diagnostic imaging practices.*

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70336 – MRI Temporomandibular Joint (TMJ)

CPT Codes: 70336

INDICATIONS FOR TEMPOROMANDIBULAR JOINT (TMJ) MRI:

Locked or Frozen Jaw (Bag, 2014; Petscavage, 2014)

- For evaluation of dysfunctional temporomandibular joint after unsuccessful conservative therapy for at least four (4) weeks with bite block or splint and anti-inflammatory medicine (Bag, 2014; Gauer, 2015)

Abnormal initial x-ray needing additional imaging (Bag, 2014)

Pre-operative evaluation in candidates for orthognathic surgery

Post-Operative Evaluation (Hoffman, 2015)

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Temporomandibular joint (TMJ) dysfunction causes pain and dysfunction in the jaw joint and muscles controlling jaw movement. Symptoms may include: jaw pain, masticator muscle stiffness, limited movement or locking of the jaw, clicking or popping in jaw joint when opening or closing the mouth, and a change in how the upper and lower teeth fit together. The cause of the condition is not always clear but may include acute or chronic trauma to the jaw or temporomandibular joint, e.g., grinding of teeth, clenching of jaw, or impact in an accident. Osteoarthritis or rheumatoid arthritis may also contribute to the condition. The modality of choice for the evaluation of temporomandibular joint dysfunction is magnetic resonance imaging (MRI) which provides tissue contrast for visualizing the soft tissue and periarticular structures of the TMJ. "Manual therapy (including joint mobilization, manipulation, or treatment of the soft tissues) and therapeutic exercises in physical therapy treatments have been increasingly used by clinicians and researched due to positive outcomes…. Manual therapy has been used to restore normal ROM, reduce local ischemia, stimulate proprioception, break fibrous adhesions, stimulate synovial fluid production, and reduce pain" (Armijo-Olivo, 2016).

POLICY HISTORY:

Review Date: May 2019

Review Summary:

- Updated background information and references

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70450 – CT Head/Brain

CPT Codes: 70450 70460 70470

REDUCING RADIATION EXPOSURE:
Brain MRI is preferred to Brain CT in most circumstances where the patient can tolerate MRI and sufficient time is available to schedule the MRI examination. Assessment of subarachnoid hemorrhage, acute trauma or bone abnormalities of the calvarium (fracture, etc) may be better imaged with CT.

INDICATIONS FOR BRAIN CT:

For evaluation of known or suspected seizure disorder:
(Krumholz, 2007; Gaillard, 2009; Ramli, 2015)
- New onset of seizures or newly identified change in seizure activity/pattern AND cannot have a Brain MRI.

For evaluation of neurologic symptoms or deficits:
(ACR, 2019)
- Acute, new, or fluctuating neurologic symptoms or deficits such as, sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes.

For evaluation of clinical assessment documenting cognitive impairment of unclear cause:
(AAN; Narayanan, 2016; HQO, 2014)
- Change in mental status with a mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12).

For evaluation of known or suspected trauma:
(ACR, 2019a; Alrajhi, 2015; Jagoda, 2008; Menditto, 2012; Lee, 2005; Polinder, 2018)
- Known or suspected trauma or injury to the head with documentation of one or more of the following acute, new, or fluctuating:
  - Focal neurologic findings
  - Motor changes
  - Mental status changes
  - Amnesia
  - Vomiting
  - Seizures
  - Headache
  - Signs of increased intracranial pressure
- Known coagulopathy or on anticoagulation
- Known or suspected skull fracture by physical exam and/or positive x-ray.
- Repeat scan 24 hours post head trauma for anticoagulated patients with suspected diagnosis of delayed subdural hematoma.

- Post concussive syndrome if persistent or disabling symptoms and imaging has not been performed
- Subacute or chronic traumatic brain injury with new cognitive and/or neurologic deficit AND cannot have a Brain MRI

For evaluation of headache:
(Frischberg, 2000; Graham, 2000; Schafer, 2007; Edlow, 2008; Gunner, 2007; ACR, 2019; Kerjnick, 2008)

- Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration) and MRI is contraindicated or cannot be performed.
- Once in patients with cluster headaches to eliminate secondary causes, and MRI is contraindicated or cannot be performed.
- Acute, sudden onset of headache with a family history (brother, sister, parent or child) of brain aneurysm or AVM (arteriovenous malformation).
- New onset (< 48 hours) of "worst headache in my life" or "thunderclap" headache. Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes.
- Prior history of stroke or intracranial bleed with sudden onset of severe headache
- New onset of headache and any of the following and MRI is contraindicated or cannot be performed
    - Acute, new, or fluctuating neurologic deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination, or mental status changes or with signs of increased intracranial pressure.
    - History of cancer, or significantly immunocompromised
    - New temporal headache in person > 55, with sedimentation rate (ESR) > 55 with tenderness over the temporal artery and MRI is contraindicated or cannot be performed.
    - New severe unilateral headache with radiation to or from the neck. Associated with suspicion of carotid or vertebral artery dissection.
    - Related to activity or event (sexual activity, exertion, position) (new or progressively worsening)
    - Persistent or worsening during a course of physician directed treatment (ACR, 2019; Kuruvilla, 2015; Martin, 2011)
    - Special considerations in the pediatric population with persistent headache (Trofimova, 2018):
        - Occipital location
        - Age < 6 years
        - No family history of headache

For evaluation of known or suspected brain tumor, mass, or metastasis:
(NCCN, 2019)

- Follow up of known malignant tumor.
- Follow up of known benign tumor if symptomatic, new/changing signs or symptoms or complicating factors
- Follow up of known meningioma if MRI is contraindicated
- Known tumor and new onset of headache.
- Suspected tumor with any acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination or mental status changes.

- Suspected recurrence or metastasis in patients with a history of cancer [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Patient with history of cancer and a recent course of chemotherapy, radiation therapy (to the brain), or surgical treatment within the last two (2) years.
- Bone tumor or abnormality of the skull.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases:
(Sanellia, 2014)
- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine

For evaluation of known or suspected stroke:
(Jauch, 2013; Smith, 1998)
- Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes
- Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms.)
- Family history of aneurysm (brother, sister, parent or child)

For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess) and MRI is contraindicated or cannot be performed:
(Tunkel, 2008)
- Intracranial abscess or brain infection with acute altered mental status OR positive lab findings (such as elevated WBC's) OR follow up assessment during or after treatment completed.
- Meningitis with positive signs and symptoms (such as fever, headache, mental status changes, stiff neck) OR positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam.)
- Suspected encephalitis with headache and altered mental status, OR positive lab finding (such as elevated WBC's).
- Endocarditis with suspected septic emboli.
- Central Nervous System (CNS) involvement in patients with known or suspected vasculitis or autoimmune disease with positive lab findings.

For evaluation of known or suspected congenital abnormality (such as hydrocephalus, craniosynostosis):
(Ashwal, 2009; Vinocur, 2010; Marchese, 2017)
- Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes.
- Evaluation of macrocephaly in an infant/child with previously abnormal US, abnormal neurodevelopmental examination (Tan, 2018), signs of increased ICP or closed anterior fontanelle and MRI is contraindicated or cannot be performed
- Microcephaly and MRI is contraindicated or cannot be performed
- Follow up shunt evaluation within six (6) months of placement or one (1) year follow up and/or with neurologic symptoms.
- Craniosynostosis and other head deformities.
- Suspected or known hydrocephalus.
- Prior or planned treatment for congenital abnormality.

Known or suspected normal pressure hydrocephalus, (NPH):
(Damasceno, 2015)
- With symptoms of gait difficulty, cognitive disturbance and urinary incontinence

Pre-operative evaluation for brain/skull surgery.

Post-operative/procedural evaluation:
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Other indications for a Brain CT:
(Tarrant, 2008; Thust, 2014; Arkuszewski, 2010; Agostoni, 2009; DeFoer, 2006; ACR, 2019)
- Suspected acute subarachnoid hemorrhage (SAH).
- Follow up for known hemorrhage, hematoma, or vascular abnormalities**.**
- Suspected central venous thrombosis - see background
- Evaluation of neurological signs or symptoms in sickle cell disease.
- Vertigo associated with any of the following and MRI is contraindicated:
    - Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation) (Welgampola, 2019; Yamada, 2019)
    - Progressive unilateral hearing loss
    - Risk factors for cerebrovascular disease
- Evaluation of known or suspected cerebrospinal fluid (CSF) leakage.
- Immunocompromised patient (e.g., transplant recipients, HIV with CD4 < 200, primary immunodeficiency syndromes, hematologic malignancies) with focal neurologic symptoms, headaches, behavioral, cognitive, or personality changes.
- Global developmental delay or developmental delay with abnormal neurological examination (Ali, 2015; Momen, 2011) where MRI cannot be performed.
- Anosmia (loss of smell) (documented by objective testing).
- Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, new onset anisocoria, visual field deficit, etc.) (Chang, 2019).
- Horner's syndrome with symptoms localizing the lesion to the central nervous system (Lee, 2007).
- Prior to lumbar puncture in patients with suspected increased intracranial pressure or at risk for herniation.
- Suspected cholesteatoma.
- Evaluation of the cranial nerves when looking for bony abnormalities in the skull base, otherwise MRI is the study of choice.
- Psychological changes with neurological deficits or a full neurological assessment completed that suggests a possible neurologic cause and MRI cannot be performed

Indications for combination studies:
- **Brain CT/Neck CTA** –
    - Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits

- **Brain CT/Brain CTA -**
    - Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
    - Suspected venous thrombosis (dural sinus thrombosis) – Brain CTV see background

- **Brain CT/Brain CTA/Neck CT-**
    - Recent stroke or transient ischemic attack (TIA)
    - Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000).

- **Brain CT/Cervical CT** –
    - For evaluation of Arnold Chiari Malformation when MRI cannot be performed

Brain CT/Orbit CT-

- For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent orbital and intracranial pathology or tumor (e.g. "trilateral retinoblastoma").
- Unilateral papilledema: to distinguish a compressive lesion on the optic nerve or optic disc swelling associated with acute demyelinating optic neuritis in multiple sclerosis from nonarteritic anterior ischemic optic neuropathy (NAION), central retinal vein occlusion, or optic nerve infiltrative disorders.
- Bilateral papilledema with visual loss (Margolin, 2019)

BACKGROUND:

Computed tomography (CT) is an imaging technique used to view the structures of the brain and is useful in evaluating pathologies in the brain. It provides more detailed information on head trauma, brain tumors, stroke, and other pathologies in the brain than regular radiographs.

CT scan for congenital abnormalities - While MRI is preferred to CT for evaluation of most congenital CNS abnormalities, in some clinical situations CT is preferred (craniosynostosis) or equivalent to MRI. CT is appropriate in the follow up of hydrocephalus or VP shunt function where the etiology of hydrocephalus has been previously determined or in patients for which MRI evaluation would require general anesthesia.

CT scan for Headache - Generally, magnetic resonance imaging is the preferred imaging technique for evaluating the brain parenchyma and CT is preferable for evaluating subarachnoid hemorrhage. CT is faster and more readily available than MRI and is often used in urgent clinical situations. Neurologic imaging is warranted in patients with headache disorders along with abnormal neurologic examination results or predisposing factors for brain pathology.

CT scan for Head Trauma - Most types of head injury are minor injuries; clinical signs and symptoms help predict the need for brain CT following injury. CT has advantages in evaluating head injury due to its sensitivity for demonstrating mass effect, ventricular size and configuration, bone injuries and acute hemorrhage. A

patient who presents with certain clinical risk factors may be more likely to benefit from CT imaging. Some of the clinical risk factors that may be used as a guide to predict the probability of abnormal CT following minor head injury are vomiting, skull fracture and age greater than 60 years. Patients with a Glasgow Coma Scale of 15 or less who also have vomiting or suspected skull fracture are likely to show abnormal results on CT scan. CT is also useful in detecting delayed hematoma, hypoxic-ischemic lesions, or cerebral edema in the first 72 hours after head injury.

CT scan for Stroke – Patients presenting with symptoms of acute stroke should receive prompt imaging to determine whether they are candidates for treatment with tissue plasminogen activator. Non-contrast CT can evaluate for hemorrhage that would exclude the patient from reperfusion therapy. Functional imaging can be used to select patients for thrombolytic therapy by measuring the mismatch between "infarct core" and "ischemic penumbra" and may define ischemic areas of the brain with the potential to respond positively to reperfusion therapy. Contrast enhanced CT angiography (CTA) may follow the non-contrast CT imaging to identify areas of large vessel stenosis or occlusion which may be a target for therapy.

CT scan and Meningitis – In suspected bacterial meningitis, contrast CT may be performed before lumbar puncture to show beginning meningeal enhancement. It may rule out causes for swelling. CT may be used to define the pathology of the base of the skull and that may require therapeutic intervention and surgical consultation. Some causes of the infection include fractures of the paranasal sinus and inner ear infection.

CT and Meningioma – Although there is no consensus on optimal management, most patients who progressed did so within 5 years of diagnosis (Islim, 2019)

CT for Macrocephaly - Consider ultrasound in infants with macrocephaly and a normal neurological examination, no evidence of increased ICP and an open anterior fontanelle. If head US is normal the infant should be monitored closely (Smith, 1998). The anterior fontanelle generally closes between 10 and 24 months of age, with 3% closing between 5-9 months and 11% after 24 months (Pindrik, 2014).

CT and developmental delay – Significant developmental delay is defined as significant delay (more than two standard deviations below the mean) in one or more developmental domains: gross/fine motor, speech/language, cognition, social/personal, and activities of daily living. Isolated delay in social/language development is characteristic of autism spectrum disorders or hearing loss. Isolated delay in motor development is characteristic of cerebral palsy (a static encephalopathy) or myopathy. Global developmental delay (GDD): a subset of developmental delay defined as significant delay (by at least 2 SD's) in two or more developmental categories. Note that the term "GDD" is usually reserved for children < 5 y.o., whereas in older children > 5 y.o, disability is quantifiable with IQ testing.

CT and NPH - Although diagnosis can be made based on CT findings alone, MRI is more accurate for disclosing associated pathologies (such as cerebrovascular disease), excluding other potential etiologies and for detecting NPH typical signs of prognostic value. A CT scan can exclude NPH and is appropriate for screening purposes and in patients who cannot undergo MRI.

CT and Central Venous Thrombosis – a CTV or MRV is indicted for the definite evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial

hypertension syndrome, seizures, focal neurological deficits and encephalopathy. Risk factors are hypercoagulable states inducing genetic prothrombotic conditions, antiphospholipid syndrome and other acquired prothrombotic diseases such as cancer, oral contraceptives, pregnancy, puerperium (6 weeks postpartum), infections, and trauma. Since venous thrombosis can cause SAH, infarctions and hemorrhage parenchymal imaging with MRI/CT is also appropriate. (Ferro, 2016; Bushnell, 2014; Courinho, 2015).

CT for evaluation of the cranial nerves – Magnetic resonance imaging (MRI) is considered the gold standard in the study of the cranial nerves. Computed tomography (CT) allows, usually, an indirect view of the nerve and is useful to demonstrate the intraosseous segments of cranial nerves, the foramina through which they exit skull base and their pathologic changes. MRI is the study of choice in the evaluation of the cranial nerves. In optic neuritis, CT has limited utility. Contrast-enhanced CT scanning of the orbits may be able to help exclude other orbital pathology. CT scanning of the brain, regardless of whether intravenous contrast material is administered or not, does not yield prognostic and treatment-altering information. In Bell's Palsy temporal bone CT is useful in the evaluation of the caliber and the course of the IAC and bony facial nerve canal in the temporal bone. When using CT to evaluate the facial nerve, pathology often can only be inferred by visualization of erosion or destruction of the adjacent bony facial nerve canal. In contrast, MRI visualizes soft tissues well and so is better suited for evaluating soft tissue facial nerve abnormalities.

MMSE - The Mini Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The MMSE has been the most commonly used measure of cognitive function in dementia research, but researchers have recognized that it is relatively insensitive and variable in mildly impaired individuals. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely.

MoCA - The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. MoCA differs from the MMSE mainly by including tests of executive function and abstraction, and by putting less weight on orientation to time and place. Ten of the MMSE's 30 points are scored solely on the time-place orientation test, whereas the MoCA assigns it a maximum of six points. The MoCA also puts more weight on recall and attention-calculation performance, while de-emphasizing language skill. Time to administer the MoCA is approximately 10 minutes. The total possible score is 30 points; a score of 26 or above is considered normal.

CT and Vertigo – The most common causes of vertigo seen are benign paroxysmal positional vertigo (BPPV), vestibular neuronitis (VN) and Ménière's disease. These peripheral causes of vertigo are benign, and treatment involves reassurance and management of symptoms. Central causes of vertigo, such as cerebrovascular accidents (CVAs), tumors and multiple sclerosis (MS), need to be considered if the patient presents with associated neurological symptoms such as weakness, diplopia, sensory changes, ataxia or confusion. Magnetic resonance imaging is appropriate in the evaluation of patients with vertigo who have neurologic signs and symptoms, progressive unilateral hearing loss or risk factors for cerebrovascular disease. MRI is more appropriate than CT for diagnosing vertigo due to its superiority in visualizing the posterior

portion of the brain, where most central nervous system disease that causes vertigo is found. A full neurologic and otologic evaluation including provocative maneuvers, vestibular function testing and audiogram can help evaluate vertigo of unclear etiology and differentiate between central and peripheral vertigo.

MRI and staging in Non-CNS Cancers – as per NCCN guidelines

POLICY HISTORY:
Review Date: August 2019
Review Summary:

- For evaluation of neurologic symptoms or deficits, added: visual loss
- For trauma, added:
    - On anticoagulation
    - Post concussive syndrome if persistent or disabling symptoms and imaging has not been performed
    - Subacute or chronic traumatic brain injury with new cognitive and/or neurologic deficit and cannot have an MRI
- For evaluation of headache, added:
    - Prior history of stroke or intracranial bleed with sudden onset of severe headache(moved)
        - Related to activity or event (sexual activity, exertion, position) (new or progressively worsening)
        - New headaches and persistent or progressively worsening during a course of physician directed treatment
        - Special considerations in the pediatric population with persistent headache:
            - Occipital location
            - Age < 6 years
            - No family history of headache
    - Specified when MRI is contradicted for cluster headaches to eliminate secondary causes
- For evaluation of brain tumor:
    - Specified 'malignant' for f/u of known tumor
    - Added: Follow up of known benign tumor if symptomatic, new/changing signs or symptoms or complicating factors; Follow up of known meningioma if MRI is contraindicated
    - Removed: Known lung cancer or rule out metastasis and/or preoperative evaluation, Metastatic melanoma (not all melanomas)
- For evaluation of suspected stroke:
    - Moved 'patient with history of a known stroke with new and sudden onset of severe headache'
    - Separated: Family history of aneurysm
- For evaluation inflammatory disease or infections:
    - Changed meningitis with positive signs and symptoms from 'And' positive lab findings to 'OR' positive labs
    - For suspected encephalitis removed 'severe' headache
- For evaluation of congenital abnormality:

        - Modified the age restriction of > 6 months age for eval of macrocephaly to include 'in an infant/child with previously abnormal US, abnormal neurodevelopmental exam, signs of increased ICP or closed anterior fontanelle' and MRI is contraindicated
    - For suspected normal pressure hydrocephalus added 'with symptoms of gait difficulty, cognitive disturbance, and urinary incontinence

    - Other indications:
        - Added detail to Vertigo when MRI is contraindicated including:
            - Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation)
            - Progressive unilateral hearing loss
            - Risk factors for cerebrovascular disease
            - After full neurologic examination and ENT work-up with concern for central vertigo
        - Modified developmental delay to include: Global developmental delay or developmental delay with abnormal neurological examination
        - Added:
            - Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, new onset anisocoria, visual field deficit etc).
            - Horner's syndrome with symptoms localizing the lesion to the central nervous system
            - Psychological changes with neurological deficits or a full neurological assessment completed that suggests a possible neurologic cause and MRI cannot be performed
- For Brain CT/Neck CTA: added 'Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits'
    - Removed Confirmed carotid occlusion >60%, surgery or angioplasty candidate
- Added Brain CT/Brain CTA section, including: Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache; AND Suspected venous thrombosis (dural sinus thrombosis)
- Added Brain CT/Brain CTA/Neck CT section, including: Recent stroke or transient ischemic attack (TIA); AND Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology
- For Brain CT/Orbit CT, added: Bilateral papilledema with visual loss; AND changed age restriction from 3 years to 8 years for children requiring anesthesia for the procedure with suspicion of concurrent orbital and intracranial pathology or tumor
- Updated background information and references

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70480 – TEMPORAL BONE, MASTOID, ORBITS CT

CPT Codes: 70480, 70481, 70482

INDICATIONS FOR ORBIT CT:
(Kennedy, 2017; Hande, 2012)

- **Abnormal external or direct eye exam** (Hande 2011):
  - Exophthalmos (proptosis) or Enophthalmos (Aiyekomogbon, 2016)
  - Unilateral papilledema approve dedicated Orbits CT even if Brain CT approved (Hata, 2017; Margolin, 2019; Passi, 2013)
  - Ophthalmoplegia (Stalcup, 2013)
  - Documented Visual Field Defect (Kedar, 2011; Fadzil, 2013
    - Unilateral or with optic disc abnormality (Prasad, 2012)
    - Not explained by underlying diagnosis, glaucoma or macular degeneration
- **Ocular tumor, suspected or known** (Hande, 2011; Kedar, 2011)
  - Orbital trauma (Lin, 2012; Sung, 2014)
    - Physical findings of direct eye injury
    - Suspected orbital trauma with indeterminate x-ray or ultrasound
  - Clinical Suspicion of Orbital Inflammatory Disease (eg, eye pain with suspected pseudotumor) (Pakdaman, 2014)
  - Clinical Suspicion of infection (Gavito-Higuera, 2016; Kirch, 2017)
  - Clinical Suspicion of osteomyelitis (Arunkumar, 2011; Habib, 2016; Lee, 2016)
    - Direct visualization of boney deformity
    - Abnormal x-rays
  - Optic Neuritis
    - If atypical presentation, severe visual impairment or poor recovery following initial onset or treatment onset if MRI is contraindicated (CMSC, 2018; Voss, 2011)

COMBINATION OF STUDIES WITH ORBIT CT:

- Brain CT/Orbit CT
  - For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000).
  - Unilateral papilledema: to distinguish a compressive lesion on the optic nerve or optic disc swelling associated with acute demyelinating optic neuritis in multiple sclerosis from nonarteritic anterior ischemic optic neuropathy (NAION), central retinal vein occlusion or optic nerve infiltrative disorders.
  - Bilateral papilledema with vision loss if MRI is contraindicated (Margolin, 2019)

INDICATIONS FOR SELLA CT:

- Evaluation of sellar and parasellar masses (Donovan, 1996).
- Suspected or known Pituitary gland disorder (Pineyro, 2017; Wu, 2014)
  - Documented Visual Field Defect suggesting optic chiasm as cause

- Laboratory findings suggesting pituitary dysfunction
- Follow-up to other imaging suggesting sella (pituitary) mass

INDICATIONS FOR TEMPORAL/MASTOID/INTERNAL AUDITORY CANAL CT:

Hearing loss (documented on audiogram) (Cunnane, 2019; Sharma, 2018):

- Asymmetric Sensorineural when MRI is contraindicated (Krause, 2010; Verbist, 2012)
- Conductive or mixed (Trojanowsak, 2012)
- Congenital (Trojanowsak, 2012)
- Cochlear Implant evaluation (Juliano, 2015)

Pulsatile tinnitus or unilateral non-pulsatile tinnitus (Kessler, 2017; Pegge, 2017; Yew, 2014)

Ear Infection:

- **Clinical Suspicion of acute mastoiditis with some of the following signs or symptoms** (Patel, 2014; Platzek, 2014)
  - Ear infection
  - Postauricular swelling
  - Postauricular erythema
  - Protrusion of the auricle
  - Otalgia
  - Fever
- **Chronic Otitis Media with or without cholesteatoma on exam** (Gomaa, 2013; Patel, 2014)
  - Failed treatment for acute otitis media

Other Indications:

- Dehiscence of the jugular bulb or carotid canal (Bozek, 2016).
- Aberrant blood vessels or malformations (Bozek, 2016).

Peripheral vertigo based on clinical exam (Head-Impulse with saccade, Spontaneous unidirectional horizontal nystagmus, unsteady gait) (Muncie, 2017; Strupp, 2013; Sharma, 2018)

- Persistent symptoms after four weeks of treatment: medication and vestibular therapy (eg, Epley's maneuvers) if indicated
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure.

Post- operative/procedural evaluation:

- When imaging, physical, or laboratory findings indicate surgical or procedural complications.

BACKGROUND:
Computed tomography's use of thin sections with multi-planar reconstruction, (e.g., axial, coronal and sagittal planes) along with its three-dimensional rendering permits thorough diagnosis and management of ocular and orbital disorders. Brain CT is often ordered along with CT of the orbit for head injury with orbital trauma.

Temporal bone, mastoid, and internal auditory canal computed tomography (CT) is a unique study performed for problems such as conductive hearing loss, chronic otitis media, mastoiditis, cholesteatoma, congenital hearing loss and cochlear implants. It is a modality of choice because it provides 3D positional information and offers a high degree of anatomic detail. It is rarely used for evaluation of VIIth of VIIIth nerve tumors.

POLICY HISTORY:
Review Date: May 2019
Review Summary:
Orbit CT:

- Added clinical suspicion of osteomyelitis
- Removed orbital asymmetry; vision loss with etiology not identified on ophthalmologic; diplopia; suspected hyperthyroidism such as Graves' disease

Combination Brain CT/Orbit CT:

- Added bilateral papilledema w/vision loss if MRI is contraindicated

Sella CT:

- Added suspected or known pituitary gland disorder

Temporal/Mastoid/IAC CT:

- Expanded peripheral vertigo indication to include persistent symptoms after four weeks of treatment, medication and vestibular therapy
- Removed: acoustic neuroma or peripheral cranial nerve palsy

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70486 – Sinus Maxillofacial CT

CPT Codes: 70486, 70487, 70488, 76380

A single authorization for CPT codes 70486, 70487, 70488, or 76380 includes imaging of the entire maxillofacial area including face and sinuses. Multiple authorizations are not required.

INDICATIONS FOR SINUS & MAXILLOFACIAL CT:

- **Clinical Suspicion of osteomyelitis** (Arunkumar, 2011; Lee, 2016; Habib, 2016)
  - Direct visualization of lesion over bone
  - Abnormal x-rays
- **Clinical Suspicion of Fungal infection** (Gavito-Higuera, 2016; Kirch, 2017, Silveira, 2019)
- **Face mass** (Kirsch, 2017; Koeller 2016)**:**
  - Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed (Kuno, 2014)
    - Unless increased risk for malignancy based on (Pynnonen, 2017)
      - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin
    - Clinical concern for abscess
    - Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).

- **Rhinosinusitis** (Chiarella, 2017; Kaplan, 2013; Mishra, 2012; Rosenfeld, 2015, Varshney 2016)
  - Symptoms persist after four (4) consecutive weeks of medication, e.g., antibiotics, steroids or anti-histamines
  - Clinical suspicion of complications such as (Dankbaar, 2015)
    - Preseptal cellulitis
    - Orbital cellulitis
    - Subperiosteal abscess
    - Orbital abscess
    - Cavernous sinus thrombosis

- **Facial trauma** (Echo, 2010; Lin, 2012, Raju, 2017; Sung, 2014, Winegar, 2013)
  - Physical findings of direct facial bone injury
  - Suspected orbital trauma with indeterminate x-ray or ultrasound
  - CSF Leak (rhinorrhea or otorrhea) (Oh, 2017; Snetty, 2015)

- **Salivary gland stones** or clinical concern for abscess (Burke, 2011; Gadodia, 2011)

- **Refractory Asthma** (De Lucas, 2018; Sahay, 2016; Wener, 2013)
- **Anosmia** on objective testing (Policeni, 2017; Rouby, 2011; Zaghouani, 2013)
- **Granulomatosis** with polyangiitis (Wegener's granulomatosis) disease (Pakalniskis, 2015)
- **Deviated nasal septum, polyp, or other** structural abnormality seen on imaging or direct visualization that may be causing significant airway obstruction (Kirsch, 2017).

Pre-operative/procedural evaluation:
- Pre-operative evaluation for a planned surgery or procedure.

Post- operative/procedural evaluation:
- When imaging, physical, or laboratory findings indicate surgical or procedural complications.

COMBINATION OF STUDIES WITH SINUS & MAXILLOFACIAL CT:

Sinus CT/Chest CT:
- For poorly controlled asthma associated with upper respiratory tract infection. May be performed without failing 4 consecutive weeks of treatment with medication.
- Granulomatosis with polyangiitis (Wegener's granulomatosis) disease (GPA) (Lohrmann, 2006).

BACKGROUND:
Computed tomography (CT) primarily provides information about bony structures, but may also be useful in evaluating soft tissue masses. It can help document the extent of facial bone fractures, facial infections and abscesses, and can aid in diagnosing salivary stones. Additionally, CT may be useful in characterizing and identifying tumor extent in the face and may be used in the assessment of chronic osteomyelitis.

CT scans can provide more detailed information about the anatomy and abnormalities of the paranasal sinuses than plain films. A CT scan provides greater definition of the sinuses and is more sensitive than plain radiography for detecting sinus pathology, especially within the sphenoid and ethmoid sinuses. CT scan findings can be nonspecific, however, and should not be used routinely in the diagnosis of acute sinusitis. The primary role of CT scans is to aid in the diagnosis and management of recurrent and chronic sinusitis, or to define the anatomy of the sinuses prior to surgery.

OVERVIEW:
Don't order sinus computed tomography (CT) or indiscriminately prescribe antibiotics for uncomplicated acute rhinosinusitis (AAAAI, 2012). Viral infections cause the majority of acute rhinosinusitis and only 0.5 percent to 2 percent progress to bacterial infections. Most acute rhinosinusitis resolves without treatment in two weeks. Uncomplicated acute rhinosinusitis is generally diagnosed clinically and does not require a sinus CT scan or other imaging. Antibiotics are not recommended for patients with uncomplicated acute rhinosinusitis

who have mild illness and assurance of follow-up. If a decision is made to treat, amoxicillin should be first-line antibiotic treatment for most acute rhinosinusitis.

CT instead of MRI – MRI allows better differentiation of soft tissue structures within the sinuses. It is used occasionally in cases of suspected tumors or fungal sinusitis. Otherwise, MRI has no advantages over CT scanning in the evaluation of sinusitis. Disadvantages of MRI include high false-positive findings, poor bony imaging, and higher cost. MRI scans take considerably longer to accomplish than CT scans and may be difficult to obtain in patients who are claustrophobic.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added: Suspected orbital trauma w/indeterminate x-ray or US
- Added specifics to Face Mass:
    - Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed (Kuno, 2014)
    - Clinical concern for abscess
    - Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).
- Removed:
    - Hyposmia
    - Immunocompromised patient

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70490 – CT Soft Tissue Neck

CPT Codes: 70490, 70491, 70492

INDICATIONS FOR NECK CT:
(ACR, 2018b)

Known tumor or cancer of skull base, tongue, larynx, nasopharynx pharynx, or salivary glands
- Initial staging (Kuno, 2014)
- Restaging during treatment
- Suspected recurrence or metastases based on symptoms or examination findings
    - New mass
    - Change in lymph nodes (Vogel, 2016)
- Diagnosed Primary Hyperparathyroidism when surgery planned
    - Previous nondiagnostic ultrasound or nuclear medicine scan (Keogh, 2008; Tian, 2018)

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:
- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

Suspected tumor or cancer (not parotid region or thyroid):
- Suspicious mass/tumor found on an imaging study and needing clarification *or* found by physical exam (ACR, 2018a)
- Palpable suspicious lesions in mouth or throat (Kuno, 2014)
- Ultrasound (US) should be completed as the initial imaging for a parotid region mass to determine if the location is inside or outside the gland (ACR, 2018a; Burke, 2011; Cicero, 2018)
- For discrete cystic lesions of the neck, an ultrasound should be performed as initial imaging.
- For all other non-thyroid neck masses with high suspicion for malignancy, start with neck CT
- Increased risk for malignancy (ACR, 2018a) with one or more of the following findings (Pynnonen, 2017):
    - Fixation to adjacent tissues
    - Firm consistency
    - Size >1.5 cm
    - Ulceration of overlying skin
    - Mass present ≥ two weeks (or uncertain duration) without significant fluctuation and not considered of infectious cause

Known or suspected deep space infections or abscesses of the pharynx or neck (Meyer, 2009)

In pediatric patients (≤18) an ultrasound should be completed as initial imaging.
Neck masses are a common presenting complaint in the pediatric population with malignant causes less likely than in adults (Brown, 2016)

Pre-operative evaluation.

Post-operative/procedural evaluation (e.g. post neck dissection):

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Other indications for a Neck CT:

- Vocal cord lesions or vocal cord paralysis (Dankbaar, 2014)
- Salivary gland stones or suspected gland abscess or mass (Cicero, 2018).
- For evaluation of tracheal stenosis (Chung, 2011; Heidinger, 2015)
- Brachial plexus dysfunction (Brachial plexopathy/Thoracic Outlet Syndrome) (Ferrante, 2012; Tharin, 2014)
- To assess for foreign body when radiograph is inconclusive or negative (Guelfguat, 2014)
- To assess extent of thyroid tissue when other imaging suggests extension through the thoracic inlet into the mediastinum or concern for airway compression* (Lin, 2016; Gharib 2016)
- Dysphagia after appropriate work up including fluoroscopy, modified barium swallow, or biphasic esophagram (ACR, 2018b)

*__NOTE__: Chest CT may be included for preoperative assessment in some cases

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BACKGROUND:

High resolution CT can visualize both normal and pathologic anatomy of the neck. It is used in the evaluation of neck soft tissue masses, abscesses, and lymphadenopathy. For neck tumors, it defines the extent of the primary tumor and identifies lymph node spread. CT provides details about the larynx and cervical trachea and its pathology. Additional information regarding airway pathology is provided by three-dimensional images created from the CT dataset. Neck CT can also accurately depict and characterize tracheal stenoses.

With the rise of human papillomavirus-related oral, pharyngeal, and laryngeal cancers in adults, contrast enhanced neck CT has become more important for the evaluation of a neck mass, deemed at risk for malignancy, surpassing ultrasound for the initial evaluation in many cases. The American Academy of Otolaryngology-Head and Neck Surgery recently issued strong recommendations for neck CT or MRI, emphasizing the importance of a timely diagnosis (Pynnonen, 2017).

POLICY HISTORY:

Review Date: April 2019

Review Summary:

- Suspected Tumor or Cancer:
    - Added specification: "Suspected tumor or cancer *(not parotid region or thyroid)"* and removed non-diagnostic specification: 'Suspicious mass/tumor found on imaging study and needing clarification or found by physical exam *and remains non-diagnostic after x-ray or ultrasound is completed'*.
    - Added: "*Ultrasound should be completed as the initial imaging*"
    - Indication: Increased risk of malignancy, removed: '*No known infection and unknown duration with no fluctuation on exam'*; Added: "*Mass present ≥ two weeks without significant fluctuation and not considered of infectious origin*"
- For pediatric patients, added indication specifying an Ultrasound should be completed as initial imaging

- Added indications: Foreign body, brachial plexus, dysphagia, extent of thyroid tissue affected after other imaging completed or concern for airway compression
- Added Background information emphasizing the importance of timely diagnosis of neck mass with Neck CT, due to prevalence of HPV and associated oral, pharyngeal, and laryngeal cancers

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70496 – CT Angiography, Head/Brain

CPT Codes: 70496

INDICATIONS FOR BRAIN CTA:

For evaluation of known intracranial vascular disease:
(ACR, 2017; Sanelli, 2014; Colen, 2007; Khan, 2007; Zuccoli, 2011; Signhal, 2016; Ancelet, 2015)

- Known intracranial aneurysm or arteriovenous malformation (AVM).
- Known vertebrobasilar insufficiency (VBI).
- Vascular abnormality visualized on previous brain imaging.
- Known vasculitis, reversible cerebral vasoconstriction syndrome or Moyomoya disease

For evaluation of suspected intracranial vascular disease:
(ACR, 2017, Chalouhi, 2011; Villablanca, 2002; Jager, 2000; Lin, 2006; Hofmann, 2013)

- Screening for suspected intracranial aneurysm in patient whose parent, brother, sister, or child has history of intracranial aneurysm. Note: If there is a first degree familial history, repeat study is recommended every 5 years.
- Screening for aneurysm in polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, neurofibromatosis, or known aortic coarctation.
- Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
- Known subarachnoid hemorrhage (SAH).
- Spontaneous intracerebral hemorrhage with concern for underlying vascular abnormality
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Lima-Neto 2017; Searls, 2012).
- Suspected arteriovenous malformation (AVM) in patient with previous or indeterminate imaging study.
- Suspected venous thrombosis (dural sinus thrombosis)-ordered as CTV see background
- Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis.
- Pulsatile tinnitus to identify a vascular etiology.
- Suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.
- Suspected primary CNS vasculitis with infectious/inflammatory lab work-up, reversible cerebral vasoconstriction syndrome or Moyomoya disease (Godasi, 2019)
- Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200.
- Neurological signs or symptoms in sickle cell disease

Pre-operative/procedural evaluation for treatment, procedure, intervention, or brain/skull surgery (Farsad, 2009).

Post-operative/procedural evaluation (Sanelli, 2004; Wallace, 2007):

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for Brain CTA/Neck CTA combination studies:

- Recent stroke or transient ischemic attack (TIA)
- Known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness or numbness, abnormal speech, vision defects, incoordination or severe dizziness.
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Searls, 2012).
- Head trauma in a patient with closed head injury with suspected carotid or vertebral artery dissection; or spontaneous injuries due to weakness of vessel wall leading to dissection.
- Pulsatile tinnitus to identify vascular etiology (Pegge, 2017)
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010)
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (AAN, 2010; Brott, 2011; Rerkasem, 2011)

Indications for Brain CT/Brain CTA combination studies:

- Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
- Suspected venous thrombosis (dural sinus thrombosis) – CTV see background

Indications for Brain CT/Brain CTA/Neck CTA combination studies:

- Recent stroke or transient ischemic attack (TIA)
- Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology

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BACKGROUND:

Computed tomography angiography (CTA) is recognized as a valuable diagnostic tool for the management of patients with cerebrovascular disease. With its three-dimensional reconstructions, CTA can simultaneously demonstrate the bony skull base and its related vasculature. CTA use of ionizing radiation and an iodine-based intravascular contrast medium is a disadvantage when compared to magnetic resonance angiography (MRA) but it is quicker and requires less patient cooperation than MRA. CTA is much less invasive than catheter angiography which involves injecting contrast material into an artery.

CTA for Evaluation of Aneurysm – CTA is useful in the detection of cerebral aneurysms. The sensitivity of CTA to detect cerebral aneurysms ≤ 5 mm is higher than that with digital subtraction angiography (DSA). Most aneurysms missed with CTA are≤ 3mm. Aneurysms in the region of the anterior clinoid process may extend into the subarachnoid space where they carry the threat of hemorrhage. CTA can help delineate the borders of the aneurysm in relation to the subarachnoid space and may help detect acute ruptured aneurysms. It may be used in the selection of patients for surgical or endovascular treatment of ruptured intracranial aneurysms.

CTA for Screening of Patients with first degree relative (parent, brother, sister or child) have a history of aneurysm – Data has suggested that individuals with a parent, brother, sister, or child harboring an intracranial aneurysm are at increased risk of aneurysms. It is likely that multiple genetic and environmental risk factors contribute to the increased risk.

CTA for Evaluation of Vertebrobasilar Insufficiency (VBI) – Multidetector CT angiography (MDCTA) may be used in the evaluation of vertebral artery pathologies. The correlation between MDCTA and color Doppler sonography is moderate. CTA is used for minimally invasive follow-up after intracranial stenting for VBI. It enables visualization of the patency of the stent lumen and provides additional information about all brain arteries and the brain parenchyma.

CTA for evaluation of Arteriovenous Malformation (AVM) – A good correlation has been found between catheter angiography and CTA in the detection of arteriovenous malformations. CTA allows calculation of the volume of an AVM nidus and identifies and quantifies embolic material within it. CTA may be used for characterization and stereotactic localization before surgical resection or radiosurgical treatment of arteriovenous malformations.

CTA and Intracerebral Hemorrhage – CTA is useful as a screening tool for an underlying vascular abnormality in the evaluation of spontaneous intracerebral hemorrhage (ICH). Etiologies of spontaneous ICH include tumor, vascular malformation, aneurysm, hypertensive arteriopathy, cerebral amyloid angiopathy, venous thrombosis, vasculitis, RCVS, drug induced vasospasm, venous sinus thrombosis, Moyomoya disease, anticoagulant use and hemorrhagic transformation of an ischemic infarct. History can help point to a specific etiology. Possible risk factors for the presence of underlying vascular abnormalities include age younger than 65, female, lobar or intraventricular location, and the absence of hypertension or impaired coagulation.

CTV and Central Venous Thrombosis – a CT Venogram is indicted for the evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial hypertension syndrome, seizures, focal neurological deficits and encephalopathy. Risk factors are hypercoagulable states inducing genetic prothrombotic conditions, antiphospholipid syndrome and other acquired prothrombotic diseases such as cancer, oral contraceptives, pregnancy, puerperium (6 weeks postpartum), infections, and trauma. Since venous thrombosis can cause SAH, infarctions and hemorrhage parenchymal imaging with MRI/CT is also appropriate. (Ferro, 2016; Bushnell, 2014; Courinho, 2015; Waleki, 2015).

POLICY HISTORY:
Review Date: August 2019
Review Summary:
Added:

- Reversible cerebral vasoconstriction syndrome or Moyomoya disease
- Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache)
- Spontaneous intracerebral hemorrhage with concern for underlying vascular abnormality
- Suspected primary CNS vasculitis with infectious/inflammatory lab work-up, reversible cerebral vasoconstriction syndrome or Moyomoya disease

- Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity >200.
- Neurological signs or symptoms in sickle cell disease
- Further clarified:
    - Suspected vertebrobasilar insufficiency (VBI) symptoms
    - CTV for suspected central venous thrombosis
- For Brain CTA/Neck CTA combination studies:
    - Removed the past two-week restriction from 'recent stroke or TIA'
    - Clarified CVA symptoms to include - known or suspected carotid or cerebral artery occlusion with sudden onset of numbness or incoordination
    - Added spontaneous injuries due to weakness of vessel wall leading to dissection
    - Added Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
    - Added Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
- Added section for Brain CT/Brain CTA combination studies, including:
    - Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
    - Suspected venous thrombosis (dural sinus thrombosis)
- Added section for Brain CT/Brain CTA/Neck CTA combination studies, including:
    - Recent stroke or transient ischemic attack (TIA)
    - Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology
- Updated background info and refs

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70498 – CT Angiography, Neck

CPT Code: 70498

INDICATIONS FOR NECK CTA:
Patients poorly suited to MRA, because of claustrophobia or an implanted device may be better suited for CTA, whereas those with extensive calcification should have MRA (Adla, 2015).

Known or suspected vascular disease:
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) (Brott, 2011; Marquardt, 2010)
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) (Brott, 2011; Rerkasem, 2011)

Findings of Takayasu arteritis in other blood vessels on previous imaging (Zhu, 2012)
- May be useful in defining giant cell arteritis (Abdel Razek, 2014; Koster, 2018)

Subclavian steal syndrome when ultrasound is positive or indeterminate or for planning interventions (Potter, 2014)

Known or suspected tumor/pulsatile mass
- Carotid body tumors, or other masses such as a paraganglioma, arteriovenous fistula pseudoaneurysm, atypical lymphovascular malformation (Nguyen, 2011).

Note: Ultrasound (US) may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass.

Pre-operative evaluation

Post-operative/procedural evaluation (e.g. carotid endarterectomy):
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

INDICATIONS FOR COMBINATION STUDIES:

Neck CTA/Brain CTA:
- New onset stroke or transient ischemic attack (TIA) (ACR, 2016)
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Lima-Neto 2017; Searls, 2012)
- Head or neck blunt injury with suspected carotid or vertebral artery dissection (Franz, 2012; Liang, 2013; Mundinger, 2013; Simon, 2019); or spontaneous injuries due to weakness of vessel wall leading to dissection. Patients with blunt cervical trauma who meet Denver Screening criteria should be assessed for cerebrovascular injury (although about 20% will not meet criteria). The criteria include:
    - Focal or lateralizing neurological deficits (not explained by head CT)
    - Infarct on head CT

- Face, basilar skull, or cervical spine fractures
- Cervical hematomas that are not expanding
- Glasgow coma score less than 8 without CT finding
- Massive epistaxis
- Cervical bruit or thrill

- Pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017)
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010)
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (AAN, 2010; Brott, 2011; Rerkasem, 2011)

BACKGROUND:
For vascular disease, MRA and CTA are generally comparable. There is no current literature comparing the efficacy of contrast enhanced CT to CTA or MRI and MRA for evaluation of pulsatile neck mass, so any are approvable (Guneyli, 2014). CTA may be complementary to CT in the following settings: evaluation of a pulsatile neck mass to assess vascular detail when needed; assessment of relevant vascular anatomy for pre-procedural evaluation; vascular supply to tumors and vessel encasement and narrowing by tumors; extent of disease in vasculitis; and to help determine the nature and extent of congenital or acquired vascular anomalies.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Added initial statement describing the use of CTA versus MRA
- Suspected or known disease: Added “Giant cell arteritis” and “Subclavian steal syndrome when ultrasound is positive or indeterminate or for planning interventions
- “Known or suspected tumor/*pulsatile* mass”: Added ‘pulsatile’;
- Neck CTA/Brain CTA: Added Denver screening criteria to assess for cerebrovascular injury
- Added background information describing CTA and MRA as complimentary information to CT or MRI

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70540 – ORBIT, FACE, NECK, SINUS MRI

CPT Codes: 70540, 70542, 70543

A single authorization for CPT code 70540, 70542, or 70543 includes imaging of the Orbit, Face, Sinuses, and Neck. Multiple authorizations are not required.

INDICATIONS FOR ORBIT MRI:
(Kennedy, 2017; Hande, 2012)

- **Abnormal external or direct eye exam** (Hande, 2011):
  - Exophthalmos (proptosis) or Enophthalmos (Aiyekomogbon, 2016)
  - Unilateral papilledema approve dedicated Orbits MRI even if Brain MRI approved. (Hata, 2017; Passi, 2013)
  - Ophthalmoplegia (Stalcup, 2013)
  - Optic Neuritis (Gala, 2015; Srikajon, 2018; Voss, 2011)
    - If atypical presentation, severe visual impairment or poor recovery following initial onset or treatment onset (CMSC, 2018)
  - Documented Visual Field Defect (Kedar, 2011; Fadzil, 2013
    - Unilateral
    - Not explained by underlying diagnosis, glaucoma or macular degeneration
  - Ocular tumor (Hande, 2011; Kedar, 2011)

- **Orbital trauma** (Lin, 2012; Sung, 2014)
  - Physical findings of direct eye injury
  - Suspected orbital trauma with indeterminate x-ray or ultrasound

- **Clinical Suspicion of Orbital Inflammatory Disease** (e.g., eye pain with suspected pseudotumor) (Pakdaman, 2014)

- **Clinical Suspicion of infection** (Gavito-Higuera, 2016; Kirch, 2017)
- **Clinical Suspicion of osteomyelitis** (Lee, 2016; Habib, 2016; Arunkumar, 2011)
  - Direct visualization of boney deformity
  - Abnormal x-rays

INDICATIONS FOR FACE/SINUS MRI:
- Acute rhinosinusitis with suspected orbital or intracranial complications (Kirsch, 2017).
- Sinonasal obstruction. Suspected mass (Kirsch, 2017).
- Clinical Suspicion of Fungal infection (Gavito-Higuera, 2016; Kirch, 2017)
- Clinical Suspicion of osteomyelitis (Lee, 2016; Habib, 2016; Arunkumar, 2011)
  - Direct visualization of lesion over bone
  - Abnormal x-rays

- **Face mass** (Kirsch, 2017; Koeller, 2016)**:**
    - Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed (Kuno, 2014)
    - Clinical concern for abscess
    - Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).
    - Prior history of tumor with suspicion of recurrence

- **Facial trauma** (Lin, 2012; Sung, 2014; Raju, 2017; Winegar, 2013; Echo, 2010)
    - Physical findings of direct facial bone injury
    - Suspected orbital trauma with indeterminate x-ray or ultrasound
    - CSF Leak (rhinorrhea or otorrhea) (Oh, 2017; Snetty, 2015)

INDICATIONS FOR NECK MRI:

- Vocal cord lesions or vocal cord paralysis (Dankbaar, 2014).
- MR Sialography (Ren, 2015)
- Salivary gland stones or clinical concern for abscess (Burke, 2011)
- Brachial plexus dysfunction associated with suspected neck mass (Brachial plexopathy/Thoracic Outlet Syndrome) (Ferrante, 2012; Tharin, 2014)
- Palpable suspicious lesions in mouth or throat (Kuno, 2014).
- Primary hyperparathyroidism with nondiagnostic ultrasound or nuclear medicine scan and surgery is planned (Khan, 2014; Piciucchi, 2012).
- Non-thyroid neck mass:
    - Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed (Kuno, 2014)
        - Unless increased risk for malignancy based on (Pynnonen, 2017)
            - Any of these:
                - Fixation to adjacent tissues
                - Firm consistency
                - Size >1.5 cm
                - Ulceration of overlying skin
    - Clinical concern for abscess
    - Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).

OTHER INDICATIONS FOR ORBIT/FACE/SINUS/NECK MRI

Known tumor or cancer of skull base, orbits, sinuses, tongue, larynx, nasopharynx, pharynx, or salivary glands

- Initial staging (Kuno, 2013)
- Restaging during treatment
- Suspected recurrence or new metastases based on symptoms or examination findings
    - New mass
    - Change in lymph nodes (Hoang, 2013)
- Anosmia on objective testing (Policeni, 2017, Zaghouani 2013, Rouby 2011)

- Trigeminal neuralgia if < 40 years of age or atypical features (ie bilateral, hearing loss, dizziness/vertigo, visual changes, sensory loss, numbness, pain > 2min, pain outside trigeminal nerve distribution, progression) (Policeni, 2017; Hughes, 2016)
- Objective Cranial Nerve Palsy (Mumtaz, 2014; Policeni, 2017)
- Granulomatosis with polyangiitis (Wegener's granulomatosis) disease (Pakalniskis, 2015)

Pre-operative/procedural evaluation:
- Pre-operative evaluation for a planned surgery or procedure.

Post- operative/procedural evaluation:
- When imaging, physical, or laboratory findings indicate surgical or procedural complications.

INDICATIONS FOR COMBINATION STUDIES: ORBIT/FACE/ SINUS/NECK MRI WITH BRAIN MRI.
- Anosmia on objective testing (Policeni, 2017; Zaghouani, 2013)
- Trigeminal neuralgia (Policeni, 2017; Hughes, 2016)
- Cranial neuropathy (weakness or sensory abnormalities of the head and neck) (Policeni, 2017)
- Unilateral papilledema: to distinguish a compressive lesion on the optic nerve or optic disc swelling associated with acute demyelinating optic neuritis in multiple sclerosis from nonarteritic anterior ischemic optic neuropathy (NAION), central retinal vein occlusion or optic nerve infiltrative disorders.
- For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000).
- Bilateral papilledema with vision loss (Margolin, 2019)
- Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent or bilateral optic neuritis (Wingerchuk, 2015)

INDICATIONS FOR COMBINATION STUDIES: Initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:
- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

BACKGROUND:
Magnetic resonance imaging (MRI) is used in the evaluation of face and neck region masses, trauma, and infection. The soft-tissue contrast between normal and abnormal tissues provided by MRI is sensitive for differentiating between inflammatory disease and malignant tumors and permits the precise delineation of tumor margins. MRI is used for therapy planning and follow-up of face and neck neoplasms. It is also used for the evaluation of neck lymphadenopathy and vocal cord lesions.

CT scanning remains the study of choice for the imaging evaluation of acute and chronic inflammatory diseases of the sinonasal cavities. MRI is not considered the first-line study for routine sinus imaging because of limitations in the definition of the bony anatomy and length of imaging time. MRI for confirmation of diagnosis of sinusitis is discouraged because of hypersensitivity (overdiagnosis) in comparison to CT without

contrast. MRI, however, is superior to CT in differentiating inflammatory conditions from neoplastic processes. MRI may better depict intraorbital and intracranial complications in cases of aggressive sinus infection, as well as differentiating soft-tissue masses from inflammatory mucosal disease. MRI may also identify fungal invasive sinusitis or encephaloceles.

POLICY HISTORY:
Review Date: July 2019
Review Summary:
ORBIT MRI:

- Removed: Orbital asymmetry and Suspected hyperthyroidism (such as Graves' disease)
- Added: Clinical suspicion of osteomyelitis

Face/Sinus MRI

- Added specifics to Face Mass:
    - Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed (Kuno, 2014)
    - Clinical concern for abscess
    - Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).
    - Prior history of tumor with suspicion of recurrence
- Added: Facial trauma with physical findings of direct facial bone injury; suspected orbital trauma w/indeterminate x-ray or US; CSF leak (rhinorrhea or otorrhea)

Other Indications

- Added: Suspected recurrence or new metastases based on symptoms or examination findings with new mass or change in lymph nodes; Anosmia on objective testing; Trigeminal neuralgia if <40 years of age or atypical features; Objective cranial nerve palsy; and Granulomatosis with polyangiitis (Wegener's granulomatosis) disease

Indications for combo studies orbit/face/sinus neck MRI with brain MRI

- Added: Bilateral papilledema with vision loss AND Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent, or bilateral optic neuritis

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70544 – MR Angiography Head/Brain

CPT Codes: 70544, 70545, 70546

INDICATIONS FOR BRAIN (HEAD) MRA/MRV:

For evaluation of known intracranial vascular disease:
(ACR, 2017; Sanelli, 2014; Obusez, 2014; Jageer, 2000; Signhal, 2016; Ancelet, 2015)

- Known intracranial aneurysm or arteriovenous malformation (AVM).
- Known vertebrobasilar insufficiency (VBI).
- Vascular abnormality visualized on previous brain imaging.
- Known vasculitis, reversible cerebral vasoconstriction syndrome or Moyomoya disease (Ancelet, 2015; Tarasow, 2011)

For evaluation of suspected intracranial vascular disease:
(ACR, 2017; Chalouhi, 2011; Khan, 2007; Lin, 2006; Ayanzen, 2000; Hofmann, 2013; Abboud, 2003; Ryan, 2003; Zuccoli, 2011)

- Screening for suspected intracranial aneurysm in patient with a first-degree familial history (parent brother, sister, or child) of intracranial aneurysm. Note: Repeat study is recommended every 5 years.
- Screening for aneurysm in polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, neurofibromatosis, or known aortic coarctation.
- Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache) (Yeh, 2010)
- Known subarachnoid hemorrhage (SAH)
- Spontaneous intracerebral hemorrhage with concern for underlying vascular abnormality
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Searls, 2012)
- Suspected arteriovenous malformation (AVM) in patient with previous or indeterminate imaging study.
- Suspected central venous thrombosis (dural sinus thrombosis) - ordered as MRV see background
- Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis
- Pulsatile tinnitus to identify a vascular etiology.
- Suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.
- Suspected primary CNS vasculitis with infectious/inflammatory lab work-up, reversible cerebral vasoconstriction syndrome or Moyomoya disease (Ancelet, 2015; Godasi, 2019; Singhal, 2016; Tarasow, 2011)
- Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200.
- Neurological signs or symptoms in sickle cell disease
- Refractory trigeminal neuralgia when done for surgical planning (Leal, 2010)

Pre-operative/procedural evaluation for treatment, procedure, intervention, or brain/skull surgery (Farsad, 2009).

Post-operative/procedural evaluation
(Wong, 2007; Lee, 2009)

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for Brain MRA/Neck MRA combination studies:

- Recent stroke or transient ischemic attack (TIA)
- Known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness or numbness, abnormal speech, vision defects, incoordination or severe dizziness.
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Searls, 2012)
- Head trauma in a patient with closed head injury with suspected carotid or vertebral artery dissection; or spontaneous injuries due to weakness of vessel wall leading to dissection.
- Pulsatile tinnitus to identify vascular etiology (Pegge, 2017).
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010)
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (AAN, 2010; Brott, 2011; Rerkasem, 2011)

Indications for Brain MRI/Brain MRA combination studies:

- Recent stroke or transient ischemic attack
- Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
- Suspected venous thrombosis (dural sinus thrombosis) – MRV*

Indications for Brain MRI/Brain MRA/Neck MRA combination studies:

- Recent stroke or transient ischemic attack (TIA)
- Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000).

BACKGROUND:

Magnetic resonance angiography (MRA) or magnetic resonance venography (MRV) can be used as a first line investigation of intracranial vascular disease. It is an alternative to invasive intra-catheter angiography that was once the mainstay for the investigation of intracranial vascular disease. MRA/MRV may use a contrast agent, gadolinium, which is non-iodine-based, for better visualization. It can be used in patients who have history of contrast allergy and who are at high risk of kidney failure. A single authorization covers both MRA and MRV.

Three different techniques of MRA/MRV are: time of flight (both 2D and 3D TOF), phase contrast (PC), and contrasted enhanced angiography. Time of flight MRA takes advantage of the phenomena of flow related enhancement and is the preferred MRA technique due to the speed at which the exam can be quired.

MRA and Cerebral Aneurysms – Studies that compared MRA with catheter angiography in detecting aneurysms found that MRA could find 77% - 94% of the aneurysms previously diagnosed by catheter angiography that were larger than 5 mm. For aneurysms smaller than 5 mm, MRI detected only 10% - 60% of those detected with catheter angiography. On the other hand, aneurysms that were missed by catheter angiography in patients with acute subarachnoid hemorrhage were detected with MRA, due to the much larger number of projections available with MRA.

MRA and Cerebral Arteriovenous Malformations (AVM) – Brain arteriovenous malformation (AVM) may cause intracranial hemorrhage and is usually treated by surgery. 3D TOF-MRA is commonly used during the planning of radio-surgery to delineate the AVM nidus, but it is not highly specific for the detection of a small residual AVM after radio-surgery.

MRA and Intracerebral Hemorrhage – MRA is useful as a screening tool for an underlying vascular (Bekelis, 2012; Delgado, 2009) abnormality in the evaluation of spontaneous intracerebral hemorrhage (ICH). Etiologies of spontaneous ICH include tumor, vascular malformation, aneurysm, hypertensive arteriopathy, cerebral amyloid angiopathy, venous thrombosis, vasculitis, RCVS, drug induced vasospasm, venous sinus thrombosis, Moyomoya disease, anticoagulant use and hemorrhagic transformation of an ischemic infarct. History can help point to a specific etiology. Possible risk factors for the presence of underlying vascular abnormalities include age younger than 65, female, lobar or intraventricular location, and the absence of hypertension or impaired coagulation.

Combination MRI/MRA of the Brain – This is one of the most misused combination studies and other than what is indicated above these examinations should be ordered in sequence, not together. Vascular abnormalities can be visualized on the brain MRI.

MRV - A pitfall of the TOF technique, particularly 3D TOF, is that in areas of slowly flowing blood, turbulence or blood which flows in the imaging plane there can be regions of absent or diminished signal. The signal loss can be confused with vascular occlusion or thrombi. To avoid this pitfall MRA performed after the intravenous administration of gadolinium based contrast agents is utilized at many facilities.

Intracranial magnetic resonance venography (MRV) is used primarily to evaluate the patency of the venous sinuses. The study can be performed with TOF, Phase contrast and IV contrast enhanced techniques. Delayed images to allow for enhancement of the venous system are required to obtain images when intravenous gadolinium enhanced studies are undertaken.

Saturation pulses are utilized in studies not undertaken with intravenous contrast to help eliminate flow related signal in a specified direction and thus display the desired arterial or venous structures on their own. In cranial applications, saturation pulses applied at the inferior margin of the imaging field eliminate signal from arterial flow in order to visualize the veins. Conversely, superior saturation pulses are used to eliminate venous flow related enhancement when evaluation of the arterial structures is desired.

MRV and Central Venous Thrombosis* – a MR Venogram is indicted for the evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial hypertension syndrome, seizures, focal neurological deficits and encephalopathy. Risk factors are hypercoagulable states inducing genetic prothrombotic conditions, antiphospholipid syndrome and other acquired prothrombotic diseases such as cancer, oral contraceptives, pregnancy, puerperium (6 weeks postpartum), infections, and trauma. Since venous thrombosis can cause SAH, infarctions and hemorrhage parenchymal imaging with MRI/CT is also appropriate (Ferro, 2016; Bushnell, 2014; Courinho, 2015).

POLICY HISTORY:

Review Date: July 2019
Review Summary:

- Added:
  - Reversible cerebral vasoconstriction syndrome or Moyomoya disease
  - Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache)
  - Spontaneous intracerebral hemorrhage with concern for underlying vascular abnormality
  - Suspected primary CNS vasculitis with infectious/inflammatory lab work-up, reversible cerebral vasoconstriction syndrome or Moyomoya disease
  - Refractory trigeminal neuralgia when done for surgical planning
- Further clarified:
  - Suspected vertebrobasilar insufficiency (VBI) symptoms
  - MRV for suspected central venous thrombosis
- For Brain MRA/Neck MRA combo:
  - Removed the past two-week restriction from 'recent stroke or TIA'
  - Clarified CVA symptoms to include - known or suspected carotid or cerebral artery occlusion with sudden onset of numbness or incoordination
  - Added spontaneous injuries due to weakness of vessel wall leading to dissection
  - Added asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
  - Added symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
- Added section for Brain MRI/Brain MRA combination studies, including:
  - Recent stroke or transient ischemic attack
  - Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
  - Suspected venous thrombosis (dural sinus thrombosis)
- Added section for Brain MRI/Brain MRA/Neck MRA combination studies, including:
  - Recent stroke or transient ischemic attack (TIA)
  - Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology
- Updated background information and references

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70547 – MR Angiography Neck

CPT Codes: 70547, 70548, 70549

INDICATIONS FOR NECK MRA:

For evaluation of vascular disease:

- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) (Marquardt 2010; Brott, 2011).
- For evaluation of symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) (Brott, 2011).
- For evaluation of head or neck blunt injury for suspected carotid or vertebral artery dissection (Franz, 2012; Mundinger, 2013).
    - Focal or lateralizing neurological deficits
    - Face or cervical fractures
    - Cervical hematomas
    - Injury by severe cervical hyperextension/rotation or hyperflexion, or "clothesline"
    - Thoracic injury

Findings of Takayasu arteritis in other blood vessels (Zhu, 2012)
May be useful in defining giant cell arteritis (Abdel Razek, 2014; Koster, 2018)
Subclavian steal syndrome when ultrasound is positive or indeterminate or for planning interventions (Potter, 2014)

For evaluation of known or suspected tumor/pulsatile mass:

- For evaluation of carotid body tumors, or other masses such as a paraganglioma, arteriovenous fistula pseudoaneurysm, atyptical lymphovascular malformation (Nguyen, 2011)

Note: US may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass.

Pre-operative evaluation

Post-operative/procedural evaluation (e.g. carotid endarterectomy):

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

INDICATIONS FOR COMBINATION STUDIES:

Neck MRA/Brain MRA:

- Evaluation of new onset stroke or transient ischemic attack (TIA)
- For evaluation of known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech (Searls, 2012)
- Head or neck blunt injury for suspected carotid or vertebral artery dissection (Franz, 2012; Mundinger, 2013); or spontaneous injuries due to weakness of vessel wall leading to dissection. Patients with blunt cervical trauma who

meet Denver Screening criteria should be assessed for cerebrovascular injury (although about 20% will not meet criteria). The criteria include:
    - Focal or lateralizing neurological deficits (not explained by head CT)
    - Infarct on head CT
    - Face, basilar skull or cervical spine fractures
    - Cervical hematomas that are not expanding
    - Glasgow coma score less than 8 without CT finding
    - Massive epistaxis
    - Cervical bruit or thrill
- For evaluation of pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017).
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. internal carotid stenosis > 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011).
- For evaluation of symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019).

BACKGROUND:
For vascular disease, in general, MRA and CTA are comparable. There is no current literature comparing the efficacy of contrast enhanced CT to CTA or MRI and MRA for evaluation of pulsatile neck mass, so any are approvable. MRA may be complementary to MRI in the following settings: evaluation of a pulsatile neck mass to assess vascular detail when needed; assessment of relevant vascular anatomy for pre-procedural evaluation; vascular supply to tumors and vessel encasement and narrowing by tumors; extent of disease in vasculitis; and to help determine the nature and extent of congenital or acquired vascular anomalies (ACR, 2015).

MRA and Carotid Body Tumor – Carotid body tumors are found in the upper neck at the branching of the carotid artery. Although most of them are benign they may be locally aggressive with a small malignant potential. MRA may be used to identify a carotid body tumor due to its ability to define the extension of the tumor in relation to the carotid arteries, involvement of the base of the skull and bilateral tumors.

Post-operative evaluation of carotid endarterectomy – Carotid endarterectomy is a vascular surgical procedure that removes plaque from the carotid artery. MRA with multiprojection volume reconstruction is a non-invasive imaging modality that is an alternative to postoperative angiography following carotid endarterectomy. It allows the surgeon to get informative and comparative data.

POLICY HISTORY:
Review Date: April 2019
Review Summary:
- Suspected or known disease: Added “Giant cell arteritis” and “Subclavian steal syndrome when ultrasound is positive or indeterminate or for planning interventions
- “Known or suspected tumor/*pulsatile* mass”: Added ‘pulsatile’;
- Neck MRA/Brain MRA: Added Denver screening criteria to assess for cerebrovascular injury
- Added background information describing MRA and CTA as complimentary information to MRI or CT

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70551 – MRI Brain (includes Internal Auditory Canal)

CPT Codes:
70551, 70552, 70553 – Brain MRI
70540, 70542, 70543 - IAC

INDICATIONS FOR BRAIN MRI:

For evaluation of suspected multiple sclerosis (MS):
(CMSC, 2018; Traboulsee, 2016; Thompson, 2017)

- For evaluation of patient with neurologic symptoms or deficits suspicious for MS with
  - A clinically isolated syndrome (optic neuritis, transverse myelitis or brain stem syndrome) OR
  - Recurrent episodes of variable neurological signs or symptoms not attributable to another cause
- To demonstrate dissemination in time for diagnosis (6-12 months for high risk, 12-24 months for low risk)

For evaluation of known multiple sclerosis (MS):
(CMSC, 2018)

- To establish a new baseline (no recent imaging, postpartum, or 6-12 months after switching disease modifying therapy)
- Prior to starting or switching disease-modifying therapy
- Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years
- New signs or symptoms suggested of an exacerbation or unexpected clinical worsening
- PML surveillance for patients on natalizumab

For evaluation of known or suspected seizure disorder:
(Krumholz, 2007; Gaillard, 2009; Ramli, 2015)

- New onset of a seizure.
- Newly identified change in seizure activity/pattern
- Medically refractory epilepsy.

