2012 NIA Standard Guidelines for Clinical Review Determinations
Guidelines for Clinical Review Determination

Preamble
NIA 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 NIA 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. They were developed following a literature search pertaining to established clinical guidelines and accepted diagnostic imaging practices.

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<table>
<thead>
<tr>
<th>Page</th>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>70336 – MRI Temporomandibular Joint (TMJ)</td>
</tr>
<tr>
<td>7</td>
<td>70450 – CT Head/Brain</td>
</tr>
<tr>
<td>12</td>
<td>70480 – CT Orbit (Includes Sella and Posterior Fossa)</td>
</tr>
<tr>
<td>14</td>
<td>70480 – CT Internal Auditory Canal</td>
</tr>
<tr>
<td>17</td>
<td>70486 – CT Maxillofacial/Sinus</td>
</tr>
<tr>
<td>21</td>
<td>70490 – CT Soft Tissue Neck</td>
</tr>
<tr>
<td>24</td>
<td>70496 – CT Angiography, Head/Brain</td>
</tr>
<tr>
<td>26</td>
<td>70498 – CT Angiography, Neck</td>
</tr>
<tr>
<td>28</td>
<td>70540 – MRI Orbit</td>
</tr>
<tr>
<td>31</td>
<td>70540 – MRI Face</td>
</tr>
<tr>
<td>32</td>
<td>70540 – MRI Neck</td>
</tr>
<tr>
<td>34</td>
<td>70544 – MR Angiography Head/Brain</td>
</tr>
<tr>
<td>37</td>
<td>70547 – MR Angiography Neck</td>
</tr>
<tr>
<td>39</td>
<td>70551 – MRI Brain (includes Internal Auditory Canal)</td>
</tr>
<tr>
<td>44</td>
<td>70554 – Functional MRI Brain</td>
</tr>
<tr>
<td>46</td>
<td>71250 – CT Chest (Thorax)</td>
</tr>
<tr>
<td>51</td>
<td>71275 – CT Angiography, Chest (non coronary)</td>
</tr>
<tr>
<td>54</td>
<td>71550 – MRI Chest (Thorax)</td>
</tr>
<tr>
<td>57</td>
<td>71555 – MR Angiography Chest (excluding myocardium)</td>
</tr>
<tr>
<td>60</td>
<td>72125 – CT Cervical Spine</td>
</tr>
<tr>
<td>64</td>
<td>72128 – CT Thoracic Spine</td>
</tr>
<tr>
<td>68</td>
<td>72131 – CT Lumbar Spine</td>
</tr>
<tr>
<td>73</td>
<td>72141 – MRI Cervical Spine</td>
</tr>
<tr>
<td>78</td>
<td>72146 – MRI Thoracic Spine</td>
</tr>
<tr>
<td>82</td>
<td>72148 – MRI Lumbar Spine</td>
</tr>
<tr>
<td>87</td>
<td>72159 – MR Angiography Spinal Canal</td>
</tr>
<tr>
<td>89</td>
<td>72191 – CT Angiography, Pelvis</td>
</tr>
<tr>
<td>91</td>
<td>72192 – CT Pelvis</td>
</tr>
<tr>
<td>98</td>
<td>72196 – MRI Pelvis</td>
</tr>
<tr>
<td>101</td>
<td>72198 – MR Angiography, Pelvis</td>
</tr>
<tr>
<td>103</td>
<td>73200 – CT Upper Extremity (Hand, Wrist, Elbow, Long Bone or Shoulder)</td>
</tr>
<tr>
<td>109</td>
<td>73206 – CT Angiography, Upper Extremity</td>
</tr>
<tr>
<td>111</td>
<td>73220 – MRI Upper Extremity</td>
</tr>
<tr>
<td>116</td>
<td>73225 – MR Angiography Upper Extremity</td>
</tr>
<tr>
<td>118</td>
<td>73700 – CT Lower Extremity (Ankle, Foot, Hip or Knee)</td>
</tr>
<tr>
<td>125</td>
<td>73706 – CT Angiography, Lower Extremity</td>
</tr>
<tr>
<td>127</td>
<td>73720 – MRI Lower Extremity</td>
</tr>
<tr>
<td>135</td>
<td>73721 – MRI Hip</td>
</tr>
<tr>
<td>139</td>
<td>73725 – MR Angiography, Lower Extremity</td>
</tr>
<tr>
<td>142</td>
<td>74150 – CT Abdomen</td>
</tr>
<tr>
<td>150</td>
<td>74174 – CT Angiography, Abdomen and Pelvis</td>
</tr>
<tr>
<td>154</td>
<td>74175 – CT Angiography, Abdomen</td>
</tr>
<tr>
<td>157</td>
<td>74176 – CT Abdomen and Pelvis Combo</td>
</tr>
<tr>
<td>166</td>
<td>74181 – MRI Abdomen</td>
</tr>
</tbody>
</table>
74185 – MR Angiography, Abdomen
74261 – CT Colonoscopy Diagnostic (Virtual)
74263 – CT Colonoscopy Screening (Virtual)
75557 – MRI Heart
75571 – Electron Beam Tomography (EBCT)
75572 – CT Heart & CT Heart Congenital
75574 – CTA Coronary Arteries (CCTA)
75635 – CT Angiography, Abdominal Arteries
76390 – MR Spectroscopy
76497 – Unlisted CT Procedure
76498 – Unlisted MRI Procedure
77058 – MRI Breast
77078 – CT Bone Density Studies
77080 – Bone Density Studies
77084 – MRI Bone Marrow
78205 – Liver SPECT Imaging
78320 – Bone and/or Joint SPECT Imaging
78451 – Nuclear Cardiology/Myocardial Perfusion Imaging
78459 – PET Scan, Heart (Cardiac)
78472 – MUGA Scan
78607 – Brain SPECT Imaging
78608 – PET Scan, Brain
78647 – Cerebrospinal Fluid Flow Imaging SPECT
78710 – Kidney SPECT Imaging
78813 – PET Scan
93307 – Transthoracic Echocardiography (TTE)
93312 – Transesophageal Echocardiography (TEE)
93350 – Stress Echocardiography
0042T – Cerebral Perfusion Analysis CT
0159T – CAD Breast MRI
S8037 – MR Cholangiopancreatography (MRCP)
INTRODUCTION:

Temporomandibular joint (TMJ) dysfunction causes pain and dysfunction in the jaw joint and muscles controlling jaw movement. Symptoms may include: jaw pain, jaw 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 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.

INDICATIONS FOR TEMPOROMANDIBULAR JOINT (TMJ) MRI:

- For evaluation of dysfunctional temporomandibular joint after unsuccessful conservative therapy with bite block or splint and anti-inflammatory medicine.
- For pre-operative evaluation of dysfunctional temporomandibular joint.
- For evaluation of locked or frozen jaw.

ADDITIONAL INFORMATION RELATED TO TEMPOROMANDIBULAR JOINT (TMJ) 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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:


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.

INDICATIONS FOR BRAIN CT:

For evaluation of neurological deficits:
- Acute, new or fluctuating neurologic deficits such as tingling (paresthesia), numbness of one side, spastic weakness (hemiparesis) of one side, paralysis, loss of muscle control, inability to speak, lack of coordination or mental status changes AND cannot have Brain MRI.

For evaluation of known or suspected trauma:
- 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
  - Signs of increases intracranial pressure
  - Skull fracture by physical exam and/positive x-ray

For evaluation of headache:
- 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 headache in occipitonasal region in individual > 55 years old AND cannot have Brain MRI.
- New temporal headache in person > 55, with Sedimentation Rate (ESR) > 55 and tenderness over the temporal artery AND cannot have Brain MRI.
- Patient with history of cancer or HIV with new onset headache AND cannot have Brain MRI.

For evaluation of known or suspected brain tumor, mass, or metastasis:
- 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.

For evaluation of known or suspected stroke:
- To evaluate patient with history of a known stroke with new and sudden onset of severe headache.
- To evaluate patient with a suspected stroke or history of a known stroke with a family history (brother, sister, parent or child) of stroke or aneurysm.
For evaluation of known or suspected aneurysm or arteriovenous malformation (AVM):
- With history of known aneurysm or AVM with new onset headache AND patient cannot have Brain MRI.
- With history or suspicion of aneurysm or AVM with family history (brother, sister, parent or child) of aneurysm or AVM AND patient cannot have Brain MRI.

For evaluation of known or suspected inflammatory disease or infection, e.g., meningitis, or abscesses:
- With positive lab findings AND patient cannot have Brain MRI.
- With positive lab findings, stiff neck (meningismus) AND patient cannot have Brain MRI.

For evaluation of known or suspected congenital abnormalities:
- To evaluate patient for suspected or known hydrocephalus or congenital abnormality. (Consider MRI to avoid radiation exposure).
- To evaluate patient for prior treatment OR treatment planned for congenital abnormality AND patient cannot have Brain MRI.

For postoperative evaluation:
- Initial follow-up of suspected or known postoperative complications.
- 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:
- 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.
- Initial evaluation of a cholesteatoma ordered by ENT, Neurologist or Neurosurgeon or primary care provider on behalf of specialist who has seen the patient.
- Follow up for known hemorrhage, hematoma or vascular abnormalities.

COMBINATION STUDIES WITH BRAIN CT:
- Brain CT/Cervical CT combination study for evaluation of Arnold Chiari malformation ordered by neurosurgeon or neurologist.

ADDITIONAL INFORMATION RELATED TO BRAIN CT:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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. 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 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** – CT has advantages in evaluating head injury due to its sensitivity for demonstrating mass effect, ventricular size and configuration, bone injuries and acute hemorrhage. CT has been used routinely as a screening tool to evaluate minor or mild head trauma in patients who are admitted to a hospital or for surgical intervention. CT is 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.

**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:**


INTRODUCTION:

Computed tomography’s use of thin sections with multi-planar scanning, (e.g., axial, coronal and sagittal planes) along with its three-dimensional reconstruction 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.

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 to the eye.
- For screening and assessment of known or suspected optic neuritis.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital Pseudotumor.

ADDITIONAL INFORMATION RELATED TO ORBIT CT:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 a mid-orbital axial 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 ophthalmopathy 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 the sclero-uveal layer. It may be seen as a well defined mass if it is more than 3 mm thick.

