2018 MAGELLAN1 CLINICAL GUIDELINES
FOR
MEDICAL NECESSITY REVIEW

HAWAII MEDICAL SERVICE ASSOCIATION
(HMSA)

Version: 4
Effective: April 2018
Guidelines for Clinical Review Determination

Preamble
Magellen 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. Guideline determinations are made based on the information provided at the time of the request. It is expected that medical necessity decisions may change as new 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 diagnostic tests. The developers of the criteria sets included representatives from the disciplines of radiology, internal medicine, nursing, and cardiology and other specialty groups. They were developed following a literature search pertaining to established clinical guidelines and accepted diagnostic imaging practices.

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All guidelines were reviewed between January 1, 2017 and September 15, 2017.

Prepared March 23, 2018
INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR TEMPOROMANDIBULAR JOINT (TMJ) MRI:

- 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.
- For pre-operative evaluation of dysfunctional temporomandibular joint in candidates for orthognathic surgery.
- For evaluation of locked or frozen jaw.
- For persistent temporomandibular joint dysfunction after surgical repair.
- 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.

ADDITIONAL INFORMATION RELATED TO TEMPOROMANDIBULAR JOINT (TMJ) MRI:

MRI Imaging of Temporomandibular Joint – Imaging of the temporomandibular joint has been difficult as the mandibular condyle is small and located close to dense and complex anatomic structures. MRI produces cross-sectional multiplanar images that document both soft and osseous tissue abnormalities of the joint and the surrounding structures and may help in determining the pathology around the joint.
REFERENCES


CPT Codes: 70450 70460 70470

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN CT:

For evaluation of known or suspected seizure disorder: 1-3
  • For the evaluation of a single study related to 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: 4
  • Acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.

For evaluation of clinical assessment documenting cognitive impairment of unclear cause: 5-7
  • 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: 8-11
  • Known or suspected trauma or injury to the head with documentation of one or more of the following acute, new or fluctuating:
    o Focal neurologic findings
    o Motor changes
    o Mental status changes
    o Amnesia
    o Vomiting
    o Seizures
    o Headache
    o Signs of increased intracranial pressure
  • Known coagulopathy
  • 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.

For evaluation of headache: 12-19
  • Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration) and MRI is contraindicated or cannot be performed.
• 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.
• New onset of headache with any acute, new or fluctuating neurologic deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.
• CT is indicated once in patients with cluster headaches to eliminate secondary causes.
• Patient with history of cancer, or significantly immunocompromised, with new onset headache.
• New headache in individual > 55 years old.
• 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.
• With history or suspicion of aneurysm or AVM with new onset of headache.

For evaluation of known or suspected brain tumor, mass, or metastasis: 20, 21
• Follow up for known tumor.
• Evaluation of suspected tumor with any acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.
• Known lung cancer, or rule out metastasis and/or preoperative evaluation.
• Evaluation of metastatic melanoma (not all melanomas).
• For patient with history of cancer with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
• Evaluation of patient with history of cancer that had a recent course of chemotherapy, radiation therapy (to the brain), or has been treated surgically within the last two (2) years.
• Evaluation for a bone tumor or abnormality of the skull.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases: 22
• ≤ 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
  • Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected stroke: 23-25
• To evaluate patient with history of a known stroke with new and sudden onset of severe headache.
• Known or suspected stroke with any acute, new or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes or with a family history (brother, sister, parent or child) of aneurysm.
• Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms.)

For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis, or abscess) and MRI is contraindicated or cannot be performed: 26
• Patients with suspected increased intracranial pressure or meningitis.
• 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 physical findings (such as fever, stiff neck) and positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam.)
• Suspected encephalitis with a severe headache, altered mental status OR positive lab finding, (such as elevated WBC’s).
• Endocarditis with suspected septic emboli.
• Evaluation for 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): 27-31
• Known or suspected congenital abnormality with any acute, new or fluctuating neurologic, motor or mental status changes.
• Evaluation of macrocephaly with child >6 months of age.
• Evaluation of 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.
• Evaluation of craniosynostosis and other head deformities.
• To evaluate patient for suspected or known hydrocephalus.
• To evaluate patient for prior treatment OR treatment planned for congenital abnormality.

Suspected normal pressure hydrocephalus, (NPH) with symptoms. 32

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: 24, 33-40
• Evaluation of suspected acute subarachnoid hemorrhage (SAH).
• Follow up for known hemorrhage, hematoma or vascular abnormalities.
• Developmental delay where MRI cannot be performed.
• Vertigo associated with headache, blurred or double vision, or a change in sensation after full neurologic examination and initial work-up and MRI is contraindicated or cannot be performed.
• Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, visual field deficit etc).
• Anosmia (loss of smell) (documented by objective testing).
• For 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.
• Suspected central venous thrombosis
• Evaluation of neurological findings in sickle cell disease
• Prior to lumbar puncture in patients with suspected increased intracranial pressure or at risk for herniation.
• Suspected cholesteatoma.

Indication for Brain CT/Cervical CT combination studies:
• For evaluation of Arnold Chiari malformation where MRI cannot be performed.

Brain CT/Orbit CT:
• For approved indications as noted above and being performed in a child under 3 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial 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.

Brain CT/Neck CTA:
• Confirmed carotid stenosis >60%, surgery or angioplasty candidate

ADDITIONAL INFORMATION RELATED TO BRAIN CT:

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” which is a target for therapy. Contrast enhanced CT angiography (CTA) may follow the non-contrast CT imaging and may define ischemic areas of the brain with the potential to respond positively to reperfusion 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 for Macrocephaly - Consider ultrasound for child <6 months of age for macrocephaly.
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.

REFERENCES


33. Thust SC, Burke C, Siddiqui A. Neuroimaging findings in sickle cell disease. Br J Radiol August 2014; 87(1040)
CPT Codes: 70480, 70481, 70482

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 especially for head injury with orbital trauma.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ORBIT CT:

- For assessment of proptosis (exophthalmos).
- For evaluation of progressive vision loss.
- For evaluation of decreased range of motion of the eyes.
- For screening and evaluation of ocular tumor, especially melanoma.
- For screening and assessment of suspected hyperthyroidism (such as Graves’ disease).
- For assessment of trauma.
- For screening and assessment of known or suspected optic neuritis if MRI is contraindicated or is unable to be performed.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital pseudotumor.
- Papilledema.
- Orbital infection.
- 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.

COMBINATION OF STUDIES WITH ORBIT CT:

- Brain CT/Orbit CT –
  - For approved indications as noted above and being performed in a child under 3 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial 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.

ADDITIONAL INFORMATION RELATED TO ORBIT CT:

Proptosis or exophthalmos – Proptosis is a bulging of one or two of the eyes. Bulging of the eyes may be caused by hyperthyroidism (Graves’ disease) or it may be caused by orbital tumors, cancer, infection, inflammation and arteriovenous malformations. The extent of proptosis, the abnormal bulging of one or two eyes, can be assessed by using orbital CT scan.
Orbital Pseudotumor – Pseudotumor may appear as a well-defined mass or it may mimic a malignancy. A sclerosing orbital pseudotumor can mimic a lacrimal gland tumor.

Grave's Disease – Enlargement of extraocular muscles and exophthalmos are features of Grave's disease. CT may show unilateral or bilateral involvement of single or multiple muscles. It will show fusiform muscle enlargement with smooth muscle borders, especially posteriorly and pre-septal edema may be evident. Quantitative CT imaging of the orbit evaluates the size and density values of extraocular muscles and the globe position and helps in detecting opthalmopathy in Grave’s disease.

Orbital Trauma – CT is helpful in assessing trauma to the eye because it provides excellent visualization of soft tissues, bony structures and foreign bodies.

Ocular Tumor – In the early stages, a choroidal malignant melanoma appears as a localized thickening of sclero-uveal layer. It may be seen as a well defined mass if it is more than 3 mm thick.

CT and Orbit Tumors- MRI is preferred to CT for evaluation of the optic nerve and in many instances the orbital contents. When MRI cannot be performed or for certain indications; including evaluation of infection, trauma, thyroid ophthalmopathy or calcified tumors, CT is a suitable alternative.

*Retinoblastoma and intracranial tumors: Histologically similar tumors may occur in the pineal, suprasellar or parasellar regions of patients with ocular retinoblastoma, also known as “trilateral retinoblastoma”. The incidence of these intracranial tumors in either unilateral or bilateral retinoblastoma patients is 1.5%-5 %.

Unilateral papilledema: The most common causes of unilateral optic disc edema are nonarteritic anterior ischemic optic neuropathy (NAION), optic neuritis (termed papillitis when disc swelling is present), and orbital compressive lesions. Idiopathic intracranial hypertension (pseudotumor cerebri) and central retinal vein occlusive lesions can also present with unilateral papilledema.

Nonarteritic anterior ischemic optic neuropathy (NAION) - Nonarteritic anterior ischemic optic neuropathy (NAION) is the most common form of ischemic optic neuropathy. It is an idiopathic, ischemic insult of the optic nerve head characterized by acute, monocular, painless visual loss with optic disc swelling. The pathophysiology for reduction in blood flow to the optic nerve is controversial.

REFERENCES


CPT Codes: 70480, 70481, 70482

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR INTERNAL AUDITORY CANAL CT:

- For evaluation of acoustic neuroma or other lesion of the VIIth or VIIIth cranial nerve in patients unable to undergo an MRI.
- For evaluation of documented conductive hearing loss.
- For evaluation of chronic otitis media.
- For evaluation of mastoiditis.
- For evaluation of cholesteatoma.
- For evaluation of congenital hearing loss.
- For evaluation of cochlear implants.
- 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.

ADDITIONAL INFORMATION RELATED TO INTERNAL AUDITORY CANAL CT:

Conductive Hearing Loss – Conductive hearing loss can have multiple causes but is often caused by fluid in the middle ear resulting from otitis media or from eustachian tube obstruction. CT scans may demonstrate underlying problems due to its visualization of the middle ear and the mastoid bone.

Chronic Otitis Media – When the eustachian tube is blocked for long periods of time, the middle ear may become infected with bacteria. The infection sometimes spreads into the mastoid bone behind the ear. Chronic otitis media may be due to chronic mucosal disease or cholesteatoma and it may cause permanent damage to the ear. CT scans of the mastoids may show spreading of the infection beyond the middle ear.

Mastoiditis – CT is an effective diagnostic tool in determining the type of therapy for mastoiditis, a common complication of acute otitis media leading to infection in the mastoid process.

Cholesteatoma – A cholesteatoma is a cyst-like mass occurring most commonly in the middle ear and mastoid region. CT scanning may help to determine the extent of the disease process. It can determine the extent of cholesteatoma by showing the combination of a soft tissue mass and associated bone erosion.
**Congenital Hearing Loss** - Genetic factors and factors present either in utero or at time of birth may cause congenital hearing loss in children. High-resolution CT provides the examination of choice furnishing anatomic detail for planning a surgical approach.

**Cochlear Implants** – Cochlear implants provide an opportunity to restore partial hearing. The electronic device, surgically implanted, converts sound to an electrical signal. CT allows the visualization of cochlear anatomy and provides 3D positional information. CT also offers contrast for different tissue types and may be used even when the implant is in place.

**REFERENCES**


CPT Codes: 70480, 70481, 70482

INTRODUCTION:

Temporal bone/mastoid 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR TEMPORAL BONE, MASTOID CT:

- For evaluation of conductive hearing loss.
- For evaluation of chronic otitis media, ear infections or drainage.
- For evaluation of mastoiditis.
- For evaluation of cholesteatoma.
- For evaluation of congenital hearing loss or deformity.
- For evaluation of dehiscence of the jugular bulb or carotid canal.
- For evaluation of aberrant blood vessels or malformations.
- For evaluation of cochlear implants.
- 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.

ADDITIONAL INFORMATION RELATED TO TEMPORAL BONE, MASTOID CT:

Conductive Hearing Loss – Conductive hearing loss can have multiple causes but is often caused by fluid in the middle ear resulting from otitis media or from eustachian tube obstruction. CT scans may demonstrate underlying problems due to its visualization of the middle ear and the mastoid bone.

Chronic Otitis Media– When the eustachian tube is blocked for long periods of time, the middle ear may become infected with bacteria. The infection sometimes spreads into the mastoid bone behind the ear. Chronic otitis media may be due to chronic mucosal disease or cholesteatoma and it may cause permanent damage to the ear. CT scans of the mastoids may show spreading of the infection beyond the middle ear.

Mastoiditis – CT is an effective diagnostic tool in determining the type of therapy for mastoiditis, a common complication of acute otitis media leading to infection in the mastoid process.

Cholesteatoma – A cholesteatoma is a cyst-like mass occurring most commonly in the middle ear and mastoid region. CT scanning may help to determine the extent of the disease process. It can determine the extent of cholesteatoma by showing the combination of a soft tissue mass and associated bone erosion.
**Congenital Hearing Loss** - Genetic factors and factors present either in utero or at time of birth may cause congenital hearing loss in children. High-resolution CT provides the examination of choice furnishing anatomic detail for planning a surgical approach.

**Cochlear Implants** – Cochlear implants provide an opportunity to restore partial hearing. The electronic device, surgically implanted, converts sound to an electrical signal. CT allows the visualization of cochlear anatomy and provides 3D positional information. CT also offers contrast for different tissue types and may be used even when the implant is in place.

**REFERENCES**


INTRODUCTION:
The sella turcica is a saddle-shaped depression in the sphenoid bone at the base of the human skull which holds the pituitary gland.

Computed tomography (CT) is useful in the delineation of the osseous margins of the sella. It is particularly helpful in evaluating the bony changes related to pathologic processes. The most frequent finding is a change in the size of the sella turcica such as an enlargement unaccompanied by bone erosion. The most common causes are the presence of intrasellar adenomas and empty sella syndrome. The shape of the sella may also be affected by pathological conditions, such as Down’s syndrome, Williams’ syndrome, and lumbosacral myelomeniogocele.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR SELLA CT:
- For assessment of proptosis (exophthalmos).
- For evaluation of progressive vision loss/visual field deficit.
- For evaluation of decreased range of motion of the eyes.
- For screening and evaluation of ocular tumor, pituitary adenoma and parasellar bony structures for the evaluation of certain sellar tumors.
- For screening and assessment of known or suspected optic neuritis if MRI is contraindicated or is unable to be performed.
- For screening and evaluation of suspected orbital pseudotumor.
- 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.

ADDITIONAL INFORMATION RELATED TO SELLA CT:

Proptosis or exophthalmos – Proptosis is a bulging of one or two of the eyes. Bulging of the eyes may be caused by hyperthyroidism (Graves’ disease) or it may be caused by orbital tumors, cancer, infection, inflammation and arteriovenous malformations. The extent of proptosis, the abnormal bulging of one or two eyes, can be assessed by orbital CT scan.

Orbital Pseudotumor – Pseudotumor may appear as a well-defined mass or it may mimic a malignancy. A sclerosing orbital pseudotumor can mimic a lacrimal gland tumor.

Grave's Disease – Enlargement of extraocular muscles and exophthalmos are features of Graves' disease. CT may show unilateral or bilateral involvement of single or multiple muscles. It will show fusiform muscle enlargement with smooth muscle borders, especially posteriorly and pre-septal edema may be evident. Quantitative CT imaging of the orbit evaluates the size and density values of extraocular muscles and the globe position and helps in detecting ophthalmopathy in Graves’ disease.
**Orbital Trauma** – CT is helpful in assessing trauma to the eye because it provides excellent visualization of soft tissues, bony structures and foreign bodies.

**Ocular Tumor** – In the early stages, a choroidal malignant melanoma appears as a localized thickening of sclero-uveal layer. It may be seen as a well defined mass if it is more than 3 mm thick.

**REFERENCES**


CPT Codes: 70486, 70487, 70488

INTRODUCTION:

Computed tomography (CT) primarily provides information about bony structures, but may also be useful in evaluating some 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR FACE CT:

- For the evaluation of sinonasal or facial tumor.
- For the assessment of osteomyelitis.
- For the diagnosis of parotid or other salivary stones.
- For the assessment of trauma, (e.g. suspected facial bone fractures).
- For the diagnosis of facial abscesses.
- 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.

ADDITIONAL INFORMATION RELATED TO FACE CT:

Facial Bone Fractures – Computed tomography (CT) of the facial bones following trauma provides high quality images of fracture sites and adjacent soft tissue injury. It is helpful in planning surgical intervention, if needed.

Sinonasal and facial tumors - Computed tomography (CT) of the face produces images depicting a patient’s paranasal sinus cavities, hollow and air-filled spaces located within the bones of the face and surrounding the nasal cavity. Face CT of this system of air channels connecting the nose with the back of the throat may be used to evaluate suspected nasopharyngeal tumors. Face CT may detect other tumors and usually provide information about the tumor invasion into surrounding bony structures.

Chronic Osteomyelitis – CT may be used in patients with chronic osteomyelitis to evaluate bone involvement and to identify soft tissue involvement (cellulitis, abscess and sinus tracts). It is used to detect intramedullary and soft tissue gas, sequestra, sinus tracts, and foreign bodies but is not sufficient for the assessment of the activity of the process.

Parotid And Other Salivary Stones – The sensitivity of CT to minimal amounts of calcific salts makes it well suited for the imaging of small, semicalcified salivary stones. Early diagnosis and intervention are important because patients with salivary stones often develop sialadenitis. With early intervention, it may be possible to avoid further gland degeneration and salivary gland removal. The CT scan identifies the exact location of a salivary stone, expediting removal.
REFERENCES


INTRODUCTION:

CT scans can provide much 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 also be quite 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR SINUS & MAXILLOFACIAL AREA CT:

For evaluation of known or suspected infections or inflammatory disease:
- Unresolved sinusitis after four (4) consecutive weeks of medication, e.g., antibiotics, steroids or anti-histamines.
- Immunocompromised patient (including but not limited to AIDS, transplant patient or patient with genetic or acquired deficiencies,) or conditions predisposed to sinusitis (e.g., cystic fibrosis and immotile cilia syndrome/Kartagener’s syndrome).
- Osteomyelitis of facial bone where imaging study, (such as plain films, or brain MRI, etc.) demonstrates an abnormality or is indeterminate.

For evaluation of known or suspected tumor:
- For known or suspected tumor with bony abnormality or opaque sinuses seen on imaging or for mucocele.

For evaluation of trauma:
- Suspected fracture AND prior imaging was nondiagnostic or equivocal.
- For follow-up trauma with fracture or opaque sinuses visualized on x-ray.

Pre-operative evaluation:
- Planned maxillo-facial surgery.
- For use as adjunct to image guided sinus exploration or surgery such as FESS (functional endoscopic sinus surgery).

Post-operative evaluation:
- Complications, e.g., suspected CSF leak, post-operative bleeding as evidenced by persistent opaqueness on imaging.
- Non-improvement two (2) or more weeks after surgery.

Other indications for Sinus CT:
- For poorly controlled asthma associated with upper respiratory tract infection. May be performed without failing 4 consecutive weeks of treatment with medication.
• For presence of polyposis on imaging or direct visualization that may be causing significant airway obstruction.
• For deviated nasal septum or structural abnormality seen on imaging or direct visualization that may be causing significant airway obstruction.
• For new onset of anosmia (lack of sense of smell) or significant hyposmia (diminished sense of smell).
• Other conditions such as granulomatosis with polyangiitis (Wegener’s granulomatosis) that may present as rhinosinusitis.
• 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.

COMBINATION OF STUDIES WITH SINUS 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).

ADDITIONAL INFORMATION RELATED TO SINUS CT:

Sinusitis - In acute sinusitis, routine imaging is not recommended except for patients with suspected complications (especially in the brain and in the orbit). In addition to CT scanning, magnetic resonance (MR) imaging of the sinuses, orbits, and brain should be performed whenever extensive or multiple complications of sinusitis are suspected. In chronic sinusitis, CT scanning is the gold standard for diagnosis and management, because it also provides an anatomic road map when surgery is required.

Allergic rhinitis - Allergic rhinitis is rhinitis caused by allergens, which are substances that trigger an allergic response. Allergens involved in allergic rhinitis come from either outdoor or indoor substances. Outdoor allergens such as pollen or mold spores are usually the cause of seasonal allergic rhinitis (also called hay fever). Indoor allergens such as animal dander or dust mites are common causes of year-round allergic rhinitis.

Multiple polyps - These are soft tissues that develop off stalk-like structures on the mucus membrane. They impede mucus drainage and restrict airflow. Polyps usually develop from sinus infections that cause overgrowth of the mucus membrane in the nose. They do not regress on their own and may multiply and cause considerable obstruction.

Deviated Septum - A common structural abnormality of the nose that causes problems with air flow is a deviated septum. The septum is the inner wall of cartilage and bone that separates the two sides of the nasal cavity. When deviated, it is not straight but shifted to one side.

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.
REFERENCES:


Dykewicz, M.S. (2003). Rhinitis and Sinusitis. Journal of Allergy and Clinical Immunology, 111(2), 520-529. ISSN: 1080-0549.


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR NECK CT:

For evaluation of known tumor, cancer or mass:
- Evaluation of neck tumor/mass, or history of cancer with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Evaluation of skull base tumor, mass or cancer.
- Evaluation of tumors of the tongue, larynx, nasopharynx, pharynx, or salivary glands.
- Evaluation of parathyroid tumor when:
  - Calcium > normal and PTH > normal WITH
    - Previous nondiagnostic ultrasound or nuclear medicine scan AND
    - Surgery planned.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of suspected tumor, cancer or mass:
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Evaluation of palpable suspicious lesions in mouth or throat.
- Evaluation of non-thyroid masses in the neck when present greater than one month, noted to be ≥ 1 cm or associated with generalized lymphadenopathy.

For evaluation of known or suspected inflammatory disease or infection:
- For evaluation of deep space infections or abscesses of the pharynx and neck.
- Evaluation of lymphadenopathy in the neck when present for greater than one month, noted to be ≥ 1 cm or associated with generalized lymphadenopathy.

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:**
- For evaluation of vocal cord lesions or vocal cord paralysis.
- For evaluation of stones of the salivary glands and ducts.
- For evaluation of tracheal stenosis.

**Indications for combination studies:**
- **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.

**ADDITIONAL INFORMATION RELATED TO NECK CT:**

**CT and Tumors of the Neck (non-thyroid)** – CT is a standard modality for imaging neck tumors. Pre-treatment imaging is important in the management of neck cancer. CT assists in pre-treatment planning by defining the extent of the primary tumor; the peripheral borders of the neoplasm must be determined as accurately as possible. In head and neck cancer, the identification of lymphatic tumor spread is crucial. Multislice CT improves the assessment of tumor spread and lymph node metastases and defines the critical relationship of tumor and lymph node metastasis. CT is also used in the follow-up after surgical, radiation or combined treatment for a neck neoplasm.

**CT and Tumoral and Non-Tumoral Trachea Stenoses** – Bronchoscopy is the “gold standard” for detecting and diagnosing tracheobronchial pathology because it can directly visualize the airway lumen, but it may be contraindicated in patients with some conditions, e.g., hypoxemia, tachycardia. CT provides a non-invasive evaluation of the trachea and may be used in most patients to assess airway patency distal to stenoses.

**CT and Parotid and Submandibular Gland and Duct Stones** – The sensitivity of CT to minimal amounts of calcific salts makes it well suited for the imaging of small, semi calcified salivary gland stones. Early diagnosis and intervention are important because patients with salivary gland stones may eventually develop sialadenitis. With early intervention, it may be possible to avoid further gland degeneration requiring salivary gland excision. The CT scan identifies the exact location of a ductal stone expediting intraoral surgical removal.

**REFERENCES**


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN CTA:

For evaluation of known intracranial vascular disease: 1-6
- To evaluate known intracranial aneurysm or arteriovenous malformation (AVM).
- To evaluate known vertebrobasilar insufficiency (VBI).
- To re-evaluate vascular abnormality visualized on previous brain imaging.
- For evaluation of known vasculitis.

For evaluation of suspected intracranial vascular disease: 6-10
- To screen 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.
- To evaluate previously diagnosed subarachnoid hemorrhage (SAH).
- To evaluate suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
- To evaluate suspected arteriovenous malformation (AVM) in patient with previous or indeterminate imaging study.
- For evaluation of suspected venous thrombosis (dural sinus thrombosis).
- Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis.
- For evaluation of pulsatile tinnitus for vascular etiology.
- For evaluation of suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.

Pre-operative evaluation for brain/skull surgery: 11

Post-operative/procedural evaluation: 12,13
- 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:
• For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
• For evaluation of known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
• For evaluation of known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness, abnormal speech, vision defects or severe dizziness.
• For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.
• For evaluation of pulsatile tinnitus for vascular etiology.

ADDITIONAL INFORMATION RELATED TO BRAIN CTA:

**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.

REFERENCES


CPT Code: 70498

INTRODUCTION

Neck computed tomography angiography (CTA) uses a computerized analysis of x-ray images enhanced by contrast material injected into a peripheral vein. Neck CTA may be performed after initial carotid duplex imaging that does not provide adequate information or shows abnormal results. Neck CTA may be used for the evaluation of carotid body tumors and for post-operative evaluation of carotid endarterectomy.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR NECK CTA:

For evaluation of vascular disease:
- For evaluation of patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 60%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries).
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

For evaluation of known or suspected tumor/mass:
- For evaluation of carotid body tumors, or other paraganglioma.
- For evaluation of pulsatile neck mass after ultrasound has been performed when there is reasonable suspicion that it is not a vascular lesion.

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:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
- For evaluation of known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness, abnormal speech, vision defects or severe dizziness.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.
- For evaluation of pulsatile tinnitus for vascular etiology.
Neck CTA/Brain CT:
• Confirmed carotid stenosis of >60%, and patient is surgery or angioplasty candidate.

ADDITIONAL INFORMATION RELATED TO NECK CTA:

CTA 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. Computed tomography angiography of carotid arteries may be performed using a multislice CT scanner. The 3D volume-rendering reconstructions provide a selective detailed visualization of the anatomic relationships between carotid body tumors, vessels, and surrounding osseous structures.

Post-operative evaluation of carotid endarterectomy – Carotid endarterectomy is a vascular surgical procedure that removes plaque from the carotid artery. CTA, 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.

The Asymptomatic Carotid Atherosclerosis Study (ACAS): The ACAS clinical trial is an often quoted study that demonstrated a 5-year reduction in stroke risk of asymptomatic patients with ≥ 60% carotid diameter reduction that underwent carotid endarterectomy compared to those who received medical treatment.

REFERENCES


CPT Codes: 70540, 70542, 70543

INTRODUCTION:

Magnetic resonance imaging (MRI) is a noninvasive and radiation free radiologic technique used in the diagnosis and management of ocular and orbital disorders. Common uses include the evaluation of suspected optic nerve involvement in patients suspected of having multiple sclerosis and assessment of tumor invasion of the orbit. MRI is used in the evaluation of hyperthyroid related exophthalmos as well as in identifying the structural causes of unilateral proptosis. It is a sensitive method for showing soft tissue abnormalities which makes it a useful technique in evaluating orbital disorders, e.g., orbital pseudotumor.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ORBIT MRI:

- For assessment of proptosis (exophthalmos).
- For evaluation of progressive vision loss.
- For evaluation of decreased range of motion of the eyes.
- For screening and evaluation of ocular tumor, especially melanoma.
- For screening and assessment of suspected hyperthyroidism (such as Graves’ disease).
- For assessment of trauma.
- For screening and assessment of known or suspected optic neuritis.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital pseudotumor.
- Papilledema.
- Orbital infection.
- 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.

COMBINATION OF STUDIES WITH ORBIT MRI:

- **Brain MRI/Orbit MRI –**
  - For approved indications as noted above and being performed in a child under 3 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial 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.

ADDITIONAL INFORMATION RELATED TO ORBIT MRI:
**MRI and Optic Neuritis** – MRI is useful in the evaluation of patients who have signs and symptoms of optic neuritis. These signs and symptoms may be the first indications of demyelinating disease, e.g., multiple sclerosis (MS). MRI findings showing the presence of three or more bright spots in brain white matter on T2-weighted images are indicative of MS and may be used as a criterion for initiating treatment.

**MRI and Exophthalmos (Proptosis)** – Proptosis is characterized by a bulging of one or two eyes and may be caused by hyperthyroidism (Graves’ disease) or it may be caused by other conditions, e.g., orbital tumors, infection and inflammation. The degree of exophthalmos in thyroid-associated ophthalmopathy is related to the orbital fatty tissue volume. MRI is able to define orbital soft tissues and measure the volumetric change in orbital fatty tissues.

**MRI and Orbit Tumors** – The most common intraocular malignant tumor is choroidal melanoma. Most choroidal melanomas can be evaluated by ophthalmoscopy and ultrasonography. MRI may be used to differentiate the types of mass lesions and to define their extent.

*Retinoblastoma and intracranial tumors:* Histologically similar tumors may occur in the pineal, suprasellar or parasellar regions of patients with ocular retinoblastoma, also known as “trilateral retinoblastoma”. The incidence of these intracranial tumors in either unilateral or bilateral retinoblastoma patients is 1.5%-5 %.

**Unilateral papilledema:** The most common causes of unilateral optic disc edema are nonarteritic anterior ischemic optic neuropathy (NAION), optic neuritis (termed papillitis when disc swelling is present), and orbital compressive lesions. Idiopathic intracranial hypertension (pseudotumor cerebri) and central retinal vein occlusive lesions can also present with unilateral papilledema.

**Nonarteritic anterior ischemic optic neuropathy (NAION)**- Nonarteritic anterior ischemic optic neuropathy (NAION) is the most common form of ischemic optic neuropathy. It is an idiopathic, ischemic insult of the optic nerve head characterized by acute, monocular, painless visual loss with optic disc swelling. The pathophysiology for reduction in blood flow to the optic nerve is controversial.

**REFERENCES**


CPT Codes: 70540, 70542, 70543

INTRODUCTION:

Magnetic resonance imaging (MRI) is useful in the evaluation of the soft tissues of the face, facial tumors, and osteomyelitis. It is indicated for evaluating soft-tissue within the sinuses and is sensitive for differentiating between inflammatory disease and malignant tumors. Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR FACE MRI:

- For evaluation of sinonasal and/or facial soft tissue masses or tumors.
- For evaluation of osteomyelitis.
- For evaluation of parotid or other salivary tumors.
- 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.

ADDITIONAL INFORMATION RELATED TO FACE MRI:

MRI and Sinonasal Tumors – Sinus tumors are rare, but the prognosis is often poor due to advanced disease at diagnosis. MRI can distinguish between tumor and retained secretions or inflammatory sinus disease. Squamous cell carcinoma is the most common malignant tumor of the sinonasal cavity. On MRI these tumors are hypointense on T2W images and heterogeneous with solid enhancement, unlike the uniform appearance of secretions.

MRI and Chronic Osteomyelitis – MRI may be used in patient with chronic osteomyelitis to identify soft tissue involvement. It may demonstrate edema in soft tissues beyond the usual sites of enhancement and the full extent of soft-tissue mass.
REFERENCES


INTRODUCTION:

Magnetic resonance imaging (MRI) is used in the evaluation of head and neck region tumors. The soft-tissue contrast between normal and abnormal tissues provided by MRI permits the precise delineation of tumor margins (e.g., the nasopharynx, oropharynx, and skull base regions). MRI is used for therapy planning and follow-up of head and neck neoplasms. It is also used for the evaluation of neck lymphadenopathy, tracheal stenosis, and vocal cord lesions.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR NECK MRI:

For evaluation of known tumor, cancer or mass:

- Evaluation of neck tumor, mass or history of cancer in patient with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Evaluation of skull base tumor, mass or cancer.
- Evaluation of tumors of the tongue, larynx, nasopharynx pharynx, or salivary glands.
- Evaluation of parathyroid tumor when:
  - Calcium> normal and PTH > normal WITH
  - Previous nondiagnostic ultrasound or nuclear medicine scan AND
  - Surgery planned.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:

- \( \leq 5 \) 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of suspected tumor, cancer or mass:

- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Evaluation of palpable suspicious lesions in mouth or throat.
- Evaluation of non-thyroid masses in the neck when persistent, greater than one month, and \( \geq 1 \) cm or associated with generalized lymphadenopathy.

For evaluation of known or suspected inflammatory disease or infection:

- Evaluation of lymphadenopathy in the neck when greater than one month, and \( \geq 1 \) cm or associated with generalized lymphadenopathy.

Pre-operative evaluation.

Post-operative/procedural evaluation (e.g. post neck dissection/exploration):
• 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 MRI:
• For evaluation of vocal cord lesions or vocal cord paralysis.
• For evaluation of stones of the salivary glands and ducts.
• Brachial plexus dysfunction (Brachial plexopathy/Thoracic Outlet Syndrome).

Indications for combination studies:
• 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.

ADDITIONAL INFORMATION RELATED TO NECK MRI:

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 the soft tissues of the neck, upper chest, and course into the arms.

MRI and Neck Tumors – MRI plays a significant role in the therapeutic management of neck tumors, both benign and malignant. It is the method of choice for therapy planning as well as follow-up of neck tumors. Frequently for skull base tumors, CT is preferred, but MRI provides valuable information to support diagnosis of the disease.

MRI and Vocal Cord Paralysis or Tumors – MRI helps in the discovery of tumors or in estimating the depth of invasion of a malignant process. It provides a visualization of pathological changes beneath the surface of the larynx. MRI scans may indicate the presence or absence of palsy and possible reasons for it. If one or both vocal cords show no movement during phonation, palsy may be assumed.

MRI and Cervical Lymphadenopathy – MRI can show a conglomerate nodal mass that was thought to be a solitary node. It can also help to visualize central nodal necrosis and identify nodes containing metastatic disease. Imaging of the neck is not done just to evaluate lymphadenopathy, but is performed to evaluate a swollen lymph node and an unknown primary tumor site. Sometimes it is necessary to require a second imaging study using another imaging modality, e.g., a CT study to provide additional information.

MRI and Salivary Stones – Early diagnosis and intervention are important because patients with salivary stones may eventually develop sialadenitis. MRI provides excellent image contrast and resolution of the salivary glands and ducts and helps in the evaluation of stones.

REFERENCES


CPT Codes: 70540, 70542, 70543

INTRODUCTION:

MRI of the sinus is useful for evaluating soft tissue involvement. It can help rule out fungal sinusitis and may differentiate between inflammatory disease and malignant tumors. MRI may also identify encephaloceles or a cerebrospinal fluid (CSF) leak.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR SINUS MRI:

- Evidence of sinonasal or skull base tumor on physical exam, plain sinus x-ray or previous CT.
- Cerebrospinal fluid (CSF) leak.
- Unresolved sinusitis after four (4) consecutive weeks of medication, e.g., antibiotics, steroids or anti-histamines, when sinus CT is insufficient, when there is a suspected mass lesion causing the disease, when there is suspected invasive fungal sinusitis, or severe complications are suspected (such as orbital or intracranial complications).
- Osteomyelitis (rare) of the facial bone.
- 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.

ADDITIONAL INFORMATION RELATED TO SINUS MRI:

Sinusitis - In addition to CT scanning, magnetic resonance (MR) imaging of the sinuses, orbits, and brain may be performed if there are extensive or severe complications of sinusitis suspected.

Limitations of sinus MRI - MRI has limitations in the definition of the bony anatomy, but is sensitive for differentiating between inflammatory disease and malignant tumors.

REFERENCES


CPT Codes: 70544, 70545, 70546

INTRODUCTION:

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 acquired.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN (HEAD) MRA/MRV:

For evaluation of known intracranial vascular disease: 1-4
- To evaluate known intracranial aneurysm or arteriovenous malformation (AVM).
- To evaluate known vertebrobasilar insufficiency (VBI).
- To re-evaluate vascular abnormality visualized on previous brain imaging.
- For evaluation of known vasculitis.

For evaluation of suspected intracranial vascular disease: 5-12
- To screen 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.
- To evaluate previously diagnosed subarachnoid hemorrhage (SAH).
- To evaluate suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
- To evaluate suspected arteriovenous malformation (AVM) in patient with previous or indeterminate imaging study.
- For evaluation of suspected venous thrombosis (dural sinus thrombosis).
- Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis.
- For evaluation of pulsatile tinnitus for vascular etiology.
- For evaluation of suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.
- For evaluation of stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity >200.
- Evaluation of neurological findings in sickle cell disease.
Pre-operative evaluation for brain/skull surgery.

Post-operative/procedural evaluation: 13, 14
- 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:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
- For evaluation of known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness, abnormal speech, vision defects or severe dizziness.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.
- For evaluation of pulsatile tinnitus for vascular etiology.

ADDITIONAL INFORMATION RELATED TO BRAIN (HEAD) MRA

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.

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.
REFERENCES


CPT Codes: 70547, 70548, 70549

INTRODUCTION:

Magnetic resonance angiography (MRA) of the neck uses magnetic resonance imaging (MRI) technology and may be performed after abnormal results are found on carotid duplex imaging. MRA is used for the evaluation and imaging of vessels in the head and the neck.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR NECK MRA:

For evaluation of vascular disease:
- For evaluation of patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 60%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries).
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

For evaluation of known or suspected tumor/mass:
- For evaluation of carotid body tumors, or other paragangliomas.
- For evaluation of pulsatile neck mass after ultrasound has been performed when there reasonable suspicion that it is not a vascular lesion.

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:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as vision changes, vertigo, or abnormal speech.
- For evaluation of known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness, abnormal speech, vision defects or severe dizziness.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.
- For evaluation of pulsatile tinnitus for vascular etiology.

Neck MRA/Brain MRI:
• Confirmed carotid stenosis >60%, and patient is surgery or angioplasty candidate.

ADDITIONAL INFORMATION RELATED TO NECK MRA:

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.

The Asymptomatic Carotid Atherosclerosis Study (ACAS): The ACAS clinical trial is an often quoted study that demonstrated a 5-year reduction in stroke risk of asymptomatic patients with ≥ 60% carotid diameter reduction that underwent carotid endarterectomy compared to those who received medical treatment.

REFERENCES


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

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN MRI:

For evaluation of suspected multiple sclerosis (MS):
- For evaluation of patient with neurologic symptoms or deficits within the last four (4) weeks.

For evaluation of known multiple sclerosis (MS):
- Stable condition with no prior imaging within the past ten (10) months or within the past six (6) months if patient has relapsing disease
- Exacerbation of symptoms or change in symptom characteristics such as frequency or type and demonstrated compliance with medical therapy.

For evaluation of known or suspected seizure disorder:
- New onset of a seizure.
- Medically refractory epilepsy.

For evaluation of suspected Parkinson’s disease:
- For evaluation of suspected Parkinson’s disease as a baseline study.

For evaluation of known Parkinson’s disease:
- For evaluation of new non-Parkinson symptoms complicating the evaluation of the current condition.

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

For evaluation of clinical assessment documenting cognitive impairment of unclear cause:
- 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: 9,10
- 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
- Known or suspected skull fracture by physical exam and positive x-ray.

For evaluation of headache: 11-17
- Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration).
- 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.
- New onset of headache with any acute, new or fluctuating neurologic deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes
- MRI is indicated once in patients with cluster headaches to eliminate secondary causes.
- Patient with history of cancer, or significantly immunocompromised, with new onset headache.
- New headache in individual > 55 years old.
- New temporal headache in person > 55, with sedimentation rate (ESR) > 55 with tenderness over the temporal artery.
- Acute, sudden onset of headache with a family history (brother, sister, parent or child) of brain aneurysm or AVM (arteriovenous malformation).
- New severe unilateral headache with radiation to or from the neck. Associated with suspicion of carotid or vertebral artery dissection.
- New onset of headache in pregnancy.

For evaluation of known or suspected brain tumor, mass or metastasis: 18
- Known tumor and new onset of headache.
- Follow up for known tumor.
- Evaluation of suspected tumor with any acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.
- Known lung cancer, or rule out metastasis and/or preoperative evaluation.
- Evaluation of metastatic melanoma (not all melanomas).
- Known or suspected pituitary tumor with corroborating physical exam (galactorrhea) neurologic findings and/or lab abnormalities.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases: 19
- ≤ 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.
  - Cancer surveillance: Active monitoring for recurrence as clinically indicated.
For evaluation of known or suspected stroke: 20
- To evaluate patient with history of a known stroke with new and sudden onset of severe headache.
- Known or suspected stroke with any acute, new or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes or with a family history (brother, sister, parent or child) of aneurysm.
- Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms).

For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess): 21-23
- 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 physical findings (such as fever, stiff neck) and positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam.)
- Suspected encephalitis with a severe headache, altered mental status OR positive lab finding, (such as elevated WBC’s).
- Endocarditis with suspected septic emboli.
- Evaluation for 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): 24,25
- Known or suspected congenital abnormality with any acute, new or fluctuating neurologic, motor or mental status changes.
- Evaluation of macrocephaly with child >6 months of age.
- 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
- To evaluate patient for suspected or known hydrocephalus.
- To evaluate patient for prior treatment OR treatment planned for congenital abnormality.

Suspected normal pressure hydrocephalus, (NPH) with symptoms.27

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):28
- 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: 29-36

- Evaluation of suspected acute subarachnoid hemorrhage (SAH).
- Follow up for known hemorrhage, hematoma or vascular abnormalities.
- Suspected central venous thrombosis.
- Evaluation of neurological findings in sickle cell disease.
- Developmental delay.
- Vertigo associated with headache, blurred or double vision, or a change in sensation after full neurologic examination and initial work-up.
- Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, visual field deficit etc).
- Anosmia (loss of smell) (documented by objective testing).
- 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)
- Optic neuritis.
- Initial evaluation for a known syrinx or syringomyelia.
- Suspected cholesteatoma.

Indications for combination studies:

- **Brain MRI/Neck MRA** –
  - Confirmed carotid occlusion >60%, surgery or angioplasty candidate.
- **Brain MRI/Cervical MRI** –
  - For evaluation of Arnold Chiari Malformation.
  - For follow-up of known multiple sclerosis (MS).
- **Brain MRI/Orbit MRI** –
  - For approved indications as noted above and being performed in a child under 3 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial 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.

ADDITIONAL INFORMATION RELATED TO BRAIN MRI:

**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, visuocognitive 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 these examinations should be ordered in sequence, not together. Vascular abnormalities can be visualized on the brain MRI.

**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 for Macrocephaly** - Consider ultrasound for child <6 months of age for macrocephaly.

**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** – 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. MRI is helpful in diagnosing vascular causes of vertigo.

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CPT Codes: 70554, 70555

INTRODUCTION:

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 is also used to image and localize abnormal brain function in patients with seizures.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR FUNCTIONAL BRAIN MRI: 1-8

Pre-operative Evaluation:
- With brain tumors where fMRI may have a significant role in mapping lesions.
- With seizures where fMRI may have a significant role in mapping lesions.

Post-operative Evaluation:
- To assess progress after surgery. A documented medical reason must clearly explain the medical necessity for the post-operative follow up.

ADDITIONAL INFORMATION RELATED TO FUNCTIONAL BRAIN MRI:

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 a single seizure focus. 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).

fMRI can determine the location of the brain functions 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.