For evaluation of movement disorders:
(ACR, 2019a; Albanese, 2011; Mascalchi, 2012; McFarland, 2014; Pyatigorskaya, 2014; Sharifi, 2014)

- For evaluation of suspected Parkinson's with atypical feature or unresponsive to levodopa
- For evaluation of new non-Parkinson symptoms in known Parkinson's disease complicating the evaluation of the current condition.
- For the evaluation of other movement disorder to exclude a structural lesion (i.e., suspected Huntington disease, chorea, atypical parkinsonian syndromes, hemiballismus, secondary dystonia).

* MRI not indicated in essential tremor or primary dystonia (Alabanese, 2011; Sharfi, 2014)

For evaluation of neurologic symptoms or deficits:
(ACR, 2019)

- Acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes.

For evaluation of clinical assessment documenting cognitive impairment of unclear cause: (Narayanan, 2016; HQO, 2014)

- Change in mental status with a mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12).

For evaluation of known or suspected trauma:
(Lee, 2005; Jagoda, 2008; ACR, 2019, Polinder, 2018)

- Known or suspected trauma or injury to the head with documentation of one or more of the following acute, new, or fluctuating:
  - Focal neurologic findings
  - Motor changes
  - Mental status changes
  - Amnesia
  - Vomiting
  - Seizures
  - Headache
  - Signs of increased intracranial pressure
- Known coagulopathy or on anticoagulation
- Known or suspected skull fracture by physical exam and positive x-ray.
- Post concussive syndrome if persistent or disabling symptoms and imaging has not been performed
- Subacute or chronic traumatic brain injury with new cognitive and/or neurologic deficit

For evaluation of headache:
(Holle, 2013; Edlow, 2008; Schaefer, 2007; Wilbrink, 2009; ACR, 2019, Gunner, 2007)

- Chronic headache with a change in character/pattern (e.g., more frequent, increased severity, or duration).
- Once in patients with cluster headaches to eliminate secondary causes.
- Acute, sudden onset of headache with a family history (brother, sister, parent or child) of brain aneurysm or AVM (arteriovenous malformation).
- New onset (< 48 hours) of “worst headache in my life” or “thunderclap” headache. Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes.
- Prior history of stroke or intracranial bleed with sudden onset of severe headache
- New onset of headache and any of the following (ACR, 2019; Mitsikostas, 2016):
  - Acute, new, or fluctuating neurologic deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes or with signs of increased intracranial pressure.
  - History of cancer or significantly immunocompromised
  - Pregnancy

- Temporal headache in person > 55, with sedimentation rate (ESR) > 55 with tenderness over the temporal artery.
- Severe unilateral headache with radiation to or from the neck, associated with suspicion of carotid or vertebral artery dissection.
- Related to activity or event (sexual activity, exertion, position) (new or progressively worsening)
- Persistent or progressively worsening during a course of physician directed treatment (ACR, 2019; Kuruvilla, 2015; Martin, 2011)
- Special considerations in the pediatric population with persistent headache (Trofimova, 2018):
    - Occipital location
    - Age < 6 years
    - No family history of headache

For evaluation of known or suspected brain tumor, mass or metastasis:
(Kerjnick, 2008)

- Follow up of known malignant tumor.
- Follow up of known benign tumor if symptomatic, new/changing signs or symptoms or complicating factors
- Follow up of known meningioma
- Known tumor and new onset of headache.
- Suspected tumor with any acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes.
- Suspected recurrence or metastasis in patients with a history of cancer [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Patient with history of cancer and a recent course of chemotherapy, radiation therapy (to the brain), or surgical treatment within the last two (2) years (Chase, 2011; NCCN, 2017).
- Known or suspected pituitary tumor with corroborating physical exam (i.e., galactorrhea or acromegaly) neurologic findings and/or lab abnormalities.
    - Asymptomatic Macroadenoma (≥ 10mm) follow up every 6-18 months, post-surgical follow up 1-2 years after surgery (Dekkers, 2008)
    - Asymptomatic, non-functioning Microadenoma < 10mm repeat in one year; if stable, repeat every 2-3 years (Lake, 2013)
- Tumor evaluation and monitoring in neurocutaneous syndromes – see background

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases: (NCCN, 2017)

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected stroke:
(Jauch, 2013)

- Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes
- Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms).

- Family history (brother, sister, parent or child) of aneurysm

For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess)
(Lummel, 2016; Oliveira, 2014)
- Intracranial abscess or brain infection with acute altered mental status OR positive lab findings (such as elevated WBC's) OR follow up assessment during or after treatment completed.
- Meningitis with positive signs and symptoms (such as fever, headache, mental status changes, stiff neck) OR positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam.)
- Suspected encephalitis with a headache, altered mental status OR positive lab finding, (such as elevated WBC's).
- Endocarditis with suspected septic emboli.
- Central Nervous System (CNS) involvement in patients with known or suspected vasculitis or autoimmune disease with positive lab findings.

For evaluation of known or suspected congenital abnormality (such as hydrocephalus, craniosynostosis):
(Ashwal, 2009; Vinocur, 2010)
- Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes.
- Evaluation of macrocephaly in an infant/child with previously abnormal US, abnormal neurodevelopmental examination (Tan, 2018), signs of increased ICP or closed anterior fontanelle.
- Evaluation of microcephaly.
- Follow up shunt evaluation within six (6) months of placement or one (1) year follow up and/or with neurologic symptoms.
- Evaluation of craniosynostosis and other skull deformities. CT is preferred imaging to assess bony structures; MRI imaging is preferred to assess intracranial soft tissue
- Suspected or known hydrocephalus.
- Prior treatment OR treatment planned for congenital abnormality.

Known or suspected normal pressure hydrocephalus (NPH):
(Damasceno, 2015)
- With symptoms of gait difficulty, cognitive disturbance and urinary incontinence

Pre-operative evaluation for brain/skull surgery:

Post-operative/procedural evaluation:
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for a Brain MRI with Internal Auditory Canal (IAC):
(Labuguen, 2006)
- Unilateral non-pulsatile tinnitus.
- Pulsatile tinnitus.

- Suspected acoustic neuroma (Schwannoma) or cerebellar pontine angle tumor with any of the following signs and symptoms: unilateral hearing loss by audiometry, headache, disturbed balance or gait, unilateral tinnitus, facial weakness, or altered sense of taste.
- Suspected cholesteatoma.
- Suspected glomus tumor.
- Asymmetric sensorineural hearing loss on audiogram.

Other indications for a Brain MRI:
(Meadows, 2000; Thust, 2014; Agostoni, 2009; ACR, 2019; Mackin, 2014; Silva, 2009p; Strickberger, 2006)
- Evaluation of suspected acute subarachnoid hemorrhage (SAH).
- Follow up for known hemorrhage, hematoma or vascular abnormalities**.**
- Suspected central venous thrombosis - see background
- Evaluation of neurological signs or symptoms in sickle cell disease.
- Vertigo associated with any of the following:
    - Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation)
    - Progressive unilateral hearing loss
    - Risk factors for cerebrovascular disease
    - After full neurologic examination and ENT work-up with concern for central vertigo
- Evaluation of known or suspected cerebrospinal fluid (CSF) leakage.
- Immunocompromised patient (e.g., transplant recipients, HIV with CD4<200, primary immunodeficiency syndromes, hematologic malignancies) with focal neurologic symptoms, headaches, behavioral, cognitive or personality changes.
- Initial imaging of a suspected or known Arnold Chiari malformation (ACM)
- Initial evaluation for a known syrinx or syringomyelia.
- Global developmental delay or developmental delay with abnormal neurological examination (Ali, 2015; Momen, 2011)
- Anosmia (loss of smell) documented by objective testing
- Optic neuritis
- Abnormal eye findings on physical or neurologic examination (papilledema, pathologic nystagmus, ocular nerve palsies, new onset anisocoria, visual field deficit, etc) (Chang, 2019)
- Horner's syndrome with symptoms localizing the lesion to the central nervous system (Lee, 2007).
- Trigeminal Neuralgia – if <40 years of age or atypical features (ie bilateral, hearing loss, dizziness/vertigo, visual changes, sensory loss, numbness, pain >2min, pain outside trigeminal nerve distribution, progression) (Cruccu, 2016)
- Bell's Palsy- if atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset (Quesnel, 2010)
- Psychological changes with neurological deficits on exam or after completion of a full neurological assessment that suggests a possible neurologic cause (ACR, 2019b)

Indications for combination studies:
- **Brain MRI/Neck MRA**
    - Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits

- **Brain MRI/Brain MRA**
  - Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
  - Suspected venous thrombosis (dural sinus thrombosis) – Brain MRV see background

- **Brain MRI/Brain MRA/Neck MRA**
  - Recent stroke or transient ischemic attack (TIA)
  - Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent *vascular* and intracranial pathology (Lawson, 2000).

- **Brain MRI/Cervical MRI**
  - For evaluation of Arnold Chiari Malformation.
  - Suspected MS with new or changing symptoms consistent with cervical spinal cord disease.
  - For follow-up of known multiple sclerosis (MS)
  - Follow up to the initiation or change in medication for patient with known Multiple Sclerosis

- **Brain MRI/Orbit MRI**
  - For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent orbital and intracranial pathology or tumor (e.g. “trilateral retinoblastoma”).
  - Unilateral papilledema: to distinguish a compressive lesion on the optic nerve or optic disc swelling associated with acute demyelinating optic neuritis in multiple sclerosis from nonarteritic anterior ischemic optic neuropathy (AION), central retinal vein occlusion or optic nerve infiltrative disorders.
  - Bilateral papilledema with visual loss (Margolin, 2019)
  - Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent or bilateral optic neuritis (Wingerchuk, 2015)

- **Brain MRI/FACE/SINUS/NECK MRI**
  - Anosmia on objective testing (Policeni, 2017; Zaghouani, 2013)
  - Trigeminal neuralgia or cranial nerve palsy that meets the above criteria (Policeni, 2017, Hughes 2016)

BACKGROUND:
Brain (head) MRI is the procedure of choice for most brain disorders. It provides clear images of the brainstem and posterior brain, which are difficult to view on a CT scan. It is also useful for the diagnosis of demyelinating disorders (disorders such as multiple sclerosis (MS) that cause destruction of the myelin sheath of the nerve). The evaluation of blood flow and the flow of cerebrospinal fluid (CSF) is possible with this non-invasive procedure.

MMSE - The Mini Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The MMSE has been the most commonly used measure of cognitive function in dementia research, but researchers have recognized that it is

relatively insensitive and variable in mildly impaired individuals. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely.

MoCA - The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. MoCA differs from the MMSE mainly by including tests of executive function and abstraction, and by putting less weight on orientation to time and place. Ten of the MMSE's 30 points are scored solely on the time-place orientation test, whereas the MoCA assigns it a maximum of six points. The MoCA also puts more weight on recall and attention-calculation performance, while de-emphasizing language skill. Time to administer the MoCA is approximately 10 minutes. The total possible score is 30 points; a score of 26 or above is considered normal.

Combination MRI/MRA of the Brain – This is one of the most misused combination studies and other than what is indicated above these examinations should be ordered in sequence, not together. Vascular abnormalities can be visualized on the brain MRI.

MRI and Movement disorders - Atypical parkinsonian syndromes include progressive supranuclear palsy (PSP), multiple system atrophy (MSA), corticobasal degeneration (CBD), and dementia with Lewy bodies.

MRI for Headache - Generally, magnetic resonance imaging is the preferred imaging technique for evaluating the brain parenchyma and CT is preferable for evaluating subarachnoid hemorrhage. CT is faster and more readily available than MRI and is often used in urgent clinical situations. Neurologic imaging is warranted in patients with headache disorders along with abnormal neurologic examination results or predisposing factors for brain pathology. Contrast enhanced MRI is performed for evaluation of inflammatory, infectious, neoplastic and demyelinating conditions.

MRI and Meningioma – Although there is no consensus on optimal management, most patients who progressed did so within 5 years of diagnosis (Islim, 2019)

MRI for Macrocephaly - Consider ultrasound in infants with macrocephaly and a normal neurological examination, no evidence of increased ICP and an open anterior fontanelle. If head US is normal the infant should be monitored closely (Smith, 1998). The anterior fontanelle generally closes between 10 and 24 months of age, with 3% closing between 5-9 months and 11% after 24 months (Pindrik, 2014).

MRI and developmental delay – Significant developmental delay is defined as significant delay (more than two standard deviations below the mean) in one or more developmental domains: gross/fine motor, speech/language, cognition, social/personal, and activities of daily living. Isolated delay in social/language development is characteristic of autism spectrum disorders or hearing loss. Isolated delay in motor development is characteristic of cerebral palsy (a static encephalopathy) or myopathy. Global developmental delay (GDD): a subset of developmental delay defined as significant delay (by at least 2 SD's) in two or more developmental categories. Note that the term "GDD" is usually reserved for children <5 y.o., whereas in older children >5 y.o, disability is quantifiable with IQ testing.

MRI and NPH - Although diagnosis can be made based on CT findings alone, MRI is more accurate for disclosing associated pathologies (such as cerebrovascular disease), excluding other potential etiologies and for detecting NPH typical signs of prognostic value. A CT scan can exclude NPH and is appropriate for screening purposes and in patients who cannot undergo MRI (Damasceno, 2015).

MRI and Positron Emission Tomography (PET) for Chronic Seizures – When MRI is performed in the evaluation of patients for epilepsy surgery, almost a third of those with electrographic evidence of temporal lobe epilepsy have normal MRI scans. Interictal positron emission tomography (PET) may be used to differentiate patients with MRI-negative temporal lobe epilepsy.

MRI and Multiple Sclerosis – Current advances in MRI improve the ability to diagnose, monitor and understand the pathophysiology of MS. Different magnetic resonance methods are sensitive to different aspects of MS pathology and by the combining of these methods, an understanding of the mechanisms underlying MS may be increased.

MRI and Vertigo – The most common causes of vertigo seen are benign paroxysmal positional vertigo (BPPV), vestibular neuronitis (VN) and Ménière's disease. These peripheral causes of vertigo are benign, and treatment involves reassurance and management of symptoms. Central causes of vertigo, such as cerebrovascular accidents (CVAs), tumors and multiple sclerosis (MS), need to be considered if the patient presents with associated neurological symptoms such as weakness, diplopia, sensory changes, ataxia or confusion. Magnetic resonance imaging is appropriate in the evaluation of patients with vertigo who have neurologic signs and symptoms, progressive unilateral hearing loss or risk factors for cerebrovascular disease. MRI is more appropriate than CT for diagnosing vertigo due to its superiority in visualizing the posterior portion of the brain, where most central nervous system disease that causes vertigo is found. A full neurologic and otologic evaluation including provocative maneuvers, vestibular function testing and audiogram can help evaluate vertigo of unclear etiology and differentiate between central and peripheral vertigo.

MRI and Central Venous Thrombosis – a MV Venogram is indicted for the definite evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial hypertension syndrome, seizures, focal neurological deficits and encephalopathy. Risk factors are hypercoagulable states inducing genetic prothrombotic conditions, antiphospholipid syndrome and other acquired prothrombotic diseases such as cancer, oral contraceptives, pregnancy, puerperium (6 weeks postpartum), infections, and trauma. Since venous thrombosis can cause SAH, infarctions and hemorrhage parenchymal imaging with MRI/CT is also appropriate. (Ferro, 2016; Bushnell, 2014; Courinho, 2015).

MRI and Neurocutaneous Syndromes – In ***NF-1***, clinical evaluation appears to be more useful to detect complications than is screening imaging in asymptomatic patients. Imaging is indicated in evaluation of suspected tumors based clinical evaluation and for follow-up of known intracranial tumors (Borofsky, 2013). Conversely in ***NF-2***, routine MR imaging screening is always indicated, given the high prevalence of CNS tumors especially vestibular schwannomas. In patients with NF-2, routine screening brain/IAC imaging is indicated annually starting from age 10 if asymptomatic or earlier with clinical signs/symptoms. Most individuals with NF2 eventually develop a spinal tumor, mostly commonly schwannomas, but meningioma and ependymomas are also seen Spinal imaging at baseline and every 2 to 3 years is also advised with more

frequent imaging if warranted based on sites of tumor involvement (Evans, 2017). In patients with **Tuberous *Sclerosis***, Brain MRI should be obtained every 1-3 years up until age 25 for surveillance for CNS abnormalities (Krueger, 2013). In ***Von Hippel Lindau Syndrome,*** imaging of the brain and spinal cord for hemangioblastomas is recommended every 2 years (Rednam, 2017). In ***Sturge Weber Syndrome***, MRI can rule out intracranial involvement after only after age 1 and is recommended in patients <1 year only if symptomatic (Comi, 2011).

MRI and staging in Non-CNS Cancers – as per NCCN guidelines

MRI and Neuromyelitis optica spectrum disorders (NMOSD) (Wingerchuk, 2015) - NMOSD are inflammatory disorders of the central nervous system characterized by severe, immune-mediated demyelination and axonal damage predominantly affecting the optic nerves and spinal cord, but also the brain and brainstem. NMOSD can be distinguished from multiple sclerosis and other inflammatory disorders by the presence of the aquaporin-4 (AQP4) antibody. Features of NMOSD include attacks of bilateral or sequential optic neuritis acute transverse myelitis and the area postrema syndrome (with intractable hiccups or nausea and vomiting). The evaluation of suspected NMOSD entails brain and spinal cord neuroimaging. In contrast to MS (in which spinal cord involvement tends to be incomplete and asymmetric), NMOSD have a longer extent of spinal cord demyelination generally involving three or more vertebral segments.

POLICY HISTORY
Review Date: August 2019
Review Summary:

- For evaluation of patient with neurologic symptoms or deficits suspicious for MS: Added: “clinically isolated syndrome OR recurrent episodes of variable neurological signs or symptoms not attributable to another cause; And Removed time frame of ‘within the last 4 weeks’
- Removed: Stable condition with no prior imaging within the past ten (10) months or within the past six (6) months if patient has relapsing disease
- Removed**:** Exacerbation of symptoms or change in symptom characteristics such as frequency or type and demonstrated compliance with medical therapy.
- For evaluation of MS, added:
    - To establish a new baseline (no recent imaging, postpartum, or 6-12 months after switching disease modifying therapy)
    - Prior to starting or switching disease-modifying therapy
    - Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years
    - New signs or symptoms suggested of an exacerbation or unexpected clinical worsening
    - PML surveillance for patients on natalizumab
- For evaluation of known or suspected seizure disorder, added:
    - Newly identified change in seizure activity/pattern
- Renamed Parkinson’s section to: Movement disorders and added:
    - For the evaluation of other movement disorder to exclude a structural lesion (i.e., suspected Huntington disease, chorea, atypical parkinsonian syndromes, hemiballismus, secondary dystonia).
    - * MRI not indicated in essential tremor or primary dystonia
    - For suspected Parkinson’s, added ‘with atypical feature or unresponsive to levodopa

- For evaluation of neurologic symptoms or deficits, added: visual loss
- For trauma, added:
    - On anticoagulation
    - Post concussive syndrome if persistent or disabling symptoms and imaging has not been performed
    - Subacute or chronic traumatic brain injury with new cognitive and/or neurologic deficit
- For evaluation of headache, added or removed:
    - Prior history of stroke or intracranial bleed with sudden onset of severe headache (moved)
    - New headache and signs of increased intracranial pressure
    - Related to activity or event (sexual activity, exertion, position) (new or progressively worsening)
    - New headache and persistent or progressively worsening during a course of physician directed treatment
    - Special considerations in the pediatric population with persistent headache:
        - Occipital location
        - Age < 6 years
        - No family history of headache
- For evaluation of brain tumor:
    - Specified 'malignant' for f/u of known tumor
    - Added: Follow up of known benign tumor if symptomatic, new/changing signs or symptoms or complicating factors; Follow up of known meningioma; and tumor evaluation and monitoring in neurocutaneous syndromes
    - Removed: Known lung cancer or rule out metastasis and/or preoperative evaluation, Metastatic melanoma (not all melanomas)
- For evaluation of suspected stroke:
    - Moved 'patient with history of a known stroke with new and sudden onset of severe headache'
    - Separated: Family history of aneurysm
- For evaluation inflammatory disease or infections:
    - Changed meningitis with positive signs and symptoms from 'And' positive lab findings to 'OR' positive labs
    - For suspected encephalitis removed 'severe' headache
- For evaluation of congenital abnormality:
    - Modified the age restriction of > 6 months age for eval of macrocephaly to include 'in an infant/child with previously abnormal US, abnormal neurodevelopmental exam, signs of increased ICP or closed anterior fontanelle'
    - For known or suspected normal pressure hydrocephalus (NPH):
        - Added - With symptoms of gait difficulty, cognitive disturbance and urinary incontinence
    - Other Indications:
        - Added detail to Vertigo including:
            - Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation)
            - Progressive unilateral hearing loss
            - Risk factors for cerebrovascular disease
            - After full neurologic examination and ENT work-up with concern for central vertigo

- Modified developmental delay to include: Global developmental delay or developmental delay with abnormal neurological examination
- Added:
  - Horner's syndrome with symptoms localizing the lesion to the central nervous system
  - Trigeminal Neuralgia – if <40 years of age or atypical features (ie bilateral, hearing loss, dizziness/vertigo, visual changes, sensory loss, numbness, pain >2min, pain outside trigeminal nerve distribution, progression)
  - Bell's Palsy- if atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset.
  - Psychological changes with neurological deficits on exam or after completion of a full neurological assessment that suggests a possible neurologic cause
  - New onset anisocoria
- Removed Objective cranial nerve palsy; and Cholesteatoma (duplicated)

- For Brain MRI/Neck MRA: deleted 'confirmed carotid occlusion > 60%, surgery or angioplasty candidate' and added 'Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits'

- Added Brain MRI/Brain MRA section, including: Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache; and Suspected venous thrombosis (dural sinus thrombosis)

- Added Brain MRI/Brain MRA/Neck MRA section, including: Recent stroke or transient ischemic attack (TIA); and Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent *vascular* and intracranial pathology

- For Brain MRI/Cervical MRI, added: Suspected MS with new or changing symptoms consistent with cervical spinal cord disease; and Follow up to the initiation or change in medication for patient with known Multiple Sclerosis

- For Brain MRI/Orbit MRI, added: Bilateral papilledema with visual loss; and Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent or bilateral optic neuritis; AND changed age restriction from 3 years to 8 years for children requiring anesthesia for the procedure with suspicion of concurrent orbital and intracranial pathology or tumor

- Added section for Brain MRI/Face/Sinus/Neck MRI, including: Anosmia on objective testing; and Trigeminal neuralgia or cranial nerve palsy that meets the above criteria

- Updated background information and references

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70554 – Functional MRI Brain

CPT Codes: 70554, 70555

INDICATIONS FOR FUNCTIONAL BRAIN MRI (ACR, 2017)

Pre-operative/procedural Evaluation (Bizzi, 2008; Petrella, 2006)
In the following where fMRI may have a significant role in the mapping a lesion in relation to eloquent cortex (i.e., language, motor, sensory and visual centers)

- Focal brain lesion (i.e., tumor or vascular malformation) for presurgical planning (Jiao, 2017; Stancanello, 2017; Chakraborty, 2008; Hall, 2009)
- Brain tumor for radiation treatment planning (Liu, 2000; Wengenroth, 2011).
- Pre-operative evaluation for epilepsy surgery (Chandrasekharan, 2008)

Post-operative/procedural Evaluation:

- Therapeutic follow-up. A documented medical reason must clearly explain the medical necessity for follow up (ie evaluation of post-treatment eloquent cortex).

BACKGROUND:
Functional MRI (fMRI) of the brain is a non-invasive imaging technique, using radio waves and a strong magnetic field, to image the brain activity of a patient prior to undergoing brain surgery for tumors or epilepsy. It is based on the increase in blood flow to the local vasculature when parts of the brain are activated and helps to determine the location of vital areas of brain function. fMRI images capture blood oxygen levels in parts of the brain that are responsible for perception, cognition, and movement allowing neurosurgeons to operate with less possibility of harming areas that are critical to the patient's quality of life

fMRI and Brain Tumors – fMRI may significantly affect therapeutic planning in patients who have potentially resectable brain tumors. Due to its non-invasiveness, its relatively high spatial resolution, and its pre-operative results, fMRI is used before surgery in the evaluation of patients with brain tumors. fMRI may have a significant role in mapping lesions that are located in close proximity to vital areas of brain function (language, sensory motor, and visual). It can determine the precise spatial relationship between the lesion and adjacent functionally essential parenchyma, allowing removal of as much pathological tissue as possible during resection of brain tumors without compromising essential brain functions. fMRI provides an alternative to other invasive tests such as the Wada test and direct electrical stimulation.

fMRI and Seizures – Brain fMRI can influence the diagnostic and therapeutic decisions of the seizure team, thereby affecting the surgical approach and outcomes. Brain surgery is often the treatment for patients with epilepsy, especially patients with s single seizure focus. fMRI can be used to image and localize abnormal brain function in patients with seizures. fMRI can help determine brain functions (language, sensory motor, and visual) of areas bordering the lesion, resulting in better outcomes with less neurologic deficit.

fMRI as an Alternative to the Invasive WADA test and Direct Electrical Stimulation – fMRI is considered an alternative to the Wada test and direct electrical stimulation as it is a non-invasive method for location of vital brain areas. The Wada test is used for the pre-operative evaluations of patients with brain tumors and seizures to determine which side of the brain is responsible for vital cognitive functions, e.g., speech and memory. It can assess the surgical risk of damaging the vital areas of the brain. The Wada test is invasive, involving an angiography procedure to guide a catheter to the internal carotid where a barbiturate is injected, putting one hemisphere of the brain to sleep. Direct electrical stimulation mapping is invasive requiring the placement of electrodes in the brain. The electrodes are used to stimulate multiple cortical sites in the planned area of resection to allow the surgeons to identify and mark which areas can be safely resected.

POLICY HISTORY:
Review Date: August 2019
Review Summary:

- Modified pre-operative/procedural evaluation section to include focal brain lesion for pre-surgical planning, brain tumor for radiation treatment planning AND epilepsy surgery pre-operative evaluation.

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71250 – CT Chest (Thorax)

CPT Codes: 71250, 71260, 71270, G0297

INDICATIONS FOR CHEST CT:

For Annual Lung Cancer Screening:
The use of low-dose, non-contrast spiral (helical) multi-detector CT imaging as an annual screening technique for lung cancer is considered **medically necessary ONLY** when used to screen for lung cancer for certain high-risk **asymptomatic** individuals when **ALL** of the following criteria are met:

- Individual is between 55-77 years of age; **AND**
- There is at least a 30 pack-year history of cigarette smoking; **AND**
- If the individual is a former smoker, the individual quit smoking within the previous 15 years (Mazzone, 2018)

Nodule on Initial LDCT:
(Wood, 2018)

- If multiple nodules, the largest and type is used for decision

*See table in Background section for follow-up interval at which LDCT can be approved to reduce radiation dose (Yang, 2018)

This Chest CT Guideline covers CPT codes 71250 (CT chest without contrast), CT chest with contrast (71260), CT chest without and with contrast (71270) and Low dose CT scan (LDCT) for lung cancer screening (G0297). **When the case is listed as CT chest in BBI and the clinical scenario or request for LDCT in the office notes meets appropriate use criteria for a LDCT, the LDCT is approvable due to these overlapping CPT codes. Reprocessing of the case to a separate LDCT request is not required.**

Lung Nodules:
(MacMahon, 2017)

- Low Risk must include the following:
  - Age < 35 years old; **AND**
  - Non-smoker; **AND**
  - No family history of lung cancer

*See table in Background section

Known Cancer:
(Carter, 2018; Hong, 2014; Lee, 2014)

- Cancer staging
- Cancer restaging
- Signs or symptoms of recurrence

Lung or Chest Mass:

(Mullan, 2011)

- Mass or lesion, including lymphadenopathy, after non-diagnostic x-ray or ultrasound
- Mass with increased risk for malignancy (Pynnonen, 2017)
  - Any of the following:
    - Fixation to adjacent tissues
    - Firm consistency
    - Size > 1.5 cm
    - Ulceration of overlying skin
- Myasthenia Gravis, Thymoma screening (Kumar, 2015)

Interstitial Lung Disease:
(Nishino, 2014; Vij, 2013)

- Initial diagnostic imaging after standard chest x-ray
- Monitoring treatment response

Chronic Cough (> 8 weeks) and chest x-ray completed (Turner, 2016)

- After evaluation for other causes and failed treatment for those diagnosed
  - Asthma
  - Gastroesophageal Reflux Disease
  - Discontinuation of ACE inhibitors
  - Post Nasal Drip
- Clinical concern for bronchiestasis

Tuberculosis (TB):
(Ko, 2018)

- Known or suspected tuberculosis and initial chest x-ray done

Infection Follow-up Imaging:

- Abscess, empyema, or pleural effusions on chest x-ray (Dean, 2016)
- For evaluation of non-resolving pneumonia documented by **at least two** imaging studies:
  - Unimproved with 4 weeks of antibiotic treatment; **OR**
  - Unresolved at 8 weeks (Bryl, 2018; Little, 2014)

Pneumothorax on Chest X-ray (Melamed, 2017)

Vocal Cord Paralysis on Endoscopic Exam (Paquette, 2012)

Granulomatosis with Polyangiitis (Wegener's Granulomatosis) (Li, 2018)

Vascular Disease:

- Superior vena cava (SVC) syndrome (Friedman, 2017)
- Clinical concern for Acute Aortic dissection (Barman, 2014)
  - Sudden painful ripping sensation in the chest or back and may include:
    - New diastolic murmur

        - Cardiac tamponade
        - Distant heart sounds
        - Hypotension or shock
- Initial evaluation of aneurysm (Erbel, 2014; Hannuksela, 2015; Hiratzka, 2010)
    - Echocardiogram shows aneurysm
    - Echocardiogram inconclusive of proximal aorta and first degree relative with thoracic aneurysm
    - Chest x-ray shows aneurysm or tortuous aorta
- Follow-up after established Thoracic Aneurysm (above these sizes surgery is usually recommended) (Erbel, 2014; Hannuksela 2015; Hiratzka, 2010)
    - Aortic Root or Ascending Aorta
        - 3.5 to 4.5 Annual
        - 4.5 to 5.4 Every 6 months
    - Genetically mediated (Marfans syndrome, Aortic Root or Ascending Aorta
        - 3.5 to 4.0 Annual
        - 4.0 to 5.0 Every 6 months
    - Descending Aorta
        - 4.0 to 5.0 Annual
        - 5.0 to 6.0 Every 6 months

Suspected Pulmonary Embolism (PE):
- Chest CT not approvable for PE

Congenital Malformations
- Thoracic malformation on chest x-ray (Ferreira, 2015)
- Congenital Heart Disease with pulmonary hypertension (Pascall, 2018)

Hemoptysis after x-ray completed (Ketai, 2014)

Pre-operative evaluation

Post-operative/procedural evaluation:
- Post-surgical follow up when records document medical reason requiring additional imaging

- Pre-operative evaluation for Electromagnetic Navigation Bronchoscopy (Khan, 2016)

Combination of studies with Chest CT:
- **Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT with MUGA** – known tumor/cancer for initial staging or evaluation before starting chemotherapy or radiation treatment.

BACKGROUND:
Computed tomography (CT) scans provide greater clarity than regular x-rays and are used to further examine abnormalities found on chest x-rays. They may be used for detection and evaluation of various disease and

conditions in the chest, e.g., tumor, inflammatory disease, vascular disease, congenital abnormalities, trauma and symptoms such as hemoptysis.

***Fleischner Guidelines:**

Nodule Type	<6mm	6-8 mm	>8mm
Single solid, low cancer risk	N/A	6,12,18,24	3mo, consider PET Scan, no specific end point
Single solid, not low cancer risk	12 mos	6,12,18,24	3mo, consider PET Scan, no specific end point
Multiple solid, low cancer risk	N/A	3,6,18,24	3,6,18,24
Multiple solid, not low cancer risk	12 mos	3,6,18,24	3,6,18,24
Single ground glass	N/A	6,12, q24 until 5 yrs	6,12, q24 until 5 yrs
Single part solid	N/A	3,6, q12 until 5 yrs	3,6, q12 until 5 yrs
Multiple ground glass or part solid	3,6,24,48	3,6, adjust based on most suspicious nodule	3,6, adjust based on most suspicious nodule

OVERVIEW:
LDCT for Lung Cancer Screening - Screening should be discontinued once a person has not smoked for 15 years or develops a health problem that substantially limits life expectancy or the ability or willingness to have curative lung surgery

CT for Management of Hemoptysis – High-resolution CT (HRCT) is useful for estimating the severity of hemoptysis, localizing the bleeding site and determining the cause of the bleeding. Its results can be related to the severity of bleeding. The volume of expectorated blood and the amount of blood that may be retained within the lungs without being coughed up are important. HRCT is a way to evaluate the amount of bleeding and its severity. It may also help in the localization of bleeding sites and help in detecting the cause of bleeding.

CT and Solitary Pulmonary Nodules – Solitary Pulmonary nodules are abnormalities that are solid, semisolid and non-solid; another term to describe a nodule is focal opacity. CT makes it possible to find smaller nodules and contrast-enhanced CT is used to differentiate benign from malignant pulmonary modules. When a nodule is increasing in size or has spiculated margins or mixed solid and ground-glass attenuation, malignancy should be expected. Patients who have pulmonary nodules and who are immunocompromised may be subject to inflammatory processes.

CT and Empyema – Contrast-enhanced CT used in the evaluation of the chest wall may detect pleural effusion and differentiate a peripheral pulmonary abscess from a thoracic empyema. CT may also detect pleural space infections and help in the diagnosis and staging of thoracic empyema.

CT and Superior Vena Cava (SVC) Syndrome – SVC is associated with cancer, e.g., lung, breast and mediastinal neoplasms. These malignant diseases cause invasion of the venous intima or an extrinsic mass effect. Adenocarcinoma of the lung is the most common cause of SVC. SVC is a clinical diagnosis with typical symptoms of shortness of breath along with facial and upper extremity edema. Computed tomography (CT), often the most readily available technology, may be used as confirmation and may provide information including possible causes.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added chart for f/u interval at which LDCT can be approved
- Removed pulmonary embolism indication
- Added statement about CPT codes
- Separate diagnostic criteria for Thoracic aneurysm
- Separated individual diagnoses.
- Expanded criteria for chronic cough.
- Updated references.

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71275 – CT Angiography, Chest (non coronary)

CPT Codes: 71275

INDICATIONS FOR CHEST CTA:
Some indications are for magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), computed tomography (CT), or computed tomography angiography (CTA). More than one should not be approved at the same time.

Suspected Pulmonary Embolism (PE)
(ACCP, 2013; ACR, 2016; Corrigan, 2016; Kirsch, 2017; Konstantinides, 2014)

- High risk for PE based on shock or hypotension
- Not high risk but positive D-dimer (Corrigan, 2016; Konstantinides, 2014)

Low risk is not approved. Low risk is defined as **NO** to **ALL** of the following questions with intermediate and high risk defined based on the number of positive responses (Singh, 2013):

- Evidence of current or prior DVT;
- HR > 100;
- Cancer diagnosis;
- Recent surgery or prolonged immobilization;
- Hemoptysis;
- History of PE;
- Another diagnosis beside PE is less likely.

Vascular Disease

- Superior vena cava (SVC) syndrome (Friedman, 2017)
- Subclavian Steal Syndrome after positive or inconclusive ultrasound (Osiro, 2012; Potter, 2014)
- Thoracic Outlet Syndrome (ACR, 2014; Povlsen, 2018)
- Takayasu's arteritis (Keser, 2014)
- Clinical concern for Acute Aortic dissection (ACR, 2017; Barman, 2014)
    - Sudden painful ripping sensation in the chest or back and may include
        - New diastolic murmur
        - Cardiac tamponade
        - Distant heart sounds
        - Hypotension or shock

Thoracic Aortic Disease
If TTE was not performed was technically inadequate, or if imaging is required beyond the proximal ascending aorta

- Screening of first-degree relatives of individuals with a thoracic aortic aneurysm (defined as > 50% above normal) or dissection, or if an associated high-risk mutation is present

- If one or more first degree relatives of a patient with a known thoracic aortic aneurysm or dissection, have thoracic aortic dilatation, aneurysm or dissection, then imaging of 2nd degree relatives is reasonable
  - Six months follow up after initial finding of a dilated thoracic aorta, for assessment of rate of change
  - Annual follow up of enlarged thoracic aorta that is above top normal for age, gender, and body surface area
  - Biannual (twice/year) follow up of enlarged aortic root > 4.5 cm or showing growth rate > 0.5 cm/year
- Evaluation of the ascending aorta in known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection (e.g., Marfan syndrome, Ehlers Danlos or Loeys-Dietz syndromes) at time of diagnosis and 6 months thereafter for growth rate assessment, followed by annual imaging, or biannual (twice yearly) if diameter ≥ 4.5 or expanding ≥ 0.5 cm/yr
- Patients with Turner's syndrome should undergo imaging to assess for bicuspid aortic valve, coarctation of the aorta or dilation of the ascending or thoracic aorta. If the initial imaging is normal and there are no additional risk factors for dissection, imaging can be done every 5-10 years. If an abnormality exists, annual imaging is recommended
- Screening of first-degree relatives of patients with a bicuspid aortic valve
- Re-evaluation of known ascending aortic dilation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management
- Re-evaluation (<1 y, generally twice a year) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV with 1 of the following:
  - Aortic diameter ≥ 4.5 cm
  - Rapid rate of change in aortic diameter when an annual growth rate of ≥ 0.5 cm is suspected.
  - Family history (first-degree relative) of aortic dissection
- Follow up post medical treatment of aortic disease:
  - Acute dissection: 1 month, 6 months, then annually
  - Chronic dissection: annually
- Follow up post either root repair or AVR plus ascending aortic root/arch repair:
  - Baseline post-op, then annually

Congenital Malformations

- Thoracic malformation on other imaging (chest x-ray, echocardiogram, GI study, or inconclusive CT) (Ferreira, 2015; Hellinger, 2011; Karaosmanoglu, 2015; Poletto, 2017)
- Congenital heart disease with pulmonary hypertension (Pascall, 2018)
- Pulmonary sequestration (Long, 2016; Al-Timmy, 2016)

Pulmonary Hypertension based on other testing (Ascha, 2017; Rose-Jones, 2015)

- Echocardiogram
- Right heart catheterization

Atrial fibrillation with ablation planned (Kolandaivelu, 2012)

Preoperative evaluation

Postoperative or post-procedural evaluation

- Post-operatives complications (Bennet, 2017; Choudhury, 2017)
- Routine post-operatives (Uthof; 2012; SVS; 2018)
  - Thoracic endovascular aneurysm repair
    - 1 month
    - 6 month if initial abnormal or if for aortic dissection
    - Annual for 5 years
  - Open surgical repair
    - 5 year intervals

Chest CTA and Abdomen CTA or Abdomen/Pelvis CTA

Transcatheter Aortic Valve Replacement (TAVR) (ACR, 2017; Achenbach, 2012)

- Acute aortic dissection (Barman, 2014)
- Takayasu's arteritis (Keser, 2014)
- Post-operatives complications (Bennet, 2017; Choudhury, 2017)

BACKGROUND:

Computed tomography angiography is a non-invasive imaging modality that may be used in the evaluation of thoracic vascular problems. Chest CTA (non-coronary) may be used to evaluate vascular conditions, e.g., pulmonary embolism, thoracic aneurysm, thoracic aortic dissection, aortic coarctation, or pulmonary vascular stenosis. The vascular structures as well as the surrounding anatomical structures are depicted by CTA.

OVERVIEW:

CTA and Coarctation of the Aorta – Coarctation of the aorta is a common vascular anomaly characterized by a constriction of the lumen of the aorta distal to the origin of the left subclavian artery near the insertion of the ligamentum arteriosum. The clinical sign of coarctation of the aorta is a disparity in the pulsations and blood pressures in the legs and arms. Chest CTA may be used to evaluate either suspected or known aortic coarctation and patients with significant coarctation should be treated surgically or interventionally.

CTA and Pulmonary Embolism (PE) – **Note**: D-Dimer blood test in patients at low risk for DVT is indicated prior to CTA imaging. Negative D-Dimer suggests alternative diagnosis in these patients.

CTA has high sensitivity and specificity and is the primary imaging modality to evaluate patients suspected of having acute pulmonary embolism. When high suspicion of pulmonary embolism on clinical assessment is combined with a positive CTA, there is a strong indication of pulmonary embolism. Likewise, a low clinical suspicion and a negative CTA can be used to rule out pulmonary embolism.

CTA and Thoracic Aortic Aneurysms – Computed tomographic angiography (CTA) allows the examination of the precise 3-D anatomy of the aneurysm from all angles and shows its relationship to branch vessels. This information is very important in determining the treatment: endovascular stent grafting or open surgical repair.

CTA and Thoracic Aorta Endovascular Stent-Grafts – CTA is an effective alternative to conventional angiography for postoperative follow-up of aortic stent grafts. It is used to review complications after thoracic endovascular aortic repair. CTA can detect luminal and extraluminal changes to the thoracic aortic after stent-grafting and can be performed efficiently with fast scanning speed and high spatial and temporal resolution.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Expanded vascular indications including:
  - Superior vena cava syndrome
  - Takayasu's arteritis
  - Subclavian steal syndrome after positive or inconclusive ultrasound
- Expanded indications for congenital anomalies to include pulmonary sequestration
- Updated thoracic aortic section to match cardiac guidelines

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71550 – MRI Chest (Thorax)

CPT Codes: 71550, 71551, 71552

INDICATIONS FOR CHEST MRI:
Some indications are for magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), computed tomography (CT), or computed tomography angiography (CTA). More than one should not be approved at the same time.

Lung or Chest Mass
(Azizad, 2016; Carter, 2015, 2016, 2017; Hochhegger, 2011; Mullan, 2011)

- Mass or lesion, including lymphadenopathy, after non-diagnostic x-ray or ultrasound, Chest CT indicated for pulmonary nodule.
- Mass with increased risk for malignancy (Pynnonen, 2017)
    - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin

Thoracic Aortic Disease
If TTE was not performed, was technically inadequate, or if imaging is required beyond the proximal ascending aorta

- Screening of first-degree relatives of individuals with a thoracic aortic aneurysm (defined as ≥ 50% above normal) or dissection, or if an associated high-risk mutation is present
    - If one or more first degree relatives of a patient with a known thoracic aortic aneurysm or dissection, have thoracic aortic dilatation, aneurysm or dissection, then imaging of 2nd degree relatives is reasonable
        - Six months follow up after initial finding of a dilated thoracic aorta, for assessment of rate of change
        - Annual follow up of enlarged thoracic aorta that is above top normal for age, gender, and body surface area
        - Biannual (twice/year) follow up of enlarged aortic root ≥ 4.5 cm or showing growth rate ≥ 0.5 cm/year
            - Evaluation of the ascending aorta in known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection (e.g., Marfan syndrome, Ehlers Danlos or Loeys-Dietz syndromes) at time of diagnosis and 6 months thereafter for growth rate assessment, followed by annual imaging, or biannual (twice yearly) if diameter ≥ 4.5 or expanding ≥ 0.5 cm/yr
            - Patients with Turner's syndrome should undergo imaging to assess for bicuspid aortic valve, coarctation of the aorta or dilation of the ascending or thoracic aorta. If the initial imaging is normal and there are no additional risk factors for dissection, imaging can be done every 5-10 years. If an abnormality exists, annual imaging is recommended

        - Screening of first-degree relatives of patients with a bicuspid aortic valve
        - Re-evaluation of known ascending aortic dilation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management
        - Re-evaluation (<1 y, generally twice a year) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV with 1 of the following:
    - Aortic diameter ≥ 4.5 cm
    - Rapid rate of change in aortic diameter when an annual growth rate of ≥ 0.5 cm is suspected.
    - Family history (first-degree relative) of aortic dissection
- Follow up post medical treatment of aortic disease:
    - Acute dissection: 1 month, 6 months, then annually
    - Chronic dissection: annually
        - Follow up post either root repair or AVR plus ascending aortic root/arch repair:
            - Baseline post-op, then annually

Myasthenia Gravis, Thymoma screening (Kumar, 2015)

Thoracic Outlet Syndrome (ACR, 2014; Povlsen, 2018; Chavhan, 2017; Smith, 2015)

- Based on provocative testing or prior imaging

Brachial Plexopathy (Vijayasarathi, 2016)

Vascular Disease (Kircher, 2012; Rajiah, 2013)

- Superior vena cava (SVC) syndrome (Friedman, 2017)
- Subclavian Steal Syndrome after positive or inconclusive ultrasound (Osiro, 2012; Potter, 2014)
- Thoracic Outlet Syndrome (ACR, 2014; Povlsen, 2018; Chavhan, 2017)
- Takayasu's arteritis (Keser, 2014)
- Clinical concern for acute aortic dissection (ACR, 2017; Barman, 2014)
    - Sudden painful ripping sensation in the chest or back and may include
        - New diastolic murmur
        - Cardiac tamponade
        - Distant heart sounds
        - Hypotension or shock

Congenital Malformations

- Thoracic malformation on other imaging (chest x-ray, echocardiogram, gastrointestinal study, or inconclusive CT) (Ferreira 2015, Hellinger 2011, Karaosmanoglu 2015, Poletto 2017)
- Congenital heart disease with pulmonary hypertension (Pascall 2018)
- Pulmonary sequestration (Long 2016, Al-Timmy 2016)

Pulmonary hypertension based on other testing (Ascha 2017, Rose-Jones 2015)

- Echocardiogram
- Right heart catheterization

Atrial fibrillation with ablation planned (Kolandaivelu 2012)

Preoperative Evaluation

Post-operative/procedural evaluation:

- Post-surgical follow up when records document medical reason requiring additional imaging

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BACKGROUND:

Magnetic Resonance Imaging (MRI) is a noninvasive imaging technique for detection and evaluation of various disease and conditions in the chest, e.g., congenital anomalies and aneurysms. MRI may be used instead of computed tomography (CT) in patients with allergies to radiographic contrast or with impaired renal function.

OVERVIEW:

MRI and Myasthenia Gravis – Myasthenia Gravis is a chronic autoimmune disease characterized by weakness of the skeletal muscles causing fatigue and exhaustion that is aggravated by activity and relieved by rest. It most often affects the ocular and other cranial muscles and is thought to be caused by the presence of circulating antibodies. Symptoms include ptosis, diplopia, chewing difficulties, and dysphagia. Thymoma has a known association with myasthenia. Contrast-enhanced MRI may be used to identify the presence of a mediastinal mass suggestive of myasthenia gravis in patients with renal failure or allergy to contrast material.

MRI and Thoracic Outlet Syndrome – Thoracic outlet syndrome is a group of disorders involving compression at the superior thoracic outlet that affects the brachial plexus, the subclavian artery and veins. It refers to neurovascular complaints due to compression of the brachial plexus or the subclavian vessels. Magnetic resonance multi-plane imaging shows bilateral images of the thorax and brachial plexus and can demonstrate the compression of the brachial plexus and venous obstruction.

MRI and Brachial Plexus - MRI is the only diagnostic tool that accurately provides high resolution imaging of the brachial plexus. The brachial plexus is formed by the cervical ventral rami of the lower cervical and upper thoracic nerves which arise from the cervical spinal cord, exit the bony confines of the cervical spine, and traverse along the soft tissues of the neck, upper chest, and course into the arms.

POLICY HISTORY:

Review Date: May 2019

Review Summary:

- Expanded indications including: vascular and congenital anomalies
- Updated thoracic aortic section and reformatted to match other guidelines.

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71555 – MR Angiography Chest

CPT Codes: 71555

INDICATIONS FOR CHEST MRA:

Magnetic resonance angiography (MRA) or computed tomography angiography (CTA) may be used for several indications but not both.

Vascular Disease

- Superior vena cava (SVC) syndrome (Friedman, 2017)
- Subclavian Steal Syndrome after positive or inconclusive ultrasound (Osiro, 2012; Potter, 2014)
- Thoracic Outlet Syndrome (ACR, 2014; Povlsen, 2018; Chavhan, 2017)
- Takayasu's arteritis (Keser, 2014)
- Clinical concern for acute aortic dissection (ACR, 2017; Barman, 2014)
    - Sudden painful ripping sensation in the chest or back and may include
        - New diastolic murmur
        - Cardiac tamponade
        - Distant heart sounds
        - Hypotension or shock
- For MRPA (MR Pulmonary Angiography) in patients with intermediate pretest probability with a positive D-dimer or high pretest probability (but only at centers that routinely perform it well and only for patients for whom standard tests are contraindicated)

Thoracic Aortic Disease

If TTE was not performed, was technically inadequate, or if imaging is required beyond the proximal ascending aorta

- Screening of first-degree relatives of individuals with a thoracic aortic aneurysm (defined as $\geq$ 50% above normal) or dissection, or if an associated high-risk mutation is present
- If one or more first degree relatives of a patient with a known thoracic aortic aneurysm or dissection, have thoracic aortic dilatation, aneurysm or dissection, then imaging of 2nd degree relatives is reasonable
    - Six months follow up after initial finding of a dilated thoracic aorta, for assessment of rate of change
    - Annual follow up of enlarged thoracic aorta that is above top normal for age, gender, and body surface area
    - Biannual (twice/year) follow up of enlarged aortic root $\geq$ 4.5 cm or showing growth rate $\geq$ 0.5 cm/year
    - Evaluation of the ascending aorta in known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection (e.g., Marfan syndrome, Ehlers Danlos or Loeys-Dietz syndromes) at time of diagnosis and 6 months thereafter for growth rate assessment, followed by annual imaging, or biannual (twice yearly) if diameter ≥ 4.5 or expanding ≥ 0.5 cm/yr

- Patients with Turner's syndrome should undergo imaging to assess for bicuspid aortic valve, coarctation of the aorta or dilation of the ascending or thoracic aorta. If the initial imaging is normal and there are no additional risk factors for dissection, imaging can be done every 5-10 years. If an abnormality exists, annual imaging is recommended
- Screening of first-degree relatives of patients with a bicuspid aortic valve
- Re-evaluation of known ascending aortic dilation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management
- Re-evaluation (<1 y, generally twice a year) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV with 1 of the following:
    - Aortic diameter ≥ 4.5 cm
    - Rapid rate of change in aortic diameter when an annual growth rate of ≥ 0.5 cm is suspected.
    - Family history (first-degree relative) of aortic dissection
- Follow up post medical treatment of aortic disease:
    - Acute dissection: 1 month, 6 months, then annually
    - Chronic dissection: annually
- Follow up post either root repair or AVR plus ascending aortic root/arch repair: baseline post-op, then annually

Congenital Malformations

- Thoracic malformation on other imaging (chest x-ray, echocardiogram, gastrointestinal study, or inconclusive CT) (Ferreira, 2015; Hellinger, 2011; Karaosmanoglu, 2015; Poletto, 2017)
- Congenital heart disease with pulmonary hypertension (Pascall, 2018)
- Pulmonary Sequestration (Long, 2016; Al-Timmy, 2016)

Pulmonary Hypertension based on other testing (Ascha, 2017; Rose-Jones, 2015):

- Echocardiogram
- Right heart catheterization

Atrial fibrillation with ablation planned (Kolandaivelu, 2012)

Pre-operative Evaluation

Post-operative or post-procedural evaluation

- Post op complications (Bennet, 2017; Choudhury, 2017)
- Routine post operative (Uthof, 2012; SVS, 2018)
    - Thoracic endovascular aneurysm repair
        - 1 month
        - 6 month if initial abnormal, or it for aortic dissection
        - Annual for 5 years
    - Open Surgical Repair
        - 5 year intervals

BACKGROUND:
Magnetic resonance angiography (MRA) is a noninvasive technique used to provide cross-sectional and projection images of the thoracic vasculature, including large and medium sized vessels, e.g., the thoracic aorta. It provides images of normal as well as diseased blood vessels and quantifies blood flow through these vessels. Successful vascular depiction relies on the proper imaging pulse sequences. MRA may use a contrast agent, gadolinium, which is non-iodine-based, for better visualization. It can be used in patients who have history of contrast allergy and who are at high risk of kidney failure.

OVERVIEW:
MRA and Coarctation of the Aorta – One of the most common congenital vascular anomalies is coarctation of the aorta which is characterized by obstruction of the juxtaductal aorta. Clinical symptoms, e.g., murmur, systemic hypertension, difference in blood pressure in upper and lower extremities, absent femoral or pedal pulses, may be present. Gadolinium enhanced 3D MRA may assist in preoperative planning as it provides angiographic viewing of the aorta, the arch vessels and collateral vessels. It may also assist in the identification of postoperative complications.

MRA and Pulmonary Embolism (PE) – Note: D-Dimer blood test in patients at low risk* for DVT is indicated prior to MRA imaging. Negative D-Dimer suggests alternative diagnosis in these patients.

Studies show mixed results regarding the value of MRA v CTA in detecting pulmonary embolism. A systematic review and meta-analysis found MRA to be inferior to CTA in detecting PE. Therefore, MRA should be used only if CTA is not available or contraindicated in a specific patient (Li, 2009).

MRA and Thoracic Aortic Aneurysm – One of the most common indications for thoracic MRA is thoracic aortic aneurysm, most often caused by atherosclerosis. These aneurysms may also be due to aortic valvular disease. Aneurysms are defined by their enlargement and patients with rapidly expanding aortas, or with aortic diameters greater than five or six centimeters, are at high risk of rupture and may require surgery.

MRA and Thoracic Aortic Dissection - The most common clinical symptom of aortic dissection is tearing chest pain and the most common risk factor is hypertension. An intimal tear is the hallmark for aortic dissection and intramural hematoma may also be detected. Unfortunately, patients with aortic dissection may be unstable and not good candidates for routine MR evaluation; MRA may be indicated as a secondary study. 3D MRA is also useful in postoperative evaluation of patients with repaired aortic dissections.

MRA and Central Venous Thrombosis – MRA is useful in the identification of venous thrombi. Venous thrombosis can be evaluated by gadolinium enhanced 3D MRA as an alternative to CTA which may not be clinically feasible due to allergy to iodine contrast media or renal insufficiency.

Other MRA Indications – MRA is useful in the assessment for postoperative complications of pulmonary venous stenosis.

MRI and Patent Ductus Arteriosus – Patent ductus arteriosus (PDA) is a congenital heart problem in which the ductus arteriosus does not close after birth. It remains patent allowing oxygen-rich blood from the aorta to mix with oxygen-poor blood from the pulmonary artery. MRI can depict the precise anatomy of a PDA to aid in

clinical decisions. It allows imaging in multiple planes without a need for contrast administration. Patients are not exposed to ionizing radiation.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Removed pulmonary embolism indication
- Added indications specifying criteria for follow-up of thoracic aneurysm
- Added statement: “For MRPA (MR Pulmonary Angiography) in patients with intermediate pretest probability with a positive D-dimer or high pretest probability (but only at centers that routinely perform it well and only for patients for whom standard tests are contraindicated)”
- Expanded criteria for congenital malformations
- Updated thoracic aortic disease section for consistency with cardiac guidelines
- Added greater specificity for post op complications

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72125 – CT Cervical Spine

CPT Codes: 72125, 72126, 72127

INDICATIONS FOR CERVICAL SPINE CT:

For evaluation of known fracture
(ACR, 2012)

- To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing
- To determine the position of fracture fragments.

For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate
(ACR, 2013; NASS, 2010)

- With any of the following new neurological deficits: extremity weakness; pathologic (e.g. Babinski, Hoffman's) or abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on physical exam; bowel or bladder dysfunction; spasticity, sensory, or motor level.

CT myelogram is indicated when signs and symptoms are incongruent with MRI findings (NASS, 2010)

For evaluation of suspected myelopathy when Cervical Spine MRI is contraindicated
(ACR, 2015; Behrbalk, 2013; Vilaca, 2016; Davies, 2018)

- Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation (Signs: unsteadiness, broad-based gait, increased muscle tone, weakness and wasting of the upper and lower limbs; diminished sensation to light touch, temperature, proprioception, vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases).

For evaluation of chronic neck pain, with any of the following when Cervical Spine MRI is contraindicated
(Allegri, 2016)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks (ACR, 2013; Eubanks, 2010) within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of new onset of neck pain when Cervical Spine MRI is contraindicated (Allegri, 2016):

- With new or worsening objective neurologic deficits on exam

- Failure of conservative treatment*, for at least six (6) weeks (ACR, 2013; Eubanks, 2010) within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013))**.**

For evaluation of trauma or acute injury
(ACR, 2018)
- Presents with any of the following neurological deficits: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.
- When the patient is clinically unevaluable or there are preliminary imaging findings (X-ray or CT) needing further evaluation.
- When office notes specify the patient meets NEXUS (National Emergency X-Radiography Utilization Study) or CCR (Canadian Cervical Rules) criteria for imaging (ACR, 2018):
    - CT for initial imaging.
    - MRI when suspect spinal cord or nerve root injury or when patient is obtunded, and CT is negative.
    - CT or MRI for treatment planning of unstable spine.

(MRI and CT provide complementary information. When indicated It is appropriate to perform both examinations" (ACR, 2018)).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018)
- With history of malignancy (if MRI is contraindicated)
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the CT will change management.

For evaluation of <u>known</u> tumor, cancer, or evidence of metastasis with any of the following (MRI is usually the preferred study, but CT may help characterize solitary indeterminate lesions (Kim, 2012))
- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory, and/or imaging findings) of new tumor or change in tumor.
- With evidence of metastasis on bone scan or previous imaging study.
- Initial imaging of new or increasing non-traumatic cervical or neck pain or radiculopathy with known active cancer and a tumor that tends to metastasize to the spine and MRI is contraindicated (ACR, 2018; Ziu, 2019).

For evaluation of suspected tumor when Cervical Spine MRI is contraindicated or inappropriate
(ACR, 2018)
- Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- < 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease when Cervical Spine MRI is contraindicated
(ACR, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma when Cervical Spine MRI is contraindicated (Nagashima, 2010; ACR, 2015)

- As evidenced by signs/symptoms, laboratory, or prior imaging findings.

As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection):**

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings.
- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other Indications for a Cervical Spine CT:

- For preoperative evaluation and Cervical Spine MRI is contraindicated
- CT discogram.
- Suspected cord compression with any of the following neurological deficits: extremity weakness; sensory deficits, abnormal gait; abnormal reflexes; spinal level; bowel or bladder incontinence and Cervical Spine MRI is contraindicated
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), and MRI is contraindicated.
- Known Arnold-Chiari syndrome and Cervical Spine MRI is contraindicated.
- Congenital abnormalities in the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) when MRI is contraindicated or for characterization of bony detail.
- Syrinx or syringomyelia (known or suspected) and Cervical Spine MRI is contraindicated:
    - With neurologic findings and/or predisposing conditions (e.g. Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),
    - To further characterize a suspicious abnormality seen on prior imaging.
    - Known syrinx with worsening symptoms.
- CSF leak highly suspected and supported by patient history and/or physical exam findings (CT myelogram).
- For pediatric population and MRI is contraindicated (ACR, 2016)

- Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
- Back pain associated with suspected inflammation, infection, or malignancy

- In rheumatoid arthritis with neurologic signs or symptoms, evidence of subluxation or positive radiograph (lateral radiograph in flexion and neutral should be the initial study) when MRI is contraindicated or for surgical treatment planning (Colebatch, 2013)

COMBINATION OF STUDIES WITH CERVICAL SPINE CT:

Cervical/Thoracic/Lumbar CTs:

- CT myelogram or discogram.
- Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (Strahle, 2015; ACR, 2018).
- Any combination of these for spinal survey in patient with metastases.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015).
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), when anesthesia required for imaging and **MRI is contraindicated.**
- Drop metastasis from brain or spine **when MRI contraindicated** (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram).

Cervical MRI/CT

- For unstable craniocervical junction.

Brain CT/Cervical CT

- For evaluation of Arnold-Chiari Malformation and Cervical Spine MRI is contraindicated.

BACKGROUND:

Computed tomography (CT) is performed for the evaluation of the cervical spine. CT may be used as the primary imaging modality or it may complement other modalities. Primary indications for CT include conditions, e.g., traumatic, neoplastic, and infectious. CT is often used to study the cervical spine for conditions such as degenerative disc disease when MRI is contraindicated. CT provides excellent depiction of bone detail and is used in the evaluation of known fractures of the cervical spine and for evaluation of postoperative patients.

OVERVIEW:

***Conservative Therapy:** (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program - (HEP)/ Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Myelopathy: Symptom severity varies and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%) and pain (67.4%) (Vilaca, 2016).

CT and Infection of the spine - Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and non-infective inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs, and paraspinal tissues. Imaging is important to obtain early diagnosis and treatment to avoid permanent neurologic deficits. When MRI is contraindicated, CT may be used to evaluate infections of the spine.

CT and Degenerative Disc Disease – Degenerative disc disease is very common and CT may be indicated, when MRI is contraindicated, when chronic degenerative changes are accompanied by conditions, e.g., new neurological deficits; onset of joint tenderness of a localized area of the spine; new abnormal nerve conductions studies; exacerbation of chronic neck or back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

MRI and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

Back Pain with Cancer History - Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

Cervical Spine Trauma Imaging (ACR, 2018): The National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian Cervical Rules (CCR) represent clinical criteria used to help determine the presence of significant cervical spine injury. Although the criteria are highly sensitive (99.6% for NEXUS), specificity is low (12.9% for Nexus).

A patient not meeting any of the NEXUS criteria of focal neurologic deficit, midline spinal tenderness, altered consciousness, intoxication or distracting injury is unlikely to have a significant cervical spine injury. Imaging evaluation of the cervical spine in these patients is not necessary. In the CCR criteria a patient without any high risk factors (Age >65 years, paresthesias in extremities, dangerous mechanism, falls from ≥3 feet/5 stairs, axial load to head, motor vehicle crash with high speed, rollover, or ejection, bicycle collision, motorized recreational vehicle accident) is next evaluated for low risk factors (Simple rear-end motor vehicle crash, patient in sitting position in emergency center, patient ambulatory at any time after trauma, delayed onset of neck pain, absence of midline cervical spine tenderness). If the patients meets a low risk criteria, they are asked to move their head 45 degrees from midline in both directions. If the patient can accomplish this the spine is cleared and imaging is not necessary.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added:
    - new or worsening objective neuro deficits for chronic and acute back pain; CSF leak
    - last 6 months for allowable post op f/u period and removed EMG comment
    - red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
    - new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;

- For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
- CT myelogram
- Rheumatoid arthritis
- Specifics on neuro deficits including pathologic reflexes and spasticity, sensory, or motor level
- Spinal trauma
- New or increasing back pain in cancer patients with high suspicion of mets

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72128 – CT Thoracic Spine

CPT Codes: 72128, 72129, 72130

INDICATIONS FOR THORACIC SPINE CT:

For evaluation of known fracture

- To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing
- To determine the position of fracture fragments.

For evaluation of neurologic deficits when Thoracic Spine MRI is contraindicated or inappropriate

- With any of the following new neurological deficits: lower extremity weakness; abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on physical exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; spasticity, sensory or motor level (Stolper, 2017).

CT myelogram is indicated when signs and symptoms are incongruent with MRI findings (NASS, 2010)

For evaluation of suspected myelopathy when Thoracic Spine MRI is contraindicated (Behrbalk, 2013; ACR, 2015; Hou, 2016)

- Progressive symptoms including lower extremity weakness, numbness in the legs, increasing difficulty with balance and ambulation (Signs: unsteadiness, broad-based gait, increased muscle tone, pins and needles sensation, weakness and wasting of the lower limbs, and diminished sensation to light touch, temperature, proprioception, and vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases).

For evaluation of chronic back pain with any of the following when Thoracic MRI is contraindicated (Jarvik, 2015; Last, 2009, Allegri, 2016)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks (ACR, 2013; Eubanks, 2010) within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a thoracic radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013)).

For evaluation of new onset of back pain when Thoracic Spine MRI is contraindicated (AANSCNS, 2014)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.

- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a thoracic radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013)).

For evaluation of trauma or acute injury (ACR, 2012**)**
- Presents with any of the following neurological deficits: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

Pars defect (spondylolysis) or spondylisthesis
- Pars defect (spondylolysis) or spondylisthesis in adults when Flexion/Extension x-rays show instability.
- Pars defect (spondylolysis with spondylisthesis) on plain films in pediatric population (< 18 yr) (flexion extension instability not required) when MRI is contraindicated.

NOTE: Initial imaging (x-ray, or planar bone scan without SPECT; Bone scan with SPECT is superior to MRI and CT in the detection of pars intrarticularis pathology including spondylolysis) (Matesan, 2016).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018)
- With history of malignancy (if MRI is contraindicated)
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the MRI will change management.

For evaluation of known tumor, cancer, or evidence of metastasis with any of the following (MRI is usually the preferred study but CT may help characterize solitary indeterminate bone lesions).
(Kim, 2012)
- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory, and/or imaging findings) of new tumor or change in tumor.
- With evidence of metastasis on bone scan or previous imaging study.

- New or increasing non-traumatic thoracic back pain or radiculopathy with known active cancer and a tumor that tends to metastasize to the spine and MRI is contraindicated (ACR, 2018; Ziu, 2019).

For evaluation of suspected tumor when Thoracic Spine MRI is contraindicated or inappropriate
(ACR, 2018)
- Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases:
- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease when Thoracic MRI is contraindicated
(ACR, 2018; Lerner, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma when Thoracic MRI is contraindicated
(ACR, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection):**

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings.
- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other Indications for a Thoracic Spine CT:

- For preoperative evaluation
- Prior to spinal cord stimulator to exclude canal stenosis if no prior imaging of the thoracic spine has been done recently and MRI is contraindicated.
- CT discogram.
- Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, sensory deficits, abnormal gait; abnormal reflexes; spinal level; bowel or bladder incontinence and Thoracic Spine MRI is contraindicated.
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH) when Thoracic Spine MRI is contraindicated
- Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup (Akgul, 2011; Bennett, 2010; Ostergaard, 2012; Seiper, 2009)

Known Arnold-Chiari syndrome and Thoracic MRI is contraindicated (Milhorat, 2009; Strahle, 2015).
Congenital abnormalities when Thoracic Spine MRI is contraindicated or for characterization of bony detail (Trenga, 2016):

- In the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
- Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging.
- Scoliosis with any of the following:
  - Progressive spinal deformity;
  - Neurologic deficit;

    - Early onset;
    - Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);
    - Pre-operative planning; OR
    - When office notes clearly document how imaging will change management.
- Syrinx or syringomyelia (known or suspected):and Thoracic Spine MRI is contraindicated:
    - With neurologic findings and/or predisposing conditions (e.g. Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),
    - To further characterize a suspicious abnormality seen on prior imaging.
    - Known syrinx with worsening symptoms.
- CSF leak highly suspected and supported by patient history and/or physical exam findings (CT myelogram).
- For pediatric population (ACR, 2016)
    - Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
    - Back pain associated with suspected inflammation, infection, or malignancy

COMBINATION STUDIES WITH THORACIC SPINE CT:

Cervical/Thoracic/Lumbar CTs:

- CT myelogram or discogram.
- Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (Strahle, 2015; ACR, 2018).
- Any combination of these for spinal survey in patient with metastases.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation and Spine MRI is contraindicated. (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015).
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), when anesthesia required for imaging and **MRI is contraindicated.**
- Drop metastasis from brain or spine **when MRI contraindicated** (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram).