REFERENCES:


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 rarely used for evaluation of VIIth or VIIIth nerve tumors. It is a modality of choice because it provides 3D positional information and offers contrast for different tissue types.

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 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.

ADDITIONAL INFORMATION RELATED TO INTERNAL AUDITORY CANAL CT:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Internal Auditory Canal (IAC) – The Internal Auditory Canal is the bony channel within the temporal bone that carries the VIIth and VIIIth cranial nerves (and blood vessels) from the inner ear to the brain stem. The IAC is approximately 1 cm in length. An acoustic neuroma is a benign tumor that arises from the nerve sheath and may cause sensorineural hearing loss, vertigo, or facial nerve weakness as it enlarges. Tumors or lipomas within the IAC have been reported.

Conductive Hearing Loss – Conductive hearing loss may be 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 aid in visualization of the middle ear space and the mastoid.

Chronic Otitis – 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 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 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 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:**


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.

**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, cystic fibrosis, immotile cilia syndrome) predisposed to sinusitis.
- Osteomyelitis of facial bone where imaging study, (such as plain films, CT or brain MRI, etc.) demonstrates an abnormality or is indeterminate.

**For evaluation of known or suspected tumor (Identified specialist: Oncologist, Ophthalmologist, ENT, Maxillo-facial surgeon):**
- When ordered by specialist or primary care provider on behalf of the specialist who has seen the patient.
- For known or suspected tumor with bony abnormality or clouded sinuses seen on imaging or for mucocele (unusual benign tumor).

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

**Pre-operative evaluation:**
- Three dimensional reconstructions as part of surgery ordered by ENT or primary care provider in consultation with specialist.
- Planned maxillo-facial surgery within thirty (30) days.
- For use as adjunct to image guided sinus exploration or surgery.

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

**Other indications for Sinus CT:**
- For recurrent asthma associated with upper respiratory tract infections when ordered by pulmonologist.
- 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 Wegener’s granulomatosis 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 - Asthma when ordered by a Pulmonologist.

ADDITIONAL INFORMATION RELATED TO SINUS CT:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 the diagnosis and the 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 airflow is a deviated septum. The septum is the inner wall of cartilage and bone that separates the two sides of the nose. When deviated, it is not straight but shifted to one side, usually the left.

A coronal CT image is the preferred initial procedure. Bone window views provide excellent resolution and a good definition of the complete osteomeatal complex and other anatomic details that play a role in sinusitis. The coronal view also correlates best with findings from sinus surgery. Approximately 30% of patients cannot lie in the needed position for coronal views and so axial views would be taken (and “reconstructed” afterwards).

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.


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 two and three-dimensional images generated by CT. It can also accurately depict and characterize tracheal stenoses.

INDICATIONS FOR NECK CT:

For evaluation of known or suspected tumor, cancer or mass:

- Known or suspected [based on symptoms or examination findings (may include new or changing lymph nodes)] neck tumor, mass or cancer for patient with history of cancer with suspected recurrence or metastasis.
- Evaluation of known or suspected skull base tumor, mass or cancer.
- Evaluation of palpable lesions in mouth or throat.
- Evaluation of suspected or known tumors of larynx, pharynx, or salivary glands.
- Evaluation of suspected or known parathyroid tumor when:
  - CA > normal and PTH > normal with
  - Previous nondiagnostic ultrasound or nuclear medicine scan AND
  - Surgery planned
- Evaluation of suspected or known nasopharyngeal tumor.
- Evaluation of suspected or known non-thyroid masses in the neck when persistent, greater than one month, noted to be >/= to 1 cm and/or associated with generalized lymphadenopathy.

For evaluation of known or suspected inflammatory disease or infections:

- For evaluation of abscesses of the pharynx and neck.
- Evaluation of lymphadenopathy in the neck when persistent, greater than one month, noted to be >/= to 1 cm and/or associated with generalized lymphadenopathy.

Other indications for a Neck CT:

- For evaluation of hoarseness, vocal cord lesions, or vocal cord paralysis.
- For evaluation of stones of the parotid and submandibular glands and ducts.
- For evaluation of tracheal stenosis.

COMBINATION OF STUDIES WITH NECK CT:

- Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT – known tumor/cancer for initial staging.
- 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:

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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 neck cancer, the identification of lymphatic tumor spread is crucial. Multislice-spiral-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. Spiral CT provides a non-invasive evaluation of the trachea and may be used in most patients to assess airway patency distal to stenoses.

**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, semicalcified parotid or submandibular 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 parotid or submandibular gland excision. The CT scan identifies the exact location of a ductal stone expediting intraoral surgical removal.

REFERENCES:

ACR Practice Guideline for the performance of computed tomography (CT) of the extracranial head and neck in adults and children, (2006)

ACR Practice Guideline for the performance of computed tomography (CT) in Neurologic Imaging, (2007)


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.

INDICATIONS FOR HEAD CTA:

- To evaluate intracranial aneurysm.
- To evaluate patient whose parent or sibling has history of intracranial aneurysm.
- To evaluate for known or suspected vertebral basilar insufficiency (VBI).
- To evaluate for known or suspected arteriovenous malformation (AVM).

ADDITIONAL INFORMATION RELATED TO HEAD CTA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 whose Parent(s) or Sibling(s) have a history of aneurysm – Data has suggested that individuals with a parent or sibling 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 Vertebral Basilar 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


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.

INDICATIONS FOR NECK CTA:

- To follow-up on the abnormal results of carotid doppler/duplex or ultrasound study.
- For the evaluation of carotid body tumors such as paragangliomas or glomus tumors.
- For post-operative evaluation of carotid endarterectomy.

ADDITIONAL INFORMATION RELATED TO NECK CTA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 spiral CT scanner. The 3D volume-rendering reconstructions provide a selective visualization of the anatomic relationships among carotid body tumors, vessels, and surrounding osseous structures with good detail.

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.

REFERENCES:


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.

**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 to the eye.
- For screening and assessment of known or suspected optic neuritis.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital Pseudotumor.

**COMBINATION OF STUDIES WITH ORBIT MRI:**

- **Brain MRI/Orbit MRI** – authorize if ordered by a Neuro Ophthalmologist.

**ADDITIONAL INFORMATION RELATED TO ORBIT 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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 (Grave’s 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. 3.0 tesla MRI has higher signal-to-noise performance of higher magnetic field which improves image spatial and temporal resolution. It is valuable in evaluating the vascularity of lesions and the internal tumor characteristics.

**REFERENCES:**


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.

INDICATIONS FOR FACE MRI:

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

ADDITIONAL INFORMATION RELATED TO FACE 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 among normal and abnormal tissues provided by MRI permits the exact delineation of tumor margins in regions, 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.

INDICATIONS FOR NECK MRI:

- For evaluation of non-thyroid masses in neck.
- For evaluation of skull base tumors.
- For evaluation of hoarseness, vocal cord lesions or vocal cord paralysis.
- For evaluation of palpable lesions in mouth or throat.
- For evaluation of suspected or known tumors of the tongue, larynx, pharynx, nasopharynx, parathyroid, or salivary glands.
- For evaluation of neck lymphadenopathy.
- For evaluation of tracheal stenosis.
- Brachial plexus dysfunction (Brachial plexopathy/Thoracic Outlet Syndrome).

COMBINATION OF STUDIES WITH NECK MRI:

- Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT – known tumor/cancer for initial staging.
- 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:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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.
Neck Tumors – MRI plays a positive 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. For skull base tumors, CT is preferred but MRI provides valuable information to support diagnosis of the disease.

Vocal Cord Paralysis, Hoarseness or Tumors – Hoarseness may be due to many conditions, e.g., vocal cord paralysis or malignant 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.

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 Submandibular Stones – Early diagnosis and intervention are important because patients with submandibular stones may eventually develop sialadenitis. MRI provides excellent image contrast and resolution of the submandibular gland and duct and helps in the evaluation of stones.

REFERENCES:


INTRODUCTION:

Magnetic resonance angiography (MRA) 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 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.

Two different techniques of MRA are: time of flight (TOF) and phase contrast (PC) angiography. Three dimensional (3D) TOF-MRA is used for the examination of intracranial vessels.

INDICATIONS FOR BRAIN (HEAD) MRA:

- To evaluate known intracranial aneurysm.
- To screen for suspected intracranial aneurysm in patient whose parent or sibling has history of intracranial aneurysm. Note: If there is a familial history, repeat study is recommended yearly with or without new symptoms.
- To evaluate known or suspected vertebral basilar insufficiency (VBI).
- To evaluate known or suspected arteriovenous malformation (AVM).
- To re-evaluate abnormality visualized on previously brain MRI when meets above criteria.

ADDITIONAL INFORMATION RELATED TO BRAIN (HEAD) MRA

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Cerebral Aneurysms and MRA – 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.

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.

**REFERENCE:**


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.

INDICATIONS FOR NECK MRA:

- For follow-up of abnormal results of carotid duplex imaging.
- For evaluation of carotid body tumors, also called paragangliomas.
- For post-operative evaluation of carotid endarterectomy.
- For evaluation of neck mass/adenopathy in an adult presenting with a pulsatile neck mass.
- For evaluation of head trauma in a patient with closed head injury to rule out carotid or vertebral artery dissection.

INDICATIONS FOR BRAIN MRA/NECK MRA COMBO:

- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of patients with a sudden onset of one-sided weakness, inability to speak, vision defects or severe dizziness.
- For evaluation of patients with an abnormal ultrasound of the neck.

ADDITIONAL INFORMATION RELATED TO NECK MRA:

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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.
REFERENCES


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.

INDICATIONS FOR BRAIN MRI:

For evaluation of suspected multiple sclerosis (MS):
- For evaluation of patient with neurological 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.
- Exacerbation of symptoms.
- For repeat follow up and no prior imaging within the past ten (10) months (unless for exacerbation of symptoms) for patients taking Tysabri (Natalizumab).

For evaluation of known or suspected seizure disorder:
- Seizure with a new onset
- Medically refractory epilepsy when ordered by neurosurgeon, neurologist or primary care provider on behalf of specialist.

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 neurological deficits:
- Acute, new or fluctuating neurologic deficits such as tingling (paresthesia), numbness of one side, spastic weakness (hemiparesis) of one side, paralysis, loss of muscle control, inability to speak, lack of coordination or mental status changes.