**REFERENCES**

CPT Codes: 71250, 71260, 71270, G0297

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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 55-80 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 evaluation of known tumor, cancer or mass:
- Initial evaluation of diagnosed cancer.
- Evaluation of known tumor or cancer for patient undergoing active treatment to assess impact of treatment.
- Evaluation of known tumor or cancer or history of prior cancer presenting with new signs (i.e., physical, laboratory, or imaging findings) or new symptoms.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Known distant cancer with suspected chest/lung metastasis based on a sign, symptom, imaging study or abnormal lab value.
- For the follow-up evaluation of a nodule with a previous CT (follow-up intervals approximately 3, 6, 12 and 24 months):
  - f/u evaluation of ground glass > 5mm up to 36 months.
  - no further f/u of solid nodules < 6mm if unchanged at 12 month

Known or suspected interstitial lung disease (e.g. idiopathic interstitial lung diseases, idiopathic pulmonary fibrosis, hypersensitivity pneumonitis, pneumoconiosis, sarcoidosis, silicosis and asbestosis) and initial x-ray has been performed:
- With abnormal physical, laboratory, and/or imaging findings requiring further evaluation.
Known or suspected infection or inflammatory disease (i.e., complicated pneumonia not responding to treatment, abscess, tuberculosis (TB), empyema or immunosuppression post-organ transplant with new symptoms or findings) and initial x-ray has been performed:

- With abnormal physical, laboratory, and/or imaging findings requiring further evaluation.
- For evaluation of known inflammatory disease:
  - Initial evaluation
  - During treatment
  - With new signs and symptoms
- For evaluation of non-resolving pneumonia documented by at least two imaging studies:
  - Unimproved with 4 weeks of antibiotic treatment OR
  - Not resolved at 8 weeks
- For evaluation of lung abscess, cavitory lesion, or empyema, demonstrated or suggested on prior imaging.

Suspected vascular disease, (e.g., aneurysm, dissection):

- For evaluation of known or suspected superior vena cava (SVC) syndrome.
- Suspected thoracic/thoracoabdominal aneurysm or dissection (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain) when contrast is contraindicated.

Known vascular disease:

- For follow up of known vascular disease (aneurysm) and contrast is not appropriate for the clinical indication.

Known or suspected congenital abnormality:

- For evaluation of known or suspected congenital abnormality
- Vascular - suggest Chest CTA or Chest MRA depending on age and radiation safety issues.
- Nonvascular - abnormal imaging and/or physical examination finding.

Hemoptysis:

- For evaluation of hemoptysis and prior x-ray performed.

Post-operative/procedural evaluation:

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

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  - Cancer surveillance - Active monitoring for recurrence as clinically indicated.

Other indications for Chest CT:

- Pre-operative evaluation.
- Re-evaluation after abnormal imaging within past 30 - 60 days and with no improvement on x-ray, (not indicated with known rib fractures).
- Evaluation of persistent unresolved cough of at least four weeks duration, unresponsive to medical treatment and chest x-ray has been performed.
- Evaluation of other chest or thorax adenopathy.
- Evaluation of pneumothorax.
- Evaluation of vocal cord paralysis.
• Suspected thymoma with myasthenia gravis.

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.

COMBINATION OF STUDIES WITH CHEST CT/SINUS CT:
• For poorly controlled asthma associated with upper respiratory tract infection. May be performed without failing 4 consecutive weeks of sinus treatment with medication.
• Granulomatosis with polyangiitis (GPA) (Wegener’s).

ADDITIONAL INFORMATION RELATED TO CHEST CT:

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 nodules. 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.

CT and Pulmonary Embolism (PE) – Spiral CT is sometimes used as a substitute for pulmonary angiography in the evaluation of pulmonary embolism. It may be used in the initial test for patients with suspected PE when they have an abnormal baseline chest x-ray. It can differentiate between acute and chronic pulmonary embolism but it can not rule out PE and must be combined with other diagnostic tests to arrive at a diagnosis. CT chest is NOT indicated if the patient has none of the risks/factors AND the D-Dimer is negative. (D-Dimer is a blood test that measures fibrin degradation products that are increased when increased clotting and clot degradation is going on in the body.)
REFERENCES


CPT Codes: 71275

Computed tomography angiography (CTA) 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. CTA depicts the vascular structures as well as the surrounding anatomical structures.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CHEST CTA:

For evaluation of suspected or known pulmonary embolism (excludes low risk*)

For evaluation of suspected or known vascular abnormalities:
- For evaluation of a thoracic/thoracoabdominal aneurysm or dissection (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain).
- Congenital thoracic vascular anomaly, (e.g., coarctation of the aorta or evaluation of a vascular ring suggested by GI study).
- Signs or symptoms of vascular insufficiency of the neck or arms (e.g., subclavian steal syndrome with abnormal ultrasound).
- Follow-up evaluation of progressive vascular disease when new signs or symptoms are present.
- Primary or secondary pulmonary hypertension.

Preoperative evaluation
- Known or suspected vascular abnormalities seen on prior imaging
- Ablation procedure for atrial fibrillation.

Postoperative or post-procedural evaluation
- Physical evidence of post-operative bleeding complication or re-stenosis.
- Post-surgical follow up when records document medical reason requiring additional imaging

Chest CTA and Abdomen CTA or Abdomen/Pelvis CTA or Pelvis CTA combo:
- For evaluation of extensive vascular disease involving the chest and abdominal cavities such as aortic dissection, vasculitic diseases such as Takayasu’s arteritis, significant post-traumatic or post-procedural vascular complications, etc.
- For preoperative or preprocedural evaluation such as transcatheter aortic valve replacement (TAVR).

ADDITIONAL INFORMATION RELATED TO CHEST CTA:

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.

*Low risk defined as NO to ALL of the following questions:
1) Evidence of current or prior DVT;
2) HR > 100;
3) Cancer diagnosis;
4) Recent surgery or prolonged immobilization;
5) Hemoptysis;
6) History of PE;
and another diagnosis is more likely.

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.

**REFERENCES**


CPT Codes: 71550, 71551, 71552

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CHEST MRI:

- For evaluation of mediastinal or hilar mass of patient with renal failure or allergy to contrast material.
- For evaluation of myasthenia gravis with suspected thymoma.
- For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome).
- For evaluation of a thoracic/thoracoabdominal aneurysm or dissection (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain).
- For evaluation of congenital heart disease or cardiac and non-cardiac malformations, [e.g., vascular rings or pulmonary slings, aortic arch anomalies and patent ductus arteriosus (PDA)].
- For evaluating whether masses invade into specific thoracic structures (e.g. aorta, pulmonary artery, brachial plexus, subclavian vessels, or thoracic spine).
- To determine the consistency of thoracic masses (cystic vs. solid vs. mixed).
- Initial evaluation of suspicious abnormality found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Post-surgical follow up when records document medical reason requiring additional imaging.

ADDITIONAL INFORMATION RELATED TO CHEST MRI:

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.

REFERENCES


CPT Codes: 71555

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CHEST MRA:

For evaluation of suspicious mass and CTA is contraindicated due to a history of contrast allergy or high risk for contrast induced renal failure.

For evaluation of suspected or known pulmonary embolism (excludes low risk*).

For evaluation of suspected or known vascular abnormalities:
- Thoracic/thoracoabdominal aneurysm or dissection (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain).
- Congenital thoracic vascular anomaly, (e.g., coarctation of the aorta or evaluation of a vascular ring suggested by GI study).
- Signs or symptoms of vascular insufficiency of the neck or arms (e.g., subclavian steal syndrome with abnormal ultrasound).
- Follow-up evaluation of progressive vascular disease when new signs or symptoms are present.
- Primary or secondary pulmonary hypertension.

Preoperative evaluation
- Known vascular abnormalities
- Ablation procedure for atrial fibrillation.

Postoperative or post-procedural evaluation
- Physical evidence of post-operative bleeding complication or re-stenosis.
- Post-surgical follow up when records document medical reason requiring additional imaging

ADDITIONAL INFORMATION RELATED TO CHEST MRA:

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 to prior to MRA imaging. Negative D-Dimer suggests alternative diagnosis in these patients.

*Low risk defined as NO to ALL of the following questions:
1) Evidence of current or prior DVT;
2) HR > 100;
3) Cancer diagnosis;
4) Recent surgery or prolonged immobilization;
5) Hemoptysis;
6) History of PE;
and another diagnosis is more likely

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.

REFERENCES


CPT Codes: 72125, 72126, 72127

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CERVICAL SPINE CT:

For evaluation of known fracture CT:
- To assess union of a fracture when physical examination or plain radiographs suggest delayed or non-healing.
- To determine the position of fracture fragments.

For evaluation of neurologic deficits:
- With any of the following new neurological deficits documented on examination of the patient: extremity weakness, abnormal reflexes, or abnormal sensory changes along a particular dermatome (nerve distribution).

For evaluation of suspected myelopathy when MRI is contraindicated:
- 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 (unsteadiness, broad-based gait), increased muscle tone, weakness and wasting of the upper and lower limbs; diminished sensation to light touch, temperature, proprioception, vibration; bowel and bladder dysfunction in more severe cases.

For evaluation of chronic back pain with any of the following when Cervical Spine MRI is contraindicated:
- 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 spinal abnormality.

For evaluation of new onset of neck pain when Cervical Spine MRI is contraindicated:
- Failure of conservative treatment*, for at least six (6) weeks.
- 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 spinal abnormality.

For evaluation of trauma or acute injury within past 72 hour:
• 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*.

**For evaluation of known tumor, cancer, or evidence of metastasis:**
• For staging of known tumor.
• For follow-up evaluation of patient undergoing active treatment.
• Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor.
• Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

**For evaluation of suspected tumor:**
• Prior abnormal or indeterminate imaging that requires further clarification.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated.

**For evaluation of known or suspected infection, abscess, or inflammatory disease when Cervical Spine MRI is contraindicated:**
• 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, lymphoma when Cervical Spine MRI is contraindicated:**
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

**For post-operative / procedural evaluation for surgery or fracture occurring within the past six (6) months:**
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

**Other indications for a Cervical Spine CT:**
• For preoperative evaluation and Cervical Spine MRI is contraindicated
• CT myelogram or discogram.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas.
• Known arnold-chiari syndrome and Cervical Spine MRI is contraindicated.
• Syrinx or syringomyelia and Cervical Spine MRI is contraindicated.

FOR COMBINATION OF STUDIES WITH CERVICAL SPINE CT:
Cervical/Thoracic/Lumbar CTs:
• CT myelogram or discogram.
• Any combination of these for spinal survey in patient with metastases.
Cervical MRI/CT - unstable craniocervical junction.
Brain CT/Cervical CT – for evaluation of Arnold Chiari Malformation.

ADDITIONAL INFORMATION RELATED TO CERVICAL SPINE CT:

*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) – 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 documentation provided regarding 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).

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%) Vitzthum, Hans-Ekkehart, Dalitz, Kristina
REFERENCES


CPT Codes: 72128, 72129, 72130

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR THORACIC SPINE CT:

For evaluation of known fracture:
- To assess union of a fracture when physical examination or plain radiographs suggest delayed or non-healing.
- To determine the position of fracture fragments.

For evaluation of neurologic deficits:
- With any of the following new neurological deficits documented on examination of the patient: lower extremity weakness, abnormal reflexes, abnormal sensory changes along a particular dermatome (nerve distribution).

For evaluation of suspected myelopathy when MRI is contraindicated:
- Progressive symptoms including 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; bowel and bladder dysfunction in more severe cases.

For evaluation of chronic back pain with any of the following when Thoracic MRI is contraindicated:
- 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 spinal abnormality.

For evaluation of new onset of back pain when Thoracic Spine MRI is contraindicated:
- Failure of conservative treatment* for at least six (6) weeks.
- 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 spinal abnormality.

For evaluation of trauma or acute injury within past 72 hours:
• 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*.

**For evaluation of known tumor, cancer or evidence of metastasis:**
• For staging of known tumor.
• For follow-up evaluation of patient undergoing active treatment.
• Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor.
• Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

**For evaluation of suspected tumor:**
• Prior abnormal or indeterminate imaging that requires further clarification.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated

**For evaluation of known or suspected infection, abscess, or inflammatory disease when Thoracic MRI is contraindicated:**
• 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, lymphoma when Thoracic MRI is contraindicated:**
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

**For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:**
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

**Other indications for a Thoracic Spine CT:**
• For pre-operative evaluation and Thoracic MRI is contraindicated
• CT myelogram or discogram.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes and Thoracic Spine MRI is contraindicated.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas
• Syrinx or syringomyelia and Thoracic Spine MRI is contraindicated.
• Known arnold-chiari syndrome.

COMBINATION OF STUDIES WITH THORACIC SPINE CT:

Cervical/Thoracic/Lumbar CTs:
• CT myelogram or discogram.
• Any combination of these for spinal survey in patient with metastases.

ADDITIONAL INFORMATION RELATED TO THORACIC SPINE CT:

*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) – 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 documentation provided regarding 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).

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.

MRI and Degenerative Disc Disease – Degenerative disc disease is very common and CT is indicated 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, and MRI is contraindicated.
REFERENCES


http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2140133/
CPT Codes: 72131, 72132, 72133

INTRODUCTION:

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

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LUMBAR SPINE CT:

For evaluation of known fracture:
- To assess union of a known fracture where physical or plain film findings suggest delayed or non-healing.
- To determine position of known fracture fragments.

For evaluation of neurologic deficits:
- With bowel or bladder dysfunction, or any of the following new neurological deficits documented on examination of the patient: lower extremity weakness, abnormal reflexes, abnormal sensory changes along a particular dermatome (nerve distribution), evidence of cauda equina syndrome, or foot drop.

For evaluation of chronic back pain with any of the following when Lumbar Spine MRI is contraindicated:
- 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 spinal abnormality.

For evaluation of new onset of back pain when Lumbar Spine MRI is contraindicated:
- Failure of conservative treatment*, for at least six (6) weeks.
- 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 spinal abnormality.

For evaluation of trauma or acute injury within past 72 hours:
- 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*.

For evaluation of known tumor, cancer or evidence of metastasis:
- For staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor.
• Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

For evaluation of suspected tumor:
• Prior abnormal or indeterminate imaging that requires further clarification

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated

For evaluation of known or suspected infection, abscess, or inflammatory disease when Lumbar Spine MRI is contraindicated:
• 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, lymphoma and Lumbar Spine MRI is contraindicated:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Lumbar Spine CT:
• For preoperative evaluation and Lumbar Spine MRI is contraindicated
• CT myelogram or discogram.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas.
• Tethered cord, known or suspected spinal dysraphism and Lumbar Spine MRI is contraindicated.
• Ankylosing Spondylitis - For diagnosis when suspected as a cause of back or sacroiliac pain and completion of the following initial evaluation and Lumbar Spine MRI is contraindicated:
  o History of back pain associated with morning stiffness
  o Sedimentation rate and/or C-reactive protein
  o HLA B27
  o Non-diagnostic or indeterminate x-ray
• Known arnold-chiari syndrome.
COMBINATION OF STUDIES WITH LUMBAR SPINE CT:

Cervical/Thoracic/Lumbar CTs:
- CT myelogram or discogram
- Any combination of these for spinal survey in patient with metastasis.
- For evaluation of spinal abnormalities associated with Chiari Malformation.

ADDITIONAL INFORMATION RELATED TO LUMBAR SPINE CT:

*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)** – 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 documentation provided regarding 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).

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

CT and Radiculopathy – Lumbar radiculopathy is caused by compression of a dorsal 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 need medical attention. Multidetector CT may be performed to rule out or localize lumbar disk herniation before surgical intervention. Radiation dose should be kept as low as possible in young individuals undergoing CT of the lumbar 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 transient compression of the cauda equina. This is a surgical emergency and CT may be performed to help assess the problem. CT scans provide visualization of the vertebral canal and may demonstrate encroachment of the canal by osteophytes, facets, pedicles or hypertrophied lamina. The anatomy of the vertebral canal is demonstrated by three-dimensional CT.

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.
**Tethered spinal cord syndrome** - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord with the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is myelomeningocele 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 (a delicate filament near the tailbone)
- History of spine trauma/surgery

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.
REFERENCES


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CERVICAL SPINE MRI:

For evaluation of known or suspected multiple sclerosis (MS):
- Evidence of MS on recent baseline Brain MRI.
- Suspected MS with new or changing symptoms consistent with cervical spinal cord disease.
- Follow up to known Multiple Sclerosis.
- Follow up to the initiation or change in medication for patient with known Multiple Sclerosis.

For evaluation of neurologic deficits:
- With any of the following new neurological deficits documented on examination of the patient: extremity weakness, abnormal reflexes, or abnormal sensory changes along a particular dermatome (nerve distribution).

For evaluation of suspected myelopathy:
- 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 (unsteadiness, broad-based gait), increased muscle tone, weakness and wasting of the upper and lower limbs; diminished sensation to light touch, temperature, proprioception, vibration; bowel and bladder dysfunction in more severe cases).

For evaluation of chronic back pain with any of the following:
- 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 spinal abnormality.

For evaluation of new onset of neck pain:
- Failure of conservative treatment*, for at least six (6) weeks.
- 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 spinal abnormality.

For evaluation of trauma or acute injury within past 72 hours:
• 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*.

For evaluation of known tumor, cancer, or evidence of metastasis:
• For staging of known tumor.
• For follow-up evaluation of patient undergoing active treatment.
• Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor.
• Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

For evaluation of suspected tumor:
• Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected infection, abscess, or inflammatory disease:
• 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, lymphoma:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation for surgery or fracture occurring within the past six (6) months:
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Cervical Spine MRI:
• For preoperative evaluation.
• Suspected cord compression with any of the following neurological deficits: extremity weakness; abnormal gait; asymmetric reflexes.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas.
• Known arnold-chiari syndrome.
• Syring or syringomyelia.

COMBINATION OF STUDIES WITH CERVICAL SPINE MRI:

Cervical/Thoracic/Lumbar MRIs:
• Any combination of these for scoliosis survey in infant/child.
• Any combination of these for spinal survey in patient with metastases.
• For evaluation of spinal abnormalities associated with Chiari Malformation.

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).

ADDITIONAL INFORMATION RELATED TO CERVICAL SPINE MRI:

*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)** – 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 documentation provided regarding 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).

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%) Vitzthum, Hans-Ekkehart, Dalitz, Kristina

MRI for Evaluation of Discitis – Discitis is a known complication of cervical discography. Postoperative discitis in the cervical spine does not occur frequently but 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 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. 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.

For example, bone metastases occur in a minority of all breast cancer patients. Low stage breast cancer patients are very unlikely to have bone metastases (Coleman RE et al.). Radiographic (X-ray) evaluation prior to MRI is appropriate. A trial of conservative care in back pain is also indicated and appropriate in these low stage patients.

Advanced stage breast cancer patients do develop bone metastases in a slight majority of cases (Coleman RE et al.). Back pain in advanced stage breast cancer patients should still be initially evaluated with X-ray (which has the chance of demonstrating cause of pain, or identifying multiple metastases, and may change the subsequent imaging choice for optimal staging). However, these patients should, in most cases, not undergo a trial of conservative care.”
REFERENCES


INTRODUCTION:

Magnetic resonance imaging 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR THORACIC SPINE MRI:

For evaluation of neurologic deficits:
- With any of the following new neurological deficits documented on examination of the patient: lower extremity weakness, abnormal reflexes, abnormal sensory changes along a particular dermatome (nerve distribution).

For evaluation of suspected myelopathy:
- Progressive symptoms including 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; bowel and bladder dysfunction in more severe cases.

For evaluation of chronic back pain with any of the following:
- 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 spinal abnormality.

For evaluation of new onset of back pain:
- Failure of conservative treatment* for at least six (6) weeks.
- 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 spinal abnormality.

For evaluation of trauma or acute injury within past 72 hours:
- 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*.

For evaluation of known tumor, cancer or evidence of metastasis:
- For staging of known tumor.
• For follow-up evaluation of patient undergoing active treatment.
• Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
• Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

For evaluation of suspected tumor:
• Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected infection, abscess, or inflammatory disease:
• 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:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Thoracic Spine MRI:
• For preoperative evaluation
• Suspected cord compression with any of the following neurological deficits: extremity weakness; abnormal gait; asymmetric reflexes.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas.
• Known arnold-chiari syndrome.
• Syrinx or syringomyelia.

COMBINATION OF STUDIES WITH THORACIC SPINE MRI:
Cervical/Thoracic/Lumbar MRIs:
- Any combination of these for scoliosis survey in infant/child.
- Any combination of these for spinal survey in patient with metastases.
- For evaluation of spinal abnormalities associated with Chiari Malformation.

ADDITIONAL INFORMATION RELATED TO THORACIC SPINE MRI

MRI imaging – Metal devices or foreign body fragments within the body, such as indwelling pacemakers and intracranial aneurysm surgical clips that are not compatible with the use of MRI, may be contraindicated. Other implanted metal devices in the patient as well as external devices such as portable O₂ tanks may also be contraindicated.

*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) – the following two elements are required to meet guidelines for completion of conservative therapy:
  o Information provided on exercise prescription/plan AND
  o Follow up with member with documentation provided regarding 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).

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 neurology 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.

MRI and Degenerative Disc Disease – Degenerative disc disease is very common and MRI is indicated 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 conduction studies: exacerbation of chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

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 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, absceses or infarcts.

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.
For example, bone metastases occur in a minority of all breast cancer patients. Low stage breast cancer patients are very unlikely to have bone metastases (Coleman RE et al). Radiographic (X-ray) evaluation prior to MRI is appropriate. A trial of conservative care in back pain is also indicated and appropriate in these low stage patients.

Advanced stage breast cancer patients do develop bone metastases in a slight majority of cases (Coleman RE et al). Back pain in advanced stage breast cancer patients should still be initially evaluated with X-ray (which has the chance of demonstrating cause of pain, or identifying multiple metastases, and may change the subsequent imaging choice for optimal staging). However, these patients should, in most cases, not undergo a trial of conservative care.”
REFERENCES


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LUMBAR SPINE MRI:

For evaluation of neurologic deficits:
- With bowel or bladder dysfunction, or any of the following new neurological deficits documented on examination of the patient: lower extremity weakness, abnormal reflexes, abnormal sensory changes along a particular dermatome (nerve distribution), evidence of cauda equina syndrome, or foot drop.

For evaluation of chronic back pain with any of the following:
- 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 spinal abnormality

For evaluation of new onset of back pain:
- Failure of conservative treatment*, for at least six (6) weeks
- 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 spinal abnormality

For evaluation of trauma or acute injury within past 72 hours:
- 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*.

For evaluation of known tumor, cancer or evidence of metastasis:
- For staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs or symptoms (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality

CPT Codes: 72148, 72149, 72158
• With evidence of metastasis on bone scan or previous imaging study.
• With no imaging/restaging within the past ten (10) months.

For evaluation of suspected tumor:
• Prior abnormal or indeterminate imaging that requires further clarification.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  o Cancer surveillance – Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected infection, abscess, or inflammatory disease:
• 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, lymphoma:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:
• 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.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a spinal abnormality.
• Surgical infection as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing fracture as evidenced by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Lumbar Spine MRI:
• For preoperative evaluation.
• Tethered cord, known or suspected spinal dysraphism.
• For evaluation of suspicious sacral dimples associated with lesions such as hairy patches or hemangiomas.
• Ankylosing Spondylitis - For diagnosis when suspected as a cause of back or sacroiliac pain and completion of the following initial evaluation:
  o History of back pain associated with morning stiffness
  o Sedimentation rate and/or C-reactive protein
  o HLA B27
  o Non-diagnostic or indeterminate x-ray
• Known arnold-chiari syndrome.

COMBINATION OF STUDIES WITH LUMBAR SPINE MRI:

Cervical/Thoracic/Lumbar MRIs:
• Any combination of these for scoliosis survey in infant/child.
• Any combination of these for spinal survey in patient with metastasis.
• For evaluation of spinal abnormalities associated with Chiari Malformation.
ADDITIONAL INFORMATION RELATED TO LUMBAR SPINE MRI:

**MRI imaging** – Metal devices or foreign body fragments within the body, such as indwelling pacemakers and intracranial aneurysm surgical clips that are not compatible with the use of MRI, may be contraindicated. Other implanted metal devices in the patient as well as external devices such as portable O2 tanks may also be contraindicated.

*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) – 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 documentation provided regarding 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).

**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 preformed to evaluate Cauda equina syndrome, severe spinal compression.

**Tethered spinal cord syndrome** - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord with the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is myelomeningocele 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 (a delicate filament near the tailbone)
- 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.

For example, bone metastases occur in a minority of all breast cancer patients. Low stage breast cancer patients are very unlikely to have bone metastases (Coleman RE et al). Radiographic (X-ray) evaluation prior to MRI is appropriate. A trial of conservative care in back pain is also indicated and appropriate in these low stage patients.

Advanced stage breast cancer patients do develop bone metastases in a slight majority of cases (Coleman RE et al). Back pain in advanced stage breast cancer patients should still be initially evaluated with X-ray (which has the chance of demonstrating cause of pain, or identifying multiple metastases, and may change the subsequent imaging choice for optimal staging). However, these patients should, in most cases, not undergo a trial of conservative care.”
REFERENCES


CPT Codes: 72159

INTRODUCTION:

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.

INDICATIONS FOR SPINAL CANAL MRA:

- For the evaluation of spinal arteriovenous malformation (AVM).
- For the evaluation of a cervical spine fracture where there is concern for vascular injury.
- For the evaluation of known or suspected vertebral artery injury.
- 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.

ADDITIONAL INFORMATION RELATED TO SPINAL CANAL MRA:

**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.

**Cervical Spine Fracture** – The American College of Radiology (ACR) appropriateness criteria scale indicates that MRA of the neck is most appropriate for suspected acute cervical spine trauma and where clinical or imaging findings suggest arterial injury.

**Vertebral Artery Injury** – Two-dimensional time-of-flight (2D TOF) magnetic resonance angiography (MRA) is used for detecting vertebral artery injury in cervical spine trauma patients.

REFERENCES


CPT Codes: 72191

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR PELVIS CTA:

**For evaluation of known or suspected 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.
- 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**
  - Known or suspected iliac artery aneurysm >2.5 cm AND equivocal or indeterminate ultrasound results OR
  - Prior imaging (e.g. ultrasound) demonstrating iliac artery aneurysm >2.5cm 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 >3.5cm, <six month follow up (and consider intervention)
- Suspected retroperitoneal hematoma or hemorrhage (To determine vascular source of hemorrhage in setting of trauma, tumor invasion, fistula or vasculitis; otherwise CT is sufficient for diagnosis).
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis.
- For evaluation of suspected pelvic vascular disease when findings on ultrasound are indeterminate.

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 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 peritoneal cavity.
• Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - 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/Pelvis CTA combo:
• For evaluation of extensive vascular disease involving the chest and abdominal cavities such as aortic dissection, vasculitic diseases such as Takayasu's arteritis, significant post-traumatic or post-procedural vascular complications, etc.
• For preoperative or preprocedural evaluation such as transcatheter aortic valve replacement (TAVR).

ADDITIONAL INFORMATION RELATED TO PELVIS CTA:

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.

Bruit - 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.

**Follow-up of asymptomatic incidentally-detected iliac artery aneurysms:**
- <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

REFERENCES


INTRODUCTION:

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. Clinician 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR PELVIS CT:

Initial staging of prostate cancer:
- PSA levels >20 ng/mL, biopsy, Gleason Score ≥8, or clinically advanced disease (T3, T4 or T1-T2 and nomogram (e.g. Partin, cancer of prostate risk assessment CAPRA) indicating probability of lymph node involvement >10%).

Known prostate cancer for workup of recurrence and response to treatment:
- 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 known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- 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.
- 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 last follow-up.

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,
• Melanoma without symptoms or signs of metastasis.
• Prostate cancer: unless PSA > 20 ng/ml, Gleason score on biopsy >/= 8 or clinically advanced disease (T3, T4 or T1-T2 and nomogram (e.g. Partin, cancer of prostate risk assessment CAPRA) indicating probability of lymph node involvement >10%).

• Three (3) month follow-up of known pelvic cancer undergoing active treatment within the past year.
• Six (6) month follow-up of known pelvic cancer undergoing active treatment within the past year.
• Follow-up of known cancer of patient undergoing active treatment within the past year.
• Known cancer with suspected metastasis based on a sign, symptom or an abnormal lab value.
• Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of enlargement of organ or abnormality seen on previous imaging:
• Evaluation of an organ enlargement such as uterus or ovaries as evidenced by physical examination or an abnormality on prior ultrasound.
• Further evaluation of organ enlargement or abnormality seen on previous imaging.

For evaluation of suspected infection or inflammatory disease:
• Suspected acute appendicitis (or severe acute diverticulitis) if pelvic pain and tenderness to palpation is present, with at LEAST one of the following:
  o WBC elevated
  o Fever
  o Anorexia or
  o Nausea and vomiting.
• 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 infection in the pelvis

For evaluation of known infection or inflammatory disease follow up:
• Complications of diverticulitis 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) **:
• 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
  o Suspected or known iliac artery aneurysm >2.5 cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging (e.g. ultrasound) demonstrating iliac artery aneurysm >2.5cm in diameter OR
  o Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of pelvic pain.
  o Follow up of iliac artery aneurysm: Six month if between 3.0-3.5 cm and if stable follow yearly. If >3.5cm, <six month follow up (and consider intervention)
• Scheduled follow-up evaluation of aorto/iliac endograft or stent.
Asymptomatic at six (6) month intervals, for two (2) years
Symptomatic/complications related to stent graft – more frequent imaging may be needed.
Suspected retroperitoneal hematoma or hemorrhage.

For evaluation of trauma:
- For evaluation of trauma with lab or physical findings of pelvic bleeding.
- For evaluation of physical or radiological evidence of pelvis fracture.

Pre-operative evaluation:
- For pelvic surgery or procedure.

For post-operative/procedural evaluation:
- Follow-up of known or suspected post-operative complication involving the hips or the pelvis.
- 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 ongoing tumor/cancer surveillance 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

Other indications for Pelvic CT:
- Persistent pelvic pain not explained by previous imaging/procedure.
- Unexplained pelvic pain in patients seventy-five (75) years or older.
- Hernia with suspected complications (e.g. bowel obstruction or strangulation) or prior to surgical repair.
- Ischemic bowel.
- Known or suspected aseptic/avascular necrosis of hip(s) and MRI is contraindicated after completion of initial x-ray.
- Sacroiliitis (infectious or inflammatory) after completion of initial x-ray and MRI is contraindicated.
  - Sacroiliac joint dysfunction and MRI contraindicated:
    - 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).

Combination of studies with Pelvis CT:
- Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT – 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.

ADDITIONAL INFORMATION RELATED TO PELVIS CT:

Ultrasound should be considered prior to a request for Pelvis CT for the following evaluations:
- Evaluation or follow up of ovarian mass
- Repeat CT for aneurysm ordered by non-surgeon.
CT for organ enlargement - An Abd/pelvis combo is most appropriate because it will demonstrate the kidneys and the ureters. Other organs may require an Abdomen CT or Pelvis CT only.

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:**
- <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. Helical CT of the prostate may be a useful alternative to MRI in patients with an increasing PSA level and negative findings on biopsy.

Prostate Cancer – For symptomatic patients and/or those with a life expectancy of greater than 5 years, a bone scan is appropriate for patients with T1 to T2 disease who also have a PSA greater than 20ng/ml or a Gleason score of 8 or higher. Patients with a T3 to T4 disease or symptomatic disease should also
receive a bone scan. Pelvic computed tomography (CT) or magnetic resonance imaging (MRI) scanning is recommended if there is T3 (tumor extent outside prostate with (T3b) or without (T3a) seminal vesicle invasion) or T4 (outside prostate but more extensive than seminal vesicle involvement) disease, or T1 (limited prostate volume involvement, typically <5%) or T2 (more extensive involvement confined to prostate) disease and a nomogram (combination of information, e.g. Gleason score, clinical stage and PSA) indicates that there is greater than 20% 10% chance of lymph node involvement, although staging studies may not be cost effective until the chance of lymph node positively reaches 45%. Biopsy should be considered for further evaluation of suspicious nodal findings. For all other patients, no addition imaging is required for staging.

**Pelvic Trauma and CT Imaging** – Helical CT is useful in the evaluation of low or high flow vascular injuries in patient with blunt 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.

**REFERENCES**


CPT Codes: 72195, 72196, 72197

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCR) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR PELVIC MRI:

Initial pelvic imaging for staging of prostate cancer:
- PSA levels >20 ng/mL, biopsy GS ≥8, or clinically advanced disease (T3, T4 or T1-T2 and nomogram (e.g. Partin, Cancer of Prostate Risk Assessment CAPRA) indicating probability of lymph node involvement >10%).

Known prostate cancer for workup of recurrence and response to treatment:
- 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) diagnostic transrectal prostate MRI:
- In patients without confirmed diagnosis of prostate cancer (with persistently elevated or rising PSA and prior negative biopsy).

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- 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.
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance unless tumor(s) are specified as highly suspicious, or change was found on last follow-up.

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,
- Melanoma without symptoms or signs of metastasis.
- Prostate cancer: unless PSA > 20 ng/ml, Gleason score on biopsy >/= 8 or clinically advanced disease (T3, T4 or T1-T2 and nomogram (e.g. Partin, cancer of prostate risk assessment CAPRA) indicating probability of lymph node involvement >10%).

- Three (3) month follow-up of known pelvic cancer undergoing active treatment within the past year.
- Six (6) month follow-up of known pelvic cancer undergoing active treatment within the past year.
- 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.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

**For evaluation of suspected infection or inflammatory disease:**
- Suspected acute appendicitis (or severe acute diverticulitis) 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 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 infection in the pelvis.

**For evaluation of known infection or inflammatory disease follow up:**
- 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).
- 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 limited to the pelvis that requires re-evaluation, or is suspected to have recurred.
- Known infection in the pelvis.

**Pre-operative evaluation:**
For pelvic surgery or procedure.

**For post-operative/procedural evaluation:**
- Follow-up of known or suspected post-operative complication involving the hips or the pelvis.
- 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.
- For evaluation of known or suspected aseptic/avascular necrosis of hip(s).
- Sacroiliitis (infectious or inflammatory)
- Sacroiliac Joint Dysfunction:
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:**
  - 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:**
  - For evaluation of persistent groin or symphsis pubis pain related to a suspected diagnosis of athletic pubalgia (sports hernia), when not responding to 4 weeks of conservative treatment*.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

**Other Indications for a Pelvic MRI:**

- For location or evaluation of undescended testes in adults and in children, including determination of location of testes, where ultrasound has been done previously.
- To provide an alternative to follow-up of an indeterminate pelvic CT when previous CT/Ultrasound was equivocal and needed to clarify a finding a CT could not.
- 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.
- For evaluation of uterus prior to embolization.
- For evaluation of endometriosis.
- Prior to uterine surgery if there is abnormality suspected on prior ultrasound.
- For evaluation of known or suspected abnormality of the fetus noted on prior imaging and no prior pelvis MRI.

**ADDITIONAL INFORMATION RELATED TO PELVIC MRI:**

*Conservative Therapy - Sacroiliac Joint Dysfunction* 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)** – 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 documentation 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).
**MRI and Undescended Testes** – The most common genital malformation in boys is undescended testis. The timely management of undescended testis is important to potentially minimize the risk of infertility and less 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 in pregnancy. 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 in pregnancy.

**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** – In selected patients diagnosed with prostate cancer, MRI of the pelvis can be used for initial staging, evaluation of recurrence and response to radiation therapy. A separate technique, transrectal prostate MRI, is used in patients with persistent PSA elevation despite prior negative biopsies.

For symptomatic patients and/or those with a life expectancy of greater than 5 years, a bone scan is appropriate for patients with T1 to T2 disease who also have a PSA greater than 20ng/mL or a Gleason score of 8 or higher. Patients with a T3 to T4 disease or symptomatic disease should also receive a bone scan. Pelvic computed tomography (CT) or magnetic resonance imaging (MRI) scanning is recommended if there is T3 or T4 disease, or T1 or T2 disease and a nomogram indicates that there is greater than 20% chance of lymph node involvement, although staging studies may not be cost effective until the chance of lymph node positively reaches 45%. Biopsy should be considered for further evaluation of suspicious nodal findings. For all other patients, no addition imaging is required for staging.

Men who suffer a biochemical recurrence following prostatectomy fall into two groups: (1) those whose PSA level fails to fall to undetectable levels after surgery, or (2) those who achieve an undetectable PSA after surgery with a subsequent detectable PSA level that increases on two or more laboratory determinations. Since PSA elevation alone does not necessary lead to clinical failure, the workup for both of these groups focuses on the assessment of distant metastasis. The specific tests depend on the clinical history, but potentially include a bone scan, biopsy, PSA doubling time assessment, CT/MRI or radioimmunologic scintigraphy. (i.e. ProstaScint scan). Bone scans are appropriate when patients develop symptoms or when the PSA level is increasing rapidly. In one study, the probability of a positive bone scan for a patient not on ADT after radical prostatectomy was less then 5% unless the PSA increased to 40 to 45 ng/mL.
Further work up is indicated in patients who are considered candidates for local therapy. These patients include those with original clinical stage T1-2, a life expectancy of greater than 10 years, and a current PSA of less than 10ng/mL. Work up includes a prostate biopsy, bone scan and additional tests as clinically indicated such as abdominal/pelvic CT, MRI or radioimmunologic scintigraphy. (i.e. ProstaScint scan).

A negative biopsy following post-radiation biochemical recurrence poses clinical uncertainties. Observation, ADT, or enrolling in clinical trials is viable options. Alternatively, the patients may undergo more aggressive workup, such as repeat biopsy, MR spectroscopy, and or endorectal MRI.

Fusion imaging of multi-parametric magnetic resonance imaging (MRI) and trasrectal ultrasound (TRUS) to guide prostate biopsy is not covered.

**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.

**REFERENCES**


CPT Codes: 72198

IMPORTANT NOTE:

Abdomen/Pelvis MRA & Lower Extremity MRA Runoff Requests: **Two auth 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.

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR PELVIS MRA:

**For evaluation of known or suspected pelvic 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.
- 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 aortic aneurysm**
  - Known or suspected iliac artery aneurysm >2.5 cm AND equivocal or indeterminate ultrasound results OR
  - Prior imaging (e.g. ultrasound) demonstrating iliac artery aneurysm >2.5cm 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 >3.5cm, <six month follow up (and consider intervention).
- Suspected retroperitoneal hematoma or hemorrhage (To determine vascular source of hemorrhage in setting of trauma, tumor invasion, fistula or vasculitis; otherwise CT is sufficient for diagnosis).
- For evaluation of suspected pelvic vascular disease when findings on ultrasound are indeterminate.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis.

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 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 peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - 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.

ADDITIONAL INFORMATION RELATED TO PELVIS MRA:

Abdomen/Pelvis MRA & Lower Extremity MRA Runoff Requests: Two auth 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.

Bruit: 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.

**Follow-up of asymptomatic incidentally-detected iliac artery aneurysms:**

- <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
REFERENCES


CPT Codes: 73200, 73201, 73202

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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

Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Suspected tumor size increase or recurrence based on a sign, symptom, imaging study or abnormal lab value.
- Surveillance: One follow-up exam if initial evaluation is indeterminate and lesion remains suspicious for cancer. No further surveillance unless tumor is specified as highly suspicious, or change was found on last imaging.

Evaluation of known cancer:
- Initial staging of known cancer in the upper extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected upper extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected infection or inflammatory disease: (e.g. osteomyelitis) and MRI is contraindicated or cannot be performed:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- With abnormal physical, laboratory, and/or imaging findings.
- Known or suspected (based upon initial workup including imaging) septic arthritis or osteomyelitis.

For evaluation of suspected (AVN) avascular necrosis (e.g., aseptic necrosis) and MRI is contraindicated or cannot be performed:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- High suspicion for AVN (e.g. corticosteroid use, transplant recipients) with negative plain films.

For evaluation of known or suspected autoimmune disease, (e.g. rheumatoid arthritis) and MRI is contraindicated or cannot be performed:
- 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, CCP).

For evaluation of known or suspected fracture and/or injury:
• Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
• Suspected fracture when imaging is negative or equivocal.
• Determine position of known fracture fragments/dislocation.
• Evaluate for delayed union or non-union of fracture or joint fusion.

For evaluation of persistent pain and initial imaging has been performed and MRI is contraindicated or cannot be performed:
• 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 or 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.

Pre-operative evaluation
• Pre-operative evaluation for planned surgery of complex fractures and/or dislocations

Post-operative/procedural evaluation:
• When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural complications.

Additional indications for an Upper Extremity (Hand, Wrist, Arm, Elbow, or Shoulder) CT:
• Bone scan, ultrasound, or x-ray is non-diagnostic or requires further evaluation.
• CT arthrogram and MRI is contraindicated or cannot be performed.
• To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, or treated osteochondral defects where physical or imaging findings suggest its presence and MRI is contraindicated or cannot be performed.
• Known or suspected partial or complete tendon rupture and MRI is contraindicated or cannot be performed.

Additional indications for Shoulder CT:
• For any evaluation of patient with shoulder prosthesis or other implanted metallic hardware where prosthetic loosening or dysfunction is suspected on physical examination or imaging.
• Evaluation of recurrent dislocation and MRI is contraindicated or cannot be performed.
• For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome) and MRI is contraindicated or cannot be performed.
• For evaluation of known or suspected rotator cuff tear, or labral tear (SLAP lesion, Bankart lesion) and MRI is contraindicated or cannot be performed.
• Impingement or rotator cuff tear indicated by positive Neer’s sign, Hawkin’s sign or drop sign and MRI is contraindicated or cannot be performed.
• Status post prior rotator cuff repair with suspected re-tear and findings on prior imaging are indeterminate and MRI is contraindicated or cannot be performed.

Additional indications for Wrist CT when MRI is contraindicated or cannot be performed:
• For evaluation of suspected ligament injury with evidence of wrist instability on examination or evidence of joint space widening on x-ray
• For suspected TFCC (triangular fibrocartilage complex) injury
• To differentiate between occult ganglion and synovitis in chronic dorsal wrist pain.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY CT:

*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.

**REFERENCES:**


CPT Codes: 73206

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR UPPER EXTREMITY CTA:

For assessment/evaluation of known or suspected vascular disease/condition:
- For evaluation of suspected vascular disease: aneurysm, arteriovenous malformation, fistula, vasculitis, or intramural hematoma.
- For evaluation of Raynaud's syndrome.
- For evaluation of vascular invasion or displacement by tumor.
- For evaluation of complications of interventional vascular procedures, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents, or stent-grafts.
- For evaluation of suspected upper extremity embolism or thrombosis.
- For evaluation of traumatic injuries to the upper extremity with clinical findings suggestive of arterial injury.

Preoperative evaluations:
- For pre-operative evaluation of known vascular disease/condition with indeterminate ultrasound.

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.

Other indications for Upper Extremity CTA:
- For evaluation of a dialysis graft.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY CTA:

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.

**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.

**REFERENCES**


CPT Codes: 73218, 73219, 73220, 73221, 73222, 73223

INTRODUCTION:

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, and abnormalities in ligaments, tendons/cartilages, septic arthritis, and infection/inflammation.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR UPPER EXTREMITY MRI (HAND, WRIST, ARM, ELBOW or SHOULDER) (plain radiographs must precede MRI evaluation):

Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification, or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Suspected tumor size increase or recurrence based on a sign, symptom, imaging study or abnormal lab value.
- Surveillance: One follow-up exam if initial evaluation is indeterminate and lesion remains suspicious for cancer. No further surveillance unless tumor is specified as highly suspicious, or change was found on last imaging.

Evaluation of known cancer:
- Initial staging of known cancer in the upper extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected upper extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated

For evaluation of known or suspected infection or inflammatory disease (e.g. osteomyelitis):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- With abnormal physical, laboratory, and/or imaging findings.
- Known or suspected (based upon initial workup including x-ray) of septic arthritis or osteomyelitis.

For evaluation of suspected (AVN) avascular necrosis (i.e. aseptic necrosis):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- High suspicion for AVN (e.g. corticosteroid use, transplant recipients) with negative plain films.

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).
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain and initial imaging (e.g. x-ray) has been performed:
- 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 or 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.

Pre-operative evaluation
- Pre-operative evaluation for planned surgery of complex fractures and/or dislocations

Post-operative/procedural evaluation:
- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural complications.