BACKGROUND:

Computed tomography is used for the evaluation, assessment of severity, and follow-up of diseases of the spine. Its use in the thoracic spine is limited, however, due to the lack of epidural fat in this part of the body. CT myelography improves the contrast severity of CT, but it is also invasive. CT may be used for conditions, e.g., degenerative changes, infection, and immune suppression, when magnetic resonance imaging (MRI) is contraindicated. It may also be used in the evaluation of tumors, cancer, or metastasis in the thoracic spine and it may be used for preoperative and post-surgical evaluations. CT obtains images from different angles and uses computer processing to show a cross-section of body tissues and organs. CT is fast and is often performed in acute settings. It provides good visualization of cortical bone.

OVERVIEW:

Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset <40). It is associated with any of the following (Akgul, 2011; Bennett, 2010; Ostergaard, 2012; Seiper, 2014):

- Sedimentation rate and/or C-reactive protein (not an essential criteria).
- HLA B27 (not an essential criteria).
- Non-diagnostic or indeterminate x-ray
- Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease.

***Conservative Therapy:** (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program - (HEP)/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Myelopathy: Symptom severity varies and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%), and pain (67.4%) (Vitzthum, 2007).

CT and Infection of the spine - Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and non-infective inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs, and paraspinal tissues. Imaging is important to obtain early diagnosis and treatment to avoid permanent neurology deficits. When MRI is contraindicated, CT may be used to evaluate infections of the spine.

CT and Degenerative Disc Disease – Degenerative disc disease is very common and CT may be indicated when MRI is contraindicated, when chronic degenerative changes are accompanied by conditions, e.g., new neurological deficits; onset of joint tenderness of a localized area of the spine; new abnormal nerve conductions studies; exacerbation of chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

CAUDA EQUINA SYNDROME:

- Symptoms include severe back pain or sciatica along with one or more of the following:
    - Saddle anesthesia - loss of sensation restricted to the area of the buttocks, perineum and inner surfaces of the thighs (areas that would sit on a saddle).
    - Recent bladder/bowel dysfunction (as listed above)
    - Achilles reflex absent on both sides
    - Sexual dysfunction that can come on suddenly
    - Absent anal reflex and bulbocavernosus reflex

MRI and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

Back Pain with Cancer History - Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

POLICY HISTORY:
Review Date: June 2019

Review Summary:

- Added:
  - new or worsening objective neuro deficits for chronic and acute back pain; CSF leak
  - last 6 months for allowable post op f/u period and removed EMG comment
  - red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
  - new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;
  - For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
  - Spinal cord stimulator
  - New or increasing back pain in cancer patients with high suspicion of mets

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72131 – CT Lumbar Spine

CPT Codes: 72131, 72132, 72133

INDICATIONS FOR LUMBAR SPINE CT:

For evaluation of known fracture

- To assess union of a fracture where physical examination, plain radiographs, or prior imaging suggest delayed or non-healing
- To determine position of known fracture fragments.

For evaluation of neurologic deficits when Lumbar Spine MRI is contraindicated or inappropriate

- With any of the following new neurological deficits: lower extremity weakness; abnormal reflexes**;** abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

CT myelogram is indicated when signs and symptoms are incongruent with MRI findings (Grams, 2010; Morita, 2011; Naganawa, 2011; NASS, 2012; Ozdoba; 2011)

For evaluation of chronic back pain with any of the following when Lumbar Spine MRI is contraindicated (ACR, 2015; AAFP, 2012; ACEP, 2014; NASS, 2013; Chou, 2007; Jarvik, 2015; Last, 2009)

- With new or worsening objective neurologic deficits on exam

Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.

- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a lumbar radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013)).

For evaluation of new onset of back pain when Lumbar Spine MRI is contraindicated (ACR, 2015; AANSCNS, 2014; ACA, 2017; ACEP, 2014; Chou, 2007)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment*, for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if (if performed) indicating a lumbar radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013))

For evaluation of trauma or acute injury (ACR, 2012; Chou, 2007)

- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes [along a particular dermatome (nerve distribution)].
- With progression or worsening of symptoms during the course of conservative treatment*.

Pars defect (spondylolysis) or spondylisthesis

- Pars defect (spondylolysis) or spondylisthesis in adults when Flexion/Extension x-rays show instability.
- Pars defect (spondylolysis with spondylisthesis) on plain films in pediatric population (<18 yr) (flexion extension instability not required) when MRI is contraindicated.

NOTE: Initial imaging (x-ray, or planar bone scan without SPECT; Bone scan with SPECT is superior to MRI and CT in the detection of of pars intrarticularis pathology including spondylolysis) (Matesan, 2016).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018)

- With history of malignancy when MRI is contraindicated.
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the MRI will change management.

For evaluation of known tumor, cancer, or evidence of metastasis with any of the following (Last, 2009) **(MRI is usually the preferred study but CT may help characterize solitary indeterminate bone lesions).** (Kim, 2012)

- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory, and/or imaging findings) of new tumor or change in tumor.
- With evidence of metastasis on bone scan or previous imaging study.

For evaluation of suspected tumor when Lumbar Spine MRI is contraindicated or inappropriate (ACR, 2015)

- Prior abnormal or indeterminate imaging that requires further clarification

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease when Lumbar Spine MRI is contraindicated (ACR, 2015; Last, 2009; Lerner, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma and Lumbar Spine MRI is contraindicated (ACR, 2015)

- As evidenced by signs/symptoms, laboratory, or prior imaging findings.

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection):**

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other indications for a Lumbar Spine CT

- For preoperative evaluation and Lumbar Spine MRI is contraindicated
- CT discogram.
- Suspicious sacral dimple (those that are deep, larger than 0.5 cm, located within the superior portion of the gluteal crease or above the gluteal crease, or associated with other cutaneous markers) (D'Alessandro, 2009; Choi, 2018) in patients < 6 months should have ultrasound) when **Lumbar Spine MRI is contraindicated**.
- Tethered cord or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH) when **Lumbar Spine MRI is contraindicated.**
- For suspected Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup
- Known Arnold-Chiari syndrome and **Lumbar Spine MRI is contraindicated** (Milhorat, 2009; Strahle, 2015).
- Congenital abnormalities when **Lumbar Spine MRI is contraindicated** or for characterization of boney detail (Trenga, 2016)**:**
    - In the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
    - Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging.
    - Scoliosis with any of the following:
        - Progressive spinal deformity;
        - Neurologic deficit;
        - Early onset;
        - Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);
        - Pre-operative planning; OR
        - When office notes clearly document how imaging will change management.
- CSF leak highly suspected and supported by patient history and/or physical exam findings (CT Myelogram)

For pediatric population if MRI is contraindicated (ACR, 2016)

- Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
- Back pain associated with suspected inflammation, infection, or malignancy

COMBINATION STUDIES WITH LUMBAR SPINE CT:

Cervical/Thoracic/Lumbar CTs:

- CT myelogram or discogram
- Any combination of these for scoliosis survey in infant/child when MRI is contraindicated (Strahle, 2015).
- Any combination of these for spinal survey in patient with metastasis.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015) and **Lumbar Spine MRI is contraindicated**.
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), when anesthesia required for imaging and **MRI is contraindicated.**
- Drop metastasis from the brain or spine **when MRI contraindicated** (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram).

BACKGROUND:

Computed tomographic scans provide bone detail and define the bony anatomy in multiple planes. It demonstrates the lumbar subarachnoid space and provides moderately good visualization of the vertebral canal. Three-dimensional reconstructions using CT help to demonstrate the anatomy of the vertebral canal.

OVERVIEW:

Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset <40). It is associated with any of the following (Akgul, 2011; Bennett, 2010; Ostergaard, 2012; Seiper, 2014):

- Sedimentation rate and/or C-reactive protein (not an essential criteria).
- HLA B27 (not an essential criteria).
- Non-diagnostic or indeterminate x-ray
- Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease.

***Conservative Therapy:** (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program** - (HEP)**/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical

reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).

- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

CT and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

CT and Fracture of the Lumbar Spine – CT scans of the lumbar spine generate high-resolution spinal images; this and the absence of superimposed structures allow accurate diagnosis of lumbar fractures.

CT and Radiculopathy –Lumbar radiculopathy is caused by compression of a nerve root and/or inflammation that has progressed enough to cause neurologic symptoms, e.g., numbness, tingling, and weakness in leg muscles. These are warning signs of a serious medical condition which needs medical attention. Multidetector CT may be performed to rule out or localize lumbar disk herniation before surgical intervention, when MRI is contraindicated. Radiation dose should be kept as low as possible in young individuals undergoing CT of the lumbar spine.

CT and Infection of the spine - Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and non-infective inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs, and paraspinal tissues. Imaging is important to obtain early diagnose and treatment to avoid permanent neurology deficits. When MRI is contraindicated, CT may be used to evaluate infections of the spine.

CT and Degenerative Disease of the Lumbar Spine – Stenosis of the lumbar canal may result from degenerative changes of the discs, ligaments and facet joints surrounding the lumbar canal. Compression of the microvasculature of the bundle of nerve roots in the lumbosacral spine may lead to significant effects on the cauda equina. This is a surgical emergency and CT may be performed to help assess the problem when MRI is contraindicated or inappropriate. CT scans can provide visualization of the vertebral canal and may demonstrate encroachment of the canal by osteophytes, facets, pedicles or hypertrophied lamina.

CT and Low Back Pain – Low back pain by itself is a self-limited condition which does not warrant any imaging studies. One of the "red flags" signifying a more complicated status is focal neurologic deficit with progressive or disabling symptoms. When magnetic resonance imaging (MRI) is contraindicated, CT of the lumbar spine with or without contrast is indicated for low back pain accompanied by a "red flag" symptom. Myelography combined with post-myelography CT is accurate in diagnosing disc herniation and may be useful in surgical planning. CT may be indicated when MRI is contraindicated, and chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

Tethered spinal cord syndrome - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord within the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is mylelomeningocele and lipomyelomeningocele; the following are other causes that vary in severity of symptoms and treatment.

- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale
- History of spine trauma/surgery
- Arnold Chiari Malformation

Sacral Dimples - Simple midline dimples are the most commonly encountered dorsal cutaneous stigmata in neonates and indicate low risk for spinal dysraphism. Only atypical dimples are associated with a high risk for spinal dysraphism, particularly those that are large (>5 mm), high on the back (>2.5 cm from the anus), or appear in combination with other lesions (D' Alessandro, 2009). High-risk cutaneous stigmata in neonates include hemangiomas, upraised lesions (i.e., masses, tails, and hairy patches), and multiple cutaneous stigmata.

Back Pain with Cancer - **History** Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

CAUDA EQUINA SYNDROME:

- Symptoms include severe back pain or sciatica along with one or more of the following:

- Saddle anesthesia - loss of sensation restricted to the area of the buttocks, perineum and inner surfaces of the thighs (areas that would sit on a saddle).
- Recent bladder/bowel dysfunction (as listed above)
- Achilles reflex absent on both sides
- Sexual dysfunction that can come on suddenly
- Absent anal reflex and bulbocavernosus reflex
    - This is a “Red Flag” situation and Lumbar Spine MRI is approvable.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added CT myelogram
- Added new or worsening objective neuro deficits for chronic and acute back pain
- Added last 6 months for allowable post op follow up period and removed EMG comment
- Added section on pars defect
- Added section on compression fractures
- In other indications removed myelogram since covered previously
- Added congenital anomalies
- Added sacral dimple and scoliosis
- Added red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
- Added CSF leak indication
- For combination studies C/T/L added drop metastasis, tethered cord, Arnold Chiari

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72141 – MRI Cervical Spine

CPT Codes: 72141, 72142, 72156

INDICATIONS FOR CERVICAL SPINE MRI:

For evaluation of known or suspected multiple sclerosis (MS)
(ACR, 2015; Filippi, 2016)

- Evidence of MS on recent baseline Brain MRI.
- Suspected MS with new or changing symptoms consistent with cervical spinal cord disease (focal neurologic deficit or clinical sign, e.g., Lhermitte sign).
- Follow up of known Multiple Sclerosis.
- Follow up to the initiation or change in medication for patient with known Multiple Sclerosis.
- Cervical and/or Thoracic MRI for evaluation of suspected multiple sclerosis (MS) when Brain MRI does not fulfill diagnostic criteria (Filippi, 2016).
- Cervical and/or Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis) (Wingerchuk, 2015)

For evaluation of neurologic deficits
(ACR, 2013; NASS, 2010)

- With any of the following new neurological deficits: extremity weakness; pathologic (e.g. Babinski, Hoffman's) or abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on physical exam; bowel or bladder dysfunction; spasticity, sensory, or motor level.

For evaluation of suspected myelopathy
(ACR, 2015; Behrbalk, 2013; Vilaca, 2016; Davies, 2018)

- Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation (Signs: unsteadiness, broad-based gait, increased muscle tone, weakness and wasting of the upper and lower limbs; diminished sensation to light touch, temperature, proprioception, vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases).

For evaluation of chronic neck pain with any of the following (Allegri, 2016)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks (ACR, 2013; Eubanks, 2010) within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013))

For evaluation of new onset of neck pain (Allegri, 2016):

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment*, for at least six (6) weeks (ACR, 2013; Eubanks, 2010) within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of trauma or acute injury

(ACR, 2018)

- Presents with any of the following neurological deficits: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.
- When the patient is clinically unevaluable or there are preliminary imaging findings (X-ray or CT) needing further evaluation.
- When office notes specify the patient meets NEXUS (National Emergency X-Radiography Utilization Study) or CCR (Canadian Cervical Rules) criteria for imaging:
    - CT for initial imaging.
    - MRI when suspect spinal cord or nerve root injury or when patient is obtunded, and CT is negative.
    - CT or MRI for treatment planning of unstable spine.

("MRI and CT provide complementary information. When indicated It is appropriate to perform both examinations") (ACR, 2018).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018):

- With history of malignancy.
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the MRI will change management.

For evaluation of <u>known</u> tumor, cancer, or evidence of metastasis with any of the following (MRI is usually the preferred study, but CT may help characterize solitary indeterminate lesions) (Kim, 2012)

- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory, and/or imaging findings) of new tumor or change in tumor.
- With evidence of metastasis on bone scan or previous imaging study.
- Initial imaging of new or increasing non-traumatic cervical or neck pain or radiculopathy with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019).

For evaluation of suspected tumor

(ACR, 2018)

- Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases:

- < 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease
(ACR, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma
(Nagashima, 2010; ACR, 2015)
As evidenced by signs/symptoms, laboratory or prior imaging findings.

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology or post-op infection):**

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other Indications for a Cervical Spine MRI:

- For preoperative evaluation.
- Suspected cord compression with any of the following neurological deficits: extremity weakness; sensory deficits, abnormal gait; abnormal reflexes; spinal level; bowel or bladder incontinence.
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH)**.**
- Known Arnold-Chiari syndrome.
- Congenital abnormalities (Trenga, 2016):
    - In the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
    - Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging.
    - Scoliosis with any of the following:
        - Progressive spinal deformity;
        - Neurologic deficit;
        - Early onset;
        - Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);
        - Pre-operative planning; OR

- When office notes clearly document how imaging will change management

- Syrinx or syringomyelia (known or suspected):
  - With neurologic findings and/or predisposing conditions (e.g. Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),
  - To further characterize a suspicious abnormality seen on prior imaging.
  - Known syrinx with worsening symptoms.
- CSF leak highly suspected and supported by patient history and/or physical exam findings.

For pediatric population (ACR, 2016)

- Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
- Back pain associated with suspected inflammation, infection, or malignancy

In rheumatoid arthritis with neurologic signs or symptoms, evidence of subluxation or positive radiograph (lateral radiograph in flexion and neutral should be the initial study (Colebatch, 2013; Tehranzadeh, 2017)

COMBINATION OF STUDIES WITH CERVICAL SPINE MRI:

Cervical/Thoracic/Lumbar MRIs:

- Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (Strahle, 2015; ACR, 2018; SRS, 2019).
- Any combination of these for spinal survey in patient with metastases.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015).
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), when anesthesia required for imaging**.**
- Drop metastasis from brain or spine (imaging also includes brain).
- Tumor evaluation and monitoring in neurocutaneous syndromes - See Background

Cervical MRI/CT

- For unstable craniocervical junction.

Brain MRI/Cervical MRI –

- For evaluation of Arnold Chiari malformation.
- For follow-up of known Multiple Sclerosis (MS) (Filippi, 2016).
- Suspected MS with new or changing symptoms consistent with cervical spinal cord disease.
- Follow up to the initiation or change in medication for patient with known Multiple Sclerosis

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BACKGROUND:

Magnetic resonance imaging (MRI) produces high quality multiplanar images of organs and structures within the body without radiation. It is the preferred modality for evaluating the internal structure of the spinal cord, providing assessment of conditions such as degenerative disc pathology, osteomyelitis, and discitis.

OVERVIEW:

***Conservative Therapy:** (Spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program - (HEP)/ Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Cervical myelopathy: Symptom severity varies and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%), and pain (67.4%) (Vilaca, 2016).

MRI and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

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Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

MRI for Evaluation of Discitis – Discitis is a known complication of cervical discography. Postoperative discitis in the cervical spine does not occur frequently but can result from accidental inoculation of bacteria into the disc space intra-operatively by a contaminated spinal needle being used as a radiological marker. There may be other causes for postoperative discitis, e.g., esophageal perforation, hematogenous spread, inoculation of bacteria during surgery. Patients with an alteration in the nature of their symptoms after cervical discectomy

and fusion may have discitis. Symptoms may include complaints of mild paresthesia in extremities and neck pain. MRI may be performed to reveal feature of discitis with associated abscesses and may help to confirm the diagnosis and decide on the further management.

MRI for Cervical Radiculopathy – MRI is a useful test to evaluate the spine because it can show abnormal areas of the soft tissues around the spine; it addition to the bones, it can also show pictures of the nerves and discs and is used to find tumors, herniated discs or other soft-tissue disorders. MRI has a role both in the pre-operative screening and post-operative assessment of radicular symptoms due to either disc or osteophyte.

MRI and Multiple Sclerosis (MS) – MRI is a sensitive method of detecting the white matter lesions of MS. These plaques on MRI generally appear as multiple, well demarcated, homogenous, small ovoid lesions which often lack mass effect and are oriented perpendicular to the long axis of the lateral ventricles. Sometimes they present as large, space occupying lesions that may be misinterpreted as tumors, abscesses, or infarcts.

MRI and Neck Pain – Neck pain is common in the general population and usually relates to musculoskeletal causes but it may also be caused by spinal cord tumors. When neck pain is accompanied by extremity weakness, abnormal gait, or asymmetric reflexes, spinal MRI may be performed to evaluate the cause of the pain. MRI may reveal areas of cystic expansion within the spinal cord. Enhancement with gadolinium contrast may suggest that the lesion is neoplastic.

Back Pain with Cancer History - Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

Cervical Spine Trauma Imaging (ACR, 2018): The National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian Cervical Rules (CCR) represent clinical criteria used to help determine the presence of significant cervical spine injury. Although the criteria are highly sensitive (99.6% for NEXUS), specificity is low (12.9% for Nexus).

A patient not meeting any of the NEXUS criteria of focal neurologic deficit, midline spinal tenderness, altered consciousness, intoxication, or distracting injury is unlikely to have a significant cervical spine injury. Imaging evaluation of the cervical spine in these patients is not necessary. In the CCR criteria a patient without any

high risk factors (Age >65 years, paresthesias in extremities, dangerous mechanism, falls from ≥3 feet/5 stairs, axial load to head, motor vehicle crash with high speed, rollover, or ejection, bicycle collision, motorized recreational vehicle accident) is next evaluated for low risk factors (Simple rear-end motor vehicle crash, patient in sitting position in emergency center, patient ambulatory at any time after trauma, delayed onset of neck pain, absence of midline cervical spine tenderness). If the patients meets a low risk criteria, they are asked to move their head 45 degrees from midline in both directions. If the patient can accomplish this the spine is cleared and imaging is not necessary.

MRI and Neurocutaneous Syndromes

- In NF-1, clinical evaluation appears to be more useful to detect complications than is screening imaging in asymptomatic patients. Imaging is indicated in evaluation of suspected tumors based clinical evaluation and for follow-up of known intracranial tumors (Borofsky, 2013).
- Conversely in NF-2, routine MR imaging screening is always indicated, given the high prevalence of CNS tumors especially vestibular schwannomas. In patients with NF-2, routine screening brain/IAC imaging is indicated annually starting from age 10 if asymptomatic or earlier with clinical signs/symptoms. Most individuals with NF2 eventually develop a spinal tumor, mostly commonly schwannomas, but meningioma and ependymomas are also seen. Spinal imaging at baseline and every 2 to 3 years is also advised with more frequent imaging if warranted based on sites of tumor involvement (Evans, 2017).
- In patients with Tuberous Sclerosis, Brain MRI should be obtained every 1-3 years up until age 25 for surveillance for CNS abnormalities (Krueger, 2013).
- In Von Hippel Lindau Syndrome, imaging of the brain and spinal cord for hemangioblastomas is recommended every 2 years (Von Hippel-Lindau, 2017).
- In Sturge Weber Syndrome, Brain MRI can rule out intracranial involvement after only after age 1 and is recommended in patients <1 year only if symptomatic (Comi, 2011).

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added:
    - new or worsening objective neuro deficits for chronic and acute back pain
    - CSF leak
    - last 6 months for allowable post op f/u period and removed EMG comment
    - red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
    - new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;
    - For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
- Improved section for evaluation of multiple sclerosis including NMO disorders and recurrent transverse myelitis; Lmproved s sign
- Modified section on evaluation of neurologic deficits; added specific pathologic findings; spasticity, sensory, or motor level changes
- Included signs in section on myelopathy including hyperreflexia and pathologic reflexes

- Enhanced sections on trauma; rheumatoid arthritis; back pain in cancer patients with known active cancer in tumors that tend to metastasize to spine
- Expanded on tethered cord in Other Indications for imaging and added section on sacral dimple
- For combination studies Brain/Cervical Spine added suspected MS with new or changing symptoms and follow up to initiation of treatment with known MS

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72146 – MRI Thoracic Spine

CPT Codes: 72146, 72147, 72157

INDICATIONS FOR THORACIC SPINE MRI:

For evaluation of known or suspected multiple sclerosis (MS)

- Suspected MS with new or changing symptoms consistent with thoracic spinal cord disease (ie, transverse myelitis, progressive myelopathy)
- Follow up of known Multiple Sclerosis with known thoracic involvement (CMSC, 2018)
- Follow up to the initiation or change in medication for patient with known Multiple Sclerosis with thoracic involvement (CMSC, 2018)
- Cervical and/or Thoracic MRI for evaluation of suspected multiple sclerosis (MS) when Brain MRI does not fulfill diagnostic criteria (Filippi, 2016)
- Cervical and/or Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis) (Wingerchuk, 2015)

For evaluation of neurologic deficits

- With any of the following new neurological deficits: extremity weakness; pathologic (e.g., Babinski) or abnormal reflexes**;** or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on physical exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; spasticity, sensory or motor level (Stolper, 2017).

For evaluation of suspected myelopathy

(ACR, 2015; Behrbalk, 2013; Hou, 2016)

Progressive symptoms including lower extremity weakness, numbness in the legs, increasing difficulty with balance and ambulation (Signs: unsteadiness, broad-based gait, increased muscle tone, pins and needles sensation, weakness and wasting of the lower limbs, and diminished sensation to light touch, temperature, proprioception, and vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases).

For evaluation of chronic back pain with any of the following

(Allegri, 2016; Jarvik, 2015)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a thoracic radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of new onset of back pain
(Allegri, 2016; ANSCNS, 2014)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment*for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a thoracic radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of trauma or acute injury

- Presents with any of the following neurological deficits: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

Pars defect (spondylolysis) or spondylisthesis

- Pars defect (spondylolysis) or spondylisthesis in adults when Flexion/Extension x-rays show instability.
- Pars defect (spondylolysis with spondylisthesis) on plain films in pediatric population (<18 yr) (flexion extension instability not required).

NOTE: Initial imaging (x-ray, or planar bone scan without SPECT; Bone scan with SPECT is superior to MRI and CT in the detection of pars intrarticularis pathology including spondylolysis) (Matesan, 2016).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018)

- With history of malignancy.
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the MRI will change management.

For evaluation of known tumor, cancer, or evidence of metastasis with any of the following (MRI is usually the preferred study but CT may help characterize solitary indeterminate lesions).
(Kim, 2012)

- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory and/or imaging findings) of new tumor or change in tumor
- With evidence of metastasis on bone scan or previous imaging study.
- New or increasing non-traumatic thoracic back pain or radiculopathy with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019).

For evaluation of suspected tumor
(ACR, 2015)

- Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease
(ACR, 2015; Lerner, 2018)
- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma
(ACR, 2015)
- As evidenced by signs/symptoms, laboratory or prior imaging findings.

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology or post-op infection):**
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other Indications for a Thoracic Spine MRI
- For preoperative evaluation
- Prior to spinal cord stimulator to exclude canal stenosis if no prior MRI imaging of the thoracic spine has been done recently).
- Suspected cord compression with any of the following neurological deficits: extremity weakness; sensory deficits, abnormal gait; abnormal reflexes; spinal level; bowel or bladder incontinence.
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS, 2019; Milhorat, 2009; NIH)**.**
- Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup
- Known Arnold-Chiari syndrome (Milhorat, 2009; Strahle, 2015).
- Congenital abnormalities (Trenga, 2016):
    - In the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
    - Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging.
    - Scoliosis with any of the following:
        - Progressive spinal deformity;
        - Neurologic deficit;
        - Early onset;

        - Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);
        - Pre-operative planning; OR
        - When office notes clearly document how imaging will change management
- Syrinx or syringomyelia (known or suspected):
    - With neurologic findings and/or predisposing conditions (e.g. Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),
    - To further characterize a suspicious abnormality seen on prior imaging.
    - Known syrinx with worsening symptoms.
- CSF leak highly suspected and supported by patient history and/or physical exam findings.
- For pediatric population (ACR, 2016)
    - Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
    - Back pain associated with suspected inflammation, infection, or malignancy

COMBINATION STUDIES WITH THORACIC SPINE MRI:

Cervical/Thoracic/Lumbar MRIs

- Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (Strahle, 2015; ACR, 2018).
- Any combination of these for spinal survey in patient with metastases.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015).
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or cutaneous stigmata (AANS, 2019; Milhorat, 2009; NIH), when anesthesia required for imaging
- Drop metastasis from brain or spine (imaging also includes brain).
- Tumor evaluation and monitoring in neurocutaneous syndromes - See Background

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BACKGROUND:

Magnetic resonance imaging (MRI) produces high quality multiplanar images of organs and structures within the body without using ionizing radiation. It is used for evaluation, assessment of severity, and follow-up of diseases of the spine and is the preferred modality for imaging intervertebral disc degeneration. High contrast resolution (soft tissue contrast) and multiplanar imaging (sagittal as well as axial planes) are helpful in the evaluation of possible disc herniation and detecting nerve root compression. MRI is one of the most useful techniques to evaluate spine infection and is also used to evaluate tumors, cancer, and immune system suppression.

OVERVIEW:

Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset < 40). It is associated with any of the following (Akgul, 2011; Bennett, 2010; Ostergaard, 2012; Seiper, 2014):

- Sedimentation rate and/or C-reactive protein (not an essential criteria).
- HLA B27 (not an essential criteria).
- Non-diagnostic or indeterminate x-ray
- Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease.

***Conservative Therapy:** (Spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program - (HEP)/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

MRI and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

Myelopathy: Symptom severity varies and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%), and pain (67.4%) (Vitzthum, 2007).

Tethered spinal cord syndrome - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord within the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is mylelomeningocele and lipomyelomeningocele; the following are other associations that vary in severity of symptoms and treatment.

- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale
- History of spine trauma/surgery
- Arnold Chiari Malformation

Magnetic resonance imaging (MRI) can display the low level of the spinal cord and a thickened filum terminale, the thread-like extension of the spinal cord in the lower back. Treatment depends upon the underlying cause of the tethering. If the only abnormality is a thickened, shortened filum then limited surgical treatment may suffice.

MRI and Spinal Infections – Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and noninfectious inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs and paraspinal tissues. Imaging is important to obtain early diagnose and treatment to avoid permanent neurologic deficits. MRI is the preferred imaging technique to evaluate infections of the spine. With its high contrast resolution and direct multiplanar imaging, it has the ability to detect and delineate infective lesions irrespective of their spinal location.

Back Pain with Cancer History - Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

CAUDA EQUINA SYNDROME:

- Symptoms include severe back pain or sciatica along with one or more of the following:
  - Saddle anesthesia - loss of sensation restricted to the area of the buttocks, perineum and inner surfaces of the thighs (areas that would sit on a saddle).

- Recent bladder/bowel dysfunction (as listed above)
- Achilles reflex absent on both sides
- Sexual dysfunction that can come on suddenly
- Absent anal reflex and bulbocavernosus reflex

Spinal MRI and Neuromyelitis optica spectrum disorders (NMOSD) - NMOSD are inflammatory disorders of the central nervous system characterized by severe, immune-mediated demyelination and axonal damage predominantly affecting the optic nerves and spinal cord, but also the brain and brainstem. NMOSD can be distinguished from multiple sclerosis and other inflammatory disorders by the presence of the aquaporin-4 (AQP4) antibody. Features of NMOSD include attacks of bilateral or sequential optic neuritis acute transverse myelitis and the area postrema syndrome (with intractable hiccups or nausea and vomiting). The evaluation of suspected NMOSD entails brain and spinal cord neuroimaging. In contrast to MS (in which spinal cord involvement tends to be incomplete and asymmetric), NMOSD have a longer extent of spinal cord demyelination generally involving three or more vertebral segments.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added:
  - new or worsening objective neuro deficits for chronic and acute back pain
  - CSF leak
  - last 6 months for allowable post op f/u period and removed EMG comment
  - red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
  - new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;
  - For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
    - Myelopathy
    - Pre op for spinal cord stimulator
    - Evaluation of MS including NMO disorders and recurrent transverse myelitis
    - Back pain in cancer patients with known active cancer in tumors that tend to metastasize
- Expanded on tethered cord in Other Indications for Imaging and added content on sacral dimple

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72148 – MRI Lumbar Spine

CPT Codes: 72148, 72149, 72158

INDICATIONS FOR LUMBAR SPINE MRI:

For evaluation of neurologic deficits

- With any of the following new neurological deficits: lower extremity weakness; abnormal reflexes; abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

For evaluation of chronic back pain with any of the following (Allegri, 2016)
(ACR, 2015; AAFP, 2012; ACEP, 2014; NASS, 2013; Jarvik, 2015; Last, 2009; Quaseem, 2017)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months
- With progression or worsening of symptoms during the course of conservative treatment*
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a lumbar radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of new onset of back pain
(ACR, 2018; AANSCNS, 2014; ACA, 2017; ACEP, 2014; Allegri, 2016; Quaseem, 2017)

- With new or worsening objective neurologic deficits on exam
- Failure of conservative treatment*, for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*
- With an abnormal electromyography or nerve conduction study (if performed) indicating a lumbar radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic or cervical spine pain (NASS, 2013)).

For evaluation of trauma or acute injury
(ACR, 2012; Quaseem, 2017)

- Presents with any of the following neurological deficits: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

Pars defect (spondylolysis) or spondylisthesis

- Pars defect (spondylolysis) or spondylisthesis in adults when Flexion/Extension x-rays show instability.
- Pars defect (spondylolysis with spondylisthesis) on plain films in pediatric population (<18 yr) (flexion extension instability not required).

NOTE: Initial imaging (x-ray, or planar bone scan without SPECT; Bone scan with SPECT is superior to MRI and CT in the detection of pars intrarticularis pathology including spondylolysis) (Matesan, 2016).

For evaluation of known or new compression fractures with worsening back pain (ACR, 2018)

- With history of malignancy.
- With an associated new focal neurologic deficit
- Prior to a planned surgery/intervention or if the results of the MRI will change management.

For evaluation of known tumor, cancer, or evidence of metastasis with any of the following: (Last, 2009) (MRI is usually the preferred study but CT may help characterize solitary indeterminate bone lesions) (ACR, 2018).
(Kim, 2012)

- For staging of known tumor.
- For follow-up evaluation of patient undergoing active cancer treatment.
- Presents with new signs or symptoms (e.g. physical, laboratory and/or imaging findings) of new tumor or change in tumor
- With evidence of metastasis on bone scan or previous imaging study.

For evaluation of suspected tumor
(ACR, 2018)

- Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected infection, abscess, or inflammatory disease
(ACR, 2018; Last, 2009; Lener, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma
(ACR, 2018)

- As evidenced by signs/symptoms, laboratory or prior imaging findings.

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2018; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection):**

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
- Changing neurologic status post-operatively.
- Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.

- Residual or recurrent symptoms with any of the following neurological deficits: Lower extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).

Other Indications for a Lumbar Spine MRI

- For preoperative evaluation.
- Suspected cord compression with any of the following neurological deficits: extremity weakness; sensory deficits, abnormal gait; abnormal reflexes; spinal level; bowel or bladder incontinence.
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH)**.**
- Suspicious sacral dimple (those that are deep, larger than 0.5 cm, located within the superior portion of the gluteal crease or above the gluteal crease, or associated with other cutaneous markers) (D'Alessandro, 2009) in patients <6 months should have ultrasound.
- For suspected Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup
- Known Arnold-Chiari syndrome (Milhorat, 2009; Strahle, 2015).
- Congenital abnormalities (Trenga, 2016):
    - In the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
    - Back pain in a child with vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) seen on preliminary imaging.
    - Scoliosis with any of the following:
        - Progressive spinal deformity;
        - Neurologic deficit;
        - Early onset;
        - Atypical curve (e.g., short segment, > 30' kyphosis, left thoracic curve, associated organ anomalies);
        - Pre-operative planning; OR
        - When office notes clearly document how imaging will change management.

CSF leak highly suspected and supported by patient history and/or physical exam findings.

For pediatric population (ACR, 2016)

- Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.
- Back pain associated with suspected inflammation, infection, or malignancy

COMBINATION OF STUDIES WITH LUMBAR SPINE MRI:

Cervical/Thoracic/Lumbar MRIs:

- Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (Strahle, 2015, ACR, 2018).
- Any combination of these for spinal survey in patient with metastasis.
- For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015)

- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), when anesthesia required for imaging**.**
- Drop metastasis from brain or spine (imaging also includes brain).
- Tumor evaluation and monitoring in neurocutaneous syndromes - See Background

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BACKGROUND:
Magnetic resonance imaging (MRI) is used in the evaluation, diagnosis, and management of spine related conditions, e.g., degenerative disc disease, cauda equine compression, radiculopathy, infections, or cancer in the lumbar spine. MRI provides high quality multiplanar images of organs and structures within the body without the use of x-rays or radiation. In the lumbar area where gonadal exposure may occur, MRI's lack of radiation is an advantage.

OVERVIEW:

Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset < 40). It is associated with any of the following (Akgul, 2011; Bennett, 2010; Ostergaard, 2012; Seiper, 2014):

- Sedimentation rate and/or C-reactive protein (not an essential criteria).
- HLA B27 (not an essential criteria).
- Non-diagnostic or indeterminate x-ray
- Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease.

***Conservative Therapy**: (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program** - (HEP)**/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

MRI and Cutaneous Stigmata (Dias, 2015)

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

MRI and Back Pain – MRI is the initial imaging modality of choice in the evaluation of complicated low back pain. Contrast administration may be used to evaluate suspected inflammatory disorders, e.g., discitis, and it is useful in evaluating suspected malignancy. Radiculopathy, disease of the nerve roots is the most common indication for MRI of patients with low back pain. The nerve roots become irritated and inflamed, due to direct pressure from degenerative changes in the lumbar spine, creating pain and numbness. Symptoms of radiculopathy also include muscle weakness. MRI is indicated for this condition if the symptoms do not improve after conservative treatment over six weeks. MRI is also performed to evaluate Cauda equina syndrome, severe spinal compression.

Sacral Dimples - Simple midline dimples are the most commonly encountered dorsal cutaneous stigmata in neonates and indicate low risk for spinal dysraphism. Only atypical dimples are associated with a high risk for spinal dysraphism, particularly those that are large (>5 mm), high on the back (>2.5 cm from the anus) or appear in combination with other lesions (D' Alessandro, 2009). High-risk cutaneous stigmata in neonates include hemangiomas, upraised lesions (i.e., masses, tails, and hairy patches), and multiple cutaneous stigmata.

Tethered spinal cord syndrome - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord within the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is mylelomeningocele and lipomyelomeningocele; the following are other associations that vary in severity of symptoms and treatment.

- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale
- History of spine trauma/surgery
- Arnold Chiari Malformation

Magnetic resonance imaging (MRI) can display the low level of the spinal cord and a thickened filum terminale, the thread-like extension of the spinal cord in the lower back. Treatment depends upon the underlying cause of the tethering. If the only abnormality is a thickened, shortened filum then limited surgical treatment may suffice.

Back Pain with Cancer - **History** Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process (Ziu, 2019).

CAUDA EQUINA SYNDROME:

- Symptoms include severe back pain or sciatica along with one or more of the following:
    - Saddle anesthesia - loss of sensation restricted to the area of the buttocks, perineum and inner surfaces of the thighs (areas that would sit on a saddle).
    - Recent bladder/bowel dysfunction (as listed above)
    - Achilles reflex absent on both sides
    - Sexual dysfunction that can come on suddenly
    - Absent anal reflex and bulbocavernosus reflex

MRI and Neurocutaneous Syndromes

- In NF-1, clinical evaluation appears to be more useful to detect complications than is screening imaging in asymptomatic patients. Imaging is indicated in evaluation of suspected tumors based clinical evaluation and for follow-up of known intracranial tumors (Borofsky, 2013).
- Conversely in NF-2, routine MR imaging screening is always indicated, given the high prevalence of CNS tumors especially vestibular schwannomas. In patients with NF-2, routine screening brain/IAC imaging is indicated annually starting from age 10 if asymptomatic or earlier with clinical signs/symptoms. Most individuals with NF2 eventually develop a spinal tumor, mostly commonly schwannomas, but meningioma and ependymomas are also seen. Spinal imaging at baseline and every 2 to 3 years is also advised with more frequent imaging if warranted based on sites of tumor involvement (Evans, 2017).
- In patients with Tuberous Sclerosis, Brain MRI should be obtained every 1-3 years up until age 25 for surveillance for CNS abnormalities (Krueger, 2013).

- In Von Hippel Lindau Syndrome, imaging of the brain and spinal cord for hemangioblastomas is recommended every 2 years (Von Hippel-Lindau, 2017).
- In Sturge Weber Syndrome, Brain MRI can rule out intracranial involvement after only after age 1 and is recommended in patients <1 year only if symptomatic (Comi, 2011).

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added:
  - new or worsening objective neuro deficits for chronic and acute back pain
  - CSF leak
  - last 6 months for allowable post op f/u period and removed EMG comment
  - red flags specifically for peds back pain and pain related to malignancy, infection, inflammation
  - new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;
  - For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
- Expanded on tethered cord in Other Indications for imaging and added section on sacral dimple

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72159 – MR Angiography Spinal Canal

CPT Codes: 72159

INDICATIONS FOR SPINAL CANAL MRA:

- For the evaluation of spinal arteriovenous malformation (AVM) (Amarouche, 2015; Backes, 2008; Mathur, 2017; NIH, 2009; Shin, 2019)
- For the evaluation of a known cervical spine fracture, disc herniation, infection, or venous thrombosis where there is concern for vascular pathology (compression or thrombosis) compromising spinal cord blood flow or venous drainage (ACR, 2015; Vargas, 2015).
- For the evaluation of known or suspected vertebral artery injury when there is also concern for vascular compromise to the spinal canal and its contents (otherwise Neck MRA or CTA is sufficient to evaluate vertebral artery injury).
- Preoperative evaluation (e.g. localization of the spinal arteries prior to complex spinal surgery, aortic aneurysm repair, or characterization of suspected vascular lesion of the spinal canal and its contents) (Backes, 2008).
- Myelopathy when the suspected etiology is compromise of blood flow or drainage to the spinal cord (ACR, 2015; Vargas, 2015).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (Mathur, 2017).

BACKGROUND:

Application of spinal magnetic resonance angiography (MRA) allows for more effective and noninvasive screening for vascular lesions than magnetic resonance imaging (MRI) alone. It may improve characterization of normal and abnormal intradural vessels while maintaining good spatial resolution. Spinal MRA may be used for the evaluation of spinal arteriovenous malformations, as well as injuries to blood vessels supplying the spine and cord.

OVERVIEW:

Spinal Arteriovenous Malformations (AVMs) – Spinal cord arteriovenous malformations are comprised of snarled tangles of arteries and veins which affect the spinal cord. They are fed by spinal cord arteries and drained by spinal cord veins. Magnetic resonance angiography (MRA) can record the pattern and velocity of blood flow through vascular lesions as well as the flow of cerebrospinal fluid throughout the spinal cord. MRA defines the vascular malformation and may assist in determining treatment.

Spinal MRA/MRV

(Backes, 2008; Vargas, 2015; Mathur, 2017)

Typically, contrast enhanced 3 D time of flight techniques and contrast enhanced CT angiography (CTA) are used for evaluation of the spinal arteries veins, and related pathology as a non-invasive alternative to the gold standard catheter angiography. The detection rate of the Adamkiewicz artery (AKA) by MRA is in the range of 69-100% but with modern equipment both MRA and CTA detection rates should approach 100% (Backes,

2008). Magnetic resonance angiography is well suited to patients who cannot receive iodinated contrast and undergo CTA. CTA has the advantage over MRA of providing greater spatial resolution, can image the entire spine during one contrast bolus, and provides for a faster exam time that is less prone to motion artifact. MRA is limited by a finite field of view typically </= 50 cm (Backes, 2008). MRI has the advantage over CT of being able to detect areas of ischemia through the use of diffusion weighted imaging. Mathur et al showed a 100% sensitivity in detecting recurrent spinal arteriovenous fistulas post treatment (Mathur, 2017).

Spinal Arteries/Veins

(Vargas, 2015)

Vascular malformations, trauma, disc herniations, neoplasms, and coagulopathies or infection causing thrombosis can compromise the spinal cord blood supply and drainage. The spinal cord arterial supply is derived from the anterior spinal artery, posterolateral spinal artery, and the arteria radicularis magna or artery of Adamkiewicz (AKA). The anterior spinal artery supplies the anterior two-thirds of the cord and arises from the vertebral arteries. It receives contributions from the ascending cervical artery, the inferior thyroid artery, the intercostal arteries, the lumbar artery, the iliolumbar artery, lateral sacral arteries, and the artery of Adamkiewicz. The AKA arises on the left side of the aorta between the T8 and L1 segments, to anastomose with the anterior spinal artery and supply the lower two-thirds of the spinal. Two posterolateral spinal arteries arise from the posteroinferior cerebellar arteries and supply the posterior third (posterior columns, posterior roots, and dorsal horns) of the spinal cord. The spinal venous system is divided into intrinsic and extrinsic veins differentiated by their location within the spinal canal or extrinsic to the canal, respectively. They drain into the radiculomedullary veins, subsequently to paravertebral and intervertebral plexuses then to the segmental veins that eventually drain into the ascending lumbar veins, azygos system, and pelvic venous plexuses.

POLICY HISTORY:

Review Date: June 2019

Review Summary:

- Updated background information and references

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72191 – CT Angiography, Pelvis

CPT Codes: 72191

IMPORTANT NOTE:
Abd/Pelvis CTA & Lower Extremity CTA Runoff Requests: Only one authorization request is required, using CPT Code 75635 Abdominal Arteries CTA. This study provides for imaging of the abdomen, pelvis and both legs. The CPT code description is CTA aorto-iliofemoral runoff; abdominal aorta and bilateral ilio-femoral lower extremity runoff.

INDICATIONS FOR PELVIS CTA - Abdominal CTA can be added when indicated:

For evaluation of known or suspected vascular disease (Eren, 2010)

- For pelvic extent of known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected pelvic extent of aortic dissection.
- Evaluation of known or suspected aneurysms limited to the pelvis or in evaluating pelvic extent of aortic aneurysm (Khosa, 2011; Uberoi, 2011; Wanhainen, 2019)*
    - Known or suspected iliac artery aneurysm **AND** equivocal or indeterminate Doppler ultrasound results
      OR
    - If repeat Doppler ultrasound is indeterminate
      OR
    - Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of pelvic pain.
- Follow up of iliac artery aneurysm: Every three years for diameter 2.0 – 2.9 cm. Six month if between 3.0-3.5 cm and if stable follow yearly. If > 3.5 cm, < six month follow up (and consider intervention).
- Retroperitoneal hematoma or hemorrhage when an underlying neoplasm is suspected and prior imaging is inconclusive (Abe, 2010).
- For evaluation of suspected pelvic vascular disease or pelvic congestive syndrome when findings on ultrasound are indeterminate (MR or CT venography may be used as the initial study for pelvic thrombosis or thrombophlebitis) (ACR, 2013; Eren, 2010).
- For evaluation of venous thrombosis in the inferior vena cava (Aw-Zoretic, 2016).
- Venous thrombosis if previous studies have not resulted in a clear diagnosis (ACR, 2013).
- Vascular invasion or displacement by tumor (Conventional CT or MRI also appropriate) (Certik, 2015; Smillie, 2015).
- For suspected May-Thurner Syndrome (iliac vein compression syndrome) (Al-Nouri 2011; Kalu, 2013)
- For known and/or suspected mesenteric ischemia/ ischemic colitis (ACR, 2018).
- Lower gastrointestinal hemorrhage: Active bleeding in a hemodynamically stable patient or non-localized intermittent bleeding as an alternative to Tc-99m RBC scan when colonoscopy did not localize the bleeding, is contraindicated or unavailable (ACR, 2014; Clerc, 2017).

- For evaluation of erectile dysfunction when a vascular cause is suspected and Doppler ultrasound is inconclusive (Shindel, 2018)

Pre- operative evaluation

(ACR, 2017)

- Evaluation of interventional vascular procedures prior to endovascular aneurysm repair (EVAR), or for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post- operative or post-procedural evaluation

- Evaluation of post-operative complications of renal transplant allograft (Bultman, 2014).
- Evaluation of endovascular/interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications e.g., pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the pelvis.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms- Chaikof, 2018; ACR, 2017; Uberoi, 2011).
    - Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
    - Asymptomatic at six (6) month intervals, for one (1) year, then annually.
    - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Chest CTA and Abdomen CTA or Abdomen/Pelvis CTA combo

- For preoperative or preprocedural evaluation such as TAVR (transcatheter aortic valve replacement) or transcatheter venous ablation (ACR, 2017; Ohana, 2015).
- Acute aortic dissection (Barman, 2014).
- Takayasu's arteritis (Keser, 2014).
- Post-operative complications (Bennet, 2017; Choudhury, 2017)

BACKGROUND:

Computed tomographic angiography (CTA) is used in the evaluation of many conditions affecting the veins and arteries of the pelvis or lower extremities. It is not appropriate as a screening tool for asymptomatic patients without a previous diagnosis.

OVERVIEW:

CT/MRI and acute hemorrhage: MRI is not indicated and MRA/MRV (MR Angiography/Venography) is rarely indicated for evaluation of intraperitoneal or retroperitoneal hemorrhage, particularly in the acute setting. CT is the study of choice due to its availability, speed of the study and less susceptibility to artifact from patient motion. Advances in technology have allowed conventional CT to not just detect hematomas but also the source of acute vascular extravasation. In special cases finer vascular detail to assess the specific source vessel

responsible for hemorrhage may require the use of CTA. CTA in diagnosis of lower gastrointestinal bleeding is such an example (Clerc, 2017).

***Follow-up of asymptomatic incidentally-detected iliac artery aneurysms** (Uberoi, 2011)

- <3.0 cm: rarely rupture, grow slowly, follow-up not generally needed
- 3.0-3.5 cm: followed up initially at 6 months
    - if stable, then annual imaging
- >3.5 cm: greater likelihood of rupture
    - <6 month follow up
    - consider intervention

POLICY HISTORY:
Review Date: June 2019
Review Summary:
Pelvis CTA

- Added important note for runoff requests and authorizations
- Added note that abdominal CTA can be added when indicated
- Removed iliac artery aneurysm size restriction of >2.5cm in diameter and changed to 'if repeat Doppler US is indeterminate
- For retroperitoneal hematoma or hemorrhage, specified 'when an underlying neoplasm is suspected and prior imaging is inconclusive'
- Added pelvic congestive syndrome; suspected May-Thurner Syndrome; erectile dysfunction when vascular cause is suspected and Doppler US inconclusive; post-operative complications of renal transplant allograft
- Modified combo study from 'Chest CTA/Pelvis CTA' to 'Chest CTA and Abdomen CTA or Abdomen/Pelvis CTA combo'
- Updated background information and references

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72192 – CT Pelvis

CPT Codes: 72192, 72193, 72194

INDICATIONS FOR PELVIS CT:

Initial staging of prostate cancer
(NCCN, 2019)

Prostate cancer when PSA levels ≥10 ng/mL or clinically advanced disease (T2b, T2c, T3, or T4) **AND** nomogram (e.g., Partin, Cancer of Prostate Risk Assessment CAPRA) indicating probability of lymph node involvement >10%) (NCCN, 2019).

Known prostate cancer for workup of recurrence and response to treatment when there is a contraindication for MRI
(NCCN, 2019)

- Initial treatment by radical prostatectomy:
  - Failure of PSA to fall to undetectable levels or PSA detectable and rising on at least 2 subsequent determinations.
- Initial treatment radiation therapy:
  - Post-RT rising PSA or positive digital exam and is candidate for local therapy.

Evaluation of suspicious or known mass/tumors:

- Initial evaluation of suspicious pelvic masses/tumors found only in the pelvis by physical exam and ultrasound has been performed or for further evaluation of abnormality seen on ultrasound (US) or when US would be inconclusive (ACR, 2013, 2014).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious or change was found on exam or last follow-up imaging.
- Initial staging of known cancer
  - All cancers, excluding the following:
    - Basal Cell Carcinoma of the skin (NCCN, 2018).
    - Melanoma without symptoms or signs of metastasis (NCCN, 2018; Trotter, 2013).
- Follow-up of Known Cancer (Bourgioti, 2016; NCCN, 2018):
  - Follow-up of known cancer of patient undergoing active treatment within the past year.
  - Known cancer with suspected pelvis metastasis based on a sign, symptom or an abnormal lab value.
  - Active monitoring for recurrence as clinically indicated.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- < 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of suspected infection or inflammatory disease
(ACR, 2013; Cartwright 2015)
Suspected acute appendicitis (or severe acute diverticulitis) in and adult if pelvic pain and tenderness to palpation is present, with **at LEAST one** of the following:

- WBC elevated;
- Fever;
- Anorexia; **OR**
- Nausea and vomiting.

- Suspected appendicitis in a child after ultrasound has been obtained (Choosing Wisely; ACR, 2018; AAP/ACS; Sanchez, 2016)
- Suspected complications of diverticulitis (known to be limited to the pelvis by prior imaging) with pelvic pain or severe tenderness, not responding to antibiotic treatment.
- Suspected perianal fistula (O'Malley, 2012; Liang, 2014)
- Suspected infection (based on elevated WBC, fever, anorexia or nausea and vomiting) in the pelvis.
- Suspected inflammatory bowel disease (Crohn's or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.

For evaluation of known infection or inflammatory disease follow up
(ACR, 2013, 2014)

- Complications of diverticulitis confined to the pelvis with severe pelvic pain or severe tenderness or mass, not responding to antibiotic treatment, (prior imaging study is not required for diverticulitis diagnosis).
- Known inflammatory bowel disease, (Crohn's or ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation.
- Any known infection that is clinically suspected to have created an abscess in the pelvis.
- Any history of fistula limited to the pelvis that requires re-evaluation, or is suspected to have recurred.
- Abnormal fluid collection seen on prior imaging that needs follow-up evaluation.
- Known infection in the pelvis.

For evaluation of known or suspected vascular disease (e.g., aneurysms, hematomas)
(Khosa, 2011; Uberoi, 2011) **

- Evidence of vascular abnormality identified on imaging studies.
- Evaluation of suspected or known aneurysms limited to the pelvis or in evaluating pelvic extent of aortic aneurysm
    - Suspected or known iliac artery aneurysm > 2.5 cm AND equivocal or indeterminate ultrasound results OR
    - Prior imaging (e.g. ultrasound) demonstrating iliac artery aneurysm > 2.5 cm in diameter OR
    - Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of pelvic pain.
    - Follow up of iliac artery aneurysm: Six month if between 3.0-3.5 cm and if stable follow yearly. If > 3.5 cm , < six month follow up (and consider intervention)
- Scheduled follow-up evaluation of aorto/iliac endograft or stent.
    - Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011).

- Asymptomatic at six (6) month intervals, for one (1) year, then annually.
- Symptomatic/complications related to stent graft – more frequent imaging may be needed.

- Suspected retroperitoneal hematoma or hemorrhage.

For evaluation of trauma
(ACR, 2012)
- For evaluation of trauma with lab or physical findings of pelvic bleeding.
- For evaluation of physical or radiological evidence of complex or occult pelvic fracture or for pre-operative planning of complex pelvic fractures.

Pre-operative evaluation:
- For diagnostic purposes prior to pelvic surgery or procedure.

For post-operative/procedural evaluation:
- Follow-up of known or suspected post-operative complication involving the hips or the pelvis (Davis, 2016; Yanny, 2012) within six months.
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Other Indications for Pelvic CT:
- Subacute or chronic pelvic pain not explained by previous imaging/procedure (ACR, 2018).
- To provide an alternative to initial or follow-up of an indeterminate or inconclusive finding on ultrasound and MRI cannot be done.
- Hernia with suspected complications (e.g. bowel obstruction or strangulation, or non-reducible) or prior to surgical repair or when physical exam or prior imaging (e.g. ultrasound) is non-diagnostic or equivocal (Lassandro, 2011; Miller, 2014; Robinson, 2013).
- Ischemic bowel (Dhatt, 2015).
- Known or suspected aseptic/avascular necrosis of hip(s) and MRI is contraindicated after completion of initial x-ray (ACR, 2015).
- Sacroiliitis (infectious or inflammatory) after completion of initial x-ray and MRI is contraindicated (ACR, 2016; Jans, 2014).
- Sacroiliac joint dysfunction and MRI contraindicated when there is:
  - Persistent back and/or sacral pain unresponsive to four (4) weeks of conservative treatment, received within the past six (6) months, including physical therapy or physician supervised home exercise plan (HEP).

If an Abdomen/Pelvis CT combo is indicated and the Abdomen CT has already been approved, then the Pelvis CT may be approved.

BACKGROUND:

CT provides direct visualization of anatomic structures in the abdomen and pelvis and is a fast imaging tool used to detect and characterize disease involving the abdomen and pelvis. Pelvic imaging begins at the iliac crests through pubic symphysis. It has an ability to demonstrate abnormal calcifications or fluid/gas patterns in the viscera or peritoneal space.

In general, ionizing radiation from CT should be avoided during pregnancy. Ultrasound is clearly a safer imaging option and is the first imaging test of choice, although CT after equivocal ultrasound has been validated for diagnosis. Clinicians should exercise increased caution with CT imaging in children, pregnant women, and young adults due to the risks of exposure to ionizing radiation. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.

OVERVIEW:

***Conservative Therapy**: (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program** - (HEP)**/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Ultrasound should be considered prior to a request for Pelvis CT for the following evaluations:

- Initial evaluation or follow up of ovarian mass or abnormal physical finding
- Repeat CT for aneurysm ordered by non-surgeon.

CT for suspected renal stones - An initial CT study is done to identify the size of the stone and rule out obstruction. *(7 mm is the key size- less than that size the expectation is that it will pass)* After the initial CT study for kidney stone is done, the stone can be followed by x-ray or US (not CT). If a second exacerbation occurs/a new stone is suspected another CT would be indicated to access the size of stone and rule out obstruction.

CT Imaging for Renal Colic and Hematuria – Multidetector computed tomography (CT) is the modality of choice for the evaluation of the urinary tract. It is fast and it has good spatial resolution. It is superior to plain-film for imaging the renal parenchyma. CT protocols include: “stone protocol” for detecting urinary tract calculi, “renal mass protocol” for characterizing known renal masses and CT urography for evaluating

hematuria. Non-contrast CT can be used for detecting most ureteral and renal stones but sometimes an intravenous contrast agent is needed to determine the relationship of the calculus to the opacified ureter. CT is an effective imaging examination for diagnosing hematuria caused by urinary tract calculi, renal tumors, and urothelial tumors.

CT Imaging for Abdominal and Pelvic Aneurysms – Abdominal and pelvic aneurysms are usually asymptomatic and most are discovered during imaging studies ordered for other indications or, particularly in the abdomen, on physical examination as a pulsatile mass. If a pulsatile abdominal mass is found, abdominal ultrasonography is an inexpensive and noninvasive technique for examination. For further examination, CT may be performed to better define the shape and extent of the aneurysm and the local anatomic relationships of the visceral and renal vessels. CT has high level of accuracy in sizing aneurysms.

****Follow-up of asymptomatic incidentally-detected iliac artery aneurysms**
(Uberoi, 2011)

- < 3.0 cm: rarely rupture, grow slowly, follow-up not generally needed
- 3.0-3.5 cm: followed up initially at 6 months
    - if stable, then annual imaging
- > 3.5 cm: greater likelihood of rupture
    - <6 month follow up
    - consider intervention

Combination request of Abdomen CT/Chest CT - A Chest CT will produce images to the level of L3. Documentation for combo is required.

Hematuria and CT Imaging of Urinary Tract – Multidetector CT urography is a first line of investigation in patients with hematuria due to its ability to display the entire urinary tract, including renal parenchyma, pelvicaliceal systems, ureters and bladder with a single imaging test. To evaluate hematuria, the urinary tract is assessed for both calculi and neoplasms of the kidney and or urothelium.

Helical CT of Prostate Cancer – Conventional CT is not useful in detecting prostate cancer as it does not allow direct visualization. Contrast-enhanced MRI is more useful in detecting prostate cancer. MRI is recommended in patients with suspected cancer but prior negative biopsy because MRI alone can miss up to 26% of clinically significant cancers that would be detected on systemic biopsy (Borofsky, 2018). Helical CT of the prostate may be a useful alternative to MRI in patients with an increasing PSA level and negative findings on biopsy but is not the imaging study of choice.

Pelvic Trauma and CT Imaging – Helical CT is useful in the evaluation of low or high flow vascular injuries in patient with blunt or penetrating pelvic trauma. It provides detailing of fractures and position of fracture fragments along with the extent of diastasis of the sacroiliac joints and pubic symphysis. CT helps determine whether pelvic bleeding is present and can identify the source of bleeding. With CT, high flow hemorrhage can be distinguished from low flow hemorrhage aiding the proper treatment.

Bladder Cancer and CT Imaging – The diagnosis of upper tract transitional cell carcinoma is dependent on imaging. CT urography is increasingly being used in the imaging of the upper urinary tract in patients with bladder cancer.
Multidetector CT scans are more accurate than the older ones and are used in the diagnosis, staging and surveillance of transitional cell carcinoma of the upper urinary tract.

Urinary Calculi and Reduced Radiation Dose – Studies have been performed to retrospectively determine the effect of 50% and 75% radiation dose reductions on sensitivity and specificity of CT for the detection of urinary calculi. Ciaschini, et al found no significant differences between the examinations at 100% radiation dose and those at the reduced dosage for the detection of calculi greater than 3 mm.

Imaging of hernias: Most hernias are diagnosed clinically with imaging recommended for the diagnosis of occult hernias or in the evaluation of hernia complications such as bowel obstruction or strangulation. To detect occult hernias, ultrasound is a first line study with a sensitivity of 86% and specificity of 77% compared to 80% sensitivity and 65% specificity for CT (Robinson, 2013). According to Miller et al "Magnetic resonance imaging is generally not considered a first- or even second-line evaluation modality for hernias…" (Miller, 2014). Based on this analysis MRI is recommended only when ultrasound and CT have been performed and fail to make a diagnosis.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Changed PSA levels from ≥ 20 ng/mL to ≥ 10 ng/mL or clinically advanced disease (T2b, T2c, T3, or T4) AND nomogram per NCCN; deleted Gleason score
- Modified guideline to align with abdomen pelvis CT guideline
- Added 'routine, baseline study (post-op/intervention) is warranted within 1-3 months for scheduled f/u evaluation of aorto/iliac endograft or stent
- Specified pelvic pain by adding subacute or chronic
- Added:
    - to provide an alternative to initial or f/u of an indeterminate or inconclusive finding on US and MRI cannot be performed
    - suspected perianal fistula;
    - hernia with suspected complications
- Added 'within 6 months' time specification for f/u of known or suspected post-operative complication involving hips or pelvis
- Updated background information and references

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72196 – MRI Pelvis

CPT Codes: 72195, 72196, 72197

INDICATIONS FOR PELVIC MRI:

Initial pelvic imaging for staging of prostate cancer
(NCCN, 2019)

- PSA levels ≥ 10 ng/mL, or clinically advanced disease (T2b, T2c, T3, or T4) **AND** nomogram (e.g., Partin, Cancer of Prostate Risk Assessment CAPRA) indicating probability of lymph node involvement >10%) (NCCN, 2019).

Known prostate cancer for workup of recurrence and response to treatment
(NCCN, 2019)

- Initial Treatment by active surveillance (asymptomatic very low, or low or intermediate risk with expected patient survival ≥ 10 years):
    - Initial mpMRI (multiparametric MRI) for patients who chose active surveillance
    - mpMRI (multiparametric MRI) to be repeated no more than every 12 months unless clinically indicated
- Initial treatment by radical prostatectomy:
    - Failure of PSA to fall to undetectable levels or PSA detectable and rising on at least 2 subsequent determinations.
- Initial treatment radiation therapy:
    - Post-RT rising PSA or positive digital exam and is candidate for local therapy.

Indication for (suspected prostate cancer) prostate MRI
(Bjurlin, 2018; Borofsky, 2018; EAU, 2018; Elkhoury, 2019)
Rising or persistent elevated PSA (with lab reports on 2 or more separate days)) OR suspicious DRE AND at least 15 year life expectancy AND negative prior biopsy (EAU, 2018)

Evaluation of suspicious or known mass/tumors

- Initial evaluation of suspicious pelvic masses/tumors found only in the pelvis by physical exam and ultrasound has been performed or for further evaluation of abnormality seen on ultrasound (US) or when US is inconclusive (ACR, 2013, 2014).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvic. No further surveillance unless tumor(s) are specified as highly suspicious or change was found on exam or last follow-up imaging.

Initial staging of known cancer:

- All cancers, excluding the following:
    - Basal Cell Carcinoma of the skin (NCCN, 2018).
    - Melanoma without symptoms or signs of metastasis (NCCN, 2018; Trotter, 2013).
- Follow-up of Known Cancer (NCCN, 2018; Bourgioti, 2016):

- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected pelvic metastasis based on a sign, symptom or an abnormal lab value.
- Active monitoring for recurrence as clinically indicated.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

For evaluation of suspected infection or inflammatory disease and preliminary imaging has been performed or is contraindicated

(ACR, 2013; Cartwright, 2015)

Suspected acute appendicitis (or severe acute diverticulitis) in an adult if pelvic pain and tenderness to palpation is present, with **at LEAST one** of the following:

- WBC elevated;
- Fever;
- Anorexia; **OR**
- Nausea and vomiting

- Suspected appendicitis in a child after ultrasound has been obtained (Choosing Wisely; ACR, 2018; AAP/ACS; Sanchez, 2016)
- Suspected complications of diverticulitis (known to be limited to the pelvis by prior imaging) with pelvic pain or severe tenderness, not responding to antibiotic treatment.
- Suspected perianal fistula (O'Malley, 2012)
- Suspected infection (based on elevated WBC, fever, anorexia or nausea and vomiting) in the pelvis.
- Suspected inflammatory bowel disease (Crohn's or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea (MRI may not be well tolerated in the acute setting of inflammatory bowel disease (ACR, 2014)).

For evaluation of known infection or inflammatory disease follow up

(ACR, 2013, 2014)

- Complications of diverticulitis confined to the pelvis with severe abdominal pain or severe tenderness or mass, not responding to antibiotic treatment, (prior imaging study is not required for diverticulitis diagnosis).
- Known inflammatory bowel disease (Crohn's or ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation.
- Any known infection that is clinically suspected to have created an abscess in the pelvis and preliminary imaging has been performed or is contraindicated.
- Any history of fistula limited to the pelvis that requires re-evaluation, or is suspected to have recurred.
- Abnormal fluid collection seen on prior imaging that needs follow-up evaluation and preliminary imaging has been performed or is contraindicated.
- Known infection in the pelvis and preliminary imaging has been performed or is contraindicated.

Pre-operative evaluation:

- For diagnostic purposes prior to pelvic surgery or procedure.

For post-operative/procedural evaluation:

- Follow-up of known or suspected post-operative complication involving the hips or the pelvis (Davis, 2016; Yanny, 2012) within six months.
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Indications for Musculoskeletal Pelvic MRI:

- Initial evaluation of suspicious mass/tumor of the bones, muscles or soft tissues of the pelvis found on an imaging study, and needing clarification, or found by physical exam and remains non-diagnostic after x-ray or ultrasound.
- Evaluation of suspected fracture and/or injury when initial imaging is inconclusive or needs further evaluation; or for confirmed stress (fatigue) fracture for "return to play" evaluation (ACR, 2016).
- For evaluation of known or suspected aseptic/avascular necrosis of hip(s) after completion of initial x-ray (ACR, 2015).
- Sacroiliitis (infectious or inflammatory) after completion of initial x-ray (ACR, 2016; Jans, 2014).
- Sacroiliac Joint Dysfunction when there is (Jans, 2014):
  - Persistent back and/or sacral pain unresponsive to four (4) weeks of conservative treatment, received within the past six (6) months, including physical therapy or physician supervised home exercise plan (HEP).
- Persistent Pain:
  - For evaluation of persistent pain unresponsive to four (4) weeks of conservative treatment received within the past six (6) months.
- Pelvic floor failure OR post-operative complications after pelvic floor surgery (ACR, 2014):
  - For evaluation of incontinence and anatomical derangements including, but not limited to uterine prolapse, rectocele, cystocele.
- For further evaluation of congenital anomalies of the sacrum and pelvis and initial imaging has been performed.
- Athletic pubalgia (Koulouris, 2008; Omar, 2008):
  - For evaluation of persistent groin or symphysis pubis pain related to a suspected diagnosis of athletic pubalgia (sports hernia), when not responding to 4 weeks of conservative treatment*.