For evaluation of known or suspected trauma:
- 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
  - Signs of increases intracranial pressure
Skull fracture by physical exam and positive x-ray

**For evaluation of headache:**
- Sudden onset (within the past 3 months) of a headache described by the patient as the worst headache of their life OR a “thunderclap” type headache. (*Concerned with aneurysm*). Note: The duration of a thunderclap type headache lasts more than 5 minutes. A headache that lasts less than 5 seconds in duration is not neurological.
- New severe unilateral headache with radiation to or from the neck. Associated with suspicion of carotid or vertebral artery dissection.
- Acute, sudden onset of headache with personal or family history (parent, sibling or child of patient) of stroke, brain aneurysm or AVM (arteriovenous malformation).
- Patient with history of cancer or HIV with new onset of headache.
- New onset headache in pregnancy.

**For evaluation of known or suspected brain tumor/metastasis:**
- Known tumor and new onset of headache.
- Follow up for known tumor without any acute, new or fluctuating neurologic, motor or mental status changes.
- With any acute, new or fluctuating neurologic, motor or mental status changes.
- Known or suspected pituitary tumor with corroborating physical exam (galactorrhea), neurologic findings and/or lab abnormalities.
- Known lung cancer, or rule out metastasis and/or preoperative evaluation.

**For evaluation of known or suspected stroke:**
- Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms) (may be tumor or **Multiple Sclerosis** [MS]).
- Known or rule out stroke with any acute, new or fluctuating neurologic, motor or mental status changes.

**For evaluation of known or suspected aneurysm or arteriovenous malformation (AVM):**
- Presents with new onset of headache or any acute, new or fluctuating neurologic, motor or mental status changes.
- Screening for aneurysm in polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, or known aortic coarctation.

**For evaluation of known or suspected infection or inflammatory disease (i.e., meningitis, abscess):**
- 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.
- Inflammatory disease (i.e. vasculitis), sarcoid or infection for patient presenting with a fever, stiff neck and positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam).
- 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.

**For evaluation of known or suspected congenital abnormality (such as hydrocephalus, craniosynostosis):**
- Treatment planned within four (4) weeks for congenital anormality (such as placement of shunt or problems with shunt; surgery).
- Known or rule out congenital anormality with any acute, new or fluctuating neurologic, motor or mental status changes.
- Evaluation of macrocephaly with child >6 months of age or microcephaly.
- Follow up shunt evaluation within six (6) months of placement or one (1) year follow up and/or with neurological symptoms.
- Suspected normal pressure hydrocephalus, (NPH) with symptoms.

Post-operative evaluation:
- Initial follow-up of suspected or known post-operative complications
- 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 MRI:
- Evaluation of suspected acute Subarachnoid Hemorrhage (SAH).
- Initial evaluation of a cholesteatoma ordered by ENT, Neurologist or Neurosurgeon or primary care provider on behalf of specialist who has seen the patient.
- Initial imaging of a suspected or known Arnold Chiari Malformation ordered by Neurosurgeon or Neurologist or primary care provider on behalf of specialist who has seen the patient.
- Optic Neuritis ordered by Ophthalmologist or Neurologist.
- Initial brain evaluation for a known syrinx or syringomyelia.
- Tinnitus (constant ringing in one or both ears), hearing loss and an abnormal audiogram (Concerned with tumor or Menieres).
- Vertigo associated with headache, blurred or double vision, or a change in sensation after full neurologic examination and initial work-up.
- Change in mental status; with a mental status score (MMSE of less than 25) AND a completed metabolic workup (including urinalysis, thyroid function testing, and complete blood count, etc).
- 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).
- Follow up for known hemorrhage, hematoma or vascular abnormalities.
- For evaluation of known or suspected cerebrospinal fluid (CSF) leakage.
- Developmental delay.

FOR COMBINATION OF STUDIES WITH BRAIN MRI:

- **Brain MRI/Neck MRA** - confirmed carotid occlusion of ≥60%, surgery or angioplasty candidate (significant lesion can flip off emboli, looking for stroke).
- **Brain MRI/Cervical MRI** - Arnold Chiari Malformation ordered by Neurosurgeon or Neurologist or primary care provider on behalf of specialist who has seen the patient.
- **Brain MRI/Orbit MRI** – authorize if ordered by a Neuro Ophthalmologist (cannot approve for Neuro specialist alone unless they have ophthalmologic training, call MDO to verify specialty status) or when ordered by a neurologist or ophthalmologist in a child under 3 years of age who will need anesthesia for the procedure.

ADDITIONAL INFORMATION RELATED TO BRAIN MRI:

Abbreviations
AVM = arteriovenous malformation  
CT = computed tomography  
DWI = diffusion-weighted imaging  
MRI = magnetic resonance imaging  
SAH = subarachnoid hemorrhage  
TIA = transient ischemic attack

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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

**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.
REFERENCES:


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 patients undergoing brain surgery for tumors. 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.

INDICATIONS FOR FUNCTIONAL BRAIN MRI:

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.

ADDITIONAL INFORMATION RELATED TO BRAIN 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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:


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 hemoptysis.

INDICATIONS FOR CHEST CT:

For evaluation of suspected pulmonary embolism:
- For evaluation of suspected pulmonary embolism when chest CTA is contraindicated (clinical findings may include but not limited to sudden onset of dyspnea, pleuritic chest pain, cough, hemoptysis and tachypnea).

For evaluation of known tumor, cancer or mass:
- Initial evaluation of known tumor.
- Evaluation of known tumor or cancer for patient undergoing active treatment with most recent follow-up study > 2 months (documentation to include but not limited to type/timing/duration of recent treatment).
- Evaluation of palpable mass where prior imaging study was indeterminate or nondiagnostic.
- Evaluation of known tumor or cancer presenting with new signs (i.e., physical, laboratory, or imaging findings) or new symptoms.
- Evaluation of known tumor or cancer with no imaging/restaging within the past 10 months.
- For the follow-up evaluation of a nodule with a previous CT (follow-up intervals approximately 3, 6, 12 and 24 months).
- Known distant/primary tumor with prior abnormal findings.

For evaluation of a suspicious mass or tumor when study is requested within 3 months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- Investigation of suspicious mass or tumor in the chest when study is requested within 3 months of imaging findings shown on plain films or previous CT.

For evaluation of known or suspected infection or inflammatory disease (i.e., complicated pneumonia not responding to treatment, abscess, T.B., sarcoidosis, pneumoconiosis, asbestosis, silicosis, empyema, and black lung disease):
- For evaluation of suspected infection or inflammatory disease ordered by surgeon or pulmonologist.
- For evaluation of known infection or inflammatory disease
  - Initial evaluation
  - During treatment
  - With new signs and symptoms
  - Annual surveillance
- For evaluation of non-resolving pneumonia with prior imaging
  - Unimproved at least 4 (four) weeks of antibiotic treatment OR
  - Not resolved at 8 (eight) weeks.
- For evaluation of lung abscess or cavity, or empyema with radiologic evidence.

For evaluation of suspected vascular disease, e.g., aneurysm:
- For evaluation of mediastinal widening with radiologic evidence.
For evaluation of known or suspected superior vena cava (SVC) syndrome.
- Suspected thoracic/thoracoabdominal aneurysm (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain).

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

For evaluation of Hemoptysis:
- Consider for evaluation of hemoptysis (gross blood in the absence of any accompanying sputum) greater than 15cc and normal chest x-ray.
- Consider for evaluation for hemoptysis (gross blood in the absence of any accompanying sputum) less than 15cc and abnormal chest x-ray.

Preoperative evaluations ordered by Oncologist, Surgeon, Pulmonologist, Cardiologist or primary care provider on behalf of specialist:
- Pre-operative evaluation when surgery is planned within 30 days.

Postoperative evaluations:
- Initial follow-up of known or suspected post-operative complication(s).
- 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 Chest CT:
- For further evaluation after abnormal imaging within past 30 - 60 days, except known rib fractures.
- For evaluation of persistent unresolved cough with at least two weeks duration, unresponsive medical treatment and chest x-ray has been performed.
- For evaluation of other chest or thorax adenopathy.
- Evaluation of pneumothorax.
- For evaluation of hoarseness, vocal cord lesion or vocal cord paralysis.
- For suspected thymoma with myasthenia gravis.

COMBINATION OF STUDIES WITH CHEST (THORAX) CT:
- Chest CT/Sinus CT – for evaluation of asthma when ordered by pulmonologist.
- Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT – for initial staging of known tumor/cancer.
- Abdomen CT/Pelvis CT/Chest CT/Neck MRI/Neck CT with MUGA – for initial staging or evaluation of known tumor/cancer before starting chemotherapy or radiation treatment.
- Abdomen CT/Pelvis CT/Chest CT – for follow-up evaluation for patient receiving treatment for cancer.

ADDITIONAL INFORMATION RELATED TO CHEST CT:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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

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

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

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

**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.

**REFERENCES**


INTRODUCTION:

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. CTA depicts the vascular structures as well as the surrounding anatomical structures.

INDICATIONS FOR CHEST CTA:

- For evaluation of suspected or known pulmonary embolism.
- For evaluation of suspected or known thoracic aortic aneurysm or thoracic aortic dissection.
- For evaluation of patient 13 – 17 years old with suspected or confirmed congenital thoracic vascular anomaly, (e.g., aortic coarctation).
- For the evaluation of known or suspected coarctation of the aorta.
- For evaluation of new signs or symptoms indicative of vascular insufficiency of the neck or arms.
- For follow-up evaluation of new signs or symptoms indicative of progressive vascular stenosis after a previous angiogram or MRA.
- For preoperative evaluation for known vascular disease and patient has not had a catheter angiogram within the last month.
- For postoperative evaluation for known vascular disease with physical evidence of a re-bleed or re-stenosis.

ADDITIONAL INFORMATION RELATED TO CHEST CTA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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) – 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.
REFERENCES:


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.

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 an aneurysm or dissection of the thoracic aorta.
- For evaluation of congenital heart disease and malformations, [e.g., 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, thoracic spine).
- To determine the consistency of thoracic masses (cystic vs solid vs mixed).