Additional indications for Upper Extremity (Hand, Wrist, Arm, Elbow, or Shoulder) MRI:
- Bone scan, ultrasound, or x-ray is non-diagnostic or requires further evaluation.
- MR arthrogram.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, or treated osteochondral defects where physical or imaging findings suggest its presence.
- Known or suspected partial or complete tendon rupture.

Additional indications for Shoulder MRI:
- For evaluation of known or suspected labral tear with instability on exam, abnormality on x-ray or history of prior known dislocation. (SLAP lesion, Bankart lesion)
- Impingement or rotator cuff tear indicated by positive Neer's sign, Hawkin's sign or drop sign.
- Status post prior rotator cuff repair with suspected re-tear and findings on prior imaging are indeterminate.
- For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome).
- For evaluation of recurrent dislocation.

Additional indications for Wrist MRI:
- For evaluation of suspected ligament injury with evidence of wrist instability on examination or evidence of joint space widening on x-ray
- For suspected TFCC (triangular fibrocartilage complex) injury.
- To differentiate between occult ganglion and synovitis in chronic dorsal wrist pain.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY MRI:

*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.

**REFERENCES**


CPT Codes: 73225

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR UPPER EXTREMITY MRA/MRV:

For assessment/evaluation of known or suspected vascular disease/condition:
- For evaluation of suspected vascular disease: aneurysm, arteriovenous malformation, fistula, vasculitis, or intramural hematoma.
- For evaluation of Raynaud's syndrome.
- For evaluation of vascular invasion or displacement by tumor.
- For evaluation of complications of interventional vascular procedures, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents, or stent-grafts.
- For evaluation of suspected upper extremity embolism or thrombosis.
- For evaluation of traumatic injuries to the upper extremity with clinical findings suggestive of arterial injury.

Preoperative evaluations:
- For pre-operative evaluation of known vascular disease/condition

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.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY MRA/MRV:

Bruit – Bruits are 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, and Coarctation of aorta.

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.

**MRA/MRV 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.

**REFERENCES**


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LOWER EXTREMITY CT (FOOT, ANKLE, KNEE, LEG or HIP):

**Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):**
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Suspected tumor size increase or recurrence based on a sign, symptom, imaging study or abnormal lab value.
- Surveillance: One follow-up exam if initial evaluation is indeterminate and lesion remains suspicious for cancer. No further surveillance unless tumor is specified as highly suspicious, or change was found on last imaging.

**Evaluation of known cancer:**
- Initial staging of known cancer in the lower extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected lower extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated

**For evaluation of known or suspected infection or inflammatory disease (e.g. osteomyelitis) and MRI is contraindicated or cannot be performed:**
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- With abnormal physical, laboratory, and/or imaging findings.
- Known or suspected (based upon initial workup including imaging) septic arthritis or osteomyelitis.

**For evaluation of suspected (AVN) avascular necrosis (e.g., aseptic necrosis, Legg-Calve-Perthes disease in children) and MRI is contraindicated or cannot be performed:**
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- High suspicion for AVN (e.g. corticosteroid use, transplant recipients) with negative plain films.

**For evaluation of known or suspected autoimmune disease, (e.g. rheumatoid arthritis) and MRI is contraindicated or cannot be performed:**
- 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).
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain, initial imaging has been performed and MRI is contraindicated or cannot be performed:
- 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 or 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.

Pre-operative evaluation.
- Pre-operative evaluation for planned surgery of complex fractures and/or dislocations.

Post-operative/procedural evaluation:
- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural complications.

Additional indications for Lower Extremity (Foot, Ankle, Knee, Leg, or Hip) CT:
- Bone scan, ultrasound, or x-ray is non-diagnostic or requires further evaluation.
- For evaluation of leg length discrepancy when physical deformities of the lower extremities would prevent standard modalities such as x-rays or a Scanogram from being performed. (Scanogram (CPT code 77073); bone length study is available as an alternative to lower extremity CT evaluation for leg length discrepancy).
- CT arthrogram and MRI is contraindicated or cannot be performed.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, or treated osteochondral defects where physical or imaging findings suggest its presence and MRI is contraindicated or cannot be performed.

Additional indications specifically for FOOT or ANKLE CT:
- Chronic (lasting 3 months or greater) pain in a child or an adolescent with painful rigid flat foot where imaging is unremarkable or equivocal or on clinician’s decision to evaluate for known or suspected tarsal coalition.
- Accompanied by physical findings of ligament damage such as an abnormal drawer test of the ankle or significant laxity on valgus or varus stress testing and/or joint space widening on x-ray, and MRI is contraindicated or cannot be performed.

Additional indications specifically for KNEE CT and MRI is contraindicated or cannot be performed:
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- Presence of a joint effusion.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (e.g. McMurray’s, Apley’s, or Thessaly’s).
- Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamentous injury determined by the drawer test, pivot shift test, or the Lachman test.
- Accompanied by physical findings of medial collateral ligament (MCL) or lateral collateral ligament (LCL) ligamentous injury determined by significant laxity on varus or valgus stress tests.
Additional indications specifically for HIP CT:

- For any evaluation of patient with hip prosthesis or other implanted metallic hardware where prosthetic loosening or dysfunction is suspected on physical examination or imaging.
- For evaluation of total hip arthroplasty patients with suspected loosening and/or wear or osteolysis or assessment of bone stock is needed.
- For evaluation of suspected slipped capital femoral epiphysis with non-diagnostic or equivocal imaging and MRI is contraindicated or cannot be performed.
- Suspected labral tear of the hip with signs of clicking and pain with hip motion especially with hip flexion, internal rotation and adduction which can also be associated with locking and giving way sensations of the hip on ambulation and MRI is contraindicated or cannot be performed.

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY CT:

*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.

REFERENCES


CPT Codes: 73706

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LOWER EXTREMITY CTA:

For assessment/evaluation of suspected or known vascular disease/condition:
- Significant ischemia in the presence of ulcers/gangrene.
- Large vessel diseases, e.g. aneurysm, dissection, arteriovenous malformations (AVMs), fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome.
- Venous thrombosis after non-diagnostic ultrasound.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis.
- Abnormal preliminary testing (ankle/brachial index, ultrasound/doppler arterial evaluation) associated with significant symptoms of claudication with exercise.
- For evaluation of traumatic injuries to the lower extremity with clinical findings suggestive of arterial injury.

Pre-operative evaluation:
- For pre-operative evaluation of known vascular disease/condition with indeterminate ultrasound.

Post-operative / procedural evaluation:
- Post-operative or interventional vascular procedure for luminal patency versus re-stenosis (due to atherosclerosis, thromboembolism, intimal hyperplasia and other causes) as well as complications such as pseudoaneurysms related to surgical bypass grafts and vascular stents and stent-grafts.
- 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.

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY CTA:

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.

**REFERENCES**


CPT Codes: 73718, 73719, 73720, 73721, 73722, 73723

INTRODUCTION:

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, and abnormalities in ligaments, tendons/cartilages, septic arthritis, and infection/inflammation.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LOWER EXTREMITY MRI (FOOT, ANKLE, KNEE, LEG or HIP) (plain radiographs must precede MRI evaluation):

Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):
- Initial evaluation of suspicious mass/tumor found on an imaging study, and needing clarification, or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Suspected tumor size increase or recurrence based on a sign, symptom, imaging study or abnormal lab value.
- Surveillance: One follow-up exam if initial evaluation is indeterminate and lesion remains suspicious for cancer. No further surveillance unless tumor is specified as highly suspicious, or change was found on last imaging.

Evaluation of known cancer:
- Initial staging of known cancer in the lower extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected lower extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of known or suspected infection or inflammatory disease (e.g. osteomyelitis):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- With abnormal physical, laboratory, and/or imaging findings.
- Known or suspected (based upon initial workup including x-ray) septic arthritis or osteomyelitis.

For evaluation of suspected (AVN) avascular necrosis (i.e. aseptic necrosis, Legg-Calve-Perthes disease in children):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- High suspicion for AVN (e.g. corticosteroid use, transplant recipients) with negative plain films.

For evaluation of known or suspected autoimmune/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).
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain and initial imaging has been performed:
- 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 or 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.

Pre-operative evaluation.
- Pre-operative evaluation for planned surgery of complex fractures and/or dislocations.

Post-operative/procedural evaluation:
- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural complications.

Additional indications for a Lower Extremity (Foot, Ankle, Knee, Leg or Hip) MRI:
- Bone scan, ultrasound, or x-ray is non-diagnostic or requires further evaluation.
- MR arthrogram.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, or treated osteochondral defects where physical or imaging findings suggest its presence.
- Known or suspected partial or complete tendon rupture.

Additional indications specifically for FOOT or ANKLE MRI
- Chronic (lasting 3 months or greater) pain in a child or adolescent with painful rigid flat foot where imaging is unremarkable or equivocal or on clinician’s decision to evaluate for known or suspected tarsal coalition.
- Accompanied by physical findings of ligament damage such as an abnormal drawer test of the ankle or significant laxity on valgus or varus stress testing and/or joint space widening on x-rays.
- Evaluation of tarsal tunnel syndrome after abnormal plain films or abnormal nerve conduction studies, or a failure of 4 weeks of conservative treatment.

Additional indications specifically for KNEE MRI:
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- For evaluation of suspected Baker’s cyst or posterior knee swelling with equivocal or non-diagnostic findings on ultrasound.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (e.g. McMurray’s, Apley’s, Thessaly’s).
- Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamentous injury determined by the drawer test, pivot shift test, or the Lachman test.
- Accompanied by physical findings of medial cruciate ligament (MCL) or lateral cruciate ligament (LCL) ligamentous injury determined by significant laxity on varus or valgus stress tests.

Additional indications specifically for HIP MRI:
- For evaluation of suspected slipped capital femoral epiphysis with non-diagnostic imaging.
- For any evaluation of patient with hip prosthesis or other implanted metallic hardware where prosthetic loosening or dysfunction is suspected on physical examination or imaging.
Suspected labral tear of the hip with signs of clicking and pain with hip motion especially with hip flexion, internal rotation and adduction which can also be associated with locking and giving way sensations of the hip on ambulation.

ADDITIONAL INFORMATION RELATED TO A LOWER EXTREMITY MRI:

*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).

**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 normal 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 physeal to detect edema in the area of the physeal.

**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.

**MRI 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. MRI is normally not used in the initial imaging of suspected ankle fractures; MRI is more specific for ligamentous injuries. MRI may identify ankle ligament injuries associated with problematic subsets of ankle fracture.

**REFERENCES**


INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LOWER EXTREMITY MRA/MRV:

For assessment/evaluation of suspected or known vascular disease/condition:
- Significant ischemia in the presence of ulcers/gangrene.
- Large vessel diseases, e.g., aneurysm, dissection, arteriovenous malformations (AVMs), fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome.
- Venous thrombosis after non-diagnostic ultrasound.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis
- Abnormal preliminary testing (ankle/brachial index, ultrasound/doppler arterial evaluation) associated with significant symptoms of claudication with exercise.
- For evaluation of traumatic injuries to the lower extremity with clinical findings suggestive of arterial injury.

Pre-operative evaluation:
- For pre-operative evaluation of known vascular disease/condition

Post-operative / procedural evaluation:
- Post-operative or interventional vascular procedure for luminal patency versus re-stenosis (due to atherosclerosis, thromboembolism, intimal hyperplasia and other causes) as well as complications such as pseudoaneurysms related to surgical bypass grafts and vascular stents and stent-grafts
- 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.

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY MRA/MRV:

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.

**Bruits**—Bruits are 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, and Coarctation of aorta.

**REFERENCES**


CPT Codes: 74150, 74160, 74170

INTRODUCTION:

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. 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 after equivocal ultrasound has been validated for diagnosis. Clinician 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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 suspicious masses/tumors found only in the abdomen by physical exam or imaging study, such as ultrasound (US).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen. No further surveillance CT unless tumor(s) are specified as highly suspicious, or change was found on last follow-up CT, new/changing sign/symptoms or abnormal lab values.

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,
    - Melanoma without symptoms or signs of metastasis.
- Three (3) month follow-up of known abdominal cancer undergoing active treatment within the past year.
- Six (6) month follow-up of known abdominal cancer undergoing active treatment within the past year.
- 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.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of an organ or abnormality seen on previous imaging:
For the evaluation of an organ enlargement such as splenomegaly or hepatomegaly as evidenced by physical examination or confirmed on any previous imaging study.

**For evaluation of suspected infection or inflammatory disease:**
- Suspected acute appendicitis (or severe acute diverticulitis) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  - WBC elevated
  - Fever
  - Anorexia or
  - Nausea and vomiting.
- Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  - Rebound, rigid abdomen, or
  - Severe tenderness to palpation present over entire abdomen.
- Suspected pancreatitis: can have pancreatitis without abnormally elevated amylase and lipase.
- Suspected inflammatory bowel disease (Crohn’s or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.
- Suspected cholecystitis or retained gallstones with recent equivocal ultrasound.
- Suspected infection in the abdomen.

**For evaluation of known infection or inflammatory disease follow up:**
- 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).
- Pancreatitis by history, (including pancreatic pseudocyst) with abdominal pain suspicious for worsening, or re-exacerbation.
- 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.
- Any history of fistula limited to the abdomen that requires re-evaluation, or is suspected to have recurred.
- 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, rigid abdomen, or
  - severe tenderness to palpation present over entire abdomen.
- Hepatitis/hepatoma screening after ultrasound and alpha-fetoprotein (AFP) have been obtained and either elevated alpha-fetoprotein (AFP) is elevated or ultrasound is abnormal, equivocal or non-diagnostic.
- Known infection in the abdomen.

**For evaluation of known or suspected vascular disease (e.g., aneurysms or hematomas)**:
- Evidence of vascular abnormality seen on imaging studies.
- Evaluation of suspected or known aneurysm limited to abdomen or in evaluating abdominal extent of aortic aneurysm**
  - Suspected or known aneurysm > 2.5 cm AND equivocal or indeterminate ultrasound results OR
  - Prior imaging (e.g. ultrasound) demonstrating aneurysm >2.5cm cm in diameter OR
  - Suspected complications of known aneurysm as evidenced by clinical findings such as new onset of abdominal pain.
- Scheduled follow-up evaluation of aorto/iliac endograft or stent (Adb/Pelvis CTA is preferred)
Asymptomatic at six (6) month intervals, for two (2) years
- Symptomatic/complications related to stent graft – more frequent imaging may be needed
- Suspected retroperitoneal hematoma or hemorrhage.

For evaluation of trauma:
- For evaluation of trauma with lab or physical findings of intra-abdominal bleeding limited to the abdomen.

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 ongoing tumor/cancer surveillance 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated

Other Indications for an Abdomen CT:
- Suspected adrenal mass based on diagnostic testing/imaging results, and/or a suspicious clinical presentation
- Persistent abdominal pain not explained by previous imaging/procedure
- 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.
- Unexplained weight loss of 5% of body weight in six months confirmed by documentation to include the following
  - 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.
- Hernia with suspected complications (e.g. bowel obstruction or strangulation) or prior to surgical repair.
- Ischemic bowel.
- Suspected complete or high-grade partial small bowel obstruction limited to the abdomen.

Combination of 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.

ADDITIONAL INFORMATION RELATED TO ABDOMEN CT:
Combination studies for suspected appendicitis, peritonitis, diverticulitis, or inflammatory bowel disease (IBD):

- Combined Abdomen CT and Pelvis CT is usually ordered
- There are situations that a combo Abd/Pelvis CT was not ordered such as Pelvis CT previously approved and separate subsequent request for Abdomen CT, etc.

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

- Possible gallstones or abnormal liver function tests with gall bladder present.
- Evaluation of cholecystitis.
- Repeat CT studies of renal mass.
- Repeat CT Hepatic mass follow-up.
- Repeat CT for aortic aneurysm.

CT for organ enlargement: An abd/pelvis combo is most appropriate because it will demonstrate the kidneys and the ureters. Other organs may require an Abdomen CT or Pelvis CT only.

CT for suspected renal stones: An initial CT study is done to identify the size of the stone and rule out obstruction. \((7 \text{ mm is the key size}; \text{ less than that size the expectation is that it will pass})\) 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: 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. CT angiography is not routinely required to assess abdominal aortic aneurysms and the decision to utilize conventional CT or CT angiography is based on factors unique to the individual case.

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. >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 \(\geq 3.0 \text{ cm or dilatation of the aorta} \geq 1.5\times \text{ the normal diameter.} \) 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

CTA is not always the study of choice to following an aneurysm. Clinicians interested in documenting size in asymptomatic patient without the concern for complications or branch vessel patency may chose a non contrast CT.

**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.

**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 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.

**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.

**Work up for distant metastasis in the initial evaluation of melanoma** - Multiple studies, including the two authored by Miranda and Yancovitz below 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.

**Initial evaluation of abdominal aortic aneurysm (AAA)** - Initial evaluation of AAA is accurately made by ultrasound. 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. >7 cm the risk of rupture goes to 7% per year. Chronic contained ruptures should meet the following criteria- known abdominal aortic aneurysm, previous pain symptoms that may have resolved; stable hemodynamic status with a normal HCT, CT scans showing retroperitoneal hemorrhage, and pathologic confirmation of organized hematoma.

**Initial evaluation of adnexal masses** - MRI is a sensitive and specific modality for evaluation of adnexal masses in comparison to CT. While improved diagnostic accuracy of MRI was not shown to be statistically significant in the study- there was a trend to more accurate results with MRI over multi-detector (16-row) CT.

**Evaluation for recurrence of ovarian cancer metastases** - MRI was noted to be superior to PET/CT (with non-contrast CT) in the detection of recurrence of ovarian cancer in a small study (36 patients).

**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.

**REFERENCES**


CPT Codes: 74174

INTRODUCTION:

Computed tomographic angiography (CTA) is used in the evaluation of many conditions affecting the veins and arteries of the abdomen and pelvis or lower extremities. This study (Abdomen/Pelvis CTA) is useful for evaluation of the arteries/veins in the peritoneal cavity (abdominal aorta, iliac arteries) while the Abdominal Arteries CTA is more useful for the evaluation of the abdominal aorta and the vascular supply to the legs. It is not appropriate as a screening tool for asymptomatic patients without a previous diagnosis.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ABDOMEN/PELVIS CTA:

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.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of known or suspected aortic aneurysm**:
  - 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 and OR
  - Suspected complications of known aneurysm as evidenced by sign/symptoms such as new inset 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 is sufficient for diagnosis)
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- For evaluation of suspected mesenteric ischemia.
- Vascular invasion or displacement by tumor.
- For evaluation of known or suspected renal artery stenosis or resistant hypertension demonstrated by any of the following:
  - Unsuccessful control after treatment with 3 or more 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.
  - New onset of hypertension after age 55 (>160/100).
  - Acute rise in blood pressure in a person with previously stable blood pressures.
  - Flash pulmonary edema without identifiable causes.
  - Malignant hypertension.
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 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).
  - Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
    - Asymptomatic at six (6) month intervals, for two (2) years.
    - 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:
- For evaluation of extensive vascular disease involving the chest and abdominal cavities such as aortic dissection, vasculitic diseases such as Takayasu’s arteritis, significant post-traumatic or post-procedural vascular complications, etc.
- For preoperative or preprocedural evaluation such as transcatheter aortic valve replacement (TAVR).

ADDITIONAL INFORMATION RELATED TO ABDOMEN/PELVIS CTA:

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.

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 2.0cm. 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):
- 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

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. Abdomen CTA (limiting evaluation to the aorta above the bifurcation and including the abdominal arteries) is the preferred study. 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.

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.

REFERENCES


CPT Codes: 74175

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ABDOMEN CTA:

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.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of known or suspected aortic aneurysm **:
  - 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 is sufficient for diagnosis).
- Suspected renal vein thrombosis in patient with known renal mass.
- For evaluation of suspected mesenteric ischemia.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- For evaluation of portal venous system (hepatic portal system) after doppler ultrasound has been performed.
- For evaluation of known or suspected renal artery stenosis or resistant hypertension demonstrated by any of the following:
  - Unsuccessful control after treatment with 3 or more 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.
  - New onset of hypertension after age 55 (>160/100).
Acute rise in blood pressure in a person with previously stable blood pressures.
Flash pulmonary edema without identifiable causes.
Malignant 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.

**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). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - 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 such as aortic dissection, vasculitic diseases such as Takayasu’s arteritis, significant post-traumatic or post-procedural vascular complications, etc.
- For preoperative or preprocedural evaluation such as transcatheter aortic valve replacement (TAVR).

**ADDITIONAL INFORMATION RELATED TO ABDOMEN CTA:**

**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.

**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.

**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 2.0cm. Aneurysmal dilatation of the infrarenal aorta is defined as diameter \( \geq 3.0 \) cm or dilatation of the aorta \( \geq 1.5 \times \) the normal diameter\(^1\). 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\(^1\). The limitations are that overlying bowel gas can obscure findings and the technique is operator dependent.\(^2\)
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):

- 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

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.

REFERENCES


CPT Codes: 74176, 74177, 74178

INTRODUCTION:

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, although CT after equivocal ultrasound has been validated for diagnosis. Clinician 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ABDOMEN/PELVIS CT:

For evaluation of hematuria:
- Hematuria

For evaluation of known or suspected kidney or ureteral stones:
- Delineation of known or suspected renal calculi or ureteral calculi.

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- 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.
- 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 change was found on last follow-up CT, new/changing sign/symptoms or abnormal lab values.

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.
    - Melanoma without symptoms or signs of metastasis.
    - Prostate cancer unless Gleason score seven plus (7+) or PSA over twenty (20)
- Three (3) month follow-up of known abdomen/pelvic cancer undergoing active treatment within the past year.
• Six (6) month follow-up of known abdomen/pelvic cancer undergoing active treatment within the past year.
• 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.
• Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of an organ enlargement:
• For the evaluation of an organ enlargement such as splenomegaly, hepatomegaly, uterus or ovaries as evidenced by physical examination or confirmed on any previous imaging study.

For evaluation of suspected infection or inflammatory disease:
• Suspected acute appendicitis (or severe acute diverticulitis) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  o WBC elevated
  o Fever
  o Anorexia or
  o Nausea and vomiting.
• Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  o Rebound, rigid abdomen, or
  o Severe tenderness to palpation present over entire abdomen.
• Suspected pancreatitis: can have pancreatitis without abnormally elevated amylase and lipase.
• Suspected complications of diverticulitis (known to be limited to the abdomen/pelvis by prior imaging) with abdominal/pelvic pain or severe tenderness, not responding to antibiotics treatment.
• Suspected inflammatory bowel disease (Crohn’s or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.
• Suspected cholecystitis or retained gallstones with recent equivocal ultrasound.
• Suspected infection in abdomen/pelvis.

For evaluation of known infection or inflammatory disease follow up:
• 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).
• Pancreatitis by history (including pancreatic pseudocyst) with abdominal pain suspicious for worsening, or re-exacerbation.
• 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 or pelvis.
• Any history of fistula that requires re-evaluation, or is suspected to have recurred in the abdomen or 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:
  o rebound, rigid abdomen, or
  o severe tenderness to palpation present over entire abdomen.
• Hepatitis/hepatoma screening after ultrasound and alpha-fetoprotein (AFP) have been obtained and either elevated alpha-fetoprotein (AFP) is elevated or ultrasound is abnormal, equivocal or non-diagnostic.
• Known infection in the abdomen/pelvis region.
For evaluation of known or suspected vascular disease (e.g., aneurysms or hematomas)**:
- Evidence of vascular abnormality seen on imaging studies.
  - Evaluation of suspected or known aortic aneurysm limited to the abdomen/pelvis or in evaluating abdominal/pelvic extent of aortic aneurysm**:
    - Suspected or known 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 clinical findings such as new onset of abdominal or pelvic pain
- Scheduled follow-up evaluation of aorto/iliac endograft or stent. (Abd/Pelvis CTA is preferred)
  - Asymptomatic at six (6) month intervals, for two (2) years
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Suspected retroperitoneal hematoma or hemorrhage

For evaluation of trauma:
- For evaluation of trauma with lab or physical findings of intra-abdominal/pelvic bleeding.
- Suspected retroperitoneal hematoma or hemorrhage.

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.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

Other indications for Abdomen/Pelvic CT Combo:
- Suspected adrenal mass or pheochromocytoma based on diagnostic testing/imaging results, and/or a suspicious clinical presentation.
- Persistent abdomen/pelvic pain not explained by previous imaging/procedure.
- 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.
- Unexplained weight loss of 5% of body weight in six months confirmed by documentation to include the following
  - 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.
- Suspected spigelian hernia (ventral hernia) or incisional hernia (evidenced by a surgical abdominal scar) when ordered as a pre-operative study.
• Hernia with suspected complications. (e.g. bowel obstruction or strangulation) or prior to surgical repair.
• Ischemic bowel.

ADDITIONAL INFORMATION RELATED TO ABDOMEN/PELVIS CT:

Ultrasound should be considered prior to a request for Abdomen or Pelvis CT for the following evaluations:
- Possible gallstones or abnormal liver function tests with gall bladder present.
- Evaluation of cholecystitis.
- Repeat CT studies of renal mass.
- Repeat CT Hepatic mass follow-up.
- Repeat CT for aortic 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: 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. CT angiography is not routinely required to assess abdominal aortic aneurysms and the decision to utilize conventional CT or CT angiography is based on factors unique to the individual case.

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. >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 2.0cm. 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

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.

Initial evaluation of abdominal aortic aneurysm (AAA) - Initial evaluation of AAA is accurately made by ultrasound.

REFERENCES


http://www.uspreventiveservicestaskforce.org/uspstf/uspsaneu.htm
CPT Codes: 74181, 74182, 74183

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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).
- 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 last follow-up.

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,
    - Melanoma without symptoms or signs of metastasis.
- Three (3) month follow-up of known abdominal cancer undergoing active treatment within the past year.
- Six (6) month follow-up of known abdominal cancer undergoing active treatment within the past year.
- 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.
- Cancer surveillance: Active monitoring for recurrence as clinically indicated.

For evaluation of suspected infection or inflammatory disease:
- Suspected acute appendicitis (or severe acute diverticulitis) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  - WBC elevated
  - Fever
  - Anorexia or
- Nausea and vomiting.
- Suspected peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  - Rebound, rigid abdomen, or
  - Severe tenderness to palpation present over entire abdomen.
- Suspected pancreatitis: can have pancreatitis without abnormally elevated amylase and lipase.
- Suspected inflammatory bowel disease (Crohn’s or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.
- Suspected cholecystitis or retained gallstones with recent equivocal ultrasound.
- Suspected infection in the abdomen.

For evaluation of known infection or inflammatory disease follow up:
- 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).
- Pancreatitis by history, (including pancreatic pseudocyst) with abdominal pain suspicious for worsening, or re-exacerbation.
- 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.
- Any history of fistula limited to the abdomen that requires re-evaluation, or is suspected to have recurred.
- Abnormal fluid collection seen on prior imaging that needs follow-up evaluation.
- Follow up of known peritonitis (from any cause) if abdominal pain and tenderness to palpation is present, and at LEAST one of the following:
  - Rebound, rigid abdomen, or
  - Severe tenderness to palpation present over entire abdomen.
- Hepatitis/hepatoma screening after ultrasound and/or alpha-fetoprotein (AFP) have been obtained and where either alpha-fetoprotein (AFP) is elevated or ultrasound is abnormal, equivocal or non-diagnostic.
- Known infection in the abdomen.

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 ongoing tumor/cancer surveillance 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.
  - Cancer surveillance – Active monitoring for recurrence as clinically indicated.

Other Indications for an Abdominal MRI:
- To provide an alternative to abdominal CT when CT would be limited due to allergy to radiographic contrast material.
- To provide an alternative to follow-up of an indeterminate abdomen CT when previous CT/Ultrasound was equivocal.
- Suspected adrenal mass or pheochromocytoma based on diagnostic testing/imaging results, and/or a suspicious clinical presentation.

ADDITIONAL INFORMATION RELATED TO ABDOMINAL MRI:

**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.

**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 apposed phase chemical shift imaging.

**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.

**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.

**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 to diagnose abdominal aortic aneurysm** – MRI can be useful in the diagnosis of aortic aneurysms in patients with chronic aortic disease. The advantages include: safety, noninvasive nature (except for intravenous contrast), wide field of view, multi-planar imaging and 3D relationship viewing. MRI, unlike CT, does not require large volumes of iodinated contrast. ECG-gated spin-echo MRI is the basis for many MRI imaging algorithms for diagnosing abdominal aortic disease. A rapid breath holds MRI, allows more comprehensive examination of the aorta and defines many types of aortic pathology.
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.

REFERENCES


CPT Codes: 74185

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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.
- Evidence of vascular abnormality seen on prior imaging studies.
- Evaluation of known or suspected aortic aneurysm**:
  - 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-keep this
- Suspected renal vein thrombosis in patient with known renal mass.
- For evaluation of suspected mesenteric ischemia/ischemic colitis.
- 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 splenic artery aneurysm.
- 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 demonstrated by any of the following:
  - Unsuccessful control after treatment with three (3) or more 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.
New onset of hypertension after age 55 (>160/100).
Acute rise in blood pressure in a person with previously stable blood pressures.
Flash pulmonary edema without identifiable causes.
Malignant 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 pretransplant evaluation of either liver or kidney.

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).
  - Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
    - Asymptomatic at six (6) month intervals, for two (2) years.
    - 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.

ADDITIONAL INFORMATION RELATED TO ABDOMEN MRA:

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) auth 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 et al) 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 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

**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 nephritic 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.

**REFERENCES**


CPT Codes: 74261, 74262

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CT COLONOSCOPY (VIRTUAL COLONOSCOPY):

For diagnostic evaluation when conventional colonoscopy is contraindicated:

- 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.

REFERENCES


CPT Codes: 75557, 75559, 75561, 75563 +75565

INTRODUCTION:

Cardiac magnetic resonance imaging (MRI) is an imaging modality utilized in the assessment and monitoring of cardiovascular disease. It has a role in the diagnosis and evaluation of both acquired and congenital cardiac disease. MRI is a noninvasive technique using no ionizing radiation resulting in high quality images of the body in any plane, unlimited anatomic visualization and potential for tissue characterization.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Based APPROPRIATE USE CRITERIA for Heart MRI, including updates through September, 2017

<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9)</td>
<td>Detection of CAD: Symptomatic</td>
</tr>
<tr>
<td>U=Uncertain (4-6)</td>
<td>Evaluation of Chest Pain Syndrome, Including Low Risk Unstable Angina (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
</tr>
<tr>
<td>2 U(4)</td>
<td>• Intermediate pre-test probability of CAD*</td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable AND able to exercise</td>
</tr>
<tr>
<td>3 A(7)</td>
<td>• Intermediate pre-test probability of CAD*</td>
</tr>
<tr>
<td></td>
<td>• ECG uninterpretable OR unable to exercise</td>
</tr>
<tr>
<td>4 A(7-9)</td>
<td>• High pre-test probability of CAD*</td>
</tr>
</tbody>
</table>

Followup of Known Ischemic CAD

Asymptomatic or Stable Symptoms

| 4a A(7-9)                                                      | ROUTINE FOLLOW-UP when last invasive or non-invasive assessment of coronary artery disease showed HEMODYNAMICALLY SIGNIFICANT CAD (ischemia on stress test or FFR <= 0.80 for a major vessel or stenosis >=70% of a major vessel) over two years ago, without supervening coronary revascularization, is an appropriate indication for stress CMR in patients with high risk clinical scenarios, such as left ventricular dysfunction (ejection fraction less than 50%) or severe unrevascularized multivessel CAD (if it will alter management), OR in patients with HIGH RISK OCCUPATIONS (e.g. associated with |
### INDICATIONS

(*Refer to Additional Information section*)

<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>A= Appropriate (7-9)</th>
<th>U=Uncertain (4-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters</strong> or a <strong>HIGH PERSONAL RISK</strong> (e.g. scuba divers, etc.).</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th><strong>New, recurrent, or worsening (progressive) symptoms in patients with known ischemic CAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4b A(7-9)</strong></td>
</tr>
<tr>
<td>• PRIOR LOW RISK CORONARY EVALUATION AT LEAST TWO YEARS EARLIER (e.g. limited extent of CORONARY ARTERY DISEASE, &lt;5% myocardium at risk), AND NOW WITH NEW STABLE (or low risk unstable), RECURRENT, OR SLOWLY WORSENING (PROGRESSIVE) SYMPTOMS of coronary ischemia, is an appropriate indication for stress CMR in this patient group. However, regardless of timing of prior non-invasive assessment, clinical documentation of continued problematic symptoms or moderate to highly likely acute coronary syndrome (Table 6) of even low mortality risk (Table 7) is often better assessed with invasive coronary arteriography, particularly when stress testing in the last 2 years and current clinical findings are at odds. This category is very documentation-sensitive and requires judgment.</td>
</tr>
</tbody>
</table>

**Note:** INVASIVE CORONARY ARTERIOGRAPHY IS GENERALLY PREFERABLE in those patients, who have a PRIOR MODERATE OR HIGH RISK STRESS TEST RESULT (especially if NOT previously evaluated by invasive coronary arteriography) or a current diagnosis of moderate to high risk UNSTABLE ANGINA, and inappropriate for repeat stress CMR unless supervening reasons to prefer a non-invasive approach are documented in the record (e.g. very unclear symptoms, CKD, dye allergy, etc.), and it could alter management.

<table>
<thead>
<tr>
<th><strong>New or Worsening Symptoms without Known CAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4c A(7—9)</strong></td>
</tr>
</tbody>
</table>
| • One of the following, when invasive coronary arteriography is not clearly indicated or appropriate (e.g.data are equivocal, symptoms not clear, CKD, dye allergy, other etiologies suspect, etc.):
  o Normal exercise EKG
  o CCTA, invasive coronary arteriography, or stress imaging did not show obstructive CAD |

| **4d U(4-6)** |
| • Abnormal prior stress imaging study, when invasive coronary arteriography is not clearly indicated or appropriate (e.g.data are equivocal, symptoms not clear, CKD, dye allergy, other etiologies suspect, etc.):
  o Post Coronary Revascularization |
<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9)</td>
<td>• Symptomatic or ischemic equivalent that is well documented</td>
</tr>
<tr>
<td>U=Uncertain (4-6)</td>
<td></td>
</tr>
<tr>
<td>4e A(7-9)</td>
<td>• Asymptomatic Minimum of 2 YEARS post coronary artery bypass grafting or 2 YEARS post percutaneous coronary intervention (whichever was the latter) is appropriate only for patients with high direct CORONARY-related risk, such as incomplete coronary revascularization with feasible additional revascularization of residual severe multivessel disease, need for otherwise unevaluated follow up of stenting of unprotected left main coronary artery (LM) disease or left ventricular dysfunction (ejection fraction less than 50%), 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) or HIGH PERSONAL RISK (e.g. scuba divers, etc.). • Evaluation of Asymptomatic Patient</td>
</tr>
<tr>
<td>4f A(7-9)</td>
<td></td>
</tr>
<tr>
<td>4g U(4-6)</td>
<td>• High Global Risk CAD • Regardless of EKG interpretability or ability to exercise &gt;2 years from last assessment</td>
</tr>
<tr>
<td></td>
<td>Evaluation of Intra-Cardiac Structures (Use of MR Coronary Angiography)</td>
</tr>
<tr>
<td>8 A(8)</td>
<td>• Evaluation of suspected coronary anomalies or coronary aneurysms</td>
</tr>
<tr>
<td></td>
<td>Acute Chest Pain (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
</tr>
<tr>
<td>9 U(6)</td>
<td>• With history of intermediate pre-test probability of CAD • No ECG changes and serial cardiac enzymes negative</td>
</tr>
<tr>
<td></td>
<td>Risk Assessment With Prior Test Results (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
</tr>
<tr>
<td>12 U(6)</td>
<td>• Intermediate Global risk • Equivocal stress imaging test (exercise, stress SPECT, or stress echo)</td>
</tr>
<tr>
<td>13 A(7)</td>
<td>• Coronary angiography (catheterization or CCTA) • Stenosis of unclear significance</td>
</tr>
<tr>
<td>13a A(7-9)</td>
<td>• Prior Exercise EKG stress test or CCTA • Equivocal result</td>
</tr>
<tr>
<td>13b A(7-9)</td>
<td>• One of the following: o High concern for ischemic EKG with intermediate to high global risk EKG, and indication for invasive coronary arteriography is not clear o Abnormal prior exercise EKG with preference to avoid invasive evaluation (e.g. unclear symptoms, mildly abnormal stress EKG, dye allergy, CKD, etc.)</td>
</tr>
<tr>
<td>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
</tbody>
</table>
| A= Appropriate (7-9)                                        | **o** Obstructive CAD on prior CCTA, and either physiologic evaluation for ischemia is required, or there are new or worsening symptoms.  
| U=Uncertain (4-6)                                           | **o** Obstructive CAD on invasive coronary angiography, and physiologic evaluation for ischemia is required  
|                                                            | **o** LEFT BUNDLE BRANCH BLOCK, when the history (intermediate to high global risk), physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress CMR |

13c U(4-6) 
- One of the following:  
  - High concern for ischemic EKG, but only low global risk CORONARY ARTERY DISEASE, and indication for invasive coronary arteriography is not clear  
  - Abnormal prior stress imaging study, and indication for invasive coronary arteriography is not clear  
  - LEFT BUNDLE BRANCH BLOCK, when the history (low global risk), physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress CMR  

Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery – Intermediate or High Risk Surgery (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)

15 A(7-9) 
- If all the following apply:  
  - Coronary evaluation before thoracoabdominal aortic surgery  
  - Patient has less than a 4 MET functional capacity  
  - Patient has one peri-operative risk factor  
  - No coronary evaluation (invasive or non-invasive) within the past year  
  - If invasive coronary arteriography is preferable, then stress CMR is not appropriate  
  - Alternatively, without the need for the above criteria, patient would be a candidate for stress CMR at the time of a preoperative evaluation if indications unrelated to the surgery were well documented in the clinical record  

Other Cardiovascular Conditions

15a A(7-9) 
- One of the following:  
  - Newly diagnosed systolic heart failure  
  - Newly diagnosed diastolic heart failure  
  - Sustained VT  
  - VF  
  - Exercise Induced VT or nonsustained VT
<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>(Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15b U(4-6)</td>
<td>• One of the following &lt;br&gt;  o Frequent PVCs (&gt;30/min) &lt;br&gt;  o Intermediate or high Global Risk CAD</td>
</tr>
<tr>
<td><strong>Valvular Structure and Function</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Evaluation of Ventricular and Valvular Function</strong></td>
<td>Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease and delayed contrast enhancement, when echocardiogram is inadequate</td>
</tr>
<tr>
<td>18 A(9)</td>
<td>• Assessment of complex congenital heart disease including anomalies of coronary circulation, great vessels, and cardiac chambers and valves  &lt;br&gt; • Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and contrast enhancement</td>
</tr>
<tr>
<td>18a A(8)</td>
<td>• Severe tricuspid regurgitation and suboptimal TTE images, for assessment of RV systolic function and systolic and diastolic volumes  &lt;br&gt; • Alternative imaging modality: CCT (U(6))</td>
</tr>
<tr>
<td>18b A(7)</td>
<td>• Severe MR suspected clinically, potentially underestimated on TTE despite optimal images: better imaging of MR jet needed  &lt;br&gt; • Alternative imaging modality: TEE A(9)</td>
</tr>
<tr>
<td>18c A(7)</td>
<td>• In chronic asymptomatic patient, to distinguish between moderate or severe primary MR, when TTE images are inadequate.  &lt;br&gt; • Alternative imaging modality: TEE A(7)</td>
</tr>
<tr>
<td>18d A(7)</td>
<td>• Discordance between clinical assessment and TTE about the severity of AR, when TTE images are inadequate.  &lt;br&gt; • Alternative imaging modality: TTE A(8), CCT A(9)</td>
</tr>
<tr>
<td>18e A(7)</td>
<td>• Pre TAVR assessment of aortic annular size and shape  &lt;br&gt; • Alternative imaging modality: TEE A(7), CCT A(9)</td>
</tr>
<tr>
<td>18f A(7)</td>
<td>• Pre TAVR assessment of aortic dimensions  &lt;br&gt; • Alternative imaging modality: CCT A(9)</td>
</tr>
<tr>
<td>19 U(6)</td>
<td>• Evaluation of LV function following myocardial infarction OR in heart failure patients</td>
</tr>
<tr>
<td>20 A(8)</td>
<td>• Evaluation of LV function following myocardial infarction OR in heart failure patients  &lt;br&gt; • Patients with technically limited images from echocardiogram</td>
</tr>
<tr>
<td>21 A(8)</td>
<td>• Quantification of LV function  &lt;br&gt; • Discordant information that is clinically significant from prior tests</td>
</tr>
<tr>
<td>22 A(8)</td>
<td>• Evaluation of specific cardiomyopathies (infiltrative [amyloidosis, sarcoidosis, hemochromatosis,], noncompaction, HCM, acute viral myocarditis or due to cardiotoxic therapies), if echocardiography is inadequate and the information might alter management</td>
</tr>
<tr>
<td>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
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</tr>
<tr>
<td>A= Appropriate (7-9) U=Uncertain (4-6)</td>
<td><strong>Use of delayed enhancement</strong></td>
</tr>
<tr>
<td><strong>23 A(8)</strong></td>
<td>• Characterization of native and prosthetic cardiac valves—including morphology of a bicuspid aortic valve’s ascending aorta, hemodynamics, planimetry of stenotic disease, quantification of regurgitant disease, preoperative/preinterventional evaluation of septal defects, and valve/inflow/outflow/conduit dimensions, necessary evaluation of congenital heart disease (e.g. anomalous pulmonary venous return, tetralogy of Fallot, etc.)</td>
</tr>
<tr>
<td><strong>23a A(8)</strong></td>
<td>• Patients with technically limited images from echocardiogram, transesophageal echocardiogram, or cardiac CT</td>
</tr>
</tbody>
</table>
| **23b A(7)** | • Re-evaluation (<1 y) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV and an ascending aortic diameter >4 cm with 1 of the following:  
  o 1) aortic diameter >4.5 cm  
  o 2) rapid rate of change in aortic diameter  
  o 3) family history (first-degree relative) of aortic dissection.  
  o Alternative imaging modality: CCT A(8), TTE A(7) |
| **23c U(5)** | • Characterization of bioprosthetic valve if suspected clinically significant valvular dysfunction and inadequate images from TTE and TEE.  
  • Alternative imaging modality: CCT A(7) |
| **24 A(9)** | • Characterization of mechanical prosthetic valve if suspected clinically significant valvular dysfunction and inadequate images from TTE and TEE  
  • Alternative imaging modality: CCT A(7), Fluoroscopy A(7) |
| **25 A(8)** | • Evaluation for arrhythmogenic right ventricular cardiomyopathy (ARVC)  
  • Patients presenting with syncope or ventricular arrhythmia |
| **26a U(6)** | • Evaluation of intra- and extra-cardiac structures  
  • Suspected cardiac mass, suspected tumor or thrombus, or potential cardiac source of emboli, when TTE images are inadequate  
  • Alternative imaging modality: TTE A(9), TEE A(7)  
  • Use of contrast for perfusion and enhancement |
| **26b A(9)** | • Detailed evaluation of a known cardiac mass (tumor or thrombus, most often previously noted on echocardiography)  
  • Use of contrast for perfusion and enhancement |
<p>| <strong>27 A(8)</strong> | • Evaluation of pericardial conditions (pericardial mass, constrictive pericarditis, constriction versus restrictive cardiomyopathy) |
| <strong>28 A(8)</strong> | • Evaluation for aortic dissection |</p>
<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9)</td>
<td>Evaluation of pulmonary veins prior to radiofrequency ablation for atrial fibrillation</td>
</tr>
<tr>
<td>U=Uncertain (4-6)</td>
<td>Left atrial and pulmonary venous anatomy including dimensions of veins for mapping purposes</td>
</tr>
<tr>
<td>29 A(8)</td>
<td>Detection of Myocardial Scar and Viability</td>
</tr>
<tr>
<td></td>
<td>Evaluation of Myocardial Scar (Use of Late Gadolinium Enhancement)</td>
</tr>
<tr>
<td>30 A(7)</td>
<td>To determine the location, and extent of myocardial necrosis including 'no reflow' regions</td>
</tr>
<tr>
<td></td>
<td>Post acute myocardial infarction</td>
</tr>
<tr>
<td>31 U(4)</td>
<td>To detect post PCI myocardial necrosis</td>
</tr>
<tr>
<td>32 A(9)</td>
<td>To determine viability prior to revascularization</td>
</tr>
<tr>
<td></td>
<td>Establish likelihood of recovery of function with revascularization (PCI or CABG) or medical therapy</td>
</tr>
<tr>
<td>33 A(9)</td>
<td>To determine viability prior to revascularization</td>
</tr>
<tr>
<td></td>
<td>Viability assessment by SPECT or dobutamine echo has provided &quot;equivocal or indeterminate&quot; results</td>
</tr>
</tbody>
</table>

INDICATIONS FOR HEART MRI:

- Where Stress Echocardiography (SE) is noted as an appropriate substitute for a Cardiac MRI indication (#’s 2, 3, 4, 12, and 13) then at least one of the following contraindications to SE must be demonstrated:
  - Stress echocardiography is not indicated; OR
  - Stress echocardiography has been performed however findings were inadequate, there were technical difficulties with interpretation, or results were discordant with previous clinical data; OR
  - Heart MRI is preferential to stress echocardiography including but not limited to following conditions:
    - Ventricular paced rhythm
    - Evidence of ventricular tachycardia
    - Severe aortic valve dysfunction
    - Severe Chronic Obstructive Pulmonary Disease, (COPD) as defined as FEV1 < 30% predicted or FEV1 < 50% predicted plus respiratory failure or clinical signs of right heart failure. (GOLD classification of COPD access http://www.pulmonaryreviews.com/jul01/pr_jul01_copd.html
    - Congestive Heart Failure (CHF) with current Ejection Fraction (EF), 40%
    - Inability to get an echo window for imaging
    - Prior thoracotomy, (CABG, other surgery)
    - Obesity BMI>40
    - Poorly controlled hypertension [generally above 180 mm Hg systolic (both physical stress and dobutamine stress may exacerbate hypertension during stress echo)]
    - Poorly controlled atrial fibrillation (Resting heart rate > 100 bpm on medication)
    - Inability to exercise requiring pharmacological stress test
    - Segmental wall motion abnormalities at rest (e.g. due to cardiomyopathy, recent MI, or pulmonary hypertension)
OR

- Arrhythmias with Stress Echocardiography • any patient on a type 1C anti-arrhythmic drug (i.e. Flecainide or Propafenone) or considered for treatment with a type 1C anti-arrhythmic drug.