Other Indications for a Pelvic MRI:

- For location or evaluation of undescended testes in adults and in children, including determination of location of testes, if ordered by a specialist (Kolon, 2014)
- For evaluation and characterization of uterine and adnexal masses, (e.g., fibroids, ovaries, tubes and uterine ligaments), or congenital abnormality where ultrasound has been done previously) (ACR, 2018).
- For evaluation of uterus prior to and after embolization (Deshmukh, 2012).
- For evaluation of endometriosis when preliminary imaging has been completed or to follow up known endometriosis (ACR, 2012; Siegelman, 2012)
- Prior to uterine surgery if there is abnormality suspected on prior ultrasound.
- For suspected placenta accreta or percreta when ultrasound is indeterminate (Kilcoyne, 2017)
- Occult hernia when physical exam or prior imaging (ultrasound AND CT) is non-diagnostic or equivocal (Lassandro, 2011; Miller, 2014; Robinson, 2013).

- For further assessment of a scrotal or penile mass when ultrasound is inconclusive (Parker, 2015; Kirkham, 2012)
- For investigation of a malfunctioning penile prosthesis
- Suspected urethral diverticula and other imaging is inconclusive (Dwarkasing, 2011)
- For evaluation of adenomyosis when ultrasound is equivocal, especially in the case of suspected focal adenomyoma when it will help determine if surgery is indicated (Li, 2018)
- For suspected pelvic congestion syndrome in patients with chronic pelvic pain when other imaging is non-diagnostic (Knuttinen, 2015)
- For suspected patent urachus when ultrasound is non diagnostic (Villavicencio, 2016)
- For evaluation of enlargement of organ abnormality seen on previous imaging - to provide an alternative to an indeterminate or inconclusive ultrasound

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BACKGROUND:
Magnetic resonance imaging of the pelvis is a noninvasive technique for the evaluation, assessment of severity, and follow-up of diseases of the male and female pelvic organs. MRI provides excellent contrast of soft tissues and provides multiplanar and 3D depiction of pathology and anatomy. Patients undergoing MRI do not have exposure to ionizing radiation or iodinated contrast materials. MRI techniques utilize body coils to image the entire pelvis or endoluminal coils for evaluation of the rectum, prostate and genitourinary system.

OVERVIEW:

PI-RADS Assessment Categories for Prostate Cancer:
(ACR, 2019)
The assignment of a Pi-RADS category is based on mpMRI findings only and does not incorporate other factors including PSA testing, DRE (digital rectal exam), or clinical history.

PIRADS 1 – Very low (clinically significant cancer is highly unlikely to be present)
PIRADS 2 – Low (clinically significant cancer is unlikely to be present)
PIRADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)
PIRADS 4 – High (clinically significant cancer is likely to be present)
PIRADS 5 – Very high (clinically significant cancer is highly likely to be present)

***Conservative Therapy**: (spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program - (HEP)/Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):
- Information provided on exercise prescription/plan AND

- Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

MRI and Undescended Testes – The most common genital malformation in boys is undescended testis. In one series 70% of undescended testes are palpable and despite the advances in ultrasound technology, ultrasound cannot reliably identify intra-abdominal testes, which comprise 20% of all undescended testes (Tasian, 2011). The timely management of undescended testis is important to potentially minimize the risk of infertility and lessen the risk of malignancy. MRI is used as a diagnostic tool in the detection of undescended testes and can reveal information for both anatomic and tissue characterization. It is noninvasive, non-ionizing, and can obtain multiplanar images.

MRI and Adnexal Masses – MRI is used in the evaluation of adnexal masses. It can identify and characterize different neoplastic and nonneoplastic abnormalities, e.g., exophytic leiomyoma, endometrioma, dermoid cyst, and ovarian edema. It is a useful adjunct when sonography is inconclusive in the evaluation of adnexal masses.

MRI and Endometriosis – MRI manifestations of endometriosis vary including endometrioma, peritoneal endometrial implant, adhesion and other rare features. The data obtained from imaging must be combined with clinical data to perform preoperative assessment of endometriosis.

MRI and Prostate Cancer – Although prostate cancer is the second leading cause of cancer in men, the majority of cases do not lead to a prostate cancer related death. Aggressive treatment of prostate cancer can have side effects such as incontinence, rectal injury, and impotence. It is very important to do an evaluation which will assist in making decisions about therapy or treatment. MRI can non-invasively assess prostate tissue, functionally and morphologically. MRI evaluation may use a large array of techniques, e.g., T1-weighted images, T2-weighted images, and dynamic contrast enhanced T1-weighted images.

Prostate Cancer –MRI is not recommended in patients with suspected cancer but prior negative biopsy because MRI alone can miss up to 26% of clinically significant cancers that would be detected on TRUS biopsy (Borofsky, 2018). Patients with suspected prostate cancer should first undergo a systematic biopsy and if that fails to demonstrate tumor, an MRI can then be obtained to guide future biopsy attempts (Bjurlin, 2018; JAMA, 2019).

Per NCCN, 2019, for asymptomatic patients with prostate cancer, in very low, low or intermediate groups with life expectancy ≤ 5 years, no further treatment or work up indicated (unless the patient becomes symptomatic). Active surveillance is indicated if life expectancy is determined to be ≥ 10 years.

MRI and Rectal Cancer – MRI is used in the evaluation of rectal cancer to visualize not only the intestinal wall but also the surrounding pelvic anatomy. MRI is an excellent imaging technique due to its high soft-tissue

contrast, powerful gradient system, and high resolution. It provides accurate evaluation of the topographic relationship between lateral tumor extent and the mesorectal fascia.

Imaging of hernias: Most hernias are diagnosed clinically with imaging recommended for the diagnosis of occult hernias or in the evaluation of hernia complications such as bowel obstruction or strangulation. To detect occult hernias, ultrasound is a first line study with a sensitivity of 86% and specificity of 77%, compared to 80% sensitivity and 65% specificity for CT (Robinson, 2013). According to Miller et al "Magnetic resonance imaging is generally not considered a first- or even second-line evaluation modality for hernias…" (Miller, 2014). Based on this analysis, MRI is recommended only when ultrasound and CT have been performed and fail to make a diagnosis.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Added the following indications:
    - rising or persistent elevated PSA OR suspicious DRE and at least 15 yr life expectancy and negative prior biopsy
    - suspected perianal fistula
    - 6 months time specification for f/u of known or suspected post-operative complication involving hips or pelvis
    - for confirmed stress (fatigue) fracture for "return to play" evaluation
    - post operative complications after pelvic floor surgery
    - For known prostate cancer: Initial treatment by active surveillance w/initial mpMRI and mpMRI to be repeated no more than every 12 months unless clinically indicated
    - suspected placenta accrete or percreta when US is indeterminate
    - further assessment of a scrotal or penile mass when ultrasound is inconclusive
    - investigation of a malfunctioning penile prosthesis
    - suspected urethral diverticula and other imaging is inconclusive
    - evaluation of adenomyosis when ultrasound is equivocal, especially in the case of suspected focal adenomyoma when it will help determine if surgery is indicated
    - suspected pelvic congestion syndrome in patients with chronic pelvic pain when other imaging is non-diagnostic
    - suspected patent urachus when ultrasound is non diagnostic
    - evaluation of enlargement of organ abnormality seen on previous imaging - to provide an alternative to an indeterminate or inconclusive ultrasound
    - PI-RADS information to background section
    - Home exercise program information updated to include dates and duration of failed PT and other

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72198 – MR Angiography, Pelvis

CPT Codes: 72198

IMPORTANT NOTE:

Abdomen/Pelvis Magnetic Resonance Angiography (MRA) & Lower Extremity MRA Runoff Requests: **Two authorization requests are required, one Abdomen MRA, CPT code 74185 and one for Lower Extremity MRA, CPT code 73725 (a separate Pelvic MRA request is not required).** This will provide imaging of the abdomen, pelvis, and both legs.

INDICATIONS FOR PELVIS MRA: Abdominal MRA can be added when indicated*

For evaluation of known or suspected pelvic vascular disease:

- For pelvic extent of known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
  - For suspected pelvic extent of aortic dissection.
  - For evaluation of known or suspected aneurysms limited to the pelvis or evaluating pelvic extent of aortic aneurysm (Khosa, 2011; Uberoi, 2011; Wanhainen, 2019)
    - Known or suspected iliac artery aneurysm **AND** equivocal or indeterminate Doppler ultrasound results and contraindication to CTA

    OR

    - If repeat Doppler ultrasound is indeterminate

    OR

    - Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of pelvic pain.
- Follow up of iliac artery aneurysm: Every three years for diameter 2.0 – 2.9 cm. Six month if between 3.0-3.5 cm and if stable follow yearly. If >3.5 cm, <six month follow up (and consider intervention).
- Retroperitoneal hematoma or hemorrhage when an underlying neoplasm is suspected and prior imaging is inconclusive (Abe, 2010).*
- For evaluation of suspected pelvic vascular disease when findings on ultrasound are indeterminate (MR or CT venography (CTV) may be used as the initial study for evaluating pelvic thrombosis or thrombophlebitis) (ACR, 2013).
- For evaluation of venous thrombus in the inferior vena cava(Aw-Zoretic, 2016)
- Venous thrombosis if previous studies have not resulted in a clear diagnosis (ACR, 2013).
- Vascular invasion or displacement by tumor (Conventional CT or MRI also appropriate) (Certik, 2015).
- Pelvic vein thrombosis or thrombophlebitis (ACR, 2013; Khalil, 2012).
- For suspected May-Thurner Syndrome (iliac vein compression syndrome) (Al-Nouri 2011; Kalu, 2013)
- For chronic mesenteric ischemia (ACR, 2018)
- Acute mesenteric ischemia assess with CTA unless contraindicated (Thakur, 2018)

Pre-operative evaluation:
(ACR, 2017)

- Evaluation of interventional vascular procedures prior to endovascular aneurysm repair (EVAR), or for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post- operative or post-procedural evaluation:

- Evaluation for post-operative complications of renal transplant allograft (Bultman, 2014)
- Evaluation of endovascular/ interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the pelvis.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011).
    - Asymptomatic at six (6) month intervals, for one (1) year, then annually.
    - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Magnetic resonance angiography (MRA) generates images of the arteries that can be evaluated for evidence of stenosis, occlusion, or aneurysms. It is used to evaluate the arteries of the abdominal aorta and the renal arteries. Contrast enhanced MRA requires the injection of a contrast agent which results in very high quality images. It does not use ionizing radiation, allowing MRA to be used for follow-up evaluations.

OVERVIEW:
Bruits: Blowing vascular sounds heard over partially occluded blood vessels. Abdominal bruits may indicate partial obstruction of the aorta or other major arteries such as the renal, iliac, or femoral arteries. Associated risks include but are not limited to; renal artery stenosis, aortic aneurysm, atherosclerosis, AVM, or coarctation of aorta.

MRA and Chronic Mesenteric Ischemia – Contrast-enhanced MRA is used for the evaluation of chronic mesenteric ischemia, including treatment follow-up. Chronic mesenteric ischemia is usually caused by severe atherosclerotic disease of the mesenteric arteries, e.g., celiac axis, superior mesenteric artery, inferior mesenteric artery. At least two of the arteries are usually affected before the occurrence of symptoms such as abdominal pain after meals and weight loss. MRA is the technique of choice for the evaluation of chronic mesenteric ischemia in patients with impaired renal function.

MRA and Abdominal Aortic Aneurysm Repair – MRA may be performed before endovascular repair of an abdominal aortic aneurysm. Endovascular repair of abdominal aortic aneurysm is a minimally invasive alternative to open surgical repair and its success depends on precise measurement of the dimensions of the aneurysm and vessels. This helps to determine selection of an appropriate stent-graft diameter and length to

minimize complications such as endoleakage. MRA provides images of the aorta and branches in multiple 3D projections and may help to determine the dimensions needed for placement of an endovascular aortic stent graft. MRA is noninvasive and rapid and may be used in patients with renal impairment.

***MRI/CT and acute hemorrhage:** MRI is not indicated and MRA/MRV (MR Angiography/Venography) is rarely indicated for evaluation of intraperitoneal or retroperitoneal hemorrhage, particularly in the acute setting. CT is the study of choice due to its availability, speed of the study, and less susceptibility to artifact from patient motion. Advances in technology have allowed conventional CT to not just detect hematomas but also the source of acute vascular extravasation. In special cases, finer vascular detail to assess the specific source vessel responsible for hemorrhage may require the use of CTA. CTA in the diagnosis of lower gastrointestinal bleeding is such an example (Clerc, 2017).

MRA/MRV is often utilized in non-acute situations to assess vascular structure involved in atherosclerotic disease and its complications, vasculitis, venous thrombosis, vascular congestion or tumor invasion. Although some of these conditions may be associated with hemorrhage, it is usually not the primary reason why MRI/MRA/MRV is selected for the evaluation. A special condition where MRI may be superior to CT for evaluating hemorrhage is to detect an underlying neoplasm as the cause of bleeding (Abe, 2010).

***Follow-up of asymptomatic incidentally-detected iliac artery aneurysms** (Uberoi, 2011**):**

- <3.0 cm: rarely rupture, grow slowly, follow-up not generally needed
- 3.0-3.5 cm: followed up initially at 6 months
    - if stable, then annual imaging
- >3.5 cm: greater likelihood of rupture
    - <6 month follow up
    - consider intervention

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Modified the follow up for iliac aneurysm
- Added ‘chronic’ to mesenteric ischemia indication; added acute mesenteric ischemia should be assessed with CTA unless contraindicated
- Added indications for post-operative complications of renal transplant allograft; venous thrombus in inferior vena cava; suspected May-Thurner syndrome

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73200 – CT Upper Extremity

CPT Codes: 73200, 73201, 73202

INDICATIONS FOR UPPER EXTREMITY CT (HAND, WRIST, ARM, ELBOW, OR SHOULDER) (Plain radiographs must precede CT evaluation):

Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.

Extremity Mass
(Mullan, 2011; Zoga, 2017)

- Adenopathy with increased risk for malignancy (Dommett, 2013; Gaddey, 2016; Mohseni, 2014)
    - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin
        - Two or more regions
        - Persistence after 4 weeks
- Mass or lesion after non-diagnostic x-ray or ultrasound
    - Includes one follow-up if first study indeterminate (Subhawong, 2010)
- Mass with increased risk for malignancy including any of the following (Sinha, 2010; Holzapfel, 2015)
    - Soft tissue mass >5 cm (golf ball size or larger)
    - Painful lump not from injury
    - Lump that is increasing in size
    - A lump of any size that is deep to the muscle fascia
    - Recurrence of a lump after previous excision

Known Cancer
(Fitzgerald, 2015; Holzapfel, 2015; Kircher, 2012; Morrison, 2013)

- Cancer staging
- Cancer Restaging
- Signs or symptoms of recurrence

Infection of bone or joint [MRI is contraindicated or cannot be done (Lee, 2016)]
(Beaman, 2017; Dodwell, 2013)

- Abnormal x-ray or ultrasound
- Negative x-ray but with:
    - Signs and symptoms of joint or bone infection:
        - Pain and localized findings
        - Decrease range of motion
        - Fevers

- Laboratory findings of infection, any of these:
  - Elevated ESR or CRP
  - Elevated white blood cell count
  - Positive joint aspiration

Osteonecrosis (Avascular necrosis (AVN)) [MRI is contraindicated or cannot be done (Wenham, 2014)] (Felten, 2019; Murphey, 2014; Murphey, 2016)

- Abnormal x-ray
- Normal X-rays but symptomatic and high risk
  - Glucocorticosteroid use
  - Glycogen storage disease
  - Renal Transplant recipient
  - Alcohol abuse (Fukushima, 2010)
  - Sickle Cell Anemia (Wali, 2011)

Inflammatory Arthropathy (Rheumatoid Arthritis or Systemic Lupus Erythematosus) [MRI is contraindicated or cannot be done (Sudol-Szopinska, 2013]
(Colebatch, 2013; Zollars, 2018)]

- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Imaging of a single joint for diagnosis or response to therapy after plain films and appropriate lab tests (e.g. RF, ANA, CRP, ESR) (Colebatch, 2013).

Bone Fracture or ligament injury

- Clinical Concern for Occult or Stress Fracture based on all the following (Kijowski, 2012; Sadineni, 2015; Patel, 2011)
  - X-rays initially and at ≥ 2 weeks are negative or non-diagnostic
  - Persistent focal pain and tenderness despite treatment for this time interval:
    - Medications (analgesics and/or anti-inflammatory) **AND**
    - Activity modification with bracing where appropriate
- Fracture on X-ray with documentation of how imaging will affect treatment (Scalcione2014)
- Concern for non-union or delayed fusion based on x-rays and physical findings, at least three months after initial treatment (Boussakri 2016, Mamede 2018)
- Clinical suspicion based on mechanism of injury and physical findings, x-ray completed and MRI is contraindicated or cannot be done
  - TFCC (triangular fibrocartilage complex) injury (Barlow, 2016; Ng, 2017)
  - SLAP (superior labral anterior to posterior complex) lesions (Somerville, 2017)

Joint or muscle pain, x-ray completed (Katz, 2013; Mordecai, 2014)

- Chronic (lasting 3 months or greater) pain and/or persistent tendonitis unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician supervised exercise**) of at least four (4) weeks, **OR**
- With progression or worsening of symptoms during the course of conservative treatment.

Occult wrist ganglion, after indeterminate or negative ultrasound and MRI is contraindicated or cannot be done (Meena, 2014)

- Clinical suspicion and failed 4 weeks conservative treatment including all of the following:
  - Activity modification
  - Rest, ice or heat
  - Splinting or orthotics
  - Medication

Ordered as CT arthrogram when MR arthrogram is contraindicated or cannot be performed (Rhee, 2012)

Osteochondral lesions (defects, fractures, osteochondritis dissecans) and x-ray done (Smith, 2012; Tuite, 2014; Van Dijk, 2010; Van Bergen, 2016)

- Clinical suspicion based on mechanism of injury and physical findings

Foreign Body (Laya, 2017)

- Indeterminate x-ray and ultrasound

Tendon or Muscle Rupture after x-ray and MRI is contraindicated or cannot be done (Garras, 2012; Peck, 2017; Wilkins, 2012)

- Clinical suspicion based on mechanism of injury and physical findings

Peripheral Nerve Entrapment and MRI is contraindicated or cannot be done, including any of the following: (Domkundwar, 2017; Dong, 2012; Donovan, 2010; Meyer, 2018; Tos, 2015)

- Abnormal Electromyogram or Nerve conduction study
- Abnormal x-ray or ultrasound
- Clinical suspicion and failed 4 weeks conservative treatment including at least two of the following (active treatment with physical therapy is not required):
  - Activity modification
  - Rest, ice or heat
  - Splinting or orthotics
  - Medication

Joint specific provocative Orthopedic examination, after x-ray completed and MRI is contraindicated or cannot be done

- Shoulder (Bencardino, 2013; Jain, 2017; Loh, 2016 (Bankart Lesion); Somerville, 2017)
  - Any positive test listed
    - Neer's Sign
    - Hawkins's sign
    - Jobe's test (empty can)
    - Drop Arm test

        - Full can test
        - Hornblower's sign
        - Anterior Shoulder Apprehension test (Bankart Lesion)
        - Load and Shift test (Bankart Lesion)
- Elbow (Kane, 2014; Karbach, 2017)
    - Any positive test listed
        - Valgus stress
        - Lateral pivot-shift test
        - Posterolateral rotatory drawer test
- Wrist (Panday, 2014; Ruston, 2013)
    - Any positive test listed
        - Watson test (scaphoid shift test)
        - Scapholunate ballottement test
        - Reagan test (lunotriquetral ballottement test)

Hemarthosis on arthrocentesis, any joint (Abbasi, 2012; Bencardino, 2013; Turan, 2015) and MRI is contraindicated or cannot be done

Brachial Plexopathy (Vijayasarathi, 2016) and MRI is contraindicated or cannot be done

Pre-operative/procedural evaluation:
- Pre-operative evaluation for a planned surgery or procedure.

Post-operative/procedural evaluation:
- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural complications.
- Joint prosthesis loosening or dysfunction, x-rays non-diagnostic (Fritz, 2014, 2015)

BACKGROUND:
Computed tomography (CT) may be used for the diagnosis, evaluation, and management of conditions of the hand, wrist, elbow and shoulder. CT is not usually the initial imaging test, but is performed after standard radiographs. CT is used for preoperative evaluation or to evaluate specific abnormalities of the bones, joints, and soft tissues of the upper extremities.

OVERVIEW:
***Conservative Therapy:** (Musculoskeletal) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program, and/or chiropractic care.

****Home Exercise Program - (HEP)** – The following two elements are required to meet guidelines for completion of conservative therapy:

- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).

CT to Evaluate Shoulder Pain – The initial work-up for chronic shoulder pain includes plain radiographs. When the diagnosis remains unclear, further testing including may include computed tomography. CT is the preferred imaging technique for evaluating bony disorders of the shoulders, e.g., arthritis, tumors, occult fractures, etc. CT may be useful in patients with suspected rotator cuff tears who cannot undergo magnetic resonance imaging (MRI).

Shoulder Dislocation – Glenoid bone loss occurs in anterior shoulder dislocation. Severe degrees of glenoid bone loss are shown on axial radiography, but it can be quantified more definitively using CT. This information is important as it helps to predict the likelihood of further dislocation and the need for bone augmentation surgery. The number of dislocations cannot reliably predict the degree of glenoid bone loss; it is important to quantify glenoid bone loss, initially by arthroscopy and later by CT. In the CT examination, both glenoids can be examined simultaneously resulting in a comparison of the width of the glenoid in the dislocating shoulder and in the non-dislocating shoulder.

Shoulder fractures – CT may be used to characterize shoulder fractures when more information is need preoperatively. CT can show the complexity of the fracture, and the displacement and angulation.

CT and Wrist Fractures – CT is indicated for wrist fractures where there is fracture comminution, displacement, or complex intraarticular extension. CT can provide a detailed evaluation of radiocarpal articular step-off and gap displacement which can predict the development of radiocarpal osteoarthritis. CT can be performed in several planes, providing soft-tissue and bone detail. CT is also useful in determining the position of known fracture fragments and in assessing the union or status of fracture healing.

CT for Preoperative Evaluation – Where more information is needed preoperatively, CT is used to demonstrate fracture complexity, displacement and angulation.

CT and Scaphoid Fractures – CT is accurate in depicting occult cortical scaphoid fractures. It may be used as a second choice diagnostic method when patients are clinically suspected of having a scaphoid fracture but radiographs are negative or equivocal. Usually the diagnosis of a scaphoid fracture of the wrist is based upon clinical presentation and conventional radiographs. However, a large percentage of patients with a high clinical probability of a scaphoid fracture have unremarkable radiographs. Computed tomography (CT) is another diagnostic tool for patients who have symptoms of a scaphoid fracture but have negative findings on conventional radiographs. Multidetector CT allows coverage of the whole wrist with excellent spatial resolution. It has been proven to be superior to MRI in the detection of cortical involvement of occult scaphoid fractures.

CT and Avascular Necrosis Complicating Chronic Scaphoid Nonunion – Preoperative CT of a scaphoid nonunion may be helpful in identifying avascular necrosis and predicting subsequent fracture union. If the

results of CT suggest avascular necrosis, treatment options may include vascularized bone grafts or limited wrist arthrodesis.

CT and Posttraumatic Elbow Effusions - Multidetector computed tomography (MDCT) may help to detect occult fractures of the elbow when posttraumatic elbow effusions are shown on radiographs without any findings of fracture. Effusions may be visualized on radiographs as fat pads, which can be elevated by the presence of fluid in the joint caused by an acute fracture. MDCT may be useful when effusions are shown on radiographs without a visualized fracture, but there is a clinical suspicion of a lateral condylar or radial head fracture.

CT and Avascular Necrosis – Sports such as racquetball and gymnastics may cause repeated microtrauma due to the compressive forces between the radial head and capitellum. Focal avascular necrosis and osteochondritis dissecans of the capitellum may result. CT may show the extent of subchondral necrosis and chondral abnormalities. The images may also help detect intraarticular loose bodies.

CT and Acute Osseous Trauma – Many elbow injuries result from repetitive microtrauma rather than acute trauma and the injuries are sometimes hard to diagnose. Non-displaced fractures are not always evident on plain radiographs. When fracture is suspected, CT may improve diagnostic specificity and accuracy.

CT and Wrist Tumor – Osteoma does not often occur in the wrist. Symptoms may resemble atypical tenosynovitis. Pain may seem to be related to an injury. CT may be used to evaluate a suspected tumor and may visualize a round lucency surrounded by a rim of sclerosis. CT can give details about the location of the tumor, relative to joints.

Upper Extremity Osteomyelitis and Septic Arthritis – CT helps to distinguish among the types of musculoskeletal infections. Its specific imaging features help identify the forms of infection in the bones and soft tissue. Osteomyelitis, a bone infection most commonly associated with an open fracture or direct trauma, is often not detected in the initial conventional radiographic evaluation because bone changes are not evident for 14-21 days after the onset of infection. CT is also used to help diagnose septic arthritis; CT features include joint effusion and bone erosions around the joint.

American Academy of Pediatrics "Choosing Wisely" Guidelines advise against ordering advanced imaging studies (MRI or CT) for most musculoskeletal conditions in a child until all appropriate clinical, laboratory and plain radiographic examinations have been completed. **"**History, physical examination, and appropriate radiographs remain the primary diagnostic modalities in pediatric orthopaedics, as they are both diagnostic and prognostic for the great majority of pediatric musculoskeletal conditions. Examples of such conditions would include, but not be limited to, the work up of injury or pain (spine, knees and ankles), possible infection, and deformity. MRI examinations and other advanced imaging studies frequently require sedation in the young child (5 years old or less) and may not result in appropriate interpretation if clinical correlations cannot be made. Many conditions require specific MRI sequences or protocols best ordered by the specialist who will be treating the patient… if you believe findings warrant additional advanced imaging, discuss with the consulting orthopaedic surgeon to make sure the optimal studies are ordered.

POLICY HISTORY:

Review Date: May 2019
Review Summary:

- Added initial statement about approvals: 'Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time'.
- Expanded Extremity mass indications including adenopathy; and mass with increased risk for malignancy
- Modified Known Cancer indication to be more broad – 'cancer staging, cancer restaging, signs or symptoms of recurrence'
- Expanded sections for bone fracture and infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)

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73206 – CT Angiography, Upper Extremity

CPT Codes: 73206

INDICATIONS FOR UPPER EXTREMITY CTA:

A request for CT Angiography includes standard CT imaging. An authorization for CT in addition to CTA is not required. When a separate CTA and CT exam is requested documentation requires a medical reason that clearly indicates why additional CT imaging of the upper extremity is needed.

Hand Ischemia (Hotchkiss, 2014; Wong, 2016)

- Arterial Doppler not needed with any of these acute symptoms:
  - Ischemic ulceration without segmental temperature change.
  - Ischemic ulceration with painful ischemia.
  - Acute sustained loss of perfusion with or without acral ulceration.
  - Imminent loss of digit.

- Clinical symptoms with arterial Doppler abnormal and will change management.
  - Includes Raynaud's (can be associated with scleroderma), Buerger disease and other vasculopathies (McMahan, 2010)
- Clinical concern for vascular cause of ulcers with abnormal or indeterminate ultrasound (Rosyd, 2017)
- After stenting or surgery with signs of recurrence or indeterminate ultrasound (Pollak, 2012)

Deep Venous Thrombosis or Embolism after abnormal ultrasound (Dill, 2014; Heil, 2017, ACR 2014)

- After abnormal ultrasound of arm veins if it will change management, or negative or indeterminate ultrasound to rule out other causes
- For evaluation of central veins
- Clinical suspicion of upper arterial emboli (Bozlar, 2014)

Clinical suspicion of vascular disease with abnormal or indeterminate ultrasound (Bozlar, 2013)

- Peripheral vascular malformations (PVM) (Madani, 2015)
- For evaluation of vascular invasion or displacement by tumor (Jin, 2018; Kransdorf, 2017)
- Vasculitis (Fonseka, 2017; Hotchkiss, 2014)
- Aneurysm (Verikokos, 2014)
- Steno-occlusions (Menke, 2010)
- Fibromuscular Dysplasia (Nguyen, 2017; Sharma, 2014)

Evaluation of traumatic injuries to the UE with clinical findings suggestive of arterial injury (Wani, 2012).

Hemodialysis Graft Dysfunction, after Doppler ultrasound not adequate for treatment decisions (Murphy, 2017)

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure (Ahmed, 2017).

Post-operative/ procedural evaluations:

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Computed tomography angiography (CTA) can visualize blood flow in arterial and venous structures throughout the upper extremity using a computerized analysis of x-ray images. It is enhanced by contrast material that is injected into a peripheral vein to promote visualization. CTA is much less invasive than catheter angiography which involves injecting contrast material into an artery. CTA is less expensive and carries lower risks than catheter angiography.

OVERVIEW:

CTA and Raynaud's Syndrome – Raynaud's syndrome is evidenced by episodic waxy pallor or cyanosis of the fingers caused by vasoconstriction of small arteries or arterioles in the fingers. It usually occurs due to a response to cold or to emotional stimuli. CTA may be used in the evaluation of Raynaud's syndrome.

CTA and Dialysis Graft – The management of the hemodialysis access is important for patients undergoing dialysis. With evaluation and interventions, the patency of hemodialysis fistulas may be prolonged. In selected cases, CTA is useful in the evaluation of hemodialysis graft dysfunction due to its speed and high resolution. Rapid data acquisition during the arterial phase, improved visualization of small vessels and lengthened anatomic coverage increase the usefulness of CTA.

CTA and Stenosis or Occlusion – CTA of the central veins of the chest is used for the detection of central venous stenoses and occlusions. High-spatial resolution CTA characterizes the general morphology and degree of stenosis. Enlarged and well-developed collateral veins in combination with the non-visualization of a central vein may be indicative of chronic occlusion, whereas less-developed or absent collateral veins are suggestive of acute occlusions. A hemodynamically significant stenosis may be indicated by the presence of luminal narrowing with local collaterals.

POLICY HISTORY:
REVIEW DATE: May 2019
REVIEW SUMMARY:

- Reformatted/modified indications to include hand ischemia; deep venous thrombosis or embolism and clinical suspicion of vascular disease
- Updated background information and references

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73220 – MRI Upper Extremity, other than Joint

CPT Codes: 73218, 73219, 73220, 73221, 73222, 73223

INDICATIONS FOR UPPER EXTREMITY MRI (HAND, WRIST, ARM, ELBOW or SHOULDER) (Plain radiographs must precede MRI evaluation):

Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.

Extremity Mass
(Mullan, 2011; Zoga, 2017)

- Adenopathy with increased risk for malignancy (Dommett, 2013; Gaddey, 2016; Mohseni, 2014)
    - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin
        - Two or more regions
        - Persistence after 4 weeks
- Mass or lesion after non-diagnostic x-ray or ultrasound
    - Includes one follow-up if first study indeterminate (Subhawong, 2010)
- Mass with increased risk for malignancy including any of the following (Sinha, 2010):
    - Soft tissue mass >5 cm (golf ball size or larger)
    - Painful lump not from injury
    - Lump that is increasing in size
    - A lump of any size that is deep to the muscle fascia
    - Recurrence of a lump after previous excision

Known Cancer
(Fitzgerald, 2015; Holzapfel, 2015; Kircher, 2012; Morrison, 2013)

- Cancer staging
- Cancer Restaging
- Signs or symptoms of recurrence

Infection of Bone or Joint
(Beaman, 2017; Dodwell, 2013)

- Abnormal x-ray or ultrasound
- Negative x-ray but with:
    - Signs and symptoms of joint or bone infection:
        - Pain and localized findings

        - Decrease range of motion
        - Fevers
    - Laboratory findings of infection, any of these:
        - Elevated ESR or CRP
        - Elevated white blood cell count
        - Positive joint aspiration

Osteonecrosis (Avascular necrosis (AVN))
(Felten, 2019; Murphey, 2014; Murphey, 2016)

- Abnormal x-ray
- Normal X-rays but symptomatic and high risk
    - Glucocorticosteroid use
    - Glycogen storage disease
    - Renal Transplant recipient
    - Alcohol abuse (Fukushima, 2010)
    - Sickle Cell Anemia (Wali, 2011)

For evaluation of known or suspected autoimmune disease (e.g. rheumatoid arthritis): (Zollars, 2018)

- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Imaging of a single joint for diagnosis or response to therapy after plain films and appropriate lab tests (e.g. RF, ANA, CRP, ESR) (Colebatch, 2013).

Bone Fracture or Ligament Injury

- Clinical Concern for Occult or Stress Fracture based on all the following (Kijowski, 2012; Sadineni, 2015; Patel, 2011, YIN 2010)
    - X-rays initially and at ≥ 2 weeks are negative or non-diagnostic
    - Persistent focal pain and tenderness despite treatment for this time interval:
        - Medications (analgesics and/or anti-inflammatory) **AND**
        - Activity modification with bracing where appropriate
- Fracture on X-ray with documentation of how imaging will affect treatment (Scalcione, 2014)
- Clinical suspicion based on mechanism of injury and physical findings and x-ray completed
    - TFCC (triangular fibrocartilage complex) injury (Barlow, 2016; Ng, 2017)
    - SLAP (superior labral anterior to posterior complex) lesions (Somerville, 2017)

Joint or Muscle Pain, X-ray Completed (Katz, 2013; Mordecai, 2014)

- Chronic (lasting 3 months or greater) pain and/or persistent tendonitis unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician supervised exercise**) of at least four (4) weeks, **OR**
- With progression or worsening of symptoms during the course of conservative treatment.

Occult wrist ganglion, after indeterminate ultrasound (Meena, 2014)

- Clinical suspicion and failed 4 weeks conservative treatment including all of the below:

- Activity modification
- Rest, ice or heat
- Splinting or orthotics
- Medication

If MRI is ordered as MR Arthrogram (Magee, 2016; Rhee, 2012) then approve.

Osteochondral Lesions (defects, fractures, osteochondritis dissecans) and x-ray done (Smith, 2012; Tuite, 2014; Van Dijk, 2010; Van Bergen, 2016)

- Clinical suspicion based on mechanism of injury and physical findings

Foreign Body

(Laya, 2017)

- Indeterminate x-ray and ultrasound

Tendon or Muscle Rupture after x-ray (Garras, 2012; Peck, 2017; Wilkins, 2012)

- Clinical suspicion based on mechanism of injury and physical findings

Peripheral Nerve Entrapment

(Domkundwar, 2017; Dong, 2012, Donovan, 2010; Meyer, 2018; Tos, 2015)

- Abnormal Electromyogram or Nerve conduction study
- Abnormal x-ray or ultrasound
- Clinical suspicion and failed 4 weeks conservative treatment including at least two of the following (active treatment with physical therapy is not required):
    - Activity modification
    - Rest, ice or heat
    - Splinting or orthotics
    - Medication

Joint specific provocative Orthopedic examination, after x-ray completed

- Shoulder (Bencardino, 2013; Jain, 2017; Loh, 2016 (Bankart Lesion), Somerville, 2017)
    - Any positive test listed
        - Neer's Sign
        - Hawkins's sign
        - Jobe's test (empty can)
        - Drop Arm test
        - Full can test
        - Hornblower's sign
        - Anterior Shoulder Apprehension test (Bankart Lesion)
        - Load and Shift test (Bankart Lesion)
- Elbow (Kane 2014, Karbach 2017)
    - Any positive test listed

        - Valgus stress
        - Lateral pivot-shift test
        - Posterolateral rotatory drawer test
- Wrist (Panday, 2014; Ruston, 2013)
    - Any positive test listed
        - Watson test (scaphoid shift test)
        - Scapholunate ballottement test
        - Reagan test (lunotriquetral ballottement test)

Hemarthosis on arthrocentesis or x-ray, any joint (Bencardino, 2013; Turan, 2015)

Brachial Plexopathy (Vijayasarathi, 2016)

Pre-operative/procedural evaluation.
- Pre-operative evaluation for a planned surgery or procedure.

Post-operative/procedural evaluation:
- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural complications.
- Joint prosthesis loosening or dysfunction, x-rays non-diagnostic (Fritz, 2014; Fritz, 2015)

BACKGROUND:
Magnetic resonance imaging shows the soft tissues and bones. With its multiplanar capabilities, high contrast, and high spatial resolution, it is an accurate diagnostic tool for conditions affecting the joint and adjacent structures. MRI has the ability to positively influence clinicians' diagnoses and management plans for patients with conditions such as primary bone cancer, fractures, abnormalities in ligaments/tendons/cartilage, septic arthritis, and infection/inflammation.

OVERVIEW:
***Conservative Therapy:** (musculoskeletal) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care

****Home Exercise Program - (HEP)** – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to

physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).

Rotator Cuff Tears – 3.0 Tesla MRI has been found valuable for the detection of partial thickness rotator cuff tendon tears and small rotator cuff tendon tears. It is especially useful in detecting the partial tears due to increased spatial resolution. Increased spatial resolution results in precise measurements of rotator cuff tendon tears in all 3 planes and it also reduces acquisition time which reduces motion artifacts. 3.0 Tesla makes it possible to adequately evaluate tendon edges and avoid underestimation of tears. MRI is less invasive than MR arthrography and it is faster and less expensive. MRI may be useful in the selection of patients that may benefit from arthroscopy.

MRI and Occult Fractures – Magnetic resonance imaging may help to detect occult fractures of the elbow when posttraumatic elbow effusions are shown on radiographs without any findings of fracture. Effusions may be visualized on radiographs as fat pads, which can be elevated by the presence of fluid in the joint caused by an acute fracture. MRI may be useful when effusions are shown on radiographs without a visualized fracture, but there is a clinical suspicion of a lateral condylar or radial head fracture.

MRI and Avascular Necrosis – Sports such as racquetball and gymnastics may cause repeated microtrauma due to the compressive forces between the radial head and capitellum. Focal avascular necrosis and osteochondritis dissecans of the capitellum may result. MRI can be used to evaluate the extent of subchondral necrosis and chondral abnormalities. The images may also help detect intraarticular loose bodies.

MRI and Acute Osseous Trauma – Many elbow injuries result from repetitive microtrauma rather than acute trauma and the injuries are sometimes hard to diagnose. Non-displaced fractures are not always evident on plain radiographs. When fracture is suspected, MRI may improve diagnostic specificity and accuracy. T1-weighted images can delineate morphologic features of the fracture.

MRI and Brachial Plexus - MRI is the only diagnostic tool that accurately provides high resolution imaging of the brachial plexus. The brachial plexus is formed by the cervical ventral rami of the lower cervical and upper thoracic nerves which arise from the cervical spinal cord, exit the bony confines of the cervical spine, and traverse along the soft tissues of the neck, upper chest, and course into the arms.

The American Academy of Pediatrics "Choosing Wisely" Guidelines advise against ordering advanced imaging studies (MRI or CT) for most musculoskeletal conditions in a child until all appropriate clinical, laboratory and plain radiographic examinations have been completed. **"**History, physical examination, and appropriate radiographs remain the primary diagnostic modalities in pediatric orthopaedics, as they are both diagnostic and prognostic for the great majority of pediatric musculoskeletal conditions. Examples of such conditions would include, but not be limited to, the work up of injury or pain (spine, knees and ankles), possible infection, and deformity. MRI examinations and other advanced imaging studies frequently require sedation in the young child (5 years old or less) and may not result in appropriate interpretation if clinical correlations cannot be made. Many conditions require specific MRI sequences or protocols best ordered by the specialist who will be treating the patient. If you believe findings warrant additional advanced imaging, discuss with the consulting orthopaedic surgeon to make sure the optimal studies are ordered.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added initial statement about approvals: 'Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time'.
- Expanded Extremity mass indications including peripheral lymphadenopathy; and mass with increased risk for malignancy
- Added indications for foreign body and peripheral nerve entrapment
- Modified Known Cancer indication to be more broad – 'cancer staging, cancer restaging, signs or symptoms of recurrence'
- Expanded sections for bone fracture and infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)

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73225 – MR Angiography Upper Extremity

CPT Codes: 73225

INDICATIONS FOR UPPER EXTREMITY MRA/MRV

A request for MR Angiography includes standard MRI imaging. An authorization for MRI in addition to MRA is not required. When a separate MRA and MRI exam is requested documentation requires a medical reason that clearly indicates why additional MRI imaging of the upper extremity is needed.

Hand Ischemia:
(Bae, 2015; Hotchkiss, 2014; Wong, 2016)

- Arterial Doppler not needed with any of these acute symptoms:
  - Ischemic ulceration without segmental temperature change.
  - Ischemic ulceration with painful ischemia.
  - Acute sustained loss of perfusion with or without acral ulceration.
  - Imminent loss of digit.
- Clinical symptoms without the above features, arterial Doppler abnormal and will change management
  - Includes Raynaud's (can be associated with scleroderma), Buerger disease and other vasculopathies (McMahan, 2010)
- Clinical concern for vascular cause of ulcers with abnormal or indeterminate ultrasound (Rosyd, 2017)
- After stenting or surgery with signs of recurrence or indeterminate ultrasound (Pollak, 2012)

Deep Venous Thrombosis or Embolism:
(Dill, 2014; Heil, 2017; ACR, 2014)

- After abnormal ultrasound of arm veins if it will change management, or negative or indeterminate ultrasound to rule out other causes
- For evaluation of central veins
- Clinical suspicion of upper arterial emboli (Bozlar, 2014)

Clinical suspicion of vascular disease with abnormal or indeterminate ultrasound or other imaging (Boziar, 2013)

- Peripheral vascular malformations (PVM) (Madani, 2015)
- Evaluation of vascular invasion or displacement by tumor (Jin, 2018; Kransdorf, 2017)
- Vasculitis (Fonseca, 2017; Hotchkiss, 2014)
- Aneurysm (Verikokos, 2014)
- Steno-occlusions (Menke, 2010)
- Fibromuscular Dysplasia (Nguyen, 2017; Sharma, 2014)

Evaluation of traumatic injuries to the UE with clinical findings suggestive of arterial injury (Wani, 2012).

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure (Ahmed, 2017).

Post-operative/procedural evaluations:

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Magnetic resonance angiography (MRA) is a noninvasive alternative to catheter angiography for evaluation of vascular structures in the upper extremity. Magnetic resonance venography (MRV) is used to image veins instead of arteries. MRA and MRV are less invasive than conventional x-ray digital subtraction angiography.

OVERVIEW:
UPPER EXTREMITY DVT- "Secondary DVT of the upper extremity is by far the most common type. Indwelling venous devices such as catheters, pacemakers, and defibrillators put patients at the highest risk of thrombus. Central venous catheters, which are difficult to place, such as those requiring multiple insertion attempts, are noted to have increased incidence of associated thrombus [9]. Other risk factors associated with higher likelihood of UEDVT include advanced age, previous thrombophlebitis, postoperative state, hypercoagulability, heart failure, cancer, right-heart procedures, and intensive care unit admissions" (ACR, 2014).

MRA/MRV and Raynaud's Syndrome – Raynaud's syndrome is evidenced by episodic waxy pallor or cyanosis of the fingers caused by vasoconstriction of small arteries or arterioles in the fingers. It usually occurs due to a response to cold or to emotional stimuli. MRA may be used in the evaluation of Raynaud's syndrome.

MRA/MRV and Stenosis or Occlusion – MRA of the central veins of the chest is used for the detection of central venous stenoses and occlusions. High-spatial resolution MRA characterizes the general morphology and degree of stenosis. Enlarged and well-developed collateral veins in combination with the non-visualization of a central vein may be indicative of chronic occlusion, whereas less-developed or absent collateral veins are suggestive of acute occlusions. A hemodynamically significant stenosis may be indicated by the presence of luminal narrowing with local collaterals (Kim, 2008).

POLICY HISTORY:
REVIEW DATE: May 2019
REVIEW SUMMARY:

- Reformatted/modified indications to include hand ischemia; deep venous thrombosis or embolism and clinical suspicion of vascular disease
- Updated background information and references

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73700 – CT Lower Extremity (Ankle, Foot, Hip or Knee)

CPT Codes: 73700, 73701, 73702

INDICATIONS FOR LOWER EXTREMITY CT (FOOT, ANKLE, KNEE, LEG or HIP):
(Plain radiographs must precede CT evaluation)

Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.

Extremity Mass
(Mullan 2011; Zoga, 2017)

- Peripheral lymphadenopathy that is unexplained by other diagnosis (eg. infection) possibly due to suspected malignancy of the extremity (Dommett, 2013; Gaddey, 2016; Mohseni, 2014)
    - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin
        - Two or more regions
        - Persistence after 4 weeks
- Mass or lesion includes popliteal (Baker's) cyst, after non-diagnostic x-ray or ultrasound
    - Includes one follow-up if first study indeterminate (Subhawong, 2010)
- Mass with increased risk for malignancy including any of the following (Sinha, 2010):
    - Soft tissue mass > 5 cm (golf ball size or larger)
    - Painful lump not from injury
    - Lump that is increasing in size
    - A lump of any size that is deep to the muscle fascia
    - Recurrence of a lump after previous excision

Known Cancer
(Fitzgerald, 2015; Holzapfel, 2015; Kircher, 2012; Morrison, 2013)

- Cancer staging
- Cancer Restaging
- Signs or symptoms of recurrence

Infection of bone or joint [MRI is contraindicated or cannot be done (Lee, 2016)] (Beaman, 2017; Dodwell, 2013)

- Abnormal x-ray or ultrasound
- Negative x-ray but with:
    - Signs and symptoms of joint or bone infection:
        - Pain and localized findings
        - Decrease range of motion

        - Fevers
    - Laboratory findings of infection, any of these:
        - Elevated ESR or CRP
        - Elevated white blood cell count
        - Positive joint aspiration

Osteonecrosis (Avascular necrosis (AVN), Legg-Calve-Perthes Disease) when MRI is contraindicated or cannot be performed (Felten, 2019; Murphey, 2014; Murphey, 2016)

- Abnormal x-ray
- Normal or indeterminate X-rays but symptomatic and high risk
    - Glucocorticosteroid use
    - Renal Transplant recipient
    - Alcohol abuse (Fukushima, 2010)
    - Sickle Cell Anemia (Wali, 2011)

For evaluation of known or suspected autoimmune disease (e.g. rheumatoid arthritis):

- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Imaging of a single joint for diagnosis or response to therapy after plain films and appropriate lab tests (e.g. RF, ANA, CRP, ESR) (Colebatch, 2013).

Bone Fracture or ligament injury

- Clinical Concern for Occult or Stress Fracture based on all the following (Kijowski, 2012; Sadineni, 2015; Patel, 2011)
    - X-rays initially and at ≥ 2 weeks are negative or non-diagnostic
    - Persistent focal pain and tenderness despite treatment for this time interval:
        - Medications (analgesics and/or anti-inflammatory) **AND**
        - Activity modification with bracing where appropriate
- Clinical concern for hip fracture with initial x-rays negative or non-diagnostic (ACR 2018; Gill, 2013)
- Fracture on X-ray with documentation of how imaging will affect treatment (Scalcione, 2014)
- Concern for fracture non-union based on x-rays and physical findings, at least three months after initial treatment (Salih, 2015; Rabinovich, 2015)

Joint or Muscle Pain, X-Ray Completed (Katz, 2013; Mordecai, 2014) (Includes tarsal Coalition and pes planus (Bouchard, 2014; Thorpe, 2012) when MRI is contraindicated or cannot be performed (Lefevre, 2016)

- Chronic (lasting 3 months or greater) pain and/or persistent tendonitis unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician supervised exercise**) of at least four (4) weeks,
- With progression or worsening of symptoms during the course of conservative treatment.
- Ordered as CT arthrogram when MR arthrogram is contraindicated or cannot be performed (Fox, 2016)

Osteochondral Lesions (defects, fractures, osteochondritis dissecans) and x-ray done (Smith, 2012; Tuite, 2014; Van Dijk, 2010; Van Bergen, 2015)

- Clinical suspicion based on mechanism of injury and physical findings

Foreign Body (Laya, 2017)

- Indeterminate x-ray and ultrasound

Tendon or Muscle Rupture after X-Ray and MRI is contraindicated or cannot be done (Garras, 2012; Peck, 2017; Wilkins, 2012)

- Clinical suspicion based on mechanism of injury and physical findings

Peripheral Nerve Entrapment when MRI is contraindicated, including any of the following: (Domkundwar, 2017; Dong 2012; Donovan, 2010; Tos, 2015)

- Abnormal Electromyogram or Nerve conduction study
- Abnormal x-ray or ultrasound
- Clinical suspicion and failed 4 weeks conservative treatment including at least 2 of the following (active treatment with physical therapy is not required):
    - Activity modification
    - Rest, ice or heat
    - Splinting or orthotics
    - Medication

Joint specific provocative orthopedic examination, after x-ray completed when MRI is contraindicated or cannot be performed

- Ankle
    - Positive drawer sign ≥ 4 days after injury (Vuurberg, 2018)
- Knee (Bennett, 2012; Doral, 2018; Katz, 2013; Slaughter, 2014; Smith, 2015; Mohankumar, 2014; Tuite, 2014)
    - Any positive test listed
        - McMurray's
        - Thessaly
        - Joint Line Tenderness
        - Apley's
        - Lachman's
        - Anterior or Posterior Drawer sign
        - Varus or valgus stress
- Hip, any positive test listed
    - Slipped Capital Femoral Epiphysis (Hesper, 2017; Kamegaya, 2011; Peck, 2017)
        - Drehman sign
        - Limited internal rotation of the hip
    - Anterior Impingement sign (labral tear) (Hananouchi, 2012, Naraghi, 2015; Ward, 2013)

Hemarthosis on arthrocentesis or x-ray, any joint and MRI is contraindicated or cannot be done (Abbas, 2012; Bencardino, 2013; Turan, 2015)

Leg length discrepancy (Guggenberger, 2014)

- Inadequate x-rays and Scanogram (CPT code 77073) cannot be done

Pre-operative/procedural evaluation.

- Pre-operative evaluation for a planned surgery or procedure. (*See exclusions)

*CT or MRI requests are *not* approvable for the following total knee arthroplasty (TKA) procedures:

- Procedures utilizing computer-navigated or patient-specific or gender-specific instrumentation (Johnson, 2011)
- Bicompartmental arthroplasty (investigational at this time) (Dudhniwala, 2016)
- Robot-assisted TKA (Makoplasty) (Banerjee, 2015; Nair, 2014)

These surgical procedures are not considered a covered service and are not reimbursable based on lack of current scientific evidence for clinically important improvement, safety or efficacy; or based on scientific evidence of increased risk of serious complications.

Post-operative/procedural evaluation:

- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural complications.
- Joint prosthesis loosening or dysfunction, x-rays non-diagnostic (Fritz, 2014, 2015)

BACKGROUND:

Plain radiographs are typically used as the first-line modality for assessment of lower extremity conditions. Computed tomography (CT) is used for evaluation of tumors, metastatic lesions, infection, fractures and other problems. Magnetic resonance imaging (MRI) is the first-line choice for imaging of many conditions, but CT may be used in these cases if MRI is contraindicated or unable to be performed.

OVERVIEW:

***Conservative Therapy:** (musculoskeletal) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program (HEP)** – the following two elements are required to meet guidelines for completion of conservative therapy:

- Information provided on exercise prescription/plan AND

- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).

CT and Ankle Fractures – One of the most frequently injured areas of the skeleton is the ankle. These injuries may include ligament sprains, as well as fractures. A suspected fracture is first imaged with conventional radiographs in anteroposterior, internal oblique and lateral projections. CT is used in patients with complex ankle and foot fractures after radiography.

CT and Hip Trauma – Computed tomography is primarily used to evaluate acute trauma, e.g., acetabular fracture or hip dislocation. It can detect intraarticular fragments and associated articular surface fractures and it is useful in surgical planning.

CT and Knee Fractures – CT is used after plain films to evaluate fractures to the tibial plateau. These fractures occur just below the knee joint, involving the cartilage surface of the knee. Soft tissue injuries are usually associated with the fractures. The meniscus is a stabilizer of the knee and it is very important to detect meniscal injury in patients with tibial plateau fractures. CT of the knee with two-dimensional reconstruction in the sagittal and coronal planes may be performed for evaluation of injuries with multiple fragments and comminuted fractures. Spiral CT has an advantage of rapid acquisition and reconstruction times and may improve the quality of images of bone. Soft tissue injuries are better demonstrated with MRI.

CT and Knee Infections – CT is used to depict early infection which may be evidenced by increased intraosseous density or the appearance of fragments of necrotic bone separated from living bone by soft tissue or fluid density. Contrast-enhanced CT may help in the visualization of abscesses and necrotic tissue.

CT and Knee Tumors – CT complements arthrography in diagnosing necrotic malignant soft-tissue tumors and other cysts and masses in the knee. Meniscal and ganglion cysts are palpable masses around the knee. CT is useful in evaluations of the vascular nature of lesions.

CT and Legg-Calve-Perthes Disease (LPD) – This childhood condition is associated with an insufficient blood supply to the femoral head which is then at risk for osteonecrosis. Clinical signs of LPD include a limp with groin, thigh or knee pain. Flexion and adduction contractures may develop as the disease progresses and eventually movement may only occur in the flexion-extension plane. This condition is staged based on plain radiographic findings. CT scans are used in the evaluation of LPD and can demonstrate changes in the bone trabecular pattern. They also allow diagnosis of bone collapse and sclerosis early in the disease where plain radiography is not as sensitive.

CT and Osteolysis – Since computed tomography scans show both the extent and the location of lytic lesions, they are useful to guide treatment decisions, as well as to assist in planning for surgical intervention when needed, in patients with suspected osteolysis after Total Hip Arthroplasty (THA).

CT and Tarsal Coalition – This is a congenital condition in which two or more bones in the mid-foot or hind-foot are joined. It usually presents during late childhood or late adolescence and is associated with repetitive

ankle sprains. Mild pain, deep in the subtalar joint and limited range of motion are clinical symptoms. Tarsal coalition is detectable on oblique radiographs, but these are not routinely obtained at many institutions. Clinical diagnosis is not simple; it requires the expertise of skilled examiners. CT is valuable in diagnosing tarsal coalition because it allows differentiation of osseous from non-osseous coalitions and also depicts the extent of joint involvement as well as degenerative changes. It may also detect the overgrowth of the medial aspect of the talus that may be associated with talocalcaneal coalitions.

American Academy of Pediatrics "Choosing Wisely" Guidelines advise against ordering advanced imaging studies (MRI or CT) for most musculoskeletal conditions in a child until all appropriate clinical, laboratory and plain radiographic examinations have been completed. **"**History, physical examination, and appropriate radiographs remain the primary diagnostic modalities in pediatric orthopaedics, as they are both diagnostic and prognostic for the great majority of pediatric musculoskeletal conditions. Examples of such conditions would include, but not be limited to, the work up of injury or pain (spine, knees and ankles), possible infection, and deformity. MRI examinations and other advanced imaging studies frequently require sedation in the young child (5 years old or less), and may not result in appropriate interpretation if clinical correlations cannot be made. Many conditions require specific MRI sequences or protocols best ordered by the specialist who will be treating the patient…if you believe findings warrant additional advanced imaging, discuss with the consulting orthopaedic surgeon to make sure the optimal studies are ordered.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Reformatting in parallel with the new LE MRI. Updated references
- Added indication: peripheral nerve entrapment
- Criteria for approval of existing indications specified within the parameters of the current evidence base
- Added initial statement about approvals: 'Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time'.
- Added Extremity mass indications including peripheral lymphadenopathy; and mass with increased risk for malignancy
- Modified Known Cancer indication to be more broad – 'cancer staging, cancer restaging, signs or symptoms of recurrence'
- Expanded section for infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)

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73706 – CT Angiography, Lower Extremity

CPT Codes: 73706

INDICATIONS FOR LOWER EXTREMITY CTA:
Abdominal Arteries CTA (CT Angiography) (CPT Code 75635) includes run-off so this is never approved when that one has been.

Peripheral Vascular Disease and Abdominal Arteries CTA (CT Angiography) (CPT Code 75635) has not been recently approved

- Critical Limb ischemia any of the below with clinical signs of peripheral artery disease. Ultrasound imaging is not needed. If done and negative, it should still be approved due to high false negative rate (Shishehbor, 2016; Weiss, 2018)
  - Ischemic rest pain
  - Tissue loss
  - Gangrene
- Claudication with abnormal (ankle/brachial index, arterial Doppler) (Ahmed, 2017; Pollak, 2012, 2013)
- Clinical concern for vascular cause of ulcers with abnormal or indeterminate ultrasound (ankle/brachial index, arterial Doppler) (Rosyd, 2017)
- After stenting or surgery with signs of recurrent symptoms OR abnormal ankle/brachial index; abnormal or indeterminate arterial Doppler, OR pulse volume recording) (Pollak, 2012)

Popliteal Artery Entrapment Syndrome with abnormal arterial ultrasound (Williams, 2015)

Deep Venous Thrombosis with clinical suspicion of lower extremity DVT after abnormal or non-diagnostic ultrasound where a positive study would change management (Hanley, 2013; Karande, 2016; Katz, 2014)

Clinical suspicion of vascular disease with abnormal or indeterminate ultrasound or other imaging

- Peripheral vascular malformations (PVM) (Madani, 2015)
- Vascular invasion or displacement by tumor (Kransdorf, 2017)
- Vasculitis (Fonseca, 2017)
- Aneurysm (Verikokos, 2014)
- Steno-occlusions (Menke, 2010)

Hemodialysis Graft Dysfunction after Doppler ultrasound not adequate for treatment decisions (Murphy, 2017)

Evaluation of traumatic injuries to the LE with clinical findings suggestive of arterial injury (Wani, 2012).

For assessment/evaluation of known vascular disease/condition.

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure (Ahmed, 2017)

Post- operative/procedural evaluation:

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Lower extremity computed tomography angiography (CTA) is an effective, noninvasive and robust imaging modality that is used in the assessment of symptomatic lower extremity vascular disease. It has excellent spatial resolution and shows accurate details of peripheral vasculature. CTA is an effective alternative to catheter-based angiography and allows accurate planning of open surgical and endovascular interventions.

OVERVIEW:

Abdominal Arteries CTA- For imaging of the abdomen, pelvis **AND** both legs (CTA aorto-iliofemoral runoff; abdominal aorta and bilateral iliofemoral lower extremity runoff) use CPT code 75635.

Peripheral Arterial Disease – Multi-detector CTA (MDCTA) is used in the evaluation of patients with peripheral arterial disease. It can be used to evaluate the patency after revascularization procedures. It is the modality of choice in patients with intermittent claudication. A drawback is its hampered vessel assessment caused by the depiction of arterial wall calcifications, resulting in a decreased accuracy in severely calcified arteries.

Chronic Limb Threatening Ischemia - Assessment and promotion of blood flow through the calf arteries is very important in patients with chronic limb threatening ischemia. MDCTA allows for visualization of pedal vessels.

Surgical or Percutaneous Revascularization – CTA is accurate in the detection of graft-related complications, including stenosis and aneurysmal changes. It can reveal both vascular and extravascular complications.

CTA and screening for peripheral vascular disease: The USPSTF (U.S. Preventative Services Task Force) does not recommend routine screening for peripheral vascular disease in asymptomatic patients. High risk patients (eg. diabetics) may be screened with ABI (ankle brachial index) and duplex ultrasound.

POLICY HISTORY:

Review Date: May 2019

Review Summary:

- Added indication for deep venous thrombosis
- Reformatting and new references.

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73720 – MRI Lower Extremity (Ankle, Foot, Knee, Hip, Leg) (Joint and other than joint)

CPT Codes: 73718, 73719, 73720, 73721, 73722, 73723

INDICATIONS FOR LOWER EXTREMITY MRI (FOOT, ANKLE, KNEE, LEG or HIP)
(Plain radiographs must precede MRI evaluation)

Some indications are for *MRI, CT, or MR or CT Arthrogram*. More than one should not be approved at the same time.

Extremity Mass
(Mullan, 2011; Zoga, 2017)

- Peripheral lymphadenopathy that is unexplained by other diagnosis (eg.infection) possibly due to suspected malignancy of the extremity (Dommett, 2013; Gaddey, 2016; Mohseni, 2014)
    - Any of these:
        - Fixation to adjacent tissues
        - Firm consistency
        - Size >1.5 cm
        - Ulceration of overlying skin
        - Two or more regions
        - Persistence after 4 weeks
- Mass or lesion includes popliteal (Baker's) cyst, after non-diagnostic x-ray or ultrasound
    - Includes one follow-up if first study indeterminate (Subhawong, 2010)
- Mass with increased risk for malignancy including any of the following(Sinha, 2010):
    - Soft tissue mass >5 cm (golf ball size or larger)
    - Painful lump not from injury
    - Lump that is increasing in size
    - A lump of any size that is deep to the muscle fascia
    - Recurrence of a lump after previous excision

Known Cancer
(Fitzgerald, 2015; Holzapfel, 2015; Kircher, 2012; Morrison, 2013)

- Cancer staging
- Cancer Restaging
- Signs or symptoms of recurrence

Infection of Bone or Joint
(Beaman, 2017; Dodwell, 2013)

- Abnormal x-ray or ultrasound
- Negative x-ray but with:

- Signs and symptoms of joint or bone infection:
  - Pain and localized findings
  - Decrease range of motion
  - Fevers
- Laboratory findings of infection, any of these:
  - Elevated ESR or CRP
  - Elevated white blood cell count
  - Positive joint aspiration

Osteonecrosis (Avascular Necrosis (AVN), Legg-Calve-Perthes Disease)
(Felten, 2019; Murphey, 2014, 2016)

- Abnormal x-ray
- Normal or Indeterminate X-rays but symptomatic and high risk
  - Glucocorticosteroid use
  - Renal Transplant recipient
  - Alcohol abuse (Fukushima, 2010)
  - Sickle Cell Anemia (Wali, 2011)

For evaluation of known or suspected autoimmune disease (e.g. rheumatoid arthritis):

- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Imaging of a single joint for diagnosis or response to therapy after plain films and appropriate lab tests (e.g. RF, ANA, CRP, ESR) (Colebatch, 2013).

Bone Fracture

- Clinical Concern for Occult or Stress Fracture based on all the following: (ACR, 2016; Kijowski, 2012; Sadineni, 2015; Patel, 2011)
  - X-rays initially and at 10-14 days are negative or non-diagnostic
  - Persistent focal pain and tenderness despite treatment for this time interval:
    - Medications (analgesics and/or anti-inflammatory) **AND**
    - Activity modification with bracing where appropriate
- Clinical concern for hip fracture with initial x-rays negative or non-diagnostic (ACR, 2018; Gill, 2013)
- Fracture on X-ray with documentation of how imaging will affect treatment (Scalcione, 2014)
- Concern for fracture non-union or delayed fusion based on x-rays and physical findings, at least three months after initial treatment (Salih, 2015; Rabinovich, 2015)

Joint or muscle pain, x-ray completed (Katz, 2013; Mordecai, 2014) (Includes tarsal Coalition and pes planus (Bouchard, 2014; Thorpe, 2012)

- Chronic (lasting 3 months or greater) pain unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician supervised exercise**) of at least four (4) weeks, **OR**
- With progression or worsening of symptoms during the course of conservative treatment.

If MRI ordered as MR arthrogram can be approved.

Osteochondral lesions (defects, fractures, osteochondritis dissecans) and x-ray done (Smith, 2012; Tuite, 2014; Van Dijk, 2010; Bergen, 2015)

- Clinical suspicion based on mechanism of injury and physical findings

Foreign Body

(Laya, 2017)

- Indeterminate x-ray and ultrasound

Tendon or Muscle Rupture after X-Ray (Garras, 2012; Peck, 2017; Rubin, 2012; Wilkins, 2012)

- Clinical suspicion based on mechanism of injury and physical findings

Peripheral Nerve Entrapment

(Domkundwar, 2017, Dong, 2012, Donovan, 2010; Tos, 2015)

- Abnormal Electromyogram or Nerve conduction study
- Abnormal x-ray or ultrasound
- Clinical suspicion and failed 4 weeks conservative treatment including at least two of the following (active treatment with physical therapy is not required):
    - Activity modification
    - Rest, ice or heat
    - Splinting or orthotics
    - Medication

Joint specific provocative orthopedic examination, after x-ray completed

- Ankle
    - Positive drawer sign ≥ 4 days after injury (Vuurberg, 2018)
- Knee (Bennett, 2012; Doral, 2018; Katz, 2013; Mohankumar, 2014; Slaughter, 2014; Smith, 2015; Tuite, 2014)
    - Any positive test listed
        - McMurray's
        - Thessaly
        - Apley's
        - Lachman's
        - Anterior or Posterior Drawer sign
        - Varus or valgus stress
- Hip, any positive test listed
    - Slipped Capital Femoral Epiphysis (Hesper, 2017; Kamegaya, 2011; Peck, 2017)
        - Drehman sign
        - Limited internal rotation of the hip
    - Anterior Impingement sign (labral tear) (Hananouchi, 2012, Naraghi, 2015; Ward, 2013)

Hemarthosis on arthrocentesis or x-ray, any joint (Abbasi, 2012, Bencardino 2013; Turan 2015)

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure (*See exclusions)

*CT or MRI requests are *not* approvable for the following total knee arthroplasty (TKA) procedures:

- Procedures utilizing computer-navigated or patient-specific or gender-specific instrumentation (Johnson, 2011)
- Bicompartmental arthroplasty (investigational at this time) (Dudhniwala, 2016)
- Robot-assisted TKA (Makoplasty) (Banerjee, 2015; Nair, 2014)

These surgical procedures are not considered a covered service and are not reimbursable based on lack of current scientific evidence for clinically important improvement, safety or efficacy; or based on scientific evidence of increased risk of serious complications.

Post-operative/procedural evaluation:

- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural complications.
- Joint prosthesis loosening or dysfunction, x-rays non-diagnostic (Fritz, 2014, 2015)

BACKGROUND:

Magnetic resonance imaging shows the soft tissues and bones. With its multiplanar capabilities, high contrast, and high spatial resolution, it is an accurate diagnostic tool for conditions affecting the joint and adjacent structures. MRI has the ability to positively influence clinicians' diagnoses and management plans for patients with conditions such as primary bone cancer, fractures, abnormalities in ligaments/tendons/cartilage, septic arthritis, and infection/inflammation.