ADDITIONAL INFORMATION RELATED TO CHEST 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.

**Intravascular administration of contrast material** may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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.

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.

MRI and Aortic Coarctation – Aortic coarctation is a congenital narrowing of the aorta. In the past, angiography was used to evaluate aortic coarctation. However, MRI, allowing excellent anatomic and functional evaluation of the aortic coarctation, may replace angiography as the first line modality for evaluating this condition.

REFERENCES:


INTRODUCTION:

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.

INDICATIONS FOR CHEST MRA:

- For evaluation of suspected or known pulmonary embolism.
- For evaluation of suspected or known thoracic aortic aneurysm or thoracic aortic dissection.
- For known or suspected coarctation of the aorta.
- For evaluation of patient 13 – 17 years old with suspected or confirmed congenital thoracic vascular anomaly, (e.g., aortic coarctation).
- For evaluation of new signs or symptoms indicative of vascular insufficiency of the neck or arms.
- For follow-up evaluation of new signs or symptoms indicative of progressive vascular stenosis after a previous angiogram or MRA.
- For preoperative evaluation for known vascular disease and patient has not had a catheter angiogram within the last month.
- For postoperative evaluation for known vascular disease with physical evidence of a re-bleed or re-stenosis.
- For evaluation of suspicious mass and CTA is contraindicated due to a history of contrast allergy or high risk for contrast induced renal failure.

ADDITIONAL INFORMATION RELATED TO CHEST MRA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 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.

REFERENCES:


Krishnam, M.S., Tomasian, A., Deshpande, V., et al. (2008). Noncontrast 3D steady-state free-precession magnetic resonance angiography of the whole chest using nonselective radiofrequency excitation over a
large field of view: Comparison with single-phase 3D contrast-enhanced magnetic resonance angiography. *Investigative Radiology*, 43(6), 411-420.


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.

INDICATIONS FOR CERVICAL 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: extremity weakness; asymmetric reflexes.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Cervical Spine MRI is contraindicated:
- With changing or new onset of radiculopathy and failure of conservative treatment for at least six (6) weeks.
- With an abnormal electromyography (EMG) or nerve conduction study.
- With exacerbation of chronic neck pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise plan (HEP), for at least six (6) weeks.

For evaluation of new onset of neck pain when Cervical Spine MRI is contraindicated:
- With radiculopathy and 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.

For evaluation of trauma or acute injury within past 72 hour:
- Presents with radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study

For evaluation of known tumor, cancer, or evidence of metastasis:
- Staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- Presents with radiculopathy.
- With an abnormal electromyography (EMG) or nerve conduction.
- 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

**For evaluation of known or suspected infection, abscess, or inflammatory disease when Cervical Spine MRI is contraindicated:**
• Paraspinal abscess as evidenced by neck pain, laboratory or x-ray findings.
• Osteomyelitis as evidenced on laboratory or x-ray findings.
• Meningitis as evidenced by positive physical findings.
• Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

**For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma when Cervical Spine MRI is contraindicated:**
• Presents with neck pain as a symptom of documented clinical findings of immune system suppression.

**For preoperative evaluation when Cervical Spine MRI is contraindicated:**
• Known tumor and meets one of the tumor guideline criteria above.
• Known infection and meets one of the infection guideline criteria above.
• Known radiculopathy and failure of conservative treatment for at least six (6) weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
• With an abnormal electromyography (EMG) or nerve conduction study.

**For follow-up evaluation for surgery or fracture occurring within the past six (6) months:**
• Changing radiculopathy and failure of conservative treatment for at least (6) six weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
• With an abnormal electromyography (EMG) or nerve conduction study.
• Physical or laboratory findings of a surgical infection.
• Physical or imaging findings of delayed or non-healing.

**Other indications for a Cervical Spine CT:**
• CT myelogram or discogram.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes.
• Known Arnold-Chiari syndrome and Cervical Spine MRI is contraindicated.

**FOR COMBINATION OF STUDIES WITH CERVICAL SPINE CT:**

• **Cervical/Thoracic/Lumbar CTs** – CT myelogram or discogram
• **Cervical/Thoracic/Lumbar CTs** – spinal survey in patient with metastases.
• **Cervical MRI/CT** - unstable craniocervical junction.
• **Brain CT/Cervical CT** – Arnold Chiari malformation.

**ADDITIONAL INFORMATION RELATED TO CERVICAL SPINE CT:**

**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.
Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**Conservative Therapy:** (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

**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 4-6 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).

**REFERENCES:**


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.

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: lower extremity weakness, lower extremity asymmetric reflexes.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Thoracic MRI is contraindicated:
- With acute onset of point tenderness of a localized area of the spine.
- With an abnormal electromyogram (EMG) or nerve conduction study
- With exacerbation of chronic back pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise program (HEP), for at least six (6) weeks.

For evaluation of new onset of back pain when Thoracic Spine MRI is contraindicated:
- With radiculopathy and 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.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With abnormal electromyography (EMG) or nerve conduction study.

For evaluation of known tumor, cancer or evidence of metastasis
- Staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- With an abnormal electromyogram (EMG) or nerve conduction study
- 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.

For evaluation of known or suspected infection, abscess, or inflammatory disease when Thoracic MRI is contraindicated:
- Paraspinal abscess as evidenced by back pain, laboratory or x-ray findings.
- Osteomyelitis as evidenced by laboratory or x-ray findings.
- Meningitis as evidenced by positive physical findings.
- Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma when Thoracic MRI is contraindicated:
- Presents with back pain as a symptom of documented clinical findings of immune system suppression.

For pre-operative evaluation when Thoracic MRI is contraindicated:
- Known tumor and meets one of the criteria for tumor evaluation above.
- Known infection and meets one of the criteria for infection evaluation above.

For follow-up evaluation of surgery or fracture occurring within past six (6) months:
- Seen or ordered by specialist (neurospecialist, orthopedist or oncologist).
- With an abnormal electromyogram (EMG) or nerve conduction study.
- Physical or laboratory findings of a surgical infection.
- Physical or imaging findings of delayed or non-healing.
- Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.
- Thoracic back pain associated with recent thoracic surgery.

Other indications for a Thoracic Spine CT:
- CT myelogram or discogram.

COMBINATION OF STUDIES WITH THORACIC SPINE CT:
- Cervical/Thoracic/Lumbar CTs – CT myelogram or discogram
- Cervical/Thoracic/Lumbar CTs– spinal survey in patient with metastases.

ADDITIONAL INFORMATION RELATED TO THORACIC SPINE CT:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.
**Conservative Therapy**: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

**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 4-6 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 conduction studies; exacerbation of chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program, and MRI is contraindicated.

**REFERENCES:**


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.

INDICATIONS FOR LUMBAR SPINE CT:

For evaluation of 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 any of the following new neurological deficits: lower extremity weakness; asymmetric reflexes; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Lumbar Spine MRI is contraindicated:
- With changing or new onset of radiculopathy and failure of conservative treatment for at least six (6) weeks.
- With an abnormal electromyography (EMG) or nerve conduction study.
- With exacerbation of chronic back pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise program (HEP), for at least six (6) weeks.

For evaluation of new onset of back pain when Lumbar Spine MRI is contraindicated:
- With radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study.

For evaluation of known tumor, cancer or evidence of metastasis:
- Staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- Presents with radiculopathy.
- With an abnormal electromyography (EMG) or nerve conduction study.
- 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
For evaluation of known or suspected infection, abscess, or inflammatory disease when Lumbar Spine MRI is contraindicated:
- Paraspinal abscess as evidenced by lumbar back pain associated with abdominal pain, laboratory or x-ray findings.
- Osteomyelitis as evidenced by laboratory or x-ray findings.
- Meningitis as evidenced by positive physical findings.
- Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma and Lumbar Spine MRI is contraindicated:
- Presents with back pain as a symptom of documented clinical findings of immune system suppression.

For preoperative evaluation and Lumbar Spine MRI is contraindicated:
- Placement of pedicle screw.
- Known tumor and meets one of the tumor guideline criteria above.
- Known infection and meets one of the infection guideline criteria above.
- Known radiculopathy and failure of conservative treatment for at least six (6) weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study.

For follow-up evaluation of surgery or fracture occurring within past six (6) months:
- Changing radiculopathy and failure of conservative treatment for at least (6) six weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study.
- Physical or laboratory findings of a surgical infection.
- Physical or imaging findings of delayed or non-healing.

Other indications for a Lumbar Spine CT:
- CT myelogram or discogram.
- Lumbar back pain associated with abdominal pain e.g., pain related to aneurysm.
- Tethered cord, known or suspected spinal dysraphism and Lumbar Spine MRI is contraindicated.

COMBINATION OF STUDIES WITH LUMBAR SPINE CT:
- Cervical/Thoracic/Lumbar CTs – any combination of these for CT myelogram or discogram or for spinal survey in patient with metastasis.

ADDITIONAL INFORMATION RELATED TO LUMBAR SPINE CT:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.
Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE: conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

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 4-6 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 myelomenigocele and lipomyelomeningocele; the following are other causes that vary in severity of symptoms and treatment:
- Dermal sinus tract (a rare congenital deformity)
- Diastemstomelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale (a delicatere 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.

INDICATIONS FOR CERVICAL SPINE MRI:

For evaluation of known or suspected multiple sclerosis (MS):
- Evidence of MS on recent baseline Brain MRI.
- Follow up to known MS with changing signs or symptoms.
- 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: extremity weakness; asymmetric reflexes.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:
- With changing or new onset of radiculopathy and failure of conservative treatment for at least six (6) weeks.
- With an abnormal electromyography (EMG) or nerve conduction study.
- With exacerbation of chronic neck pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise plan (HEP), for at least six (6) weeks.

For evaluation of new onset of neck pain:
- With radiculopathy and 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.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study.

For evaluation of known tumor, cancer, or evidence of metastasis:
- Staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- Presents with radiculopathy.
- With an abnormal electromyography (EMG) or nerve conduction.
- 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.
For evaluation of known or suspected infection, abscess, or inflammatory disease:
- Paraspinal abscess as evidenced by neck pain, laboratory or x-ray findings.
- Osteomyelitis as evidenced on laboratory or x-ray findings.
- Meningitis as evidenced by positive physical findings.
- Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma:
- Presents with neck pain as a symptom of documented clinical findings of immune system suppression.