For all other requests, the patient must meet ACCF/ASNC Appropriateness criteria for indications (score 4-9) above.

**INDICATIONS IN ACC GUIDELINES WITH “INAPPROPRIATE” DESIGNATION:**

Patient meets ACCF/ASNC Appropriateness criteria for indications (score 1-3) noted below OR meets any one of the following:

- For any combination imaging study
- For same imaging tests less than six weeks part unless specific guideline criteria states otherwise.
- For different imaging tests, such as CTA and MRA, of same anatomical structure less than six weeks apart without high level review to evaluate for medical necessity.
- For re-imaging of repeat or poor quality study

**ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Based APPROPRIATE USE CRITERIA for Heart MRI, including updates through September, 2017**

<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of CAD: Symptomatic</td>
<td>Evaluation of Chest Pain Syndrome (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>• Low pre-test probability of CAD • ECG interpretable AND able to exercise</td>
<td>I(2)</td>
</tr>
<tr>
<td>Evaluation of Chest Pain Syndrome (Use of MR Coronary Angiography)</td>
<td>5</td>
<td>• Intermediate pre-test probability of CAD • ECG interpretable AND able to exercise</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>• High pre-test probability of CAD</td>
</tr>
<tr>
<td>Acute Chest Pain (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td>10</td>
<td>• With history of high pre-test probability of CAD • ECG - ST segment elevation and/or positive cardiac enzymes</td>
</tr>
<tr>
<td>Risk Assessment With Prior Test Results (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td>11</td>
<td>• Normal prior stress test (exercise, nuclear, echo, MRI) • High CHD risk (Framingham)</td>
</tr>
<tr>
<td>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
<td>APPROPRIATE USE SCORE (1-3): I= Inappropriate</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>• Within 1 year of prior stress test</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery – Low Risk Surgery (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>• Intermediate perioperative risk predictor</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>Detection of CAD: Post-Revascularization (PCI or CABG)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Chest Pain Syndrome (Use of MR Coronary Angiography)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>• Evaluation of bypass grafts</td>
<td>I(2)</td>
</tr>
<tr>
<td>17</td>
<td>• History of percutaneous revascularization with stents</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

**ADDITIONAL INFORMATION RELATED TO HEART MRI:**

**Abbreviations**

ACS = acute coronary syndrome  
CABG = coronary artery bypass grafting surgery  
CAD = coronary artery disease  
CCT = cardiac CT  
CCTA = coronary CT angiography  
CHD = coronary heart disease  
CHF = congestive heart failure  
CT = computed tomography  
CTA = computed tomographic angiography  
ECG = electrocardiogram  
ERNA = equilibrium radionuclide angiography  
FP = First Pass  
HF = heart failure  
LBBB = left bundle-branch block  
LV = left ventricular  
MET = estimated metabolic equivalent of exercise  
MI = myocardial infarction  
MPI = myocardial perfusion imaging  
MRI = magnetic resonance imaging  
PCI = percutaneous coronary intervention  
PET = positron emission tomography  
RNA = radionuclide angiography  
SE = stress echocardiography  
SPECT = single positron emission CT (see MPI)

**What is a valid anginal or ischemic equivalent?**
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, etc.), 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 by itself is generally not considered an anginal equivalent, and is handled under a separate category in this guideline.

**Exercise Treadmill Testing** - Exercise Treadmill Testing (ETT) is the appropriate first line test in most patients with suspected CAD. In appropriately selected patients the test provides adequate sensitivity and specificity with regard to diagnosis and prognostication. There are patients in whom the test is not the best choice, for example those with resting ECG abnormalities, inability to exercise and perhaps diabetes. Also of note from an operational standpoint the test does not require pre-authorization.

An uninterpretable baseline EKG includes:

- Abnormalities of ST segment depression of 0.1 mV (1 mm with conventional calibration) or more
- Ischemic looking T wave inversions of at least 0.25 mV (2.5 mm with conventional calibration)
- EKG findings of probable or definite LVH, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use or hypokalemia
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload (e.g. rate-pressure product less than 20-25K)
- Prior false positive stress EKG

*Pretest Probability of CAD for Symptomatic (Ischemic Equivalent) Patients:*

**Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.

**Atypical Angina (Probable):** Chest pain or discomfort that **lacks 1** of the characteristics of definite or typical angina.

**Nonanginal Chest Pain:** Chest pain or discomfort that **meets 1 or none** of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical / Definite Angina Pectoris</th>
<th>Atypical / Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td></td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>
Very low: Less than 5% pretest probability of CAD
Low: Less than 10% pretest probability of CAD
Intermediate: Between 10% and 90% pretest probability of CAD
High: Greater than 90% pretest probability of CAD

**Coronary Heart Disease (CHD) Risk**

- **CHD Risk—Low**
  - Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CHD risk less than 10%.

- **CHD Risk—Moderate**
  - Defined by the age-specific risk level that is average or above average. In general, moderate risk will correlate with a 10-year absolute CHD risk between 10% and 20%.

- **CHD Risk—High**
  - Defined as the presence of diabetes mellitus or the 10-year absolute CHD risk of greater than 20%.

**Definition of Peripheral Arterial Disease/Cerebrovascular Disease:**

Non-coronary arterial narrowing causing symptoms (claudication, related tissue demise, threatened limb loss), asymptomatic 70% or more narrowing by non-invasive or invasive evaluation, atherosclerotic arterial aneurysm by non-invasive or invasive evaluation, or aortic atheroma of at least 4 mm thickness. As a subset of peripheral arterial disease, cerebrovascular disease is also defined as a history of stroke or TIA.

**Global CAD Risk:**

It is assumed that clinicians will use current standard methods of global risk assessment in the asymptomatic patient for primary prevention, based upon Framingham-ATP IV, Reynolds, Pooled Cohort Equation (includes cerebrovascular risk), ACC/AHA Risk Calculator, MESA Risk Calculator (includes calcium score), or very similar risk calculator) CAD risk refers to 10-year risk for any hard cardiac event (e.g., myocardial infarction or CAD death).

- **Low global CAD risk**
  - Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk <10%. However, in women and younger men, low risk may correlate with 10-year absolute CAD risk <6%.

- **Intermediate global CAD risk**
  - Defined by the age-specific risk level that is average. In general, moderate risk will correlate with a 10-year absolute CAD risk range of 10% to 20%. Among women and younger age men, an expanded intermediate risk range of 6% to 20% may be appropriate.

- **High global CAD risk**
  - Defined by the age-specific risk level that is above average. In general, high risk will correlate with a 10-year absolute CAD risk of >20%. CAD equivalents (e.g., peripheral arterial disease (defined in additional information), cerebrovascular disease (history of stroke or TIA), or multiple simultaneous anti-rejection medications (e.g. cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine, long term supraphysiologic doses of glucocorticoids, but not everolimus or sirolimus/rapamycin), peripheral arterial disease) can also define high risk. High global risk can be further defined by **COMPELLING NON-INVASIVE DATA**, such as clearly pathologic Q waves on the EKG, marked ST-segment and/or T wave abnormalities of myocardial ischemia without symptoms, clear regional wall motion abnormalities of the left ventricle, or reduced ejection fraction below 50%.
Peri-Operative Cardiac Risk Factors

These are specifically: ischemic coronary artery disease (by study more than two years ago with lesions, which are: >=70% or ischemia producing on prior stress testing or with FFR <=0.80), cerebrovascular disease, insulin-requiring diabetes mellitus, history of congestive heart failure or ejection fraction less than 40%, or CKD with creatinine >= 2 mg/dl.

***Duke Treadmill Score

The equation for calculating the Duke treadmill score (DTS) is,

DTS = exercise time - (5 * ST deviation) - (4 * exercise angina), with 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.

The Duke Score provides an annual mortality estimate: <1% for low risk, 1-3% for intermediate risk, and >3% for high risk.

Determinants of a 4 MET functional capacity:

Examples of activities:

<4 METs: Slow ballroom dancing, golfing with a cart, playing a musical instrument, and walking at approximately 2 mph to 3 mph

>4 METs: Climbing a flight of stairs or walking up a hill, walking on level ground at 4 mph, and performing heavy work around the house

Tools for Characterization of Unstable Angina:

Risk Stratification in Acute Coronary Syndrome from 2007 ACC/AHA Guidelines

Three Principal Presentations of Unstable Angina (as defined within a two week time frame) (Braunwald)

<table>
<thead>
<tr>
<th>Class</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest angina</td>
<td>Angina occurring at rest and prolonged, usually greater than 20 min</td>
</tr>
<tr>
<td>New-onset angina</td>
<td>New-onset angina of at least CCS class III severity</td>
</tr>
<tr>
<td>Increasing angina</td>
<td>Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by 1 or more CCS class to at least CCS class III severity)</td>
</tr>
</tbody>
</table>

Table 6: Likelihood that Symptoms Represent an Acute Coronary Syndrome
Table 7: Short Term Risk of Death or Nonfatal MI in Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td>Any of the following:</td>
<td>Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina</td>
<td>Chest or left arm pain or discomfort as chief symptom</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Known history of CAD, including MI</td>
<td>Age greater than 70 years</td>
</tr>
<tr>
<td><strong>Examination</strong></td>
<td>Transient MR murmur, hypotension, diaphoresis, pulmonary edema, or rales</td>
<td>Extracardiac vascular disease</td>
<td>Chest discomfort reproduced by palpation</td>
</tr>
<tr>
<td><strong>EGO</strong></td>
<td>New, or presumably new, transient ST-segment deviation (5 mm or greater) or T-wave inversion in multiple or all leads</td>
<td>Fixed Q waves</td>
<td>T-wave flattening or inversion less than 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td><strong>Cardiac markers</strong></td>
<td>Elevated cardiac TnT, TnT, or CK-MB</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>


The **TIMI Risk Score** is determined by the sum of the presence of 7 variables at admission: 1 point is given for each of the following variables: age ≥65 years, at least 3 risk factors for CAD, prior coronary stenosis of ≥50%, ST-segment deviation on ECG presentation, at least 2 anginal events in prior 24 hours, use of aspirin in prior 7 days, and elevated serum cardiac biomarkers

**Low-Risk TIMI Score:** TIMI score <2; **High-Risk TIMI Score:** TIMI score ≥2. A low risk TIMI score might still warrant invasive coronary arteriography, when other features, such as symptoms, are compelling.

**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.
Metal devices or foreign body fragments within the body, such as indwelling pacemakers and intracranial aneurysm surgical clips that are not compatible with the use of MRI, may be contraindicated. Other implanted metal devices in the patient as well as external devices such as portable O2 tanks may also be contraindicated.

Cardiomyopathy – Cardiac MRI is used to diagnose and differentiate cardiomyopathies in the same study. Very small morphological and functional changes in different types of cardiomyopathy may be detected and may be used to evaluate the chance of functional recovery after surgical revascularization.

Cardiac Tumors – MRI is the modality of choice to evaluate cardiac tumors due to its high contrast resolution and multiplanar capability which allows for optimal evaluation of myocardial infiltration, pericardial involvement and extracardiac vascular structures within and beyond the thorax. It is also useful in the differentiation of benign and malignant cardiac tumors and in differentiating thrombi from cardiac tumors.

Pericardial abnormalities – Complicated pericardial diseases may cause significant morbidity and mortality without therapeutic interventions. MRI imaging has an important role in the evaluation of pericardial abnormalities; the pericardium is well visualized on MRI due to its superb contrast resolution and multiplanar capability.

REFERENCES


Alfayoumi, F., Gradman, A., Traub, D., & Biedermann, R. (2007). Evolving clinical application of cardiac MRI. *Reviews in Cardiovascular Medicine, 8(3)*, 135-44. PMID: 17938613


CPT Codes: 75572, 75573

INTRODUCTION:

Cardiac computed tomography (Heart CT) can be used to image the cardiac chambers, valves, myocardium and pericardium to assess cardiac structure and function. Applications of Heart CT listed and discussed in this guideline include: characterization of congenital heart disease, characterization of cardiac masses, diagnosis of pericardial diseases, and pre-operative coronary vein mapping.

The table below correlates and matches the clinical indications with the Appropriate Use Score based on a scale of 4 to 9, where the upper range (7 to 9) implies that the test is generally acceptable and is a reasonable approach. The mid-range (4 to 6) indicates uncertainty in the appropriateness of the test for the clinical scenario. In all cases, additional factors should be taken into account including but not limited to cost of test, impact of the image on clinical decision making when combined with clinical judgment and risks, such as radiation exposure and contrast adverse effects, should be considered.

Where the Heart CT is the preferred test based upon the indication the Appropriate Use Score will be in the upper range such as noted with indication #51 assessment of right ventricular morphology or suspected arrhythmogenic right ventricular dysplasia.

For indications in which there are one or more alternative tests with an appropriate use score rating (appropriate, uncertain) noted, for example indication #52 (Assessment of myocardial viability, prior to myocardial revascularization for ischemic left ventricular systolic dysfunction and other imaging modalities are inadequate or contraindicated), additional factors should be considered when determining the preferred test (Stress Echocardiogram if there are no contra-indications).

Where indicated as alternative tests, TTE (transthoracic echocardiography) and SE (Stress echocardiography) are a better choice, where possible, because of avoidance of radiation exposure. Heart MRI can be considered as an alternative, especially in young patients, where recurrent examinations may be necessary.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR HEART CT:

- To qualify for cardiac computed tomography, the patient must meet ACCF/ASNC Appropriateness Use Score (Appropriate Use Score 7 – 9 or Uncertain Appropriate Use Score 4-6).

ACCF/SCCT/ACR/AHA/ASE/ASNC/NASCI/SCAI/SCMR based Appropriate Use Criteria, including updates through September, 2017
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>Adult Congenital Heart Disease</th>
<th>Evaluation of Intra- and Extracardiac Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart CT (Indication and Appropriate Use Score)</td>
<td>A= Appropriate; U=Uncertain</td>
<td></td>
</tr>
</tbody>
</table>

**ACCF et al. Criteria #**

<table>
<thead>
<tr>
<th>#</th>
<th><strong>INDICATIONS</strong> (*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 A (9)</td>
<td>Evaluation of Cardiac Structure and Function</td>
</tr>
<tr>
<td>47 A (8)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>48 A (7)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>50 A (7)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>51 A (7)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>52 U (5)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>53 A (8)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>54 A (8)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>55 U (6)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
<tr>
<td>56 A (8)</td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
</tr>
</tbody>
</table>

**Evaluation of Cardiac Structure and Function**

- **Adult Congenital Heart Disease**

  - **46 A (9)**
    - Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels
      (*for “anomalies of coronary arterial vessels” CCTA preferred and for “other thoracic arteriovenous vessels” Heart CT preferred)
      - For evaluation of structural heart disease, such as TGA, when MRI might be preferable but cannot be performed.

  - **47 A (8)**
    - Further assessment of complex adult congenital heart disease after confirmation by TTE echocardiogram

  - **48 A (7)**
    - Evaluation of left ventricular function
    - Following acute MI or in HF patients
    - Inadequate images from other noninvasive methods

  - **50 A (7)**
    - Quantitative evaluation of right ventricular function

  - **51 A (7)**
    - Assessment of right ventricular morphology
    - Suspected arrhythmogenic right ventricular dysplasia

  - **52 U (5)**
    - Assessment of myocardial viability
    - Prior to myocardial revascularization for ischemic left ventricular systolic dysfunction
    - Other imaging modalities are inadequate or contraindicated

**Evaluation of Intra- and Extracardiac Structures**

- **53 A (8)**
  - Characterization of native cardiac valves
  - Suspected clinically significant valvular dysfunction
  - Inadequate images from other noninvasive methods
  - Re-evaluation (<1 y) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV and an ascending aortic diameter >4 cm with 1 of the following:
    - 1) aortic diameter >4.5 cm
    - 2) rapid rate of change in aortic diameter
    - 3) family history (first-degree relative) of aortic dissection.
  - Alternative imaging modality: CMR A(8), TTE A(7)

- **54 A (8)**
  - Characterization of prosthetic cardiac valves
  - For assessment of prosthetic valve thrombosis for suspected clinically significant valvular dysfunction
  - Inadequate images from other noninvasive method

- **55 U (6)**
  - Severe TR and suboptimal TTE images, for assessment of RV systolic function and systolic and diastolic volumes.
  - Alternative imaging modality is CMR A(8)

- **56 A (8)**
  - Evaluation of cardiac mass (suspected tumor or thrombus)
  - Inadequate images from other noninvasive methods
ACCF et al.
Criteria #
Heart CT
(Indication and
Appropriate Use
Score)
A= Appropriate;
U=Uncertain

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>(*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>57 A (8)</td>
<td>• Evaluation of pericardial anatomy</td>
</tr>
<tr>
<td>58 A (8)</td>
<td>• Evaluation of pulmonary vein anatomy</td>
</tr>
<tr>
<td></td>
<td>• Prior to radiofrequency ablation for atrial fibrillation</td>
</tr>
<tr>
<td>59 A (8)</td>
<td>• Noninvasive coronary vein mapping</td>
</tr>
<tr>
<td></td>
<td>• Prior to placement of biventricular pacemaker</td>
</tr>
<tr>
<td>60 A (8)</td>
<td>• Localization of coronary bypass grafts and other retrosternal anatomy*</td>
</tr>
<tr>
<td></td>
<td>• Prior to preoperative chest or cardiac surgery</td>
</tr>
<tr>
<td></td>
<td>(*for “localization of coronary bypass grafts” CCTA preferred and for “other retrosternal anatomy” Heart CT preferred)</td>
</tr>
</tbody>
</table>

Preoperative or Pre-Procedural Evaluation
- Pre-op evaluation prior to structural heart interventions, such as Transcatheter Aortic Valve Replacement (TAVR).

For indications in which there are one or more alternative tests with an appropriate use score rating (appropriate, uncertain) noted, (for example indication #52) then additional factors should be considered when determining the preferred test (Stress Echocardiogram if there are no contraindications).

Indication #52 of Heart CT:
- Assessment of myocardial viability
- Prior to myocardial revascularization for ischemic left ventricular systolic dysfunction
- Other imaging modalities are inadequate or contraindicated

INDICATIONS IN ACC GUIDELINES WITH “INAPPROPRIATE” DESIGNATION:
- Patient meets ACCF/ASNC Appropriateness Use Score for inappropriate indications (median score 1-3) noted below OR one or more of the following:
  o For same imaging tests less than six weeks apart unless specific guideline criteria states otherwise.
  o For different imaging tests, such as CT and MRI, of same anatomical structure less than six weeks apart without high level review to evaluate for medical necessity.
  o For re-imaging of repeat or poor quality studies.
  o For imaging of pediatric patients twelve years old and younger under prospective authorizations.
- Contraindications - There is insufficient data to support the routine use of Heart CT for the following:
  o As the first test in evaluating symptomatic patients (e.g. chest pain)
  o To evaluate chest pain in an intermediate or high risk patient when a stress test (exercise treadmill, stress echo, MPI, cardiac MRI, cardiac PET) is clearly positive or negative.
  o Preoperative assessment for non-cardiac, nonvascular surgery
- Preoperative imaging prior to robotic surgery (e.g. to visualize the entire aorta)
- Evaluation of left ventricular function following myocardial infarction or in chronic heart failure.
- Myocardial perfusion and viability studies.
- Evaluation of patients with postoperative native or prosthetic cardiac valves who have technically limited echocardiograms, MRI or TEE.

**ADDITIONAL INFORMATION RELATED TO HEART CT:**

**Abbreviations**

- ACS = acute coronary syndrome
- ARVC = arrhythmogenic cardiomyopathy
- ARVD = arrhythmogenic right ventricular dysplasia
- CABG = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- CCS = coronary calcium score
- CCT = cardiac (heart) CT
- CHD = coronary heart disease
- CT = computed tomography
- CTA = computed tomography angiography
- ECG = electrocardiogram
- EF = ejection fraction
- HF = heart failure
- MET = estimated metabolic equivalent of exercise
- MI = myocardial infarction
- MPI = Myocardial Perfusion Imaging or Nuclear Cardiac Imaging
- PCI = percutaneous coronary intervention
- SE = Stress Echocardiogram
- TTE = Transthoracic Echocardiography
- TAVR = Transcatheter Aortic Valve Replacement

**ECG—Uninterpretable**

Refers to ECGs with resting ST-segment depression (≥0.10 mV), complete LBBB, preexcitation (Wolff-Parkinson-White Syndrome), or paced rhythm.

**Acute Coronary Syndrome (ACS):**

Patients with an ACS include those whose clinical presentations cover the following range of diagnoses: unstable angina, myocardial infarction without ST-segment elevation (NSTEMI), and myocardial infarction with ST-segment elevation (STEMI)

*Pretest Probability of CAD for Symptomatic (Ischemic Equivalent) Patients:*

- **Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- **Atypical Angina (Probable):** Chest pain or discomfort that **lacks** 1 of the characteristics of definite or typical angina.
- **Nonanginal Chest Pain:** Chest pain or discomfort that **meets 1 or none** of the typical **angina characteristics**.
Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the pretest probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

- **Very low**: Less than 5% pretest probability of CAD
- **Low**: Less than 10% pretest probability of CAD
- **Intermediate**: Between 10% and 90% pretest probability of CAD
- **High**: Greater than 90% pretest probability of CAD

**Global CAD Risk**:

It is assumed that clinicians will use current standard methods of global risk assessment such as those presented in the National Heart, Lung, and Blood Institute report on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III [ATP III]) (18) or similar national guidelines. CAD risk refers to 10-year risk for any hard cardiac event (e.g., myocardial infarction or CAD death).

- **Low global CAD risk**
  Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk <10%. However, in women and younger men, low risk may correlate with 10-year absolute CAD risk <6%.

- **Intermediate global CAD risk**
  Defined by the age-specific risk level that is average. In general, moderate risk will correlate with a 10-year absolute CAD risk range of 10% to 20%. Among women and younger age men, an expanded intermediate risk range of 6% to 20% may be appropriate.

- **High global CAD risk**
  Defined by the age-specific risk level that is above average. In general, high risk will correlate with a 10-year absolute CAD risk of >20%. CAD equivalents (e.g., diabetes mellitus, peripheral arterial disease) can also define high risk.

**Perioperative Clinical Risk Predictors**:

- History of ischemic heart disease
- History of compensated or prior heart failure
- An ejection fraction of <40%
- History if cerebrovascular disease
- Diabetes mellitus (requiring insulin)
- Renal insufficiency (creatinine >2.0)
Surgical Risk Categories (As defined by the ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation of Non-Cardiac Surgery)

- **High-Risk Surgery**—cardiac death or MI greater than 5%
  - Emergent major operations (particularly in the elderly), aortic and peripheral vascular surgery, prolonged surgical procedures associated with large fluid shifts and/or blood loss.

- **Intermediate-Risk Surgery**—cardiac death or MI = 1% to 5%
  - Carotid endarterectomy, head and neck surgery, surgery of the chest or abdomen, orthopedic surgery, prostate surgery.

- **Low-Risk Surgery**—cardiac death or MI less than 1%
  - Endoscopic procedures, superficial procedures, cataract surgery, breast surgery.

**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.

**Echocardiography** – This study remains the best test for initially examining children in the assessment of congenital heart disease. However, if findings are unclear or need confirmation, CT is useful and can often be performed with only mild sedation because of the short acquisition time.

**CT and Congenital Heart Disease (CHD)** – Many more children with congenital heart disease (CHD) are surviving to adulthood, increasing the need for specialized care and sophisticated imaging. Currently more adults than children have CHD. CT provides 3D anatomic relationship of the blood vessels and chest wall, and depicts cardiovascular anatomic structures. It is used in the evaluation of congenital heart disease in adults, e.g., ventricular septal defect and anomalies of the aortic valve. CT is also used increasingly in the evaluation of patients with chest pain, resulting in detection of unsuspected congenital heart disease. CT is useful in the evaluation of children with CHD when findings from echocardiography are unclear or need confirmation.

**CT and Cardiac Masses** – CT is used to evaluate cardiac masses, describing their size, density and spatial relationship to adjacent structures. Nearly all cardiac tumors are metastases. Primary tumors of the heart are rare and most are benign. Cardiac myxoma is the most common type of primary heart tumor in adults and usually develops in the left atrium. Characteristic features of myxomas that can be assessed accurately on CT include location in the left atrium, lobulated margin, inhomogeneous content, and a CT attenuation value lower that that of blood. Echocardiography is the method of choice for the diagnosis of cardiac myxoma; CT is used to evaluate a patient with suspected myxoma before surgery. Cardiac tumors generally vary in their morphology and CT assessment may be limited. MRI may be needed for further evaluation.

**CT and Pericardial Disease** – CT is used in the evaluation of pericardial conditions. Echocardiography is most often used in the initial examination of pericardial disease, but has disadvantages when compared with CT which provides a larger field of view than echocardiography. CT also has superior soft-tissue contrast and provides anatomic delineations enabling localization of pericardial masses. Contrast-enhanced CT is sensitive in differentiating restrictive cardiomyopathy from constrictive pericarditis which is caused most often by cardiac surgery and radiation therapy. CT can depict thickening and calcification of the pericardium, which along with symptoms of physiologic constriction or restriction, may indicate constrictive pericarditis. CT is also used in the evaluation of pericardial masses which are often detected initially with echocardiography. CT can accurately define the site and extent of masses, e.g., cysts, hematomas and neoplasms.
CT and Radiofrequency Ablation for Atrial Fibrillation – Atrial fibrillation, an abnormal heart rhythm originating in the atria, is the most common supraventricular arrhythmia in the United States and can be a cause of morbidity. In patients with atrial fibrillation, radiofrequency ablation is used to electrically disconnect the pulmonary veins from the left atrium. Prior to this procedure, CT may be used to define the pulmonary venous anatomy which is commonly variable. Determination of how many pulmonary veins are present and their ostial locations is important to make sure that all the ostia are ablated.

REFERENCES

ACCF/SCCT/ACR/AHA/ASE/ASNC/NASCI/SCAI/SCMR 2010 Appropriate Use Criteria for Cardiac Computed Tomography: A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the North American Society for Cardiovascular Imaging, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance. J. Am. Coll. Cardiol. 56, 1864-1894 Retrieved from http://content.onlinejacc.org/cgi/content/short/56/22/1864


CPT Codes: 75574

INTRODUCTION:

Coronary computed tomographic angiography (CCTA) is a noninvasive imaging study that uses intravenously administered contrast material and high-resolution, rapid imaging CT equipment to obtain detailed volumetric images of blood vessels. CTA can image blood vessels throughout the body. However, imaging of the coronary vasculature requires shorter image acquisition times to avoid blurring from the motion of the beating heart. The advanced spatial and temporal resolution features of these CT scanning systems offer a unique method for imaging the coronary arteries and the heart in motion, and for detecting arterial calcification that contributes to coronary artery disease.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

The table below correlates and matches the clinical indications with the Appropriate Use Score based on a scale of 4 to 9, where the upper range (7 to 9) implies that the test is generally acceptable and is a reasonable approach. The mid-range (4 to 6) indicates uncertainty in the appropriateness of the test for the clinical scenario. In all cases, additional factors should be taken into account including but not limited to cost of test, impact of the image on clinical decision making when combined with clinical judgment and risks, such as radiation exposure and contrast adverse effects, should be considered.

Where the CCTA is the preferred test based upon the indication, the Appropriate Use Score will be in the upper range such as noted with indication # 46, Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels.

AN IMPORTANT COMMENT ON THE CONCEPT OF RISK:

It is important to adhere to the concept of risk in making appropriateness determinations. However, the terminology for risk assessment must be clarified here.

An asymptomatic patient should be assessed for GLOBAL RISK, using an accepted calculator, as listed in the references section, with available links to those calculators. Asymptomatic patients with known calcium scores should have their GLOBAL RISK assessed with the MESA calculator.

Symptomatic patients are assessed based upon whether their presentation is acute/subacute or stable/nonacute. The assessment of the stable/nonacute patient is referred to as the PRETEST PROBABILITY of coronary artery disease (CAD). Once tested, the patient has a POST-TEST PROBABILITY of coronary artery disease. The POST-TEST PROBABILITY becomes the PRETEST PROBABILITY for any subsequent test for coronary artery disease. For example, a DUKE score of negative 10 to positive 4 represents intermediate risk.

When the presentation is acute/subacute, the means of assessment for such potential acute coronary syndromes typically involves conventional history and physical, EKG, biomarkers, etc., and if no actionable diagnosis has been established at that point, the patient is generally considered to be at an
equivocal or low-to-intermediate risk for an acute coronary syndrome, for which further imaging, such as CCTA, might be appropriate.

When there has been an actionable diagnosis of an acute coronary syndrome, separate risk categorizations for that scenario apply.

ACCF/SCCT/ACR/AHA/ASE/ASNC/NASCI/SCAI/SCMR based Appropriate Use Criteria, including updates through September, 2017

<table>
<thead>
<tr>
<th>ACCF et al. Criteria # CCTA (Indication and Appropriate Use Score)</th>
<th>INDICATIONS (*)Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of CAD in Symptomatic Patients Without Known Heart Disease</td>
<td></td>
</tr>
<tr>
<td>Stable/Nonacute Symptoms Possibly Representing an Ischemic Equivalent</td>
<td></td>
</tr>
<tr>
<td>1 I(1-3)</td>
<td>• Low pretest probability of CAD* AND • ECG interpretable and able to exercise</td>
</tr>
<tr>
<td>1 U(4-6)</td>
<td>• Intermediate pretest probability of CAD* AND • ECG interpretable AND able to exercise</td>
</tr>
<tr>
<td>2 U(4-6)</td>
<td>• Low pretest probability of CAD* AND • ECG uninterpretable or unable to exercise</td>
</tr>
<tr>
<td>2 A(8)</td>
<td>• Intermediate pretest probability of CAD* AND • ECG uninterpretable or unable to exercise</td>
</tr>
<tr>
<td>2 U(4-6)</td>
<td>• High pretest probability of CAD* AND • Regardless of ECG interpretability and ability to exercise</td>
</tr>
<tr>
<td>Acute Symptoms With Suspicion of ACS (Urgent Presentation) after Standard Evaluation Has Not Resulted in an Actionable Diagnosis</td>
<td></td>
</tr>
<tr>
<td>4 U(6)</td>
<td>• Persistent ECG ST-segment elevation following exclusion of MI by invasive coronary arteriography.</td>
</tr>
<tr>
<td>5 A(7-9)</td>
<td>If one of the following apply: • Acute chest pain of uncertain cause (differential diagnosis includes pulmonary embolism, aortic dissection, and ACS [&quot;triple rule out&quot;] • Equivocal diagnosis due to single troponin elevation without additional evidence of ACS • Equivocal diagnosis with ischemic symptoms resolved hours before testing • Low-to-intermediate likelihood of ACS based upon TIMI RISK Score = 0, with early high sensitivity troponin negative • Low-to-intermediate likelihood of ACS based upon normal/nonischemic initial EKG and normal initial troponin • SERIAL EKGs and troponins negative or if either is borderline for NSTEMI/ACS</td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>CCTA (Indication and Appropriate Use Score)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5 U(4-6)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Acute Symptoms with Suspicion of ACSx (Urgent Presentation), when the History Reveals a Particular Pretest Probability</strong></td>
<td><em><em>6 Low/Int Pretest Probability</em> A(7)</em>* High Pretest Probability* U(4)</td>
</tr>
<tr>
<td></td>
<td><em><em>7 Low/Int Pretest Probability</em> A(7)</em>* High Pretest Probability* U(4)</td>
</tr>
<tr>
<td></td>
<td><em><em>8 Low/Int Pretest Probability</em> A(7)</em>* High Pretest Probability* U(4)</td>
</tr>
<tr>
<td><strong>Additional CAD/Risk Assessment, Based Upon Pre-existing GLOBAL RISK, in ASYMPTOMATIC Individuals Without Known CAD</strong></td>
<td><strong>Noncontrast CT for Coronary Calcium Score</strong></td>
</tr>
<tr>
<td><strong>10 Intermediate Global Risk (10-20%, or 6-20% in women and younger men)</strong> U(4-6)</td>
<td><strong>Coronary CTA with Contrast in the Asymptomatic Individual</strong></td>
</tr>
<tr>
<td><strong>10 High Global Risk (&gt;20%)</strong> U(4-6)</td>
<td><strong>Coronary CTA Following Heart Transplantation</strong></td>
</tr>
<tr>
<td><strong>12 U(6)</strong></td>
<td><strong>Detection of CAD in Other Clinical Scenarios</strong></td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>CCTA (Indication and Appropriate Use Score)</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>Newly Diagnosed Heart Failure <strong>A</strong>(7-9)</td>
</tr>
<tr>
<td>14</td>
<td>Newly Diagnosed Heart Failure <strong>U</strong>(4-6)</td>
</tr>
</tbody>
</table>

Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery or Noncoronary Intervention

<table>
<thead>
<tr>
<th>15</th>
<th><strong>A</strong>(7-9)</th>
<th>If all the following apply:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Coronary evaluation before thoracoabdominal aortic surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Patient has less than a 4 MET functional capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Patient has one peri-operative risk factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No coronary evaluation (invasive or non-invasive) within the past year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If invasive coronary arteriography is preferable, then CCTA is not appropriate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Alternatively, without the need for the above criteria, patient would be a candidate for CCTA at the time of a preoperative evaluation if indications unrelated to the surgery were well documented in the clinical record</td>
</tr>
<tr>
<td><strong>15a</strong></td>
<td><strong>U</strong>(5)</td>
<td>• Prior to TAVR as an alternative to coronary arteriography</td>
</tr>
</tbody>
</table>

Arrhythmias—Etiology Unclear After Initial Evaluation

<table>
<thead>
<tr>
<th>17</th>
<th><strong>I</strong>(1-3)</th>
<th>Any one of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Infrequent PVCs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New Onset atrial fibrillation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17</th>
<th><strong>U</strong>(4-6)</th>
<th>Any one of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Exercise induced or nonsustained ventricular tachycardia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ventricular fibrillation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sustained VT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Frequent PVCs (&gt;30/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prior to initiation of antiarrhythmic therapy in high global risk (CAD) patients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18</th>
<th><strong>I</strong>(1-3)</th>
<th>Syncope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Low Global CAD risk</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18</th>
<th><strong>U</strong>(4-6)</th>
<th>Syncope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Intermediate and High global CAD risk** initial evaluation includes echocardiogram</td>
</tr>
</tbody>
</table>

Elevated Troponin of Uncertain Clinical Significance

| 19                     | **U**(6)   | • Elevated troponin without additional evidence of ACS or symptoms suggestive of CAD |

Use of CTA in the Setting of Prior Test Results

<p>| Prior ECG or ECG Exercise Testing |</p>
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # CCTA (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(*Refer to Additional Information section)</td>
</tr>
<tr>
<td><strong>20 A(7)</strong></td>
<td>• Normal ECG exercise test AND</td>
</tr>
<tr>
<td></td>
<td>• Continued symptoms</td>
</tr>
<tr>
<td><strong>21 A(7)</strong></td>
<td>• Prior ECG exercise AND</td>
</tr>
<tr>
<td></td>
<td>• Intermediate mortality risk***based upon Duke Treadmill Score</td>
</tr>
<tr>
<td><strong>21 U(4-6)</strong></td>
<td>• Abnormal rest ECG (highly concerning for ischemia, without clear indication for invasive coronary arteriography)</td>
</tr>
<tr>
<td></td>
<td>• <strong>LEFT BUNDLE BRANCH BLOCK</strong>, when the history, physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress imaging (MPI or echo).</td>
</tr>
</tbody>
</table>

### Sequential Testing After Stress Imaging Procedures

<table>
<thead>
<tr>
<th><strong>22 A(8)</strong></th>
<th>• Discordant ECG exercise and imaging results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>23</strong></td>
<td>• Prior stress ECG or stress imaging results:</td>
</tr>
<tr>
<td><strong>Equivocal for Ischemia</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mild Ischemia U(6)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Prior CCS</strong></td>
<td></td>
</tr>
<tr>
<td>• No longer applicable.</td>
<td></td>
</tr>
<tr>
<td>• Use MESA Global Risk Calculator and base decision on Global Risk</td>
<td></td>
</tr>
<tr>
<td>• Please refer to the “Additional Information section” for clarity.</td>
<td></td>
</tr>
</tbody>
</table>

### Evaluation of New or Worsening Symptoms in the Setting of Past Stress Imaging Study

| **29 A(7-9)** | • Previous stress ECG or stress imaging study abnormal when a noninvasive approach is preferable to proceeding to invasive coronary arteriography (unclear nature of symptoms, mildly abnormal or borderline EKG stress test or stress with echocardiogram/MPI, CKD, dye allergy, etc.) |
|               | • Previous stress ECG study normal when a noninvasive approach is preferable to proceeding to invasive coronary arteriography (unclear nature of symptoms, mildly abnormal or borderline EKG stress test or stress with echocardiogram/MPI, CKD, dye allergy, etc.) |
|               | • Previous stress imaging study normal within the past 2 years and currently compelling coronary history or symptoms should be considered appropriate indication for a CCTA, particularly if there are reasons to avoid cardiac catheterization (CKD, dye allergy, etc.), unless invasive coronary arteriography is strongly indicated (e.g. compelling presentation of moderate or high risk unstable angina). |

### Risk Assessment Preoperative Evaluation of Noncardiac Surgery Without Active Cardiac Conditions

| **Intermediate-Risk Surgery** | |
| • See indication #15. |

### Vascular Surgery
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # CCTA (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
<th>(*Refer to Additional Information section)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>· See indication #15.</td>
<td></td>
</tr>
<tr>
<td>Risk Assessment Post revascularization (PCI or CABG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptomatic (Ischemic Equivalent) Post Coronary Revascularization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39 U(4-6)</td>
<td>· Evaluation of graft patency after CABG or evaluation post percutaneous coronary intervention, with good documentation of symptomatic presentation, are indications for CCTA if it could affect management</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic—Post Coronary Revascularization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 U(4-6)</td>
<td>· Prior left main coronary stent</td>
<td></td>
</tr>
<tr>
<td>Evaluation of Cardiac Structure and Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Congenital Heart Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46 A(9)</td>
<td>· Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels. This includes long term follow-up of Kawasaki disease for aneurysm formation. *</td>
<td></td>
</tr>
<tr>
<td>(*for “anomalies of coronary arterial vessels” CCTA preferred and for “other thoracic arteriovenous vessels” Heart CT preferred)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Intra- and Extracardiac Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 A(8)</td>
<td>· Localization of coronary bypass grafts and other retrosternal anatomy*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Prior to preoperative chest or cardiac surgery</td>
<td></td>
</tr>
<tr>
<td>(*for “localization of coronary bypass grafts” CCTA preferred and for “other retrosternal anatomy” Heart CT preferred)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INDICATIONS FOR CORONARY CT ANGIOGRAPHY (CCTA):**

- CCTA may also be appropriately used when evaluating chest pain syndromes with low to intermediate risk CAD profiles such as in emergency room or observation unit situations.