OVERVIEW:

***Conservative Therapy:** (Musculoskeletal) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

****Home Exercise Program (HEP)** – the following two elements are required to meet guidelines for completion of conservative therapy:

- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).

Stress Fractures- "Certain stress fractures are considered high risk based on a tendency for nonunion or delayed union. High-risk stress fractures include the anterior tibial diaphysis, lateral femoral neck and femoral head (patella, medial malleolus, navicular, fifth metatarsal base, proximal second metatarsal, tibial hallux sesamoid, and talus. The second-line test to diagnose a stress fracture should be guided by the location of the patient's pain and likelihood of high-risk injury. A follow-up radiographic examination has increased sensitivity compared to initial radiographs but is less sensitive than MRI" (ACR, 2016)

MRI and Knee Trauma - MRI is an effective means of evaluating internal derangements of the knee with a very high accuracy for detection of meniscal injury. On MRI of the knee, meniscal injury may appear "free-floating", corresponding to a meniscal avulsion or detachment from the tibial plateau. The floating meniscus seen on MRI is a result of significant trauma. It may also be associated with significant ligamentous injury. The results of the MRI are valuable to the surgeon as he plans to reattach the meniscus to the tibial plateau.

MRI and Osteonecrosis – Osteonecrosis is a complication of knee surgery which may be accompanied by new or persistent pain after meniscal surgery. It can be detected by MRI with subcortical low signal intensity of T1-weighted images with or without central high signal intensity on T2-weighted images. Osteonecrosis can result in collapse of the articular surface.

MRI and Legg-Calve-Perthes Disease (LPD) –This childhood condition is associated with an insufficient blood supply to the femoral head which is then at risk for osteonecrosis. Clinical signs of LPD include a limp with groin, thigh or knee pain. Flexion and adduction contractures may develop as the disease progresses and eventually movement may only occur in the flexion-extension plane. This condition is staged based on plain radiographic findings. MRI is used in identifying the early stage of LPD when plain films are normal. It is also used in preoperative planning to diagnose "hinge abduction" (lateral side of the femoral head contacts the acetabular margin and femoral head does not slide as it should). However, MRI is not used as a standard diagnostic tool.

MRI and Septic Arthritis – Young children and older adults are the most likely to develop septic arthritis in the hip joint. Early symptoms include pain in the hip, groin, or thigh along with a limping gait and fever. It is sometimes hard to differentiate this condition from transient synovitis, a less serious condition with no known long-term sequelae. MRI may help in the differential diagnosis of these two conditions. Coronal T1-weighted MRI, performed immediately after contrast administration, can evaluate blood perfusion at the femoral epiphysis.

MRI and Slipped Capital Femoral Epiphysis – This condition, where the femoral head is displaced in relation to the femoral neck, is the most common hip disorder in adolescents and it is more common in obese children. Its symptoms include a limping gait, groin pain, thigh pain and knee pain. Most cases are stable and the prognosis is good with early diagnosis and treatment. Unstable slipped capital femoral epiphysis may lead to avascular necrosis. MRI is used for diagnosis of slipped capital femoral epiphysis. Its image can be oriented to a plane orthogonal to the plane of the physis to detect edema in the area of the physis.

MRI and Tarsal Coalition – This is a congenital condition in which two or more bones in the midfoot or hindfoot are joined. It usually presents during late childhood or late adolescence and is associated with repetitive ankle sprains. Mild pain, deep in the subtalar joint and limited range of motion are clinical

symptoms. Tarsal coalition is detectable on oblique radiographs, but these are not routinely obtained at many institutions. Clinical diagnosis is not simple; it requires the expertise of skilled examiners. MRI is valuable in diagnosing tarsal coalition because it allows differentiation of osseous from non-osseous coalitions and also depicts the extent of joint involvement as well as degenerative changes. It may also detect overgrowth of the medial aspect of the talus that may be associated with talocalcaneal coalitions.

MRI and Tarsal Tunnel – Tarsal Tunnel Syndrome is due to compression of the posterior tibial nerve as it passes through the tarsal tunnel into the foot. Compression can cause a sensation of burning or numbness to the bottom of the foot. Common causes include flat foot, over-protonation, and arthritis. Nerve conduction studies can reveal damage to the posterior tibial nerve. MRI may be valuable in demonstrating other structures causing extrinsic compression on the nerve.

The American Medical Society for Sports Medicine "Choosing Wisely" Guidelines advise against ordering a knee MRI for a patient with anterior knee pain without mechanical symptoms or effusion unless the patient has not improved following completion of an appropriate functional rehabilitation program. "The most common cause of anterior knee pain is patellofemoral pain syndrome. Magnetic resonance imaging (MRI) is rarely helpful in managing this syndrome. Treatment should focus on a guided exercise program to correct lumbopelvic and lower limb strength and flexibility imbalances. If pain persists, if there is recurrent swelling or if mechanical symptoms such as locking and painful clicking are present, and radiographs are non-diagnostic, an MRI may be useful."

The American Academy of Pediatrics "Choosing Wisely" Guidelines advise against ordering advanced imaging studies (MRI or CT) for most musculoskeletal conditions in a child until all appropriate clinical, laboratory and plain radiographic examinations have been completed. **"**History, physical examination, and appropriate radiographs remain the primary diagnostic modalities in pediatric orthopaedics, as they are both diagnostic and prognostic for the great majority of pediatric musculoskeletal conditions. Examples of such conditions would include, but not be limited to, the work up of injury or pain (spine, knees and ankles), possible infection, and deformity. MRI examinations and other advanced imaging studies frequently require sedation in the young child (5 years old or less), and may not result in appropriate interpretation if clinical correlations cannot be made. Many conditions require specific MRI sequences or protocols best ordered by the specialist who will be treating the patient… if you believe findings warrant additional advanced imaging, discuss with the consulting orthopaedic surgeon to make sure the optimal studies are ordered.

POLICY HISTORY:

Review Date: May 2019
Review Summary:

- Added initial statement about approvals: 'Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time'.
- Added joint or muscle pain when x-ray completed
- Expanded Extremity mass indications including peripheral lymphadenopathy; and mass with increased risk for malignancy
- Added indications for foreign body and peripheral nerve entrapment

- Modified Known Cancer indication to be more broad – 'cancer staging, cancer restaging, signs or symptoms of recurrence'
- Expanded sections for bone fracture and infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)

Review Date: January 2020
Review Summary:

- Bullet on Joint Line Tenderness removed from the bulleted list specified under Joint specific provocative orthopedic examination, after x-ray completed

- Added section on infectious criteria qualifying for MRI

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73725 – MR Angiography, Lower Extremity

CPT Code: 73725

A request for MR Angiography includes standard MRI imaging. An authorization for MRI in addition to MRA is not required. When a separate MRA and MRI exam is requested documentation requires a medical reason that clearly indicates why additional MRI imaging of the lower extremity is needed.

Lower Extremity MRA & Abdomen/Pelvis Magnetic Resonance Angiography (MRA) Runoff Requests: **Two authorization requests are required, one Abdomen MRA, CPT code 74185 and one for Lower Extremity MRA, CPT code 73725.** This will provide imaging of the abdomen, pelvis and both legs.

Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.

INDICATIONS FOR LOWER EXTREMITY MRA/MRV:

Peripheral Vascular Disease

- Critical Limb ischemia AND any of the below with clinical signs of peripheral artery disease. Ultrasound imaging is not needed. If done and negative, it should still be approved due to high false negative rate (Shishehbor, 2016; Weiss, 2018)
    - Ischemic rest pain
    - Tissue loss
    - Gangrene
- Claudication with abnormal (ankle/brachial index, pulse volume recording or arterial Doppler (Ahmed, 2017; Pollak, 2012, 2013)
- Clinical concern for vascular cause of ulcers with abnormal or indeterminate ultrasound (ankle/brachial index, arterial Doppler) (Rosyd, 2017)
- After stenting or surgery with signs of recurrent symptoms OR abnormal ankle/brachial index ; abnormal or indeterminate arterial Doppler, OR pulse volume recording) (Pollak, 2012)

Popliteal Artery Entrapment Syndrome with abnormal arterial ultrasound (Williams, 2015)

Deep Venous Thrombosis with clinical suspicion of lower extremity DVT after abnormal or non-diagnostic ultrasound where a positive study would change management. (Hanley, 2013; Karande, 2016; Katz, 2014)

Clinical suspicion of vascular disease with abnormal or indeterminate ultrasound or other imaging

- Peripheral vascular malformations (PVM) (ACR, 2019; Madani 2015)
- Tumor invasion (Jin, 2018)
- Trauma (Wani, 2012)
- Vasculitis (Fonseka, 2017)
- Aneurysm (Verikokos, 2014)

- Steno-occlusions (Menke, 2010)

For assessment/evaluation of suspected or known vascular disease/condition

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure (Ahmed, 2017).

Post-operative/procedural evaluation:

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Magnetic resonance angiography (MRA) is a noninvasive alternative to catheter angiography for evaluation of vascular structures in the lower extremity. Magnetic resonance venography (MRV) is used to image veins instead of arteries. MRA and MRV are less invasive than conventional x-ray digital subtraction angiography.

OVERVIEW:
Noninvasive testing- **Noninvasive Hemodynamic Testing**
"Noninvasive testing (NIVT), both before and after intervention, has been used for decades as a first-line investigatory tool in the diagnosis and categorization of PAD. It is widely available and provides a large amount of information at low cost without the use of ionizing radiation [6]. NIVT can consist of one or more of the following components: the ABI, segmental pressure measurements (SPMs), pulse-volume recordings (PVRs)," (ACR 2017)
photoplethysmography (PPG), and transcutaneous oxygen pressure measurement (TcPO2).

MRA of Foot – Fast contrast-enhanced time-resolved 3D MR angiography is used in evaluating the arterial supply of the foot. It does not require the use of ionizing radiation and iodinated contrast medium and it is minimally invasive, safe, fast, and accurate. Dorsalis pedis bypass surgery is an option for preserving a foot in a patient with arterial occlusive disease and MRA may be used in the preoperative evaluation. It can discriminate arteries from veins and can provide other key information, e.g., patency of the pedal arch, presence of collateral pathways, and depiction of target vessel suitable for surgical bypass. Time-resolved gadolinium enhanced MRA can identify injured fat pads in the foot before they have become ulcerated.

MRA and arterial obstructive disease –Catheter angiography is the standard of reference for assessing arterial disease but MRA with contrast enhanced media has gained acceptance and can image the entire vascular system. Contrast agents such as high dose gadolinium have been associated with the development of nephrogenic systemic fibrosis in patients with chronic renal insufficiency. Gadolinium dosage may be decreased without compromising image quality in high-spatial-resolution contrast-enhanced MRA of the lower extremity.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added initial statement about approvals: ‘Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time’.
- Added background information and updated references

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74150 – CT Abdomen

CPT Codes: 74150, 74160, 74170

INDICATIONS FOR ABDOMEN CT:

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:

- Initial evaluation of a palpable abdominal or abdominal wall mass/tumor found by physical exam or imaging study, such as ultrasound (US) (ACR, 2019).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen. No further surveillance unless tumor(s) are specified as highly suspicious, or change was found on exam or last follow-up imaging.

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as ultrasound (US):

- Initial staging of known cancer
    - All cancers, excluding the following:
        - Basal cell carcinoma of the skin (NCCN, 2018).
        - Melanoma without symptoms or signs of metastasis (NCCN, 2018; Trotter, 2013).
- Follow-up of known cancer (Bourgioti, 2016; NCCN, 2018):
    - Follow-up of known cancer of patient undergoing active treatment within the past year.
    - Known cancer with suspected abdominal metastasis based on a sign, symptom or an abnormal lab value.
    - Active monitoring for recurrence as clinically indicated.

For evaluation of suspected infection or inflammatory disease based on exam or discovered on previous imaging:

(ACR, 2018; Cartwright, 2015; Sartelli, 2015)

- Right upper quadrant pain for suspected biliary disease with negative or equivocal ultrasound or HIDA scan
- Suspected cholecystitis or retained gallstones with recent equivocal ultrasound.
- For epigastric or left upper quadrant pain if labs or other imaging are inconclusive (Ecanow, 2015)

For evaluation of an organ or abnormality seen on previous imaging:

ADRENAL:

- To locate a pheochromocytoma once there is clear biochemical evidence (may require abdomen and pelvis imaging)
- Suspected adrenal mass ≥ 1 cm incidentally discovered with no history of malignancy (one follow-up in 6-12 months to document stability).
- If adrenal mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning (surgery to rule out adrenal cortical carcinoma)

- For adrenal mass < 4 cm with history of malignancy (if ≥ 4 cm consider biopsy or PET/CT unless pheochromocytoma is suspected)

LIVER:

Indeterminate liver lesion > 1 cm seen on ultrasound (MRI study of choice but CT can be approved)**

- Hepatitis/hepatoma screening after ultrasound is abnormal, equivocal, or non-diagnostic (may be limited in patients who are obese, those with underlying hepatic steatosis, as well as nodular livers (Bruix, 2011; Lee, 2014; Marquardt, 2016; Mayo-Smith, 2017)). (No literature supports the use of AFP alone in the screening of HCC). For jaundice or abnormal liver function tests after equivocal or abnormal ultrasound (Vagvala, 2018).
- For follow up of suspected adenoma every 6-12 months
- To confirm diagnosis of focal nodular hyperplasia seen on other imaging.
- For follow up of focal nodular hyperplasia (FNH) annually if US is inconclusive (Marrero, 2014)
- For surveillance of HCC in patients who have received liver-directed therapy, surgical resection, medical treatment or transplant (MRI or CT) at one month post treatment and then every 3 months for up to two years* (Horowitz, 2017; Vagvala, 2018)

PANCREAS:

- Pancreatic cystic lesion found on initial imaging
- Intraductal papillary mucinous neoplasm (IPMN) and mucinous cystic neoplasm (MCN) require surveillance imaging as follows (if MRI is contraindicated) if indeterminate on initial imaging and duct communication is present:
    - For cysts under 1.5cm separated by age: < 65 with follow up yearly and 65-79 with FU every 2 years.
- Cysts that are 1.5-1.9 cm followed yearly for 5 years, then every 2 years for 4.
- For lesions 20 mm to < 30 mm MRI/CT or EUS biannually for 1 year, then every year until stable
- For lesions ≥ 30 mm MRI/CT or EUS every 6 months (Han, 2018)
- Yearly surveillance for individuals determined to have greater than 5% lifetime risk of developing pancreatic cancer starting at age 50, or 10 years younger than the earliest age of cancer affected first degree relative (except with Peutz-Jeghers start at age 35)** (Hu, 2018; Syngal, 2015)
- For suspected acute pancreatitis with pain and abnormal amylase and lipase and <48-72 hours if ultrasound is inconclusive (ACR, 2019).

Presentation with atypical signs and symptoms including equivocal amylase and lipase (Mathur, 2015).

Known necrotizing pancreatitis requiring follow up.

Pancreatitis by history, (including pancreatic pseudocyst) with abdominal pain suspicious for worsening, or re-exacerbation

RENAL:

- For an indeterminate renal mass on other imaging (ACR, 2014)
- Active surveillance for patients with tuberous sclerosis and known angiomyolipomas if MRI is contraindicated (Vos, 2018)
- Follow up for solid renal masses under 1 cm at 6 and 12 months then annually (Herts, 2018)

SPLEEN:

- Incidental findings of the spleen that are indeterminate on other imaging

Other Indications for an Abdominal CT:

- Occult hernia when physical exam or prior imaging (ultrasound AND MRI) is non-diagnostic or equivocal (Lassandro, 2011; Miller, 2014; Robinson, 2013) and limited to the abdomen

For evaluation of suspected infection or for follow-up known infection:

- Persistent abdominal pain not explained by previous imaging/procedure
- Any known infection that is clinically suspected to have created an abscess in the abdomen.
- Any history of fistula limited to the abdomen that requires re-evaluation, or is suspected to have recurred.
- Abnormal fluid collection limited to the abdomen seen on prior imaging that needs follow-up evaluation.
- For diagnosis of diverticulitis or appendicitis in an adult if abdominal pain and tenderness to palpation is present and **at LEAST one** of the following:
    - WBC elevated
    - Fever
    - Anorexia
    - Nausea and vomiting
- Suspected appendictitis in a child after ultrasound has been obtained (Choosing Wisely, ACR/AAP/ACS).
- Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and **at LEAST one** of the following:
    - Rebound, guarding or rigid abdomen, **OR**
    - Severe tenderness to palpation over the entire abdomen
- Complications of diverticulitis with severe abdominal pain or severe tenderness or mass, not responding to antibiotic treatment, (prior imaging study is not required for diverticulitis diagnosis (Cartwright, 2015)

For evaluation of suspected inflammatory disease or follow-up:

- For suspected of inflammatory bowel disease (Crohn's or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea (Arif-Tiwari, 2019; Kilcoyne, 2016).
- Known inflammatory bowel disease, (Crohn's or ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation

Pre-operative evaluation:

- For abdominal surgery or procedure.

Post-operative/procedural evaluation:

- Follow-up of known or suspected post-operative complication involving only the abdomen.
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

Combination studies with Abdomen CT:

- **Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT with MUGA** – known tumor/cancer for initial staging or evaluation before starting chemotherapy or radiation treatment.

If an Abdomen/Pelvis CT combo is indicated and the Abdomen CT has already been approved, then the Pelvis CT may be approved.

BACKGROUND:

CT provides direct visualization of anatomic structures in the abdomen and pelvis and is a fast imaging tool used to detect and characterize diseases involving the abdomen and pelvis. Abdominal imaging begins at the diaphragm and extends to the umbilicus or iliac crests.
CT uses x-rays and multiple detectors to create cross sectional images of the normal anatomy, as well as demonstrate abnormal soft tissue densities, calcifications or fluid/gas patterns in the viscera or peritoneal space.

In general, ionizing radiation from CT should be avoided during pregnancy. Ultrasound is clearly a safer imaging option and is the first imaging test of choice, although CT or MRI after equivocal ultrasound has been validated for diagnosis. Clinicians should exercise increased caution with CT imaging in children, and young adults due to the risks of exposure to ionizing radiation. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.
Cross sectional imaging (liver ultrasound with Doppler, CT or MRI) should be completed no more than a month prior to the Transjugular Intrahepatic Portosystemic Shunt (TIPS) to assess for vascular patency and look for hepatic masses or other problems that could complicate the procedure.

Post procedure, an ultrasound of the liver a day after to assess shunt patency. Hepatic encephalopathy (HE) is the most common complication and usually occurs 2-3 weeks after insertion of TIPS. Unique complications may include intravascular hemolysis and infection of the shunt. Other complications can include capsule puncture, intraperitoneal bleed, hepatic infarction, fistula, hematobilia, thrombosis of stent, occlusion or stent migration and may require cross sectional imaging.

Follow up and maintenance imaging if complications suspected include Doppler ultrasound to assess shunt velocity. If asymptomatic sonogram performed at 4 weeks post placement, then every 6 months to a year. The gold standard for shunt patency is portal venography, usually reserved if concern for shunt occlusion.

OVERVIEW:

Ultrasound should be considered prior to a request for Abdomen CT for the following evaluations:

- Possible gallstones or abnormal liver function tests.
- Evaluation of cholecystitis.
- Follow up for aortic aneurysm.

Screening for Hepatocellular carcinoma (HCC): AASLD (American Association for the Study of Liver Diseases) recommends screening for HCC with ultrasound every 6 months for patients with hepatitis C and B (Bruix, 2011). The literature differs on the role of AFP (alpha fetoprotein) in the screening of HCC. Some authors

argue against its use altogether due to its lack of sensitivity and specificity in detecting HCC (Bruix, 2011; Marquardt, 2016) and instead recommend ultrasound alone for screening. According to Marquardt the AASLD and EASLD (European Association for the Study of the Liver) "do not endorse its [AFP] use in clinical routine, neither alone nor in combination with ultrasound". This approach is supported by reports of patients with chronic viral hepatitis and elevated AFP but normal livers on imaging. AFP elevation in these cases is due to hepatic inflammation and viral replication (Patil, 2013), not neoplasm. Others advocate for combined ultrasound and AFP for screening (Tzartzeva, 2018; Tan, 2011) citing increased sensitivity compared to ultrasound alone in detecting early stage HCC particularly in cirrhotic patients. In a meta- analysis by Tzartzeva, et al of thirty-two studies (13,367 patients with cirrhosis), ultrasound with AFP had a 63% sensitivity of detecting early stage HCC, compared to 45% for ultrasound alone. In the final analysis, no literature supports the use of AFP alone in the screening of HCC.

Although most international groups recommend US screening and surveillance for HCC, the evidence to support this practice is weak. The recommendation for screening with US every 6 months by the AASLD is based on a prospective Chinese study of hepatitis B patients that showed that patients who had an US survived longer. However, there is no good evidence to show that these results apply to the population in the United States, which has a much higher percentage of obese patients, fewer patients with chronic hepatitis B, and many more patients with alcoholic cirrhosis, often with hepatitis C and NAFLD. US is insensitive for detection of HCC in patients with hepatic steatosis, as well as, nodular cirrhotic livers who are undergoing surveillance. The regenerative nodules in cirrhotic livers alter the background hepatic echotexture, making HCC difficult to detect. Another inherent limitation of US is its operator dependence (ACR, 2017).

- Incidental liver lesions – "Incidental hepatic lesions that are ≥1 cm and have distinctly benign imaging features do not require follow-up. Such features include sharp margin, homogeneous low attenuation (≤20 HU) on noncontrast or portal venous–phase imaging, or characteristic features of hemangiomas, FNH, or perfusional changes (including focal fatty sparing or deposition). Incidental hepatic lesions that are ≥1 cm and have suspicious imaging features require further workup with prompt MRI or biopsy, depending on the lesion's size and features and the patient's risk level. Suspicious imaging features include ill-defined margins, heterogeneous density, mural thickening or nodularity, thick septa, and intermediate to high attenuation on portal venous–phase imaging (>20 HU, in the absence of pseudoenhancement)."

A diagnosis of HCC can be made with CT or MRI if the typical characteristics are present: a solid FLL with enhancement in the arterial phase with washout in the delayed venous phase should be considered to have HCC until otherwise proven (strong recommendation, moderate quality of evidence. If the characteristic features are not seen on imaging, a biopsy may be indicated.
"A study by Serst et al, performed CT, MRI, and biopsy for a series of 74 patients with nodules identified by surveillance ultrasound. The authors concluded that sensitivity and specificity of the combination of the two diagnostic tests was 98% and 81%, respectively, and that biopsy could be reserved for those without definitive findings on either CT or MRI" (Heimbach, 2018).

A CT or MRI should be performed in cirrhotics with an ultrasound showing a lesion of > 1 cm, an elevated or rising α -fetoprotein in the absence of a liver lesion on US, or when there is a clinical suspicion for the presence of HCC. The choice of MRI versus CT is controversial at this time.

**Surveillance for HCC is required for patients who have received liver-directed therapy, surgical resection, medical treatment, or a transplant for HCC. However, because of
the higher risk of tumor recurrence, US is not typically used for surveillance for HCC in the first 2 years after treatment. The European Association for the Study of the Liver recommends multiphase CT or MRI to assess response 1 month after resection or locoregional or systemic therapies, followed by one imaging technique every 3 months to complete at least 2 years, and then regular US every 6 months. This schedule is more frequent than some of the other society recommendations and the most common practice among interventional radiologists (every 3 months).

The AASLD (American Association for the Study of Liver Diseases) recommends screening for the following high-risk groups: Asian male hepatitis B carriers over age 40, Asian female hepatitis B carriers over age 50, hepatitis B carriers with a family history of HCC, Africans and African Americans with hepatitis B, cirrhotic hepatitis B carriers, individuals with hepatitis C cirrhosis, individuals with stage 4 primary biliary cirrhosis, individuals with genetic hemochromatosis and cirrhosis, individuals with alpha 1-antitypsin deficiency and cirrhosis, individuals with cirrhosis from other etiologies.
We scan patients with cirrhosis from any etiology every 6 months with ultrasound. Ultrasonography remains the primary imaging modality of choice for HCC surveillance. It is more cost-effective than CT and MRI, and more widely available. A meta-analysis reported a sensitivity of 94% in detecting lesions and a specificity of >90%, although the figures were less favourable for lesions measuring less than 2 cm. The sensitivity for early HCC is 63%. Although our liver clinic routinely uses alpha-fetoprotein as an adjunct to imaging screening, it is acknowledged that it is neither sensitive nor specific for early diagnosis of HCC (Willatt, 2018).

CT for incidental adrenal mass: In general, masses found < 1 cm do not need to be pursued. If an adrenal mass has diagnostic features of a benign mass such as a myelolipoma (presence of macroscopic fat), cyst, or hemorrhage (masses without enhancement, defined as change in pre- and postcontrast imaging of <10 HU), no additional workup or follow-up imaging is needed. If the mass has a density of 10 HU on unenhanced CT or signal loss compared with the spleen between in- and opposed-phase images of a chemical-shift MRI (CS-MRI) examination,
these features are almost always diagnostic of a lipid-rich adenoma, regardless of size. If no benign imaging features but stable for a year or longer, very likely benign and needs no further imaging. The role of adrenal mass biopsy is reserved predominantly to confirm a suspected adrenal metastasis; this procedure has been shown to be safe with a low morbidity. If
there are signs or symptoms of pheochromocytoma, plasma-fractionated metanephrine and normetanephrine levels should be obtained prior to biopsy . Otherwise endocrine workup of an incidental adrenal mass is controversial. Current guidelines from the American Association of Clinical Endocrinologists and the American Association of Endocrine Surgeons recommend an initial biochemical evaluation of all adrenal incidentalomas to exclude pheochromocytoma,
subclinical Cushing's syndrome, and hyperaldosteronism.

CT of the kidney- Recommendations for follow up of a complex cystic renal masse are made using Bosniak criteria (Muglia, 2014):

- Bosniak I (water density 0-20 HU); no further follow up

- Bosniak II (one or a few thin septations, small or fine calcifications, hyperdense cysts up to 3 cm); no further follow up
- Bosniak IIF felt to be benign but too complex to be diagnosed with certainty; image at 6 and 12 months, then annually for 5 years
- Bosniak III thick-walled cystic lesions with wall or septal enhancement; resection favored
- Bosniak IV malignant cystic renal mass with enhancing soft tissue components; resection favored

Screening for pancreatic cancer:
** Surveillance of individuals with genetic predisposition for pancreatic adenocarcinoma should include known mutation carriers from hereditary syndromes such as Peutz-Jeghers (10-30% lifetime risk), hereditary pancreatitis, familial atypical multiple melanoma and mole syndrome (10-30% risk) or for members of familial pancreatic cancer with a first degree family member with pancreatic cancer. In patients who are mutation carriers in BRCA2 (5-10% lifetime risk), PALB2 (5-10% lifetime risk), and Lynch syndrome (5-10%) families. Surveillance for patients with BRCA1 (2% lifetime risk) and ATM serine/threonine kinase (1-5% lifetime risk) is limited to those with first or second degree relatives with pancreatic cancer.

Patients with a family history of pancreatic cancer affecting two first-degree relatives meet criteria for familial pancreatic cancer and are candidates for genetic testing. It should be noted that 90% of families meeting criteria for familial pancreatic cancer, will not have a pathogenic mutation (Stoeffel, 2019).

Combination request of Abdomen CT/Chest CT - A Chest CT will produce images to the level of L3. Documentation for combo is required.

REDUCING RADIATION EXPOSURE:
CT urography - Utilization of appropriate imaging techniques can reduce radiation exposure in performance of CT urography. Some protocols may result in 15-35 mSv of exposure. In the article by Chow, et al. a technique involving administration of IV contrast in two boluses separated by a suitable time delay, allows nephrographic and excretory phases to be acquired in a single imaging pass. This allows for full non-contrast and contrast imaging to be obtained with two imaging passes.

Consider the role of barium contrast studies - Effective doses for fluoroscopic SBFT (small bowel follow through) imaging ranged between 1.37-3.83 mSv for the right lower quadrant, central abdomen and pelvis, respectively. The findings by Jaffe, et al suggest a modified examination for Crohn's disease indications would have lower effective doses than these. For MDCT the effective dose was 16.1 mSv. This indicates a 5 fold increase in the use of MDCT over SBFT.

For patients with Crohn's disease, efforts should be made to minimize the number of CT examinations, decrease the CT dose or consider MR Enterography. Limitations of SBFT include partial evaluation of extramucosal and extraluminal disease, impaired evaluation of small-bowel loops, especially those inaccessible in the deep pelvis.

Work up for distant metastasis in the initial evaluation of melanoma - Multiple studies, including the two authored by Miranda and Yancovitz, indicate that imaging studies including Chest x-ray, Chest CT, Abdomen/Pelvis CT, Brain CT or Brain MRI in the absence of symptoms or findings of metastatic disease have

extremely low yields (< 1%) in the survey evaluation of newly diagnosed melanoma, even in the presence of a positive sentinel node biopsy. The further work-up of the more common benign incidental finding (5-7%) on these studies lead to many more diagnostic tests, including surgery, which are seldom warranted.

Pre-operative evaluation of primary rectal cancer - Abdomen CT may detect hepatic and extra-hepatic disease relevant to decision making and prognosis in rectal cancer- but complete imaging through the pelvis does not add useful information. The area of the pelvis in pre-operative evaluation of rectal cancer is better defined by Pelvis MRI.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- For evaluation of suspected infection or inflammatory disease, Added:
  - Right upper quadrant pain for suspected biliary disease with negative or equivocal US or HIDA scan
  - For epigastric or left upper quadrant pain if labs or other imaging are inconclusive
- For evaluation of an organ or abnormality seen on previous imaging
  - Removed: For the evaluation of an organ enlargement such as splenomegaly or hepatomegaly as evidenced by physical exam or confirmed on any previous imaging study"
  - Added: To locate a pheochromocytoma once there is clear biochemical evidence
  - Changed adrenal indications from mass >4 cm to ≥1 cm with no hx of malignancy; AND adrenal mass ≥4 cm and no diagnosis of cancer, can approve for preoperative planning; AND adrenal mass <4 cm with history of malignancy
- Added indications for: liver lesions, adenoma, hyperplasia; modified hepatitis/hepatoma screening; pancreatic cystic lesions, pancreatitis, pancreatic cancer risk; renal mass; spleen
- Modified hernia indications from suspected spigelian hernia or hernia with suspected complications to occult hernia when physical exam or prior imaging is non diagnostic or equivocal
- Removed follow-up for periotonitis; evaluation of trauma; unexplained weight loss; removed age restrictions for abdominal pain
- Added Background information and updated references

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74174 – CT Angiography, Abdomen and Pelvis

CPT Codes: 74174

INDICATIONS FOR ABDOMEN/PELVIS CTA:

For evaluation of known or suspected abdominal/pelvis vascular disease:

- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis (ACR, 2018; Thakur, 2018).
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection (Baliga, 2014)
- Evaluation of known or suspected aortic aneurysm (Chaikof, 2018; Khosa, 2013; Kumar, 2017)
    - Known or suspected aneurysm >2.5 cm **AND** equivocal or indeterminate ultrasound results; **OR**
    - Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain
        - Known or suspected **iliac artery aneurysm** defined as dilatation of the common iliac vessel generally greater than 17 mm in men and 14 mm in women, or internal iliac >17mm AND equivocal or indeterminate Doppler ultrasound results OR
        - Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of pelvic pain
        - Surveillance imaging every three years for diameter 2.0-2.9 cm and annually for 3.0-3.4 cm if DUS inconclusive. If >3.5 cm , <6 month follow up (and consider intervention) (Wanhainen, 2019)**
- Suspected retroperitoneal hematoma or hemorrhage: to determine **vascular source** of hemorrhage, in setting of trauma, tumor invasion, fistula or vasculitis* (Ioannou, 2018)
- Lower gastrointestinal hemorrhage: Active bleeding in a hemodynamically stable patient or non-localized intermittent bleeding as an alternative to Tc-99m RBC scan when colonoscopy did not localize the bleeding, or is contraindicated or unavailable (ACR, 2014; Clerc, 2017).
- For hemodynamically unstable patients (Saltzman, 2019)
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- For evaluation of suspected mesenteric ischemia (ACR, 2018; Aw-Zoretic, 2016; Thakur, 2018)

For evaluation of venous thrombosis in the inferior vena cava (IVC) (Aw-Zuretic, 2016).

Vascular invasion or displacement by tumor (Conventional CT or MRI also appropriate) (Certik, 2015).

- For evaluation of known or suspected renal artery stenosis (Akbeyaz, 2017; Gulas, 2018; Mohammed, 2012) or resistant hypertension in the setting of normal renal function (with impaired renal function, eGFR <30, use US with Doppler) unrelated to recent medication (Harvin, 2017; Whelton, 2018) demonstrated by any of the following (Bailey, 2018; Hartman, 2009; Tullus, 2010)**:**
    - Unsuccessful control after treatment with 3 or more (>2) anti-hypertensive medication at optimal dosing and one should be a diuretic.
    - Acute elevation of creatinine after initiation of an angiotension converting enzyme inhibitor (ACE inhibitor) or angiotension receptor blocker (ARB).

- Asymmetric kidney size noted on ultrasound.
- Onset of hypertension in a person younger than age 30 without any other risk factors or family history of hypertension**.
- Significant hypertension (diastolic blood pressure > 110 mm Hg) in a young adult (i.e., younger than 35 years) suggestive of fibromuscular dysplasia (Kong, 2018)
- Diagnosis of a syndrome with a higher risk of vascular disease, such as neurofibromatosis, tuberous sclerosis and Williams' syndrome.
- New onset of hypertension after age 50.
- Acute rise in blood pressure in a person with previously stable blood pressures.
- Flash pulmonary edema without identifiable causes.
- Malignant or accelerated hypertension.
- Bruit heard over renal artery and hypertension.

Pre-operative evaluation:

- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Prior to repair of AAA
- For imaging of the deep inferior epigastric arteries for surgical planning (breast reconstructive surgery) (ACR, 2017)

Post- operative or post-procedural evaluation:

- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the peritoneal cavity.
- Suspected complications of inferior vena cava (IVC) filters
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms.
- Routine, baseline study (post-op/intervention) is warranted within 1 month (ACR, 2017; Chaikof, 2018; Uberoi, 2011).

If asymptomatic at 6 month intervals, for one year, then annually.
If symptomatic/complications related to stent graft – more frequent imaging may be needed.

- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Chest CTA/Abdomen/Pelvis CTA combo:

- Transcatheter Aortic Valve Replacement (TAVR) (ACR, 2017; Achenbach, 2012)
- Acute Aortic dissection (Barman, 2014)
- Takayasu's arteritis (Keser, 2014)
- Post op complications (Bennet, 2017; Choudhury, 2017)

BACKGROUND:
Body CTA is a method used to characterize vascular anatomy, diagnose vascular diseases, and plan treatment. Following contrast thin section CT acquisition is utilized and timed to coincide with peak arterial and venous enhancement. Both multiplanar and 3D reconstructions can be reformatted.

Abd/Pelvis CTA & Lower Extremity CTA Runoff Requests: Only one authorization request is required, using CPT Code 75635 Abdominal Arteries CTA. This study provides for imaging of the abdomen, pelvis, and both legs. The CPT code description is CTA aorto-iliofemoral runoff; abdominal aorta and bilateral ilio-femoral lower extremity runoff.

Bruits - blowing vascular sounds heard over partially occluded blood vessels. Abdominal bruits may indicate partial obstruction of the aorta or other major arteries such as the renal, iliac, or femoral arteries. Associated risks include but are not limited to; renal artery stenosis, aortic aneurysm, atherosclerosis, AVM, or coarctation of aorta.

Peripheral Artery Disease (PAD) – Before the availability of computed tomography angiography (CTA), peripheral arterial disease was evaluated using CT and only a portion of the peripheral arterial tree could be imaged. Multi-detector row CT (MDCT) overcomes this limitation and provides an accurate alternative to CT and is a cost-effective diagnostic strategy in evaluating PAD. Abdominal Arteries CTA (including runoff to the lower extremities) is the preferred study when evaluation of arterial sufficiency to the legs is part of the evaluation

****Follow-up of asymptomatic incidentally-detected iliac artery aneurysms:**
(Uberoi, 2011)

- <3.0 cm: Rarely rupture, grow slowly, follow-up not generally needed
- 3.0-3.5 cm: Followed up initially at 6 months
    - If stable, then annual imaging
- >3.5 cm: Greater likelihood of rupture
    - <6 month follow up
    - Consider intervention

GI bleeding- Colonoscopy should be the initial diagnostic procedure for nearly all patients presenting with acute LGIB (strong recommendation, low-quality evidence). Hematochezia associated with hemodynamic instability should lead to consideration of a brisk UGIB source, especially in at-risk patients such as those with a history of peptic ulcer disease or liver
disease with portal hypertension and those using antiplatelet or anticoagulant medications and an upper endoscopy should be performed (Strate, 2016)

CTA and Abdominal Aortic Aneurysm – Endovascular repair is an alternative to open surgical repair of an abdominal aortic aneurysm. It has lower morbidity and mortality rates and is minimally invasive. In order to be successful, it depends on precise measurement of the aneurysm and involved vessels. CTA with 3D reconstruction is useful in obtaining exact morphologic information on abdominal aortic aneurysms. CTA is also used for the detection of postoperative complications of endovascular repair.

CTA and Abdominal Aortic Aneurysm ** – The normal diameter of the suprarenal abdominal aorta is 3.0 cm and that of the infrarenal is 2.0 cm. Aneurysmal dilatation of the infrarenal aorta is defined as diameter >/= 3.0 cm or dilatation of the aorta >/= 1.5x the normal diameter.

Recommended intervals for initial follow-up imaging of ectatic aortas and abdominal aortas (follow up intervals may vary depending on comorbidities and the growth rate of the aneurysm) from the white paper of the ACR Incidental Findings Committee II on vascular findings using ultrasound (Chaikof, 2018)):
2.5-2.9 cm: …….5yr
3.0-3.4 cm:……. 3yr
3.5-3.9 cm:……2yr
4.0-4.4 cm:……1yr
4.5-4.9 cm……6 mo
5.0-5.5 cm:……3-6 mo

The Society of Vascular Surgery has different follow up intervals for AAA (Chaikof, 2018):
>2.5 cm - <3 cm……..10 yr
3.0 - 3.9 cm……3 yr
4.0 - 4.9 cm……12 mo
5.0 - 5.4 cm……..6 mo.

The Society of Vascular Surgery recommends elective repair of AAA >/= 5.5 cm in patients at low or acceptable surgical risk (Chaikof, 2018)

CTA and Thoracic Aorta Endovascular Stent-Grafts – CTA is an effective alternative to conventional angiography for postoperative follow-up of aortic stent grafts. It is used to review complications after thoracic endovascular aortic repair. CTA can detect luminal and extraluminal changes to the thoracic aortic after stent-grafting and can be performed efficiently with fast scanning speed and high spatial and temporal resolution.

***MRI/CT and acute hemorrhage:** MRI is not indicated and MRA/MRV (MR Angiography/Venography) is rarely indicated for evaluation of intraperitoneal or retroperitoneal hemorrhage, particularly in the acute setting. CT is the study of choice due to its availability, speed of the study and less susceptibility to artifact from patient motion. Advances in technology have allowed conventional CT to not just detect hematomas but also the source of acute vascular extravasation. In special cases finer vascular detail to assess the specific source vessel responsible for hemorrhage may require the use of CTA. CTA in diagnosis of lower gastrointestinal bleeding is such an example (Clerc, 2017). In this case, colonoscopy should be the initial diagnostic procedure.

MRA/MRV is often utilized in non acute situations to assess vascular structure involved in atherosclerotic disease and its complications, vasculitis, venous thrombosis, vascular congestion or tumor invasion. Although some of these conditions may be associated with hemorrhage, it is usually not the primary reason why MRI/MRA/MRV is selected for the evaluation. A special condition where MRI may be superior to CT for evaluating hemorrhage is to detect an underlying neoplasm as the cause of bleeding (Abe, 2010).

POLICY HISTORY:
Review Date: May 2019

Review Summary:

- Added indications for vascular disease for iliac artery aneurysm; complications of known aneurysm; surveillance imaging timeline; hemodynamically unstable patients; evaluation of venous thrombosis in the inferior vena cava; suspected complications of inferior vena cava (IVC) filters; and for post op complications
- For pre-op evaluation, added indications for prior to repair of AAA; and for imaging of the deep inferior epigastric arteries for surgical planning
- Added/modified Background information and updated references

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74175 – CT Angiography, Abdomen

CPT Codes: 74175

INDICATIONS FOR ABDOMEN CTA:

For evaluation of known or suspected abdominal vascular disease:

- For known large vessel diseases (celiac, splenic, renal arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis limited to the abdomen.
- For suspected aortic dissection (approve CTA/MRA abdomen and pelvis).
- For diagnosis or follow up of visceral artery aneurysm (Ibrahim, 2018; Junternamms, 2018):
- Evidence of vascular abnormality seen on prior imaging studies and limited to the abdomen.

Evaluation of known or suspected aortic aneurysm (Chaikof, 2018; Khosa, 2013):

  - Known or suspected aneurysm >2.5 cm **AND** equivocal or indeterminate ultrasound results; **OR**
  - Prior imaging (e.g. ultrasound) demonstrating aneurysm >2.5cm in diameter; **OR**
  - Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain.

- Suspected retroperitoneal hematoma or hemorrhage (to determine vascular source of hemorrhage in setting of trauma, tumor invasion, fistula or vasculitis; otherwise CT (rather than CTA) is sufficient and the modality of choice for diagnosing hemorrhage).
- For evaluation of suspected mesenteric ischemia (ACR, 2012).
- Suspected renal vein thrombosis in patient with known renal mass or from other causes (Mazhar, 2018)
- Venous thrombosis if previous studies have not resulted in a clear diagnosis and limited to the abdomen.
- Vascular invasion or displacement by tumor in the abdomen.
- For evaluation of portal venous system (hepatic portal system) after doppler ultrasound has been performed.
- For evaluation of transjugular intrahepatic portosystemic shunt (TIPS) when Doppler ultrasound indicates suspected complications (Darcy, 2012; Dariushnia, 2016; Farsad, 2014; Raissi, 2019).
- For evaluation of known or suspected renal artery stenosis (Akbeyaz, 2017; Gulas, 2018; Mohammed, 2012) or resistant hypertension in the setting of normal renal function (with impaired renal function, eGFR <30, use US with Doppler) unrelated to recent medication (Harvin, 2017; Whelton, 2018) demonstrated by any of the following (Bailey, 2018; Hartman, 2009; Tullus, 2010)**:**
  - Unsuccessful control after treatment with 3 or more (>2) anti-hypertensive medication at optimal dosing and one should be a diuretic.
  - Acute elevation of creatinine after initiation of an angiotension converting enzyme inhibitor (ACE inhibitor) or angiotension receptor blocker (ARB).
  - Asymmetric kidney size noted on ultrasound.
  - Onset of hypertension in a person younger than age 30 without any other risk factors or family history of hypertension**.
  - Significant hypertension (diastolic blood pressure > 110 mm Hg) in a young adult (i.e., younger than 35 years) suggestive of fibromuscular dysplasia (Kong, 2018)

- Diagnosis of a syndrome with a higher risk of vascular disease, such as neurofibromatosis, tuberous sclerosis and Williams' syndrome.
- New onset of hypertension after age 50.
- Acute rise in blood pressure in a person with previously stable blood pressures.
- Flash pulmonary edema without identifiable causes.
- Malignant or accelerated hypertension.
- Bruit heard over renal artery and hypertension.

Pre-operative evaluation:

- Evaluation prior to interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- For pre-transplant evaluation of either liver or kidney.
- Imaging of the deep inferior epigastric arteries for surgical planning (breast reconstruction surgery), include pelvic MRA (ACR, 2017)

Post-operative or post-procedural evaluation:

- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents, and stent-grafts in the peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011).
  - Asymptomatic at six (6) month intervals for one (1) year, then annually.
- Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Chest CTA/Abdomen CTA combo:

- For evaluation of extensive vascular disease involving the chest and abdominal cavities:
- For pre-op or preprocedural evaluation for Transcatheter Aortic Valve Replacement (TAVR) (Achenbach, 2012; ACR, 2017)
- Acute Aortic dissection (Barman, 2014)
- Takayasu's arteritis (Keser, 2014)
- Post op complications (Bennet, 2017; Choudhury, 2017)
- Significant post-traumatic or post-procedural vascular complications

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BACKGROUND:

Computed tomography angiography (CTA) generates images of the arteries that can be evaluated for evidence of stenosis, occlusion, or aneurysms. It is used to evaluate the arteries of the abdominal aorta and the renal arteries. CTA uses ionizing radiation and requires the administration of iodinated contrast agent which is a

potential hazard in patients with impaired renal function. Abdominal CTA is not used as a screening tool, e.g. evaluation of asymptomatic patients without a previous diagnosis.

Cross sectional imaging (liver ultrasound with Doppler, CT or MRI) should be completed no more than a month prior to the Transjugular intrahepatic Portosystemic shunt (TIPS) to assess for vascular patency and look for hepatic masses or other problems that could complicate the procedure.

Post procedure, an ultrasound of the liver a day after to assess shunt patency. Hepatic encephalopathy (HE) is the most common complication and usually occurs 2-3 weeks after insertion of TIPS. Unique complications may include intravascular hemolysis and infection of the shunt. Other complications can include capsule puncture, intraperitoneal bleed, hepatic infarction, fistula, hematobilia, thrombosis of stent, occlusion or stent migration and may require cross sectional imaging.

Follow up and maintenance imaging if complications suspected include Doppler ultrasound to assess shunt velocity. If asymptomatic sonogram performed at 4 weeks post placement, then every 6 months to a year. The gold standard for shunt patency is portal venography, usually reserved if concern for shunt occlusion.

OVERVIEW:
CTA and Renal Artery Stenosis – Renal artery stenosis is the major cause of secondary hypertension. It may also cause renal insufficiency and end-stage renal disease. Atherosclerosis is one of the common causes of this condition, especially in older patients with multiple cardiovascular risk factors and worsening hypertension or deterioration of renal function. CTA is used to evaluate the renal arteries and detect renal artery stenosis. **NF1 may present with hypertension due to renal artery stenosis in children. All young patients (<30 year) with hypertension should be clinically screened for secondary causes of hypertension, including NF1, so that renal revascularization can be offered before permanent end organ damage has occurred (Duan, 2014).

Asymptomatic Aneurysms may require treatment when:

- Diameter is > 2 cm
- Identified during pregnancy
- Multiple aneurysms are present
- Hepatic transplant

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added indications for transjugular intrahepatic portosystemic shunt when Doppler ultrasound indicates suspected complications; accelerated hypertension; pre-transplant evaluation of either liver or kidney; imaging of deep inferior epigastric arteries for surgical planning (breast reconstruction surgery
- For chest CTA/Abdomen CTA combo: added Transcatheter Aortic Valve Replacement; Acute Aortic dissection; Takayasu's arteritis; post op complications; significant post-traumatic or post-procedural vascular complications
- Added and modified Background information and updated references

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74176 – CT Abdomen and Pelvis

CPT Codes: 74176, 74177, 74178

INDICATIONS FOR ABDOMEN/PELVIS Computed Tomography (CT):

Evaluation of suspicious or known mass/tumors:

- Initial evaluation of suspicious masses/tumors found by physical exam or imaging study such as ultrasound (US), and both the abdomen and pelvis are likely affected (ACR, 2013, 2014).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen and pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious or a change was found on the last follow-up CT, new/changing sign/symptoms or abnormal lab values.
  Initial staging of known cancer
    - All cancers, excluding the following:
        - Basal Cell Carcinoma of the skin (NCCN, 2018)
        - Melanoma without symptoms or signs of metastasis (NCCN, 2018; Trotter, 2013)
    - Prostate cancer when PSA levels ≥10 ng/mL, biopsy GS ≥8, or clinically advanced disease (T2b, T2c, T3, or T4) **AND** nomogram (e.g., Partin, Cancer of Prostate Risk Assessment CAPRA) indicating probability of lymph node involvement >10%) (NCCN, 2019, Reese, 2012; Tosian, 2017).
- Follow-up of known cancer (Bourgioti, 2016; NCCN, 2018)
    - Follow-up of known cancer of patient undergoing active treatment within the past year
    - Known cancer with suspected abdominal/pelvic metastasis based on a sign, symptom or an abnormal lab value
    - Active monitoring for recurrence as clinically indicated

For evaluation of hematuria:

(ACR, 2014; Davis, 2012; Sharp, 2013)

- For hematuria (should be documented by greater than 3 red blood cells (RBC) per high-power field on urinalysis and not based on a dipstick test) (Davis, 2012)
- For macroscopic or gross hematuria (non-infectious documented by urinalysis)

For evaluation of known or suspected kidney or ureteral stones:

(ACEP, 2014; Brisbane, 2016)

- For acute flank pain with hematuria (can be confirmed by dip stick)
- For flank pain without hematuria with indeterminate or positive findings on other imaging
- Known calculi in patients >50 years of age
- Known renal calculi in patients <50 years of age after ultrasound has been obtained and is non-diagnostic, inconclusive, or shows an abnormality needing further evaluation (ACEP, 2014)

For evaluation of pyelonephritis in the following situations:

- When other imaging such as ultrasound is abnormal

- For a patient who remains febrile after 72 hours of treatment (Bonkat, 2017) or symptoms resolve and then recur within 2 weeks (Grabe, 2015)

For evaluation of Recurrent Urinary tract Infections in women (defined as at least 3 episodes of uncomplicated infection in the past twelve months):

- When there is suspicion of renal calculi or outflow obstruction (Anger 2019; Bonkat 2017)

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine

For evaluation of suspected infection or inflammatory disease:

(ACR, 2013; Cartwright, 2015)

- Suspected diverticulitis or acute appendicitis for initial imaging along with **ONE** of the following (Linzay, 2018):
  - WBC Elevated
  - Fever
  - Anorexia
  - Nausea and vomiting
- Suspected appendicitis in a child after ultrasound has been obtained (Choosing Wisely; ACR, 2018; AAP/ACS; Sanchez, 2016)
- Consider ultrasound or MRI in pregnant women with suspected appendicitis (ACR, 2018)

Suspected acute pancreatitis:

- For first time presentation with pain and abnormal amylase and lipase and < 48-72 hours (ACR, 2019)
- Presentation with high clinical suspicion of acute pancreatitis (amylase and lipase may be normal) (Mathur, 2015)
- Known necrotizing pancreatitis requiring follow up

Suspected inflammatory bowel disease (Crohn's or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea (Panizza, 2017)

Suspected small bowel obstruction when there is a strong clinical suspicion:

- Crampy pain, vomiting, distention, high pitched or absent bowel sounds, prior history of abdominal surgery or based on initial radiograph (ACR, 2013; Paulson, 2015)

Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and at LEAST ONE of the following:

- Rebound, guarding (not voluntary) or rigid abdomen, **OR**
- Severe tenderness to palpation present over entire abdomen

Suspected colonic or mesenteric ischemia (Dhatt, 2015) **CTA also appropriate** (ACR, 2018)

For follow up evaluation of known infection or inflammatory disease:
(ACR, 2013; Cartwright, 2015)

- Complications of diverticulitis with severe abdominal/pelvic pain or severe tenderness or mass not responding to antibiotic treatment (prior imaging study is not required for diverticulitis diagnosis) (Cartwright, 2015)
- Pancreatitis by history (including pancreatic pseudocyst) with continued abdominal pain, early satiety, nausea, vomiting or signs of infection greater than 4 weeks from initial presentation (ACR, 2019)
- Known inflammatory bowel disease, (Crohn's or Ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation
- Any known infection that is clinically suspected to have created an abscess in the abdomen and pelvis
- Any history of fistula that requires re-evaluation, or is suspected to have recurred in the abdomen and pelvis
- Abnormal fluid collection seen on prior imaging that needs follow-up evaluation
- Follow up for peritonitis (from any cause) if abdominal/pelvic pain and tenderness to palpation is present, and **at LEAST ONE** of the following:
    - Rebound, guarding, or rigid abdomen; **OR**
    - Severe tenderness to palpation present over entire abdomen

For evaluation of known or suspected aortic aneurysm-CTA or MRA are the gold standards but CT abdomen and pelvis also can be approved (Khosa, 2013; Kumar, 2017; Chaikof, 2018):

- Known or suspected aneurysm > 2.5 cm **AND** equivocal or indeterminate ultrasound results
- Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain
- Scheduled follow-up evaluation of aorto/iliac endograft or stent (Abd/Pelvic CTA preferred)
- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011).
    - Asymptomatic at six (6) month intervals, for one (1) year, then annually.
    - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

For evaluation of trauma:
(ACR, 2012)

- Suspected retroperitoneal hematoma or hemorrhage based on lab or physical findings
- Blunt injury with suspicion of multisystem trauma and hematuria
- Penetrating abdominal injury with suspicion of multisystem trauma with or without hematuria (ACR, 2012)

Pre-operative evaluation:

- For abdominal/pelvic surgery or procedure

Post-operative/procedural evaluation:

- Follow-up of known or suspected post-operative complication
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Other Indications for Abdomen/Pelvic CT Combo:

- Persistent abdomen/pelvic pain not explained by previous imaging/procedure
- To locate a pheochromocytoma once there is clear biochemical evidence
- For B symptoms of fevers to more than 101 F, drenching night sweats, and unexplained weight loss of more than 10% of body weight over 6 months, if CXR, labs and an ultrasound of the abdomen and pelvis have been completed (can also approve chest CT) (Cheson, 2014).
- Unexplained weight loss of 10% of body weight in two months (patient history is acceptable); with a second MD visit documenting some further decline in weight (Gaddey, 2014).
- Unexplained weight loss of 5% of body weight in six months confirmed by documentation to include the following (Bosch, 2017; Wong, 2014):
    - Related history and abdominal exam
    - Chest x-ray
    - Abdominal ultrasound
    - Lab tests, must include TSH
    - Colonoscopy if patient fifty plus (50+) years old
- Unexplained abdominal pain in patients seventy-five (75) years or older (USPSTF does not recommend screening colonoscopy in patients over 75)
- Suspected spigelian hernia (ventral hernia) or incisional hernia *(evidenced by a surgical abdominal scar)* when ordered as a pre-operative study OR when physical exam or prior imaging (e.g. ultrasound) is non-diagnostic or equivocal (Lassandro, 2011) **OR** ultrasound is contraindicated due to obesity.
- Hernia with suspected complications (e.g. bowel obstruction or strangulation) or prior to surgical repair OR when physical exam or prior imaging (e.g. ultrasound) is non-diagnostic or equivocal (Lassandro, 2011; Miller, 2014; Robinson, 2013)

BACKGROUND:

CT provides direct visualization of anatomic structures in the abdomen and pelvis and is a fast imaging tool used to detect and characterize disease involving the abdomen and pelvis. Abdomen/pelvis imaging begins at the diaphragmatic dome through pubic symphysis. CT uses x-rays and multiple detectors to create cross sectional images of the normal anatomy as well as demonstrate abnormal soft tissue densities, calcifications or fluid/gas patterns in the viscera or peritoneal space.

In general, ionizing radiation from CT should be avoided during pregnancy. Ultrasound is clearly a safer imaging option and is the first imaging test of choice, followed by MRI in appropriate situations. Clinicians

should exercise increased caution with CT imaging in children, pregnant women, and young adults due to the risks of exposure to ionizing radiation. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.

OVERVIEW:
CT for suspected renal stones: An initial CT study is done to identify the size of the stone and rule out obstruction *(a stone < 6 mm has a 68% probability of passing).* After the initial CT study for kidney stone is done, the stone can be followed by x-ray or US (not CT). If a second exacerbation occurs/a new stone is suspected another CT would be indicated to access the size of stone and rule out obstruction.

CT Imaging for renal colic and hematuria: CT protocols include: "stone protocol" for detecting urinary tract calculi, "renal mass protocol" for characterizing known renal masses, and CT urography for evaluating hematuria. Non-contrast CT can be used for detecting most ureteral and renal stones but sometimes an intravenous contrast agent is needed to determine the relationship of the calculus to the opacified ureter. CT is an effective imaging examination for diagnosing hematuria caused by urinary tract calculi, renal tumors and urothelial tumors.

CT Imaging for abdominal aortic aneurysms: If a pulsatile abdominal mass is found in an asymptomatic patient, abdominal ultrasonography is an inexpensive and noninvasive technique for initial evaluation. For further examination, CT may be performed to better define the shape and extent of the aneurysm and the local anatomic relationships of the visceral and renal vessels. CT has high level of accuracy in sizing aneurysms. CTA and MRA are the gold standards for imaging. The majority of evidence regarding AAA surveillance using CT is based on CTA data and is primarily related to
contrast bolus timing. Contrast-enhanced CT is well established in the literature and is capable of identifying aortic aneurysms, with many papers discussing incidental AAA identification (ACR 2018).
Risk of rupture in 6 years for an AAA < 4 cm is 1%. For a 4-5 cm AAA the risk of rupture increases to 1-3% per year and becomes 6-11% per year for AAA 5-7 cm in cross sectional diameter. For >7 cm the risk of rupture goes to 7% per year.

****Abdominal aneurysms and general guidelines for follow-up:**
The normal diameter of the suprarenal abdominal aorta is 3.0 cm and that of the infrarenal is 2.0 cm. Aneurysmal dilatation of the infrarenal aorta is defined as diameter≥ 3.0 cm or dilatation of the aorta ≥ 1.5x the normal diameter. Initial evaluation of AAA is accurately made by ultrasound. Ultrasound can detect and size AAA, with the advantage of being relatively inexpensive, noninvasive and not require iodinate contrast. The limitations are that overlying bowel gas can obscure findings and the technique is operator dependent.

Recommended intervals for initial follow-up imaging (any modality) of ectatic aortas and abdominal aortas (follow up intervals may vary depending on comorbidities and the growth rate of the aneurysm):
2.5-2.9 cm: ……5yr
3.0-3.4 cm: ……. 3yr
3.5-3.9 cm: ……2yr
4.0-4.4 cm: ……1yr
4.5-4.9 cm: ……6 mo
5.0-5.5 cm: ……3-6 mo

The Society of Vascular Surgery has different follow up intervals for AAA (SVS, 2018):
>2.5 cm - <3 cm……..10 yr
3.0 - 3.9 cm……3 yr
4.0 - 4.9 cm……12 mo
5.0 - 5.4 cm……..6 mo.

The Society of Vascular Surgery recommends elective repair of AAA ≥ 5.5 cm in patients at low or acceptable surgical risk (Chaikof, 2018).

CT for Mesenteric Ischemia
CT of the abdomen and pelvis with intravenous (IV) contrast performed during the venous phase has been less well studied compared with CTA in diagnosing mesenteric ischemia. CT with IV contrast can assess nonvascular findings, major arterial lesions, and mesenteric veins; however, the lack of arterial phase may lead to suboptimal evaluation of the mesenteric arteries compared to CTA (ACR AUC 2018).

Consider the role of capsule endoscopy - Retrospective comparison of capsule endoscopy (CE) to CT in patients with no evidence of a small-bowel stricture at barium examination was the focus of the article by Hara, et al. Studies were done for bleeding of unknown origin after colonoscopy and/or Gastroenterologist, inflammatory bowel disease or chronic abdominal pain.
CE was found to be more sensitive than CT examination in the 19 patients that underwent both. CE provides a complimentary and sensitive approach to the evaluation of the small bowel without radiation exposure. A negative examination does not completely rule out pathology.

Combination request of Abdomen CT/Chest CT - A Chest CT will produce images to the level of L3. Documentation for combo is required.

REDUCING RADIATION EXPOSURE:

Evaluation for appendicitis following clinical and laboratory evaluation -
Sonography of the right upper quadrant and pelvis followed by graded compression and color Doppler sonography of the right lower quadrant was used by Gaitini and colleagues as the initial imaging study in 420 consecutive patients referred for emergency evaluation of acute appendicitis. This method correctly diagnosed acute appendicitis in 66 of 75 patients (88%) and excluded it correctly in 312 of 326 patients (96%). It was inconclusive in 19 patient (<5%). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 74.2%, 97%, 88%, 93%, and 92%, respectively and comparable to CT.

Appropriate and timely diagnosis of acute appendicitis is needed. Negative laparotomy rates can range from 16% to 47% when based on clinical and laboratory data alone, while perforation rate can reach 35% when surgery is delayed. Appropriate initial imaging can lower the negative laparotomy rate to 6-10%. Ultrasound has a higher non-diagnostic rate (4%) vs. 0.8% for MDCT. In a prospective study operator experience and patient BMI did not affect diagnostic accuracy.

Consider alternatives to CT imaging in patients with Crohn disease: In facilities where the technical and clinical expertise exists, MR enterography is emerging as the study of choice (replacing CT) for patients

requiring frequent follow up examinations to determine disease extent or progression. The technique also has advantage over small bowel follow through (SBFT) in that it avoids ionizing radiation completely, yet allows evaluation of extramucosal and extraluminal disease.

Consider the role of capsule endoscopy - Retrospective comparison of capsule endoscopy (CE) to CT in patients with no evidence of a small-bowel stricture at barium examination was the focus of the article by Hara, et al. Studies were done for bleeding of unknown origin after colonoscopy and/or Gastroenterologist, inflammatory bowel disease or chronic abdominal pain.

CE was found to be more sensitive than CT examination in the 19 patients that underwent both. CE provides a complimentary and sensitive approach to the evaluation of the small bowel without radiation exposure. A negative examination does not completely rule out pathology.

Consider the role of barium contrast studies - Effective doses for fluoroscopic SBFT (small bowel follow through) imaging ranged between 1.37-3.83 mSv for the right lower quadrant, central abdomen and pelvis, respectively. The findings by Jaffe et al suggest a modified examination for Crohn's disease indications would have lower effective doses than these. For MDCT the effective dose was 16.1 mSv. This indicates a 5 fold increase in the use of MDCT over SBFT.

For patients with Crohn's disease, efforts should be made to minimize the number of CT examinations, decrease the CT dose or consider MR Enterography. Limitations of SBFT include partial evaluation of extramucosal and extraluminal disease, impaired evaluation of small-bowel loops, especially those inaccessible in the deep pelvis.

Initial evaluation of abdominal aortic aneurysm (AAA) - Initial evaluation of AAA is accurately made by ultrasound.

Imaging of hernias: Most hernias are diagnosed clinically with imaging recommended for the diagnosis of occult hernias or in the evaluation of hernia complications, such as bowel obstruction or strangulation. To detect occult hernias, ultrasound is a first line study with a sensitivity of 86% and specificity of 77%, compared to 80% sensitivity and 65% specificity for CT (Robinson, 2013). According to Miller, et al "Magnetic resonance imaging is generally not considered a first- or even second-line evaluation modality for hernias…" (Miller, 2014). Based on this analysis, MRI is recommended only when ultrasound and CT have been performed and fail to make a diagnosis.

POLICY HISTORY:
Review Date: May, 2019
Review Summary:

- For hematuria, clarified that testing should not be done by dipstick; for infectious hematuria, removed restriction of 6 week completion of antibiotic therapy
- Modified indication for prostate cancer imaging when PSA levels ≥10 ng/mL per NCCN update

- Removed indication for evaluation of organ enlargement; suspected cholecystitis or retained gallstones; hepatitis screening; adrenal mass; ischemic bowel; suspected partial small bowel obstruction
- Added indications for known necrotizing pancreatitis; acute flank pain with or without hematuria; pregnant women with suspected appendicitis consider US or MRI; blunt injury or penetrating abdominal injury; evaluation of endovascular/interventional abdominal vascular procedures; follow up for post endovascular repair or open repair of abdominal aortic aneurysm; symptoms of fevers, night sweats, unexplained weight loss over 6 months if CXR, labs, and US have been performed
- Added time frame to Pancreatitis history to include >4 weeks of symptoms

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74181 – MRI MRCP Abdomen

CPT Codes: 74181, 74182, 74183, S8037

IMPORTANT NOTE: A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed.

INDICATIONS FOR MRCP:
(ACR, 2019; Akisik, 2013; Lindor, 2015)

- Evaluation of suspected congenital anomaly of the pancreaticobiliary tract, e.g., aberrant ducts, choledochal cysts, pancreas divisum or related complications.
- Evaluation of chronic pancreatitis or related complications (pseudocysts and bile duct strictures).
- Evaluation of persistent symptoms when abnormalities are identified on other imaging (eg, ultrasound, CT, or MRI).
- Evaluation of abnormality related to the pancreatic or biliary tree based on symptoms or laboratory findings and initial imaging has been performed or is contraindicated (e.g. renal failure prevents contrast CT or body habitus limits US).
- Evaluation of pancreatobiliary disease in pregnant patients after ultrasound has been done
- As an alternative to CT for evaluating acute pancreatitis when iodinated contrast is contraindicated due to impaired renal function or allergy

INDICATIONS FOR ABDOMEN MRI:

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:

- Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study, such as ultrasound (US) (ACR, 2019).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen. No further surveillance unless tumor(s) are specified as highly suspicious, or change was found on exam or last follow-up imaging.