For preoperative evaluation [if surgery scheduled within the next thirty (30) days]:
- Known tumor and meets one of the tumor guideline criteria above.
- Known infection and meets one of the infection guideline criteria above.
- Known radiculopathy and failure of conservative treatment for at least six (6) weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study.

For follow-up evaluation for surgery or fracture occurring within the past six (6) months:
- Changing radiculopathy and failure of conservative treatment for at least (6) six weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study.
- Physical or laboratory findings of a surgical infection.
- Physical or imaging findings of delayed or non-healing.

Other indications for a Cervical Spine MRI:
- Suspected cord compression with any of the following neurological deficits: extremity weakness; abnormal gait; asymmetric reflexes.
- Known Arnold-Chiari Syndrome.
- Syrinx or syringomyelia.

COMBINATION OF STUDIES WITH CERVICAL SPINE MRI:
- Cervical/Thoracic/Lumbar MRIs – any combination of these for scoliosis survey in infant/child
- Cervical/Thoracic/Lumbar MRIs – any combination of these for spinal survey in patient with metastases
- Cervical MRI/CT – for unstable craniocervical junction.
- Brain MRI/Cervical MRI – For Arnold Chiari malformation ordered by neurosurgeon or neurologist

ADDITIONAL INFORMATION RELATED TO CERVICAL SPINE 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

**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 4-6 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 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; in 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.

**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.

INDICATIONS FOR THORACIC SPINE MRI:

For evaluation of neurologic deficits:
- With any of the following new neurological deficits: lower extremity weakness, lower extremity asymmetric reflexes.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:
- With acute onset of point tenderness of a localized area of the spine.
- With an abnormal electromyogram (EMG) or nerve conduction study.
- With exacerbation of chronic back pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise program (HEP), for at least six (6) weeks.

For evaluation of new onset of back pain:
- With radiculopathy and 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.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study.

For evaluation of known tumor, cancer or evidence of metastasis:
- Staging of known tumor.
- For follow-up evaluation of patient undergoing active treatment.
- Presents with new signs (e.g., laboratory and/or imaging findings) of new tumor or change in tumor
- With an abnormal electromyogram (EMG) or nerve conduction study.
- 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.

For evaluation of known or suspected infection, abscess, or inflammatory disease:
- Paraspinal abscess as evidenced by back pain, laboratory or x-ray findings.
- Osteomyelitis as evidenced by laboratory or x-ray findings.
- Meningitis as evidenced by positive physical findings.
- Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

**For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma:**
- Presents with back pain as a symptom of documented clinical findings of immune system suppression.

For preoperative evaluation [if surgery scheduled within the next thirty (30) days]:
- Known tumor and meets one of the criteria for tumor evaluation above.
- Known infection and meets one of the criteria for infection evaluation above.

**For follow-up evaluation of surgery or fracture occurring within past six (6) months:**
- Seen by or ordered by specialist (neurospecialist, orthopedist or oncologist).
- With an abnormal electromyogram (EMG) or nerve conduction study.
- Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.
- Thoracic back pain associated with recent thoracic surgery.

**Other indications for a Thoracic Spine MRI:**
- Syrinx or syringomyelia.

**COMBINATION OF STUDIES WITH THORACIC SPINE MRI:**

- **Cervical/Thoracic/Lumbar MRIs** – for scoliosis survey in infant/child.
- **Cervical/Thoracic/Lumbar MRIs** – spinal survey in patient with metastases.

**ADDITIONAL INFORMATION RELATED TO THORACIC SPINE 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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**Conservative Therapy:** (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part.**NOTE** - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.
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 4-6 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 conductions studies; exacerbation of chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

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.

INDICATIONS FOR LUMBAR SPINE MRI:

For evaluation of neurologic deficits:
- With any of the following new neurological deficits: lower extremity weakness; asymmetric reflexes; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:
- With changing or new onset of radiculopathy and failure of conservative treatment for at least six (6) weeks.
- With an abnormal electromyography (EMG) or nerve conduction study.
- With exacerbation of chronic back pain or new extremity numbness or tingling and unresponsive to trial of conservative treatment, including physical therapy or physician supervised home exercise program (HEP), for at least six (6) weeks.

For evaluation of new onset of back pain:
- With radiculopathy and 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.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy.
- With progression or worsening of symptoms during the course of conservative treatment.
- With an abnormal electromyography (EMG) or nerve conduction study.

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 (e.g., laboratory and/or imaging findings) of new tumor or change in tumor.
- Presents with radiculopathy.
- With an abnormal electromyography (EMG) or nerve conduction study.
- 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.
For evaluation of known or suspected infection, abscess, or inflammatory disease:
- Paraspinal abscess as evidenced by lumbar back pain associated with abdominal pain, laboratory or x-ray findings.
- Osteomyelitis as evidenced by laboratory or x-ray findings.
- Meningitis as evidenced by positive physical findings.
- Septic arthritis or discitis as evidenced by laboratory or x-ray findings.

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma:
- Presents with back pain as a symptom of documented clinical findings of immune system suppression.

For preoperative evaluation (if surgery scheduled within the next thirty (30) days):
- Known tumor and meets one of the tumor guideline criteria above.
- Known infection and meets one of the infection guideline criteria above.
- Known radiculopathy and failure of conservative treatment for at least six (6) weeks and when ordered by a neurosurgeon, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study.

For follow-up evaluation of surgery or fracture occurring within past six (6) months.
- Changing radiculopathy and failure of conservative treatment for at least six (6) weeks when ordered by a neurospecialist, orthopedist or surgeon.
- With an abnormal electromyography (EMG) or nerve conduction study,
- Physical or laboratory findings of a surgical infection,
- Physical or plain film findings of delayed or failed healing,

Other indications for a Lumbar Spine MRI:
- Lumbar back pain associated with abdominal pain, e.g., pain related to aneurysm
- Tethered cord or known/suspected spinal dysraphism.
- Ankylosing Spondylitis- For diagnosis when suspected as a cause of back or sacroiliac pain and completion of the following initial evaluation:
  - History of back pain associated with morning stiffness
  - Sedimentation rate and/or C-reactive protein
  - HLA B27
  - Non-diagnostic or indeterminate x-ray

COMBINATION OF STUDIES WITH LUMBAR SPINE MRI:
- Cervical/Thoracic/Lumbar MRIs – any combination of these for scoliosis survey in infant/child.
- Cervical/Thoracic/Lumbar MRIs – any combination of these for spinal survey in patient with metastasis.

ADDITIONAL INFORMATION RELATED TO LUMBAR SPINE 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.
Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

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 4-6 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 myelomenigocele and lipomyelomeningocele; the following are other causes that vary in severity of symptoms and treatment.

- Dermal sinus tract (a rare congenital deformity)
- Diastemstomelia (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:

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 is used for the evaluation of spinal arteriovenous malformations, cervical spine fractures and vertebral artery injuries.

INDICATIONS FOR SPINAL CANAL MRA:

- For the evaluation of spinal arteriovenous malformation (AVM).
- For the evaluation of a cervical spine fracture.
- For the evaluation of known or suspected vertebral artery injury.

ADDITIONAL INFORMATION RELATED TO SPINAL CANAL MRA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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:


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.

INDICATIONS FOR PELVIS CTA:

For evaluation of known or suspected vascular disease:
- Significant ischemia that could be related to the presence of ulcers/gangrene or significant claudication.
- Large vessel diseases, e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome.
- 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 (surgery scheduled within the next 30 days):
- Evaluation of aortoiliac occlusion or peripheral vascular disease of the leg after ultrasound has indicated significant disease and an indeterminate conclusion about whether the condition would be amenable to surgery.
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative evaluation:
- Evaluation of 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.
- 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 CTA:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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, 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.

**Artery Entrapment Syndrome** – The syndrome usually results in manifestations of calf pain during exercise and intermittent or progressive claudication. CTA aids in the diagnosis, characterization and classification of the syndrome, providing high-spatial-resolution images of a large anatomic range and high soft-tissue contrast. Axial images provided by CTA can help assess arterial stenoses or occlusions and to evaluate surrounding muscular anomalies.

**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. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.

INDICATIONS FOR PELVIS CT:

For known prostate cancer for recurrence workup:
- Prostatic cancer with:
  - PSA greater than twenty
  - Gleason score of seven or greater.
- Failure of PSA to fall to undetectable after radical prostatectomy or PSA detectable and rising on two or more subsequent determinations.

For evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer):
- Initial evaluation of suspicious pelvis masses/tumors found only in the pelvis by physical exam or imaging study.
- Follow-up of known pelvic masses/tumors undergoing active treatment within the past year.
- Suspected pelvis tumor size increase or recurrence based on a sign, symptom or abnormal lab value.
- 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 CT.

For evaluation of known cancer:
- Initial staging of known cancers:
  - All cancers, excluding the following:
    - Excluding Basal Cell Carcinoma of the skin,
    - Excluding Melanoma without symptoms or signs of metastasis.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected pelvis metastasis based on a sign, symptom or an abnormal lab value.
- Surveillance after known cancer: Once per year (last test must be over ten (10) months ago before new approval) for surveillance of known cancer.

For evaluation of enlargement of organ:
- For the evaluation of an organ enlargement such as uterus, ovaries, or prostate as evidenced by physical examination or confirmed on any previous imaging.
For evaluation of suspected infection or inflammatory disease:

- Suspected acute appendicitis (or severe acute diverticulitis) if abdominal 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 antibiotics treatment.

- Suspected infection in the pelvis ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

For evaluation of known infection or inflammatory disease follow up:

- Complications of diverticulitis with severe abdominal pain or severe tenderness, 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 ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

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 aorta aneurysm limited to the pelvis
  - Suspected or known aneurysm < 4 cm AND equivocal or indeterminate ultrasound results OR
  - Prior imaging demonstrated aneurysm ≥ 4 cm in diameter OR
  - Suspected complications of known aneurysm as evidenced clinical findings such as new onset of pelvic pain.

- Scheduled follow-up evaluation of aorto/iliac endograft.
  - Asymptomatic at six (6) month intervals, for 2 years
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.