**INDICATIONS IN ACC GUIDELINES WITH “INAPPROPRIATE” DESIGNATION:**

The patient must meet ACCF/ASNC Appropriateness criteria for inappropriate indications (median score 1 – 3) below OR meets any one of the following:

- Contra-indications to beta blockers used to slow heart rate during procedure.
- Acute chest pain/angina (*Patients with acute angina/chest pain may need to go directly to catheterization. Refer for MD Review*).
- Pre-op request for non-cardiac surgery
- Significant premature ventricular contractions, significant frequent atrial fibrillation, or relative contra-indication to CCTA
### ACCF et al. Criteria # CCTA

### INDICATIONS

(*Refer to Additional Information section)

### APPROPRIATE USE SCORE (1-3); I= Inappropriate

<table>
<thead>
<tr>
<th>Detection of CAD in Symptomatic Patients Without Known Heart Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonacute Symptoms Possibly Representing an Ischemic Equivalent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>High pretest probability of CAD*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ECG interpretable and able to exercise</td>
</tr>
<tr>
<td></td>
<td>I(3)</td>
</tr>
</tbody>
</table>

#### Acute Symptoms With Suspicion of ACS (Urgent Presentation)

<table>
<thead>
<tr>
<th>3</th>
<th>Definite MI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(1)</td>
</tr>
</tbody>
</table>

#### Detection of CAD/Risk Assessment in Asymptomatic Individuals Without Known CAD

**Noncontrast CT for CCS**

<table>
<thead>
<tr>
<th>10</th>
<th>Low global CHD risk estimate**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(2)</td>
</tr>
</tbody>
</table>

**Coronary CTA**

<table>
<thead>
<tr>
<th>11</th>
<th>Low or Intermediate global CHD risk estimate**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(2)</td>
</tr>
</tbody>
</table>

#### Detection of CAD in Other Clinical Scenarios

**Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery**

<table>
<thead>
<tr>
<th>15</th>
<th>High pretest probability of CAD*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coronary evaluation before noncoronary cardiac surgery</td>
</tr>
<tr>
<td></td>
<td>I(3)</td>
</tr>
</tbody>
</table>

**Arrhythmias—Etiology Unclear After Initial Evaluation**

<table>
<thead>
<tr>
<th>16</th>
<th>New-onset atrial fibrillation (atrial fibrillation is underlying rhythm during imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(2)</td>
</tr>
</tbody>
</table>

#### Use of CTA in the Setting of Prior Test Results

**ECG Exercise Testing**

<table>
<thead>
<tr>
<th>21</th>
<th>Prior ECG exercise testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duke Treadmill Score***—low risk findings</td>
</tr>
<tr>
<td></td>
<td>I(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>22</th>
<th>Prior ECG exercise testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duke Treadmill Score***—high risk findings</td>
</tr>
<tr>
<td></td>
<td>I(3)</td>
</tr>
</tbody>
</table>

**Sequential Testing After Stress Imaging Procedures**

<table>
<thead>
<tr>
<th>23</th>
<th>Stress imaging results: moderate or severe ischemia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(2)</td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS (Refer to Additional Information section)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Prior CCS</strong></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>• Positive Coronary Calcium Score &gt;2 y ago</td>
</tr>
<tr>
<td><strong>Periodic Repeat Testing in Asymptomatic OR Stable Symptoms With Prior Stress Imaging or Coronary Angiography</strong></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>• No known CAD</td>
</tr>
<tr>
<td></td>
<td>• Last study done &lt;2 y ago</td>
</tr>
<tr>
<td>27</td>
<td>• No known CAD</td>
</tr>
<tr>
<td></td>
<td>• Last study done ≥2 y ago</td>
</tr>
<tr>
<td>28</td>
<td>• Known CAD</td>
</tr>
<tr>
<td></td>
<td>• Last study done &lt;2 y ago</td>
</tr>
<tr>
<td>28</td>
<td>• Known CAD</td>
</tr>
<tr>
<td></td>
<td>• Last study done ≥2 y ago</td>
</tr>
<tr>
<td><strong>Risk Assessment</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Preoperative Evaluation of Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Low-Risk Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>• Preoperative evaluation for noncardiac surgery risk assessment, irrespective of functional capacity</td>
</tr>
<tr>
<td><strong>Intermediate-Risk Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>• No clinical risk predictors</td>
</tr>
<tr>
<td>32</td>
<td>• Functional capacity ≥4 METs</td>
</tr>
<tr>
<td>34</td>
<td>• Asymptomatic &lt;1 y following a normal coronary angiogram, stress test, or a coronary revascularization procedure</td>
</tr>
<tr>
<td><strong>Vascular Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>• No clinical risk predictors</td>
</tr>
<tr>
<td>36</td>
<td>• Functional capacity ≥4 METs</td>
</tr>
<tr>
<td>38</td>
<td>• Asymptomatic &lt;1 y following a normal coronary angiogram, stress test, or a coronary revascularization procedure</td>
</tr>
<tr>
<td><strong>Risk Assessment</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Post revascularization (PCI or CABG)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Symptomatic (Ischemic Equivalent)</strong></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>• Prior coronary stent with stent diameter &lt;3 mm or not known</td>
</tr>
<tr>
<td><strong>Asymptomatic—CABG</strong></td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>42</td>
<td>• Prior coronary bypass surgery &lt;5 y ago</td>
</tr>
</tbody>
</table>

### Asymptomatic—Prior Coronary Stenting

| 44                     | • Prior coronary stent with stent diameter <3 mm or not known | I(2) |
| 45                     | • Prior coronary stent with stent diameter ≥3 mm            | I(3) |
|                        | • Less than 2 y after PCI                                    |     |

### Evaluation of Cardiac Structure and Function

### Evaluation of Ventricular Morphology and Systolic Function

| 48                     | • Initial evaluation of left ventricular function          | I(2) |
|                        | • Following acute MI or in HF patients                    |     |

### Evaluation of Intra- and Extracardiac Structures

| 55                     | • Initial evaluation of cardiac mass (suspected tumor or thrombus) | I(3) |

### ADDITIONAL INFORMATION RELATED TO CORONARY CT ANGIOGRAPHY:

#### Abbreviations

- ACS = acute coronary syndrome
- CABG = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- CCS = coronary calcium score
- CHD = coronary heart disease
- CT = computed tomography
- CTA = computed tomography angiography
- ECG = electrocardiogram
- HF = heart failure
- MET = estimated metabolic equivalent of exercise
- MI = myocardial infarction
- MPI = Myocardial Perfusion Imaging
- PCI = percutaneous coronary intervention
- SE = Stress Echocardiogram
- TTE = Transthoracic Echocardiography
- TAVR = Transcatheter Aortic Valve Replacement

#### What is a valid anginal or ischemic equivalent?

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, etc.), 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 by itself is generally not considered an anginal equivalent, and is handled under a separate category in this guideline.

**Exercise Treadmill Testing** - Exercise Treadmill Testing (ETT) is the appropriate first line test in most patients with suspected CAD. In appropriately selected patients the test provides adequate sensitivity and specificity with regard to diagnosis and prognostication. There are patients in whom the test is not the best choice, for example those with resting ECG abnormalities, inability to exercise and perhaps diabetes. Also of note from an operational standpoint the test does not require pre-authorization.

An uninterpretable baseline EKG includes:

- Abnormalities of ST segment depression of 0.1 mV (1 mm with conventional calibration) or more
- Ischemic looking T wave inversions of at least 0.25 mV (2.5 mm with conventional calibration)
- EKG findings of probable or definite LVH, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use or hypokalemia
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload (e.g. rate-pressure product less than 20-25K)
- Prior false positive stress EKG

*Pretest Probability of CAD for Symptomatic (Ischemic Equivalent) Patients:*

- **Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- **Atypical Angina (Probable):** Chest pain or discomfort that lacks 1 of the characteristics of definite or typical angina.
- **Nonanginal Chest Pain:** Chest pain or discomfort that meets 1 or none of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the pretest probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

- Very low: Less than 5% pretest probability of CAD
- Low: Less than 10% pretest probability of CAD
Intermediate: Between 10% and 90% pretest probability of CAD
High: Greater than 90% pretest probability of coronary artery disease

Definition of Peripheral Arterial Disease/Cerebrovascular Disease:
Non-coronary arterial narrowing causing symptoms (claudication, related tissue demise, threatened limb loss), asymptomatic 70% or more narrowing by non-invasive or invasive evaluation, atherosclerotic arterial aneurysm by non-invasive or invasive evaluation, or aortic atheroma of at least 4 mm thickness. As a subset of peripheral arterial disease, cerebrovascular disease is also defined as a history of stroke or TIA.

**Global CAD Risk:**
It is assumed that clinicians will use current standard methods of global risk assessment in the asymptomatic patient for primary prevention, based upon Framingham-ATP IV, Reynolds, Pooled Cohort Equation (includes cerebrovascular risk), ACC/AHA Risk Calculator, MESA Risk Calculator (includes calcium score), or very similar risk calculator) CAD risk refers to 10-year risk for any hard cardiac event (e.g., myocardial infarction or CAD death).

- Low global CAD risk
  Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk <10%. However, in women and younger men, low risk may correlate with 10-year absolute CAD risk <6%.

- Intermediate global CAD risk
  Defined by the age-specific risk level that is average. In general, moderate risk will correlate with a 10-year absolute CAD risk range of 10% to 20%. Among women and younger age men, an expanded intermediate risk range of 6% to 20% may be appropriate.

- High global CAD risk
  Defined by the age-specific risk level that is above average. In general, high risk will correlate with a 10-year absolute CAD risk of >20%. CAD equivalents (e.g., peripheral arterial disease (defined in additional information), cerebrovascular disease (history of stroke or TIA), or multiple simultaneous anti-rejection medications (e.g. cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine, long term supraphysiologic doses of glucocorticoids, but not everolimus or sirolimus/rapamycin), peripheral arterial disease) can also define high risk. High global risk can be further defined by COMPELLING NON-INVASIVE DATA, such as clearly pathologic Q waves on the EKG, marked ST-segment and/or T wave abnormalities of myocardial ischemia without symptoms, clear regional wall motion abnormalities of the left ventricle, or reduced ejection fraction below 50%.

Peri-Operative Cardiac Risk Factors
These are specifically: ischemic coronary artery disease (by study more than two years ago with lesions, which are: >=70% or ischemia producing on prior stress testing or with FFR <=0.80), cerebrovascular disease, insulin-requiring diabetes mellitus, history of congestive heart failure or ejection fraction less than 40%, or CKD with creatinine >= 2 mg/dl.

***Duke Treadmill Score
The equation for calculating the Duke treadmill score (DTS) is:
\[ \text{DTS} = \text{exercise time} \cdot (5 \times \text{ST deviation}) \cdot (4 \times \text{exercise angina}) \]
with 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 \( \geq +5 \)), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of \( \leq -11 \)) categories. The Duke Score provides an annual mortality estimate: <1% for low risk, 1-3% for intermediate risk, and >3% for high risk.

**Determinants of a 4 MET functional capacity:**

Examples of activities:

- **<4 METs:** Slow ballroom dancing, golfing with a cart, playing a musical instrument, and walking at approximately 2 mph to 3 mph
- **>4 METs:** Climbing a flight of stairs or walking up a hill, walking on level ground at 4 mph, and performing heavy work around the house

**Tools for Characterization of Unstable Angina:**

Risk Stratification in Acute Coronary Syndrome from 2007 ACC/AHA Guidelines

Three Principal Presentations of Unstable Angina (as defined within a two week time frame) (Braunwald)

<table>
<thead>
<tr>
<th>Class</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest angina*</td>
<td>Angina occurring at rest and prolonged, usually greater than 20 min</td>
</tr>
<tr>
<td>New-onset angina</td>
<td>New-onset angina of at least CCS class III severity</td>
</tr>
<tr>
<td>Increasing angina</td>
<td>Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by 1 or more CCS class to at least CCS class III severity)</td>
</tr>
</tbody>
</table>

**Table 6: Likelihood that Symptoms Represent an Acute Coronary Syndrome**

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina</td>
<td>Chest or left arm pain or discomfort as chief symptom</td>
<td>Probable ischemic symptoms in absence of any of the intermediate likelihood characteristics</td>
</tr>
<tr>
<td>Known history of CAD, including MI</td>
<td>Age greater than 70 years</td>
<td>Male sex</td>
<td>Recent cocaine use</td>
</tr>
<tr>
<td>Examination</td>
<td>Extradiscalvascular disease</td>
<td>Electrocardiogram findings in multiple leads</td>
<td>Chest discomfort reproduced by palpation</td>
</tr>
<tr>
<td>ECG Nonsimultaneous, transient ST-segment elevation (5 mm or greater), or T-wave inversion in multiple precordial leads</td>
<td>Fixed 0 waves</td>
<td>ST depression 0.5 to 1 mm or T-wave inversion greater than 1 mm</td>
<td>T-wave flattening or inversion less than 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td>Echocardiographic markers</td>
<td>Elevated cardiac TnT, TnF, or cTnI</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>


**Table 7: Short Term Risk of Death or Nonfatal MI in Acute Coronary Syndrome**
The **TIMI Risk Score** is determined by the sum of the presence of seven (7) variables at admission: 1 point is given for each of the following variables:

1. age ≥65 years,
2. at least 3 risk factors for CAD,
3. prior coronary stenosis of ≥50%,
4. ST-segment deviation on ECG presentation,
5. at least 2 anginal events in prior 24 hours,
6. use of aspirin in prior 7 days, and
7. elevated serum cardiac biomarkers

**Low-Risk TIMI Score**: TIMI score <2; **High-Risk TIMI Score**: TIMI score ≥2. A low risk TIMI score might still warrant invasive coronary arteriography, when other features, such as symptoms, are compelling.

**Definitions of Equivocal and Mild Ischemia**

Equivocal for ischemia on stress testing can be defined as a post test probability of significant coronary narrowing of approximately 20-50%, such that a decision to proceed with invasive coronary arteriography is not clear, and additional non-invasive testing would be expected to frequently enable a greater or lesser probability of significant coronary artery disease.

Mild ischemia on stress testing can be defined as a stress EKG with a Duke score above 4 without stress imaging, a stress EKG response that is of borderline positivity, stress echocardiography that shows <=2 segments of myocardial hypokinesia, or myocardial perfusion imaging with <5% myocardium at risk, such that a decision to proceed with invasive coronary arteriography is not clear, and additional non-invasive
testing would be expected to frequently enable a greater or lesser probability of significant coronary artery disease.

**Risk Calculators - Links to Cardiac/Vascular Risk Online Calculators:**

Framingham-ATP IV:  

Reynolds Risk Score (Adds in family history):  

Pooled Cohort Equation (includes cardiac and cerebrovascular risk):  

ACC/AHA Risk Calculator (includes cardiac and cerebrovascular risk):  

MESA Risk Calculator with addition of Coronary Artery Calcium Score:  
[https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx](https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx)

Equivocal for ischemia on stress testing can be defined as a post test probability of significant coronary narrowing of approximately 20-50%, such that a decision to proceed with invasive coronary arteriography is not clear, and additional non-invasive testing would be expected to frequently enable a greater or lesser probability of significant coronary artery disease.

Mild ischemia on stress testing can be defined as a stress EKG with a Duke score above 4 without stress imaging, a stress EKG response that is of borderline positivity, stress echocardiography that shows <=2 segments of myocardial hypokinesia, or myocardial perfusion imaging with <5% myocardium at risk, such that a decision to proceed with invasive coronary arteriography is not clear, and additional non-invasive testing would be expected to frequently enable a greater or lesser probability of significant coronary artery disease.

**REFERENCES**


Einstein, A. (2012). Effects of radiation exposure coming from cardiac imaging: how good are the data? *Journal of the American College of Cardiology*, 59(6), 553-565. Retrieved from [http://content.onlinejacc.org/cgi/content/short/59/6/553](http://content.onlinejacc.org/cgi/content/short/59/6/553)


**CCTA in the ER**


Calcium Scoring


Reference for Kawasaki Disease

CPT Codes: 75635

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.

INTRODUCTION

Computed tomography angiography (CTA) provides a cost-effective and accurate imaging assessment in patients with suspected thoracic aortic aneurysms, aortic dissections or peripheral arterial disease. Early detection and treatment of a thoracic aortic aneurysm is important as it may rupture or dissect resulting in life-threatening bleeding. High resolution CTA may be used in the diagnosis and follow-up of patients with aortic dissection and lower extremity peripheral arterial disease (PAD).

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ABDOMINAL ARTERIES CTA:

For evaluation of known or suspected abdominal vascular disease:
- For known or suspected peripheral arterial disease based on prior imaging or noninvasive ultrasound.
- Significant ischemia that could be related to the presence of an ulcer, gangrene or significant claudication.

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.

ADDITIONAL INFORMATION RELATED TO ABDOMINAL ARTERIES CTA:

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.
Thoracic Aortic Aneurysm – CTA is useful in diagnosing thoracic aortic aneurysms, determining their extent, and predicting best treatment. The Dual Source 64 slice CTA allows for removal of many artifacts on the images, thus improving image quality. Prior to initiating thoracic endovascular aneurysm repair for a ruptured aneurysm, CTA may assess the access route for device delivery.

Thoracic Aortic Dissection – Thoracic aortic dissection is difficult to diagnose as many other conditions share similar symptoms with dissection. It is the most common aortic life-threatening emergency and must be diagnosed and treated quickly. With a small amount of contrast medium, the 64-slice CT scanner can accurately locate aortic dissection and other vascular problems within a short period of time.

Suspected Peripheral Arterial Disease – CTA is an excellent tool to diagnose lower extremity peripheral arterial disease (PAD). Benefits include the fast scanning time and accurate detection of occlusions and stenoses.

REFERENCES


INTRODUCTION:

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 radiation necrosis from recurring brain tumor.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN MRS: 1-8

- For the evaluation of a recurrent or residual brain tumor from post-treatment changes e.g., radiation necrosis.
- To assess progress after surgery. A documented medical reason must clearly explain the medical necessity for the post-operative follow up

ADDITIONAL INFORMATION RELATED TO BRAIN MRS:

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 allows 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.

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.

MRS in other diseases 9 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.
REFERENCES


76497 - Unlisted CT

IMPORTANT NOTE:

The CPT code that has been selected is considered to be an “unlisted code”.

For all other studies, another CPT code should be selected that describes the specific service being requested otherwise this procedure can not be approved.
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 can not be approved.
CPT Codes:
Unilateral  77058
Bilateral      77059

INTRODUCTION:
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. 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 results, and the results of mammography and any other prior breast imaging.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BREAST MRI:

**Silicone Implants:**
- Confirmation of silicone gel-filled breast implant ruptures, when this diagnosis cannot be confirmed by mammography or breast ultrasound.
- For postoperative evaluation of silicone breast implant complications.

**No History of Known Breast Cancer**

**For screening examination to detect breast cancer in any of the following situations:**
- Inconclusive screening mammogram due to breast characteristics limiting the sensitivity of mammography (e.g., extremely or heterogeneously dense breasts, implants).
- A Breast Cancer Risk Assessment (by the 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).
- Two or more first degree relatives (parents, siblings, and children) have history of breast cancer.
- Patients with histories of extensive chest irradiation (usually as treatment for Hodgkin’s or other lymphoma.) Approve annually starting at age 30.
- Patients with known BRCA mutation. Approve annually starting at age 30.
- Patients not yet tested for BRCA gene, but with known BRCA mutation in first degree relative. Approve annually starting at age 30.

**For evaluation of identified lesion, mass or abnormality in breast in any of the following situations:**
- Two or more first degree relatives (parents, siblings, and children) have history of breast cancer.
- 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).
- Previous positive breast biopsy within the previous four (4) months and no intervening previous breast MRI.
• Inconclusive screening mammogram due to breast characteristics limiting the sensitivity of mammography (e.g., extremely or heterogeneously dense breasts, implants).
• Evaluation of palpable lesion on physical examination and not visualized on ultrasound or mammogram and MRI guided biopsy considered.
• For evaluation of axillary node metastasis or adenocarcinoma with normal physical examination and normal breast mammogram.
• Patients diagnosed with biopsy-proven lobular neoplasia or ADH (atypical ductal hyperplasia).
• Personal history of or first-degree relative with Le-Fraumeni syndrome (TP53 mutation), Cowden syndrome (PTEN) or Bannayan-Riley-Ruvalcaba syndrome (BRRS).

History of Known Breast Cancer

For screening examination to detect breast cancer in any of the following situations:
• Patients with a known history of Breast Cancer: Approve initial staging, with treatment [within three (3) months], and yearly surveillance for detection of recurrence or a new cancer.

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 diagnosed breast cancer.
• For evaluation of suspicious mass, lesion, distortion or abnormality of breast in patient with history of breast cancer.

Preoperative:
• For preoperative evaluation for known breast cancer when surgery planned within thirty (30) days.
• Evaluation of more than two (2) lesions to optimize surgical planning when requested by surgeon or primary care provider on behalf of surgeon who has seen the patient.

ADDITIONAL INFORMATION RELATED TO BREAST MRI:

CAD Breast MRI: There are no proven indications for use of CAD with/without an approved Breast MRI.

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.

MRI imaging – Metal devices or foreign body fragments within the body, such as indwelling pacemakers and intracranial aneurysm surgical clips that are not compatible with the use of MRI, may be contraindicated. Other implanted metal devices in the patient as well as external devices such as portable O₂ tanks may also be contraindicated.

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 material-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 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. MRI is used in the evaluation of ILC and can measure the extent of the disease with high reliability.

**REFERENCES**


*Breast MRI for the Early Detection of Breast Cancer: Approved by the Cancer.Net Editorial Board, 03/2014*  


Saslow et al American Cancer Society Guidelines for Breast Screening with MRI as an Adjunct to Mammography CA Cancer J Clin 2007;57:75–89


CPT Codes: 77078

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CT BONE DENSITY STUDY:

For first time baseline screening in patient with suspected osteoporosis or osteopenia:

- 65 years of age or older.
- 40 years of age or older AND at least ONE of the following risk factors:
  - Currently on medications associated with development of osteoporosis, e.g., steroids or glucocorticosteroids, anticonvulsants, heparin, lithium.
  - Currently a cigarette smoker and has a low body weight (<127 lbs.).
  - Caucasian with estrogen deficiency and low calcium intake or alcoholism.
  - Caucasian with adult history of fracture.
  - Evidence of osteoporosis or osteopenia from x-ray or ultrasound.
  - Patient’s parents or siblings have adult history of fracture.
- Steroid therapy equivalent to 7.5 mg of Prednisone or greater per day for more than three (3) months.
- Initiation of selective estrogen receptor modulators (SERMs), calcitonin, or biphosphonates, e.g., Actonel, Etidronate, Calcimar, Didronel, Evista, Fosamax, Miacalcin within last six (6) months.
- Back pain associated with loss of vertebral body height per x-ray.
- Loss of body height.
- Multiple fractures including compression fractures of the spine.
- Malabsorption syndrome.
- Metabolic bone disease.
- Hyperparathyroidism.
- Hypogonadism.
- Thyroid hormone therapy or hyperthyroidism.
- Chemotherapy.
- Long term heparin therapy.
- Spinal deformities.
- Renal osteodystrophy.

For screening of an individual with known osteoporosis or osteopenia:

- Has not had a bone mineral density study within the past 23 months.
• Had bone density within past 23 months AND meets any one of the following risk factor criteria:
  o Hormone replacement therapy
  o SERMs, calcitonin, or biphosphonates within the past 6 months (Actonel, Etidronate, Calcimar, Calcitonin, Didronel, Evista, Fosamax, Micalcin)
  o Steroid therapy equivalent to 7.5 mg of Prednisone or greater per day for more than 3 months.
  o Back pain associated with loss of vertebral body height per x-ray.
  o Loss of body height.
  o Multiple fractures including compression fractures of the spine.
  o Malabsorption syndrome.
  o Metabolic bone disease. Metabolic bone disease, i.e. osteomalacia and vitamin D deficiency.
  o Hyperparathyroidism.
  o Hypogonadism
  o Thyroid hormone therapy or hyperthyroidism.
  o Chemotherapy
  o Long term Heparin therapy
  o Spinal deformities
  o Renal osteodystrophy
• In the following situations, follow-up imaging may be required in less than 23 months:
  o Glucocorticoid or anticonvulsant therapy greater than 3 months duration
  o Uncorrected hyperparathyroidism

ADDITIONAL INFORMATION RELATED TO CT BONE DENSITOMETRY:

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.

REFERENCES


CPT Codes: 77084

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BONE MARROW MRI:

- For vertebral fractures with suspected bone metastasis.
- For the diagnosis, staging and follow-up of patients with multiple myeloma and related disorders.
- 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.

ADDITIONAL INFORMATION RELATED TO BONE MARROW MRI:

General Information - 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 and it should be used as the first-line imaging method for detecting skeletal involvement in patients with multiple myeloma. Sensitive detection is mandatory in order to estimate prognosis and to determine adequate therapy.

REFERENCES


http://www.ajronline.org/doi/pdf/10.2214/AJR.09.4134


CPT Codes: 78205, 78206

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR A LIVER/SPLEEN SPECT SCAN:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging is insufficient alone:

- Evaluation of hepatic artery catheter placement. (For evaluation of the hepatosplenic vascular distribution and or aberrant flow pattern prior to chemotherapeutic infusion).
- Detection of accessory splenic tissue or asplenia.
- Evaluation of suspected hepatic hemangioma or focal nodular hyperplasia.
- Evaluation of patients with suspected liver or spleen rupture or hematoma and Abdominal CT and MRI are contraindicated.
- Evaluation of size, shape, and position of liver and spleen and Abdominal CT and MRI are contraindicated.
- Detection of space-occupying lesions: abscesses, cysts, and primary tumors and Abdominal CT and MRI are contraindicated.
- Evaluation of hepatic primary or metastatic tumors (pre and post-therapy).
- 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.

ADDITIONAL INFORMATION RELATED TO A LIVER SPECT SCAN:
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 scan: (hepatobiliary iminodiacetic acid) an imaging procedure utilizing the IV administration of Tc99M labeled iminodiacetic acid which is excreted by hepatocytes like bile. Unlike Liver and spleen imaging 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 to evaluate cystic duct obstruction (cholecystitis), common bile duct obstruction, congenital biliary system anomalies and bile leaks.

REFERENCES


INTRODUCTION:

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 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR A BONE/JOINT SPECT SCAN:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging is insufficient alone:

- 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. (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.
- Assess the distribution of osteoblastic activity before radionuclide therapy for bone pain.
- 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).
- 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.

ADDITIONAL INFORMATION RELATED TO BONE/JOINT SPECT SCAN:
**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.

**REFERENCES**


Society of Nuclear Medicine Procedure Standards.  
INTRODUCTION: This guideline is organized around seven clinical scenarios:

I. Suspected Coronary Artery Disease (CAD)
II. Incompletely Evaluated CAD
III. Follow-up of Known Ischemic CAD
IV. CAD in Presence of Other New Cardiac Concerns
V. Prior to Noncardiac Surgery
VI. Prior to Cardiac Rehabilitation or Exercise Program
VII. Post Cardiac Transplantation

This guideline is for stress imaging, specifically myocardial perfusion imaging (MPI), with appropriate preference for suitable alternatives, such as stress echocardiography (stress echo) or stress EKG alone, when more suitable, using the following stream of logic:

- A stress EKG alone is often appropriate. A baseline EKG which does not allow interpretation of ischemic findings with exercise will sometimes, but not always, require the addition of stress imaging.

- When stress imaging is appropriate, as an addition to stress EKG alone, stress echo is preferred when the patient is able to exercise, MPI when the patient cannot exercise. This document does not endorse dobutamine echocardiography for pragmatic reasons.

- When stress echo is precluded by specific imaging difficulties (e.g. poor quality image despite contrast medium, uncontrolled atrial fibrillation, ventricular paced rhythm, baseline wall motion abnormalities, etc., as listed in the Additional Information section), then MPI is preferable.

Compelling indications (e.g. ACC Class I or IIA or Appropriate Use Criteria ‘A’) for stress imaging (MPI and echo) are the foundation, and the less compelling indications (IIB or ‘M’) have been selected as appropriate for those scenarios in which the clinical presentation incurs high risk. If a patient fits two or more clinical scenarios, the scenario which endorses stress imaging (MPI or echo) supersedes any category which does not.

Issues such as pretest probability, global risk of coronary or cardiovascular disease, anginal equivalent, aspects of different types of stress testing, etc. are discussed in the Additional Information section at the end of this document, and the reader is encouraged to refer to that section, in order to optimally utilize this guideline.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR STRESS IMAGING (MPI or ECHO) BY CLINICAL SCENARIO

I. SUSPECTED (CAD):
   High Global Risk asymptomatic OR
Stable symptomatic OR
Low risk “unstable” symptomatic (Tables 6 & 7)

- SYMPTOMATIC: LOW PRETEST PROBABILITY patients should undergo a treadmill exercise stress EKG alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG.

- SYMPTOMATIC: INTERMEDIATE OR HIGH PRETEST PROBABILITY patients are appropriate for stress imaging (MPI or echo).

- REPEAT STRESS TESTING FOR SIMILAR SYMPTOMS AND SAME PRETEST PROBABILITY should not be performed for at least 5 years following prior stress testing or invasive coronary arteriography, unless there has been a change in clinical presentation.

- ASYMPTOMATIC HIGH GLOBAL RISK (>20% coronary or vascular event rate over ensuing 10 years) based upon a COMPELLING HISTORY, such as patients with peripheral arterial disease (defined in additional information), cerebrovascular disease (history of stroke or TIA), or multiple simultaneous anti-rejection medications (e.g. cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine, long term supraphysiologic doses of glucocorticoids, but not everolimus or sirolimus/rapamycin) should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG.

- ASYMPTOMATIC HIGH GLOBAL RISK (>20% coronary or vascular event rate over ensuing 10 years, based upon Framingham-ATP IV, Reynolds, Pooled Cohort Equation (includes cerebrovascular risk), ACC/AHA Risk Calculator, MESA Risk Calculator (includes calcium score), or very similar risk calculator) or based upon COMPELLING NON-INVASIVE DATA, such as clearly pathologic Q waves on the EKG, marked ST-segment and/or T wave abnormalities of myocardial ischemia without symptoms, clear regional wall motion abnormalities of the left ventricle, or reduced ejection fraction below 50%, should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG. (Patients with ejection fraction < 50%, with contraindication to invasive coronary arteriography, are reasonable candidates for stress imaging (MPI or echo).

- REPEAT EKG STRESS TEST ALONE OF ASYMPTOMATIC HIGH GLOBAL RISK patients (as described in the 2 bullets immediately above), whose last invasive or non-invasive test was over two years ago and was negative for hemodynamically significant obstructive coronary artery disease (i.e. no ischemia on stress testing, no Fractional Flow Reserve (FFR) <= 0.80 for a major vessel, or no angiographic stenosis >70% for a major vessel), is reasonable.

- HIGH OCCUPATIONAL RISK patients (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or HIGH PERSONAL RISK patients (e.g. scuba divers, etc.), should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG. Determinations for screening of asymptomatic patients (without known coronary artery disease) in high-risk occupations should be deferred to those agencies that manage such non-medical necessity.

II. INCOMPLETELY EVALUATED CAD:
Requires further evaluation within 2 years of a prior coronary evaluation for CLARIFICATION OF DIAGNOSIS OR DISEASE SEVERITY

- **NORMAL EXERCISE STRESS TEST EKG** within the past 2 years and currently compelling coronary history or symptoms should be considered appropriate indication for a repeat stress test with imaging (MPI or echocardiogram), particularly if there are reasons to avoid cardiac catheterization (CKD, dye allergy, etc.), unless invasive coronary arteriography is strongly indicated (e.g. compelling presentation of moderate or high risk unstable angina).

- **ABNORMAL OR INDETERMINATE EXERCISE STRESS EKG or CCTA (coronary computed tomographic angiography) within the past 2 years**, for whom a noninvasive approach is preferable to proceeding to invasive coronary arteriography (unclear nature of symptoms, mildly abnormal or borderline EKG stress test or CCTA, CKD, dye allergy, etc.), is an appropriate indication for stress imaging (MPI or echo).

- **A WELL DOCUMENTED MYOCARDIAL INFARCTION OR moderate to high risk ACUTE CORONARY SYNDROME WITHIN THE PAST 2 YEARS**, when stable, without subsequent stress imaging of invasive coronary arteriography, can be appropriate for stress imaging, especially when a non-invasive approach is documented to be preferable to invasive coronary arteriography.

- **SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT**, in order to assist with the management strategy, in patients with prior invasive coronary arteriography within the past 2 years and unclear lesional significance, is an appropriate indication for stress imaging (MPI or echo), if it will affect management.

### III. FOLLOW-UP of KNOWN ISCHEMIC CAD:

#### A. In need of FOLLOW-UP TESTING for known ischemic coronary artery disease, either ASYMPTOMATIC OR WITH STABLE symptoms

**ROUTINE FOLLOW-UP** when last invasive or non-invasive assessment of coronary artery disease showed HEMODYNAMICALLY SIGNIFICANT CAD (ischemia on stress test or FFR <= 0.80 for a major vessel or stenosis >=70% of a major vessel) over two years ago, without supervening coronary revascularization, is an appropriate indication for stress imaging (MPI or echo) in patients with high risk clinical scenarios, such as left ventricular dysfunction (ejection fraction less than 50%) or severe unrevascularized multivessel CAD (if it will alter management), OR in patients with HIGH RISK OCCUPATIONS (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or a HIGH PERSONAL RISK (e.g. scuba divers, etc.).

- **SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT**, in order to assist with the management strategy, in patients with recent invasive coronary arteriography AND suspected residual ischemia post incomplete coronary revascularization, is an appropriate indication for stress imaging (MPI or echo), if it will affect management.

- **MYOCARDIAL VIABILITY TESTING BY REST MYOCARDIAL PERFUSION IMAGING** prior to coronary revascularization is reasonable in patients with ejection fraction less than or equal to 50%, if it could significantly alter the revascularization strategy.
B. NEW, RECURRENT, OR WORSENING (PROGRESSIVE) SYMPTOMS in patients with known ischemic CAD (ischemia on stress testing, lesion stenosis $\geq 70\%$, or FFR $\leq 0.80$), which has not been revascularized.

- PRIOR LOW RISK CORONARY EVALUATION AT LEAST TWO YEARS EARLIER (e.g. limited extent of CORONARY ARTERY DISEASE, $<$5% myocardium at risk), AND NOW WITH NEW STABLE (or low risk unstable), RECURRENT, OR SLOWLY WORSENING (PROGRESSIVE) SYMPTOMS of coronary ischemia, is an appropriate indication for stress imaging (MPI or echo) in this patient group. However, regardless of timing of prior non-invasive assessment, clinical documentation of continued problematic symptoms or moderate to highly likely acute coronary syndrome (Table 6) of even low mortality risk (Table 7) is often better assessed with invasive coronary arteriography, particularly when stress testing in the last 2 years and current clinical findings are at odds. This category is very documentation-sensitive and requires judgment.

- INVASIVE CORONARY ARTERIOGRAPHY IS GENERALLY PREFERABLE in those patients, who have a PRIOR MODERATE OR HIGH RISK STRESS TEST RESULT (especially if NOT previously evaluated by invasive coronary arteriography) or a current diagnosis of moderate to high risk UNSTABLE ANGINA, and inappropriate for repeat stress imaging (MPI or echo), unless supervening reasons to prefer a non-invasive approach are documented in the record (e.g. very unclear symptoms, CKD, dye allergy, etc.), and it could alter management.

C. FOLLOW-UP OF PATIENTS POST CORONARY REVASCULARIZATION

- ASYMPTOMATIC, ROUTINE FOLLOW-UP, STRESS IMAGING (MPI OR ECHO) at a minimum of 2 YEARS post coronary artery bypass grafting or 2 YEARS post percutaneous coronary intervention (whichever was the latter) is appropriate only for patients with high direct CORONARY-related risk, such as incomplete coronary revascularization with feasible additional revascularization of residual severe multivessel disease, need for otherwise unevaluated follow up of stenting of unprotected left main coronary artery (LM) disease or left ventricular dysfunction (ejection fraction less than 50%), 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) or HIGH PERSONAL RISK (e.g. scuba divers, etc.),

- NEW, RECURRENT, OR WORSENING SYMPTOMS POST CORONARY REVASCULARIZATION, with good documentation, are an indication for stress imaging (MPI or echo) if it could affect management.

IV. CAD IN PRESENCE OF OTHER NEW CARDIAC CONCERNS

- NON-CORONARY CARDIAC DIAGNOSES support use of stress imaging (MPI or echo) in newly diagnosed systolic or diastolic heart failure, sustained VT (> 100 bpm), VF, exercise induced VT or nonsustained VT, frequent PVCs (over 30 per hour), and/or required initiation of antiarrhythmic drug (AAD) therapy when invasive coronary arteriography is not necessarily indicated.

- NEW ONSET ATRIAL FIBRILLATION, in patients with coronary artery disease and/or moderate or high global risk, are candidates for stress imaging if there has been no coronary evaluation by stress imaging or invasive coronary arteriography within the preceding two years.
• **LEFT BUNDLE BRANCH BLOCK**, when the history, physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress imaging (MPI or echo).

• **EKG STRESS TESTING without imaging** is reasonable for **EVALUATION OF EXERCISE-INDUCED ARRHYTHMIA** (or long QT interval evaluation when the resting QTc is normal), when coronary artery disease is not suspected.

• **EXERCISE HEMODYNAMICS** can be obtained with Stress echocardiography with Doppler when it will affect management.

• **KAWASAKI DISEASE** long-term surveillance is better performed with **CCTA**, which includes aneurysm assessment.

V. **Prior to NONCARDIAC SURGERY**

• **THORACOABDOMINAL AORTIC VASCULAR SURGERY** is an indication for **PREOPERATIVE STRESS IMAGING** (MPI or echo) if the patient has less than a 4 MET (see Additional Information section) exercise functionality, AND that patient has at least one OPERATIVE clinical risk factor from the list: ischemic coronary artery disease (by study more than two years ago with lesions, which are: >=70% or ischemia producing on prior stress testing or with FFR <=0.80), cerebrovascular disease, insulin-requiring diabetes mellitus, history of congestive heart failure or ejection fraction less than 40%, or CKD with creatinine >= 2 mg/dl. (Such stress imaging is restricted to patients who have not had either stress imaging or invasive coronary arteriography within the past year.) **If invasive coronary arteriography is preferable, then preoperative stress imaging is not appropriate.**

• **UNRELATED TO THE PLANNED SURGICAL PROCEDURE**, stress imaging might be indicated for other reasons at the time patients are seen for preoperative cardiac risk evaluation. When such indications for stress imaging are unrelated to the need for the intended non-cardiac surgery, then the **record must document** those reasons in order to support proceeding with appropriate stress imaging (MPI or echo).

• **BARIATRIC SURGERY** is not considered an indication for preoperative stress testing.

• **SOLID ORGAN TRANSPLANTATION** is an indication for preoperative stress imaging (MPI or echo) if: invasive coronary arteriography is not intended as the initial preoperative evaluation of choice, AND there has not been an adequate coronary evaluation within the past year.

VI. **Prior to CARDIAC REHABILITATION or EXERCISE PROGRAM**

• **CARDIAC REHABILITATION ENTRY** or **DETERMINATION OF EXERCISE CAPACITY** is an indication for **stress testing with EKG alone**, when performed as part of the cardiac rehabilitation program or for purposes of exercise prescription.

VII. **Post CARDIAC TRANSPLANTATION**
• **During the first five years post cardiac transplantation, patients with glomerular filtration rates less than 40 mL/min/1.73 sq M, or who otherwise should not undergo invasive coronary arteriography every 1-2 years, are appropriate for stress imaging (MPI or echo) every 1-2 years.**

• **After the first five years post cardiac transplantation, in lieu of invasive coronary arteriography:**
  1) **patients considered at low risk for transplant vasculopathy** (i.e., with normal invasive coronary arteriography) can have annual stress imaging (MPI or echo), and 2) **patients with transplant coronary vasculopathy can have annual stress imaging (MPI or echo), if the risk of annual invasive coronary arteriography is not acceptable** (i.e., high risk of contrast nephropathy).

**ADDITIONAL INFORMATION:**

**Definitions of Coronary Artery Disease:**

1. Percentage stenosis refers to diameter stenosis when angiography is the method and refers to cross sectional narrowing when IVUS (intravascular ultrasound) is the method of determination.
2. 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 (similar to an ankle brachia index, family history of coronary artery disease, or high sensitivity C-reactive protein). Its incorporation into Global Risk can be achieved by using the MESA risk calculator.
3. Stenoses less than 50% are considered nonobstructive coronary artery disease, while stenoses of 50% or more are considered obstructive coronary artery disease. However, the contents of this Guideline are very clear about specifying that **ischemic heart disease** requires one of three possible determinants:
   i. Percentage stenosis of at least 70% - by angiography or IVUS (intravascular ultrasound), as described above, for a major vessel
   ii. FFR (fractional flow reserve) of 0.80 or less for a major vessel
   iii. Demonstrable ischemic findings on stress testing (acceptable EKG or imaging), that are at least mild in degree
4. A major vessel would be a coronary vessel that would typically be substantial enough for revascularization, if it were indicated. Lesser forms of coronary artery disease would be labeled as “limited.” (i.e. A 50% lesion in a tiny septal would be limited obstructive coronary artery disease.)
5. 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.
6. 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 reduction in coronary flow.

**Definition of Peripheral Arterial Disease/Cerebrovascular Disease:**

Non-coronary arterial narrowing causing symptoms (claudication, related tissue demise, threatened limb loss), asymptomatic 70% or more narrowing by non-invasive or invasive evaluation, atherosclerotic arterial aneurysm by non-invasive or invasive evaluation, or aortic atheroma of at least 4 mm thickness. As a subset of peripheral arterial disease, cerebrovascular disease is also defined as a history of stroke or TIA.

**What is a valid anginal equivalent?**
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, etc.), 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 by itself is generally not considered an anginal equivalent, and is handled under a separate category in this guideline.

**Pretest Probability of CAD for Symptomatic Patients:**

Pretest probability is a reference to symptoms that need evaluation as potentially coronary in origin.

- **Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.

- **Atypical Angina (Probable):** Chest pain or discomfort that lacks 1 of the characteristics of definite or typical angina.

- **Nonanginal Chest Pain:** Chest pain or discomfort that meets 1 or none of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

- **Very low:** Less than 5% pretest probability of CAD
- **Low:** Less than 10% pretest probability of CAD
- **Intermediate:** Between 10% and 90% pretest probability of CAD
- **High:** Greater than 90% pretest probability of CAD

**Global Risk of CAD or Vascular Disease**

Global risk of CAD is defined as the probability of developing CAD, including myocardial infarction or CAD death over a given time period and refers to asymptomatic patients without known coronary artery disease. It should be determined by the Framingham Risk Score (ATP IV risk tool), the Reynolds Risk Index, or the Pooled Cohort Equation (which includes cerebrovascular risk). A high risk is considered greater than a 20% risk of a coronary or major vascular event over the ensuing 10 years.

- **CAD Risk—Low**
  Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk less than 10%.
• **CAD Risk—Moderate**
  Defined by the age-specific risk level that is average or above average. In general, moderate risk will correlate with a 10-year absolute CAD risk between 10% and 20%.

• **CAD Risk—High**
  Defined as the presence of peripheral arterial disease, cerebrovascular disease, or a 10-year absolute CAD risk of greater than 20%.

**Duke Treadmill Score**

The equation for calculating the Duke treadmill score (DTS) is,

\[ DTS = \text{exercise time in minutes} - (5 \times \text{ST deviation in mm or } 0.1 \text{ mV increments}) - (4 \times \text{exercise angina score}) \]

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 \( \geq +5 \)), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of \( \leq -11 \)) categories.

**What Type of Stress Test is Appropriate?**

**EKG Stress Test versus Stress Echocardiography versus Stress Myocardial Perfusion Imaging**

Appropriate resource utilization, cost effectiveness, and radiation exposure limitation dictate choices in stress testing options.

Five prominent scenarios for an EKG stress test WITHOUT imaging (i.e. exercise treadmill EKG test) are endorsed by the guidelines presented above, often (but not always) requiring that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable EKG for ischemia during exercise:

- The (symptomatic) low pretest probability patient who is able to exercise and has an interpretable EKG
- The (asymptomatic) high global risk patient who is able to exercise and has an interpretable EKG
- The patient who is under evaluation for exercise induced arrhythmia (or long QT interval evaluation when the resting QTc is normal), and coronary artery disease is not suspected
- The patient who requires an entrance stress test EKG for a cardiac rehab program or for an exercise prescription

An uninterpretable baseline EKG includes:

- Abnormalities of ST segment depression of 0.1 mV (1 mm with conventional calibration) or more
- Ischemic looking T wave inversions of at least 0.25 mV (2.5 mm with conventional calibration)
- EKG findings of probable or definite LVH, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use or hypokalemia
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload (e.g. rate-pressure product less than 20-25K)
- Prior false positive stress EKG

Exercise remains a valid stressor:

- In patients who can exercise to near maximal heart rate
- For entrance to cardiac rehabilitation or determination of an exercise prescription
- For exercise induced arrhythmia evaluation
• Even with an uninterpretable EKG if stress imaging is appropriate and EKG un-interpretability is acknowledged

Scenarios for choosing stress echocardiography over myocardial perfusion imaging:

• The patient can exercise to near maximal heart rate for at least 3 minutes of Bruce protocol and has an interpretable echocardiogram, with usage of contrast medium if necessary to enable quality imaging

AND

There is normal baseline systolic function, without moderately severe or severe valvular disease. Stress echocardiography with Doppler is appropriate in the patient for whom determination of exercise hemodynamics is required.