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as ultrasound (US) and CT:

- Initial staging of known cancer
    - All cancers, excluding the following:
        - Basal Cell Carcinoma of the skin (NCCN, 2018)
        - Melanoma without symptoms or signs of metastasis (NCCN, 2018; Trotter, 2013)
- Follow-up of known cancer (Bourgioti, 2016; NCCN, 2018):
    - Follow-up of known cancer of patient undergoing active treatment within the past year

- Known cancer with suspected abdominal metastasis based on a sign, symptom or an abnormal lab value
- Active monitoring for recurrence as clinically indicated

For evaluation of an organ or abnormality seen on previous imaging:

ADRENAL:
- To locate a pheochromocytoma once there is clear biochemical evidence** (Lenders, 2014)
- Suspected adrenal mass ≥ 1 cm incidentally discovered with no history of malignancy (one follow-up in 6 – 12 months to document stability)
- If adrenal mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning (surgery to rule out adrenal cortical carcinoma)
- For adrenal mass < 4 cm with history of malignancy (if ≥ 4 cm consider biopsy or FDG-PET/CT unless pheochromocytoma is suspected)

LIVER:
- Indeterminate liver lesion ≥ 1cm seen on prior imaging (MRI study of choice, but CT can be approved)
- Hepatitis/hepatoma screening after ultrasound is abnormal, equivocal, or non-diagnostic (may be limited in patients who are obese, those with underlying hepatic steatosis, as well as nodular livers (ACR, 2017; Bruix, 2011; Lee, 2014; Marquardt, 2016)). (No literature supports the use of AFP alone in the screening of HCC).
- For jaundice or abnormal liver function tests after equivocal or abnormal ultrasound (Vagvala, 2018)
- For follow up of suspected adenoma every 6-12 months
- For follow up of focal nodular hyperplasia (FNH) annually if US is inconclusive (Marrero, 2014)
- For surveillance of HCC in patients who have received liver-directed therapy, surgical resection, medical treatment or transplant (MRI or CT) at one month post treatment and then every 3 months for up to two years* (Arif-Tawari, 2017)

Evaluation of iron overload in the following settings:
- Initial evaluation of liver iron in Hemochromatosis diagnosed in lieu of liver biopsy (Labranche, 2018)
- Annual evaluation for high risk patients: transfusion-dependent thalassemia major, sickle cell disease and other congenital anemias (Wood, 2014)

PANCREAS:
- Pancreatic cystic lesion found on initial imaging
- Intraductal papillary mucinous neoplasm (IPMN) and mucinous cystic neoplasm (MCN) require surveillance imaging as follows if indeterminate on initial imaging and duct communication is present:
  - For lesions under 5 mm (white dot on MRI T2) one follow up CT or MRI at 2 years.
  - For cysts under 1.5 cm separated by age: < 65 with follow up yearly and 65-79 with FU every 2 years.
- Cysts that are 1.5-1.9 cm followed yearly for 5 years, then every 2 years for 4.
- For lesions 20 mm to < 30 mm MRI/CT or EUS biannually for 1 year, then every year until stable
- For lesions ≥ 30 mm MRI/CT or EUS every 6 months (Han, 2018)

- Yearly surveillance for individuals determined to have greater than 5% lifetime risk of developing pancreatic cancer starting at age 50 or 10 years younger than the earliest age of cancer affected first degree relative (except with Peutz-Jeghers start at age 35)** (Hu, 2018; Syngal, 2015)
- Suspected acute pancreatitis (when CT is indeterminate or contraindicated)
- For first time presentation with pain and abnormal amylase and lipase and < 48-72 hours if ultrasound is inconclusive (ACR, 2019).
- Presentation with atypical signs and symptoms including equivocal amylase and lipase (Mathur, 2015).
- Known necrotizing pancreatitis requiring follow up.
- Pancreatitis by history, (including pancreatic pseudocyst) with abdominal pain suspicious for worsening, or re-exacerbation.

RENAL (MRI if CT contraindicated):
- For an indeterminate renal mass on other imaging (ACR, 2014)
- Active surveillance for indeterminate cystic renal mass, not a simple renal cyst.
- Follow up for solid renal masses under 1 cm at 6 and 12 months, then annually (Herts, 2018)
- Active surveillance for patient with tuberous sclerosis and known angiomyolipomas (Vos, 2018)

SPLEEN:
- Incidental findings of the spleen on ultrasound or CT that are indeterminate (Thut, 2017)

Other Indications for an Abdominal MRI:
- Occult hernia when physical exam or prior imaging (ultrasound AND CT) is non-diagnostic or equivocal (Lassandro, 2011; Miller, 2014; Robinson, 2013) and limited to the abdomen

For evaluation of suspected infection or for follow-up known infection:
- Persistent abdominal pain not explained by previous imaging/procedure
- Any known infection that is clinically suspected to have created an abscess in the abdomen.
- Any history of fistula limited to the abdomen that requires re-evaluation, or is suspected to have recurred.
- Abnormal fluid collection limited to the abdomen seen on prior imaging that needs follow-up evaluation.
- For diagnosis of diverticulitis or appendicitis in an adult if abdominal pain and tenderness to palpation is present and **at LEAST one** of the following:
  - WBC elevated
  - Fever
  - Anorexia
  - Nausea and vomiting
- Suspected appendicitis in a child after ultrasound has been obtained (Choosing Wisely, ACR/AAP/ACS).
- Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and **at LEAST one** of the following:
  - Rebound, guarding or rigid abdomen, **OR**
  - Severe tenderness to palpation over the entire abdomen
- Complications of diverticulitis with severe abdominal pain or severe tenderness or mass, not responding to antibiotic treatment (prior imaging study is not required for diverticulitis diagnosis (Cartwright, 2015)

For evaluation of suspected inflammatory disease or follow-up:

- For suspected of inflammatory bowel disease (Crohn's or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea (Arif-Tiwari, 2019; Kilcoyne, 2016).
- Known inflammatory bowel disease (Crohn's or ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases:

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

INDICATIONS RELEVANT TO ABDOMEN MRI OR MRCP:

Pre-operative evaluation:

- For abdominal surgery or procedure.

Post-operative/procedural evaluation:

- Follow-up of known or suspected post-operative complication involving only the abdomen.
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed

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BACKGROUND:

***Abdominal Magnetic Resonance Imaging (MRI)** is a proven and useful tool for the diagnosis, evaluation, assessment of severity and follow-up of diseases of the abdomen. It is more expensive than computed tomography (CT) but it avoids exposing the patient to ionizing radiation. MRI may be the best imaging procedure for patients with allergy to radiographic contrast material or renal failure. It may also be the procedure of choice for suspected lesions that require a technique to detect subtle soft-tissue contrast and provide a three dimensional depiction of a lesion. Abdominal MRI studies are usually targeted for further evaluation of indeterminate or questionable findings, identified on more standard imaging exams such as Ultrasound (US) and CT.

Magnetic Resonance enterography is an excellent study for assessing submucosal pathology in inflammatory bowel disease. It generates highly reproducible images of the large and small bowel with excellent sensitivity and specificity. It can determine the presence and extent of transmural inflammation, fibrotic disease, and other intra-abdominal complications. It is also useful in assessment of bowel obstruction, abscess formation, tethering and fistula and is less dependent on bowel distention than CT enterography (Arif-Tiwari, 2019).

Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive radiologic technique for imaging the biliary and pancreatic ducts in the clinical setting of cholestatic liver function tests, right upper quadrant pain, recurrent pancreatitis, and assessing postoperative complications. MRCP is reliable for the diagnosis of pancreatic ductal abnormalities, e.g., pancreas divisum. It is also used to diagnose bile duct stones and assess

the level of biliary obstruction. MRCP is especially useful as an alternative to ERCP (Endoscopic retrograde cholangiopancreatography) when a noninvasive exam is desired or when there is a very small likelihood that the patient will need therapeutic intervention afforded by ERCP. MRCP is unwarranted in patients with known pathology requiring ERCP mediated intervention. Due to the variable accuracy of ultrasound in detecting choledocholithiasis, preoperative MRCP prior to cholecystectomy has been advocated particularly in the setting of acute cholecystitis, near normal common bile duct diameter (where ultrasound is less accurate) and elevated liver functions, especially alanine amino transaminase (ALT) (Qiu, 2015). Secretin-enhanced MR Cholangiopancreatography has been recently developed to improve the diagnostic quality of MRCP images (Tirkes, 2013).

In diagnosing acute pancreatitis MRI and MRCP are not as practical as CT. The latter can be performed more quickly and provide better images due to less motion artifact (if patient cannot cooperate with instructions for MRI) in acutely ill patients (ACR, 2017). In selected patients who cannot receive iodinated contrast for CT, MRI and MRCP may be considered. Complications of chronic pancreatitis using MRCP are well imaged in cooperative patients.

Cross sectional imaging (liver ultrasound with Doppler, CT or MRI) should be completed no more than a month prior to the Transjugular intrahepatic Portosystemic shunt (TIPS) to assess for vascular patency and look for hepatic masses or other problems that could complicate the procedure.

Post procedure, an ultrasound of the liver a day after to assess shunt patency. Hepatic encephalopathy (HE) is the most common complication and usually occurs 2-3 weeks after insertion of TIPS. Unique complications may include intravascular hemolysis and infection of the shunt. Other complications can include capsule puncture, intraperitoneal bleed, hepatic infarction, fistula, hematobilia, thrombosis of stent, occlusion or stent migration and may require cross sectional imaging.

Follow up and maintenance imaging if complications suspected include Doppler ultrasound to assess shunt velocity. If asymptomatic sonogram performed at 4 weeks post placement, then every 6 months to a year. The gold standard for shunt patency is portal venography, usually reserved if concern for shunt occlusion.

OVERVIEW:

MRI of the liver – The liver is a common site of metastatic spread. Patients with a history of known or suspected malignancy, especially tumors from the colon, lung, pancreas and stomach, are at risk for developing hepatocellular carcinoma. Patients with chronic liver disease are also at risk for developing liver cancer and undergo periodic liver screening for focal liver lesion detection, usually with ultrasonography (US). Extra-cellular gadolinium chelate contrast-enhanced MRI is used for evaluating patients with an abnormal US. Patients with hepatic metastases being considered for metastasectomy undergo contrast-enhanced MRI using tissue-specific contrast agents.

Screening for Hepatocellular carcinoma (HCC): AASLD (American Association for the Study of Liver Diseases) recommends screening for HCC with ultrasound every 6 months for patients with hepatitis C and B (Bruix, 2011). The literature differs on the role of AFP (alpha fetoprotein) in the screening of HCC. Some authors argue against its use altogether due to its lack of sensitivity and specificity in detecting HCC (Bruix, 2011; Marquardt, 2016) and instead recommend ultrasound alone for screening. According to Marquardt the AASLD

and EASLD (European Association for the Study of the Liver) "do not endorse its [AFP] use in clinical routine, neither alone nor in combination with ultrasound". This approach is supported by reports of patients with chronic viral hepatitis and elevated AFP but normal livers on imaging. AFP elevation in these cases is due to hepatic inflammation and viral replication (Patil, 2013), not neoplasm. Others advocate for combined ultrasound and AFP for screening (Tan, 2011; Tzartzeva, 2018) citing increased sensitivity compared to ultrasound alone in detecting early stage HCC particularly in cirrhotic patients. In a meta- analysis by Tzartzeva, et al of thirty-two studies (13,367 patients with cirrhosis) ultrasound with AFP had a 63% sensitivity of detecting early stage HCC compared to 45% for ultrasound alone. In the final analysis, no literature supports the use of AFP alone in the screening of HCC.

MRI of the adrenal glands – The adrenal glands are susceptible for metastases from various tumors, especially of lung or breast. Adrenal lesions may also represent primary tumors of the adrenal cortex of medulla, both benign and malignant. MRI may be done to distinguish between benign and malignant lesions. Metastases are predominantly hypointense on T1-weighted images and hyperintense on T2-weighted images. Benign lesions, which have high lipid content, exhibit a drop in signal intensity on opposed phase chemical shift imaging.

In general, masses found < 1 cm do not need to be pursued. If an adrenal mass has diagnostic features of a benign mass such as a myelolipoma (presence of macroscopic fat), cyst, or hemorrhage (masses without enhancement, defined as change in pre- and postcontrast imaging of <10 HU), no additional workup or follow-up imaging is needed. If the mass has a density of 10 HU on unenhanced CT or signal loss compared with the spleen between in- and opposed-phase images of a chemical-shift MRI (CS-MRI) examination, these features are almost always diagnostic of a lipid-rich adenoma, regardless of size. If no benign imaging features but stable for a year or longer, very likely benign and needs no further imaging. The role of adrenal mass biopsy is reserved predominantly to confirm a suspected adrenal metastasis; this procedure has been shown to be safe with a low morbidity.

If there are signs or symptoms of pheochromocytoma, plasma free metanephrine and normetanephrine levels or urinary fractionated metanephrines should be obtained prior to biopsy. Imaging recommended with CT (MRI as second option) once biochemical evidence confirmed. Otherwise endocrine workup of an incidental adrenal mass is controversial. Current guidelines from the American Association of Clinical Endocrinologists and the American Association of Endocrine Surgeons recommend an initial biochemical evaluation of all adrenal incidentalomas to exclude pheochromocytoma, subclinical Cushing's syndrome, and hyperaldosteronism.

MRI of the pancreas – The most common pancreatic endocrine tumors, accounting for up to 50% of all cases, are insulinomas, which are usually benign. The next most common is gastrinomas. Patients with gastrinomas generally present with recurrent, multiple or 'ectopic' peptic ulceration, the Zollinger-Ellison syndrome. After a diagnosis of gastrinomas has been confirmed, imaging should be done to localize and stage the disease. Other pancreatic endocrine tumors are rare and often associated with genetic disorders such as the multiple endocrine neoplasia type 1 (MEN 1). MRI is the preferred imaging for follow-up in patients with MEN 1 where repeated imaging may be required to assess the response to therapy.

** Surveillance of individuals with genetic predisposition for pancreatic adenocarcinoma should include known mutation carriers from hereditary syndromes such as Peutz-Jeghers (10-30% lifetime risk), hereditary

pancreatitis, familial atypical multiple melanoma and mole syndrome (10-30% risk) or for members of familial pancreatic cancer with a first degree family member with pancreatic cancer. In patients who are mutation carriers in BRCA2 (5-10% lifetime risk), PALB2 (5-10% lifetime risk), and Lynch syndrome (5-10%) families. Surveillance for patients with BRCA1 (2% lifetime risk) and ATM serine/threonine kinase (1-5% lifetime risk) is limited to those with first or second degree relatives with pancreatic cancer.

Patients with a family history of pancreatic cancer affecting two first-degree relatives meet criteria for familial pancreatic cancer and are candidates for genetic testing. It should be noted that 90% of families meeting criteria for familial pancreatic cancer will not have a pathogenic mutation (Stoeffel, 2019).

MRI of the kidney – MRI in renal imaging has been used to differentiate benign lesions versus malignant lesions in patients unable to undergo CT scanning with contrast media or in cases where the CT findings were questionable. Initial evaluation of renal lesions is often undertaken with ultrasound. MRI can have additional diagnostic value in the evaluation of lesions with minimal amounts of fat or with intracellular fat. MRI may have a higher accuracy than CT in the evaluation of early lymph node spread. Although MRI of the kidney has not yet found broad clinical application, it may have an increasing role in the management of patients with renal disease.

Recommendations for follow up of a complex cystic renal mass are made using Bosniak criteria (Muglia, 2014):

- Bosniak I (water density 0-20 HU); no further follow up
- Bosniak II (one or a few thin septations, small or fine calcifications, hyperdense cysts up to 3 cm); no further follow up
- Bosniak IIF felt to be benign but too complex to be diagnosed with certainty; image at 6 and 12 months, then annually for 5 years
- Bosniak III thick-walled cystic lesions with wall or septal enhancement; resection favored
- Bosniak IV malignant cystic renal mass with enhancing soft tissue components; resection favored

MRI of the spleen – Among some radiologists, the spleen is considered a 'forgotten organ' although it is included and demonstrated on every abdominal CT and MRI. Malignant tumors of the spleen are rare; malignant lymphomas are the most common and are usually a manifestation of generalized lymphoma. Splenic metastases are predominantly hypointense on T1-weighted images and hyperintense on T2-weighted images and MRI is used for the detection of necrotic or hemorrhagic metastases.

MRI for the evaluation of vascular abnormalities such as renal artery stenosis and celiac/superior mesenteric artery stenosis (in chronic mesenteric ischemia) - Doppler Ultrasound, MRA or CTA should be considered as the preferred imaging modalities.

Imaging of hernias: Most hernias are diagnosed clinically with imaging recommended for the diagnosis of occult hernias or in the evaluation of hernia complications such as bowel obstruction or strangulation. To detect occult hernias, ultrasound is a first line study with a sensitivity of 86% and specificity of 77%, compared to 80% sensitivity and 65% specificity for CT (Robinson, 2013). According to Miller, et al "Magnetic resonance imaging is generally not considered a first- or even second-line evaluation modality for hernias…" (Miller, 2014). Based on this analysis MRI is recommended only when ultrasound and CT have been performed and fail to make a diagnosis.

Ultrasound: Ultrasound is the initial imaging technique used for screening suspected biliary or pancreatic disease, but it has limited ability to characterize abnormalities in the biliary and pancreatic ducts.

Endoscopic retrograde cholangiopancreatography (ERCP): ERCP can combine diagnosis with therapeutic intervention, e.g., removal of stones, but it is an invasive procedure that carries significant risk of complications, e.g., pancreatitis. ERCP is also technically challenging in patients with post-surgical biliary and/or surgical anastomoses.

Cystic Pancreatic neoplasms: In the evaluation of cystic neoplasms, MRCP is more sensitive than ERCP in differentiating mural nodules from mucin globules and in studying the duct anatomy, as ERCP quality is negatively affected when intraductal mucin plugs obscure the filling of the pancreatic duct (Cao, 2010). It also consistently demonstrates the internal architecture of the main duct and the extent of IPMN (Intraductal Papillary Mucinous Neoplasms) better than ERCP (Elta, 2018).

Biliary strictures (Byrne, 2008): Approximately 15% of biliary strictures in the western world are benign. 80% are related to previous surgery, usually an injury during gallbladder surgery. After liver transplantation anastomotic strictures usually develop 3-6 months after surgery. Rare causes of stricture formation include infectious agents such as TB, parasites and viruses. Other etiologies include recurrent pyogenic cholangitis, Mirizzi syndrome with external compression of the bile duct by an inflamed gallbladder, blunt trauma and an even smaller number of strictures of unknown etiology also occur.

PSC (primary sclerosing cholangitis): The American College of Gastroenterology recommends MRCP as the preferred modality over endoscopic retrograde cholangiopancreatography ERCP) to establish a diagnosis of PSC. Liver biopsy to make the diagnosis is reserved for patients with unexplained cholestatic liver function tests and normal cholangiograms suspected of having small duct PSC (Lindor, 2015). Although direct cholangiography is more sensitive, it has been nearly replaced by the noninvasive MRCP technique. Neither liver histology nor cholangiography alone will reliably reflect the severity of the disease. They must be used together with symptoms, physical findings, blood tests, and imaging or upper endoscopy tests that indicate the presence and severity of portal hypertension (Griffin, 2012).

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Created combo guideline by absorbing MRCP guideline within the Abdomen MRI
- Added Note: “A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed”.
- Added indications for evaluation of an organ or abnormality seen on previous imaging; liver lesions; jaundice or abnormal liver function; follow up of suspected adenoma and focal nodular hyperplasia; surveillance of HCC in patients who have received liver-directed therapy/surgical resection/medical

treatment or transplant; pancreatic cystic lesion; intraductal papillary mucinous neoplasm and mucinous cystic neoplasm; pancreatic cancer risk; known necrotizing pancreatitis; renal mass; and spleen

- Changed size parameters for adrenal mass:
    - Old: Suspected adrenal mass > 4 cm and there is a history of primary malignancy
    - Revised: Suspected adrenal mass ≥ 1 cm with no history of malignancy; if mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning; for mass < 4 cm with history of malignancy
- Added/modified Background information and updated references

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74185 – MR Angiography, Abdomen

CPT Codes: 74185

INDICATIONS FOR ABDOMEN MRA:

For evaluation of known or suspected abdominal vascular disease:

- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- For diagnosis or follow up of visceral artery aneurysm (Ibrahim, 2018; Junternamms, 2018)
- Evidence of vascular abnormality seen on prior imaging studies and limited to the abdomen.
- Evaluation of known or suspected aortic aneurysm (Chaikof, 2018; Khosa, 2013)*:
    - Known or suspected aneurysm > 2.5 cm AND equivocal or indeterminate ultrasound results; **OR**
    - Prior imaging (e.g. ultrasound) demonstrating aneurysm >2.5 cm in diameter; **OR**
    - Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain.
- To determine the vascular source of retroperitoneal hematoma or hemorrhage when CTA is contraindicated**
- Suspected renal vein thrombosis in patient with known renal mass or from other causes (Mazhar, 2018).
- For evaluation of suspected acute mesenteric ischemia/ischemic colitis when CTA is contraindicated (ACR, 2018).
- For suspected chronic mesenteric ischemia***
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- For evaluation of hepatic blood vessel abnormalities (aneurysm, hepatic vein thrombosis, stenosis post-transplant) after doppler ultrasound has been performed; to clarify or further evaluate ultrasound findings.
- For evaluation of transjugular intrahepatic portosystemic shunt (TIPS) when Doppler ultrasound indicates suspected complications
- Kidney failure or renal insufficiency if initial evaluation performed with Ultrasound is inconclusive.
- For evaluation of known or suspected renal artery stenosis or resistant hypertension in the setting of normal renal function or impaired renal function unrelated to recent medication (ACR, 2017) demonstrated by any of the following (Hartman, 2009; Tullus, 2010):
    - Unsuccessful control after treatment with 3 or more (>2) anti-hypertensive medication at optimal dosing.
    - Acute elevation of creatinine after initiation of an angiotension converting enzyme inhibitor (ACE inhibitor) or angiotension receptor blocker (ARB).
    - Asymmetric kidney size noted on ultrasound.
    - Onset of hypertension in a person younger than age 30 without any other risk factors or family history of hypertension.

- Significant hypertension (diastolic blood pressure > 110 mm Hg) in a young adult (i.e., younger than 35 years) suggestive of fibromuscular dysplasia
- Diagnosis of a syndrome with a higher risk of vascular disease, such as neurofibromatosis, tuberous sclerosis and Williams' syndrome
- New onset of hypertension after age 50.
- Acute rise in blood pressure in a person with previously stable blood pressures.
- Flash pulmonary edema without identifiable causes.
- Malignant hypertension.
- Bruit heard over renal artery and hypertension.

Pre-operative evaluation:

- Evaluation prior to interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- For pre transplant evaluation of either liver or kidney.
- Imaging of the deep inferior epigastric arteries for surgical planning (breast reconstruction surgery), include pelvic MRA (ACR, 2017)

Post-operative or post-procedural evaluation:

- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents, and stent-grafts in the peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011).
  - Asymptomatic at six (6) month intervals for one (1) year, then annually.
- Symptomatic/complications related to stent graft – more frequent imaging may be needed
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Magnetic resonance angiography (MRA) generates images of the arteries that can be evaluated for evidence of stenosis, occlusion or aneurysms. It is used to evaluate the arteries of the abdominal aorta and the renal arteries. Contrast enhanced MRA requires the injection of a contrast agent which results in very high quality images. MRA does not use ionizing radiation, allowing MRA to be used for follow-up evaluations. Abdominal MRA is not used as a screening tool, e.g. evaluation of asymptomatic patients without a previous diagnosis.

OVERVIEW:

MRI Follow-up for post-endovascular repair (EVAR) – Although studies have shown that MRA is as sensitive as CT in detecting endoleaks, CT is generally the study of choice in this evaluation due to convenience, improved spatial resolution and less artifact from components of the stent graft. MRA is most helpful in the

postoperative evaluation of patients with impaired renal function, but not severe enough to have contraindication to gadolinium administration.

Abd/Pelvis MRA & Lower Extremity MRA Runoff Requests: Two (2) authorization requests are required, one Abd MRA, CPT code 74185 and one for Lower Extremity MRA, CPT code 73725. This will provide imaging of the abdomen, pelvis, and both legs.

MRA and Abdominal Aortic Aneurysm – Endovascular repair is an alternative to open surgical repair of an abdominal aortic aneurysm. It has lower morbidity and mortality rates and is minimally invasive. In order to be successful, it depends on precise measurement of the aneurysm and involved vessels. MRA with gadolinium allows visualization of the aorta and major branches and is effective and reliable for use in planning the placement of the endovascular aortic stent graft. MRA is also used for the detection of postoperative complications of endovascular repair.

***Abdominal Aneurysms and general guidelines for follow-up:**
The normal diameter of the suprarenal abdominal aorta is 3.0 cm and that of the infrarenal is 2.0 cm. Aneurysmal dilatation of the infrarenal aorta is defined as diameter ≥ 3.0 cm or dilatation of the aorta ≥ 1.5x the normal diameter (Khosa, 2013). Initial evaluation of AAA is accurately made by ultrasound. Ultrasound can detect and size AAA, with the advantage of being relatively inexpensive, noninvasive and not require iodinate contrast. The limitations are that overlying bowel gas can obscure findings and the technique is operator dependent.

Asymptomatic Aneurysms require treatment when:

- The diameter is greater than 2 cm
- Identified during pregnancy
- Multiple aneurysms are present
- Hepatic transplant

Recommended intervals for initial follow-up imaging of ectatic aortas and abdominal aortas (follow up intervals may vary depending on comorbidities and the growth rate of the aneurysm) from the white paper of the ACR Incidental Findings Committee II on vascular findings (Khosa, 2013):
2.5-2.9 cm:……5yr
3.0-3.4 cm:……3yr
3.5-3.9 cm:……2yr
4.0-4.4 cm:……1yr
4.5-4.9 cm:……6 mo
5.0-5.5 cm:……3-6 mo

The Society of Vascular Surgery has different follow up intervals for AAA (SVS, 2018):
>2.5 cm - <3 cm……..10 yr
3.0 - 3.9 cm……3 yr
4.0 - 4.9 cm……12 mo
5.0 - 5.4 cm……..6 mo.

The Society of Vascular Surgery recommends elective repair of AAA >/= 5.5 cm in patients at low or acceptable surgical risk (Chaikof, 2018).

***MRA and Chronic Mesenteric Ischemia-"MRA has become increasingly accurate in depicting and grading stenosis of the mesenteric vessels, particularly for the celiac artery and SMA, with reported sensitivity and specificity in suspected chronic mesenteric ischemia up to 95% to 100%" and may be used for measuring flow in the SMA and superior mesenteric veins (ACR, 2018).

MRA and Renal Artery Stenosis – Renal artery stenosis is the major cause of secondary hypertension. It may also cause renal insufficiency and end-stage renal disease. Atherosclerosis is one of the common causes of this condition, especially in older patients with multiple cardiovascular risk factors and worsening hypertension or deterioration of renal function. Navigator-gated MR angiography is used to evaluate the renal arteries and detect renal artery stenosis.

MRA and Renal Vein Thrombosis – Renal vein thrombosis is a common complication of nephrotic syndrome and often occurs with membranous glomerulonephritis. Gadolinium-enhanced MRA can demonstrate both the venous anatomy and the arterial anatomy and find filling defects within renal veins. The test can be used for follow-up purposes as it does not use ionizing radiation

****MRI/CT and acute hemorrhage:** MRI is not indicated and MRA/MRV (MR Angiography/Venography) is rarely indicated for evaluation of intraperitoneal or retroperitoneal hemorrhage, particularly in the acute setting. CT is the study of choice due to its availability, speed of the study, and less susceptibility to artifact from patient motion. Advances in technology have allowed conventional CT to not just detect hematomas but also the source of acute vascular extravasation. In special cases finer vascular detail to assess the specific source vessel responsible for hemorrhage may require the use of CTA. CTA in diagnosis of lower gastrointestinal bleeding is such an example (Clerc, 2017).

MRA/MRV is often utilized in non-acute situations to assess vascular structure involved in atherosclerotic disease and its complications, vasculitis, venous thrombosis, vascular congestion or tumor invasion. Although some of these conditions may be associated with hemorrhage, it is usually not the primary reason why MRI/MRA/MRV is selected for the evaluation. A special condition where MRI may be superior to CT for evaluating hemorrhage is to detect an underlying neoplasm as the cause of bleeding (Abe, 2010).

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added indications for visceral artery aneurysm; suspected chronic mesenteric ischemia; transjugular intrahepatic portosystemic shunt when US indicates suspected complications; imaging of deep inferior epigastric arteries for surgical planning (breast reconstruction surgery)
- Added Background information and updated references

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74261 – CT Colonoscopy Diagnostic (Virtual)

CPT Codes: 74261, 74262

INDICATIONS FOR CT COLONOGRAPHY (VIRTUAL COLONOSCOPY):

For diagnostic (symptomatic patient) evaluation when conventional colonoscopy is contraindicated or could not be completed:
(AGA, 2015)

- Patient had failed colonoscopy due to conditions such as hypotension secondary to the sedation; adhesions from prior surgery; excessive colonic tortuosity.
- Patient has obstructive colorectal cancer.
- Patient is unable to undergo sedation or has medical conditions, e.g., recent myocardial infarction, recent colonic surgery, bleeding disorders, severe lung and/or heart disease.

BACKGROUND:
Computed tomographic (CT) colonography, also referred to as virtual colonoscopy, is used to examine the colon and rectum to detect abnormalities such as polyps and cancer. Polyps may be adenomatous (which have the potential to become malignant) or completely benign.

Colorectal cancer (CRC) is the third most common cancer and the second most common cause of cancer death in the United States. Symptoms include blood in the stool, change in bowel habit, abdominal pain, and unexplained weight loss.

In addition to its use as a diagnostic test in symptomatic patients, CT colonography may be used in asymptomatic patients with a high risk of developing colorectal cancer. Conventional colonoscopy and double-contrast barium enema are the main methods currently used for examining the colon.

OVERVIEW:
Request for a follow-up study - A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Corrected terminology to "CT Colonography" and "Virtual Colonoscopy"
- Updated references

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74263 – CT Colonoscopy Screening (Virtual)

CPT Codes: 74263

INDICATIONS FOR CT COLONOGRAPHY (VIRTUAL COLONOSCOPY) SCREENING:
CT (computer tomographic) colonography (CTC) is considered medically appropriate as an alternative to colonoscopy for screening an "average risk" and "moderate risk" member, every 5 (five) years, who is (ACR, 2018; USPSTF, 2016):

Average, Moderate, or High Risk:
(ACR, 2013)
After incomplete colonoscopy
Unable to undergo sedation or has medical conditions, e.g., recent myocardial infarction, recent colonic surgery, bleeding disorders, severe lung and/or heart disease.

Average Risk Individuals:

- 50 – 75 years of age (*See list of other weak evidence rec below)*
- Asymptomatic; **AND**
  - **WITHOUT** any of the following:
    - *A family history of known genetic disorders that predispose them to a high lifetime risk of colorectal cancer (such as Lynch syndrome (Hereditary Nonpolyposis Colorectal Cancer)) (ACR, 2018; ACS, 2018; Rex, 2017)
    - *A personal history of inflammatory bowel disease (ACR, 2018; ACS, 2018; Rex, 2017)

  NOTE*: Patients with these indications should undergo colonoscopy.

Moderate Risk Individuals:

- First degree family member with history of cancer or adenoma (ACR, 2018) - In these instances the USMSTF recommends initiation of earlier screening (Rex, 2017)**
- Average-risk individual after positive fecal occult blood test (FOBT) or positive fecal immunochemical test indicating a relative elevation in risk (ACR, 2018).

BACKGROUND:
The goal of CTC, sometimes referred to as CT colonography or virtual colonoscopy screening is to reduce colo-rectal cancer mortality through cancer prevention and early detection. Virtual colonoscopy is an American Cancer Society-recommended screening exam that has been shown in studies in the United States and abroad to increase screening rates where offered. Virtual colonoscopy has been proven comparably accurate to colonoscopy in most people of screening age. Mandatory insurance coverage of CT colonography and the other USPSTF-recognized exams is a major step forward in the battle against colorectal cancer (USPSTF, 2016).

OVERVIEW:
CT Colonography every 5 years (also known as "virtual" colonoscopy) is endorsed in the updated U.S. Multi-Society Task Force on Colorectal Cancer (USMSTF) guideline as a "tier 2" alternative to colonoscopy every 10

years for patients who decline colonoscopy. The College includes the technique as an alternative to colonoscopy in light of recent studies which reveal that CTC has a sensitivity of 82% to 92% for adenomas ≥1 cm. "Although the benefits of CTC include low risk of perforation compared to colonoscopy, the College does not consider CTC as an equivalent to colonoscopy as a screening strategy for several reasons:

- Its inability to detect polyps 5 millimeters and smaller, which constitute 80 percent of colorectal neoplasms;
- False positives are common with CTC; and concerns about the radiation risk associated with one or repeated CT colonography studies, although the exact risk associated with radiation is unclear."

Screening Recommendations, the USPSTF, ACG, ACR, and ACS:

The United States Preventative Services Task Force (USPSTF), the U.S. Multi-Society Task Force on Colorectal Cancer (USMSTF), and American College of Radiology (ACR) recommend colorectal screening of asymptomatic adults starting at the age of 50 until 75 for the general population. The USMSTF, but not the USPSTF or ACR, indicates "limited evidence" supports screening for African Americans starting at age 45 (Rex, 2017). The USPSTF gives screening a grade of "A". This means "the USPSTF recommends the service and there is high certainty that the net benefit is substantial". For adults older than 76 years, and younger than 85, the USPSTF recommendation grade is a "C" indicating "there is at least moderate certainty that the net benefit is small and the service should be offered "….for selected patients depending on individual circumstances". All three organizations' guidelines exclude from these general screening criteria some groups with an increased risk of developing cancer compared to the general population based on "genetic disorders that predispose them to a high lifetime risk of colorectal cancer (such as Lynch syndrome or familial adenomatous polyposis), or a personal history of inflammatory bowel disease….(ACR, 2013). These patients are screened more frequently with colonoscopy and are not candidates for CTC.

According to the USMSTF "The advantages of colonoscopy include high sensitivity for cancer and all classes of precancerous lesions, single-session diagnosis and treatment, and long intervals between examinations (10 years) in subjects with normal examinations". The ACR appropriateness criteria does not measure the relative merits of no radiologic tests for colorectal screening such as colonoscopy, flexible sigmoidoscopy, fecal occult blood test, fecal immunochemical test, or serum testing (Septin9 assay is the first FDA approved test) but comments in the appropriates criteria text: "….of the structural tests available, colonoscopy is currently considered to be the most sensitive and specific for detecting colorectal polyps and cancers". The ACR indicates in its recommendation charts for high risk individuals with hereditary non-polyposis colorectal cancer, or inflammatory bowel disease, that colonoscopy is the preferred procedure giving CTC a "usually not appropriate" rating.

The American Cancer Society follows the screening intervals described by the organizations above but does not provide recommendations on the preferred exam. They recommend screening every 10 years for CT colonoscopy and every 5 years for CTC, flexible sigmoidoscopy, and double contrast barium enema (ACR, 2018).

U.S. Multi-Society Task Force on Colorectal Cancer (USMSTF) and the ACR has divided colorectal cancer risk levels into three categories (ACR, 2018):

- Average (individuals ≥50 years of age),

- Moderate (first-degree relative with a history of adenoma or carcinoma), AND
- High (individuals with hereditary syndromes, such as hereditary nonpolyposis colorectal cancer and familial polyposis, or a personal history of ulcerative colitis or Crohn colitis).

***The U.S. Multi-Society Task Force on Colorectal Cancer**: The American College of Gastroenterology, the American Gastroenterological Association, and the American Society for Gastrointestinal Endoscopy

MSTF: https://gi.org/guideline/colorectal-cancer-screening-recommendations-for-physicians-and-patients-from-the-u-s-multi-society-task-force-on-colorectal-cancer/

****Recommendations**

- We suggest that persons with 1 first-degree relative with CRC or a documented advanced adenoma diagnosed at age <60 years or with 2 first-degree relatives with CRC and/or documented advanced adenomas undergo colonoscopy every 5 years beginning 10 years younger than the age at which the youngest first-degree relative was diagnosed or age 40, whichever is earlier (weak recommendation, low-quality evidence).
- We suggest that persons with 1 first-degree relative diagnosed with CRC or a documented advanced adenoma at age ≥60 years begin screening at age 40. The options for screening and the recommended intervals are the same as those for average-risk persons (weak recommendation, very-low-quality evidence).
- We suggest that persons with 1 or more first-degree relatives with a documented advanced serrated lesion (SSP or traditional serrated adenoma ≥10 mm in size or an SSP with cytologic dysplasia) should be screened according to above recommendations for persons with a family history of a documented advanced adenoma (weak recommendation, very-low-quality evidence).
- We recommend that persons with 1 or more first-degree relatives with CRC or documented advanced adenomas, for whom we recommend colonoscopy, should be offered annual FIT if they decline colonoscopy (strong recommendation, moderate-quality evidence).

Surveillance of patients with colorectal cancer:

There is consensus that patients previously treated for colorectal cancer (CRC) should undergo surveillance with colonoscopy. In a population of patients previously treated for CRC with resection Weinberg, et al demonstrated CTC was inferior to colonoscopy for detecting polyps ≥6 mm (Weinberg, 2018).

The USMSTF recommends that patients who have undergone curative resection of CRC and rectal cancer should have a surveillance colonoscopy at one year, and if disease free followed by colonoscopy at three years (four years after surgery), and then at five-year intervals. For those with rectal cancer, sigmoidoscopy or rectal ultrasound should be done every 3 to 6 months for the first 2 or 3 years after surgery. Regarding CTC, the USMSTF concludes, “although CTC has good diagnostic accuracy for cancer, the optimal timing of CTC in post-CRC resection surveillance and how it is best used in conjunction with other modalities remain undefined” (Kahi, 2016).

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Corrected terminology to “CT Colonography” and “Virtual Colonoscopy”
- Added indication: “Average risk individuals after positive fecal occult blood test or positive fecal immunochemical test indicating a relative elevation in risk
- Added Background information regarding the difference between screening and surveillance
- Updated references

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74712 – Fetal MRI

CPT Codes: 74712, +74713

INDICATIONS:

- To better define or confirm a known or suspected abnormality of the fetus after ultrasound has been performed during the second trimester (Prayer, 2017) or when fetal surgery is planned, and/or to make a decision about therapy, delivery or to advise the family about prognosis (ACR-SPR, 2015; SPR, 2011).

Safety guidelines and possible contraindications:

There are no documented fetal indications for the use of MRI contrast, but there may be rare instances where contrast is considered potentially helpful in assessing the pregnant patient's anatomy or pathology.

The decision to administer contrast must be made on a case-by-case basis by the covering level 2 MR personnel-designated attending radiologist who will assess the risk-benefit ratio for that particular patient. The decision to administer a gadolinium-based MR contrast agent to pregnant patients should be accompanied by a well-documented and thoughtful risk-benefit analysis.

BACKGROUND:

MRI not only contributes to diagnosis, but also serves as an important guide to treatment, delivery planning, and counseling. However, sonography is the screening modality of choice in the fetus. The advantage of MRI over ultrasound is its ability to image deep soft tissue structures without relying on the skill of the operator, or limitations of patient body habitus. Fetal MRI should be performed only for a valid medical reason and only after careful consideration of sonographic findings or family history of an abnormality for which screening with MRI might be beneficial. According to the American College of Obstetricians and Gynecologists' Committee on Obstetric Practice the preponderance of animal studies demonstrate no risk of teratogenesis to the fetus and tissue heating from MRI scanners is negligible near the uterus. Furthermore, in human studies of patients undergoing MRI there has been no acoustic injuries to the fetus during prenatal MRI (ACOG, 2017).

POLICY HISTORY:

Review Date: June 2019

Review Summary:

- For known or suspected abnormality of the fetus after ultrasound, added time restriction 'during the second trimester' and included 'to make a decision about therapy, delivery, or to advise the family about prognosis'
- Updated background information and references

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75557 – MRI Heart

CPT Codes: 75557, 75559, 75561, 75563 +75565

INDICATIONS FOR CARDIAC MAGNETIC RESONANCE (CMR)

Congenital Heart Disease

- Evaluation of cardiac structure, function, measurement of shunts and cardiac and extra-cardiac conduits in patients with congenital heart disease
- Assessment of right ventricle (RV) size and function in repaired Tetralogy of Fallot, systemic right ventricles and other conditions associated with RV volume and pressure overload
- Sinus Venosus defects
- Vascular rings
- Identification of anomalous pulmonary venous connections
- Quantification of valvular regurgitation in patients with congenital heart disease
- Congenital Aortic Disease (such as coarctation, complete interruption or pseudo-coarctation of the aorta
    - Assess post-operative complications, after surgery for coarctation, such as restenosis and pseudoaneurysm
- Baseline imaging of patients with congenital pulmonary stenosis
- Initial screening for suspected coronary anomalies
- Evaluation of arteriovenous fistulas with a continuous murmur
- Evaluation of the great arteries and veins in patients with prior atrial baffle procedures and congenitally corrected transposition of the great arteries

Valvular Heart Disease

- Evaluation of valvular stenosis, regurgitation, or valvular masses when transthoracic echocardiography (TTE) is inadequate
- Pre TAVR assessment of aortic annular size and shape and/or the aortic dimensions, when the patient cannot undergo cardiac CT (Otto 2017)
- Prior to transcatheter mitral valve intervention, when TTE and TEE result in uncertain assessment of the severity of mitral regurgitation (Wunderlich 2018)
- Suspected clinically significant bioprosthetic valvular dysfunction and inadequate images from TTE and TEE

Myocardial Dysfunction & Heart Failure
(Patel 2013, Yancy 2013)

- Assessment of patients with left ventricular (LV) dysfunction to determine the etiology such as:
    - Dilated cardiomyopathy with normal coronary arteries
    - Positive cardiac enzymes without obstructive disease on coronary angiography
    - Suspected infiltrative disease such as a myloidosis, sarcoidosis, hemochromatosis, or endomyocardial fibrosis

- Management of patients requiring cardiotoxic chemotherapy, with **ONE** of the following:
    - TTE has been inadequate, or discordant with prior information.
    - Candidacy for cardiotoxic chemotherapy is questionable due to borderline left ventricular dysfunction on other imaging
- Diagnosis of acute myocarditis, with suspicion based upon new, unexplained findings such as:
    - Rise in troponin not clearly due to acute myocardial infarction
    - Change in ECG suggesting acute myocardial injury or pericarditis, without evident myocardial infarction, often with arrhythmia
    - Abnormal systolic function on other imaging
- Assessment of hypertrophic cardiomyopathy, when TTE is inadequate for diagnosis. management or operative planning, or when tissue characterization (degree of fibrosis) will impact indications for ICD
- Arrythmogenic right ventricular cardiomyopathy to aid in identification and diagnosis (assessment of myocardial fat, fibrosis and RV tissue characteristics), based upon reason for suspicion, such as:
    - Nonsustained ventricular tachycardia (VT)
    - Unexplained syncope
    - ECG abnormalities
    - First degree relatives with positive genotype for ARVD
- Noncompaction cardiomyopathy to aid in the diagnosis (measurement of compacted to noncompacted myocardium) when TTE is suggestive

Evaluation of Intra- and Extra-Cardiac Structures

- Suspected cardiac mass, paravalvular abscess, differentiation of tumors from thrombi, and differentiation of benign vs. malignant tumors (when TTE and/or TEE images are inadequate)
- Evaluation of pericardial disease to provide structural and functional assessment and differentiate constrictive vs restrictive physiology
- Assessment of left ventricular pseudoaneurysm, when TTE was inadequate
- Identification and characteristics of coronary aneurysms

Pre Ablation Planning

- Evaluation of left atrium and pulmonary veins prior to radiofrequency ablation for atrial fibrillation

Aortic Pathology

- CT, MR, or echocardiogram can be used for screening and follow up, with CT and MR preferred for imaging beyond the proximal ascending thoracic aorta
- Screening of first degree relatives with a history of thoracic aortic aneurysm
- Six month follow-up after initial diagnosis of thoracic aortic aneurysm to measure rate of change
- Annual follow up for an enlarged thoracic aortic aneurysm (usually defined as > 4.4.cm)
- Biannual (2x/year) follow up of enlarged aortic root or showing growth rate ≥ 0.5 cm /year
- Screening of first degree relative with a bicuspid aortic valve
- Patients with Turner's syndrome annually if an abnormality exists; if initial study normal can have imaging every 5 - 10 years
- Evaluation in patients with known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection, such as Marfan's, Ehler's Danlos or Loetz- Dietz syndrome (at the time of

diagnosis and 6 months thereafter), followed by annual imaging (can be done more frequently if > 4.5 cm or rate of growth > 0.5 cm/ year- 2x/yr)

Coronary Artery Disease Evaluation

(CMR as an alternative to pharmacologic MPI)

- Stress CMR, which is done pharmacologically, is used for the assessment of coronary artery disease when a stress echocardiogram (SE) cannot be performed.
    - If the patient cannot walk and would otherwise be a candidate for a pharmacologic MPI a stress CMR can be performed
    - If the patient is able to walk and is having a MPI for another reason (LBBB, CABG, etc) MPI is chosen over the CMR
- Assessment of LV wall motion to identify patients with akinetic segments that would benefit from coronary revascularization
- To identify the extent and location of myocardial necrosis in patients with chronic or acute ischemic heart disease

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BACKGROUND
(Pennell 2010)

- CMR is an imaging modality used to assess cardiac or vascular anatomy, function, perfusion and tissue characteristics in a single examination, regardless of patient's body habitus or exposure to ionizing radiation or contrast medium. In lesions affecting the right heart, CMR provides excellent visualization and volume determination regardless of RV shape. This is particularly useful in patients with congenital heart disease

- **CMR Safety** (Brignole 2013, Indik 2017, Nazarian 2017, Russo 2017)
  Since many cardiac patients have cardiac implanted electrical devices), the risk of CMR to the patient and the device must be weighed against the benefit to the patient, in terms of clinical value in optimal management.

Cardiac magnetic imaging (CMR) is often required when transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) provide inadequate imaging data.

Stress CMR for assessment of coronary artery disease (CAD) is performed pharmacologically either as:
- Vasodilator perfusion imaging with gadolinium contrast; **OR**
- Dobutamine inotropic wall motion (ventriculography)

With respect to CAD evaluation, since CMR is only pharmacologic (non-exercise stress), and stress echocardiography (SE) or myocardial perfusion imaging (MPI) provide similar information about CAD:
- Requests for stress CMR require **diversion** to exercise SE first, and to exercise MPI second.
- **Exemptions** for the diversion to SE or exercise MPI:
    - If body habitus or marked obesity (e.g. BMI ≥ 40) would interfere significantly with imaging with SE and MPI (Shah 2014)
    - Evaluation of young (< 55 years old) patients with documented complex CAD, who are likely to need frequent non-invasive coronary ischemia evaluation and/or frequent radiation exposure from other testing (Hirshfeld 2018)

OVERVIEW

CMR in CORONARY ARTERY DISEASE (CAD)
(Fihn 2012, Montalescot 2013, Wolk 2013)

Stable patients without known CAD fall into 2 categories (Fihn 2012, Montalescot 2013, Wolk 2013):

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant (≥ 50%) CAD (below):

The 3 Types of Chest Pain or Discomfort

- **Typical Angina (Definite)** is defined as including all **3** characteristics:
    - Substernal chest pain or discomfort with characteristic quality and duration
    - Provoked by exertion or emotional stress
    - Relieved by rest and/or nitroglycerine
- **Atypical Angina (Probable)** has only **2** of the above characteristics
- **Nonanginal Chest Pain/Discomfort** has only **0 - 1** of the above characteristics

Once the type of chest pain has been established from the medical record, the pretest probability of CAD (meaning obstructive CAD defined as coronary arterial narrowing ≥ 50%) is estimated from the **Diamond Forrester Table** below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability (Wolk 2013):

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40 – 49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50 – 59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Very low:** < 5%pretest probability of CAD, usually not requiring stress evaluation (Fihn 2012)
- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

Table 17. Suggested Follow-Up of Aortic Pathologies After Repair or Treatment

Pathology	Interval	Study
Acute dissection	Before discharge, 1 mo, 6 mo, yearly	CT or MR, chest plus abdomen TTE
Chronic dissection	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen TTE
Aortic root repair	Before discharge, yearly	TTE
AVR plus ascending	Before discharge, yearly	TTE
Aortic arch	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen
Thoracic aortic stent	Before discharge, 1 mo, 2 mo, 6 mo, yearly Or 30 days*	CXR, CT, chest plus abdomen
Acute IMH/PAU	Before discharge, 1 mo, 3 mo, 6 mo, yearly	CT or MR, chest plus abdomen

*US Food and Drug Administration stent graft studies usually required before discharge or at 30-day CT scan to detect endovascular leaks. If there is concern about a leak, a predischarge study is recommended; however, the risk of renal injury should be borne in mind. All patients should be receiving beta blockers after surgery or medically managed aortic dissection, if tolerated. Adapted from Erbel et al (539).

AVR indicates aortic valve replacement; CT, computed tomographic imaging; CXR, chest x-ray; IMH, intramural hematoma; MR, magnetic resonance imaging; PAU, penetrating atherosclerotic ulcer; and TTE, transthoracic echocardiography.

Abstracted from Hiratzka, 2010

Abbreviations

ARVD/C	Arrhythmogenic right ventricular dysplasia/cardiomyopathy
CABG	Coronary artery bypass grafting surgery
CAD	Coronary artery disease
CMR	Cardiac magnetic resonance (imaging)
CT	Computed tomography
ECG	Electrocardiogram
ICD	Implantable cardioverter-defibrillator
LBBB	Left bundle-branch block
LV	Left ventricular
MPI	Myocardial perfusion imaging
MR	Mitral regurgitation
MR(I)	Magnetic resonance (imaging)
RV	Right ventricle
SE	Stress echocardiography
TAVR	Transcatheter Aortic Valve Replacement
TTE	Transthoracic Echo
TEE	Transesophogeal Echo
VT	Ventricular tachycardia

POLICY HISTORY:
Review Date: July 2019
Review Summary:

- Removed table of comparison to Cardiac CT
- Removed global risk calculator for asymptomatic patients
- Removed scenarios for which approval of CMR is not approvable as well as follow-up indications
- Removed section on MRI compatibility with Pacemakers
- Format change: moved CAD section – clarification of indication of use of MRI in CAD and removed detailed indications
- Expanded aortic screening section with removal of chart for “normal” sizes of aortic aneurysm
- Expanded indication for prosthetic heart valves
- Removed indication of screening with a strong family history of cardiomyopathy

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75571 – Electron Beam Tomography (EBCT)

CPT Codes: 75571, S8092

INDICATIONS FOR CORONARY ARTERY CALCIUM (CAC) TESTING
(Blankstein 2017, Goff 2014, Greenland 2018, Hecht 2017, Mahabadi 2017, McClelland 2015, Nasir 2015, Pender 2016, Piepoli 2016)

- In the context of shared decision making for patients aged 40 to 75, (without clinical atherosclerotic cardiovascular disease), with intermediate-to-low 10-year risk (5 - 20%), with documentation that the CAC score is necessary to adjust management, such as statin therapy (Hecht 2017, Michos 2017, Stone 2013, Wilkins, 2018)

- Patients who are over 75 or younger than 40 years old can be considered for CAC testing when there is well-documented evidence that the results could alter management (Tota-Maharaj 2012)

    - Patients with estimated 10-year risk of less than 5%, but are suspected to be at elevated atherosclerotic cardiovascular disease (ASCVD) risk because of a major risk factor not accounted for in the global risk equations, such as family history of premature CAD (Greenland 2018, Hecht 2017)

    - Patients in whom statin therapy is indicated, but have intolerable adverse effects from, or are reluctant to take statin medication, in order to guide the need for alternative lipid-lowering strategies (Blankstein 2017, Michos 2017, Nasir 2015)

    - CAC testing may be repeated for risk re-assessment after a minimum of 5 years, if documentation indicates it will alter management (Greenland 2018, Hecht 2017, Michos 2017). It should not be repeated if the patient already has two CAC Scores of zero 5 years apart or has a score ≥ 400 (Greenland 2018)

BACKGROUND:
(Blankstein 2017, Greenland, 2018, Hecht 2017)

Coronary artery calcium (CAC) testing is a cardiovascular risk assessment tool, applicable only to the patient without known cardiovascular disease, for the purpose of primary prevention. It is not for the patient with suspected or known cardiovascular disease, coronary or otherwise, who already requires aggressive risk factor modification.

CAC testing, by either EBCT or non-contrast CCT, provides a quantitative assessment of coronary artery calcium content in Agatston units, as an adjunct to the estimation of global risk for coronary or cardiovascular events over the next 10 years (McClelland 2015). A CAC Score > 0 is a highly specific feature of coronary atherosclerosis.

CAC score > 100 can also provide support for aspirin therapy (Hecht 2017, Miedema 2014) and statin therapy (Mortenen 2018).

Patients who have already manifested cardiovascular **disease** are already at high global risk and the Global Cardiovascular Risk Calculators are not applicable.

Links to Global Cardiovascular Risk Calculators
(D'Agostino 2008, Goff 2014, McClelland 2015, Ridker 2007)

Risk Calculator	Website for Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Risk Tiers:

- **Low <** 10%.
- **Moderate** 10% - 20%.
- **High risk ≥**20%.

Abbreviations

ASCVD	Atherosclerotic cardiovascular disease
CAC	Coronary artery calcium
CAD	Coronary artery disease
CCT	Cardiac computed tomography
EBCT	Electron beam computed tomography

POLICY HISTORY:

Review Date: July 22, 2019
Review Summary:

- Repeat CAC testing indication revised as follows: It should not be repeated if the patient has already had two CAC Scores of zero 5 years apart added clause 'or has a score ≥ 400.'
- For patients with estimated 10-year risk of less than 5%, but are suspected to be at elevated atherosclerotic cardiovascular disease (ASCVD) risk because of a major risk factor not accounted for in the global risk equations, only family history of premature CAD was included as an example.

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75572 – CT Heart

CPT Codes: 75572, 75573

INDICATIONS FOR HEART COMPUTED TOMOGRAPHY (CT)
(Douglas 2011, Taylor 2010)

Evaluation of Cardiac Structure and Function (Baumgartner 2010, Kilner 2010, Orwat 2014, Stout 2018, Wiant 2009)

Congenital Heart Disease

- When transthoracic echocardiography (TTE) and/or transesophageal echocardiography (TEE) have been or are expected to be insufficient for clinical management in complex congenital heart disease, cardiac magnetic resonance imaging (CMR) or computed tomography (CT) may be required. For the choice between CMR and CT, several aspects must be considered including radiation exposure, resolution required, sum of information required, impact upon management, the presence of a pacemaker/implantable cardioverter defibrillator (ICD) or other implants, and patient claustrophobia. Indications include:
  - Evaluation of anomalous thoracic arteriovenous vessels, such as transposition of the great arteries, when magnetic resonance imaging (MRI) cannot be performed (Cohen 2016, Warnes 2008)
  - Quantification of right ventricle (RV) volumes and ejection fraction (Tetralogy of Fallot, systemic RV, and tricuspid regurgitation) [CMR better than CT, if available] (Benza 2008, Dupont 2009, Haddad 2008)
  - Evaluation of the RV outflow tract and RV-PA conduits (CMR or CT)
  - Evaluation of pulmonary arteries (stenosis and aneurysms) and the aorta (coarctation) (CMR or CT)
  - Evaluation of systemic and pulmonary veins (anomalous connection, obstruction) (CMR or CT)
  - Aorto-pulmonary collaterals and arteriovenous malformations (either, but CT is superior to CMR for spatial resolution)
  - Coronary anomalies and CAD (indication for CCTA, better than CMR)
  - Quantification of myocardial (muscle) mass (CMR or CT)
  - Assessment of right ventricular morphology in suspected arrhythmogenic right ventricular cardiomyopathy, based upon other findings such as:
    - Nonsustained VT
    - Unexplained syncope
    - ECG abnormalities
    - First degree relative with positive genotype of ARVC
      (either, but CMR is superior to CT) (Marcus 2010, te Riele 2015)

Left Ventricular Function Assessment

- Left ventricular systolic dysfunction in the absence of severe valvular disease, when TTE and MUGA are inadequate (Fihn 2012, Patel 2013)

Valvular Heart Disease

- Characterization of native or prosthetic valves with clinical signs or symptoms suggesting valve dysfunction, when TTE, TEE, and/or fluoroscopy have been inadequate (Doherty 2017)
- Evaluation of RV function in severe TR, including systolic and diastolic volumes, when TTE images are inadequate and CMR is not readily available
- Pulmonary hypertension in the absence of severe valvular disease

- Evaluation of suspected infective endocarditis with moderate to high pretest probability (i.e. staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inadequate.
- Evaluation of suspected paravalvular infections when the anatomy cannot be clearly delineated by TTE and TEE (Nishimura 2014)
- Patients with bicuspid aortic valve and aortic dilation > 4.0 cm require annual imaging with CT, MRI, or echocardiography. Echocardiography is required when it can evaluate the full extent of pathology under surveillance. This would increase to biannual (twice-yearly) imaging in the event of any one of the additional conditions: diameter > 4.5 cm, rapid rate of change 0.5 cm/yr, or a family history of a first degree relative with aortic dissection. Initial imaging with first 6 month re-evaluation for rate of expansion is appropriate.

Evaluation of Intra- and Extra-cardiac Structures

- Evaluation of cardiac mass, suspected tumor or thrombus, or cardiac source of emboli, when imaging with TTE and TEE have been inadequate
- Re-evaluation of prior findings for interval change (i.e. reduction or resolution of atrial thrombus after anticoagulation), when a change in therapy is anticipated
  (Baumgartner 2017, Doherty 2017, Kassop 2014, Nishimura 2014)

Evaluation of pericardial anatomy, when TTE and/or TEE are inadequate or for better tissue characterization of a mass and detection of metastasis [CMR superior for physiologic assessment (constrictive versus restrictive) and tissue characterization, CT superior for calcium assessment] (Klein 2013, Pennell 2010)

Electrophysiologic Procedure Planning

- Evaluation of pulmonary venous anatomy prior to radiofrequency ablation of atrial fibrillation and for follow up when needed for evaluation of pulmonary vein stenosis (Niinuma 2008, Ohana 2015, Raijah 2013, Schoenhagen 2010, Wai-ee 2012)
- Non-invasive coronary vein mapping prior to placement of biventricular pacing leads (Heydari 2012, Raijah 2013, Van de Veire 2006)
- Evaluation of suspected post-ablation pulmonary vein stenosis

Transcatheter Structural Intervention Planning

- Assessment of the aortic annular dimensions, aortic root, and aortic valve, in planning for transcatheter aortic valve replacement (TAVR) (Doherty 2017, Otto 2017, Raijah 2013, Schoenhagen 2010)
- When TTE and TEE cannot provide adequate imaging, CT imaging can be used for planning: robotic mitral valve repair, atrial septal defect closure, left atrial appendage closure, ventricular septal defect closure, endovascular grafts, and percutaneous pulmonic valve implantation (Flachskampf 2014, Pison 2015, Raijah 2013, Schoenhagen 2010)
- Evaluation for suitability of transcatheter mitral valve procedures, alone or in addition to TEE (Wunderlich 2018)

Aortic Pathology (Baumgartner 2014, Bhave 2018, Doherty 2017, Doherty 2018, Erbel 2014, Hendel 2006, Hiratzka 2010, Nishimura 2014, Svensson 2013)

TTE is recommended when it can evaluate the full extent of pathology under surveillance.

- CT, MR, or echo can be used for screening and follow up, with CT and MR preferred for imaging beyond the proximal ascending thoracic aorta (see table below for top normal sizes) in the following scenarios:
  - Evaluation of dilated aortic sinuses or ascending aorta identified by TTE
  - Suspected acute aortic pathology, such as dissection
    Re-evaluation of known aortic dilation or aortic dissection with a change in clinical status or cardiac examination or when findings would alter management

- Screening first degree relatives of individuals with a history of thoracic aortic aneurysm (defined as ≥ 50% above top normal) or dissection, or an associated high-risk mutation for thoracic aneurysm in common
- Screening second degree relative of a patient with thoracic aortic aneurysm (defined as ≥ 50% above top normal), when the first degree relative has aortic dilation, aneurysm, or dissection
- Six-month follow up after initial finding of a dilated thoracic aorta, for assessment of rate of change
- Annual follow up of enlarged thoracic aorta that is above top normal for age, gender, and size up to 4.4 cm
- Biannual (twice/yr) follow up of enlarged aortic root ≥ 4.5 cm (> 4.5 cm for bicuspid aortic valve) or showing growth rate ≥ 0.5 cm/year

Aortic diameters: Upper limits of normal[a]

		Ascending aorta (mm)		Descending aorta (mm)	
Age (years)	BSA (m^2)	Women (n = 1,147)	Men (n = 1,805)	Women (n = 736)	Men (n = 1,195)
< 45	< 1.70	33.8	33.0	23.0	NA
	1.70–1.89	34.4	36.3	24.6	26.6
	1.90–2.09	35.0	36.3	22.7	26.7
	> 2.1	NA	38.3	NA	28.3
45–54	< 1.70	35.2	38.6	24.3	24.2
	1.70–1.89	37.2	38.1	25.4	27.5
	1.90–2.09	38.9	39.7	27.2	29.2
	> 2.1	40.6	40.6	28.3	29.6
55–64	< 1.70	36.9	36.3	25.9	26.1
	1.70–1.89	37.0	39.7	27.1	28.6
	1.90–2.09	39.0	41.2	27.8	29.9
	> 2.1	42.0	43.1	31.7	31.6
≥ 65	< 1.70	37.5	38.5	27.0	NA
	1.70–1.89	39.2	41.0	27.4	32.4
	1.90–2.09	42.7	42.2	29.0	31.0
	> 2.1	NA	42.4	29.8	32.5

[a]Upper limits of normal are 2 standard deviations above the mean. Not calculated if there were fewer than 6 patients in a group.
BSA = body surface area; NA = not available

Adapted from Wolak 2008, Cikach 2018.

- Patients with Marfan's syndrome require annual imaging with CT, MRI or TTE, with increase to biannual (twice-yearly) when diameter ≥ 4.5 cm or when expansions is > 0.5 cm /yr
- Patient with Turner's syndrome patients should undergo initial imaging with CT, MRI, or TTE, for evidence of dilatation of the ascending thoracic aorta. If imaging is normal and there are no risk factors for aortic dissection, repeat imaging should be performed every 5 - 10 years, or if otherwise indicated. If the aorta is enlarged, appropriate follow up imaging should be done according to size, as above.

- Evaluation of the aorta in the setting of a known or suspected connective tissue disease or genetic condition that predisposes to aortic aneurysm or dissection (i.e. Loeys-Dietz, Ehlers-Danlos), with re-evaluation at 6 months for rate of expansion. Complete evaluation with CMR from the cerebrovascular circulation to the pelvis is recommended with Loeys-Dietz syndrome.

Table 17. Suggested Follow-Up of Aortic Pathologies After Repair or Treatment

Pathology	Interval	Study
Acute dissection	Before discharge, 1 mo, 6 mo, yearly	CT or MR, chest plus abdomen TTE
Chronic dissection	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen TTE
Aortic root repair	Before discharge, yearly	TTE
AVR plus ascending	Before discharge, yearly	TTE
Aortic arch	Before discharge, 1 y, 2 to 3 y	CT or MR, chest plus abdomen
Thoracic aortic stent	Before discharge, 1 mo, 2 mo, 6 mo, yearly Or 30 days*	CXR, CT, chest plus abdomen
Acute IMH/PAU	Before discharge, 1 mo, 3 mo, 6 mo, yearly	CT or MR, chest plus abdomen

*US Food and Drug Administration stent graft studies usually required before discharge or at 30-day CT scan to detect endovascular leaks. If there is concern about a leak, a predischarge study is recommended; however, the risk of renal injury should be borne in mind. All patients should be receiving beta blockers after surgery or medically managed aortic dissection, if tolerated. Adapted from Erbel et al (539).

AVR indicates aortic valve replacement; CT, computed tomographic imaging; CXR, chest x-ray; IMH, intramural hematoma; MR, magnetic resonance imaging; PAU, penetrating atherosclerotic ulcer; and TTE, transthoracic echocardiography.

Adapted from Hiratzka, 2010

BACKGROUND:

- Cardiac computed tomography (Heart CT) images the cardiac chambers, great vessels, valves, myocardium and pericardium to assess cardiac structure and function, particularly when echocardiography (transthoracic echocardiography and transesophageal echocardiography) cannot provide adequate information.
- CT imaging can be used for assessment of:
  - Structures of the heart (chambers, valves, great vessels, masses, etc.), as in this guideline
  - The coronary circulation, as in the separate coronary computed tomography angiography (CCTA) guideline
  - Quantitative level of calcium in the walls of the coronary arteries, in the separate coronary artery calcium (CAC) scoring guideline

Modality	Cardiac CT	Cardiac MR
Contrast	Often required	Required for some tissue characterization studies, often unnecessary
Radiation*	Yes	None, advantage for young patients and those requiring frequent exams
Resolution	Higher spatial	Higher temporal
Flow	Not standard	Standard
Patient comfort	Relatively easy	Claustrophobia issues
Ferromagnetic implants	No issue	Relative contraindication

*(Hirshfeld, 2018)

Some scenarios might provide more detail with low dose CT than with CMR, thereby overriding the radiation risk (Ohana 2015, Schoenhagen 2005)

OVERVIEW

(Raijah 2013, Schoenhagen 2005, Taylor 2010)

Imaging in Congenital Heart Disease

Echocardiography remains the best test for initial assessment of congenital heart disease. However, if findings are unclear or need confirmation, CMR or CT can be useful. CT and CMR provide 3D anatomic relationship of the blood vessels and cardiac anatomic structures (Warnes 2008, Wiant 2009).

CT and Cardiac Masses

CT and CMR are used to evaluate cardiac masses, describing their size, density, tissue characteristics, and spatial relationship to adjacent structures. Cardiac myxoma is the most common type of primary heart tumor in adults and usually develops in the left atrium. Echocardiography is typically the first method for evaluation of cardiac myxoma. CT and CMR can provide adjunctive information on myxomas when necessary (Kassop 2014).

CT and Pericardial Disease

While echocardiography is most often used in the initial examination of pericardial disease, CT and CMR can evaluate pericardial thickening and masses which are often detected initially with echocardiography. CT and CMR can accurately define the site and extent of masses, e.g., cysts, hematomas and neoplasms (Klein 2013).