- Suspected retroperitoneal hematoma or hemorrhage.

For evaluation of trauma:

- Follow up for trauma ordered by Gastroenterologist, Urologist, Nephrologist, Surgeon or primary care provider on behalf of identified specialist who has seen the patient.

- 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 (Surgery scheduled within next thirty (30) days):

- For pelvic surgery or procedure ordered by identified specialists for pre-operative evaluation: Oncologist, Urologist, Nephrologist, Gynecologist, Gastroenterologist, or Surgeon or primary care provider on behalf of identified specialist who has seen the patient.
For post-operative evaluation:
- Follow-up of known or suspected post-operative complication involving only the pelvis.

Other indications for Pelvic CT:
- 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.
- Persistent pelvic pain not explained by multiple previous imaging studies ordered by a Gastroenterologist, Surgeon or Oncologist where at least two (2) of the following have been performed: plain film, laparoscopy, ultrasound, endoscopy including capsule endoscopy, colonoscopy, sigmoidoscopy or IVP.
- Unexplained pelvic pain in patients seventy-five (75) years or older.
- Hernia with suspected complications.
- Ischemic bowel.
- Known or suspected aseptic/avascular necrosis of hip(s) and MRI is contraindicated.

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:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Ultrasound should precede any request for 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 or adrenal mass.
- Repeat CT Hepatic mass follow-up.
- Repeat CT for aortic 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 urothelia tumors.

CT Imaging for Abdominal Aortic Aneurysms – Abdominal aortic aneurysms are usually asymptomatic and most are discovered during imaging studies ordered for other indications or on physical examination as a
pulsatile abdominal 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.

**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.

**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 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 test depends on the clinical history, but potentially includes a bone scan, biopsy, PSA doubling time assessment, CT/MRI or radioimmunologic scintigraphy. (e.g., 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.

**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.

**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**


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.

INDICATIONS FOR PELVIC MRI:

- For location or evaluation of undescended testes in adults and in children, including determination of location of testes.
- For evaluation and characterization of uterine and adnexal masses, (e.g., fibroids, ovaries, tubes and uterine ligaments).
- For evaluation of endometriosis.
- For evaluation of intrauterine embolization.
- For staging/restaging of known abdominal/pelvic tumor or cancer with no prior imaging for >10 months (cervical, uterine, prostate, rectal cancer or other pelvic tumor).
- Known tumor or cancer presenting with new signs or new symptoms
- For evaluation of known or suspected aseptic/avascular necrosis of hip(s).
- For evaluation of known or suspected abnormality of the fetus noted on prior imaging and no prior pelvis MRI.

For known or suspected prostate cancer for recurrence workup:

- Failure of PSA to fall to undetectable or PSA detectable and rising on two or more subsequent determinations, OR
  - Candidate for local therapy
  - Original clinical state T1-T2, NX or N0
  - Life expectancy >10 years
  - PSA now <10 ng/ml

ADDITIONAL INFORMATION RELATED TO PELVIC 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.
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 – 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.
**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:


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.

INDICATIONS FOR PELVIS MRA:

- For evaluation of an abdominal aortic aneurysm.
- For preoperative evaluation for repair of abdominal aortic aneurysm.
- For evaluation of suspected atherosclerotic renal artery disease or stenosis.
- For evaluation of suspected chronic mesenteric ischemia.
- For evaluation of portal venous system (hepatic portal system).
- For evaluation of systemic venous system abnormalities.
- For imaging of the renal arteries and the aortoiliac arteries in the absence of abdominal aortic aneurysm or aortic dissection.

ADDITIONAL INFORMATION RELATED TO PELVIS MRA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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, 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.

**REFERENCES:**


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 to evaluate joints and soft tissues of the upper extremities.

Shoulder pain is a common complaint and may have different causes, e.g., fractures, neoplasms, infections and rotator cuff tears. The shoulder joint is the most unstable joint in the body and is hard to assess clinically as it is also has the most mobility. Computed tomography (CT) is often used for preoperative evaluation to characterize fractures when more information is needed. CT can demonstrate the complexity, displacement and angulation of the fracture. Radiographs are usually obtained before CT images.

Computed tomography (CT) may be used for specific abnormalities in the elbow. It may be used to detect an osteochondral lesion or intra-articular body or to evaluate suspected chondral and osteochondral abnormalities. Osteoma may be identified with CT.

INDICATIONS FOR UPPER EXTREMITY CT:

For evaluation of known tumor, cancer or mass of bone:
- Initial evaluation of known tumor.
- Patient undergoing active treatment with most recent follow-up study > two (2) months (documentation to include but not limited to type/timing/duration of recent treatment).
- Palpable mass where imaging study, (such as ultrasound, MRI, x-ray, etc.) demonstrates a lesion.
- With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
- With no imaging/restaging within the past ten (10) months.

For evaluation of a suspicious mass or tumor when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- Investigation of suspicious mass or tumor when study is requested within three (3) months of imaging findings shown on plain films or previous CT.
- Investigation of suspicious mass or tumor when study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or suspected infection of bone:
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.

For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis or Scleroderma) AND cannot have MRI:
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist.
- Known or suspected auto immune disease when imaging findings are abnormal.
For evaluation of trauma that occurred within the past seven (7) days:
- Any of the following are present: abnormal imaging; joint immobility or instability; or demonstrated joint effusion.
- With a previous CT and new signs or symptoms are present.
- With prescription for immobilization.

For evaluation of pain persisting greater than three (3) days AND cannot have an MRI:
- With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
- With prescription for immobilization
- With failed joint injection.

Pre-operative evaluation:
- Scheduled surgery within thirty (30) days.

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

Shoulder fracture or subluxation:
- For assessment to rule out suspected fracture or subluxation with significant trauma when plain x-rays are normal.
- For evaluation to determine position of known fracture or subluxation.
- For assessment of union of a known fracture where physical or plain x-ray findings suggest delayed or failed healing.

For evaluation of impingement or rotator cuff tear or labral tear AND cannot have Shoulder MRI:
- For evaluation of known or suspected impingement, rotator cuff tear, or labral tear (SLAP lesion, Bankart lesion) when ordered by orthopedic specialist.
- Known or suspected impingement or when impingement test is positive and MRI is ordered by orthopedic surgeon.
- 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.

To evaluate other conditions requiring an Upper Extremity CT:
- When MRI is contraindicated and other guideline criteria are met.
- For evaluation for abnormal physical examination or imaging results that needs further imaging.
- For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome).
- For evaluation of non-painful or painful recurrent dislocation when requested by orthopedic surgeon.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY CT:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.
Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

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 4-6 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 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 can not 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 nondislocating 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 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.

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.

Occult Scaphoid Fractures – 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 proved to be superior to MRI in the detection of cortical involvement of occult scaphoid fractures.

**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.

**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 of 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:**


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.

INDICATIONS FOR UPPER EXTREMITY CTA:

- For evaluation of a dialysis graft.
- 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 preoperative evaluations.
- For postoperative evaluations.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY CTA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 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.

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. 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.
REFERENCES:


INTRODUCTION:

MRI produces high quality sectional images in multiple planes and is used for evaluating conditions, e.g., tumors, infection, fractures, in the non-joint upper extremity as well as in the hand, wrist or elbow.

It is useful in the evaluation of wrist conditions, e.g., avascular necrosis, occult fractures, neoplasms, and infections.

It is the preferred imaging technique for the evaluation of suspected osteochondral fracture or intra-articular osteocartilaginous bodies when radiographs are nondiagnostic. MRI is used to evaluate suspected occult injuries that are not evident on plain film. It can evaluate suspected unstable osteochondral injuries and suspected masses when x-rays are nondiagnostic. MRI may be used to detect both traumatic as well as stress fractures and can accurately determine the nature and extent of the pathologic changes in ligaments, tendons and muscle structures of the elbow.

Shoulder pain is a common complaint and may have different causes, e.g., fractures, neoplasms, infections and rotator cuff tears. The shoulder joint is the most unstable joint in the body and is hard to assess clinically as it is also has the most mobility. Magnetic resonance imaging is used to detect osseous and soft tissue abnormalities in the shoulder and is the procedure of choice for evaluating hidden fractures and soft tissues of the shoulder, including the tendons, ligaments, muscles, and labrocapsular structures. Radiographs are usually obtained before MRI images.

INDICATIONS FOR UPPER EXTREMITY MRI (Hand, wrist, elbow or shoulder) (plain radiographs must precede MRI evaluation):

For evaluation of known tumor, cancer or mass of bone:
- Initial evaluation of known tumor.
- Patient undergoing active treatment with most recent follow-up study > two (2) months (documentation to include but not limited to type/timing/duration of recent treatment).
- Palpable mass where imaging study, (such as ultrasound, CT, x-ray, etc.) demonstrates a lesion.
- With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
- With no imaging/restaging within the past ten (10) months.

For evaluation of a suspicious mass or tumor when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- Investigation of suspicious mass or tumor when study is requested within three (3) months of imaging findings shown on plain films or previous CT.
- Investigation of suspicious mass or tumor when study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or suspected infection of bone:
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.
For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis or Scleroderma):
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist.
- Known or suspected auto immune disease when imaging findings are abnormal.

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

For evaluation of trauma that occurred within the past seven (7) days:
- Any of the following are present: abnormal imaging; joint immobility or instability; or demonstrated joint effusion.
- With a previous MRI and new signs or symptoms are present.
- With prescription for immobilization.

For evaluation of pain persisting greater than three (3) days:
- With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
- With prescription for immobilization
- With failed joint injection.

Pre-operative evaluation:
- Scheduled surgery within thirty (30) days.

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

For evaluation of impingement or rotator cuff tear or labral tear:
- For evaluation of known or suspected impingement, rotator cuff tear, or labral tear (SLAP lesion, Bankart lesion) when ordered by orthopedic specialist.
- Known or suspected impingement or when impingement test is positive and MRI is ordered by orthopedic surgeon.
- 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.

Other indications for Upper Extremity MRI:
- For evaluation for abnormal physical examination or imaging results that needs further imaging.
- For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome).
- For evaluation of non-painful or painful recurrent dislocation when requested by orthopedic surgeon.
ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

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 4-6 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).

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 under-estimation 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 arthroscopic surgery.