• Exercise Doppler with hemodynamics is the main reason for stress testing.

When is Myocardial Perfusion Imaging Preferred Over Stress Echocardiography?

There are circumstances in which myocardial perfusion imaging is generally preferable to stress echocardiography:

• BMI >/= 40
• Ventricular paced rhythm, LBBB, WPW
• Frequent PVCs interfering with wall motion assessment
• Prior coronary artery bypass grafting with resultant paradoxical septal motion
• Currently in poorly controlled atrial fibrillation
• Poor cardiac window on echo (documented on echo report as technically limited or difficult, without likely benefit of contrast medium)
• Documented regional wall motion abnormality: dyskinesia, akinesia, or hypokinesia
• Unable to perform ADL’s with documented extent of limitations
• Functional capacity <4 METS or < 3’ Bruce protocol
• Arthritis with documented limitations
• Leg/foot amputation
• Active foot wound/ulcer
• Ambulation requires cane or walker
• Confinement to a wheelchair
• Severe chronic obstructive pulmonary disease (based upon PFT findings), severe dyspnea on exertion, or requirement for home oxygen use
• Systolic congestive heart failure with ejection fraction <40%
• Recent orthopedic surgery limiting use of a lower extremity

Determinants of a 4 MET functional capacity:

Examples of activities:

<4 METs: Slow ballroom dancing, golfing with a cart, playing a musical instrument, and walking at approximately 2 mph to 3 mph

>4 METs: Climbing a flight of stairs or walking up a hill, walking on level ground at 4 mph, and performing heavy work around the house
Tools for Characterization of Unstable Angina:

Risk Stratification in Acute Coronary Syndrome from 2007 ACC/AHA Guidelines

Three Principal Presentations of Unstable Angina (as defined within a two week time frame) (Braunwald)

<table>
<thead>
<tr>
<th>Class</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest angina*</td>
<td>Angina occurring at rest and prolonged, usually greater than 20 min</td>
</tr>
<tr>
<td>New-onset angina</td>
<td>New-onset angina of at least CCS class III severity</td>
</tr>
<tr>
<td>Increasing angina</td>
<td>Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by 1 or more CCS class to at least CCS class III severity)</td>
</tr>
</tbody>
</table>

Table 6: Likelihood that Symptoms Represent an Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any of the following:</td>
<td>Absence of high-likelihood features and presence of any of the following:</td>
<td>Absence of high- or intermediate-likelihood features but may have:</td>
</tr>
<tr>
<td>History</td>
<td>Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina</td>
<td>Chest or left arm pain or discomfort as chief symptom</td>
<td>Probable ischemic symptoms in absence of any of the intermediate likelihood characteristics</td>
</tr>
<tr>
<td>Known history of CAD, including MI</td>
<td>Age greater than 70 years</td>
<td>Male sex</td>
<td>Recent cocaine use</td>
</tr>
<tr>
<td>Exmaination</td>
<td>Transient MR murmur, hypotension, diaphoresis, pulmonary edema, or rales</td>
<td>Extracardiac vascular disease</td>
<td>Chest discomfort reproduced by palpation</td>
</tr>
<tr>
<td>EDG</td>
<td>New, or presumably new, transient ST-segment deviation (3 mm or greater) or T-wave inversion in multiple precedent leads</td>
<td>Fixed Q waves</td>
<td>T-wave flattening or inversion less than 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated cardiac TnI, TnT, or CK-MB</td>
<td>ST depression 0.5 to 1 mm or T-wave inversion greater than 1 mm</td>
<td>Normal EKG</td>
</tr>
</tbody>
</table>


ACS = acute coronary syndrome; CAD = coronary artery disease; CK-MB = MB fraction of creatine kinase; EKG = electrocardiogram; MI = myocardial infarction; MR = mitral regurgitation; TnI = troponin I; TnT = troponin T.

Table 7: Short Term Risk of Death or Nonfatal MI in Acute Coronary Syndrome
The **TIMI Risk Score** is determined by the sum of the presence of 7 variables at admission: 1 point is given for each of the following variables: age ≥65 years, at least 3 risk factors for CAD, prior coronary stenosis of ≥50%, ST-segment deviation on ECG presentation, at least 2 anginal events in prior 24 hours, use of aspirin in prior 7 days, and elevated serum cardiac biomarkers.

**Low-Risk TIMI Score**: TIMI score <2; **High-Risk TIMI Score**: TIMI score ≥2. A low risk TIMI score might still warrant invasive coronary arteriography, when other features, such as symptoms, are compelling.

**Abbreviations:**

<table>
<thead>
<tr>
<th>AAD</th>
<th>antiarrhythmic drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADLs</td>
<td>activities of daily living</td>
</tr>
<tr>
<td>CAD</td>
<td>coronary artery disease</td>
</tr>
<tr>
<td>CCS</td>
<td>Canadian Cardiovascular Society</td>
</tr>
<tr>
<td>CKD</td>
<td>chronic kidney disease</td>
</tr>
<tr>
<td>EKG</td>
<td>electrocardiogram</td>
</tr>
<tr>
<td>FFR</td>
<td>fractional flow reserve</td>
</tr>
<tr>
<td>LBBB</td>
<td>left bundle-branch block</td>
</tr>
<tr>
<td>LVH</td>
<td>left ventricular hypertrophy</td>
</tr>
<tr>
<td>MI</td>
<td>myocardial infarction</td>
</tr>
<tr>
<td>MET</td>
<td>estimated metabolic equivalent of exercise</td>
</tr>
<tr>
<td>PFT</td>
<td>pulmonary function test</td>
</tr>
<tr>
<td>PVCs</td>
<td>premature ventricular contractions</td>
</tr>
<tr>
<td>TIMI</td>
<td>Thrombolysis in Myocardial Infarction (Study Group)</td>
</tr>
<tr>
<td>WPW</td>
<td>Wolf Parkinson White</td>
</tr>
</tbody>
</table>
REFERENCES

General References


References for cardiovascular risk:
(Also see links to Online Calculators at end of Reference Section)


NIH Estimate of 10 Year coronary artery disease risk from Framingham Risk Score:

References for High Occupational Risk


Reference for peri-operative risk


Reference for unstable angina risk


Reference for indications for cardiac catheterization/ invasive coronary arteriography:

Reference for bariatric surgery risk


Reference for number of PVCs


Reference for syncope


Reference for left bundle branch block


Reference for right bundle branch block


Reference for police, fireman, pilots, etc.


Reference for Arrhythmias and Long QT Syndrome

http://ajcc.aacnjournals.org/content/15/4/431.full.pdf+html

http://electrophysiology.onlinejacc.org/article.aspx?articleid=2506118[resultClick=3#tab1

http://circ.ahajournals.org/content/124/20/2181.long


Reference for Cardiac Transplantation Patients

Gustafsson F. (2016) Diagnosis and prognosis of cardiac allograft vasculopathy. UpToDate. 
http://www.uptodate.com/contents/diagnosis-and-prognosis-of-cardiac-allograft-vasculopathy?source=machineLearning&search=transplant+vasculopathy+follow+up&selectedTitle=1%7E150&sectionRank=1&anchor=H12357202#H12357202

Reference for Microvascular Coronary Disease


Reference for Kawasaki Disease


Reference for Anti-rejection Medication and Vascular Disease

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2810018/

Links to Cardiac/Vascular Risk Online Calculators:

Framingham-ATP IV:  
http://cvdrisk.nhlbi.nih.gov/

Reynolds Risk Score:  
http://www.reynoldsriskscore.org/
Pooled Cohort Equation (includes cardiac and cerebrovascular risk):
http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example

ACC/AHA Risk Calculator (includes cardiac and cerebrovascular risk):
http://tools.acc.org/ASCVD-Risk-Estimator/

MESA Risk Calculator with addition of Coronary Artery Calcium Score:
https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx
CPT Codes: 78459, 78491, 78492, 0482T

INTRODUCTION:

Cardiac PET has two major clinical uses. First, it can characterize myocardial blood flow (perfusion scan). The FDA has approved both rubidium-82 (Rb-82) and nitrogen-13(N-13) radiotracers for this purpose. Second, PET can identify regions of myocardial viability that appear scarred (dead) on standard rest or stress SPECT/MPI imaging. The FDA has approved use of fluorine 18 (F-18) fluorodeoxyglucose for this purpose.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR CARDIAC PET SCAN WITH APPROVED FDA RADIOISOTOPES:

- Evaluation of myocardial viability prior to possible percutaneous or surgical revascularization if:
  - Previous SPECT/MPI imaging for viability is inadequate; AND
  - Patient has severe left ventricular dysfunction (LVEF ≤ 35%).

- Evaluation in patient with suspected or known Coronary Artery Disease.
  - To qualify for PET perfusion scan done either at rest or with pharmacologic stress, the patient must meet criteria for indicated nuclear cardiac imaging/myocardial perfusion study AND is likely to experience attenuation artifact with SPECT imaging due to factors such as morbid obesity, large breasts, breast implants, previous mastectomy, chest wall deformity, pleural/pericardial effusion; OR
  - Patient had a previous inadequate SPECT/MPI imaging due to inadequate findings, technical difficulties with interpretation, or discordant results with previous clinical data.

- For the diagnosis of suspected cardiac involvement in patients with sarcoidosis as evidenced by reduced heart function on transthoracic echocardiogram or heart block on baseline electrocardiogram
  - For patients who have a contraindication to MRI or who have had an MRI of the heart with results equivocal for sarcoid involvement.
  - Examples of patients who are unable to undergo MRI include, but are not limited to, patients with a pacemaker, automatic implanted cardioverter-defibrillator (AICDs), or other metal implant.
ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 APPROPRIATE USE CRITERIA for Nuclear Cardiac Imaging / Myocardial Perfusion Study:

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain (MPI / Stress Echo)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluation of Ischemic Equivalent (Non-Acute)</strong></td>
<td></td>
</tr>
</tbody>
</table>
| 2 / 115 | • Low pretest probability of CAD*  
• ECG uninterpretable OR unable to exercise A(7) / A(7) |
| 3 / 116 | • Intermediate pretest probability of CAD*  
• ECG interpretable AND able to exercise A(7) / A(7) |
| 4 / 117 | • Intermediate pretest probability of CAD*  
• ECG uninterpretable OR unable to exercise A(9) / A(9) |
| 5 / 118 | • High pretest probability of CAD*  
• Regardless of ECG interpretability and ability to exercise A(8) / A(7) |
| **Detection of CAD: Asymptomatic (Without Ischemic Equivalent)** | |
| 14 / 126 | • Intermediate CHD risk (ATP III risk criteria)**  
• ECG uninterpretable U(5) / U(5) |
| 15 / 127 | • High CHD risk (ATP III risk criteria)** ✓  
A(8) / U(5) ✓ |
| **New-Onset or Newly Diagnosed Heart Failure With LV Systolic Dysfunction Without Ischemic Equivalent** | |
| 16 / 128 | • No prior CAD evaluation AND no planned coronary angiography A(8) / A(7) |
| **New-Onset Atrial Fibrillation ♦** | |
| 17 / 132 | • Part of evaluation when etiology unclear U(6) / U(6) |
| **Ventricular Tachycardia ♦** | |
| 18 / NA | • Low CHD risk (ATP III risk criteria)**  
A(7) / NA |
| 19 / NA | • Intermediate or high CHD risk (ATP III risk criteria)**  
A(8) / NA |
| **Syncope** | |
| 21 / 134 | • Intermediate or high CHD risk (ATP III risk criteria)**  
A(7) / A(7) |
| **Elevated Troponin** | |
| 22 / 135 | • Troponin elevation without additional evidence of acute coronary syndrome (with ischemia is not subject to Stress Echocardiogram contraindications) ✓  
A(7) / A(7) ✓ |

*Not subject to Stress Echocardiogram contraindications as noted in section “Indications for a Nuclear Cardiac Imaging / Myocardial Perfusion Study”. Please see explanation in Introduction, paragraph “6”.

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Proprietary

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<table>
<thead>
<tr>
<th>ACCE et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI / Stress Echo</td>
<td></td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
<tr>
<td><strong>INDICATIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(*Refer to Additional Information section)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Not subject to Stress Echocardiogram contraindications as noted in section “Indications for a Nuclear Cardiac Imaging / Myocardial Perfusion Study”. Please see explanation in Introduction, paragraph “6”</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 / 145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Intermediate to high CHD risk (ATP III risk criteria)*** ✓</td>
<td>U(6) / U(4) ✓</td>
<td></td>
</tr>
<tr>
<td>• Last stress imaging study done more than or equal to 2 years ago</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If known CAD, not subject to Stress Echo contraindications</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 / 147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Known CAD on coronary angiography OR prior abnormal stress imaging study</td>
<td>U(5) / U(6)</td>
<td></td>
</tr>
<tr>
<td>• Last stress imaging study done more than or equal to 2 years ago</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prior Noninvasive Evaluation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 / 153</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern</td>
<td>A(8) / A(8)</td>
<td></td>
</tr>
<tr>
<td><strong>New or Worsening Symptoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 / 151</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Abnormal coronary angiography OR abnormal prior stress imaging study</td>
<td>A(9) / A(7)</td>
<td></td>
</tr>
<tr>
<td>31 / 152</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Normal coronary angiography OR normal prior stress imaging study</td>
<td>U(6) / U(5)</td>
<td></td>
</tr>
<tr>
<td><strong>Coronary Angiography (Invasive or Noninvasive)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 / 141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Coronary stenosis or anatomic abnormality of uncertain significance</td>
<td>A(9) / A(8)</td>
<td></td>
</tr>
<tr>
<td><strong>Asymptomatic Prior Coronary Calcium Agatston Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 / 137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Low to intermediate CHD risk***</td>
<td>U(5) / U(5)</td>
<td></td>
</tr>
<tr>
<td>• Agatston score between 100 and 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 / 138</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• High CHD risk*** ✓</td>
<td>A(7) / U(6) ✓</td>
<td></td>
</tr>
<tr>
<td>• Agatston score between 100 and 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 / 139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Agatston score greater than 400</td>
<td>A(7) / A(7)</td>
<td></td>
</tr>
<tr>
<td><strong>Duke Treadmill Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 / 149</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Intermediate-risk Duke treadmill score****</td>
<td>A(7) / A(7)</td>
<td></td>
</tr>
<tr>
<td>39 / 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• High-risk Duke treadmill score****</td>
<td>A(8) / A(7)</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intermediate-Risk Surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (4-9):</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>MPI / Stress Echo</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
<tr>
<td>□ Not subject to Stress Echocardiogram contraindications as noted in section “Indications for a Nuclear Cardiac Imaging / Myocardial Perfusion Study”. Please see explanation in Introduction, paragraph “6”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43 / 157</td>
<td>• Greater than or equal to 1 clinical risk factor ✔️</td>
<td>A(7) / U(6) ✔️</td>
</tr>
<tr>
<td></td>
<td>• Poor or unknown functional capacity (less than 4 METs)</td>
<td></td>
</tr>
<tr>
<td><strong>Vascular Surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47 / 161</td>
<td>• Greater than or equal to 1 clinical risk factor</td>
<td>A(8) / A(7)</td>
</tr>
<tr>
<td></td>
<td>• Poor or unknown functional capacity (less than 4 METS)</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Within 3 Months of an Acute Coronary Syndrome</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STEMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 / 164</td>
<td>• Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF</td>
<td>A(8) / A(7)</td>
</tr>
<tr>
<td></td>
<td>• To evaluate for inducible ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No prior coronary angiography</td>
<td></td>
</tr>
<tr>
<td><strong>UA/NSTEMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52 / 166</td>
<td>• Minor perioperative risk predictor</td>
<td>A(9) / A(8)</td>
</tr>
<tr>
<td></td>
<td>• Normal exercise tolerance (greater than or equal to 4 METS) Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To evaluate for inducible ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No prior coronary angiography</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Postrevascularization (Percutaneous Coronary Intervention or Coronary Artery Bypass Graft)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Symptomatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 / 169</td>
<td>• Evaluation of ischemic equivalent</td>
<td>A(8) / A(8)</td>
</tr>
<tr>
<td><strong>Asymptomatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56 / 170</td>
<td>• Incomplete revascularization</td>
<td>A(7) / A(7)</td>
</tr>
<tr>
<td></td>
<td>• Additional revascularization feasible</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>• Less than 5 years after CABG ✔️</td>
<td>U(5) ✔️</td>
</tr>
<tr>
<td>58 / 172</td>
<td>• Greater than or equal to 5 years after CABG</td>
<td>A(7) / U(6)</td>
</tr>
<tr>
<td>60 / 174</td>
<td>• Greater than or equal to 2 years after PCI</td>
<td>U(6) / U(5)</td>
</tr>
<tr>
<td><strong>Assessment of Viability/Ischemia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ischemic Cardiomyopathy/Assessment of Viability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62 / 176</td>
<td>• Known severe LV dysfunction</td>
<td>A(9) / A(8)</td>
</tr>
<tr>
<td></td>
<td>• Patient eligible for revascularization</td>
<td></td>
</tr>
</tbody>
</table>

◊ INDICATIONS FOR A NUCLEAR CARDIAC IMAGING/MYOCARDIAL PERFUSION STUDY:

• To qualify for SPECT/MPI, the patient must meet ACCF/ASNC Appropriateness criteria for appropriate indications above and meets any one of the following conditions:
Stress echocardiography is not indicated; OR
Stress echocardiography has been performed however findings were inadequate, there were technical difficulties with interpretation, or results were discordant with previous clinical data; OR
MPI is preferential to stress echocardiography including but not limited to following conditions:
- Ventricular paced rhythm
- Evidence of ventricular tachycardia
- Severe aortic valve dysfunction
- Severe Chronic Obstructive Pulmonary Disease, (COPD) as defined as FEV1 \(< 30\% \) predicted or FEV1 \(< 50\% \) predicted plus respiratory failure or clinical signs of right heart failure. (GOLD classification of COPD access [http://www.pulmonaryreviews.com/jul01/pr_jul01_copd.html](http://www.pulmonaryreviews.com/jul01/pr_jul01_copd.html))
- Congestive Heart Failure (CHF) with current Ejection Fraction (EF) \(< 40\%
- Inability to get an echo window for imaging
- Prior thoracotomy, (CABG, other surgery)
- Obesity BMI>40
- Poorly controlled hypertension [generally above 180 mm Hg systolic (both physical stress and dobutamine stress may exacerbate hypertension during stress echo)]
- Poorly controlled atrial fibrillation (Resting heart rate > 100 bpm on medication to control rate)
- Inability to exercise requiring pharmacological stress test
- Segmental wall motion abnormalities at rest (e.g. due to cardiomyopathy, recent MI, or pulmonary hypertension)

OR

Arrhythmias with Stress Echocardiography - any patient on a type 1C anti-arrhythmic drug (i.e. Flecainide or Propafenone) or considered for treatment with a type 1C anti-arrhythmic drug.

For all other requests, the patient must meet ACCF/ASNC Appropriateness criteria for indications with Appropriate Use Scores 4-9, as noted above.

ADDITIONAL INFORMATION:

Cardiac neoplasm and metastasis
- Aid in the determination of cardiac malignancy and may be helpful in detecting metastases of malignant cardiac tumors.

The applications for Cardiac Viability Imaging with FDG PET are:
- The identification of patients with partial loss of heart muscle movement or hibernating myocardium is important in selecting candidates with compromised ventricular function to determine appropriateness for revascularization.
- Distinguish between dysfunctional but viable myocardial tissue and scar tissue in order to affect management decisions in patients with ischemic cardiomyopathy and left ventricular dysfunction.

Use of class IC antiarrhythmic agents:
Flecainide (Tambocor) and propafenone (Rythmol) are class IC anti arrhythmic agents. They are used to treat ventricular and supraventricular tachyarrhythmias. They are contraindicated in patients with structural heart disease due to the risk of precipitating life-threatening ventricular arrhythmias. These drugs can depress systolic function. They can suppress the sinus node in patients with sick sinus
syndrome and impair AV and infra nodal conduction in patients with conduction disease. Propafenone has beta adrenergic receptor blocking effect.

*Pretest Probability of CAD for Symptomatic (Ischemic Equivalent) Patients:

**Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.

**Atypical Angina (Probable):** Chest pain or discomfort that lacks 1 of the characteristics of definite or typical angina.

**Nonanginal Chest Pain:** Chest pain or discomfort that meets 1 or none of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Typical / Definite Angina Pectoris</th>
<th>Atypical / Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

- **Very low:** Less than 5% pretest probability of CAD
- **Low:** Less than 10% pretest probability of CAD
- **Intermediate:** Between 10% and 90% pretest probability of CAD
- **High:** Greater than 90% pretest probability of CAD

REFERENCES


CPT Codes: 78472, 78473, 78494, +78496

INTRODUCTION:

Multiple-gated acquisition (MUGA) scanning is a radionuclide ventriculography technique to evaluate the pumping function of the ventricles of the heart. During this noninvasive nuclear test, radioactive tracer is injected into a vein and a gamma camera detects the radiation released by the tracer, providing moving images of the heart. From these images, the health of the heart’s pumping chamber, the left ventricle, can be assessed. It is used to evaluate the left ventricular ejection fraction (LVEF), a measure of overall cardiac function. It may also detect areas of poor contractility following an ischemic episode and it is used to evaluate left ventricular hypertrophy.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR MULTIPLE-GATED ACQUISITION (MUGA) SCAN:

- To evaluate left ventricular (LV) function at baseline before chemotherapy or cardiotoxic therapy; may be repeated prior to subsequent chemotherapy cycles until a total cardiotoxic dose has been reached.
- To evaluate ejection fraction in a patient with congestive heart failure (CHF), when prior cardiac imaging has proven inadequate for an accurate determination of ejection fraction.
- To evaluate patient, who is obese or who has chronic obstructive pulmonary disease (COPD), for coronary artery disease (CAD).
- As an alternative form of stress imaging instead of echocardiography or myocardial perfusion imaging, based upon similar necessity criteria for the evaluation of coronary or valvular heart disease.
- 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.

COMBINATION OF STUDIES WITH MUGA:

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.

ADDITIONAL INFORMATION RELATED TO MUGA:

MUGA Scan Monitoring during Chemotherapy – Chemotherapeutic drugs that are used in cancer treatment may be toxic to the heart muscle. To minimize the risk of damaging the heart muscle with these drugs, the patient’s cardiac function may be monitored with the MUGA scan before and during administration of the drug. Before the first dose of the drug, a MUGA scan may be performed to establish a baseline left ventricle ejection fraction (LVEF). It may then be repeated after cumulative doses. If the LVEF begins to decrease, cardio toxicity risk must be considered if continuing the treatment.
REFERENCES


CPT Codes: 78607

INTRODUCTION

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. In the assessment of transient ischemic disease 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

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.
- For the evaluation of suspected dementia, for patient who has had a recent Brain CT or MRI AND all three (3) of the following were completed:
  - Thyroid study
  - B12 assay
  - Mini Mental State Exam (MMSE or MoCA)
- For pre-surgical localization of epileptic foci, patient has had either a Brain CT or Brain MRI AND surgery is tentatively scheduled.
- 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.
- To evaluate cerebrovascular reserve in planning appropriate endovascular vascular intervention or neurovascular surgical approach.
- 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).
- 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.
ADDITIONAL INFORMATION RELATED TO A BRAIN SPECT:

- 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 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.

REFERENCES


CPT Codes: 78608, 78609

Positron Emission Tomography (PET) scanning is useful in brain tumor imaging and in the preoperative evaluation of refractory epilepsy. It is useful in the identification of epileptic foci in the brain as an adjunct to surgical planning and is useful for follow-up of brain tumor surgery or treatment. It helps in the evaluation of known brain tumor with new signs or symptoms indicative of a recurrence of cancer.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN PET SCAN:
For evaluation of known brain tumor or cancer:
- Known brain tumor or cancer with new signs or symptoms indicative of a recurrence of cancer.
- Brain tumor follow-up after surgery and/or after treatment recently completed, to differentiate scarring/fibrosis from residual/recurrent tumor, when Brain MRI cannot provide sufficient information.

For pre-operative evaluation:
- Pre-surgical evaluation for refractory epilepsy, when patient has failed conventional medical therapy.

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.

For evaluation of Dementia:
- A scan is reasonable and necessary in patients (who meet all of the following) with:
  1. Documented cognitive decline of at least six months (request date of onset of symptoms).
  2. Recent assessment done of patient’s mental status - documented by neuro-diagnostic testing, such as:
     a. Change in mental status with a mental status score of either MMSE or MoCA of less than 26, or other similar mental status exams showing at least mild cognitive impairment, AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, etc).
  3. Appropriate baseline work-up for other treatable causes.

ADDITIONAL INFORMATION RELATED TO BRAIN PET:

Information applicable to Dementia/Alzheimer's:
- Cognition is the act or process of thinking, perceiving, and learning.
- Symptoms develop when the underlying condition affects areas of the brain involved with learning, memory, decision-making, and language.
- Memory impairment is often the first symptom to be noticed. Someone with dementia may be unable to remember ordinary information, such as their birth date and address, and may be unable to recognize friends and family members.
• There is progressive decline in these cognitive functions as well:
  o Decision making
  o Judgment
  o Orientation in time and space
  o Problem solving
  o Verbal communication
• Behavioral changes may include the following:
  o Eating, dressing, toileting (e.g., unable to dress without help; becomes incontinent)
  o Interests (e.g., abandons hobbies)
  o Routine activities (e.g., unable to perform household tasks)
  o Personality (e.g., inappropriate responses, lack of emotional control).
• Frontotemporal dementia diagnostic criteria:
  o Behavioral symptoms that should be recorded include apathy, aspontaneity, or, oppositely, disinhibition.
  o Executive function should also be assessed; patients would show impairment in ability to perform skills that require complex planning or sequencing (multi-step commands, drawing the face of a clock).
  o Primitive reflexes showing frontal release should be assessed including palmomental reflex, rooting reflex and palmar grasp.
• Alzheimer’s criteria:
  o Memory impairment (assessed as part of mini-mental status exam MMSE)
  o Cognitive disturbance (one or more) evidenced by
  o Aphasia (language disturbance)
  o Apraxia (impaired ability to carry out motor activities despite intact motor function)
  o Agnosia - failure to recognize or identify objects despite intact sensory (vision, touch, etc) function
  o Disturbance in executive function - patients would show impairment in ability to perform skills that require complex planning or sequencing (multi-step commands, drawing the face of a clock).
• Metabolic testing (in addition to neurologic examination, MMSE):
  o Urinalysis (to r/o urinary tract infection as a cause of dementia)
  o CBC (to r/o infection or anemia as a cause of impaired mental function)
  o Serum electrolytes, including magnesium
  o Serum chemistries, including liver function testing
  o Thyroid function tests (TSH or super sensitive (ss) TSH)
  o Vitamin B12
  o Erythrocyte Sedimentation Rate (ESR, “Sed Rate”, etc)
  o Serologic test for syphilis (to r/o tertiary syphilis)
  o Possibly toxicology tests to r/o poisoning or overdose - salicylates, alcohol, other
• Medicines that may be causing cognitive impairment:
  o Anti-diarrheals
  o Anti-epileptic medications
  o Antihistamines, cold and flu medications
  o Lithium
  o Sleeping pills
  o Tricylic antidepressants
  o Opiates
  o Salicylates

PET in Seizure Disorders – Refractory epilepsy is defined as epilepsy that does not respond to medical treatment. These patients struggle with recurrent seizures even while undergoing treatment with
antiepileptic drugs (AEDs). However, the definition is unclear as some of these patients will partially respond to treatment or will worsen when AEDs are discontinued. PET is helpful in locating the area of the brain causing seizures and is used in the preoperative evaluation of patients who have failed to respond to conventional medical treatment of epilepsy.

**PET and Known Brain Tumor/Cancer** – Studies have shown that PET is useful in patients who have undergone surgery. PET, a biochemical and physiologic technology, provides precise information about brain tumors which helps to distinguish between brain tumors and other anatomic structures or surgical scars, when the more sensitive brain MRI often cannot. It is useful in identifying tumors in the brain after surgery, radiation or chemotherapy, when MRI demonstrates equivocal or indeterminate findings. With the sensitivity and specificity of the radiotracer 18-F FDG, PET is frequently able to differentiate recurrent tumor from treatment-induced changes.

**REFERENCES**


CPT Codes: 78647

INTRODUCTION

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.

CSF fluid flow studies for the evaluation of hydrocephalus or CSF leak are performed after the intrathecal administration of radionuclide. In the setting of suspected shunt obstruction the radiopharmaceutical is injected 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. In patients without hydrocephalus or CSF leak there is a predictable radiopharmaceutical distribution. In patients without 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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR A CEREBROSPINAL FLUID FLOW (CSF) SPECT SCAN:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging is insufficient alone:

- Evaluation of hydrocephalus and the patient has had a CT or MRI imaging of the head recently performed and compared to prior exams.
- Detection of CSF leak and the patient has had a recent surgical procedure.
- Detection of CSF leak AND patient experienced recent trauma.
- 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.
- 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.
- 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.

ADDITIONAL INFORMATION RELATED TO CSF SPECT SCAN:

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.

REFERENCES


Society of Nuclear Medicine Procedure Standards.
http://www.snmmi.org/ClinicalPractice/content.aspx?ItemNumber=6414


INTRODUCTION:

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.

INDICATIONS FOR A KIDNEY DYNAMIC PLANAR SCAN WITH SPECT:

Complex clinical scenarios involving the following indications wherein routine dynamic planar imaging is insufficient alone:

- Evaluation of renal perfusion and function, with signs, symptoms and laboratory findings supporting the need for such an evaluation.
- Evaluation of renal, ureteral, or other urinary tract trauma or surgery, with signs, symptoms and laboratory findings supporting the need for such an evaluation.
- For diagnosis of reno-vascular hypertension, with signs, symptoms, and laboratory findings or other imaging supporting the need for such a diagnosis.
- Detection and evaluation of renal collecting system obstruction.
- Diagnosis of acute tubular necrosis.
- Diagnosis of renal transplant complications.
- Evaluation of renal infections and discrimination of pyelonephritis from cortical scarring.
- 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.

ADDITIONAL INFORMATION RELATED TO KIDNEY SPECT SCAN:

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.
Renal Transplant evaluation: Vascular compromise (arterial stenosis/occlusion, venous thrombosis, segmental infarction), ureteral obstruction, acute rejection and acute tubular necrosis can affect renal transplants. 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. ATN is the most common medical complication observed at renal scintigraphy and is more common in cadavaeric 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.

REFERENCES


INTRODUCTION:

Positron emission tomography (PET) is a rapidly developing 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 useful or beneficial for slow growing tumors.

Radioactive tracer uptake may occur in various types of active inflammation and is not specific for cancer. Thus it is not used for the initial diagnosis of cancer, but is useful in staging and monitoring cancer cell viability and for the diagnosis and detection of recurrence of cancer. PET is also useful for monitoring the response to treatment of various cancers.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

IMPORTANT NOTE:

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.

- The following are noncovered for all other indications including (but not limited to):
  - Breast Cancer – Initial Treatment Strategy (formerly diagnosis and initial staging) of axillary lymph nodes.
  - Melanoma – Initial Treatment Strategy (formerly Evaluation) of regional lymph nodes.
  - Prostate Cancer – Initial Treatment Strategy (formerly Diagnosis and initial staging.)
  - Infection and/or Inflammation - PET for chronic osteomyelitis, infection of hip arthroplasty, and fever of unknown origin.
INDICATIONS FOR AN ONCOLOGICAL FDG PET SCAN:

**Initial Treatment Strategy**

All solid tumors, including myeloma, with biopsy proven cancer or strongly suspected based on other diagnostic testing:

Including
- 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)
- 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.)

Excluding
- ALL - acute lymphoblastic leukemia
- AML – acute myelogenous leukemia
- BCC – basal cell carcinoma (of the skin)
- Prostate cancer

- 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.

**Subsequent Treatment Strategy**

Restaging or monitoring response to active treatment, and/or a single evaluation after completion/cessation of therapy not to be performed within 4 weeks of completion of therapy (ideally FDG PET is delayed 2-3 months 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.)

- Breast cancer (female and males)
- Cervical cancer
- Colorectal cancer (including colon, rectal, appendiceal or anal cancer)
- Esophageal cancer
- Head and neck cancer (not including Brain cancer/tumor; thyroid noted below)
- Lung cancer - Non-small cell
- Lymphoma
- Melanoma
- Myeloma
- Ovarian cancer

Subsequent PET Scans may be performed only if other imaging (ie. US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed:
- Brain cancer: (with metastasis to non-head areas) Refer to Brain PET Scan Guidelines to image the brain
- Lung cancer - Small cell
- Neuroendocrine cancer (e.g. carcinoid, pheochromocytoma, etc)
- Pancreatic cancer
- Prostate cancer
- Soft tissue sarcoma
- Testicular cancer
- Tumors of unknown origin
- Other malignancies where the tumor has been shown to be FDG avid on prior PET/CT imaging, and other imaging (ie: US, CT, MRI, NM) is inconclusive in determining a treatment plan or unable to be performed

**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:
  - A thyroidectomy and radioiodine ablation initially, and
  - Current serum thyroglobulin > 10ng/mL, and
  - Current whole body I-131 scan is negative.
- Medullary thyroid cancer when calcitonin levels are elevated post-operatively.

**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**

*For the following neuroendocrine tumors:*
- Gastrointestinal tract, pancreas, lung, thymus (carcinoid tumors)
- Pheochromocytoma, paraganglioma
- Large or small cell carcinoma other than lung
- Neuroendocrine tumors of unknown primary

*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** WITH recent Chest/Abdominal (for example, if lung or thymus) or Abdominal/pelvic (for example, if GI tract, pancreatic, MEN-1, MEN-2) multiphasic CT or MRI having 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. (Asymptomatic surveillance is not approvable.)

**NOTE:** Gallium-68 DOTATATE PET/CT scans should be performed only if other imaging (CT, MRI) is inconclusive/insufficient AND the patient has not already been evaluated with Somatostatin Receptor SPECT scanning (another form of somatostatin receptor imaging performed on standard nuclear cameras), or that scanning was negative or equivocal.

**Surveillance/Remission**

Both somatostatin receptor imaging (Gallium-68 DOTATATE PET) and FDG PET/CT are NOT recommended for routine surveillance.

**ADDITIONAL INFORMATION RELATED TO PET SCANS:**

**Initial Treatment Strategy** - “Initial Anti-tumor Treatment Strategy” or “Initial Treatment Strategy” is replacing “diagnosis and initial staging”.

**Subsequent Treatment Strategy** - “Subsequent Anti-tumor Treatment Strategy” or “Subsequent Treatment Strategy” is replacing “restaging and monitoring response to treatment”.

**PET in the setting of immunotherapy** - Be aware that cancer immunotherapy with cytokines, immune-modulating antibodies, and cancer vaccines, is changing the landscape of imaging evaluation of cancer treatment response. Early experience with these therapies has demonstrated a delayed imaging response to therapy as compared to traditional chemotherapy. Transient enlargement and intensification of radiotracer activity in tumors, nodal and metastatic disease is well documented. This “pseudoprogression” may necessitate additional PET/CT surveillance. Literature currently supports repeat interval PET/CT after such a transient worsening on imaging so as to determine whether the changes seen are true progression or merely brisk immune response.

**PET/CT or PET with CT Attenuation Correction** – In contrast to the simple PET scan which requires a complex process of evaluation of body habitus to adjust for tissue density, modern scanners have the capacity to obtain a preliminary, general assessment of a patient’s habitus through the use of CT technology. Automatic adjustments to the PET data (based on tissue attenuation) are made. This is one study, not a combination study. This is interchangeably referred to as a PET/CT or PET/CT fusion examination. These provide the anatomical detail of a CT with PET’s ability to measure tissue metabolic activity. The ability to view both the morphology and metabolic activity simultaneously helps to evaluate tumors with speed and clarity. PET alone is normally not the standard of care and is significantly less accurate than PET/CT. The combination of PET and computed tomography (PET/CT) has advantages over PET alone because areas of tracer uptake are better localized and the image acquisition time is reduced.

**PET and Breast Cancer** - PET provides important qualitative and quantitative metabolic information that is important in the initial staging and re-staging of breast cancer.

**PET and Cervical Cancer** – Studies have shown that PET may be useful for the pre-treatment detection of retroperitoneal nodal metastasis in cervical cancer.
**PET and Colorectal Cancer** – PET is useful in the detection of recurrent disease, the localization of recurrence in patients with a rise of carcinoembryonic antigen (CEA), the assessment of residual masses after treatment, and in staging patients before surgery.

**PET and Esophageal Cancer** – The most common use of PET in esophageal cancer is to detect distant metastases and distant lymph node disease. It may also be used to assess therapy response and evaluate for esophageal tumor recurrence after treatment. PET findings do not specify each separate type of lesion. It is very helpful in detecting distant spread from invasive thymic carcinomas.

**PET and Head and Neck Cancer** – PET is used to evaluate cancer/tumor in the head and neck region, e.g., face, orbit, temporal, neck and is useful to rule out head and/or neck cancer/tumor as the “primary” when there is evidence of tumor elsewhere in the body and clinical examination or conventional imaging has failed to localize the lesion. It is also used to distinguish a benign tumor from a malignant tumor.

**PET and Lung Cancer** – The most common cause of death from cancer in western countries is lung cancer. PET is helpful in the evaluation of patients diagnosed with early-stage non small lung cancer. It is valuable in picking up otherwise occult metastasis. PET identifies areas of hypermetabolism such as neoplasia or inflammation and reveals occult metastases. The detection of hidden or unsuspected metastasis prevents unnecessary surgery or treatments.

**PET and Lymphoma** – PET is used in the early assessment of response to chemotherapy in Hodgkin lymphoma (HL) as well as in aggressive non-Hodgkin lymphoma (NHL). Soon after the initiation of therapy, changes in radioactive tracer uptake may occur and these changes precede changes in tumor volume. This information may be used to guide treatment for patients with HL and NHL. However, PET/CT scan at early/interim restaging can lead to increased false positives and should be carefully considered in select cases.

**PET and Melanoma** – PET is not used in the diagnosis of melanoma. It may be used in the evaluation of stage III melanoma for detection of distant metastases and to identify candidates for further treatment or surgery.

**PET and Pancreatic Cancer** – In difficult cases, the presence of diffuse uptake of radioactive tracer by the pancreas or concomitant extra pancreatic uptake by the salivary glands on PET/CT can be used to aid in differentiation of autoimmune pancreatitis and pancreatic cancer.

**PET and Solitary Pulmonary Nodule** – PET may be used in the evaluation of patients with a single solitary nodule. It measures glucose metabolism which is different between benign and malignant nodules. FDG-PET is accurate in evaluation of the nodule. However, it may provide false positive results in patients who have inflammatory disease or active infections.

**PET and Thyroid Cancer** – The differentiated thyroid carcinoma (DTC) represents the most common type of thyroid cancer. It can be cured with surgical treatment and adjunctive therapy, but tumor recurrence is associated with significant morbidity and mortality. PET is used to evaluate DTC patients with negative radiiodine scans and elevated thyroglobulin (Tg) levels to detect recurrent or metastatic DTC. When thyroid carcinoma is differentiated it tends to retain the ability to accumulate iodine and iodine-based imaging is therefore the most appropriate imaging exam. When thyroid carcinoma becomes dedifferentiated, it tends to lose the ability to accumulate iodine and instead begins to act like other aggressive carcinomas.
PET in pediatric age group – While radiation dose and stochastic effects of radiation are of greater concern in the pediatric age group as compared to the adult age group, there are no PET/CT-specific radiation safety precautions. Prudence with all forms of imaging requiring ionizing radiation is recommended.

**Gallium 68 DOTATATE PET/CT** - Because most neuroendocrine tumors express high-affinity receptors for somatostatin, radiolabeled somatostatin receptor scintigraphy or Gallium 68 DOTATATE PET/CT may be used in the initial evaluation of patients with neuroendocrine tumors, when workup utilizing CT or MRI is reasonably deemed insufficient. However, somatostatin receptor scintigraphy is not routinely recommended for surveillance after definitive resection, but may be indicated to assess disease location and disease burden for comparison in cases of subsequent possible recurrence. (NCCN).

**REFERENCES**


CPT Codes: G0235

IMPORTANT NOTE:

PET imaging, any site, not otherwise specified, is a non-covered CPT code.
CPT Codes: S8037, 74181, 74182, 74183

INTRODUCTION:

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive radiologic technique for imaging the biliary and pancreatic ducts, and it is used to evaluate patients with cholestatic liver function tests, right upper quadrant pain, and recurrent pancreatitis. The MRCP uses magnetic resonance imaging (MRI) to produce detailed pictures of the pancreas, liver and bile ducts. MRCP is reliable for the diagnosis of ductal abnormalities, e.g., pancreas divisum. It is also used to diagnose bile duct stones and assess the level of obstruction. MRCP is especially useful when a noninvasive exam is desired. 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 aminotransaminase (ALT).

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR MRCP:

- 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 the complications related to such (pseudocysts and bile duct strictures).
- Pre-operative evaluation: Prior to surgery or other invasive procedure.
- Post-operative evaluation: For evaluation of suspected biliary abnormalities after surgery or invasive procedure.
- Further evaluation of inconclusive abnormalities identified on other imaging (ultrasound, CT, or MRI).
- Evaluation of abnormality related to the biliary tree based on symptoms or laboratory findings and initial imaging has been performed.

ADDITIONAL INFORMATION RELATED TO MRCP:

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.

Magnetic resonance Cholangiopancreatography (MRCP) – MRCP is a noninvasive method for depicting biliary and pancreatic ducts and assessing the level of obstruction. It is also used to evaluate congenital
anomalies of these structures. In clinical practice MRCP is often combined with conventional MRI imaging of the liver and pancreas. MRCP does not require the use of any contrast materials. Unlike ERCP, it does not combine diagnosis with therapeutic intervention. MRCP is not cost effective if the patient will need ERCP mediated intervention after the MRCP. MRCP is preferred over ERCP when a noninvasive examination is needed or when there is a very small likelihood that the patient will need therapeutic intervention afforded by ERCP. Secretin-enhanced MR Cholangiopancreatography has been recently developed to improve the diagnostic quality of MRCP images.

**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 et al). It also consistently demonstrates the internal architecture of the main duct and the extent of IPMN (Intraductal Papillary Mucinous Neoplasms) better than ERCP. (ACG-GL)

**Biliary strictures**: 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 anastomatic 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)**: Magnetic resonance cholangiography is increasingly available but does not yet visualize the intrahepatic bile ducts sufficiently to replace direct cholangiography. 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 et al)

**REFERENCES**


CPT Codes: G0297

INTRODUCTION:

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.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LOW DOSE CT FOR LUNG CANCER SCREENING:

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:

- Individual is between 55-80 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.

ADDITIONAL INFORMATION:

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.

REFERENCES

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.
INTRODUCTION

Pacemakers are implantable devices indicated for the treatment of slow heart rhythms (bradycardia) and, less commonly, for decreased heart muscle strength (cardiomyopathy). They are also very rarely used for the treatment of rapid heart rates (tachycardia) or hypertrophic cardiomyopathy. Dual chamber devices have been established to be beneficial for the vast majority of patients in terms of quality of life and incidence of congestive heart failure and atrial fibrillation, and they have become standard of care in most patients without permanent atrial fibrillation.

The majority of the patients with dilated cardiomyopathy received implantable defibrillators with cardiac resynchronization therapy (CRT) capability, but pacemakers are sometimes chosen due to patient and physician preference. In order to identify if CRT is appropriate for a specific patient, CRT requires separate authorization.