Abbreviations

ARVD/C	Arrhythmogenic right ventricular dysplasia/ cardiomyopathy
CABG	Coronary artery bypass grafting surgery
CAD	Coronary artery disease
CCS	Coronary calcium score
CCT	Cardiac (heart) CT
CHD	Coronary heart disease
CMR	Cardiac magnetic resonance (imaging)
CT	Computed tomography
CTA	Computed tomography angiography
ECG	Electrocardiogram
EF	Ejection fraction
HF	Heart failure
MI	Myocardial infarction
MPI	Myocardial perfusion Imaging or cardiac nuclear imaging
MR(I)	Magnetic resonance (imaging)
PCI	Percutaneous coronary intervention
PVML	Paravalvular mitral leak
RV	Right ventricle
SE	Stress Echocardiogram
TAVR	Transcatheter Aortic Valve Replacement
TMVR	Transcatheter mitral valve replacement
TR	Tricuspid regurgitation
TTE	Transthoracic echocardiography

POLICY HISTORY:
Review Date: July 22, 2019
Review Summary:

- Added the following indication: Evaluation of anomalous thoracic arteriovenous vessels, such as transposition of the great arteries, when magnetic resonance imaging (MRI) cannot be performed
- For valvular heart disease added indication for pulmonary hypertension in the absence of severe valvular disease
- Removed indication: to assess degree of calcification in calcific aortic stenosis
- For evaluation of intra- and extra-cardiac structures, the following indication was added: Re-evaluation of prior findings for interval change (i.e. reduction or resolution of atrial thrombus after anticoagulation), when a change in therapy is anticipated
- Removed section: scenarios in which heart CT is not indicated
- Removed statement: CT imaging is competitive with MRI, but left in table in comparing two modalities (removed cost comparison)

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75574 – CTA Coronary Arteries (CCTA)

CPT Codes: 75574

INDICATIONS FOR CORONARY COMPUTED TOMOGRAPHIC ANGIOGRAPHY (CCTA)
(Fihn 2012, Montalescot 2013, Taylor 2010, Wolk 2014)

Evaluation in Suspected Coronary Artery Disease (CAD):
(Cheng 2011 Douglas 2015, Fordyce 2016, Newby 2015)

- Intermediate or high pretest probability patients in whom stress echo cannot be performed (see Background section)
- Low pretest probability patients in whom either exercise stress electrocardiogram (ECG) (uninterpretable) or stress echo cannot be performed (see Background section)
- Appropriate exercise ECG stress test with low Duke Treadmill Score (≥ 5) and continued symptoms concerning for CAD
- Exercise ECG stress test with intermediate Duke Treadmill Score (- 10 to + 4).
- Equivocal, borderline, or discordant stress imaging evaluationwith continued symptoms concerning for CAD
- Repeat testing in patient with new or worsening symptoms since prior normal stress imaging (Taylor 2010, Wolk 2013)
- Newly diagnosed clinical systolic heart failure (ejection fraction [EF] < 50%) without recent CAD evaluation, in the presence of angina or an anginal equivalent (Patel 2012, Patel 2013, Taylor 2010, Wolk 2013)
- Reduced EF (EF ≤ 40%) as an alternative to invasive coronary arteriography
- Before valve surgery or transcatheter intervention in patients with low or intermediate pretest probability of CAD as an alternative to coronary angiography (Baumgartner 2017, Chaikriangkrai 2018, Nishimura 2014)
- To establish the etiology of mitral regurgitation (Nishimura 2014)
- Evaluation of coronary anomaly or aneurysm (CMR favored in young patients) (Bluemke 2008, Grani 2017, Newburger 2016)
- Evaluation of coronary artery bypass grafts, to assess (Eisenberg 2017, Taylor 2010):
  - Patency and location, when invasive coronary arteriography was either nondiagnostic or would like to be avoided
  - Location prior to cardiac or other chest surgery

BACKGROUND

Coronary computed tomographic angiography (CCTA) is a noninvasive imaging study that uses intravenously administered contrast material and high-resolution, rapid imaging computed tomography (CT) equipment to obtain detailed volumetric images of the coronary blood vessels. Cardiac CT perfusion can be added to the CCTA, with increasing data regarding its diagnostic accuracy (Nakamura 2018, Pontone 2018).

Image quality depends on keeping HR optimally < 60 bpm, a regular rhythm, limited coronary calcification, stents > 3.0 mm in diameter, ≥ 5 second breath hold, and vessels requiring imaging ≥ 1.5 mm diameter (Abbara 2016).

Coronary artery disease (CAD) stenosis ≥ 70% is considered clinically significant or obstructive CAD. Hemodynamically or functionally significant CAD means the degree of stenosis is severe enough to cause ischemia. This is discussed in more detail in the Background section (Fihn 2012, Montalescot 2013, Wolk 2013).

Stable patients without known CAD fall into 2 categories (Fihn 2012, Montalescot 2013, Wolk 2013):

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online (see Part III in the Background section).
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant CAD.

The Three Types of Chest Pain or Discomfort:

- **Typical Angina (Definite)** is defined as including all **3** characteristics:
    - Substernal chest pain or discomfort with characteristic quality and duration
    - Provoked by exertion or emotional stress
    - Relieved by rest and/or nitroglycerin
- **Atypical Angina (Probable)** has only **2** of the above characteristics
- **Nonanginal Chest Pain/Discomfort** has only **0 - 1** of the above characteristics
- Once the type of chest pain has been established from the medical record, the Pretest Probability of significant CAD is estimated from the **Diamond Forrester Table** below, recognizing that additional coronary risk factors could increase pretest probability (Wolk 2013):

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40 – 49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50 – 59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

OVERVIEW

Scenarios that support MPI over SE
(Henzlova 2016)

Poor Quality Echo Image

- Obesity with body mass index (BMI) > 40 kg/m^2 or poor acoustic imaging window

Inability to Exercise

- Physical limitations precluding ability to exercise for at least 3 full minutes of Bruce protocol
- The patient has limited functional capacity (< 4 METS) **such as one** of the following:
    - o Unable to take care of their activities of daily living (ADLs) or ambulate
    - o Unable to walk 2 blocks on level ground
    - o Unable to climb 1 flight of stairs
    - o Unable to vacuum, dust, do dishes, sweep, or carry a small grocery bag

Other Comorbidities

- Prior cardiac surgery (coronary artery bypass graft or valvular)
- Left ventricular ejection fraction ≤ 40%
- Severe chronic obstructive pulmonary disease (COPD) with pulmonary function test (PFT) documentation, severe shortness of breath on minimal exertion, or requirement of home oxygen during the day
- Poorly controlled hypertension, with systolic blood pressure (BP) > 180 or Diastolic BP > 120

ECG and Echo Related Baseline Findings

- Pacemaker or implantable cardioverter defibrillator (ICD)
- Poorly controlled atrial fibrillation/ectopy
- Resting wall motion abnormalities that would make SE interpretation difficult
- Complete LBBB

Risk Related

- High pretest probability in suspected CAD
- Intermediate or high global risk in patients requiring type IC antiarrhythmic drugs
- Arrhythmia risk with exercise

ECG Stress Test Alone versus Stress Testing with Imaging

Prominent scenarios suitable for an ECG stress test WITHOUT imaging (i.e. exercise treadmill ECG test) require that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable ECG for ischemia during exercise (Wolk 2013):

- The (symptomatic) low or intermediate pretest probability patient who is able to exercise and has an interpretable ECG (Wolk, 2014)
- The patient who is under evaluation for exercise induced arrhythmia
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription
- For the evaluation of syncope or presyncope during exertion (Shen 2017)

Duke Exercise ECG Treadmill Score calculates risk from ECG treadmill alone**:**

- The equation for calculating the Duke treadmill score (DTS) is: DTS = exercise time in minutes - (5 x ST deviation in mm or 0.1 mV increments) - (4 x exercise angina score), with angina score being 0 = none, 1 = non-limiting, and 2 = exercise-limiting
- The score typically ranges from - 25 to + 15. These values correspond to low-risk (with a score of ≥ + 5), intermediate risk (with scores ranging from - 10 to + 4), and high-risk (with a score of ≤ - 11) categories

An uninterpretable baseline ECG includes (Fihn 2012):

- ST segment depression of 1 mm or more (not for non-specific ST - T wave changes)
- Ischemic looking T wave inversions of at least 2.5 mm

- LVH with repolarization abnormalities, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use with associated ST - T abnormalities
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload
- Note: RBBB with less than 1 mm ST depression at rest may be suitable for EKG treadmill testing

Global Risk of Cardiovascular Disease

Global risk of CAD is defined as the probability of manifesting cardiovascular disease over the next 10 years and refers to **asymptomatic** patients without known cardiovascular disease. It should be determined using one of the risk calculators below. A high risk is considered greater than a 20% risk of a cardiovascular event over the ensuing 10 years.

High global risk by itself generally lacks scientific support as an indication for stress imaging (Cheng 2011).

There are rare exemptions, such as patients requiring I-C antiarrhythmic drugs, who might require coronary risk stratification prior to initiation of the drug, when global risk is moderate or high.

- **CAD Risk—Low**
  10 - year absolute coronary or cardiovascular risk less than 10%
- **CAD Risk—Moderate**
  10 - year absolute coronary or cardiovascular risk between 10% and 20%
- **CAD Risk—High**
  10 - year absolute coronary or cardiovascular risk of greater than 20%

Websites for Global Cardiovascular Risk Calculators*
*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators.
(D'Agostino 2008, Goff 2014, McClelland 2015, Ridker 2007)

Risk Calculator	Websites for Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Coronary Artery Calcium Scoring
(Arnett 2019)

Non-contrast coronary computed tomography (non-contrast coronary CT) and its older technological version, electron beam computed tomography (EBCT), provide quantitative coronary artery calcium scoring, which is appropriate for further evaluation of coronary risk in asymptomatic patients without known cardiovascular disease, who are at low to intermediate or intermediate global risk for coronary or overall cardiovascular disease. Non-contrast coronary CT (computed tomography) and EBCT are supported by a separate CPT code and guideline document with references titled EBCT or Non-Contrast Coronary CT.

Definitions of Coronary Artery Disease
(Fihn 2012, Mintz 2016, Montalescot 2013, Patel 2017)

- Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and can be estimated or measured using angiography or more accurately measured with intravascular ultrasound (IVUS).
- Coronary artery calcification is a marker of risk, as measured by Agatston score on coronary artery calcium imaging. It is not a diagnostic tool so much as it is a **risk stratification** tool. Its incorporation into global risk can be achieved by using the MESA risk calculator.
- Stenoses ≥ 70% are considered obstructive coronary artery disease (also referred to as clinically significant), while stenoses ≤ 70% are considered non-obstructive coronary artery disease (Patel 2017).
- Ischemia-producing disease (also called hemodynamically or functionally significant disease, for which revascularization might be appropriate) generally implies at least one of the following:
    - Suggested by percentage diameter stenosis ≥ 70% by angiography; borderline lesions are 40 - 70% (Fihn 2012)
    - For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum luminal cross sectional area on IVUS ≤ 6 square mm (Fihn 2012, Mintz 2016)
    - FFR (fractional flow reserve) ≤ 0.80 for a major vessel (Mintz 2016)
    - iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies 2017, Gotberg 2017)
    - Demonstrable ischemic findings on stress testing (ECG or stress imaging), that are at least mild in degree
- A major vessel would be a coronary vessel that would be amenable to revascularization, if indicated. This assessment is made based on the diameter of the vessel and/or the extent of myocardial territory served by the vessel.
- Microvascular ischemic coronary artery disease, as might be described by a normal FFR (fractional flow reserve) above 0.80 with a reduced CFR (coronary flow reserve less than 2.5), has not otherwise been addressed in this manuscript, because it is very rarely an issue in compliance determinations. However, it would constitute a form of ischemic heart disease.
- FFR is the distal to proximal pressure ratio across a coronary lesion during maximal hyperemia induced by either intravenous or intracoronary adenosine. Less than or equal to 0.80 is considered a significant reduction in coronary flow.
- Instantaneous wave-free ratio (iFR) measures the ratio of distal coronary to aortic pressure during the wave free period of diastole, with a value ≤ 0.89 considered hemodynamically significant (Davies 2017, Gotberg 2017).
- Newer technology that estimates FFR from CCTA images is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent
(Fihn 2012, Moya 2009, Shen 2017)

Development of an anginal equivalent (e.g. shortness of breath, fatigue, or weakness) either with or without prior coronary revascularization should be based upon the documentation of reasons that symptoms other than chest discomfort are not due to other organ systems (e.g. dyspnea due to lung disease, fatigue due to anemia), by presentation of clinical data such as respiratory rate, oximetry, lung exam, etc. (as well as d-dimer, chest CT(A), and/or PFTs, when appropriate), and then incorporated into the evaluation of coronary artery disease as would chest discomfort. Syncope per se is not an anginal equivalent.

Abbreviations

ACS	Acute coronary syndrome
CABG	Coronary artery bypass grafting surgery
CAD	Coronary artery disease
CCS	Coronary calcium score
CCTA	Coronary computed tomography angiography
ECG	Electrocardiogram
MI	Myocardial infarction
MPI	Myocardial Perfusion Imaging
PCI	Percutaneous coronary intervention
SE	Stress echocardiography
TTE	Transthoracic echocardiography
TAVR	Transcatheter aortic valve replacement

POLICY HISTORY:
Review Date: July 20, 2019
Review Summary:

- CCTA can be used as an alternative to coronary angiography in appropriate patients prior to valve surgery or transcatheter intervention
- Noted CMR is favored over CCTA in young patients for evaluation of coronary anomaly or aneurysm
- Global Risk of Cardiovascular Disease information expanded in background section for additional clarification

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75635 – CT Angiography, Abdominal Arteries

CPT Codes: 75635

IMPORTANT NOTE:
Only one authorization request is required, using CPT Code 75635 Abdominal Arteries CTA. This study provides for imaging of the abdomen, pelvis, and both legs and is the noninvasive equivalent to an "aortogram and run-off".

INDICATIONS FOR ABDOMINAL ARTERIES CTA:

For evaluation of an organ or abnormality seen on previous imaging.

For evaluation of known or suspected abdominal, pelvic, or peripheral vascular disease:
(Conte, 2015)
- For known or suspected peripheral arterial disease when non-invasive studies (pulse volume recording, ankle-brachial index, or ultrasound) are abnormal or equivocal.

Pre-operative evaluation:
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative or post-procedural evaluation:
- Evaluation of post-operative complications, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents and stent-grafts.
- Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Computed tomography angiography (CTA) provides a cost-effective and accurate imaging assessment in patients with aortic dissections, or peripheral arterial disease. High resolution CTA may be used in the diagnosis and follow-up of patients with aortic dissection and lower extremity peripheral arterial disease (PAD).

OVERVIEW:
Suspected Peripheral Arterial Disease – CTA (or MRA) is an excellent tool to diagnose lower extremity peripheral arterial disease (PAD). Benefits include the fast scanning time and accurate detection of occlusions and stenosis. According to the Society for Vascular Surgery guidelines (Conte, 2015) "Measurement of the ankle-brachial index (ABI) is the primary method for establishing the diagnosis of PAD. An ABI of ≤0.90 has been demonstrated to have high sensitivity and specificity for the identification of PAD compared with the gold standard of invasive arteriography. The presence of a normal ABI at rest and following exercise almost excludes atherosclerotic disease as a cause for leg claudication (Ahmed, 2017; Stoner, 2016).

When an ABI is >1.40 and clinical suspicion is high, other tests such as toe-brachial index <8, a resting toe pressure <40 mm Hg, a systolic peak posterior tibial artery flow velocity < 10cm/s may be used. In symptomatic patients in whom revascularization treatment is being considered, we recommend anatomic imaging studies, such as arterial duplex ultrasound, CTA, MRA, and contrast arteriography". This later statement is accompanied by a "B" (moderate) rating for the accompanying evidence ("A" = high, "C" = low) "In patients with limited renal function or planned surgical intervention, noninvasive imaging tests (particularly MRA and CTA) may obviate the need for diagnostic catheter angiography to visualize the location and severity of peripheral vascular disease" (Ahmed, 2017).

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Added indication for evaluation of an organ or abnormality seen on previous imaging
- Removed indication for ischemia related to presence of ulcer, gangrene, or claudication
- Added/modified Background information and updated references

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76376 – 3D Rendering (CT Multiplanar Reconstruction)

CPT Codes: 76376, 76377

IMPORTANT NOTE:

These procedures should always be approved.

This organization does not review these services for medical necessity.

POLICY HISTORY:
Review Date: April 2019
Review Summary: No changes

76390 – MR Spectroscopy

CPT Codes: 76390

INDICATIONS FOR BRAIN MRS (ACR, 2018; Barajas, 2009; Lin, 2005; Smith, 2009; Sundgren, 2009):

- For the evaluation of a recurrent or residual brain tumor from post-treatment changes e.g., radiation necrosis (Smith, 2009)
- For further evaluation a brain lesion to distinguish a brain tumor from other non-tumor diagnoses (e.g. abscess or other infectious or inflammatory process) (Alam, 2011; Majos 2009; Mishra, 2004)

BACKGROUND:
(Hellström 2018; Alam 2011; Majos 2009; Debnam, 2007; Vezina, 2008)

Magnetic resonance spectroscopy (MRS) is a noninvasive imaging technique that determines the concentration of brain metabolites such as N-acetylaspartate, choline, creatine, and lactate within the body tissue examined. Radiofrequency waves are translated into biochemical composition of the scanned tissue; the resulting metabolic profile is useful in identifying brain tumors, e.g., differentiating neoplastic and non-neoplastic brain lesions. In selected cases, MRS may be a valuable supplement to MRI. It is sensitive, but nonspecific. This modality should be considered as an adjunct to conventional imaging rather than replacement for histopathological evaluation.

In terms of imaging of brain tumors carefully designed, multi-center trials complying with criteria of evidence-based medicine have not yet been completed (Horska, 2010)

Tumor Recurrence vs. Radiation Necrosis – Differentiation between recurrent brain tumors and treatment related injury, e.g., radiation necrosis, is difficult using conventional MRI. The typical appearance of radiation necrosis is similar to that of recurrent brain tumors. MRS is a new, quantitative approach, measuring various brain metabolic markers, to help in the differentiation of recurrent tumors and radiation necrosis. This differentiation is important as additional radiation can benefit recurrent disease but can be detrimental to radiation necrosis. It may help in determining treatment options and in preventing unnecessary surgery. In addition, a tumor recurrence diagnosed by MRS allows the surgeon to begin treatment early instead of having to wait for symptoms of recurrence or biopsy confirmation (Smith, 2009). However, no consensus exists regarding the value of this in clinical decision making and no approach has yet been validated to be sufficiently accurate (Sungren, 2009; Walker, 2014; Chuang, 2016).

Glioma – MRS has been proposed for pre-operative grading of gliomas and differentiating high-grade gliomas (HGGs) from low-grade gliomas. It has been found to have moderate diagnostic value and should be combined with other advanced imaging techniques to improve accuracy. Currently, the data is limited; more research is need for a definite conclusion for the utility of MRS for this indication. Therefore, it remains experimental/investigational (Wang, 2016; Abrigo, 2018).

Cystic lesions vs. cystic metastasis or cystic primary neoplasm – MRS may determine the concentration of certain brain metabolites whose ratios help in distinguishing abscesses from cystic necrotic tumors. For example, an increased choline signal or the ratio of certain brain metabolites may indicate the presence of cancerous cells. MRS may be used to diagnose the disease and to determine appropriate treatment (Mishra, 2004).

MRS in other diseases (Oz, 2014) **-** A role for MRS has been suggested in the management of neurodegenerative disease, epilepsy, and stroke. However, to better define this role, it will be necessary to standardize the MRS methodology, as well as the collection, analysis, and interpretation of data so it can be consistently translated to the applicable clinical settings. Currently, these potential applications remain experimental/investigational

POLICY HISTORY:

Review Date: July 2019
Review Summary:

- Deleted therapeutic f/u indication
- Added tumor versus non tumor indication
- Updated background info and refs

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76497 – Unlisted CT Procedure

76497 - Unlisted CT
76498 – Unlisted MRI

IMPORTANT NOTE:

The CPT code that has been selected is considered to be an "unlisted code".

CPT Code 76498, Unlisted MRI, can be used in the context of radiation treatment planning.

For all other studies, another CPT code should be selected that describes the specific service being requested, otherwise this procedure cannot be approved.

POLICY HISTORY:
Review Date: August 22, 2019
Review Summary: No changes.

76498 – Unlisted MRI Procedure

76497 - Unlisted CT
76498 – Unlisted MRI

IMPORTANT NOTE:

The CPT code that has been selected is considered to be an "unlisted code".

CPT Code 76498, Unlisted MRI, can be used in the context of radiation treatment planning.

For all other studies, another CPT code should be selected that describes the specific service being requested, otherwise this procedure cannot be approved.

POLICY HISTORY:
Review Date: August 22, 2019
Review Summary: No changes.

77012 – CT Needle Guidance
77014 – CT Guidance for Radiation Fields
77021 – MRI Guidance for Needle Placement

CPT Codes:
CT: 77011, 77012, 77013, 77014
MRI: 77021, 77022

IMPORTANT NOTE:

The CPT codes describe the CT or MRI "guidance" component of a diagnostic procedure. Requests for these services should always be approved. This organization does not review these for medical necessity.

POLICY HISTORY:
Review Date: April 2019
Review Summary: No changes

77046 – MRI Breast

CPT Codes:
Unilateral without contrast 77046
Bilateral without contrast 77047
Unilateral without and with contrast 77048
Bilateral without and with contrast 77049

INDICATIONS FOR BREAST MRI:
(Please see boxed statement below for State of Connecticut specific requirements)

Silicone Implants:
(ACR, 2018; Laurence, 2018)

- Confirmation of suspected silicone gel-filled breast implant ruptures in symptomatic patients, when this diagnosis cannot be confirmed by mammography or breast ultrasound.
- For postoperative evaluation of silicone breast implant complications when other imaging is inconclusive.

NO HISTORY OF KNOWN BREAST CANCER:
For screening examination to detect breast cancer in any of the following situations:

- Inconclusive screening mammogram when category 0 has been specifically assigned due to breast characteristics limiting the sensitivity of mammography (e.g., extremely or heterogeneously dense breasts, implants obscure breast tissue)
- A Breast Cancer Risk Assessment (by the Gail, or modified Gail risk or other validated breast cancer risk assessment models) that identifies the patient as having a lifetime risk of 20% or greater of developing breast cancer (Approve annually beginning 10 years prior to youngest family member's age at diagnosis but not before age 30) (ACR, 2018; ASBrS, 2017; Marino, 2018; NCCN, 2018).
- Patients with histories of extensive chest irradiation (usually as treatment for Hodgkin's or other lymphoma between ages ten and thirty). Begin ten years after radiation, but not prior to age 25 (NCCN, 2018).
- Patients with known BRCA mutation. Approve annually starting at age 25 (ASBrS, 2017; NCCN, 2019).
- Patients not yet tested for BRCA gene, but with known BRCA mutation in first degree relative. Approve annually starting at age 25 (ASBrS, 2017, NCCN, 2019).
- Personal history of germline mutations known to predispose to a high risk of breast cancer: Li-Fraumeni syndrome (TP53 mutation)(begin age 20-29), Cowden syndrome (PTEN) or Bannayan-Riley-Ruvalcaba syndrome (BRRS) (begin 30-35 or 5-10 y before earliest breast cancer in family), ATM (begin age 40), CDH1 (begin age 30), CHEK2 (begin age 40), NF1(begin age 30), PALB2 (begin age 30) (ASBrS, 2017; NCCN, 2019)

For evaluation of identified lesion, mass or abnormality in breast in any of the following situations:

- Evaluation of suspected breast cancer when other imaging examinations, such as ultrasound and mammography, and physical examination are inconclusive for the presence of breast cancer, and biopsy could not be performed (e.g. seen only in single view mammogram without ultrasound

correlation).Includes skin changes of suspected inflammatory breast cancer (ASBrS, 2017; Geiss, 2017; Yader, 2018).
- Inconclusive screening mammogram due to breast characteristics limiting the sensitivity of mammography (e.g., extremely or heterogeneously dense breasts, implants) (ACR, 2018).
- When the presence of a palpable lesion is questionable (does not meet the criteria for biopsy by clinical exam) and remains indeterminate on mammography and ultrasound (ASBrS, 2017).
- For evaluation of axillary node metastasis or adenocarcinoma with normal physical examination and normal breast mammogram (ASBrS, 2017; Zhou, 2018).
- Patients diagnosed with biopsy-proven lobular neoplasia or ADH/ALH (atypical ductal hyperplasia/Atypical Lobular Hyperplasia), LCIS (Lobular Carcinoma in Situ) (ASBrS, 2017; Hartman, 2015; McLaughlin, 2015; NCCN, 2019).
- Spontaneous unilateral serous or bloody nipple discharge when conventional imaging is normal and there is no palpable mass (ASBrS, 2017; Bahl, 2015; NCCN, 2019).
- Paget's disease of the nipple: to detect underlying ductal carcinoma when conventional imaging is normal and there is no palpable mass (ASBrS, 2017).
- Follow-up of a probably benign (BI-RADS 3) lesion seen only on prior MRI (when prior mammogram and ultrasound did not show the abnormality) (Lee, 2018; Panigrahi; 2019; Spick, 2018).

HISTORY OF KNOWN BREAST CANCER:

Staging, treatment, and surveillance of patients with a known history of Breast Cancer:
- Approve initial staging when conventional imaging is indeterminate in defining multifocal, multicentric, contralateral cancer or there is a discrepancy in estimated tumor size between physical exam and imaging (ASBrS, 2017).
- During or after treatment: To identify candidates for breast conserving therapy or evaluate response to treatment, including preoperative neoadjuvant therapy [within three (3) months] (ASBrS, 2017).
- Yearly surveillance in patients with genetic or other risk factors placing them at high risk for a new cancer or recurrence (ASBrS, 2017; Park, 2018).

For evaluation of identified lesion, mass or abnormality in breast in any of the following situations:
- For evaluation of breast lesion, identifying whether single or multi-focal, in patient with newly diagnosed breast cancer (ASBrS, 2017; NCCN, 2018).
- For evaluation of suspicious mass, lesion, distortion or abnormality of breast in patient with history of breast cancer when other imaging is inconclusive.

Pre-operative:
- For preoperative evaluation for known breast cancer when surgery planned within thirty (30) days (ASBrS, 2017; Susnik, 2018; Wong, 2018).

Post-operative/procedural evaluation:
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (ACR, 2018).

FOR STATE OF NORTH CAROLINA ONLY

Medicaid and NCHC cover magnetic resonance imaging (MRI) for the detection of:

1. *Breast cancer in beneficiaries who are at a high genetic risk for breast cancer:*
    A. *known BRCA 1 or 2 mutation in beneficiary;*
    B. *known BRCA 1 or 2 mutation in relatives; or*
    C. *pattern of breast cancer history in multiple first-degree relatives, often at a young age and bilaterally.*
2. *Breast cancer in beneficiaries who have breast characteristics limiting the sensitivity of mammography (such as dense breasts, implants, scarring after treatment for breast cancer).*
3. *A suspected occult breast primary tumor in beneficiaries with axillary nodal adenocarcinoma with negative mammography and clinical breast exam.*
4. *Breast cancer in beneficiaries with a new diagnosis of breast cancer. It can be used to determine the extent of the known cancer and/or to detect disease in the contralateral breast.*
5. *To evaluate implant integrity in beneficiaries with breast implants.*

FOR STATE OF CONNECTICUT ONLY

Coverage for breast MRI is mandated within the State of Connecticut without coinsurance, copay of more than $20 deductible, or other out of pocket expenses for women with dense breast tissue if the woman is believed to be at increased risk of breast cancer because of family or personal history of breast cancer, positive genetic testing. Coverage is also mandated for other indications determined by a woman's physician, or when screening is recommended by a physician and the woman is over age 40, has a family or prior history of breast cancer or has breast disease diagnosed through biopsy as benign. This applies to high deductible plans unless plans are used to establish an HRA or HSA to the extent permitted by federal law. Though not designated in the original intent of the bill, language includes the above provisions and criteria for breast MRI.

BACKGROUND:

Magnetic resonance imaging (MRI) of the breast is a useful tool for the detection and characterization of breast disease, assessment of local extent of disease, evaluation of treatment response, and guidance for biopsy and localization (Panourgies, 2018). Breast MRI should be bilateral except for those with a history of mastectomy or when the MRI is being performed expressly to further evaluate or follow findings in one breast. MRI findings should be correlated with clinical history, physical examination, and the results of mammography and any other prior breast imaging.

OVERVIEW:

MRI as First-Line Screening Modality – Only recently has the use of MRI for screening been encouraged. It is now used for screening in patients with increased risk for breast cancer due to certain factors, e.g., history of mediastinal irradiation for Hodgkin disease, mutation in a breast cancer susceptibility gene, and familial clustering of breast cancer. Certain mutations, including BRCA1 and BRCA2 genes confer significantly elevated risk of breast cancer. Even when a patient tests negative for BRCA mutations, this patient may still be at risk for breast cancer if the patient has first degree relatives with a history of breast cancer or positive BRCA mutations.

MRI in Patient with Normal Physical Examination and Normal Mammogram but with Clinical Signs of Breast Cancer – Metastatic spread in the axillary lymph nodes suggest the breast as the site of the primary cancer even when the results of a mammogram are normal. MRI is useful in detecting primary breast malignancies in these cases. A negative MRI may also be used to prevent an unnecessary mastectomy.

MRI during or after Neoadjuvant Chemotherapy – Dynamic contrast enhanced MRI may be used to monitor response of a tumor to neoadjuvant chemotherapy used to shrink the tumor before surgery. This is very important in clinical decision making as alternative therapies may be selected based upon the results obtained from the MRI. It may also be used to depict residual disease after neoadjuvant chemotherapy. MRI-compatible localization tissue markers should be placed prior to neoadjuvant chemotherapy to evaluate the location of the tumor in the event of complete response (ACR, 2018).

MRI and Breast Implants – MRI may be used in patients with breast implants to evaluate breast implant integrity. It may also detect cancers arising behind an implant that may not be diagnosed with mammography.

MRI and Invasive Lobular Carcinoma – Invasive lobular carcinoma (ILC) is not the most common type of breast carcinoma but it is second to invasive ductal carcinoma. Because of it multicentricity nature, MRI is used in the evaluation of ILC and can measure the extent of the disease with high reliability.

Breast pain - NCCN Guidelines and the ASBrS do not recommend breast MRI for evaluation of breast pain (ASBrS, 2017).

MRI and Known Breast Cancer - "The ASBrS does not recommend routine diagnostic MRI in newly diagnosed breast cancer patients except as part of a scientific study…..Routine annual MRI is not indicated for screening of women with a prior history of breast cancer unless they have a known genetic or other significant risk factor placing them at high-risk for a new breast cancer …" (ASBrS, 2017).

Nipple Discharge - Nipple discharge is a common complaint with at least 80% of women having at least 1 episode. Discharge that is considered pathologic is unilateral, spontaneous, from one duct orifice and serous or bloody. Physiologic discharge will be bilateral, from multiple ducts, and white, green, or yellow in color. "In general, MRI should be considered in cases in which other approaches have failed to identify an underlying cause of pathologic nipple discharge. The sensitivities of breast MRI for detection of underlying cause of pathologic nipple discharge are 86% to 100% for invasive cancer and 40% to 100% for noninvasive disease" (ACR, 2016). Ductography (galactography) has the ability to demonstrate very small lesions in the specific duct that is secreting the pathologic nipple discharge. However, it is invasive and may cause discomfort and pain. It can be time-consuming and technically challenging and the rate of incomplete ductography is as high as 15%. The discharge must be present on the day of the study so that a cannula can be placed in the appropriate duct. Failure to cannulate the discharging duct may occur and cannulation of the wrong duct may cause a false-negative ductogram (ACR, 2016).

BI-RADS 3 (Probably Benign) MRI and Follow-up - A follow up MRI study may be indicated to confirm stability of a probably benign mass seen only on prior MRI. In a review of sixteen studies of high-risk patients the frequency of MRI examinations reported as BI-RADS 3 was between 6 and 12% (Lee, 2018). In an average risk screening population of 2120 women and 3,861 MRI exams 4.9% of MRI exams were BI-RADS 3 (Kuhl, 2017). Specific features of what constitutes a BI-RADS 3 lesion were not described in these studies, is at the discretion of the reporting radiologist, and the definition was still evolving during the study periods. At this writing the appropriate use of BI-RADS 3 for breast MRI has not been fully defined (Panigrahi, 2019). "The most appropriate and common use of BI-RADS 3 assessment is for a round- or oval-shaped mass with circumscribed margins and hyperintense T2 signal, which has either homogeneous enhancement or dark internal septations on a baseline examination. A mass meeting these criteria is most likely an intramammary lymph node or fibroadenoma" (Lee, 2018). The reported malignancy rate is ≤ 2% for lesions classified as BI-RADS 3 (Lee, 2018; Spick, 2018).

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- For silicone implants indication, added qualifying terms to assure patient is symptomatic and other imaging is inconclusive
- For 'No history of breast cancer, screening examinations' added specifics about when the screening should be done
- Removed indication "Two or more first degree relatives (parents, siblings, and children) have history of breast cancer"
- Provided specifics on chest radiation including when to start screening: "Patients with histories of extensive chest irradiation (usually as treatment for Hodgkin's or other lymphoma between ages ten and thirty. Begin ten years after radiation, but not prior to age 25"
- For indication: "Personal history of germline mutations", removed 'or first degree relative with' and added some of the different mutations and when screening should begin
- For indication: "For evaluation of identified lesion, mass, or abnormality in breast in any of the following situations", removed "Two or more first degree relatives with history of breast cancer"
- For "Evaluation of breast cancer when other imaging exams are inconclusive" added "includes skin changes of suspected inflammatory breast cancer"
- Expanded the suspicious precursor lesions to include "atypical lobular hyperplasia and lobular carcinoma in situ"
- Added indications: "Spontaneous unilateral serous or bloody nipple discharge when conventional imaging is normal and there is no palpable mass" AND "Paget's disease of the nipple: to detect underlying ductal carcinoma when conventional imaging is normal and there is no palpable mass"
- Added indication: "Follow-up of a BI-RAD 3 lesion seen only on prior MRI when prior mammogram and US did not show the abnormality"
- History of Known Breast Cancer: Changed subheading from "Screening exam to detect breast cancer" to "Staging, treatment, and surveillance of patients with a known history of breast cancer" AND added specific indications including:
  - Approve initial staging when conventional imaging is indeterminate in defining multifocal, multicentric, contralateral cancer or there is a discrepancy in estimated tumor size between physical exam and imaging
  - During or after treatment to identify candidates for breast conserving therapy or evaluate response to treatment, including preoperative neoadjuvant therapy [within three (3) months]
  - Yearly surveillance in patients with genetic or other risk factors placing them at high risk for a new cancer or recurrence"
- For evaluation of suspicious mass, lesion, distortion or abnormality of breast in patient with history of breast cancer: added - 'when other imaging is inconclusive'
- Added Background information on Nipple Discharge and specifics on screening for newly diagnosed or patients with breast cancer history
- Updated references

POLICY HISTORY:
Review Date: September 2019
Review Summary:

- Added state specific language boxes for State of Connecticut and State of North Carolina

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77078 – CT Bone Density Study

CPT Codes: 77078

INDICATIONS FOR CT BONE DENSITY STUDY:

For first time baseline study:
(ACR, 2016, 2017; Cosman, 2014; ISCD, 2015)

In patient with suspected osteoporosis or osteopenia meeting any of the following criteria when DEXA scanning is not available or for patients >50 years of age with advanced degenerative changes of the spine that may limit the efficacy of DEXA scans

- Asymptomatic women 65 years of age or older and men 70 and older
- Women aged 50-64 years old with a 9.3% or greater 10-year fracture risk based on the WHO (World Health Organization Fracture Risk Assessment (FRAX) tool (USPSTF, 2011)*.
- Individuals with **at least ONE** of the following risk factors:
    - Currently on medications associated with development of osteoporosis (e.g., steroids or glucocorticosteroids, anticonvulsants, heparin, lithium, estrogen receptor modulators (SERMs), calcitonin, or bisphosphonates, etc.)
    - Post-menopausal women younger than 65 and a low body weight (BMI <21 kb/$m^{2)}$
    - Estrogen deficiency and low calcium intake or alcoholism.
    - In postmenopausal women and men age 50 and older who have had an adult age fracture or individuals of any age who develop 1 or more insufficiency fractures.
    - Evidence of osteoporosis or osteopenia from x-ray or ultrasound.
- Back pain associated with loss of vertebral body height per x-ray without significant traumatic event
- Loss of body height (>4 cm (>1.5 inches)) (ACR, 2017).
- Multiple fractures including compression fractures of the spine.
- Conditions that cause or contribute to osteoporosis and fractures (e.g. malabsorption syndromes, inflammatory bowel disease and other gastrointestinal conditions, metabolic bone disease, hyperparathyroidism, hypogonadism, thyroid hormone therapy or hyperthyroidism, chemotherapy, long term heparin therapy, rheumatologic and autoimmune diseases, renal failure, hematologic disorders, etc.).
- Amenorrhea for greater than 1 year before the age of 42

For follow-up of individuals with known osteoporosis or osteopenia:
(Cosman, 2014)

- No previous bone mineral density study within the past 23 months.
- Previous bone density within past 23 months **AND** meets any one of the above risk factor criteria. (More frequent BMD testing may be warranted in certain clinical situations and should be determined on a case by case basis).

- After initiation of medical therapy for osteoporosis**: 1 to 2 years after initiating therapy for osteoporosis and every two years subsequent to the initial study (More frequent BMD testing may be warranted in certain clinical situations and should be determined on a case by case basis) (Cosman, 2014).

BACKGROUND:
Bone mineral density (BMD) measurement identifies patients with low bone density and increased fracture risk. Methods for measuring BMD are non-invasive, painless, and available on an outpatient basis. Dual energy x-ray absorptiometry (DXA), previously referred to as DEXA, is the most commonly used method of evaluating BMD and is the only BMD technology for which World Health Organization (WHO) criteria for the diagnosis of osteoporosis can be used. Patients who have a BMD that is 2.5 standard deviations below that of a "young normal" adult (T-score at or below -2.5) are deemed to have osteoporosis. Quantitative computed tomography (QCT) has not been validated for WHO criteria but can identify patients with low BMD compared to the QCT reference database and it can be used to identify patients who are at risk of fracture.

OVERVIEW:
DXA – Dual energy x-ray absorptiometry (DXA) is most often used to measure bone mineral density due to its low radiation exposure, low precision error, and capacity to measure multiple skeletal sites (spine, hip, or total body).

Axial DXA – This provides the "gold standard". Axial DXA predicts fracture risk at the site being measured.

Peripheral DXA – This device measures BMD at peripheral sites, generally at the heel or wrist. It is relatively cheap and portable and is an option when there is limited access to axial DXA.

Fracture Risk Assessment* - The fracture risk assessment (FRAX) tool developed by the World Health Organization estimates the 10 year risk of having a fracture based on factors such as age, sex, body mass index (BMI), previous fractures, parental fracture history, glucocorticoid use, Rheumatoid arthritis, and conditions predisposing to secondary osteoporosis (insulin dependent diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or malabsorption and chronic liver disease) and tobacco and alcohol use. Based on FRAX, a 65-year-old women without any additional conditions increasing fracture risk has a 9.3% 10-year risk of developing a fracture. This value is therefore used as the risk level cut-off recommending screening in patients younger than 65. The FRAX tool is available on line at https://www.sheffield.ac.uk/FRAX/tool.jsp.

Ethnicity and Screening - Due to the potential negative consequences of fractures and the lack of an optimal age at which to screen populations of different ethnicity the USPSTF now recommends screening of all women aged 65 and older regardless of race and ethnicity.

Follow up Imaging -** Follow up imaging is performed on patients at risk of developing osteoporosis or to evaluate the outcome of osteoporosis treatment. Follow up imaging is generally performed at 1-2 years after initiation of therapy for osteoporosis and subsequently every 2 years unless clinical circumstances prompt earlier imaging. In patients at increased risk for developing osteoporosis, imaging may be performed more frequently, particularly with patients with certain medical conditions and taking medications predisposing to

fracture. The later population includes those undergoing long term therapy with common medications such as heparin or glucocorticoids.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Changed language by removing "screening" in the following: "For first time baseline ~~screening~~ study" AND "For ~~screening~~ follow-up of individuals with known osteoporosis or osteopenia"
- Removed erroneous chart information that was not intended for inclusion in guideline
- Updated references

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77084 – MRI Bone Marrow

CPT Codes: 77084

INDICATIONS FOR BONE MARROW MRI:

- For the diagnosis, staging and follow-up of patients with multiple myeloma and related disorders (Dutoit, 2016).
- Suspected progression of smoldering multiple myeloma (SMM) to multiple myeloma (MM) or high risk SMM patients (Caers, 2016; IMWG, 2015).
- Diagnosis and assessment of treatment response in diffuse or multifocal marrow disorders (e.g. Chronic Recurrent Multifocal Osteomyelitis; marrow involvement in storage diseases such as Gaucher's; or hematologic malignancies when the diagnosis is in doubt) (Laudermann, 2016; Simpson, 2014; Voit, 2015).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Magnetic Resonance Imaging (MRI) is currently used for the detection of metastatic disease in the bone marrow. Whole body MRI, using moving tables and special coils to survey the whole body, is used for screening to search for primary tumors and metastases. The unique soft-tissue contrast of MRI enables precise assessment of bone marrow infiltration and adjacent soft tissues allowing detection of alterations within the bone marrow earlier than with other imaging modalities. MRI results in a high detection rate for both focal and diffuse disease, mainly due to its high sensitivity in directly assessing the bone marrow components: fat and water bound protons.

When bone marrow MRI is indicated it is a single CPT code study with large field of view images covering the osseous structures, usually in two planes. Individual CPT codes corresponding to multiple separate studies of portions of the axial and appendicular skeleton are not necessary.

Some conditions with diffuse marrow infiltration are not confined to the musculoskeletal system. Additional dedicated organ MRI exams may also be required for these patients.

OVERVIEW:
MRI allows bone marrow components to be visualized and is the most sensitive technique for the detection of bone marrow pathologies. The soft-tissue contrast of MRI enables detection of alterations within the bone marrow before osseous destruction becomes apparent in CT. Whole-body MRI has been applied for bone marrow screening of metastasis, as well as for systemic primary bone malignancies such as multiple myeloma (MM). Sensitive detection is mandatory in order to estimate prognosis and to determine adequate therapy.

Multiple myeloma and related conditions include: "1. Multiple myeloma- monoclonal proliferation of plasma cells with myeloma-defining CRAB (Calcium level elevation, Renal failure, Anemia, or Bone lesions) findings; 2.

MGUS (monoclonal gammopathy of undetermined significance) - monoclonal proliferation of plasma cells without myeloma-defining CRAB; 3. Solitary plasmacytoma – monoclonal plasma cells manifesting as a single tumor; and 4. Smoldering myeloma - monoclonal proliferation of plasma cells in bone marrow and/or serum/urine with abnormal levels of monoclonal protein" (Navarro, 2017).

MRI findings are included as one of the International Myeloma Working Group (IMWG) diagnostic criteria of active myeloma (Dutoit, 2016). Although MRI is not the only imaging tool for diagnosis, when "more than one focal lesion on MRI that is at least 5mm or greater in size" in addition to >10% clonal bone marrow plasma cells the diagnosis of active myeloma can be made. For smoldering multiple myeloma (SMM), defined as asymptomatic patients with increased levels of M protein and increased bone marrow plasma cells, "The IMWG now recommends that one of PET-CT, [Low dose whole body CT] (LDWBCT), or MRI of the whole body or spine be done in all patients with suspected smoldering myeloma, with the exact imaging modality determined by availability and resources" (IMWG, 2015). The importance of imaging in the diagnosis of active myeloma is highlighted as "The IMWG consensus statement now recommends that SMM patients with more than one unequivocal focal lesion (diameter > 5 mm) should be considered to have symptomatic myeloma that requires treatment" (Dutoit, 2016). Recent advances have allowed the identification of a subset of SMM patients with a greater than 80% risk of progression to MM in 2 years based on biomarkers (Caers, 2016).

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Removed indication "vertebral fractures with suspected bone metastasis'
- Added indication: "Diagnosis and assessment of treatment response in diffuse or multifocal marrow disorders (e.g. Chronic Recurrent Multifocal Osteomyelitis; marrow involvement in storage diseases such as Gaucher's; or hematologic malignancies when the diagnosis is in doubt)"
- Added Background info to clarify when this study is indicated
- Added Overview section to explain multiple myeloma and related conditions
- Updated references

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78451 – Myocardial Perfusion Imaging (Nuc Card)

CPT Code: 78451, 78452, 78453, 78454, 78466, 78468, 78469, 78481, 78483, 78499

INDICATIONS for MPI
(Fihn 2012, Hendel 2009, Montalescot 2013, Wolk 2014)

SUSPECTED Coronary Artery Disease (CAD)

Symptomatic patients without known CAD (Use Diamond Forrester table)

- Low pretest probability and unable to exercise (SE diversion not required)
- Intermediate pre-test probability with an uninterpretable ECG or unable to exercise (Wolk 2014)
- High pretest probability (SE diversion not required) (Hachamovitch 2004)
- Repeat testing in a patient with new or worsening symptoms and negative result at least one year prior

Asymptomatic patients without known CAD (SE diversion not required)

- Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities (See Overview section)
- Previously unevaluated pathologic Q waves
- Unevaluated complete left bundle branch block

INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN

- Exercise stress ECG with low risk Duke treadmill score (≥5), but patient's current symptoms indicate an intermediate or high pretest probability (SE diversion not required for high pretest probability)
- Exercise stress ECG with an intermediate Duke treadmill score
- Intermediate coronary computed tomography angiography (CCTA) (e.g. 30 - 70% lesions)
- Non-diagnostic exercise stress test with inability to achieve target heart rate (THR) (SE diversion not required)
- An indeterminate (equivocal, borderline, or discordant) evaluation by prior stress imaging (SE or CMR) within the past 2 years

FOLLOW-UP OF PATENTS POST CORONARY REVASCULARIZATION (PCI or CABG) (Wolk 2014)

- **Asymptomatic follow-up stress imaging (MPI or SE)** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia, or a history of a prior left main stent (Wolk 2014).

  OR

For patients with high occupational risk (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers and firefighters)

- **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging (MPI or SE), if it will alter management

FOLLOW-UP OF KNOWN CAD

- **Follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging (MPI or SE) in patients if it will alter management

SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION

- Prior acute coronary syndrome (as documented in MD notes), without invasive or non-invasive coronary evaluation (SE diversion not required)
    - Newly diagnosed systolic heart failure (EF < 50%) with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (SE diversion not required) (Fihn 2012, Patel 2013, Yancy 2013)
    - LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary revascularization (SE diversion not required) (Patel 2013; Yancy 2013)
    - Ventricular arrhythmias
        - Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise induced VT, when invasive coronary arteriography is not immediately planned (Al-Khatib 2018) (SE diversion not required)
        - Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, or frequent PVCs (defined as greater than or equal to 30/hour) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed (Zimetbaum 2018)
    - Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), in intermediate and high global risk patients (SE diversion not required) (Reiffel 2015)
    - Assessment of hemodynamic significance of one of the following documented conditions (Anagnostopoulos 2004):
        - Anomalous coronary arteries (Grani 2017)
        - Myocardial bridging of coronary artery (perform with exercise stress) (Tang 2011)
- Coronary aneurysms in Kawasaki's disease (Newburger 2016) or due to atherosclerosis
- Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti 2013)

PRIOR TO ELECTIVE NON CARDIAC SURGERY

- Patients who have no above indication for non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met:
    - Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal; **AND**
    - The patient has **at least one** of the additional cardiac complication risk factors:
        - Ischemic Heart Disease
        - History of stroke or TIA
        - History of congestive heart failure or ejection fraction ≤ 35%

        - Insulin-requiring diabetes mellitus
        - Creatinine ≥ 2.0 mg/dl

      AND

    - The patient has limited functional capacity (< 4 METS), such as one of the following:
        - Unable to take care of their activities of daily living (ADLs) or ambulate
        - Unable to walk 2 blocks on level ground
        - Unable to climb 1 flight of stairs

      AND

    - There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year; and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery.

- Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year and one of the following: (SE diversion not required) (Lentine 2012):
    - The patient has limited functional capacity (< 4 METS), such as one of the following:
        - Unable to take care of their ADLs or ambulate
        - Unable to walk 2 blocks on level ground
        - Unable to climb 1 flight of stairs

      OR

    In a patient with ≥ 3 of the following (Lentine 2012):
        - Age > 60
        - Smoking
        - Hypertension
        - Dyslipidemia
        - Left ventricular hypertrophy
        - > 1 year on dialysis (for renal transplant patients)
        - Diabetes mellitus
        - Prior ischemic heart disease

POST CARDIAC TRANSPLANT (SE diversion not required)

- Annually, for the first five years post cardiac transplantation, in a patient who otherwise will not undergo annual invasive coronary arteriography

- After the first five years post cardiac transplantation:
    - Patients with documented transplant coronary vasculopathy can be screened annually if the risk of annual invasive coronary arteriography is not acceptable (e.g. high risk of contrast nephropathy) or not desired.

BACKGROUND

This guideline is for stress imaging, specifically myocardial perfusion imaging (MPI), with appropriate preference for alternatives, such as stress echocardiography (SE) or stress ECG alone when more suitable (see section below).

Radionuclide myocardial perfusion imaging (MPI) allows for evaluation of cardiac perfusion at rest and at exercise, as well as using pharmacologic agents for the diagnosis and management of coronary artery disease. With radionuclide MPI, pharmacologic stress may be performed with an inotropic agent or vasodilator. There are currently 3 vasodilators approved for MPI stress testing: dipyridamole, adenosine, and regadenoson. They are indicated for patients who cannot reach an adequate endpoint with physical exercise stress testing (Pagnanelli 2017).

Stable patients without known CAD fall into 2 categories (Fihn 2012, Montalescot 2013, Wolk 2013):

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online (see Websites for Global Cardiovascular Risk Calculators section).
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant (≥ 70%) CAD (below):

The 3 Types of Chest Pain or Discomfort

- **Typical Angina (Definite)** is defined as including all **3** characteristics:
  - Substernal chest pain or discomfort with characteristic quality and duration
  - Provoked by exertion or emotional stress
  - Relieved by rest and/or nitroglycerine

- **Atypical Angina (Probable)** has only **2** of the above characteristics

- **Nonanginal Chest Pain/Discomfort** has only **0 - 1** of the above characteristics

Once the type of chest pain has been established from the medical record, the Pretest Probability of obstructive CAD is estimated from the **Diamond Forrester Table** below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability (Fihn 2012, Wolk 2013):

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40–49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50–59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Very low:** < 5%pretest probability of CAD, usually not requiring stress evaluation
- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

OVERVIEW:

MPI may be performed without diversion to SE in any of the following (see below): (Henzlova 2016, Wolk 2013):

- Inability to exercise
- Other comorbidities
- Electrocardiography (ECG) and Echocardiography-related baseline abnormalities
- Risk related scenarios

Scenarios that support MPI over SE
(Henzlova 2016)

Inability to Exercise

- Physical limitations precluding ability to exercise for at least 3 full minutes of Bruce protocol
- Limited functional capacity (< 4 METS) **such as one** of the following:
    - Unable to take care of their ADLs or ambulate
    - Unable to walk 2 blocks on level ground
    - Unable to climb 1 flight of stairs

Other Comorbidities

- Severe chronic obstructive pulmonary disease (COPD) with pulmonary function test (PFT) documentation, severe shortness of breath on minimal exertion, or requirement of home oxygen during the day
- Poorly controlled hypertension, with systolic BP > 180 or diastolic BP > 120 (and clinical urgency not to delay MPI)

ECG and Echo Related Baseline Findings

- Prior cardiac surgery (coronary artery bypass graft or valvular)
- Obesity with body mass index (BMI) over 40 kg/m2 or documented poor acoustic imaging window

- Left ventricular ejection fraction ≤ 40%
- Pacemaker or ICD
- Atrial fibrillation
- Resting wall motion abnormalities that would make SE interpretation difficult
- Complete left bundle branch block (LBBB)

Risk Related
- High pretest probability in suspected CAD
- Intermediate or high global risk in patients requiring type IC antiarrhythmic drugs (prior to initiation of therapy)
- Arrhythmia risk with exercise

ECG Stress Test Alone versus Stress Testing with Imaging

Prominent scenarios suitable for an ECG stress test WITHOUT imaging (i.e. exercise treadmill ECG test) require that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable ECG for ischemia during exercise (Wolk 2013):
- The (symptomatic) low or intermediate pretest probability patient who is able to exercise and has an interpretable ECG (Wolk, 2014)
- The patient who is under evaluation for exercise induced arrhythmia
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription
- For the evaluation of syncope or presyncope during exertion (Shen 2017)

Duke Exercise ECG Treadmill Score calculates risk from ECG treadmill alone**:**
- The equation for calculating the Duke treadmill score (DTS) is: DTS = exercise time in minutes - (5 x ST deviation in mm or 0.1 mV increments) - (4 x exercise angina score), with angina score being 0 = none, 1 = non-limiting, and 2 = exercise-limiting
- The score typically ranges from - 25 to + 15. These values correspond to low-risk (with a score of ≥ + 5), intermediate risk (with scores ranging from - 10 to + 4), and high-risk (with a score of ≤ - 11) categories

An uninterpretable baseline ECG includes (Fihn 2012):
- ST segment depression 1 mm or more; (not for non-specific ST- T wave changes)
- Ischemic looking T waves; at least 2.5 mm inversions (excluding V1 and V2)
- LVH with repolarization abnormalities, pre-excitation pattern such as WPW, ventricular paced rhythm, or LBBB
- Digitalis use with associated ST segment abnormalities

Global Risk of Cardiovascular Disease

Global risk of CAD is defined as the probability of manifesting cardiovascular disease over the next 10 years and refers to **asymptomatic** patients without known cardiovascular disease. It should be determined using one of the risk calculators below. A high risk is considered greater than a 20% risk of a cardiovascular event over the ensuing 10 years. **High global risk by itself generally lacks scientific support as an indication for stress imaging.** There are rare exemptions, such as patients requiring IC antiarrhythmic drugs, who might require coronary risk stratification prior to initiation of the drug, when global risk is moderate or high.
- **CAD Risk—Low**
  10-year absolute coronary or cardiovascular risk less than 10%.
- **CAD Risk—Moderate**
  10-year absolute coronary or cardiovascular risk between 10% and 20%.

- **CAD Risk—High**
  10-year absolute coronary or cardiovascular risk of greater than 20%.

Websites for Global Cardiovascular Risk Calculators*
(D'Agostino 2008, Goff 2014, McClelland 2015, Ridker 2007)

*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators.

Risk Calculator	Websites for Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Definitions of Coronary Artery Disease
(Fihn 2012, Mintz 2016, Montalescot 2013, Patel 2017)

Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and can be estimated or measured using angiography or more accurately measured with intravascular ultrasound (IVUS).

- Coronary artery calcification is a marker of risk, as measured by Agatston score on coronary artery calcium imaging. It is not a diagnostic tool so much as it is a **risk stratification** tool. Its incorporation into global risk can be achieved by using the MESA risk calculator.
- Ischemia-producing disease (also called hemodynamically or functionally significant disease, for which revascularization might be appropriate) generally implies at least one of the following:
  - Suggested by percentage diameter stenosis ≥ 70% by angiography; borderline lesions are 40 - 70% (Fihn 2012)
  - For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum lumen cross sectional area on IVUS ≤ 6 square mm (Fihn 2012, Mintz 2016)
  - FFR (fractional flow reserve) ≤ 0.80 for a major vessel (Mintz 2016)
  - iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies 2017, Gotberg 2017)
  - Demonstrable ischemic findings on stress testing (ECG or stress imaging), that are at least mild in degree
- A major vessel would be a coronary vessel that would be amenable to revascularization, if indicated. This assessment is made based on the diameter of the vessel and/or the extent of myocardial territory served by the vessel.

- FFR (fractional flow reserve) is the distal to proximal pressure ratio across a coronary lesion during maximal hyperemia induced by either intravenous or intracoronary adenosine. Less than or equal to 0.80 is considered a significant reduction in coronary flow.
- iFR (instantaneous wave-free ratio) measures the ratio of distal coronary to aortic pressure during the wave free period of diastole, with a value ≤ 0.89 considered hemodynamically significant (Davies 2017, Gotberg 2017).
- Newer technology that estimates FFR from CCTA image is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent
(Fihn 2012, Moya 2009, Shen 2017)

Development of an anginal equivalent (e.g. shortness of breath, fatigue, or weakness) either with or without prior coronary revascularization should be based upon the documentation of reasons to suspect that symptoms other than chest discomfort are not due to other organ systems (e.g. dyspnea due to lung disease, fatigue due to anemia. This may include respiratory rate, oximetry, lung exam, etc. (as well as d-dimer, chest CT(A), and/or PFTs, when appropriate), and then incorporated into the evaluation of coronary artery disease as would chest discomfort. Syncope per se is not an anginal equivalent.

Abbreviations

AAD	Antiarrhythmic drug
ADLs	Activities of daily living
BSA	Body surface area in square meters
CAD	Coronary artery disease
ECG	Electrocardiogram
FFR	Fractional flow reserve
LBBB	Left bundle-branch block
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy
MI	Myocardial infarction
MET	Estimated metabolic equivalent of exercise
MPI	Myocardial perfusion imaging
PFT	Pulmonary function test
PVCs	Premature ventricular contractions
SE	Stress echocardiography
VT	Ventricular tachycardia
VF	Ventricular fibrillation
WPW	Wolf Parkinson White

POLICY HISTORY:
Review Date: July 23, 2019
Review Summary:

- For special diagnostic consideration, prior acute coronary syndrome (as documented in MD notes), the following clause was added: 'without subsequent invasive or non-invasive coronary evaluation (SE diversion not required)'
- For section on prior to elective non-cardiac surgery the following was added: 'There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year'
- For section on prior to elective non-cardiac surgery indication 'Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year'
- Added indication for follow-up every 2 years for patients with known CAD in high-risk occupations
- Added prior left main stent in asymptomatic patients as follow-up every two years
- Clarification of diversion to stress echo in suitable patients post-revascularization
- Clarification of post cardiac transplant
- Removed section on Global Risk Calculator
- Added "with EKG changes," as indication for stress echo in patients on digoxin or with LVH
- Removed indication for ETT in asymptomatic patients
- Added presyncope and syncope with exercise as an indication for ETT

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78459 – PET Scan, Heart (Cardiac)

CPT Codes: 78459, 78491, 78492, +78434

SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

Symptomatic patients without known CAD (use Diamond Forrester Table)

- Low pretest probability and unable to exercise
- Intermediate pre-test probability with an uninterpretable electrocardiogram (ECG) or unable to exercise (Wolk 2014)
- High pretest probability
- Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago

Asymptomatic patients without known CAD

- Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities
- Previously unevaluated pathologic Q waves
- Unevaluated complete left bundle branch block

INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- Exercise stress ECG with low risk Duke treadmill score (≥5), but patient's current symptoms indicate an intermediate or high pretest probability
- Exercise stress ECG with an intermediate Duke treadmill score
- Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g. 40 - 70% lesions)
- Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR)
- An intermediate evaluation by prior stress imaging (within the past 2 years)

FOLLOW-UP OF PATENTS POST CORONARY REVASCULARIZATION (PCI or CABG) When LVEF is ≤ 40% and revascularization is under consideration

- **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia, or a history of a prior left main stent
  OR
  For patients with high occupational risk (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers and firefighters)

- **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging, if it will alter management

FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- **Routine follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis

greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management

SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation
- Newly diagnosed systolic heart failure (EF < 50%), especially with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (Fihn 2012, Patel 2013, Yancy 2013)
- Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary (Diversion from PET not required when LVEF less than or equal to 40%) (Patel 2013, Tsai 2014, Yancy 2013)
- Ventricular arrhythmias
    - Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise induced VT, when invasive coronary arteriography is not the immediately planned test (Al-Khatib 2018)
    - Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed
- Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), in intermediate and high global risk patients (SE diversion not required) (Reiffel 2015)
- Assessment of hemodynamic significance of one of the following documented conditions (Anagnostopoulos 2004):
    - Anomalous coronary arteries (Grani 2017)
    - Muscle bridging of coronary artery (perform with exercise stress) (Sorajja 2018)
- Coronary aneurysms in Kawasaki's disease (McCrindle 2017) or due to atherosclerosis
- Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti 2013)
- **Cardiac Sarcoidosis** (Blankstein 2014, Bravo 2017, Vita 2018)
    - Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed
    - Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion (Vita 2018)
- Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy (Vita 2018)
    - Initial and follow up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years (Bokhari 2017, Osborne 2014)

- **Infective Endocarditis**
    - In suspected infective endocarditis with moderate to high probability (i.e. staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications (Doherty 2017, Habib 2016, Wang 2018)

- **Aortitis**
    - For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI hybrid imaging (Bhave 2018)

PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- Patients who have no other indication for a non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met:
    - Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal;

    AND
    - The patient has **at least one** of the additional cardiac complication risk factors:
        - Ischemic Heart Disease
        - History of stroke or TIA
        - History of congestive heart failure or ejection fraction ≤ 35%
        - Insulin-requiring diabetes mellitus
        - Creatinine ≥ 2.0 mg/dl

    AND
    - The patient has limited functional capacity (< 4 METS), such as one of the following:
        - Unable to take care of their activities of daily living (ADLs) or ambulate
        - Unable to walk 2 blocks on level ground
        - Unable to climb 1 flight of stairs

    AND
    - There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery.

- Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year and one of the following: (SE diversion not required) (Lentine 2012)
    - The patient has limited functional capacity (< 4 METS), such as one of the following:
        - Unable to take care of their ADLs or ambulate
        - Unable to walk 2 blocks on level ground
        - Unable to climb 1 flight of stairs

    OR
    - In a patient with ≥ 3 of the following (Lentine 2012)
        - Age > 60
        - Smoking
        - Hypertension
        - Dyslipidemia
        - Left ventricular hypertrophy
        - 1 year on dialysis (for renal transplant patients)
        - Diabetes mellitus
        - Prior ischemic heart disease

POST CARDIAC TRANSPLANT (SE diversion not required)
(McArdle 2012)

- Annually, for the first five years post cardiac transplantation, in patient who otherwise will not undergo annual invasive coronary arteriography
- After the first five years post cardiac transplantation:
    - Patients with documented transplant coronary vasculopathy, can be screened annually if the risk of annual invasive coronary arteriography is not acceptable (e.g. high risk of contrast nephropathy) or not desired

BACKGROUND
(Bateman 2016, Fazel 2011)

- PET is indicated when all the criteria for MPI is met
  OR
  BMI > 40
  OR
  There is likely to be equivocal imaging results because of BMI or large breasts or implants or prior thoracic surgery or results of a prior MPI
- For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine a patient's potential benefit from coronary revascularization (Patel 2013, Tsai 2014, Yancy 2013)
- When strong suspicion of balanced ischemia is noted, and further non-invasive coronary evaluation required, PET can be used, without diversion from PET (Bengel 2009)
- Prior alternative **perfusion** (MPI or CMR) imaging resulted in an indeterminate evaluation for CAD
- Cardiac positron emission tomography (PET) can characterize myocardial blood flow by perfusion scanning with either rubidium-82 (Rb-82) or nitrogen-13 (N-13) ammonia
- PET can identify regions of myocardial viability with hibernating myocardium (viable, with poor flow and contractility) by imaging with fluorine18 (F-18) fluorodeoxyglucose (FDG or 18-FDG) for this purpose.
- PET poses a reduced radiation burden (2 - 3 mSv) compared to stress myocardial perfusion imaging (MPI) with technetium-based tracers (7 - 24 mSv), the short half-life of PET tracers does not work well for exercise stress testing.
- PET can be use useful in the evaluation of inflammation: e.g. evaluation and therapy monitoring in patients with sarcoidosis, after documentation of cardiac involvement by echo or electrocardiography (ECG), in place of, or subsequent to CMR if needed to help with an uncertain diagnosis

Coronary application of PET includes evaluation of **stable patients without known CAD**, who fall into two categories (Fihn 2012, Montalescot 2013, Wolk 2013)

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant (≥ 50%) CAD (below):

The 3 Types of Chest Pain or Discomfort

- **Typical Angina (Definite)** is defined as including all **3** characteristics:
  - Substernal chest pain or discomfort with characteristic quality and duration
  - Provoked by exertion or emotional stress
  - Relieved by rest and/or nitroglycerine
- **Atypical Angina (Probable)** has only **2** of the above characteristics
- **Nonanginal Chest Pain/Discomfort** has only **0 - 1** of the above characteristics

Once the type of chest pain has been established from the medical record, the Pretest Probability of CAD (meaning obstructive CAD defined as coronary arterial narrowing ≥ 50%) is estimated from the **Diamond Forrester Table** below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability (Fihn 2012, Wolk 2013):

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40 – 49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50 – 59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

OVERVIEW:

ECG Stress Test Alone versus Stress Testing with Imaging
Prominent scenarios suitable for an ECG stress test WITHOUT imaging (i.e. exercise treadmill ECG test) require that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable ECG for ischemia during exercise (Wolk 2013):

- The (symptomatic) low or intermediate pretest probability patient who is able to exercise and has an interpretable ECG (Wolk 2014)
- The patient who is under evaluation for exercise induced arrhythmia
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription.
- For the evaluation of syncope or presyncope during exertion (Shen 2017)

Duke Exercise ECG Treadmill Score calculates risk from ECG treadmill alone**:**

- The equation for calculating the Duke treadmill score (DTS) is: DTS = exercise time in minutes - (5 x ST deviation in mm or 0.1 mV increments) - (4 x exercise angina score), with angina score being 0 = none, 1 = non-limiting, and 2 = exercise-limiting.
- The score typically ranges from - 25 to + 15. These values correspond to low-risk (with a score of ≥ + 5), intermediate risk (with scores ranging from - 10 to + 4), and high-risk (with a score of ≤ - 11) categories.

An uninterpretable baseline ECG includes (Fihn 2012):

- ST segment depression 1 mm or more (not for non-specific ST- T wave changes)
- Ischemic looking T waves; at least 2.5 mm inversions (excluding V1 and V2)
- LVH with repolarization abnormalities, pre-excitation pattern such as WPW, ventricular paced rhythm, or left bundle branch block
- Digitalis use

Global Risk of Cardiovascular Disease

Global risk of CAD is defined as the probability of manifesting cardiovascular disease over the next 10 years and refers to **asymptomatic** patients without known cardiovascular disease. It should be determined using one of the risk calculators below. A high risk is considered greater than a 20% risk
of a cardiovascular event over the ensuing 10 years. **High global risk by itself generally lacks scientific support as an indication for stress imaging.** There are rare exemptions, such as patients requiring I-C antiarrhythmic drugs, who might require coronary risk stratification prior to initiation of the drug, when global risk is moderate or high.

- **CAD Risk—Low**
  10-year absolute coronary or cardiovascular risk less than 10%
- **CAD Risk—Moderate**
  10-year absolute coronary or cardiovascular risk between 10% and 20%
- **CAD Risk—High**
  10-year absolute coronary or cardiovascular risk of greater than 20%

Websites for Global Cardiovascular Risk Calculators*
*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators (D'Agostino 2008, Goff 2014, McClelland 2015, Ridker 2007).

Risk Calculator	Websites for Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Definitions of Coronary Artery Disease
(Fihn 2012, Mintz 2016, Montalescot 2013, Patel 2017)

Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and can be estimated or measured using angiography or more accurately measured with intravascular ultrasound (IVUS).