Scleroderma – “Morphea” which is a term for localized scleroderma, is an autoimmune condition characterized by skin thickening and increased collagen deposition. The lesions can extend over muscular fascia, muscle tissue, tendons and joint synovia. MRI is used to aid in diagnosis, showing the involvement of the skin, subcutaneous fatty tissue, and muscle fasciae.

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:


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.

INDICATIONS FOR UPPER EXTREMITY MRA/MRV:

- For evaluation of suspected upper extremity embolism or venous thrombosis

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY MRA/MRV:

**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 O\textsubscript{2} tanks may also be contraindicated.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**Bruit**s - 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, Coarctation of aorta.

**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.

REFERENCES:


INTRODUCTION:

Plain radiographs are used as the first-line modality for assessment of most ankle conditions. Computed tomography (CT) is used after radiography in patients with complex ankle and foot fractures. It may detect occult intra-articular or juxta-articular fractures that are not shown on radiographs. Multidetector-row CT (MDCT) has fast image processing and has better temporal, spatial and contrast resolution than conventional helical CT. Magnetic resonance imaging (MRI) is the first-line choice for imaging of many ankle conditions, but CT may be used in these cases if MRI is contraindicated.

Computed tomography (CT) is used for the evaluation of hip fractures when radiographs are normal but fractures are clinically suspected. It is also used in the evaluation of tumors and metastatic lesions and to evaluate occult fractures. CT is indicated for other hip conditions when MRI is contraindicated. MRI is the imaging technique of choice for these hip disorders.

Computed tomography (CT) is used to evaluate knee fractures and for other problems of the knee, e.g., tumors, infection, ligament tears and cartilage damage when magnetic resonance imaging is contraindicated.

INDICATIONS FOR LOWER EXTREMITY CT:

ANKLE, FOOT, & HIP JOINT:
For evaluation of known tumor, cancer or mass of bone:
- Initial evaluation of known tumor.
- Patient undergoing active treatment with most recent follow-up study > two (2) months (documentation to include but not limited to type/timing/duration of recent treatment).
- Palpable mass where imaging study, (such as ultrasound, MRI, x-ray, etc.) demonstrates a lesion.
- With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
- With no imaging/restaging within the past ten (10) months.

For evaluation of a suspicious mass or tumor of bone when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- When study is requested within three (3) months of imaging findings shown on plain films or previous CT.
- When study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or rule out infection or inflammatory disease:
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.
- Known or suspected (based upon initial workup including x-ray) of septic arthritis or osteomyelitis.

For evaluation of suspected aseptic or avascular necrosis:
- When ordered by orthopedist or pediatrician.
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.
• Aseptic necrosis [avascular necrosis (AVN)] of the femoral head, (AVN in adults; Legg-Calve-Perthes disease in children) with prior x-ray.

For evaluation of trauma within the last seven (7) days:
• Severe trauma to rule out suspected fracture when plain x-ray result is normal.
• Shown on an abnormal or indeterminate imaging.
• Suspected labral tear with the following signs and symptoms:
  o Pain, clicking, transient locking, and giving way of the hip by physical examination OR
  o MR arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist.
• Determine position of known fracture fragments/dislocation.
• Occult fracture when prior imaging is negative or equivocal.

For evaluation of pain persisting greater than three (3) days AND cannot have an MRI:
• With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
• With prescription for non-weight bearing status or immobilization.

Pre-operative evaluation:
• Surgery scheduled within next thirty (30) days.

Post-operative evaluation:
• When ordered by an orthopedic specialist.
• Physical or laboratory findings show an infection, or delayed or non-healing.
• 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 Lower Extremity CT AND cannot have a MRI:
• Abnormal bone scans.
• Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which includes - medical therapy (may include physical therapy or chiropractic treatments) and/or - physician supervised home exercise of at least four (4) weeks AND - negative/normal hip x-ray
• For evaluation to rule out slipped femoral capital epiphysis with nondiagnostic or equivocal imaging.
• Known or suspected septic arthritis or osteomyelitis.
• Known tarsal coalition or to rule out suspected tarsal coalition.
• When MRI is contraindicated and other guideline criteria are met.

KNEE JOINT:

For evaluation of known tumor, cancer or mass of bone:
• Initial evaluation of known tumor of knee.
• Patient undergoing active treatment with most recent follow-up study > two (2) months (documentation to include but not limited to type/timing/duration of recent treatment).
• Palpable knee mass where imaging study, (such as ultrasound, MRI, x-ray, etc.) demonstrates a lesion.
• With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
• With no imaging/restaging within the past ten (10) months.
For evaluation of a suspicious mass or tumor of bone when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- When study is requested within three (3) months of imaging findings shown on plain films or previous CT.
- When study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or suspected infection of bone:
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.

For evaluation of suspected aseptic or avascular necrosis:
- When ordered by orthopedist or pediatrician.
- Shown on abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.

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

For evaluation of trauma within the last seven (7) days:
- When ordered by an orthopedic specialist or primary care on behalf of specialist who has seen the patient.
- Shown on an abnormal or indeterminate imaging.
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration
- Accompanied by an effusion. Must be able to differentiate joint effusion from swelling of the surrounding soft tissues and/or bursa.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (McMurray’s, Apley’s) or significant laxity on varus or valgus stress tests.
- Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamental injury determined by the drawer test or the Lachman test.
- With prescription for non-weight bearing status or immobilization.

For evaluation of pain persisting greater than seven (7) days AND cannot have a Knee MRI:
- When ordered by an orthopedic specialist or primary care provider on behalf of specialist who has seen the patient.
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- Accompanied by an effusion. Must be able to differentiate joint effusion from swelling of the surrounding soft tissues and/or bursa.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (McMurray’s, Apley’s) or significant laxity on varus or valgus stress tests.
- Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamental injury determined by the drawer test or the Lachman test.
- With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
- With prescription for non-weight bearing status or immobilization.
- With failed joint injection.

Pre-operative evaluation:
• Surgery scheduled within next thirty (30) days.

**Post-operative evaluation:**
• When ordered by an orthopedic specialist.
• Physical or laboratory findings show a joint infection, or delayed or non-healing.
• 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 Knee CT AND cannot have a Knee MRI:**
• For evaluation of joint effusion seen on plain film, when ordered by a musculoskeletal specialist, (orthopedic, rheumatologist, physiologist).
• To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence.
• When MRI is contraindicated and other guideline criteria are met.

**ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY CT:**

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**Conservative Therapy:** (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. **NOTE** - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

**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 4-6 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 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 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 is 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.

**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 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 early diagnosis of bone collapse and sclerosis early in the disease where plain radiography is not as sensitive.

**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 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.

**REFERENCES:**


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.

INDICATIONS FOR LOWER EXTREMITY CTA:

For 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), and fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- 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.

Pre-operative evaluation (surgery scheduled within the next 30 days):
- Evaluation of known aortoiliac occlusion or peripheral vascular disease of the leg and ultrasound indicates significant disease and an indeterminate conclusion about whether the condition would be amenable to surgery.

Post-operative 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:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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.

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 aneurismatic changes. It can reveal both vascular and extravascular complications.

**REFERENCES**


INTRODUCTION:

Although the hip is one of the most stable joints in the body, it is susceptible to problems due to excessive pressure. It is a ball-and-socket joint that allows motion while providing stability needed to bear body weight. Trauma in the hip may cause fractures or dislocations. Microorganisms may enter the hip joint causing septic arthritis following a penetrating trauma or contiguously from an adjacent osteomyelitis. Primary bone cancer, e.g., osteosarcoma, chondrosarcoma, may occur in the hip. Childhood hip disorders, e.g., Legg-Calve-Perthes and slipped upper femoral epiphysis, may benefit from early diagnosis. MRI is used increasingly to evaluate musculoskeletal infections in children. MRI may be used in all of the above conditions except where contraindicated, e.g., metal implants, renal disease.

Magnetic Resonance Imaging (MRI) is used to assess knee problems and conditions. Subtle abnormalities in ligaments, tendons and cartilage are well demonstrated on MRI scans.

Magnetic resonance imaging of the ankle shows the soft tissues and bones of the ankle. With its multiplanar capabilities, high contrast and high spatial resolution, it is an accurate diagnostic tool for conditions affecting the joint and adjacent structures of the ankle. MRI has the ability to positively influence clinicians’ diagnoses and management plans for patients with ankle conditions, (e.g., fractures, septic arthritis).

INDICATIONS FOR LOWER EXTREMITY MRI:

LOWER EXTREMIT Y (NON-JOINT):
- For the evaluation of known or suspected mass or tumor.
- Abnormal bone scans.
- Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which includes - medical therapy (may include physical therapy or chiropractic treatments) and/or - physician supervised home exercise of at least four (4) weeks AND - negative/normal x-ray
- To assess union of a known fracture where physical or plain film findings suggest delay or non-healing.
- To determine position of known fracture fragments.
- Known or suspected septic arthritis or osteomyelitis.

ANKLE, FOOT AND HIP JOINT:

For evaluation of known tumor, cancer or mass of bone:
- Initial evaluation of known tumor.
- Patient undergoing active treatment with most recent follow-up study > two (2) months (documentation to include but not limited to type/timing/duration of recent treatment).
- Palpable mass where imaging study, (such as ultrasound, CT, x-ray, etc.) demonstrates a lesion.
- With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
- With no imaging/restaging within the past ten (10) months.

For evaluation of a suspicious mass or tumor of bone when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- When study is requested within three (3) months of imaging findings shown prior imaging.
• When study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or suspected infection:
• Shown on abnormal or indeterminate imaging.
• With abnormal physical or laboratory findings.

For evaluation of suspected aseptic or avascular necrosis:
• When ordered by orthopedist or pediatrician.
• Shown on abnormal or indeterminate imaging.
• With abnormal physical or laboratory findings.

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

For evaluation of trauma within the last seven (7) days:
• Severe trauma to rule out suspected fracture when plain x-ray result is normal.
• Shown on an abnormal or indeterminate imaging.

For evaluation of pain persisting greater than three (3) days:
• With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
• With prescription for non-weight bearing status or immobilization.

Pre-operative evaluation:
• Surgery scheduled within next thirty (30) days.