Approximately one third of patients who receive ICDs are also candidates for cardiac resynchronization therapy (CRT) because of congestive heart failure (CHF) and an abnormally wide QRS. CRT typically requires three leads, one each to pace the right and left ventricles, and a third to pace the atrium. This allows near-simultaneous stimulation (resynchronization) of both ventricles. CRT improves cardiac function and quality of life and decreases cardiac events and mortality among appropriately chosen patients. The improved survival in patients with CRT is greater than that provided by ICD insertion alone. Criteria for CRT are based on a 2012 focused update of the ACC/AHA/HRS 2008 ICD guideline. This guideline supports approval of ICD and CRT indications that are classed as IIb or higher. Relevant considerations are assigning designations I, IIa, and IIb are LVEF, QRS pattern and duration, and whether atrial fibrillation is present.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS AND CONTRAINDICATIONS FOR PACEMAKERS BY CONDITION

- **Cardiac Resynchronization Therapy (CRT):**  
  (Note: If CRT is indicated, use of an ICD with CRT should be considered).
  - LVEF ≤35%, sinus rhythm, LBBB with a QRS >119 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT (guideline-directed medical therapy). Also consider ICD with CRT.
  - LVEF ≤35%, sinus rhythm, a non-LBBB pattern with a QRS duration ≥120 ms, and NYHA class III/ambulatory class IV symptoms on GDMT.
  - Atrial fibrillation and LVEF ≤35% on GDMT if a) the patient requires ventricular pacing or otherwise meets CRT criteria and b) AV nodal ablation or pharmacologic rate control allows near 100% ventricular pacing with CRT.
  - LVEF ≤35%, on GDMT, with planned new or replacement device placement with anticipated requirement for (40%) ventricular pacing.
LVEF <30%, ischemic etiology of heart failure, sinus rhythm, LBBB with a QRS duration ≥150 ms, and NYHA class I symptoms on GDMT.

LVEF <35%, sinus rhythm, a non-LBBB pattern with a QRS duration ≥150 ms, and NYHA class II.

**Contraindications for Cardiac Resynchronization Therapy (CRT):**

- NYHA class I or II symptoms and non-LBBB pattern with QRS duration <150 ms.
- Comorbidities and/or frailty expected to limit survival to <1 year.

**Pacing for Sinus Node Dysfunction:**

- Symptomatic bradycardia, which includes syncope, near-syncope, dizziness, lethargy, congestive heart failure (CHF), fatigue, or dyspnea, whether spontaneous or as a result of clinically indicated medications or procedures (e.g. medical or catheter treatment for atrial fibrillation) that intentionally slow the heart rate, documented by EKG or telemetry.
- Symptomatic heart beat pauses, documented by EKG or telemetry.
- Chronotropin incompetence, documented by stress test or telemetry.
- Heart rate less than 40 with symptoms consistent with bradycardia.
- Syncope with electrophysiologic study (EPS) findings of abnormal sinus node function.

**Contraindications for Sinus Node Dysfunction:**

- Asymptomatic.
- Symptoms in the absence of bradycardia.
- Bradycardia resulting from nonessential drug therapy.

**Pacing for Acquired Third-Degree and Advanced Second-Degree Atrioventricular Block:**

- Persistent third-degree atrioventricular block, with or without symptoms
- In atrial fibrillation and while awake, pauses in heartbeat ≥ 5 seconds with or without symptoms.
- In sinus rhythm and while awake, pauses in heartbeat ≥ 3 seconds or heart rates less than 40 beats per minute or an escape rhythm below the AV node, with or without symptoms.
- Following catheter ablation of the AV junction.
- Following cardiac surgery, if expected to be permanent.
- In neuromuscular diseases such as myotonic muscular dystrophy, Erb dystrophy (limb-girdle muscular dystrophy), Kearns-Sayre syndrome, and peroneal muscular atrophy.
- Exercise-induced heart block without myocardial ischemia.

**Contraindications for Acquired Third-Degree and Advanced Second-Degree Atrioventricular Block:**

- AV block is expected to resolve and is unlikely to recur (e.g. drug toxicity, Lyme disease, or transient increases in vagal tone or during hypoxia in sleep apnea syndrome) and without symptoms.
- AV block secondary to nonessential drug therapy.

**Pacing for Other Presentations of First- and Second-Degree AV Block:**

- Symptomatic second-degree AV block.
- Type II second-degree AV block, with or without symptoms.
- Second-degree AV block due to EP-documented intra- or infra-His levels.
- First- or second-degree AV block with “pacemaker syndrome” symptoms or hemodynamic compromise (i.e. hypotension, syncope and pulmonary edema).
In neuromuscular diseases such as myotonic muscular dystrophy, Erb dystrophy (limb-girdle muscular dystrophy), Kearns-Sayre syndrome, and peroneal muscular atrophy.

AV block due to drug use and/or drug toxicity AND block is expected to recur after drug withdrawal.

Exercise-induced second degree heart block without myocardial ischemia.

Contraindications for Other Presentations of First- and Second-Degree AV Block:

- AV block is expected to resolve and is unlikely to recur (e.g. drug toxicity, Lyme disease, or transient increases in vagal tone or during hypoxia in sleep apnea syndrome) and without symptoms.
- AV Block secondary to nonessential drug therapy.

Permanent Pacing for Chronic Bifascicular Block:

- Type II second-degree AV block, advanced second-degree AV block (see definitions section) or intermittent third-degree AV block.
- Alternating bundle-branch block.
- Syncope and bifascicular block when other likely causes have been excluded, specifically ventricular tachycardia.
- Electrophysiologic study (EPS) documentation of an H-V interval ≥100 milliseconds, even in asymptomatic patients.
- Electrophysiologic study (EPS) documentation of non-physiological, pacing-induced infra-His block.
- In neuromuscular diseases such as myotonic muscular dystrophy, Erb dystrophy (limb-girdle muscular dystrophy), and peroneal muscular atrophy with bifascicular block or any fascicular block.

Contraindications for Permanent Pacing for Chronic Bifascicular Block:

- Asymptomatic fascicular block without AV block.
- Asymptomatic fascicular block with first-degree AV block.

Permanent Pacing After the Acute Phase of Myocardial Infarction:

- Persistent second- or third-degree AV block after STEMI.
- Transient second- or third-degree AV block below the AV node after STEMI. If the site of block is uncertain, electrophysiologic study (EPS) may be necessary.

Contraindications for Permanent Pacing After the Acute Phase of Myocardial Infarction:

- Bradycardia secondary to nonessential drug therapy.
- Transient AV block without intraventricular conduction defects.
- Transient AV block with isolated left anterior fascicular block.
- New bundle-branch block or fascicular block without AV block.
- Asymptomatic first-degree AV block with bundle-branch or fascicular block.

Permanent Pacing in Hypersensitive Carotid Sinus Syndrome and Neurocardiogenic Syncope:

- Recurrent syncope due to spontaneously occurring carotid sinus stimulation AND carotid sinus pressure induces ventricular asystole ≥3 seconds.
- Syncope without clear, provocative events and with a hypersensitive cardioinhibitory response (asystole) of 3 seconds or longer.
- Neurocardiogenic syncope associated with bradycardia occurring spontaneously or at the time of tilt-table testing.
Contraindications for Permanent Pacing in Hypersensitive Carotid Sinus Syndrome and Neurocardiogenic Syncope:
- Hypersensitive cardioinhibitory response to carotid sinus stimulation without symptoms or with vague symptoms.
- Situational neurocardiogenic syncope in which avoidance behavior is effective and preferred.

Pacing following Cardiac Transplantation:
- Persistent inappropriate or symptomatic bradycardia not expected to resolve and for all other indications for permanent pacing.
- Prolonged bradycardia limiting rehabilitation or discharge.
- Syncope after transplantation even when bradyarrhythmia has not been documented.

Contraindications for Pacing following Cardiac Transplantation:
- Bradycardia secondary to nonessential drug therapy.

Permanent Pacemakers That Automatically Detect and Pace to Terminate Tachycardia:
- Symptomatic recurrent supraventricular tachycardia documented to be pacing terminated in the setting of failed catheter ablation and/or drug treatment or intolerance.

Contraindications for Permanent Pacemakers That Automatically Detect and Pace to Terminate Tachycardia:
- Presence of an accessory pathway with capacity for rapid anterograde conduction.

Pacing to Prevent Tachycardia:
- Sustained pause-dependent VT, with or without QT prolongation.
- High-risk congenital long-QT syndrome.
- Symptomatic, drug-refractory, recurrent atrial fibrillation in patients with coexisting Sinus Node Dysfunction (SND).

Contraindications for Pacing to Prevent Tachycardia:
- Ventricular ectopic without sustained VT in the absence of the long-QT syndrome.
- Reversible, e.g., drug-related, Torsade de pointes VT.

Pacing in Patients with Hypertrophic Cardiomyopathy:
- Symptomatic hypertrophic cardiomyopathy and hemodynamically significant resting or provoked LV outflow tract obstruction AND refractory to medical therapy.

Contraindications for Pacing in Patients with Hypertrophic Cardiomyopathy:
- Asymptomatic OR symptoms controlled on medical therapy.
- Without significant LV outflow tract obstruction.

Pacing in Children, Adolescents, and Patients with Congenital Heart Disease:
- Second- or third-degree AV block with symptomatic bradycardia, ventricular dysfunction, or low cardiac output.
- SND with symptoms and age-inappropriate bradycardia. The definition of bradycardia varies with the patient’s age and expected heart rate. For normal heart rates by age, please see the table at the end.
- Postoperative advanced second- or third-degree AV block that is expected to be permanent or that persists >7 days after cardiac surgery.
o Congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction.
o Congenital third-degree AV block in the infant with a ventricular rate <55 bpm or with congenital heart disease and a ventricular rate <70 bpm.
o Congenital heart disease and sinus bradycardia for the prevention of recurrent episodes of intra-atrial reentrant tachycardia, either intrinsic or secondary to anti-arrhythmic treatment.
o Congenital third-degree AV block after age 1 year with an average heart rate <50 bpm, abrupt pauses in ventricular rate that are 2 or 3 times the basic cycle length, or associated with symptoms due to chronotropic incompetence.
o Sinus bradycardia with complex congenital heart disease AND a resting heart rate < 40 bpm OR pauses in ventricular rate >3 seconds.
o Congenital heart disease and impaired hemodynamics due to sinus bradycardia or loss of AV synchrony.
o Unexplained syncope after prior congenital heart surgery complicated by transient complete heart block, with residual fascicular block after a careful evaluation to exclude other causes of syncope.
o Transient postoperative third-degree AV block that reverts to sinus rhythm with residual bifascicular block.
o Permanent pacemaker implantation may be considered for congenital third-degree AV block in asymptomatic children or adolescents with an acceptable rate, a narrow QRS complex and normal ventricular function.
o Asymptomatic sinus bradycardia following biventricular repair of congenital heart disease with a resting heart rate < 40 bpm or pauses in ventricular rate > 3 seconds.

Contraindications for Pacing in Children, Adolescents, and Patients with Congenital Heart Disease:
o Asymptomatic transient postoperative AV block with return of normal AV conduction.
o Asymptomatic bifascicular block +/-first-degree AV block after surgery for congenital heart disease in the absence of prior transient complete AV block.
o Asymptomatic type I second-degree AV block.
o Asymptomatic sinus bradycardia with the longest RR interval < 3 seconds and a minimum heart rate > 40 bpm.
o Bradycardia secondary to nonessential drug therapy.

ADDITIONAL INFORMATION:

Appropriate use criteria have not been established for pacemaker insertion. Rather, clinicians rely upon ACC/AHA/HRS guidelines, which were updated for bradycardia indications in 2008. A focused guideline update was published in 2012, which considered Left ventricular ejection fraction (LVEF), QRS pattern, QRS duration, and consideration regarding the presence of atrial fibrillation in its differentiation between classes, I, IIa, and IIb indications.

A pacemaker system is composed of a pulse generator and one or more leads. The pulse generator is implanted under the skin, usually below one of the collarbones. It contains a battery, a microprocessor that governs timing and function, and a radio antenna to allow for noninvasive reprogramming. The leads are insulated cables that conduct electricity from the pulse generator to the heart. Leads are most commonly inserted into a vein and then advanced under fluoroscopy (X-ray guidance) to within one or more heart chambers. The leads are fastened within the chambers to the heart muscle using either hooks or retractable/extendable screws, which are built into their tips. Timed electrical impulses are sent from the pulse generator down the leads to the heart, where stimulation results in heart muscle contraction.
The most recent guidelines stress that asymptomatic bradycardia rarely qualifies as a class I indication for pacemaker insertion. However, there are some asymptomatic bradycardic rhythms for which pacemaker insertion is indicated because they present a risk of injury or death. In addition, there are also a small number of situations in which the electrocardiogram (EKG) or an invasive electrophysiologic study (EPS) can reveal evidence of specific disease in the cardiac conduction system that warrants pacemaker insertion in the absence of symptoms, for the same reason. Guidelines are fairly specific and technical in these instances.

In the case dilated cardiomyopathy, near-simultaneous stimulation of both ventricles, referred to as cardiac resynchronization therapy (CRT) has been demonstrated to improve cardiac performance and quality of life and to decrease cardiac event rates and mortality among a subset of patients. Device implantation requires the insertion of leads that pace both the right and left ventricles, most commonly with a coronary sinus lead for the LV pacing. The majority of these patients received implantable defibrillators with CRT capability, but pacemakers are sometimes chosen due to patient and physician preference. A focused ACCF/AHA/HRS guideline update was published in 2012, which considered LVEF, QRS pattern, QRS duration, and consideration regarding the presence of atrial fibrillation in its differentiation between classes, I, IIa, and IIb indications. This document will provide criteria for approval of all CRT indications that are presently defined as IIb or stronger.

Current guidelines group pacemaker indications together according to anatomic source and clinical syndromes, and this document follows this approach. Class I through IIb indications are condensed and included as approvable in this document. Generally speaking, for indications that are listed in this summary without reference to symptoms, the presence or absence of symptoms differentiate between class I and II indications.

**NYHA Class Definitions:**
- **Class I:** No limitation of functional activity or only at levels of exertion that would limit normal individuals.
- **Class II:** Slight limitation of activity. Dyspnea and fatigue with moderate exercise.
- **Class III:** Marked limitation of activity. Dyspnea with minimal activity.
- **Class IV:** Severe limitation of activity. Symptoms even at rest.

**Heart Block Definitions:**
- **First Degree:** All atrial beats are conducted to the ventricles, but with a delay of > 200ms.
- **Second Degree:** Intermittent failure of conduction of single beats from atrium to ventricles.
  - Type I: Conducted beats have variable conduction times from atrium to ventricles.
  - Type II: Conducted beats have uniform conduction times from atrium to ventricles.
  - Advanced: Two or more consecutive non-conducted beats.
- **Third Degree:** No atrial beats are conducted from atrium to ventricle

**Abbreviations:**
- AV = Atrioventricular
- CHF = congestive heart failure
- CRT = Cardiac resynchronization therapy
- EKG = Electrocardiogram
- EPS = Electrophysiologic Study
- GDMT = Guideline-Directed Medical Therapy
- HRS = Heart Rhythm Society
- HV = His-ventricle
ICD = Implantable cardioverter-defibrillator  
LBBB = left bundle-branch block  
LV = Left ventricular/left ventricle  
LVEF = Left ventricular ejection fraction  
MI = myocardial infarction  
MS = milliseconds  
NYHA = New York Heart Association  
STEMI = ST-elevation Myocardial Infarction  
SND = Sinus node dysfunction  
VT = Ventricular tachycardia

Normal Pediatric Heart Rates: From: www.pediatriccareonline.org/pco/ub/view/Pediatric-Drug-Lookup/153929/0/normal_pediatric_heart_rates

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Adapted from The Harriet Lane Handbook, 12th ed, Greene MG, ed, St Louis, MO: Mosby Yearbook, 1991

REFERENCES


CPT Codes: 33230, 33240, 33249, 33262, 33263

INTRODUCTION:

Implantable cardioverter defibrillators (ICDs) are indicated for the treatment of life-threatening ventricular tachycardia and ventricular fibrillation. An ICD system includes a pulse generator and one or more leads. ICDs are indicated both for patients who have survived life threatening rhythm disturbances (secondary prevention) and for those who are at risk for them (primary prevention). Most ICD implantations are for primary prevention in patients with ischemic cardiomyopathy. Studies published in the last decade have confirmed improved survival in patient with reduced left ventricular ejection fraction (LVEF) even when no cardiac arrhythmias have been noted.

Approximately one third of patients who receive ICDs are also candidates for cardiac resynchronization therapy (CRT) because of congestive heart failure (CHF) and an abnormally wide QRS. CRT typically requires three leads, one each to pace the right and left ventricles, and a third to pace the atrium. This allows near-simultaneous stimulation (resynchronization) of both ventricles. CRT improves cardiac function and quality of life and decreases cardiac events and mortality among appropriately chosen patients. The improved survival in patients with CRT is greater than that provided by ICD insertion alone. Criteria for CRT are based on a 2012 focused update of the ACC/AHA/HRS 2008 ICD guideline. This guideline supports approval of ICD and CRT indications that are classed as IIb or higher. Relevant considerations are assigning designations I, IIa, and IIb are LVEF, QRS pattern and duration, and whether atrial fibrillation is present.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR ICDINSERTION:

- Cardiac arrest secondary to ventricular fibrillation (VF) or hemodynamically unstable sustained (at least 30 seconds) ventricular tachycardia (VT) after evaluation of etiology of event and exclusion of completely reversible causes.
- Spontaneous sustained VT in patients with structural heart disease, whether hemodynamically stable or unstable.
- Syncope of undetermined origin with hemodynamically significant sustained (30 seconds duration, causing hemodynamic collapse, or requiring cardioversion) VT or VF induced at electrophysiological study.
- LVEF ≤35% due to prior myocardial infarction (MI), New York Heart Association (NYHA) functional Class II or III and at least 40 days post-MI and 90 days post-revascularization.
- Non-ischemic dilated cardiomyopathy (DCM) with LVEF less than or equal to 35% and NYHA functional Class I, II, or III and at least 90 days after diagnosis of DCM.
- LVEF ≤30% due to prior MI and at least 40 days post-MI and 90 days post-revascularization.
- Non-sustained VT with prior MI and LVEF less than or equal to 40% and inducible VF or sustained VT at electrophysiological study.
- Unexplained syncope with significant LV dysfunction and nonischemic DCM.
- Sustained VT with normal or near-normal LV function.
• Hypertrophic cardiomyopathy (HCM) who have one or more major risk factors for Sudden Cardiac Death (SCD). Risk factors include syncope, nonsustained VT, family history of sudden death, 30 mm septal thickness, or abnormal blood pressure response to exercise.
• Arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) and one or more risk factors for SCD, which include positive EP study, nonsustained VT, male gender, severe right ventricular (RV) dilatation, extensive RV involvement, LV involvement, unexplained syncope, or high-risk genotype.
• Long-QT syndrome with syncope and/or VT despite beta blocker therapy.
• Non-hospitalized patients awaiting cardiac transplantation.
• Brugada syndrome with syncope or documented VT.
• Arrhythmogenic polymorphic VT with syncope and/or documented sustained VT while receiving beta blockers.
• Cardiac sarcoidosis or giant cell myocarditis or Chagas disease, accompanied by clinically relevant arrhythmia.
• Long-QT syndrome and risk factors for SCD, including syncope despite drug therapy, family history of sudden cardiac death, concern regarding medication compliance or intolerance, or high-risk genotype.
• Syncope and advanced structural heart disease (including congenital) in which thorough invasive and noninvasive investigations have failed to define a cause.
• Familial cardiomyopathy associated with SCD.
• LV noncompaction.

CONTRAINDICATIONS FOR ICD IMPLANTATION:

• Patients with less than 1 year of expected survival, even if they otherwise meet ICD implantation criteria.
• Incessant VT or VF.
• Significant psychiatric illnesses that may be aggravated by device implantation or that may preclude systematic follow-up.
• NYHA Class IV symptoms with drug-refractory congestive heart failure and who are not eligible for cardiac transplantation, ventricular assist device, or CRT-D.
• Syncope of undetermined origin with no inducible ventricular tachyarrhythmias or structural heart disease.
• VF or VT amenable to surgical or catheter ablation (e.g., atrial arrhythmias associated with the Wolff-Parkinson-White syndrome, RV or LV outflow tract VT, idiopathic VT, or fascicular VT), in the absence of structural heart disease.
• Ventricular tachyarrhythmias due to a completely reversible disorder in the absence of structural heart disease (e.g., electrolyte imbalance, drugs, or trauma).

INDICATIONS FOR CARDIAC RESYNCHRONIZATION THERAPY (CRT):

• LVEF ≤ 35% and:
  o sinus rhythm with left bundle-branch block (LBBB) with a QRS duration ≥120 ms and NYHA class II, III, or ambulatory IV symptoms on Guideline-Directed Medical Therapy (GDMT).
  o sinus rhythm with a non-LBBB pattern with a QRS duration ≥120 ms and NYHA class III, or ambulatory class IV symptoms on GDMT.
  o sinus rhythm with a non-LBBB pattern with a QRS duration ≥150 ms and NYHA class II
  o atrial fibrillation if:
    ▪ the patient requires ventricular pacing or otherwise meets CRT criteria and
• AV nodal ablation or pharmacologic rate control will allow near 100% ventricular pacing with CRT.
  o planned new or replacement device placement and anticipated requirement for significant (40%) ventricular pacing.
• LVEF <30% and ischemic heart failure with sinus rhythm and LBBB with a QRS duration ≥150 ms and NYHA class I symptoms on GDMT.

CONTRAINDICATIONS FOR CARDIAC RESYNCHRONIZATION THERAPY (CRT):

• NYHA class I or II symptoms and non-LBBB pattern with QRS duration less than 150 ms.
• A projected survival of less than 1 year.

ADDITIONAL INFORMATION:

Implantable cardioverter defibrillators (ICDs) are indicated for the treatment of life-threatening ventricular tachycardia and ventricular fibrillation. An ICD system includes a pulse generator and one or more leads. ICDs are indicated both for patients who have survived life threatening rhythm disturbances (secondary prevention) and for those who are at risk for them (primary prevention).

• An ICD continually monitors heart rhythm. If a rapid rhythm is detected, the device delivers electrical therapy directly to the heart muscle in order to terminate the rapid rhythm and restore a normal heart rhythm. There are two types of therapy that can be delivered.
  o Rapid pacing, which is painless, is often effective in terminating ventricular tachycardia.
  o High-voltage shocks, which are painful to the patient, are necessary for ventricular fibrillation and also for instances where rapid pacing has failed to correct ventricular tachycardia.
• In addition, all ICDs have pacing capability, and they deliver pacing therapy for slow heart rhythms (bradycardia).
• The parameters defining limits for pacing therapy and for tachycardia therapy are programmable using noninvasive radio signals on all available ICDs.

• Waiting Period: An important issue in the timing of ICD insertion for primary prevention, which has garnered increasing attention recently, is the “waiting period” prior to ICD implantation for certain indications. This has resulted from guidelines and payment policies, predominantly on the part of CMS, which mirror the inclusion criteria of published primary and secondary prevention trials. For example, most primary prevention trials have excluded patients with recent coronary revascularization (under 90 days) or recent myocardial infarction (under 40 days). In addition, studies of patients who have received ICDs early after myocardial infarction have not demonstrated a mortality benefit.
  o A recent study of a large Medicare database, which received a great deal of media attention, concluded that over 20% of ICD insertions in the United States are “inappropriate”, predominantly due to violations of these waiting periods.
  o Most thought leaders and practicing clinicians feel that the waiting periods are largely reasonable and appropriate, but there are certain clinical scenarios in which following them reduces the quality of care and increases patient risk without any benefit. For example, a patient with a longstanding cardiomyopathy, who is a candidate for an ICD, might have a small non-revascularized non-ST-elevation Myocardial Infarction (STEMI). This patient’s LVEF will certainly not improve over the next 40 days, and withholding an ICD makes little sense.
  o This scenario would be rendered even more problematic if the patient required a pacemaker, since waiting 40 days to upgrade a pacemaker to an ICD would subject the patient (and payer) to two
procedures instead of one. Therefore, these guidelines will adhere to the current waiting periods but also provide an opportunity to request exemptions where patient benefit is clearly documented.

- **NYHA Class Definitions**:
  - Class I: No limitation of functional activity or only at levels of exertion that would limit normal individuals.
  - Class II: Slight limitation of activity. Dyspnea and fatigue with moderate exercise.
  - Class III: Marked limitation of activity. Dyspnea with minimal activity.
  - Class IV: Severe limitation of activity. Symptoms even at rest.

**ABBREVIATIONS**

- ARVD/C = Arrhythmogenic right ventricular dysplasia/cardiomyopathy
- AV = Atrioventricular
- CHF = Congestive heart failure
- CRT = Cardiac resynchronization therapy
- CRT-D = Cardiac resynchronization therapy ICD system
- DCM = Dilated cardiomyopathy
- EKG = Electrocardiogram
- EPS = Electrophysiologic Study
- GDMT = Guideline-Directed Medical Therapy
- HCM = Hypertrophic cardiomyopathy
- HRS = Heart Rhythm Society
- HV = His-ventricle
- ICD = Implantable cardioverter-defibrillator
- LBBB = Left bundle-branch block
- LV = Left ventricular/left ventricle
- LVEF = Left ventricular ejection fraction
- MI = Myocardial infarction
- MS = Milliseconds
- NYHA = New York Heart Association
- RV = Right ventricular/right ventricle
- STEMI = ST-elevation Myocardial Infarction
- SND = Sinus node dysfunction
- VT = Ventricular tachycardia
- VF = Ventricular fibrillation

**REFERENCES**


INTRODUCTION: This guideline is organized around seven clinical scenarios:

VIII. Suspected Coronary Artery Disease (CAD)
IX. Incompletely Evaluated CAD
X. Follow-up of Known Ischemic CAD
XI. CAD in Presence of Other New Cardiac Concerns
XII. Prior to Noncardiac Surgery
XIII. Prior to Cardiac Rehabilitation or Exercise Program
XIV. Post Cardiac Transplantation

This guideline is for stress imaging, specifically myocardial perfusion imaging (MPI), with appropriate preference for suitable alternatives, such as stress echocardiography (stress echo) or stress EKG alone, when more suitable, using the following stream of logic:

- A stress EKG alone is often appropriate. A baseline EKG which does not allow interpretation of ischemic findings with exercise will sometimes, but not always, require the addition of stress imaging.

- When stress imaging is appropriate, as an addition to stress EKG alone, stress echo is preferred when the patient is able to exercise, MPI when the patient cannot exercise. This document does not endorse dobutamine echocardiography for pragmatic reasons.

- When stress echo is precluded by specific imaging difficulties (e.g. poor quality image despite contrast medium, uncontrolled atrial fibrillation, ventricular paced rhythm, baseline wall motion abnormalities, etc., as listed in the Additional Information section), then MPI is preferable.

Compelling indications (e.g. ACC Class I or IIA or Appropriate Use Criteria ‘A’) for stress imaging (MPI and echo) are the foundation, and the less compelling indications (IIB or ‘M’) have been selected as appropriate for those scenarios in which the clinical presentation incurs high risk. If a patient fits two or more clinical scenarios, the scenario which endorses stress imaging (MPI or echo) supersedes any category which does not.

Issues such as pretest probability, global risk of coronary or cardiovascular disease, anginal equivalent, aspects of different types of stress testing, etc. are discussed in the Additional Information section at the end of this document, and the reader is encouraged to refer to that section, in order to optimally utilize this guideline.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR STRESS IMAGING (MPI or ECHO) BY CLINICAL SCENARIO

VI. SUSPECTED (CAD):
High Global Risk asymptomatic OR
Stable symptomatic OR
Low risk “unstable” symptomatic (Tables 6 & 7)

- SYMPTOMATIC: LOW PRETEST PROBABILITY patients should undergo a treadmill exercise stress EKG alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG.

- SYMPTOMATIC: INTERMEDIATE OR HIGH PRETEST PROBABILITY patients are appropriate for stress imaging (MPI or echo).

- REPEAT STRESS TESTING FOR SIMILAR SYMPTOMS AND SAME PRETEST PROBABILITY should not be performed for at least 5 years following prior stress testing or invasive coronary arteriography, unless there has been a change in clinical presentation.

- ASYMPTOMATIC HIGH GLOBAL RISK (>20% coronary or vascular event rate over ensuing 10 years) based upon a COMPELLING HISTORY, such as patients with peripheral arterial disease (defined in additional information), cerebrovascular disease (history of stroke or TIA), or multiple simultaneous anti-rejection medications (e.g. cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine, long term supraphysiologic doses of glucocorticoids, but not everolimus or sirolimus/rapamycin), should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG.

- ASYMPTOMATIC HIGH GLOBAL RISK (>20% coronary or vascular event rate over ensuing 10 years, based upon Framingham-ATP IV, Reynolds, Pooled Cohort Equation (includes cerebrovascular risk), ACC/AHA Risk Calculator, MESA Risk Calculator (includes calcium score), or very similar risk calculator) or based upon COMPELLING NON-INVASIVE DATA, such as clearly pathologic Q waves on the EKG, marked ST-segment and/or T wave abnormalities of myocardial ischemia without symptoms, clear regional wall motion abnormalities of the left ventricle, or reduced ejection fraction below 50%, should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG. (Patients with ejection fraction < 50%, with contraindication to invasive coronary arteriography, are reasonable candidates for stress imaging (MPI or echo).

- REPEAT EKG STRESS TEST ALONE OF ASYMPTOMATIC HIGH GLOBAL RISK patients (as described in the 2 bullets immediately above), whose last invasive or non-invasive test was over two years ago and was negative for hemodynamically significant obstructive coronary artery disease (i.e. no ischemia on stress testing, no Fractional Flow Reserve (FFR) <= 0.80 for a major vessel, or no angiographic stenosis >70% for a major vessel), is reasonable.

- HIGH OCCUPATIONAL RISK patients (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or HIGH PERSONAL RISK patients (e.g. scuba divers, etc.), should be assessed with EKG STRESS TEST alone, with stress imaging (MPI or echo) reserved only for those unable to exercise OR with an uninterpretable EKG. Determinations for screening of asymptomatic patients (without known coronary artery disease) in high-risk occupations should be deferred to those agencies that manage such non-medical necessity.

VII. INCOMPLETELY EVALUATED CAD:
Requires further evaluation within 2 years of a prior coronary evaluation for CLARIFICATION OF DIAGNOSIS OR DISEASE SEVERITY

- NORMAL EXERCISE STRESS TEST EKG within the past 2 years and currently compelling coronary history or symptoms should be considered appropriate indication for a repeat stress test with imaging (MPI or echocardiogram), particularly if there are reasons to avoid cardiac catheterization (CKD, dye allergy, etc.), unless invasive coronary arteriography is strongly indicated (e.g. compelling presentation of moderate or high risk unstable angina).

- ABNORMAL OR INDETERMINATE EXERCISE STRESS EKG or CCTA (coronary computed tomographic angiography) within the past 2 years, for whom a noninvasive approach is preferable to proceeding to invasive coronary arteriography (unclear nature of symptoms, mildly abnormal or borderline EKG stress test or CCTA, CKD, dye allergy, etc.), is an appropriate indication for stress imaging (MPI or echo).

- A WELL DOCUMENTED MYOCARDIAL INFARCTION OR moderate to high risk ACUTE CORONARY SYNDROME WITHIN THE PAST 2 YEARS, when stable, without subsequent stress imaging of invasive coronary arteriography, can be appropriate for stress imaging, especially when a non-invasive approach is documented to be preferable to invasive coronary arteriography.

- SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT, in order to assist with the management strategy, in patients with prior invasive coronary arteriography within the past 2 years and unclear lesional significance, is an appropriate indication for stress imaging (MPI or echo), if it will affect management.

VIII. FOLLOW-UP of KNOWN ISCHEMIC CAD:

D. In need of FOLLOW-UP TESTING for known ischemic coronary artery disease, either ASYMPTOMATIC OR WITH STABLE symptoms

ROUTINE FOLLOW-UP when last invasive or non-invasive assessment of coronary artery disease showed HEMODYNAMICALLY SIGNIFICANT CAD (ischemia on stress test or FFR <= 0.80 for a major vessel or stenosis >=70% of a major vessel) over two years ago, without supervening coronary revascularization, is an appropriate indication for stress imaging (MPI or echo) in patients with high risk clinical scenarios, such as left ventricular dysfunction (ejection fraction less than 50%) or severe unrevascularized multivessel CAD (if it will alter management), OR in patients with HIGH RISK OCCUPATIONS (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or a HIGH PERSONAL RISK (e.g. scuba divers, etc.).

- SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT, in order to assist with the management strategy, in patients with recent invasive coronary arteriography AND suspected residual ischemia post incomplete coronary revascularization, is an appropriate indication for stress imaging (MPI or echo), if it will affect management.

- MYOCARDIAL VIABILITY TESTING BY REST MYOCARDIAL PERFUSION IMAGING prior to coronary revascularization is reasonable in patients with ejection fraction less than or equal to 50%, if it could significantly alter the revascularization strategy.
E. NEW, RECURRENT, OR WORSENING (PROGRESSIVE) SYMPTOMS in patients with known ischemic CAD (ischemia on stress testing, lesion stenosis $\geq 70\%$, or FFR $\leq 0.80$), which has not been revascularized.

- PRIOR LOW RISK CORONARY EVALUATION AT LEAST TWO YEARS EARLIER (e.g. limited extent of CORONARY ARTERY DISEASE, $<5\%$ myocardium at risk), AND NOW WITH NEW STABLE (or low risk unstable), RECURRENT, OR SLOWLY WORSENING (PROGRESSIVE) SYMPTOMS of coronary ischemia, is an appropriate indication for stress imaging (MPI or echo) in this patient group. However, regardless of timing of prior non-invasive assessment, clinical documentation of continued problematic symptoms or moderate to highly likely acute coronary syndrome (Table 6) of even low mortality risk (Table 7) is often better assessed with invasive coronary arteriography, particularly when stress testing in the last 2 years and current clinical findings are at odds. This category is very documentation-sensitive and requires judgment.

- INVASIVE CORONARY ARTERIOGRAPHY IS GENERALLY PREFERABLE in those patients, who have a PRIOR MODERATE OR HIGH RISK STRESS TEST RESULT (especially if NOT previously evaluated by invasive coronary arteriography) or a current diagnosis of moderate to high risk UNSTABLE ANGINA, and inappropriate for repeat stress imaging (MPI or echo), unless supervening reasons to prefer a non-invasive approach are documented in the record (e.g. very unclear symptoms, CKD, dye allergy, etc.), and it could alter management.

F. FOLLOW-UP OF PATIENTS POST CORONARY REVASCULARIZATION

- ASYMPTOMATIC, ROUTINE FOLLOW-UP, STRESS IMAGING (MPI OR ECHO) at a minimum of 2 YEARS post coronary artery bypass grafting or 2 YEARS post percutaneous coronary intervention (whichever was the latter) is appropriate only for patients with high direct CORONARY-related risk, such as incomplete coronary revascularization with feasible additional revascularization of residual severe multivessel disease, need for otherwise unevaluated follow up of stenting of unprotected left main coronary artery (LM) disease or left ventricular dysfunction (ejection fraction less than 50%), 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) or HIGH PERSONAL RISK (e.g. scuba divers, etc.),

- NEW, RECURRENT, OR WORSENING SYMPTOMS POST CORONARY REVASCULARIZATION, with good documentation, are an indication for stress imaging (MPI or echo) if it could affect management.

IX. CAD IN PRESENCE OF OTHER NEW CARDIAC CONCERNS

- NON-CORONARY CARDIAC DIAGNOSES support use of stress imaging (MPI or echo) in newly diagnosed systolic or diastolic heart failure, sustained VT (> 100 bpm), VF, exercise induced VT or nonsustained VT, frequent PVCs (over 30 per hour), and/or required initiation of antiarrhythmic drug (AAD) therapy when invasive coronary arteriography is not necessarily indicated.

- NEW ONSET ATRIAL FIBRILLATION, in patients with coronary artery disease and/or moderate or high global risk, are candidates for stress imaging if there has been no coronary evaluation by stress imaging or invasive coronary arteriography within the preceding two years.
• **LEFT BUNDLE BRANCH BLOCK**, when the history, physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress imaging (MPI or echo).

• **EKG STRESS TESTING** without imaging is reasonable for **EVALUATION OF EXERCISE-INDUCED ARRHYTHMIA** (or long QT interval evaluation when the resting QTc is normal), when coronary artery disease is not suspected.

• **EXERCISE HEMODYNAMICS** can be obtained with Stress echocardiography with Doppler when it will affect management.

• **KAWASAKI DISEASE** long-term surveillance is better performed with CCTA, which includes aneurysm assessment.

X. **Prior to NONCARDIAC SURGERY**

• **THORACOABDOMINAL AORTIC VASCULAR SURGERY** is an indication for **PREOPERATIVE STRESS IMAGING** (MPI or echo) if the patient has less than a 4 MET (see Additional Information section) exercise functionality, AND that patient has at least one **OPERATIVE clinical risk factor from the list**: ischemic coronary artery disease (by study more than two years ago with lesions, which are: >=70% or ischemia producing on prior stress testing or with FFR <=0.80), cerebrovascular disease, insulin-requiring diabetes mellitus, history of congestive heart failure or ejection fraction less than 40%, or CKD with creatinine >= 2 mg/dl. (Such stress imaging is restricted to patients who have not had either stress imaging or invasive coronary arteriography within the past year.) **If invasive coronary arteriography is preferable, then preoperative stress imaging is not appropriate.**

• **UNRELATED TO THE PLANNED SURGICAL PROCEDURE,** stress imaging might be indicated for other reasons at the time patients are seen for preoperative cardiac risk evaluation. When such indications for stress imaging are **unrelated to the need for the intended non-cardiac surgery,** then the **record must document** those reasons in order to support proceeding with appropriate stress imaging (MPI or echo).

• **BARIATRIC SURGERY** is not considered an indication for preoperative stress testing.

• **SOLID ORGAN TRANSPLANTATION** is an indication for preoperative stress imaging (MPI or echo) if: invasive coronary arteriography is not intended as the initial preoperative evaluation of choice, AND there has not been an adequate coronary evaluation within the past year.

VI. **Prior to CARDIAC REHABILITATION or EXERCISE PROGRAM**

• **CARDIAC REHABILITATION ENTRY or DETERMINATION OF EXERCISE CAPACITY** is an indication for stress testing with **EKG alone,** when performed as part of the cardiac rehabilitation program or for purposes of exercise prescription.

VII. **Post CARDIAC TRANSPLANTATION**
• **During the first five years post cardiac transplantation**, patients with glomerular filtration rates less than 40 mL/min/1.73 sq M, or who otherwise should not undergo invasive coronary arteriography every 1-2 years, are appropriate for stress imaging (MPI or echo) every 1-2 years.

• **After the first five years post cardiac transplantation**, in lieu of invasive coronary arteriography:
  1) **patients considered at low risk for transplant vasculopathy** (i.e., with normal invasive coronary arteriography) can have annual stress imaging (MPI or echo), and
  2) **patients with transplant coronary vasculopathy** can have annual stress imaging (MPI or echo), if the risk of annual invasive coronary arteriography is not acceptable (i.e., high risk of contrast nephropathy).

**ADDITIONAL INFORMATION:**

**Definitions of Coronary Artery Disease:**

7. Percentage stenosis refers to diameter stenosis when angiography is the method and refers to cross sectional narrowing when IVUS (intravascular ultrasound) is the method of determination.

8. 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 (similar to an ankle brachia index, family history of coronary artery disease, or high sensitivity C-reactive protein). Its incorporation into Global Risk can be achieved by using the MESA risk calculator.

9. Stenoses less than 50% are considered nonobstructive coronary artery disease, while stenoses of 50% or more are considered obstructive coronary artery disease. However, the contents of this Guideline are very clear about specifying that **ischemic heart disease** requires one of three possible determinants:
   i. Percentage stenosis of at least 70% - by angiography or IVUS (intravascular ultrasound), as described above, for a major vessel
   ii. FFR (fractional flow reserve) of 0.80 or less for a major vessel
   iii. Demonstrable ischemic findings on stress testing (acceptable EKG or imaging), that are at least mild in degree

10. A major vessel would be a coronary vessel that would typically be substantial enough for revascularization, if it were indicated. Lesser forms of coronary artery disease would be labeled as “limited.” (i.e. A 50% lesion in a tiny septal would be limited obstructive coronary artery disease.)

11. 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.

12. 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 reduction in coronary flow.

**Definition of Peripheral Arterial Disease/Cerebrovascular Disease:**

Non-coronary arterial narrowing causing symptoms (claudication, related tissue demise, threatened limb loss), asymptomatic 70% or more narrowing by non-invasive or invasive evaluation, atherosclerotic arterial aneurysm by non-invasive or invasive evaluation, or aortic atheroma of at least 4 mm thickness. As a subset of peripheral arterial disease, cerebrovascular disease is also defined as a history of stroke or TIA.

**What is a valid anginal equivalent?**
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, etc.), 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 by itself is generally not considered an anginal equivalent, and is handled under a separate category in this guideline.

**Pretest Probability of CAD for Symptomatic Patients:**

Pretest probability is a reference to symptoms that need evaluation as potentially coronary in origin.

- **Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- **Atypical Angina (Probable):** Chest pain or discomfort that lacks 1 of the characteristics of definite or typical angina.
- **Nonanginal Chest Pain:** Chest pain or discomfort that meets 1 or none of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

- **Very low:** Less than 5% pretest probability of CAD
- **Low:** Less than 10% pretest probability of CAD
- **Intermediate:** Between 10% and 90% pretest probability of CAD
- **High:** Greater than 90% pretest probability of CAD

**Global Risk of CAD or Vascular Disease**

Global risk of CAD is defined as the probability of developing CAD, including myocardial infarction or CAD death over a given time period and refers to asymptomatic patients without known coronary artery disease. It should be determined by the Framingham Risk Score (ATP IV risk tool), the Reynolds Risk Index, or the Pooled Cohort Equation (which includes cerebrovascular risk). A high risk is considered greater than a 20% risk of a coronary or major vascular event over the ensuing 10 years.

- **CAD Risk—Low**
  Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk less than 10%.
• **CAD Risk—Moderate**
  Defined by the age-specific risk level that is average or above average. In general, moderate risk will correlate with a 10-year absolute CAD risk between 10% and 20%.

• **CAD Risk—High**
  Defined as the presence of peripheral arterial disease, cerebrovascular disease, or a 10-year absolute CAD risk of greater than 20%.

**Duke Treadmill Score**

The equation for calculating the Duke treadmill score (DTS) is,

\[
DTS = \text{exercise time in minutes} - (5 \times \text{ST deviation in mm or 0.1 mV increments}) - (4 \times \text{exercise angina score}),
\]

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 \(\geq +5\)), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of \(\leq -11\)) categories.

**What Type of Stress Test is Appropriate?**

**EKG Stress Test versus Stress Echocardiography versus Stress Myocardial Perfusion Imaging**

Appropriate resource utilization, cost effectiveness, and radiation exposure limitation dictate choices in stress testing options.