- Coronary artery calcification is a marker of risk, as measured by Agatston score on coronary artery calcium imaging. It is not a diagnostic tool so much as it is a **risk stratification** tool. Its incorporation into global risk can be achieved by using the MESA risk calculator.
- Ischemia-producing disease (also called hemodynamically or functionally significant disease, for which revascularization might be appropriate) generally implies at least one of the following:

- Suggested by percentage diameter stenosis ≥ 70% by angiography; borderline lesions are 40 - 70% (Fihn 2012)
- For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum lumen cross sectional area on IVUS ≤ 6 square mm (Fihn 2012, Mintz 2016)
- FFR (fractional flow reserve) ≤ 0.80 for a major vessel (Mintz 2016)
- iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies 2017, Gotberg 2017)
- Demonstrable ischemic findings on stress testing (ECG or stress imaging), that are at least mild in degree

- A major vessel would be a coronary vessel that would be amenable to revascularization if indicated. This assessment is made based on the diameter of the vessel and/or the extent of myocardial territory served by the vessel.
- FFR (fractional flow reserve) is the distal to proximal pressure ratio across a coronary lesion during maximal hyperemia induced by either intravenous or intracoronary adenosine. Less than or equal to 0.80 is considered a significant reduction in coronary flow.
- iFR (instantaneous wave-free ratio) measures the ratio of distal coronary to aortic pressure during the wave free period of diastole, with a value ≤ 0.89 considered hemodynamically significant (Davies 2017, Gotberg 2017).
- Newer technology that estimates FFR from CCTA image is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent
(Fihn 2012, Moya 2009, Shen 2017)

Development of an anginal equivalent (e.g. shortness of breath, fatigue, or weakness) either with or without prior coronary revascularization should be based upon the documentation of reasons to suspect that symptoms other than chest discomfort are not due to other organ systems (e.g. dyspnea due to lung disease, fatigue due to anemia), by presentation of clinical data such as respiratory rate, oximetry, lung exam, etc. (as well as d-dimer, chest CT(A), and/or PFTs, when appropriate), and then incorporated into the evaluation of coronary artery disease as would chest discomfort. Most syncope per se is not an anginal equivalent.

Abbreviations

AAD	Antiarrhythmic drug
ADLs	Activities of daily living
BSA	Body surface area in square meters
CAD	Coronary artery disease
ECG	Electrocardiogram
FFR	Fractional flow reserve
LBBB	Left bundle-branch block
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy
MI	Myocardial infarction
MET	Estimated metabolic equivalent of exercise
MPI	Myocardial perfusion imaging
PFT	Pulmonary function test
PVCs	Premature ventricular contractions
SE	Stress echocardiography
VT	Ventricular tachycardia

VF	Ventricular fibrillation
WPW	Wolf Parkinson White

Policy History:
Review Date: August 2019

Review Summary:

- Changes in CAD indications in line with MPI/SE
- Added infective endocarditis and aortitis indications
- Removed cardiac neoplasms and masses indication section
- Added myocardial viability indications
- Expanded indications for cardiac sarcoidosis as the initial and follow-up study

November 2019

- Removed CPT code +0482T and replaced with code +78434

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78472 – MUGA Scan

CPT Codes: 78472, 78473, 78494, +78496

Indications for Multiple Gated Acquisition (MUGA) Scan
(Doherty, 2019)

- To evaluate left ventricular function in a patient with coronary artery disease, valvular heart disease, myocardial disease, or congenital heart disease, in any of the following scenarios:
    - When ventricular function is required for management, and transthoracic echocardiography (TTE) or other imaging has proven inadequate (Patel 2013, Yancy 2013)
    - When there are conflicting results between other testing (i.e. Myocardial Perfusion Imaging and TTE) in the measurement of ejection fraction (EF), and the results of the MUGA will help in the management of the patient
    - Prior TTE has demonstrated systolic dysfunction (EF < 50%) and management will change based on the results of the MUGA scan
    - For accurate verification of EF after the appropriate time interval following revascularization and/or optimal medical therapy to assess candidacy for an implantable cardioverter defibrillator and/or cardiac resynchronization therapy

- In the course of cardiotoxic chemotherapy when TTE images are inadequate to evaluate left ventricular systolic function (Patel 2013, Plana 2014, Zamorano 2016, Yancy 2013):
    - Prior to cardiotoxic chemotherapy, and subsequently for monitoring and follow up. The frequency of testing should be left to the discretion of the ordering physician, but generally no more often than at baseline and every 6 weeks thereafter

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BACKGROUND:
(Friedman 2006, Mitra 2012, Patel 2013, Ritchie 1995)

Multiple-gated acquisition (MUGA) scanning uses radio-labelled red blood cells to scan right and left ventricular images in a cine loop format that is synchronized with the electrocardiogram (ECG).

TTE is generally preferred for the evaluation of patients before, during, and after cancer therapy.

CMR is recommended when TTE is inadequate and/or candidacy for cardiotoxic chemotherapy based upon LVEF is questionable (Plana 2014). MUGA can also be considered when CMR is not available

Abbreviations

ECG	Electrocardiogram
EF	Ejection Fraction
MUGA	Multiple Gated Acquisition (nuclear scan of ventricular function)
MPI	Myocardial Perfusion Imaging
TTE	Transthoracic echocardiography

POLICY HISTORY:
Review Date: July 23, 2019
Review Summary:

- Removed chart on individual dosing for specific chemotherapeutic agents
- Added indication for when there are conflicting results between other testing (i.e. MPI and TTE) in the measurement of ejection fraction, and the results of the MUGA will help in the management of the patient
- Removed section on Radionuclide Angiography, Combination of Other Studies with MUGA, section on TTE and strain
- Removed CAD indication
- Added indication for cardiotoxicity as follows:
    - In the course of cardiotoxic chemotherapy when TTE images are inadequate to evaluate left ventricular systolic function (Patel 2013, Plana 2014, Yancy 2013, Zamorano 2016):
        - Prior to cardiotoxic chemotherapy, and subsequently for monitoring and follow up. The frequency of testing should be left to the discretion of the ordering physician, but generally no more often than at baseline and every 6 weeks thereafter
        - In patients with EF < 50% on TTE receiving potentially cardiotoxic chemotherapy, more frequent monitoring (every 4 weeks) may be appropriate
        - Removed section on Radionuclide Angiography, Combination of Other Studies with MUGA, section on TTE and strain

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TOC

78608 – PET Scan, Brain

CPT Codes: 78608, 78609

INDICATIONS FOR BRAIN PET SCAN using FDG (fluourodeoxyglucose):

Known brain tumor or cancer:
- To differentiate radiation necrosis or post treatment change from residual/recurrent tumor on MRI (NCCN 2019)

To determine operability of refractory seizures (Govil-Dalela 2018, Jones, 2016)

Post-operative/procedural evaluation:
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) of requested imaging.

Mild Cognitive Impairment or Dementia:
- Diagnosis: both have been met
    - Objective cognitive impairment on longitudinal assessment, i.e., historical or observed evidence of decline over time (Albert, 2011; Iaccarino, 2017)
        - Mini Mental Status Evaluation (MMSE) or Montreal Cognitive Assessment (MoCA) less than 26 (Davis, 2015) OR
        - Formal neuropsych testing showing mild cognitive impairment (Caminiti 2018, Inui 2017)
    - Potential treatable causes assessed and addressed (Albert, 2011)
        - Metabolic such as thyroid or vitamin deficiency, anemia, or chemical encephalopathy
        - Medication side effects (Campbell, 2010)
        - Medical causes such as vascular or traumatic or inflammatory
        - Brain MRI* to rule out structural causes

        ***Note**: Brain CT if MRI is contraindicated

BACKGROUND:
Positron Emission Tomography (PET) scanning using FDG (fluorodeoxyglucose) assesses brain metabolism and perfusion. Uses include identifying epileptic foci prior to surgery, differentiation of residual tumor versus scar, and causes of cognitive decline (Wippold, 2015).

Current agents which show promise in assessing plaques of the protein beta-amyloid include: florbetapir F 18, florbetaben F 18, and flutemetamol F 18 with PET. PET/MR is also being studied (Zhang, 2017). Some other new agents look at the tau protein and microglial activation.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Changed indications title to specify: ‘using FDG (fluourodeoxyglucose)’
- For indication: Mild Cognitive Impairment or Dementia, added ‘*Brain MRI to rule out structural causes or Brain CT if MRI is contraindicated*’
- Added information to background section

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78803 – Radiopharmaceutical Tumor Localization (SPECT), Single Area

CPT Codes: 78803

This guideline refers to SPECT imaging for the following: Bone/Joint Scan; Brain; Cerebrospinal Fluid; Kidney; Liver/Spleen

INDICATIONS FOR A BONE/JOINT SPECT SCAN:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging is insufficient alone (ACR, 2017; Bartel, 2018; Donohoe, 2017; O'Sullivan, 2017).

- Evaluation of **HIGH RISK** patients with primary bone tumors or tumors that are known to metastasize frequently to bone and patient has any of the following tumors (such as breast, lung, prostate, thyroid or kidney) diagnosed by biopsy or other imaging study and patient has **NOT** had a previous nuclear bone scan within the past three (3) months*
- Detection of early osteomyelitis with documented history of having a plain x-ray AND an MRI of the area performed, unless MRI is contraindicated.
- Detection of early avascular necrosis, bone infarct, or bone graft viability and patient has had a plain x-ray **OR** a CT of the suspicious area and MRI is contraindicated or inconclusive.
- Detection of stress fractures and other occult skeletal trauma and patient has localized pain in the suspected area (Bartel, 2018). (If history of recent MRI of suspected area, those MRI results should be either positive or inconclusive to necessitate bone SPECT.)
- Resolution of questionable/inconclusive abnormal skeletal radiographs when MRI or CT is inconclusive or cannot be performed.
- Assess the distribution of osteoblastic activity before radionuclide therapy for bone pain (Bartel, 2018).
- For evaluation of unexplained extremity pain when clinical criteria and other imaging (x-ray, MRI, Ultrasound or CT) evaluation is inconclusive (e.g. differentiating complex regional pain syndrome from other causes of pain) (Kwon, 2011; Shin, 2017).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Single-photon emission computed tomography (SPECT) is a nuclear medicine imaging technique based on the use of computed tomography to localize data from gamma ray emitting injected radiopharmaceuticals to specific anatomical locations within the patient. The resulting 3D images can be reconstructed in multiple planes. As a general rule, the detection efficiency and spatial resolution improves as the number of detecting cameras comprising the imaging system increases. Radiopharmaceuticals used vary based on the clinical

indication. The technique is applied in brain, cardiac, pulmonary, abdominal, endocrine, and musculoskeletal imaging.

Bone Single-Photon Emission Computed Tomography (SPECT) differs from traditional "planar" or 2D bone scan imaging (scintigraphy) through the use of computerized techniques and advanced imaging systems to help improve the localization of osseous pathology. The ability to manipulate the imaging data into distinct multiplanar slices improves the diagnostic capability and spatial resolution while using the same pharmaceutical as with traditional planar bone scan. Due to advances in cross sectional imaging, the technique currently has limited indications for detecting bone pathology. It is used in patients who cannot undergo MRI or CT imaging. The major utility of bone scanning is in defining the distribution of disease (metastasis or multifocal bone lesions) by imaging the entire skeleton. Furthermore, for many indications SPECT imaging is not routinely employed unless precise anatomical localization of pathology is required.

OVERVIEW:
SPECT Scan - Single photon emission computed tomography (SPECT) is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera to acquire multiple 2-D images (also called projection), from multiple angles.

Nuclear medicine bone imaging is commonly performed with Technicium-99m-MDP (methylene diphosphonate) or less frequently to evaluate infection with Indium-111 labelled white blood cells. The technique for all indications of bone imaging has largely been replaced by MRI and CT. Ultrasound has also replaced nuclear medicine imaging as a quick, readily available and less expensive study to determine soft tissue sterile or infected fluid collections. When indicated, for patients with impaired renal function who cannot receive iodinated or gadolinium based contrast agents or undergo MRI for other reasons, SPECT imaging can improve the performance of conventional planar nuclear bone imaging. Although 18F labelled sodium fluoride (NaF) PET scanning is highly sensitive for detecting bone lesions, its routine use has not replaced conventional bone scanning due to the latter's "effectiveness, widespread availability, low cost and favorable dosimetry" (O'Sullivan, 2015).

In the evaluation of Complex regional pain syndrome (CRPS), formerly reflex sympathetic dystrophy, three phase bone scintigraphy (flow, blood pool and delayed images) and MRI imaging sensitivities reported in the medical literature, ranges widely (Shin, 2017). In general, scintigraphy is more specific than MRI. SPECT imaging however is not routinely used for this indication.

*The Society of Nuclear Medicine recently released updated guidelines for bone scanning in patients with breast and prostate cancer (Donohoe, 2017). For prostate cancer "Bone scintigraphy is usually not appropriate for initial staging in patients with a low risk of metastatic disease (PSA level, <10 ng/mL, Gleason score, < 6, and no other clinical signs or symptoms of disease)". "Breast neoplastic disease discovered at an early stage is unlikely to metastasize to bone; therefore, unless there are signs or symptoms suggesting metastasis in early-stage disease, bone imaging is not necessary."

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Emphasized the indication is for High Risk patients and not routine workup for all patients with cancer
- Updated references

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INDICATIONS FOR A BRAIN SPECT:

- For the evaluation of suspected brain trauma for patient with recent neurological symptoms or deficits (such as one-sided weakness, speech impairments, or vision defects) **AND** patient has had a recent Brain CT or Brain MRI (ACR, 2015).
- For the evaluation of suspected dementia, for patient who has had a recent Brain CT or MRI (Hort, 2010) **AND** all three (3) of the following were completed (ACR, 2015; Falk, 2018):
    - Thyroid study
    - B_{12} assay
    - Mini Mental State Exam (MMSE or MoCA) score of less than 26 or similar mental status instrument showing at least mild cognitive impairment
- For pre-surgical localization of epileptic foci, patient has had either a Brain CT or Brain MRI **AND** surgery is tentatively scheduled (Kim, 2011).
- For patient with history of cerebral vascular accident or stroke with recent Brain CT and/or MRI **AND** there are acute neurological changes or deficits not explained on the recent imaging study (ACR, 2016)
- To evaluate cerebrovascular reserve in planning appropriate endovascular vascular intervention or neurovascular surgical approach (ACR, 2016)
- For the diagnosis of movement disorders: e.g. Parkinson's syndrome (PS) when there is an unclear clinical presentation or lack of response to treatment (differentiation of PS from essential tremor or drug induced PS) (Mittal, 2018; Seifert, 2013).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Single-Photon Emission Computed Tomography (SPECT) is a nuclear medicine imaging technique based on the use of computed tomography to localize data from gamma ray emitting injected radiopharmaceuticals to specific anatomical locations within the patient. The resulting 3D images can be reconstructed in multiple planes. As a general rule, the detection efficiency and spatial resolution improves as the number of detecting cameras comprising the imaging system increases. Radiopharmaceuticals used vary based on the clinical indication. The technique is applied in brain, cardiac, pulmonary, abdominal, endocrine, and musculoskeletal imaging.

Single-Photon Emission Computed Tomography (SPECT) brain imaging is based on the correlation between neuronal activity and cerebral perfusion. Technicium labeled radiopharmaceuticals are injected into the patient and cross the blood brain barrier where they emit gamma rays that are detected by the imaging system. A 3D image of the brain is created using computerized techniques with the degree of radionuclide activity corresponding to neuronal activity and cerebral blood flow. Pathological conditions evaluated include cerebrovascular disease, dementia, detection of seizure foci, neuropsychological disorders, infection, and trauma. DaTscan™ utilizes injection of the radiopharmaceutical Ioflupane I 123 and SPECT imaging for the evaluation of parkinsonian syndromes through assessment of dopamine transport.

SPECT scanning is usually employed in selected scenarios when clinical symptoms, laboratory findings, and conventional imaging are inconclusive for providing a definitive diagnosis. In the evaluation of cognitive impairment, various dementias can be differentiated through characteristic perfusion patterns. In the assessment of transient ischemic disease, reduced perfusion can be seen earlier than changes on conventional imaging and may help plan appropriate therapeutic intervention. For this indication, the technique can be performed with agents that enhance regional blood flow such as Acetazolamide which causes regional arterial dilatation by increasing local carbon dioxide. Recent studies indicate some positron emission tomography (PET) techniques may be superior to SPECT for this indication (Acker 2017). In traumatic brain injury, SPECT studies have shown areas of hypoperfusion without corresponding MRI or CT findings (ACR, 2015). When the location of a seizure focus is in doubt prior to surgery SPECT scans performed in a monitored environment during a seizure are compared with a nonictal study. Suspicious seizure foci demonstrate greater blood flow during the ictal scan.

OVERVIEW:
Literature for evaluation of brain trauma indicates that SPECT can help evaluate perfusion abnormalities not only in cases evaluating blunt brain trauma, but also in cases of post-concussive syndrome and whiplash.

Evaluation of suspected dementia requires both specialty management and requires that several preliminary tests be performed. The majority of the literature indicates that SPECT can assist in the differential diagnosis of dementia disorders when used in conjunction with clinical examination and neuropsychological testing. However, there are several negative studies in the literature that suggest that the predictive value of SPECT is not high enough to be used on a routine clinical basis. In addition, there are other pathological processes that can produce patterns consistent with AD (Alzheimer's Disease) and FTD (Frontotemporal Dementia) patterns, most notably brain injury that affects the prefrontal cortex pole and anterior temporal lobes (like FTD) or a brain injury that affects the temporal and parietal lobes. As with any test it is important that SPECT be used and interpreted within a clinical context.

Pre-operative evaluation for epilepsy seeks information as to whether an anatomic study (CT and/or MRI) has been performed and if the surgery has been scheduled. While a number of authors have evaluated the utility of brain SPECT and various structural techniques for the localization of seizure foci, at the time of writing the preferred examination under these circumstances (if available) is a functional MRI (fMRI) To put these advantages in perspective, functional images obtained by the earlier method of positron emission tomography (PET), PET or SPECT require injections of radioactive isotopes, multiple acquisitions, and, therefore, extended imaging times. Further, the expected resolution of PET images is much larger than the usual fMRI pixel size.

Evaluation of cerebral vascular disease = Perfusion SPECT can provide valuable information in acute stroke with respect to complications, but anatomic studies such as CT and/or MRI must have also been performed.

Classic Parkinson Disease (PD) features include tremor, rigidity, bradykinesia, and unstable posture, however not all patients exhibit clear clinical symptoms. Furthermore, pathology only confirms 80% of clinically diagnosed PD. The study of Seifert et al indicated the results of DaT (dopamine transporter) scan changed the diagnosis in 31 of 112 patients studied. In patients where DaT scan reinforced the clinical diagnosis of PD yet the patients did not respond to initial medication, change in medication was initiated.

POLICY HISTORY:

Review Date: April 2019
Review Summary: Updated references only

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INDICATIONS FOR A CEREBROSPINAL FLUID FLOW (CSF) SPECT SCAN:

Complex clinical scenarios involving the following indications wherein CT, MRI, or routine dynamic planar imaging is insufficient alone:

- Evaluation of hydrocephalus in the absence of CSF shunting and the patient has had a CT or MRI imaging of the head recently performed and compared to prior exam or when MRI is contraindicated (Thut, 2014).
- Detection of CSF leak and the patient has had a recent surgical procedure and CT or MRI imaging of the surgical site has been performed (Bowser, 2015; Epstein, 2013; Lloyd, 2008).
- Detection of CSF leak AND patient experienced recent trauma and CT or MRI imaging has been performed (Lloyd, 2008).
- Evaluation of the function of a CSF shunt and the patient has had a CT or MRI imaging of the head recently performed and compared to prior exams and radiographic evaluation of shunt catheter has been recently performed (Chiewvit, 2014)
- For evaluation of Normal Pressure hydrocephalus where differentiation from other, or the presence of concurrent, neurodegenerative disorders based on clinical criteria is difficult and MRI for evaluating CSF dynamics is contraindicated (Damasceno, 2015; Halperin, 2015; Thut, 2014).
- Suspected spontaneous intracranial hypotension (SIH) with CSF pressure below 6 cm H_2O and preliminary CT or MRI and/or MRI or CT myelography have been performed (Lin, 2017).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Single-photon emission computed tomography (SPECT) is a nuclear medicine imaging technique based on the use of computed tomography to localize data from gamma ray emitting injected radiopharmaceuticals to specific anatomical locations within the patient. The resulting 3D images can be reconstructed in multiple planes. As a general rule, the detection efficiency and spatial resolution improves as the number of detecting cameras comprising the imaging system increases. Radiopharmaceuticals used vary based on the clinical indication. The technique is applied in brain, cardiac, pulmonary, abdominal, endocrine, and musculoskeletal imaging.

Due to the development of superior cross-sectional imaging modalities (CT, CT myelography, MRI) and MRI techniques that provide functional CSF flow information (cine phase contrast and diffusion tensor), nuclear medicine CSF flow studies with or without SPECT are seldom used. Cerebrospinal fluid (CSF) flow studies for the evaluation of obstructive or non-obstructive hydrocephalus of various etiologies or CSF leaks (CSF cisternography) are performed after the intrathecal administration of radionuclide. In patients without hydrocephalus or CSF leak there is a predictable radiopharmaceutical distribution. To evaluate ventriculoperitoneal shunt patency, radionuclide is injected into the shunt reservoir. The radionuclides used for CSF flow studies are Indium-111 DTPA for cisternography and leaks and Tc-99m DTPA for shunt studies (Ma, 2015). Due to advances in thin section CT, as well as MRI and CT myelographic techniques, CSF flow studies for detecting leaks have been reserved for complex cases where the diagnosis is in question (Lloyd, 2008). Advanced MRI CSF flow dynamic techniques (e.g. cine phase-contrast MRI) provide functional

information and have largely replaced scintigraphy for evaluating normal pressure hydrocephalus (ACR, 2015; Damasceno, 2015; Halperin, 2015).

OVERVIEW:
SPECT SCAN - Single photon emission computed tomography (SPECT) is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera to acquire multiple 2-D images (also called projections), from multiple angles.

According to Tsai, more than 30% of patients treated with CSF shunting for hydrocephalus will develop shunt obstruction within the first year of shunt insertion (Tsai, 2017). In the setting of hydrocephalus from suspected shunt obstruction the diagnostic evaluation, following CT or MRI scanning of the head and x-ray shunt series, involves injection of radiopharmaceutical into the shunt reservoir. Normal shunt patency is confirmed by showing activity along the entire course of the shunt, ultimately spilling into the abdominal cavity.

CSF scintigraphy is also utilized in diagnosing hydrocephalus unrelated to shunt malfunction (e.g. normal pressure hydrocephalus). In the absence of hydrocephalus, radionuclide activity is normally seen over the convexities of the brain at 24 hours and may be transiently present in the lateral ventricles within the first 24 hours. Persistence of activity in the lateral ventricles after 24 hours of imaging is diagnostic of hydrocephalus. Cine phase contrast MRI is the preferred technique for evaluating CSF flow dynamics and helps determines which patients with NPH will benefit from treatment (Damasceno, 2015; Halperin, 2015).

CSF leaks are more commonly acquired, either iatrogenic or post traumatic (Lloyd, 2008), than congenital or spontaneous and can occur anywhere along the cranial spinal axis. Scintigraphy for detecting CSF leaks has been superseded by CT and MRI myelographic techniques due to their better spatial resolution (Epstein, 2013). Diagnosis using scintigraphy requires intrathecal administration of radionuclide followed by imaging typically at three, six, and twenty-four hours. Pledgets can be placed in the nasal cavity or auditory canal in the setting of CSF rhinorrhea and otorrhea, respectively. The greatest limitation of the technique relative to CT or MRI imaging is that CSF has to be actively leaking at the time of imaging. By comparison, for cranial trauma or post-operative complications, thin section CT can detect osseous skull base defects with a sensitivity of 92% and specificity of nearly 100% without the need for active CSF leaking (Lloyd, 2008).

The usefulness of scintigraphy is primarily as a second line study in patients with suspected CSF leaks who have undergone MRI and or CT myelography without detecting the leak. Because delayed imaging can be carried out, CSF scintigraphy is useful for evaluating slow or intermittent CSF leaks and as a second line study in the work up of spontaneous idiopathic hypotension (SIH). In this condition a CSF leak anywhere along the neuraxis is not detected in nearly one third of patients thought to be due to the slow or intermittent nature of these leaks (Lin, 2017).

Spontaneous idiopathic hypotension (SIH), also known as craniospinal hypotension, poses a diagnostic challenge due to its protean clinical symptoms, inconsistently demonstrated imaging findings on conventional MRI scanning and lack of awareness of the diagnosis among clinicians. SIH often presents a variable mix of symptoms including orthostatic headaches, visual defects or blurred vision, limb paresthesia, transient 3rd cranial nerve palsy, numbness in the face or limbs, cognitive deficits, behavioral changes, neck pain and stiffness, taste alteration, or Parkinsonism.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Added content explaining this study is appropriate after other imaging has been completed or is contraindicated
- Updated references

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INDICATIONS FOR A KIDNEY DYNAMIC PLANAR SCAN WITH SPECT:

Complex clinical scenarios involving the following indications wherein cross sectional imaging and routine nuclear medicine dynamic planar imaging is insufficient alone:

- Evaluation of renal, ureteral, or other urinary tract trauma or surgery with signs, symptoms, and laboratory findings supporting the need for such an evaluation; **AND**
  - CT has been performed and is inconclusive or contraindicated.
- For diagnosis of reno-vascular hypertension with signs, symptoms, laboratory findings, or other imaging supporting the need for such a diagnosis when MRA or CTA cannot be performed or is contraindicated; **AND**
  - Ultrasound is inconclusive; **AND**
  - The patient has adequate renal function (GFR >30) mL/min/1.73 m2.) to undergo the study

  (ACR, 2017)
- Detection and evaluation of renal collecting system obstruction **AND** ultrasound has been performed (ACR, 2017).
- Diagnosis of intrinsic renal acute kidney injury when other causes of renal failure have been excluded and evaluated with ultrasound; **OR**
  - The diagnosis is suspected due to past medical history, preceding ischemic, infectious or toxic events

  (ACR, 2016)
- Diagnosis of renal transplant complications after ultrasound has been performed (ACR, 2017).
- Evaluation of renal infections and discrimination of pyelonephritis from cortical scarring (ACR, 2017).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Single-photon emission computed tomography (SPECT) is a nuclear medicine imaging technique based on the use of computed tomography to localize data from Gamma ray emitting injected radiopharmaceuticals to specific anatomical locations within the patient. The resulting 3D images can be reconstructed in multiple planes. As a general rule, the detection efficiency and spatial resolution improves as the number of detecting cameras comprising the imaging system increases. The technique is applied in brain, cardiac, pulmonary, abdominal, endocrine, and musculoskeletal imaging.

Renal scintigraphy remains an important technique for evaluation of the renal circulation, parenchyma, and collecting system. Through the acquisition of serial images over time and graphic depiction of radionuclide activity, information about renal blood flow and function not typically afforded by cross sectional imaging can be achieved. Tailored studies utilizing the administration of diuretic or angiotensin-converting enzyme inhibitors, in conjunction with the radionuclide imaging agent, allows for evaluation of suspected hydronephrosis or renovascular hypertension, respectively. The ability to create 3D multiplanar images with the SPECT technique greatly improves the diagnostic capability over traditional planar imaging.

OVERVIEW:

SPECT Scan - Single photon emission computed tomography (SPECT) is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera to acquire multiple 2-D images (also called projections), from multiple angles.

Causes of acute kidney injury (AKI) are classified as prerenal, postrenal, and intrinsic renal. Nuclear medicine renal scanning is useful in evaluation AKI when other causes have been excluded by clinical, laboratory or imaging (e.g. ultrasound). Acute tubular necrosis (ATN) is the most common type of intrinsic renal AKI in hospitalized patients (Rahman, 2012). Certain patterns of radionuclide distribution can provide information on the cause of intrinsic intrarenal AKI such as ATN, acute cortical necrosis and acute glomerulonephritis (ACR, 2013).

Renal Transplant evaluation: Vascular compromise (arterial stenosis/occlusion, venous thrombosis, and segmental infarction), ureteral obstruction, acute rejection and acute tubular necrosis can affect renal transplants. In evaluating the failing transplant, ultrasound and scintigraphy are complimentary studies. Renal ultrasound with doppler is the initial modality for evaluation of renal transplants and allows detection of vascular compromise, hydronephrosis or post-operative fluid collections (urinoma/ seroma/hematoma. The occurrence of various insults to the transplant usually involve a predictable post-operative timeframe and provides a clue to the cause of deteriorating renal function. Acute tubular necrosis (ATN) is the most common medical complication observed at renal scintigraphy and is more common in cadaveric transplants than living donors owing to organ ischemia as the underlying cause. ATN is differentiated from acute rejection as it usually occurs within the first few days after transplantation whereas acute rejection occurs from one week to months after transplantation. In cases of ATN parenchymal perfusion to the transplant is relatively well maintained but there is no excretion. With rejection both perfusion and function are compromised. Although scintigraphy is sensitive in detecting renal transplant dysfunction it cannot distinguish between acute rejection, ATN and cyclosporin toxicity (ACR, 2016). Post-transplant studies are obtained by some centers as a baseline for future comparison.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Changed the following indication: "Diagnosis of ~~acute tubular necrosis~~ intrinsic renal acute kidney injury when other causes of renal failure have been excluded and evaluated with US"
- Added Background information to provide a summary of non-transplant related application
- Updated references

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INDICATIONS FOR A LIVER/SPLEEN SPECT SCAN:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging and other imaging (US, CT (A), MRI (A) or angiography) is insufficient alone (ACR, 2014):

- Evaluation of hepatic artery catheter placement. (For evaluation of the hepatosplenic vascular distribution and or aberrant flow pattern prior to chemotherapeutic infusion) when CT angiography cannot be performed or is indeterminate (Morsbach, 2014).
- Detection of accessory splenic tissue or asplenia **AND** Abdominal CT and/or MRI are indeterminate or contraindicated (Lake, 2012; Ekmekci, 2015)**.**
- Evaluation of suspected hepatic hemangioma or focal nodular hyperplasia **AND** Abdominal CT and MRI are contraindicated (ACR, 2014).
- Evaluation of patients with suspected liver or spleen rupture or hematoma **AND** Abdominal CT and MRI are contraindicated.
- Detection of space-occupying lesions: abscesses, cysts, and primary tumors when ultrasound is inconclusive, **AND** Abdominal CT and MRI are contraindicated.
- Evaluation of hepatic primary or metastatic tumors (pre and post-therapy) when ultrasound is inconclusive, **AND** Abdominal CT and MRI are contraindicated.
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:

Single-photon emission computed tomography (SPECT) is a nuclear medicine imaging technique based on the use of computed tomography to localize data from gamma ray emitting injected radiopharmaceuticals to specific anatomical locations within the patient. The resulting 3D images can be reconstructed in multiple planes. As a general rule, the detection efficiency and spatial resolution improves as the number of detecting cameras comprising the imaging system increases. Radiopharmaceuticals used vary based on the clinical indication. The technique is applied in brain, cardiac, pulmonary, abdominal, endocrine and musculoskeletal imaging.

Due to the improved anatomical detail afforded by CT, MRI and Ultrasound, these techniques have largely replaced radionuclide liver and spleen imaging. Liver and spleen Single-Photon Emission Computed Tomography (SPECT) imaging, depending on the indication, can be undertaken using either the IV injection of sulfur colloid or red blood cells labeled with Tc99M. Sulfur colloid images are created by taking advantage of the reticuloendothelial cells ability to phagocytize the agent. Indications using this agent include the detection of hepatosplenomegaly, hepatocellular disease, and certain focal hepatic lesions. Red blood cell scanning is limited to the evaluation of liver hemangiomas. The ability to create 3D multiplanar images with the SPECT technique greatly improves the diagnostic capability over traditional planar imaging.

OVERVIEW:

SPECT Scan - Single photon emission computed tomography (SPECT) is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera to acquire multiple 2-D images (also called projections), from multiple angles.

Hepatobiliary imaging or HIDA (hepatobiliary iminodiacetic acid) scan: Unlike liver spleen scans, HIDA is an imaging procedure utilizing the IV administration of Tc99M labeled iminodiacetic acid which is excreted by hepatocytes like bile. This technique utilizes a series of standard planar images over time to determine the progression of the radionuclide through the biliary system. HIDA scanning is used primarily to evaluate cystic duct obstruction (cholecystitis), common bile duct obstruction, congenital biliary system anomalies, and bile leaks, rather than hepatic parenchymal abnormalities for which liver spleen scanning and cross sectional imaging (CT, MRI, US) is utilized.

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Added 'when ultrasound is inconclusive' to the following indications:
  - Detection of space-occupying lesions….when US is inconclusive
  - Evaluation of hepatic primary or metastatic tumors….when US is inconclusive
- Updated references

REFERENCES:

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78813 – PET Scans

78811 - Limited area e.g. Chest, head/neck
78812 - Skull base to mid thigh
78813 - Whole Body
78814 - With CT attenuation (Limited area e.g. Chest, head/neck)
78815 - With CT attenuation (Skull base to mid thigh)
78816 - With CT attenuation (Whole Body)

The appropriateness of an ordered PET/CT study is fully dependent on the answer to the question of which radiopharmaceutical will be used for the PET/CT. This guideline only covers the radiopharmaceuticals F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine (Axumin)

The following are noncovered for F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine (NCCN 2019):

- **Adrenal** (except pheochromocytoma/ paraganglioma) - Initial or Restaging
- **ALL** (Acute Lymphoblastic Leukemia)/ **AML** (Acute Myelogenous Leukemia) - Unless prior imaging suggests lymphomatous involvement
- **BCC** (Basal Cell Carcinoma (of the skin))
- **Bladder Cancer** - non muscle invasive (by imaging or tissue sample)
- **Breast cancer** - Initial Staging for Stage I and II Breast Cancer
- **Chordoma** – Restaging
- **Gallbladder/ Extrahepatic Cholangiocarcinoma** - Restaging
- **Gastric Cancer** - Initial staging if there is evidence of metastases (M1), or very early disease (T1)
- **Hepatocellular / Intrahepatic Cholangiocarcinoma** - Initial and Restaging
- **Infection and/or Inflammation**
- **Melanoma** - Initial and Restaging for Stage I and II Melanoma (NCCN 2016)
- **Myeloma, Smoldering** - except to discern smoldering from active myeloma with negative skeletal survey
- **Ovarian Cancer** - Restaging if stage I
- **Pancreatic Cancer** – Restaging
- **Pleural Mesothelioma, Malignant** - Initial staging except if stage I-IIIA and presurgical
- **Prostate Cancer** - Initial or Restaging
- **Renal Cancer** - Initial and Restaging
- **Small bowel adenocarcinoma** - Initial Staging
- **Small cell lung cancer** - Staging (Initial or Restaging) for extensive disease
- **Squamous Cell Carcinoma, Skin** - Restaging
- **Vulvar Cancer** <T2 or no suspicion of metastatic disease

INDICATIONS FOR AN ONCOLOGICAL F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine PET SCAN:
Note: for radiation treatment planning, contact health plan directly

INITIAL TREATMENT STRATEGY:

Indicated for most solid tumors, including active myeloma, with biopsy proven cancer or strongly suspected, based on other diagnostic testing, including:

- **CLL** (Chronic Lymphocytic Leukemia): only when high-grade histologic transformation is suspected (NCCN, 2018)
- **SPN** (Solitary or clearly dominant indeterminate Pulmonary Nodule ≥ to 8mm in size without existing tissue diagnosis (**Note**: Patient may have other non-suspicious nodules in the lung, such as granulomas and hamartomas) (Bueno, 2018; MacMahon, 2017).
- To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor; **OR**
- To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic (eg. surgery) procedure; **OR**
- To determine the optimal anatomic location for an invasive procedure AND prior imaging insufficient.

For the following solid tumors initial staging is only indicated after prior inconclusive imaging (NCCN 2019):

- Bladder cancer, Muscle invasive
- Chordoma
- Colorectal
- Endometrial Cancer
- Gallbladder/ Extrahepatic Cholangiocarcinoma
- Neuroendocrine tumors which are poorly differentiated, with prior negative Ga68 Dotatate/ MIBG/Octreotide scan (includes Pheochromocytoma/ paraganglioma, extrapulmonary large/small cell)
- Ovarian/ Fallopian
- Pancreatic Cancer (unless high risk features: borderline resectable, markedly elevated CA19-9 >180 U/ml, large primary tumor/ lymph nodes, very symptomatic (jaundice, symptomatic gastric outlet obstruction, venous thromboembolism, extreme pain and weight loss))
- Penile (for palpable nodes only)
- Sarcoma/ GIST/ Uterine/Rhabdomyosarcoma
- Skin squamous Cell Carcinoma
- Tumor of unknown origin/Occult Primary

SUBSEQUENT TREATMENT STRATEGY (NCCN 2019):

Restaging or monitoring response to active treatment (including immunotherapy), and/or a single evaluation after completion/cessation of therapy. The interval should ideally be 6-12 weeks after surgery, and 12 weeks after radiation. PET can be performed 1 - 3 weeks after neoadjuvant chemotherapy or neoadjuvant chemoradiation to assess stage for surgery. PET evaluation can also be done for suspicion of recurrence due to new or changing signs/symptoms, rising tumor markers, or inconclusive findings on CT or MRI. Asymptomatic surveillance is not approvable (NCCN 2018, 2019):

- Cervical cancer
- Esophageal and esophagogastric cancer
- Head and neck cancer (not including Brain cancer/tumor; thyroid noted below)
- Lung cancer - Non-small cell and limited stage small cell cancer
- Lymphoma
- Melanoma- only stage III, IV (excludes uveal melanoma)

- Merkel Cell Carcinoma
- Mesothelioma, if surgery is planned
- Myeloma, active/plasmacytoma
- Soft tissue sarcoma: only stage II/III for response to neoadjuvant Rx
- Vulvar/vaginal

Subsequent PET Scans may be performed **only if other imaging (i.e. US, CT, MRI, NM) is inconclusive/ insufficient in determining a treatment plan or unable to be performed or with rising tumor markers and negative/ insufficient other imaging.**

PET may be indicated if CT cannot be performed due to significant iodinated contrast allergy or chronic renal failure **AND** MRI cannot be performed due to significant gadolinium contrast allergy or if renal failure with GFR < 30 (RSNA, 2014).

Solid malignancies, except for those not covered for F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine, where other imaging (i.e., US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed. PET CT is to be used only if the cancer is known to be generally F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine avid. Malignancies such as (not an all-inclusive list):

- Adenocarcinoma of the small bowel
- Anal/ Vulvar/ Penile Carcinoma
- Bladder cancer, only if metastatic
- Bone Sarcoma
- Brain cancer (with metastasis to non-head areas) - Refer to Brain PET Scan Guidelines to image the brain
- Breast cancer (female and males)
- Colorectal Cancer – resectable metastatic disease only
- Endometrial cancer if candidate for surgery/locoregional therapy
- Extensive small cell lung cancer
- Gastric Cancer
- Ovarian/ malignant germ cell tumors/primary peritoneal cancer – Stage II-IV
- Poorly differentiated or dedifferentiated neuroendocrine tumors with prior negative Ga68 Dotatate/ MIBG/Octreotide scan (includes Pheochromocytoma/ paraganglioma, extrapulmonary large/small cell)
- Sarcoma/ GIST/ Uterine/Rhabdomyosarcoma
- Testicular cancer
- Tumor of unknown origin/Occult Primary

Thyroid Cancer:

- Subsequent treatment strategy for recurrence or distant metastasis for thyroid cancer of Papillary, Follicular, or Hurthle cell origin **AND** patient has the following (NCCN 2019, ATA 2015):
    - A thyroidectomy and radioiodine ablation initially; **AND**
    - Stimulated serum thyroglobulin > 5 ng/ml or high anti- thyroglobulin antibody (anti-Tg Ab) >1 year after treatment (Na SJ 2012) **AND**
    - Current stimulated whole body I-131/ I-123 scan is negative (Alzahranj 2012)

Medullary thyroid cancer when calcitonin levels ≥ 150 pg/ml post primary treatment (NCCN 2019, Souteiro 2019)
Anaplastic: Initial and Restaging after prior inconclusive/ insufficient CT/MRI (NCCN 2019)

PEDIATRIC CANCERS (for indications different from adult guidelines)

- Nasopharyngeal Cancer- Initial staging after inconclusive/ insufficient MRI; Restaging. (Cheuk 2012)

- Neuroblastoma/ other cancers under Ga68 imaging: only with prior negative/ inconclusive MIBG/ Octreotide/ Ga68 PETCT (Uslu 2015, Alexander 2018, Kong 2016, Li 2018, Elkhatib 2017)
- Sarcoma - Initial and Restaging (Quartuccio 2015)

Surveillance/Remission

Surveillance/remission PET scan testing to assess for possible changes in status with no signs or symptoms of active cancer changes and not on any active treatment. Unless otherwise specified above, PET scan is not indicated for surveillance/remission.

INDICATIONS FOR AN ONCOLOGICAL GALLIUM 68 DOTATATE PET/CT SCAN:

Initial Treatment Strategy or Subsequent Treatment Strategy (NCCN 2019, Deppen, 2016 a, b)

For the following Neuroendocrine Tumors:
- Gastrointestinal tract, pancreas, lung, thymus (carcinoid tumors)
- Large or small cell carcinoma other than lung
- Medullary Thyroid Cancer for Initial staging; and Restaging when calcitonin ≥ 150 pg/ml
- Neuroendocrine tumors of unknown primary
- Pheochromocytoma, paraganglioma

OR Syndromes*:*
- Multiple endocrine neoplasia 1 (MEN-1)
- Multiple endocrine neoplasia 2 (MEN-2)

Neuroendocrine tumors should be:
- **Biopsy proven** (required in unknown primary cases) or **very strongly suspected based on other diagnostic testing**
  AND
- Site specific multiphasic CT or MRI has been performed and **reasonably deemed insufficient** for the following:
  - To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor; **OR**
  - To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure; **OR**
  - To determine the optimal anatomic location for an invasive procedure
  - Restaging or monitoring response to active treatment, and/or evaluation for suspicion of recurrence due to new or changing signs/symptoms and rising biomarkers (asymptomatic surveillance is not approvable).

Surveillance/Remission

Both somatostatin receptor imaging (Gallium-68 DOTATATE PET) and F^{18} FDG, F^{18} Fluciclovine PET/CT are **NOT** recommended for routine surveillance.

INDICATIONS FOR AN ONCOLOGICAL ^{18}F-Fluciclovine (Axumin) PET/CT SCAN (Recurrent Prostate Cancer): Known prostate cancer for workup of recurrence and response to treatment, only if other imaging (CT, MRI) AND Bone scan is inconclusive/insufficient. (NCCN 2019, Andriole 2019, Bach-Gansmo 2017)

- ^{18}F-Fluciclovine PET/CT:

    - Post radical prostatectomy with
        - Failure of PSA to fall to undetectable levels or PSA detectable and rising on at least 2 subsequent determinations
    - Post radiation therapy with
        - Rising/persistent PSA (increase should be >2ng/ml unless doubling time <=8 months or pt is a candidate for local salvage therapy)

BACKGROUND:
Positron emission tomography (PET) is a rapidly developing and changing technology that is able to detect biochemical reactions, e.g., metabolism, or abnormal distribution of cell receptors within body tissues. A radioactive tracer is used during the procedure. Unlike other nuclear medicine examinations, PET can measure metabolic activity of the cells of body tissues, providing information about the functionality and structure of the particular organ or tissue examined. PET may also detect biochemical changes that help to evaluate malignant tumors and other lesions.

The degree of radioactive tracer uptake may indicate increased metabolism in the cells of body tissues or an abnormal distribution of cell receptors. Cancer cells may show increased radioactive tracer relative to tissue not involved with tumor. Radioactive tracer uptake is often higher in fast-growing tumors; PET is often not as beneficial for slow growing tumors. Radioactive tracer uptake may occur in various types of active inflammation and is not specific for cancer.

POLICY HISTORY:
Review Date: September 2019
Review Summary:

- Removed Introduction section
- Removed "Important Note"
- Changed title "The following are noncovered for all other indications including (but not limited to):" to "The following are noncovered for F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine (NCCN 2019):"
- Under noncovered for F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine section, added the following:
    - Breast cancer - Initial Staging for Stage I and II Breast Cancer
    - Melanoma - Initial and Restaging for Stage I and II Melanoma (NCCN 2016)
    - Bladder Cancer - non muscle invasive (by imaging or tissue sample)
    - Vulvar Cancer < T2 or no suspicion of metastatic disease
    - Prostate Cancer - Initial or Restaging
    - Small cell lung cancer - Staging (Initial or Restaging) for extensive disease
    - Ovarian Cancer - Restaging if stage I
    - Pancreatic Cancer - Restaging
    - Renal Cancer - Initial and Restaging
    - Skin Squamous Cell Carcinoma - Restaging
    - Gastric Cancer - Initial staging if there is evidence of metastases (M1), or very early disease (T1)
    - Malignant Pleural Mesothelioma - Initial staging except if stage I-IIIA and pre-surgical
    - Hepatocellular / Intrahepatic Cholangiocarcinoma - Initial and Restaging
    - Gallbladder/ Extrahepatic Cholangiocarcinoma - Restaging
    - Small bowel adenocarcinoma - Initial Staging
    - Chordoma – Restaging
    - Adrenal (except pheochromocytoma/ paraganglioma) - Initial or Restaging
    - Smoldering Myeloma - except to discern smoldering from active myeloma with negative skeletal survey
    - ALL (Acute Lymphoblastic Leukemia)/ AML (Acute Myelogenous Leukemia) - Unless prior imaging suggests lymphomatous involvement
    - BCC (Basal Cell Carcinoma (of the skin))
    - Infection and/or Inflammation: removed "- PET for chronic osteomyelitis, infection of hip arthroplasty, and fever of unknown origin."
- Under indications for oncological PET heading, added: "Note: for radiation treatment planning, contact health plan directly"
- Under Initial Treatment Strategy, the first sentence now specifies "active myeloma" instead of "myeloma" previously
- Under Initial Treatment Strategy, the last sentence now replaces "after a" with "AND": "To determine the optimal anatomic location for an invasive procedure AND prior imaging insufficient"
- "CLL – chronic lymphocytic leukemia (PET/CT is generally not useful in CLL/SLL but may be necessary to direct nodal tissue sampling when high-grade histologic transformation is suspected) (NCCN, 2018)." has been changed to "CLL (Chronic Lymphocytic Leukemia): only when high-grade histologic transformation is suspected (NCCN, 2018)"
- Changed references for SPN to "(Bueno, 2018; MacMahon, 2017)" from previous "(Vansteenkiste, 2006)"
- Removed the section:
  " Excluding
    • ALL- acute lymphoblastic leukemia

    - Unless prior CT imaging suggest lymphomatous involvement
  - AML – acute myelogenous leukemia
    - Unless clinical suspicion for extramedullary disease
  - BCC – basal cell carcinoma (of the skin)
  - Prostate cancer (NCCN, 2018)"
- Added "EXCEPT for the following, which are only indicated after prior inconclusive imaging (NCCN 2019):
  - Colorectal
  - Ovarian/ fallopian
  - Sarcoma/ GIST/ Uterine/Rhabdomyosarcoma
  - Chordoma
  - Muscle invasive bladder cancer
  - Endometrial Cancer
  - Penile (for palpable nodes only)
  - Occult Primary
  - Pancreatic Cancer (unless high risk features: borderline resectable, markedly elevated CA19-9 > 180 U/ml, large primary tumor/ lymph nodes)
  - Skin squamous Cell Carcinoma
  - Gallbladder/ Extrahepatic Cholangiocarcinoma
  - Poorly differentiated neuroendocrine tumors with prior negative Ga68 Dotatate/ MIBG/Octreotide scan (includes Pheochromocytoma/ paraganglioma, extrapulmonary large/small cell)"
- Under subsequent Treatment Strategy, first line has been modified by adding parenthesis as follows: Restaging or monitoring response to active treatment (including immunotherapy)"
- Under subsequent Treatment Strategy, changed "not to be performed within 4 weeks of completion of therapy (ideally F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine PET is delayed 2 - 3months after surgical therapy, 2 - 3 months after radiation therapy if locoregional assessment is the imaging goal), and/or evaluation for suspicion of recurrence due to new or changing signs/symptoms. (Asymptomatic surveillance is not approvable) (NCCN, 2018)." to "The interval should ideally be 6 - 12 weeks after surgery, and 12 weeks after radiation. PET can be performed 1-3 weeks after neoadjuvant chemotherapy or neoadjuvant chemoradiation to assess stage for surgery. PET evaluation can also be done for suspicion of recurrence due to new or changing signs/symptoms or rising tumor markers, or inconclusive findings on CT. Asymptomatic surveillance is not approvable. (NCCN 2018, 2019)"

- List of cancers under subsequent imaging (without needing prior inconclusive imaging) has been changed. The following were removed: Breast cancer (female and males),
colorectal cancer (including colon, rectal, appendiceal or anal cancer), ovarian cancer. The following were changed as follows:
- "Lung cancer - Non-small cell" to "Lung cancer - Non-small cell and limited stage small cell cancer"
- "Esophageal cancer" to "Esophageal and esophagogastric cancer"
- "Melanoma" to Melanoma- only stage III, IV (excludes uveal melanoma)
- "Myeloma to "Active Myeloma/plasmacytoma"
- Added for Soft tissue sarcoma: "only stage II/III for response to neoadjuvant Rx"
- Added Merkel cell carcinoma
- Added "Mesothelioma, if also presurgical"
- Individual References were removed for soft tissue sarcoma and vulvar/ vaginal cancer.

- Statement regarding subsequent PET scans needing prior inconclusive imaging has been modified from "only if other imaging (ie. US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed

" to "only if other imaging (ie. US, CT, MRI, NM) is inconclusive/ insufficient in determining a treatment plan or unable to be performed or with rising tumor markers and negative/ insufficient other imaging. PETCT is to be used only if the cancer is known to be generally F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine avid. It may be indicated if iodinated and gadolinium contrast are both contraindicated due to significant allergy or chronic renal failure without dialysis (NCCN 2019). "

- Under subsequent PET scans needing prior inconclusive imaging, the following were changed:
  Added: Breast cancer (female and males), Bladder cancer, only if metastatic, Colorectal Cancer – resectable metastatic disease only, Anal/ Vulvar/ Penile Carcinoma, Bone Sarcoma, Sarcoma/ GIST/ Uterine/Rhabdomyosarcoma, Ovarian/ malignant germ cell tumors/primary peritoneal cancer – Stage II-IV, Endometrial cancer if candidate for surgery/locoregional therapy; Poorly differentiated Cancers, or Dedifferentiated neuroendocrine tumors with prior negative Ga68 Dotatate/ MIBG/Octreotide scan
  - Removed: prostate cancer, pancreatic cancer, individual references for cancers
  - Changed: "Lung cancer -Small cell" to "Extensive small cell lung cancer"; "Tumor of unknown Origin" to "Occult primary"; "Neuroendocrine cancer (e.g. carcinoid, pheochromocytoma, etc)" to "Poorly differentiated or dedifferentiated neuroendocrine tumors with prior negative Ga68 Dotatate/ MIBG/Octreotide scan (includes Pheochromocytoma/ paraganglioma, extrapulmonary large/small cell)".
  - Last sentence has been changed from "Other malignancies where the tumor has been shown to be F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovineavid on prior PET/CT imaging if done, and other imaging (ie: US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed " to "Other malignancies where other imaging (i.e., US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed."

- Under thyroid Cancer,
  - Added references " (NCCN 2019, ATA 2015)" to subsequent treatment strategy for papillary/follicular/ hurthle cancers
    - Changed "Stimulated serum thyroglobulin > 2 ng/ml" to "Stimulated serum thyroglobulin > 5 ng/ml or high anti- thyroglobulin antibody (anti-Tg Ab) > 1 year after treatment (Na SJ 2012)"
    - Changed " Current whole body I-131 scan is negative (Kloos, 2005)" to "Current stimulated whole body I-131/ I-123 scan is negative (Alzahranj 2012)"
  - Changed " Medullary thyroid cancer when calcitonin levels > 150 pg/ml post-operatively (Wells, 2015)" to "Medullary thyroid cancer when calcitonin levels ≥ 150 pg/ml post primary treatment (NCCN 2019, Souteiro 2019)"
  - Changed " Anaplastic 3-6 months after initial treatment, 3-6 month interval if persistent structural disease (Smallridge, 2012)" to "Anaplastic: Initial and Restaging after prior inconclusive/ insufficient CT/MRI (NCCN 2019)"
- Added pediatric cancers section as follows: "PEDIATRIC CANCERS (for indications different from adult guidelines):
  - Sarcoma - Initial and Restaging (Quartuccio 2015)
  - Neuroblastoma/ other cancers under Ga68 imaging: only with prior negative/ inconclusive MIBG/ Octreotide/ Ga68 PETCT (Uslu 2015, Alexander 2018, Kong 2016, Li 2018, Elkhatib 2017)
  - Nasopharyngeal Cancer- Initial staging after inconclusive/ insufficient MRI; Restaging. (Cheuk 2012)
- For Gallium 68 Dotatate PET:
  - Added references for initial or subsequent treatment strategy: (NCCN 2019, Deppen, 2016 a, b)
  - Added under neuroendocrine tumors: "Medullary Thyroid Cancer for Initial staging; and Restaging when calcitonin ≥ 150 pg/ml"
  - Modified last part of the last sentence as follows: "and rising biomarkers (asymptomatic surveillance is not approvable). "
- Under 18F-Fluciclovine PET/CT SCAN:

- Added "(Axumin)" after 18F-Fluciclovine
- Removed reference "(Bach-Gansmo, 2017)"
- Changed "18F-Fluciclovine PET/CT scans should be performed only if other imaging (CT, MRI, US, NM) is inconclusive/insufficient AND the patient has not already been evaluated with an F^{18} FDG, Ga^{68} Dotatate, F^{18} Fluciclovine PET/CT Scan" to "Known prostate cancer for workup of recurrence and response to treatment, only if other imaging (CT, MRI) AND Bone scan is inconclusive/insufficient. (NCCN 2019, Andriole 2019, Bach-Gansmo 2017)"
- Removed:" Known prostate cancer for workup of recurrence and response to treatment:"
- "Initial treatment by radical prostatectomy with" was replaced by "Post radical prostatectomy with"
- "Initial treatment radiation therapy with" was replaced by "Post radiation therapy with"
- "Post-RT rising PSA or positive digital exam and is candidate for local therapy" was replaced by "rising/persistent PSA (increase should be >2ng/ml unless doubling time ≤ 8 months or pt is a candidate for local salvage therapy)"

- Removed: "NOTE: Not all plans cover 18F-Fluciclovine (A9588), such as Magellan Complete Care of Florida and Magellan Complete Care of Arizona. If you are unsure, you should check with the Health Plan prior to requesting a PET with Fluciclovine from NIA."
- Added Background section as follows:

"BACKGROUND:

Positron emission tomography (PET) is a rapidly developing and changing technology that is able to detect biochemical reactions, e.g., metabolism, or abnormal distribution of cell receptors within body tissues. A radioactive tracer is used during the procedure. Unlike other nuclear medicine examinations, PET can measure metabolic activity of the cells of body tissues, providing information about the functionality and structure of the particular organ or tissue examined. PET may also detect biochemical changes that help to evaluate malignant tumors and other lesions.

The degree of radioactive tracer uptake may indicate increased metabolism in the cells of body tissues or an abnormal distribution of cell receptors. Cancer cells may show increased radioactive tracer relative to tissue not involved with tumor. Radioactive tracer uptake is often higher in fast-growing tumors; PET is often not as beneficial for slow growing tumors. Radioactive tracer uptake may occur in various types of active inflammation and is not specific for cancer."

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0042T – Cerebral Perfusion Analysis CT

CPT Codes: 0042T

INDICATIONS FOR CEREBRAL PERFUSION CT:
(Dapeng, 2016; Guerrero, 2012; Katramados, 2009; Lui, 2010; Masterson, 2009)

In the following settings after initial CT and/or MRI has been performed or when MRI is contraindicated:

- For noninvasive evaluation of vasospasm after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate (ACR, 2016; Lui, 2010).
- For assessment of cerebrovascular reserve by using acetazolamide challenge in patients with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment (Lui, 2010).
- For the assessment of microvascular permeability in patients with intracranial neoplasms (Jain, 2011).
- For the assessment of cerebral blood flow after carotid artery stent placement in patients with severe carotid artery stenosis (Dapeng, 2016; Guerrero, 2012; Katramados, 2009; Lui, 2010; Masterson, 2009).
- For early detection of acute cerebral ischemia and infarct (Dapeng, 2016; Guerrero, 2012; Katramados, 2009; Lui, 2010; Masterson, 2009).
- Differentiating post ictal paralysis from acute stroke or seizure secondary to stroke after MRI has been completed or is contraindicated (Guerrero, 2012; Katramados, 2009; Lui, 2010; Masterson, 2009).
- Pre-operative evaluation of cerebral blood flow in patients at high risk for developing cerebral hyperperfusion after carotid revascularization (Dapeng, 2016).
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

BACKGROUND:
Cerebral perfusion computed tomography (CT) or CT perfusion (CTP) is an imaging technique that provides quantitative evaluation of cerebral perfusion by generating maps of cerebral blood flow, cerebral blood volume and mean transit time after passage of an IV contrast bolus through the region of interest. The technique is not widely used for any indication especially for outpatients. It is useful in specific scenarios after initial CT and/or MRI imaging has been obtained for assessment, not only of patients with acute stroke, but also a wide range of patients with other cerebrovascular diseases. It may provide the information needed to assess the most effective procedures or treatments for the conditions. In evaluating acute stroke, CTP is usually performed in specialized research centers and is not recommended for screening of these patients in the community setting (Huisa, 2012). It may assist in differentiating the unsalvageable core infarct and salvageable ischemic regions of the brain that may benefit from thrombectomy or thrombolysis (Lui, 2010).

OVERVIEW:

Cerebral Ischemia and Infarction and Evaluation of Vasospasm after Subarachnoid Hemorrhage – Cerebral perfusion CT measures cerebral blood flow, cerebral blood volume, and mean transit time which can be useful in identifying patients at risk for cerebral ischemia or infarction and for evaluation of vasospasm after subarachnoid hemorrhage. This information may be useful in identifying urgent medical or endovascular treatment. According to the ACR appropriateness criteria "definitive diagnosis of cerebral vasospasm after SAH is made with catheter angiography. Screening for vasospasm is performed with TCD US [transcranial doppler ultrasound]. CTA or MRA may be useful in the setting of indeterminate TCD" (ACR, 2016). CT or MR perfusion can help differentiate patients with vascular narrowing but normal perfusion due to the presence of collateral circulation from those without adequate collaterals.

Cerebrovascular Reserve - Cerebral perfusion CT, in conjunction with acetazolamide challenge in patients with intracranial vascular stenosis can evaluate cerebrovascular reserve capacity and help in estimating the potential risk of stroke. It may help to identify candidates for bypass surgery and endovascular treatment to increase cerebral blood flow.

Temporary Balloon Occlusion (BTO) – Balloon occlusion testing is utilized prior to a planned endovascular or surgical procedure that will disrupt blood supply to a part of the brain. Quantitative analysis of cerebral blood flow may be useful in identifying patient who may not tolerate permanent or prolonged occlusion. Due to the significant failure to predict strokes after sacrifice of the carotid artery there is a vast number of monitoring techniques and protocols during preoperative test occlusion. As CTP monitoring of BTO entails carotid occlusion times ranging from 15-30 minutes and the need to transfer the patient with a catheter in place to the angiography suite, other methods with 60-90 second occlusion times are generally preferred (Galego, 2014; Sorteberg, 2014)

Intracranial tumors – Cerebral perfusion CT generates permeability measurements in images of brain tumors depicting areas of different blood flow within tumors and the surrounding tissues. This may allow for diagnosis and grading of tumors and may help to monitor treatment.

Carotid Artery Stent Placement/Revascularization – Cerebral perfusion CT provides a quantitative evaluation of cerebral perfusion and helps in the assessment of the hemodynamic modifications in patients with severe carotid stenosis. Pre-operatively, CTP may help identify patients at high risk of developing hyperperfusion syndrome after carotid revascularization. The syndrome may result in fatal outcomes. Presenting symptoms include "…throbbing frontotemporal or periorbital headache, confusion, macular oedema [sic], visual disturbances, seizures, or focal neurological deficits" (Dapeng, 2016). "The presence of internal carotid artery (ICA) stenosis ≥90% is a main risk factor for the development of HPS. Other important risk factors include severe contralateral ICA disease, poor collateral flow, hypertension, and recent stroke or ischaemia [sic]" (Dapeng, 2016). Post-operatively CTP provides valuable information for a more thorough assessment in the follow-up of patients after they have undergone carotid stent placement.

Acute Cerebral Ischemia (Stroke) – Cerebral perfusion CT can quantitatively distinguish the extent of irreversibly infarcted brain tissue (infarct core) from the severely ischemic but salvageable tissue (penumbra), providing a basis for the selection of acute stroke patients that are most likely to benefit from thrombolytic treatment.

POLICY HISTORY:
Review Date: June 2019
Review Summary:

- Removed:
  - diagnosis of cerebral ischemia and infarction
  - evaluation of patients undergoing temporary balloon occlusion to assess collateral flow and cerebrovascular reserve
- Added:
  - Specified for vasospasm after subarachnoid hemorrhage 'when transcranial Doppler cannot be performed or is indeterminate'
  - A f/u study may be needed to evaluate progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason indicating why additional imaging is needed.
- Updated background information and references

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G0219 – PET Imaging whole body, melanoma - noncovered

CPT Codes: G0219

IMPORTANT NOTE:

PET scan for whole body; melanoma for non-covered indications is considered to be **not medically necessary** and is therefore a non-covered study (Frary, 2016; Scheier, 2016).

POLICY HISTORY:
Review Date: April 2019
Review Summary:

- Added references

REFERENCES:

Frary EC, Gad D, Bastholt L, et al. The role of FDG-PET/CT in preoperative staging of sentinel lymph node biopsy-positive melanoma patients. *EJNMMI Res*. 2016; 6:73.

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G0235 – PET imaging, any site, not otherwise specified

CPT Codes: G0235

IMPORTANT NOTE:

PET imaging, any site, not otherwise specified, is a non-covered CPT code.

POLICY HISTORY:
Review Date: April 2019

G0252 – PET imaging, initial diagnosis of breast cancer

CPT Codes: G0252

IMPORTANT NOTE

PET scan imaging, full and partial-ring pet scanners only, for initial diagnosis of breast cancer and/or surgical planning for breast cancer (e.g. initial staging of axillary lymph nodes) is considered to be **not medically necessary and is therefore a non-covered study** (Sasada, 2018).

POLICY HISTORY:
Review Date: April 2018
Review Summary:

- Updated reference

REFERENCES:

Sasada S, Masumoto N, Goda N, et al. Which type of breast cancers is undetectable on ring-type dedicated breast PET? *Clin Imaging*. 2018 Sep-Oct; 51:186-91.

G0297 – Low Dose CT for Lung Cancer Screening

CPT Codes: G0297

INDICATIONS FOR LOW DOSE CT FOR LUNG CANCER SCREENING (LDCT):

For annual lung cancer screening:
The use of low-dose, non-contrast spiral (helical) multi-detector CT imaging as a screening technique for lung cancer is considered medically necessary ONLY when used to screen for lung cancer for certain high-risk, asymptomatic individuals when ALL of the following criteria are met (Mazzone, 2018):

- Individual is between 55-77 years of age; AND
- There is at least a 30 pack-year history of cigarette smoking; AND
- If the individual is a former smoker, that individual had quit smoking within the previous 15 years.

For nodule seen on initial LDCT:
(Wood, 2018)
- Chart below shows the follow-up interval at which LDCT can be approved to reduce radiation dose (Yang, 2018)
- If multiple nodules, the largest and type is used for decision

NODULE TYPE	**<5mm**	**6-7 mm**	**8-14 mm**	**>14**
Single solid	annual	6 mo	3mo, consider PET Scan	Chest CT
Single partial solid, solid <6mm	annual	6 mo	3mo, consider PET Scan	N/A
Single partial solid, solid 6-7 mm	annual	3mo, consider PET Scan	N/A	N/A
Single partial solid, solid >7 mm	N/A	N/A	Chest CT	Chest CT
	non-solid size→>	**<20 mm**	**>20 mm**	
Single non-solid nodule	N/A	Annual	6 mo	

BACKGROUND:
Smoking-related lung cancer is the leading cause of cancer deaths in both men and women in the United States. Treatment for most lung cancer is focused on surgery which is usually curative only when the tumors are very small. Screening for early lung cancer with sputum cytology and chest x-rays has not been successful in reducing deaths from lung cancer. However, in 2011 a large, prospective, multicenter trial was published

that showed CT Chest screening identified early cancers better than other approaches and reduced the death rate from lung cancer. In 2014, the United States Preventive Service Task Force (USPSTF) recommended annual low dose CT Chest screening (CPT code G0297) for people with current or recent past smoking histories.

OVERVIEW:
Screening should be discontinued once a person has not smoked for 15 years or develops a health problem that substantially limits life expectancy or the ability or willingness to have curative lung surgery.

POLICY HISTORY:
Review Date: May 2019
Review Summary:

- Criteria for repeating at less than one year were added.
- Upper age range changed from 80 to 77 years of age
- Chart added for the f/u interval at which LDCT can be approved to reduce radiation dose

REFERENCES:

Mazzone PJ, Silvestri GA, Patel S, et al. Screening for lung cancer CHEST guideline and expert panel report. *Chest.* 2018; 153(4):954-985.

Wood DE, Kazerooni EA, Baum SL, et al. Clinical practice guidelines in oncology: Lung cancer screening. Version 3.2018. *J Natl Compr Canc Netw*. 2018; 16(4):412–441.

Yang C, Liu R, Ming X, et al. Thoracic organ radiation doses and cancer risk from low pitch helical 4-dimensional computed tomography scans. *Biomed Res Int.* 2018; 2018:8927290.

S8042 – Low Field MRI

CPT Codes: S8042

IMPORTANT NOTE:

Low Field MRI services are not considered to be medically necessary, are not approvable for payment, and cannot be approved.

BACKGROUND:

MRI scanners with a field strength of greater than 1.0 Tesla (T) are considered high field. The typical high field MRI units in clinical practice range between 1.0 – 3.0 Tesla. In October 2017 the FDA cleared the first 7 T MRI units. The definition of mid and low field MRI is more variable with mid field units having a lower field strength range of 0.3 to 0.5 and an upper limit under 1.0 T. Low field units have field strengths below 0.3 to 0.2 T. The major disadvantage of low field strength MRI relative to higher field scanners is lower signal to noise ratios, less homogeneity in the magnetic field, lower detection of calcification, hemorrhage or gadolinium enhancement. Lee et al showed that low field (<0.5 T) units were effective in evaluating medial meniscal, anterior cruciate ligament, and rotator cuff tears but not effective for evaluating lateral meniscal tears, osteochondral defects, or shoulder superior labrum-anterior posterior (SLAP) ligament complex pathology (Lee 2013, 2014).

POLICY HISTORY:
Review Date: April 2019
Review Summary: No changes

REFERENCES:

Lee CS, Davis SM, McGroder C, et al. Analysis of low-field magnetic resonance imaging scanners for evaluation of knee pathology based on arthroscopy. *Orthop J Sports Med*. December 2013; 1(7):2325967113513423. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4555514/. Retrieved January 10, 2018.

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