Five prominent scenarios for an EKG stress test WITHOUT imaging (i.e. exercise treadmill EKG test) are endorsed by the guidelines presented above, often (but not always) requiring that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable EKG for ischemia during exercise:

- The (symptomatic) low pretest probability patient who is able to exercise and has an interpretable EKG
- The (asymptomatic) high global risk patient who is able to exercise and has an interpretable EKG
- The patient who is under evaluation for exercise induced arrhythmia (or long QT interval evaluation when the resting QTc is normal), and coronary artery disease is not suspected
- The patient who requires an entrance stress test EKG for a cardiac rehab program or for an exercise prescription

An uninterpretable baseline EKG includes:

- Abnormalities of ST segment depression of 0.1 mV (1 mm with conventional calibration) or more
- Ischemic looking T wave inversions of at least 0.25 mV (2.5 mm with conventional calibration)
- EKG findings of probable or definite LVH, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use or hypokalemia
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload (e.g. rate-pressure product less than 20-25K)
- Prior false positive stress EKG

Exercise remains a valid stressor:

- In patients who can exercise to near maximal heart rate
- For entrance to cardiac rehabilitation or determination of an exercise prescription
- For exercise induced arrhythmia evaluation
• Even with an uninterpretable EKG if stress imaging is appropriate and EKG un-interpretability is acknowledged

Scenarios for choosing stress echocardiography over myocardial perfusion imaging:

• The patient can exercise to near maximal heart rate for at least 3 minutes of Bruce protocol and has an interpretable echocardiogram, with usage of contrast medium if necessary to enable quality imaging

AND

There is normal baseline systolic function, without moderately severe or severe valvular disease. Stress echocardiography with Doppler is appropriate in the patient for whom determination of exercise hemodynamics is required.

• Exercise Doppler with hemodynamics is the main reason for stress testing.

When is Myocardial Perfusion Imaging Preferred Over Stress Echocardiography?
There are circumstances in which myocardial perfusion imaging is generally preferable to stress echocardiography:

• BMI >/= 40
• Ventricular paced rhythm, LBBB, WPW
• Frequent PVCs interfering with wall motion assessment
• Prior coronary artery bypass grafting with resultant paradoxical septal motion
• Currently in poorly controlled atrial fibrillation
• Poor cardiac window on echo (documented on echo report as technically limited or difficult, without likely benefit of contrast medium)
• Documented regional wall motion abnormality: dyskinesia, akinesia, or hypokinesia
• Unable to perform ADL’s with documented extent of limitations
• Functional capacity <4 METS or < 3’ Bruce protocol
• Arthritis with documented limitations
• Leg/foot amputation
• Active foot wound/ulcer
• Ambulation requires cane or walker
• Confinement to a wheelchair
• Severe chronic obstructive pulmonary disease (based upon PFT findings), severe dyspnea on exertion, or requirement for home oxygen use
• Systolic congestive heart failure with ejection fraction <40%
• Recent orthopedic surgery limiting use of a lower extremity

Determinants of a 4 MET functional capacity:
Examples of activities:

<4 METs: Slow ballroom dancing, golfing with a cart, playing a musical instrument, and walking at approximately 2 mph to 3 mph

>4 METs: Climbing a flight of stairs or walking up a hill, walking on level ground at 4 mph, and performing heavy work around the house
**Tools for Characterization of Unstable Angina:**

Risk Stratification in Acute Coronary Syndrome from 2007 ACC/AHA Guidelines

Three Principal Presentations of Unstable Angina (as defined within a two week time frame) (Braunwald)

<table>
<thead>
<tr>
<th>Class</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest angina*</td>
<td>Angina occurring at rest and prolonged, usually greater than 20 min</td>
</tr>
<tr>
<td>New-onset angina</td>
<td>New-onset angina of at least CCS class III severity</td>
</tr>
<tr>
<td>Increasing angina</td>
<td>Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by 1 or more CCS class to at least CCS class III severity)</td>
</tr>
</tbody>
</table>

Table 6: Likelihood that Symptoms Represent an Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Chest or left arm pain or discomfort as chief symptom</td>
<td>Absence of high-likehood features and presence of any of the following:</td>
<td>Probable ischemic symptoms in absence of any of the intermediate likelihood characteristics</td>
</tr>
<tr>
<td>Known History of CAD, including MI</td>
<td>Age greater than 70 years</td>
<td>Diabetes mellitus</td>
<td>Recent cocaine use</td>
</tr>
<tr>
<td>Examination</td>
<td>Transient MR murmur, hypotension, diaphoresis, pulmonary edema, or rales</td>
<td>Extracardiac vascular disease</td>
<td>Chest discomfort reproduced by palpation</td>
</tr>
<tr>
<td>EDG</td>
<td>New, or presumably new, transient ST-segment deviation (1 mm or greater) or T-wave inversion in multiple precordial leads</td>
<td>Fixed Q waves</td>
<td>T-wave flattening or inversion less than 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated cardiac TnI, TnT, or CK-MB</td>
<td>ST depression 0.5 to 1 mm or T-wave inversion greater than 1 mm</td>
<td>Normal EKG</td>
</tr>
</tbody>
</table>


ACOS — acute coronary syndrome; CAD — coronary artery disease; CK-MB — MB fraction of creatinine kinases; EKG — electrocardiogram; MI — myocardial infarction; MR — mitral regurgitation; TnI — troponin I; TnT — troponin T.

Table 7: Short Term Risk of Death or Nonfatal MI in Acute Coronary Syndrome
The TIMI Risk Score is determined by the sum of the presence of 7 variables at admission: 1 point is given for each of the following variables: age ≥65 years, at least 3 risk factors for CAD, prior coronary stenosis of ≥50%, ST-segment deviation on ECG presentation, at least 2 anginal events in prior 24 hours, use of aspirin in prior 7 days, and elevated serum cardiac biomarkers.

**Low-Risk TIMI Score:** TIMI score <2;  **High-Risk TIMI Score:** TIMI score ≥2. A low risk TIMI score might still warrant invasive coronary arteriography, when other features, such as symptoms, are compelling.

**Abbreviations:**

- AAD: antiarrhythmic drug
- ADLs: activities of daily living
- CAD: coronary artery disease
- CCS: Canadian Cardiovascular Society
- CKD: chronic kidney disease
- EKG: electrocardiogram
- FFR: fractional flow reserve
- LBBB: left bundle-branch block
- LVH: left ventricular hypertrophy
- MI: myocardial infarction
- MET: estimated metabolic equivalent of exercise
- PFT: pulmonary function test
- PVCs: premature ventricular contractions
- TIMI: Thrombolysis in Myocardial Infarction (Study Group)
- WPW: Wolf Parkinson White
REFERENCES

General References


References for cardiovascular risk:
(Also see links to Online Calculators at end of Reference Section)


NIH Estimate of 10 Year coronary artery disease risk from Framingham Risk Score:


References for High Occupational Risk

ACC/AHA/ASNC Guidelines for the Clinical Use of Cardiac Radionuclide Imaging – Executive Summary.


Reference for peri-operative risk


Reference for unstable angina risk


Reference for indications for cardiac catheterization/ invasive coronary arteriography:

Rhythm Society, Society of Critical Care Medicine, Society of CardiovascularComputed Tomography, 
http://content.onlinejacc.org/article.aspx?articleid=1182705

Reference for bariatric surgery risk

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Reference for number of PVCs

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http://circ.ahajournals.org/content/5/1/229.full

Reference for syncope

and management of syncope. Task Force for the Diagnosis and Management of Syncope. Eur Heart J 

Reference for left bundle branch block

Sauer et al, Left Bundle Branch Block. Up to Date, November 4, 2014. 

Reference for right bundle branch block

Fernandez-Lozano I., Brugada J. (2013) Right Bundle Branch Block: Are We Looking in the Right 

Referenced for police, fireman, pilots, etc.

Gibbons RJ., Balady GJ., Beasley JW., Bricker TJ., Duvernoy WF.,Froelicher VF., Mark DB. (1997) ACC/ 
AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart 
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Significance of Exercise-Induced Atrial Arrhythmia. JACC, Vol. 43, No. 7, 2004, 1236-1240 

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http://circ.ahajournals.org/content/124/20/2181.long


Reference for Cardiac Transplantation Patients

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http://www.uptodate.com/contents/diagnosis-and-prognosis-of-cardiac-allograft-vasculopathy?source=machineLearning&search=transplant+vasculopathy+follow+up&selectedTitle=1%7E150&sectionRank=1&anchor=H12357202#H12357202

Reference for Microvascular Coronary Disease


Reference for Kawasaki Disease


Reference for Anti-rejection Medication and Vascular Disease

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2810018/

Links to Cardiac/Vascular Risk Online Calculators:

Framingham-ATP IV: http://cvdrisk.nhlbi.nih.gov/

Reynolds Risk Score: http://www.reyoldsriskscore.org/

Pooled Cohort Equation (includes cardiac and cerebrovascular risk): http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator (includes cardiac and cerebrovascular risk):
http://tools.acc.org/ASCVD-Risk-Estimator/

MESA Risk Calculator with addition of Coronary Artery Calcium Score:
https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx
CPT Codes: 93350, 93351, + 93352

INTRODUCTION: This guideline is organized around eight clinical scenarios:

I. Suspected Coronary Artery Disease (CAD)
II. Incompletely Evaluated CAD
III. Follow-up of Known Ischemic CAD
IV. CAD in Presence of Other New Cardiac Concerns
V. Chronic Valvular Disease and Pulmonary Hypertension
VI. Prior to Noncardiac Surgery
VII. Prior to Cardiac Rehabilitation or Exercise Program
VIII. Post Cardiac Transplantation

This guideline is for stress imaging, specifically stress echocardiography, with exercise or dobutamine, with appropriate preference for suitable alternatives, such as stress EKG alone or stress testing with myocardial perfusion imaging, when more suitable, using the following stream of logic:

• A stress EKG alone is often appropriate. A baseline EKG, which does not allow interpretation of ischemic findings with exercise, will sometimes, but not always, require the addition of stress imaging (echo or MPI).

• When stress imaging is appropriate, as an addition to stress EKG alone, stress echo is preferred when the patient is able to exercise, MPI when the patient cannot exercise. This document does not actively endorse dobutamine echocardiography as a recommended alternative to stress myocardial perfusion imaging for pragmatic reasons, but dobutamine echocardiography can certainly be an acceptable alternative to stress myocardial perfusion imaging when preferred by the clinical provider.

• When stress echo is precluded by specific imaging difficulties (e.g. poor quality image despite contrast medium, uncontrolled atrial fibrillation, ventricular paced rhythm, baseline wall motion abnormalities, etc., as listed in the Additional Information section), then MPI is referred to as the preferable or default strategy.

• Echocardiographic contrast medium is appropriate for those studies in which at least 2 contiguous myocardial segments (of the 16 ACC/AHA myocardial segments) are not visible on the study.

• Hemodynamic assessment can be a reason for preference of stress echocardiography over alternative stress testing.

Compelling indications (e.g. ACC Class I or IIA or Appropriate Use Criteria ‘A’) for stress imaging (echo and MPI) are the foundation, and the less compelling indications (IIB or ‘M’) have been selected as appropriate for those scenarios in which the clinical presentation incurs high risk. If a patient fits two or more clinical scenarios, the scenario which endorses stress echo (MPI only if the default) supersedes any category which does not.
Issues such as pretest probability, global risk of coronary or cardiovascular disease, anginal equivalent, aspects of different types of stress testing, etc. are discussed in the Additional Information section at the end of this document, and the reader is encouraged to refer to that section, in order to optimally utilize this guideline.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR STRESS ECHO (MPI only if the default) BY CLINICAL SCENARIO

I. SUSPECTED (CAD):
   High Global Risk asymptomatic OR
   Stable symptomatic OR
   Low risk “unstable” symptomatic (Tables 6 & 7)

- SYMPTOMATIC: LOW PRETEST PROBABILITY patients should undergo a treadmill exercise stress EKG alone, with stress echocardiography reserved for those whose EKG is uninterpretable. (MPI is to be chosen only when it is the default strategy.)

- SYMPTOMATIC: INTERMEDIATE OR HIGH PRETEST PROBABILITY patients are appropriate for stress echo (or MPI if it is the default strategy).

- REPEAT STRESS TESTING FOR SIMILAR SYMPTOMS AND SAME PRETEST PROBABILITY should not be performed for at least 5 years following prior stress testing or invasive coronary arteriography, unless there has been a change in clinical presentation.

- ASYMPTOMATIC HIGH GLOBAL RISK (>20% coronary or vascular event rate over ensuing 10 years, based upon Framingham-ATP IV, Reynolds, Pooled Cohort Equation (includes cerebrovascular risk), ACC/AHA Risk Calculator, MESA Risk Calculator (includes calcium score), or very similar risk calculator) or based upon COMPELLING NON-INVASIVE DATA, such as clearly pathologic Q waves on the EKG, marked ST-segment and/or T wave abnormalities of myocardial ischemia without symptoms, clear regional wall motion abnormalities of the left ventricle, or reduced ejection fraction below 50%, should be assessed with EKG STRESS TEST alone, with stress echocardiography reserved for those whose EKG is uninterpretable. (Patients with ejection fraction < 50%, with contraindication to invasive coronary arteriography, are reasonable candidates for stress echocardiogram, with MPI used only if it is the default strategy, e.g. segmental wall motion abnormality, ejection fraction < 40%, unable to exercise, etc.). Patients taking multiple simultaneous anti-rejection medications (e.g. cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine, long term supraphysiologic doses of glucocorticoids, but not everolimus or sirolimus/rapamycin), should be assessed with EKG STRESS TEST alone, with stress echocardiography reserved for those whose EKG is uninterpretable. (MPI is to be chosen only when it is the default strategy.)

- REPEAT EKG STRESS TEST ALONE OF ASYMPTOMATIC HIGH GLOBAL RISK patients (as described in the 2 bullets immediately above), whose last invasive or non-invasive test was over two years ago and was negative for hemodynamically significant obstructive coronary artery disease (i.e. no ischemia on stress testing, no Fractional Flow Reserve (FFR) <= 0.80 for a major vessel, or no angiographic stenosis >70% for a major vessel), is reasonable.
• **HIGH OCCUPATIONAL RISK patients** (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or **HIGH PERSONAL RISK** patients (e.g. scuba divers, etc.), should be assessed with **EKG STRESS TEST** alone, with stress echocardiography reserved for those whose EKG is uninterpretable. (MPI is to be chosen only when it is the **default** strategy.) Determinations for screening of asymptomatic patients (without known coronary artery disease) in high-risk occupations should be deferred to those agencies that manage such non-medical necessity.

II. **INCOMPLETELY EVALUATED CAD:**
Requires further evaluation within 2 years of a prior coronary evaluation for **CLARIFICATION OF DIAGNOSIS OR DISEASE SEVERITY**

• **NORMAL EXERCISE STRESS TEST EKG** within the past 2 years and currently compelling coronary history or symptoms should be considered appropriate indication for a repeat stress test with stress echocardiography (or MPI if it is the **default** strategy), particularly if there are reasons to avoid cardiac catheterization (CKD, dye allergy, etc.), unless invasive coronary arteriography is strongly indicated (e.g. compelling presentation of moderate or high risk unstable angina).

• **ABNORMAL OR INDETERMINATE EXERCISE STRESS EKG** or **CCTA (coronary computed tomographic angiography) within the past 2 years,** for whom a noninvasive approach is preferable to proceeding to invasive coronary arteriography (unclear nature of symptoms, mildly abnormal or borderline EKG stress test or CCTA, CKD, dye allergy, etc.), is an appropriate indication for stress echocardiography (or MPI only if it is the **default** strategy).  

• **A WELL DOCUMENTED MYOCARDIAL INFARCTION OR moderate to high risk ACUTE CORONARY SYNDROME WITHIN THE PAST 2 YEARS,** when stable, without subsequent stress imaging or invasive coronary arteriography, can be appropriate for stress echocardiography, (MPI only if it is the **default** strategy), especially when a non-invasive approach is documented to be preferable to invasive coronary arteriography.

• **SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT,** in order to assist with the management strategy, in patients with prior invasive coronary arteriography **within the past 2 years** and unclear lesional significance, is an appropriate indication for stress echo (MPI only if it is the **default** strategy), if it will affect management.

III. **FOLLOW-UP of KNOWN ISCHEMIC CAD:**

G. In need of **FOLLOW-UP TESTING** for known ischemic coronary artery disease, either **ASYMPTOMATIC OR WITH STABLE symptoms**

• **ROUTINE FOLLOW-UP** when last invasive or non-invasive assessment of coronary artery disease showed **HEMODYNAMICALLY SIGNIFICANT CAD** (ischemia on stress test or FFR <= 0.80 for a major vessel or stenosis >=70% of a major vessel) over two years ago, without supervening coronary revascularization, is an appropriate indication for stress echocardiography (MPI only if it is the **default** strategy) in **patients with high risk clinical scenarios,** such as left ventricular dysfunction (ejection fraction less than 50%) or severe un-revascularized multivessel CAD (if it will alter management), OR in **patients with HIGH RISK OCCUPATIONS** (e.g. associated with public
safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) or a HIGH PERSONAL RISK (e.g. scuba divers, etc.).

- **SEVERITY/EXTENT OF ISCHEMIA ASSESSMENT**, in order to assist with the management strategy, in patients with recent invasive coronary arteriography AND suspected residual ischemia post incomplete coronary revascularization, is an appropriate indication for stress echo (MPI only if it is the default strategy), if it will affect management.

- **MYOCARDIAL VIABILITY TESTING BY Dobutamine Stress Echocardiography** (myocardial perfusion imaging at rest is equally suitable), prior to coronary revascularization is reasonable in patients with ejection fraction less than or equal to 50%, if it could significantly alter the revascularization strategy.

  **H. NEW, RECURRENT, OR WORSENING (PROGRESSIVE) SYMPTOMS** in patients with known ischemic CAD (ischemia on stress testing, lesion stenosis >=70%, or FFR <=0.80), which has not been revascularized.

  - **PRIOR LOW RISK CORONARY EVALUATION AT LEAST TWO YEARS EARLIER** (e.g. limited extent of CORONARY ARTERY DISEASE, <5% myocardium at risk), AND NOW WITH NEW STABLE (or low risk unstable), RECURRENT, OR SLOWLY WORSENING (PROGRESSIVE) SYMPTOMS of coronary ischemia, is an appropriate indication for stress echo (MPI only if it is the default strategy) in this patient group. However, regardless of timing of prior non-invasive assessment, clinical documentation of continued problematic symptoms or moderate to highly likely acute coronary syndrome (Table 6) of even low mortality risk (Table 7) is often better assessed with invasive coronary arteriography, particularly when stress testing in the last 2 years and current clinical findings are at odds. This category is very documentation-sensitive and requires judgment.

  - **INVASIVE CORONARY ARTERIOGRAPHY IS GENERALLY PREFERABLE** in those patients, who have a PRIOR MODERATE OR HIGH RISK STRESS TEST RESULT (especially if NOT previously evaluated by invasive coronary arteriography) or a current diagnosis of moderate to high risk UNSTABLE ANGINA, and inappropriate for repeat stress echo (or MYOCARDIAL PERFUSION IMAGING when it is the default strategy), unless supervening reasons to prefer a non-invasive approach are documented in the record (e.g. very unclear symptoms, CKD, dye allergy, etc.), and it could alter management.

**I. FOLLOW-UP OF PATIENTS POST CORONARY REVASCULARIZATION**

- **ASYMPTOMATIC, ROUTINE FOLLOW-UP**, stress echocardiography (MPIx only if it is the default strategy) at a minimum of 2 YEARS post coronary artery bypass grafting or 2 YEARS post percutaneous coronary intervention (whichever was the latter) is appropriate only for patients with high direct CORONARY-related risk, such as incomplete coronary revascularization with feasible additional revascularization of residual severe multivessel disease, need for otherwise unevaluated follow up of stenting of unprotected left main coronary artery (LM) disease or left ventricular dysfunction (ejection fraction less than 50%), 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) or HIGH PERSONAL RISK (e.g. scuba divers, etc.).
NEW, RECURRENT, OR WORSENING SYMPTOMS POST CORONARY REVASCULARIZATION, with good documentation, are an indication for stress echocardiography (MPI only if it is the default strategy) if it could affect management.

IV. CAD IN PRESENCE OF OTHER NEW CARDIAC CONCERNS

- NON-CORONARY CARDIAC DIAGNOSES support use of stress echocardiography (MPI only if it is the default strategy) in newly diagnosed systolic or diastolic heart failure, sustained VT (> 100 bpm), VF, exercise induced VT or nonsustained VT, frequent PVCs (over 30 per hour), and/or required initiation of antiarrhythmic drug (AAD) therapy when invasive coronary arteriography is not necessarily indicated.

- NEW ONSET ATRIAL FIBRILLATION, in patients with coronary artery disease and/or moderate or high global risk, are candidates for stress echocardiography (MPI only if it is the default strategy) if there has been no coronary evaluation by stress imaging or invasive coronary arteriography within the preceding two years.

  Note: Syncope is no longer an accepted indication for stress imaging. Stress imaging is rarely required for evaluation of syncope, and the indication for high global risk is already stated in the NIA guideline elsewhere (see Shen et al).

- LEFT BUNDLE BRANCH BLOCK, when the history, physical examination, and/or noninvasive ejection fraction together support further evaluation, and invasive coronary arteriography is not already indicated, is an indication for stress echocardiography (MPI only if it is the default strategy).

- EKG STRESS TESTING without imaging is reasonable for EVALUATION OF EXERCISE-INDUCED ARRHYTHMIA (or long QT interval evaluation when the resting QTc is normal), when coronary artery disease is not suspected.

- KAWASAKI DISEASE long-term surveillance is better performed with CCTA, which includes aneurysm assessment.

V. CHRONIC VALVULAR DISEASE AND PULMONARY HYPERTENSION - HEMODYNAMIC ASSESSMENT:

EXERCISE HEMODYNAMICS can be obtained with Stress echocardiography with Doppler when it will affect management of chronic valvular heart disease (e.g. lead to surgery, valvuloplasty, transvalvular heart valve replacement, mitral clip, etc.) and/or pulmonary hypertension (e.g. lead to major change in medical management, surgery for congenital heart disease, etc.):

- Asymptomatic patients with moderate or severe chronic valvular heart disease, is an appropriate indication for stress echocardiography, when there is an inconsistency between clinical presentation and the resting echocardiogram in patients with moderate or severe valvular disease,
and exercise echocardiography with Doppler can improve assessment of functional capacity and/or valvular disease severity, and the assessment will thereby affect management.

- **Symptomatic patients with mild or moderate mitral stenosis, moderate mitral regurgitation, or equivocal severe aortic stenosis (low cardiac output, low stroke volume index <35 ml/sq. M, and/or left ventricular systolic dysfunction),** if it will affect management, is an appropriate indication for stress echocardiography, with dobutamine required for the assessment.

- **For documented suspicion of pulmonary hypertension with normal or borderline elevated pressures on resting echocardiogram, and when needed to assess the effect of therapy for pulmonary hypertension, if it will affect management, stress echocardiography is appropriate.**

### VI. Prior to NONCARDIAC SURGERY

- **THORACOABDOMINAL AORTIC VASCULAR SURGERY** is an indication for PREOPERATIVE Stress echo (MPI only if it is the default strategy) if the patient has less than a 4 MET (see Additional Information section) exercise functionality, and patient has at least one OPERATIVE clinical risk factor from the list: ischemic coronary artery disease (by study more than two years ago with lesions, which are: >=70% or ischemia producing on prior stress testing or with FFR <=0.80), cerebrovascular disease, insulin-requiring diabetes mellitus, history of congestive heart failure or ejection fraction less than 40%, or CKD with creatinine >= 2 mg/dl. (Such stress imaging is restricted to patients who have not had either stress imaging or invasive coronary arteriography within the past year.) If invasive coronary arteriography is preferable, then preoperative stress imaging is not appropriate.

- **UNRELATED TO THE PLANNED SURGICAL PROCEDURE,** stress imaging might be indicated for other reasons at the time patients are seen for preoperative cardiac risk evaluation. When such indications for stress imaging are unrelated to the need for the intended non-cardiac surgery, then the record must document those reasons in order to support proceeding with appropriate stress echocardiography (MPI only if it is the default strategy).

- **BARIATRIC SURGERY** is not considered an indication for preoperative stress testing.

- **SOLID ORGAN TRANSPLANTATION** is an indication for preoperative stress echocardiography (MPI only if it is the default strategy) if: invasive coronary arteriography is not intended as the initial preoperative evaluation of choice, and there has not been an adequate coronary evaluation within the past year.

### VII. Prior to CARDIAC REHABILITATION or EXERCISE PROGRAM

- **CARDIAC REHABILITATION** ENTRY or DETERMINATION OF EXERCISE CAPACITY is an indication for stress testing with EKG alone, when performed as part of the cardiac rehabilitation program or for purposes of exercise prescription.

### VIII. Post CARDIAC TRANSPLANTATION

- During the first five years post cardiac transplantation, patients with glomerular filtration rates less than 40 mL/min/1.73 sq M, or who otherwise should not undergo invasive coronary
arteriography every 1-2 years, are appropriate for stress echocardiography (MPI only if it is the default strategy) every 1-2 years.

- **After the first five years post cardiac transplantation**, in lieu of invasive coronary arteriography:
  1) **patients considered at low risk for transplant vasculopathy** (i.e., with normal invasive coronary arteriography) can have annual stress echocardiography (MPI only if it is the default strategy), and
  2) **patients with transplant coronary vasculopathy** can have annual stress echocardiography (MPI only if it is the default strategy), if the risk of annual invasive coronary arteriography is not acceptable (i.e., high risk of contrast nephropathy).

**ADDITIONAL INFORMATION:**

**Definitions of Coronary Artery Disease:**

13. Percentage stenosis refers to diameter stenosis when angiography is the method and refers to cross sectional narrowing when IVUS (intravascular ultrasound) is the method of determination.

14. 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 (similar to an ankle brachia index, family history of coronary artery disease, or high sensitivity C-reactive protein). Its incorporation into Global Risk can be achieved by using the MESA risk calculator.

15. Stenoses less than 50% are considered nonobstructive coronary artery disease, while stenoses of 50% or more are considered obstructive coronary artery disease. However, the contents of this Guideline are very clear about specifying that ischemic heart disease requires one of three possible determinants:
   
   i. Percentage stenosis of at least 70% - by angiography or IVUS (intravascular ultrasound), as described above, for a major vessel
   
   ii. FFR (fractional flow reserve) of 0.80 or less for a major vessel
   
   iii. Demonstrable ischemic findings on stress testing (acceptable EKG or imaging), that are at least mild in degree

16. A major vessel would be a coronary vessel that would typically be substantial enough for revascularization, if it were indicated. Lesser forms of coronary artery disease would be labeled as “limited.” (i.e. A 50% lesion in a tiny septal would be limited obstructive coronary artery disease.)

17. 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.

18. 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 reduction in coronary flow.

**Definition of Peripheral Arterial Disease/Cerebrovascular Disease:**

Non-coronary arterial narrowing causing symptoms (claudication, related tissue demise, threatened limb loss), asymptomatic 70% or more narrowing by non-invasive or invasive evaluation, atherosclerotic arterial aneurysm by non-invasive or invasive evaluation, or aortic atheroma of at least 4 mm thickness. As a subset of peripheral arterial disease, cerebrovascular disease is also defined as a history of stroke or TIA.

**What is a valid anginal equivalent?**
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, etc.), 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 by itself is generally not considered an anginal equivalent, and is handled under a separate category in this guideline.

### Pretest Probability of CAD for Symptomatic Patients:

Pretest probability is a reference to symptoms that need evaluation as potentially coronary in origin.

- **Typical Angina (Definite):** Defined as 1) substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.

- **Atypical Angina (Probable):** Chest pain or discomfort that lacks 1 of the characteristics of definite or typical angina.

- **Nonanginal Chest Pain:** Chest pain or discomfort that meets 1 or none of the typical angina characteristics.

Once the presence of symptoms (Typical Angina/Atypical Angina/Non angina chest pain/Asymptomatic) is determined, the probabilities of CAD can be calculated from the risk algorithms as follows:

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40-49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>50-59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

- **Very low:** Less than 5% pretest probability of CAD
- **Low:** Less than 10% pretest probability of CAD
- **Intermediate:** Between 10% and 90% pretest probability of CAD
- **High:** Greater than 90% pretest probability of CAD

### Global Risk of CAD or Vascular Disease

Global risk of CAD is defined as the probability of developing CAD, including myocardial infarction or CAD death over a given time period and refers to asymptomatic patients without known coronary artery disease. It should be determined by the Framingham Risk Score (ATP IV risk tool), the Reynolds Risk Index, or the Pooled Cohort Equation (which includes cerebrovascular risk). A high risk is considered greater than a 20% risk of a coronary or major vascular event over the ensuing 10 years.

- **CAD Risk—Low**
  Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk less than 10%.
• **CAD Risk—Moderate**
  Defined by the age-specific risk level that is average or above average. In general, moderate risk will correlate with a 10-year absolute CAD risk between 10% and 20%.

• **CAD Risk—High**
  Defined as the presence of peripheral arterial disease, cerebrovascular disease, or a 10-year absolute CAD risk of greater than 20%.

**Duke Treadmill Score**

The equation for calculating the Duke treadmill score (DTS) is:

\[ DTS = \text{exercise time in minutes} - (5 \times \text{ST deviation in mm or 0.1 mV increments}) - (4 \times \text{exercise angina score}) \]

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 \( \geq +5 \)), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of \( \leq -11 \)) categories.

**What Type of Stress Test is Appropriate?**

**EKG Stress Test versus Stress Echocardiography versus Stress Myocardial Perfusion Imaging**

Appropriate resource utilization, cost effectiveness, and radiation exposure limitation dictate choices in stress testing options.

Five prominent scenarios for an EKG stress test WITHOUT imaging (i.e. exercise treadmill EKG test) are endorsed by the guidelines presented above, often (but not always) requiring that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable EKG for ischemia during exercise:

- The (symptomatic) low pretest probability patient who is able to exercise and has an interpretable EKG
- The (asymptomatic) high global risk patient who is able to exercise and has an interpretable EKG
- The patient who is under evaluation for exercise induced arrhythmia (or long QT interval evaluation when the resting QTc is normal), and coronary artery disease is not suspected
- The patient who requires an entrance stress test EKG for a cardiac rehab program or for an exercise prescription

An uninterpretable baseline EKG includes:

- Abnormalities of ST segment depression of 0.1 mV (1 mm with conventional calibration) or more
- Ischemic looking T wave inversions of at least 0.25 mV (2.5 mm with conventional calibration)
- EKG findings of probable or definite LVH, WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use or hypokalemia
- Resting HR under 50 bpm on a beta blocker and an anticipated suboptimal workload (e.g. rate-pressure product less than 20-25K)
- Prior false positive stress EKG

Exercise remains a valid stressor:

- In patients who can exercise to near maximal heart rate
- For entrance to cardiac rehabilitation or determination of an exercise prescription
- For exercise induced arrhythmia evaluation
- Even with an uninterpretable EKG if stress imaging is appropriate and EKG un-interpretabiliy is acknowledged

Scenarios for choosing stress echocardiography over myocardial perfusion imaging:

- The patient can exercise to near maximal heart rate for at least 3 minutes of Bruce protocol, with usage of contrast medium if necessary to enable quality imaging

AND

There is normal baseline systolic function or mild global hypokinesia (ejection fraction 40-50%), without moderate or severe valvular disease. Stress echocardiography with Doppler is appropriate in the patient for whom determination of exercise hemodynamics is helpful.

- Exercise Doppler with hemodynamics is the main reason for stress testing.

**When is Myocardial Perfusion Imaging Preferred Over Stress Echocardiography?**

There are circumstances in which myocardial perfusion imaging is generally preferable to stress echocardiography:

- BMI >/= 40
- Ventricular paced rhythm, LBBB, WPW
- Frequent PVCs interfering with wall motion assessment
- Prior coronary artery bypass grafting with resultant paradoxical septal motion
- Currently in poorly controlled atrial fibrillation
- Poor cardiac window on echo (documented on echo report as technically limited or difficult, without likely benefit of contrast medium)
- Documented regional wall motion abnormality: dyskinesia, akinesia, or hypokinesia
- Unable to perform ADL’s with documented extent of limitations
- Functional capacity <4 METS or < 3’ Bruce protocol
- Arthritis with documented limitations
- Leg/foot amputation
- Active foot wound/ulcer
- Ambulation requires cane or walker
- Confinement to a wheelchair
- Severe chronic obstructive pulmonary disease (based upon PFT findings), severe dyspnea on exertion, or requirement for home oxygen use
- Systolic congestive heart failure with ejection fraction <40%
- Recent orthopedic surgery limiting use of a lower extremity

**Determinants of a 4 MET functional capacity:**

Examples of activities:

<4 METs: Slow ballroom dancing, golfing with a cart, playing a musical instrument, and walking at approximately 2 mph to 3 mph

>4 METs: Climbing a flight of stairs or walking up a hill, walking on level ground at 4 mph, and performing heavy work around the house
Tools for Characterization of Unstable Angina:

Risk Stratification in Acute Coronary Syndrome from 2007 ACC/AHA Guidelines

Three Principal Presentations of Unstable Angina (as defined within a two week time frame) (Braunwald)

<table>
<thead>
<tr>
<th>Class</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest angina*</td>
<td>Angina occurring at rest and prolonged, usually greater than 20 min</td>
</tr>
<tr>
<td>New-onset angina</td>
<td>New-onset angina of at least CCS class III severity</td>
</tr>
<tr>
<td>Increasing angina</td>
<td>Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by 1 or more CCS class to at least CCS class III severity)</td>
</tr>
</tbody>
</table>

Table 6: Likelihood that Symptoms Represent an Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina</td>
<td>Chest or left arm pain or discomfort as chief symptom</td>
<td>Probable ischemic symptoms in absence of any of the intermediate likelihood characteristics</td>
</tr>
<tr>
<td>Known history of CAD, including MI</td>
<td>age greater than 70 years</td>
<td>Male sex</td>
<td>Recent cocaine use</td>
</tr>
<tr>
<td>Examinations</td>
<td>Transient MR murmur, hypotension, diaphoresis, pulmonary edema, or rales</td>
<td>Extracardiac vascular disease</td>
<td>Chest discomfort reproduced by palpation</td>
</tr>
<tr>
<td>EDG</td>
<td>New, or presumably now, transient ST-segment deviation (1 mm or greater) or T-wave inversion in multiple precordial leads</td>
<td>Fixed Q waves</td>
<td>T-wave flattening or inversion less than 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated cardiac Troponin I, Troponin T, or CK-MB</td>
<td>ST depression 0.5 to 1 mm or T-wave inversion greater than 1 mm</td>
<td>Normal ECG</td>
</tr>
</tbody>
</table>


ACS = acute coronary syndrome; CAD = coronary artery disease; CK-MB = MB fraction of creatine kinase; ECG = electrocardiography; MI = myocardial infarction; MR = mitral regurgitation; TnI = troponin I; TnT = troponin T.
### Table 7: Short Term Risk of Death or Nonfatal MI in Acute Coronary Syndrome

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Risk</th>
<th>Intermediate Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>At least 1 of the following features must be present:</td>
<td>No high-risk feature, but must have 1 of the following:</td>
<td>No high- or intermediate-risk feature but may have any of the following features:</td>
</tr>
<tr>
<td>Character of pain</td>
<td>Accelerating tempo of ischemic symptoms in preceding 48 h</td>
<td>Prolonged (greater than 20 min) rest pain</td>
<td>Increased angina frequency, severity, or duration</td>
</tr>
<tr>
<td></td>
<td>Prolonged (greater than 20 min) rest pain</td>
<td>or mild, prior aspirin use</td>
<td>Angina provoked at a lower threshold</td>
</tr>
<tr>
<td></td>
<td>Previous MI, peripheral or cerebrovascular disease, or CASS; prior aspirin use</td>
<td>Rest angina (greater than 20 min) or relieved with rest or sublingual NTG</td>
<td>New onset angina with onset 2 weeks to 2 months prior to presentation</td>
</tr>
<tr>
<td></td>
<td>Coronary artery disease, or CASS; prior aspirin use</td>
<td>No-dysrhythmic angina</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MI, non-ST segment depression, or CASS; prior aspirin use</td>
<td>No-onset or progressive CCS class III or IV angina in the past 2 weeks without</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prior MI, peripheral or cerebrovascular disease, or CASS; prior aspirin use</td>
<td>prolonged (greater than 20 min) rest pain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prior MI, peripheral or cerebrovascular disease, or CASS; prior aspirin use</td>
<td>but with intermediate or high likelihood of CAD (see Table 6)</td>
<td></td>
</tr>
<tr>
<td>Clinical findings</td>
<td>Pulmonary edema, most likely due to ischemia</td>
<td>Age greater than 70 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New or worsening MR murmur</td>
<td>Age greater than 75 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Systolic hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medical history, such as CABG, PCI, or CABG/PCI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertension, heart disease, tachycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age greater than 75 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG</td>
<td>Angina at rest with transient ST-segment changes greater than 0.5 mm</td>
<td>T-wave changes</td>
<td>Normal or unchanged ECG</td>
</tr>
<tr>
<td></td>
<td>Bundle-branch block, new or presumed new</td>
<td>Pathological Q waves or resting ST-depression</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sustained ventricular tachycardia</td>
<td>less than 1 mm in multiple lead groups (anterior, inferior, lateral)</td>
<td></td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated cardiac TnT, TnI, or CK-MB (e.g., TnT or TnI greater than 0.1 ng per ml)</td>
<td>Slightly elevated cardiac TnT, TnI, or CK-MB</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e.g., TnT greater than 0.01 but less than 0.1 ng per ml)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:

AAD  antiarrhythmic drug  
ADLs activities of daily living  
CAD coronary artery disease  
CCS Canadian Cardiovascular Society  
CKD chronic kidney disease  
EKG electrocardiogram  
FFR fractional flow reserve  
LBBB left bundle-branch block  
LVH left ventricular hypertrophy  
MI myocardial infarction  
MET estimated metabolic equivalent of exercise  
PFT pulmonary function test  
PVCs premature ventricular contractions  
TIMI Thrombolysis in Myocardial Infarction (Study Group)

The **TIMI Risk Score** is determined by the sum of the presence of 7 variables at admission: 1 point is given for each of the following variables: age ≥65 years, at least 3 risk factors for CAD, prior coronary stenosis of ≥50%, ST-segment deviation on ECG presentation, at least 2 anginal events in prior 24 hours, use of aspirin in prior 7 days, and elevated serum cardiac biomarkers.

**Low-Risk TIMI Score**: TIMI score <2; **High-Risk TIMI Score**: TIMI score ≥2. A low risk TIMI score might still warrant invasive coronary arteriography, when other features, such as symptoms, are compelling.
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Reference for number of PVCs


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Reference for syncope


Reference for left bundle branch block


Reference for right bundle branch block


Referenced for police, fireman, pilots, etc.


Referenced for Arrhythmias and Long QT Syndrome


Reference for Cardiac Transplantation Patients

Gustafsson F. (2016) Diagnosis and prognosis of cardiac allograft vasculopathy. UpToDate.
http://www.uptodate.com/contents/diagnosis-and-prognosis-of-cardiac-allograft-vasculopathy?source=machineLearning&search=transplant+vasculopathy+follow+up&selectedTitle=1%7E150&sectionRank=1&anchor=H12357202#H12357202

Reference for Microvascular Coronary Disease


Reference for Kawasaki Disease


Reference for Anti-rejection Medication and Vascular Disease


Links to Cardiac/Vascular Risk Online Calculators:

Framingham-ATP IV: http://cvdrisk.nhlbi.nih.gov/

Reynolds Risk Score: http://www.reynoldsriskscore.org/

Pooled Cohort Equation (includes cardiac and cerebrovascular risk): http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example

ACC/AHA Risk Calculator (includes cardiac and cerebrovascular risk): http://tools.acc.org/ASCVD-Risk-Estimator/

MESA Risk Calculator with addition of Coronary Artery Calcium Score: https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx
INTRODUCTION:

Heart Catheterization is an invasive angiographic procedure used to evaluate the presence and extent of coronary artery disease (CAD) as well as ventricular and valvular function. It can be used to perform various tests, including angiography, intravascular ultrasonography, and measurement of cardiac output (CO), detection and quantification of shunts, endomyocardial biopsy, and measurements of myocardial metabolism.

It should be primarily used in acute coronary syndromes and when an intervention is anticipated. These guidelines apply to patients with chronic stable conditions or new but stable conditions. In many but not all of these patients, exercise testing should be done prior to consideration of a left heart catheterization. However, a positive stress test should not automatically lead to cardiac catheterization since angioplasty/stenting may not be the best first-line therapy for stable coronary artery disease.

This guideline may also apply to patients in the acute setting, e.g. patients with acute coronary syndrome or unstable angina, who should receive emergency medical care.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR LEFT HEART CATHETERIZATION:

- **Acute coronary syndromes:**
  - ST elevation or non-ST elevation myocardial infarction.
  - Acute chest pain suspicious for unstable angina with or without ECG changes.
- **Identification of clinical syndromes in which revascularization may result in prolonged survival:**
  - Left main coronary artery disease.
  - Three vessel coronary artery disease with left ventricular Ejection Fraction (EF) < 50%.
  - Strongly positive stress study, [abnormal hemodynamics, reduced exercise tolerance, strongly positive symptoms, (chest pain/ashen complexion)] and multiple wall motion defects on imaging.
- **The clinical diagnosis of unstable angina, even in cases lacking additional supportive noninvasive cardiac testing.**
- **Evaluation of patients with known CAD:**
  - results of noninvasive cardiac studies are equivocal or non-diagnostic, AND
  - symptoms are not responding adequately to optimized medical therapy
- **Evaluation of patients who:**
  - are unresponsive to optimized medical therapy, AND
  - require invasive procedures for pain relief.
- **Further evaluation of the presence and/or extent of coronary artery disease, identified by noninvasive imaging studies, for those cases in which the results of catheterization will have a material impact on the patient management.**
• Causal evaluation of left ventricular dysfunction (congestive heart failure) (EF<50%) in patients suspected of having coronary artery disease.
• Further evaluation of patients in whom non-invasive testing raised concerns for potential significant (>10%) jeopardized myocardium.
• Further evaluation in cases where recent noninvasive cardiac testing resulted in:
  o inability to delineate the clinical problem, or
  o indication for intervention or evaluation of the following conditions:
     suspicion of cardiomyopathy, or myocarditis.
     progression of known CAD when symptoms are worsening.
     coronary grafts.
     previously placed coronary artery stents.
     structural disease.
• To rule out coronary artery disease prior to non-coronary cardiac or great vessel surgery (cardiac valve surgery, aortic dissection, aortic aneurysm, congenital disease repair such as atrial septal defect, or pericardial surgery).
• Significant ventricular arrhythmia such as Ventricular Tachycardia/Ventricular Fibrillation (VT/VF).
• Assessment of cardiac transplant for rejection.
• For evaluation of coronary anatomy, with consideration of percutaneous coronary intervention, prior to TAVR (Transcatheter Aortic Valve Replacement.)
• Based upon a high pretest probability of significant ischemia-producing coronary artery disease, coronary arteriography is indicated. Such high pretest probability of stable coronary artery disease requires specific details of the symptoms, to ascertain whether the presentation truly meets the ACC definition of typical angina, in appropriate age and gender categories, which would result in a pretest likelihood of ischemia-producing coronary artery disease above 80%.

ADDITIONAL INFORMATION:

Persistent symptoms indicative of CAD can include typical angina (e.g. exertional chest pain), atypical angina (e.g. arm or jaw pain, chest pressure or tightness), or angina equivalent (e.g. shortness of breath)

Optimized Medical Therapy Optimized Medical Therapy is defined as medical therapy for patients with known CAD consisting of at least an antiplatelet, antianginal, and lipid lowering agent. If a patient has a documented contraindication to any of these medications, they have met the criteria for being on OMT. Pharmaceutical agents may include(where tolerated): antiplatelet agents, calcium channel antagonists, partial fatty acid oxidase inhibitors (e.g. ranolazine), statins, short-acting nitrates as needed, long-acting nitrates, beta blocker drugs (if no contraindication and patient can tolerate), angiotensin converting enzyme (ACE) inhibitors/angiotensin receptor blocking (ARB) agents (if no contraindication and patient can tolerate).

* NOTE: For those patients in whom heart catheterization is being requested for the diagnosis of CAD, this may not be required.

REFERENCES