Post-operative evaluation:
• When ordered by an orthopedic specialist.
• Physical or laboratory findings show an infection, or delayed or non-healing.
• 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 an MRI:
• Abnormal bone scans.
• Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which includes - medical therapy (may include physical therapy or chiropractic treatments) and/or - physician supervised home exercise of at least four (4) weeks AND - negative/normal x-ray
• Known or suspected septic arthritis or osteomyelitis.
• Known tarsal coalition or to rule out suspected tarsal coalition.
• Intra-articular loose body or loose fragment or Charcot joint.
• For evaluation to rule out slipped femoral capital epiphysis with nondiagnostic or equivocal imaging.
• For any evaluation of patient with hip prosthesis or other implanted metallic hardware where prosthetic looseness or dysfunction is suspected on physical examination or imaging.
KNEE JOINT:

For evaluation of known tumor, cancer or mass of joint or soft tissue:
- Initial evaluation of known tumor of the knee.
- Patient undergoing active treatment with most recent follow-up study > 2 months (documentation to include but not limited to type/timing/duration of recent treatment)
- Palpable knee mass where imaging study, (such as ultrasound, x-ray, etc.) demonstrates a lesion.
- With new signs (e.g., physical, laboratory, or imaging findings) or new symptoms.
- With no imaging/restaging within the past ten (10) months.

For evaluation of a suspicious mass or tumor of joint or soft tissue when study is requested within three (3) months of original findings on prior imaging (plain film x-ray, CT, bone scan, ultrasound, etc.):
- When study is requested within three (3) months of imaging findings shown on plain films or previous CT.
- When study is requested within three (3) months of findings when a distant primary tumor is known to exist with prior abnormal exam, lab or imaging findings requires documentation of primary tumor diagnosis (type of cancer, mo/yr diagnosed or biopsied).

For evaluation of known or suspected infection of joint or soft tissue:
- Shown on an abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.

For evaluation of suspected aseptic or avascular necrosis:
- Shown on an abnormal or indeterminate imaging.
- With abnormal physical or laboratory findings.

For evaluation of known fracture of the knee:
- To assess union of a known fracture where physical or plain film findings suggest delayed or failed healing.

For evaluation of trauma within the last seven (7) days:
- When ordered by an orthopedic specialist or primary care on behalf of specialist who has seen the patient.
- Shown on an abnormal or indeterminate imaging.
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- Accompanied by effusion. Must be able to differentiate joint effusion from swelling of the surrounding soft tissues and/or bursa.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (McMurray’s, Apley’s) or significant laxity on varus or valgus stress tests.
- Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamental injury determined by the drawer test or the Lachman test.
- With prescription for non-weight bearing status or immobilization.

For evaluation of pain persisting greater than seven (7) days:
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration
- Accompanied by effusion. Must be able to differentiate joint effusion from swelling of the surrounding soft tissues and/or bursa.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (McMurray’s, Apley’s) or significant laxity on varus or valgus stress tests.
• Accompanied by physical findings of anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) ligamental injury determined by the drawer test or the Lachman test.
• With failed course of conservative treatment, including active therapy, of at least four (4) weeks.
• With prescription for non-weight bearing status or immobilization.
• With failed joint injection.

**Pre-operative evaluation:**
• Surgery scheduled within next thirty (30) days.

**Post-operative evaluation:**
• When ordered by an orthopedic specialist.
• When imaging findings, physical or laboratory findings show joint infection or delayed or non-healing.
• 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 knee MRI:**
• For evaluation of suspected Baker’s cyst or posterior knee swelling with ultrasound requiring further evaluation.
• To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence.

**ADDITIONAL INFORMATION RELATED TO A LOWER EXTREMITY 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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**Conservative Therapy:** (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. **NOTE** - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

**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 4-6 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 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 physic to detect edema in the area of the physis.

**MRI and Tarsal Coalition** – This is a congenital condition in which two or more bones in the midfoot or hindfoot are joined. It usually presents during late childhood or late adolescence and is associated with repetitive ankle sprains. Mild pain, deep in the subtalar joint and limited range of motion are clinical symptoms. Tarsal coalition is detectable on oblique radiographs, but these are not routinely obtained at many institutions. Clinical diagnosis is not simple; it requires the expertise of skilled examiners. MRI is valuable in diagnosing tarsal coalition because it allows differentiation of osseous from non-osseous coalitions and also depicts the extent of joint involvement as well as degenerative changes. It may also detect overgrowth of the medial aspect of the talus that may be associated with talocalcaneal coalitions.

**MRI and 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:

Although the hip is one of the most stable joints in the body, it is susceptible to problems due to excessive pressure. It is a ball-and-socket joint that allows motion while providing stability needed to bear body weight. Trauma in the hip may cause fractures or dislocations. Microorganisms may enter the hip joint causing septic arthritis following a penetrating trauma or contiguously from an adjacent osteomyelitis. Primary bone cancer, e.g., osteosarcoma, chondrosarcoma, may occur in the hip. Childhood hip disorders, e.g., Legg-Calve-Perthes and slipped upper femoral epiphysis, may benefit from early diagnosis. MRI is used increasingly to evaluate musculoskeletal infections in children. It may be used in all of the above conditions except where contraindicated, e.g., metal implants, renal disease.

INDICATIONS FOR HIP MRI:

For evaluation of known tumor, cancer or rule out metastasis of the hip:
- Initial evaluation of known tumor.
- Evaluation of known tumor or cancer for patient undergoing active treatment with most recent follow-up study > 2 months (documentation to include but not limited to type/timing/duration of recent treatment).
- Evaluation of known tumor or cancer presenting with new signs (i.e., physical, laboratory, or imaging findings) or new symptoms.
- Evaluation of known tumor or cancer with no imaging/restaging within the past ten (10) months.

For evaluation of suspected tumor, cancer or mass of the hip
- Suspected palpated mass or rule out tumor with description of abnormality including size, consistency, mobility/fixed, etc.

For evaluation of known or rule out infection or inflammatory disease of the hip:
- For evaluation of known or suspected (based upon initial workup including x-ray) of septic arthritis or osteomyelitis.
- For evaluation to rule out aseptic necrosis [avascular necrosis (AVN)] of the femoral head, (AVN in adults; Legg-Calve-Perthes disease in children) with prior x-ray.

For evaluation of trauma and/or injury of the hip:
- For evaluation of severe trauma to rule out suspected fracture of hip when plain x-ray result is normal.
- Suspected labral tear with the following signs and symptoms:
  o Pain, clicking, transient locking, and giving way of the hip by physical examination OR
  o MR arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist
- For evaluation to determine position of known fracture fragments/dislocation.
- For evaluation of suspected occult fracture when prior imaging is negative or equivocal.

Other indications for a Hip MRI:
- Abnormal bone scans.
- Pre or post surgical evaluation for operation planned within four (4) weeks or performed within the past three (3) months.
• Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which includes - medical therapy (may include physical therapy or chiropractic treatments) and/or - physician supervised home exercise of at least four (4) weeks AND - negative/normal hip x-ray
• For evaluation to rule out slipped femoral capital epiphysis with nondiagnostic or equivocal imaging.
• For any evaluation of patient with hip prosthesis or other implanted metallic hardware where prosthetic looseness or dysfunction is suspected on physical examination or imaging.
• 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 HIP 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Conservative Therapy: (musculoskeletal) includes a combination of modalities, 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 (epidural, facet, bursal, and/or joint, not including trigger point), diathermy, chiropractic treatments, physician supervised home exercise program. Part of this combination may include the physician instructing patient to rest the area or stay off the injured part. NOTE - conservative therapy can be expanded to require active therapy components (physical therapy and/or physician supervised home exercise) as noted in some elements of the guideline.

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• Information provided on exercise prescription/plan AND
• Follow up with member with information provided regarding completion of HEP (after suitable 4-6 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 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 physis.

**REFERENCES:**


INTRODUCTION:

MRA is used for imaging arterial obstructive disease in the lower extremity. It is noninvasive and has little risk. It can image tibia and pedal arteries and can evaluate symptoms that occur after angiography.

INDICATIONS FOR LOWER EXTREMITY MRA/MRV:

- For evaluation of lower extremity ischemia, claudication, and foot ulcer

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY MRA/MRV:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 - 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, Coarctation of aorta.
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. Abdominal imaging begins at the diaphragm and extends to the umbilicus or iliac crests. 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. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.

INDICATIONS FOR ABDOMINAL CT:

For evaluation of known or suspected kidney or ureteral stones:
- Delineation of known or suspected renal calculi or ureteral calculi known to be only within the abdomen with completion of initial work-up.

For evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer):
- Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study.
- Follow-up of known abdomen masses/tumors found only in the abdomen undergoing active treatment within the past year.
- Suspected abdominal tumor size increase or recurrence based on a sign, symptom or abnormal lab value.
- 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.

For evaluation of known cancer:
- Initial staging of known cancer
  - All cancers, excluding the following:
    - Excluding Basal Cell Carcinoma of the skin,
    - Excluding 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 two (2) years.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected abdomen metastasis based on a sign, symptom or an abnormal lab value.
- Surveillance after known cancer: Once per year [last test must be over ten (10) months ago before new approval] for surveillance of known cancer.

For evaluation of an organ enlargement:
- For the evaluation of an organ enlargement such as hydronephrosis, 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, with 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 with abnormal elevation of amylase or lipase results.
- Suspected complications of diverticulitis (known to be limited to the abdomen by prior imaging) with abdominal 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 with recent equivocal ultrasound.
- Suspected infection in the abdomen ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

For evaluation of known infection or inflammatory disease follow up:

- Complications of diverticulitis with severe abdominal pain or severe tenderness, 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.
- Hepatitis C/hepatoma evaluation with elevated alpha-fetoprotein (AFP) or equivocal ultrasound
- Known infection ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

For evaluation of suspected or known vascular disease (e.g., aneurysms or hematomas):

- Evidence of vascular abnormality seen on imaging studies.
- Evaluation of suspected or known aorta aneurysm limited to abdomen
- Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
- Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
- Suspected complications of known aneurysm as evidenced clinical findings such as new onset of abdominal pain.
- Scheduled follow-up evaluation of aorto/iliac endograft.
- 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:

- Follow up for trauma ordered by Gastroenterologist, Urologist, Nephrologist, Surgeon or primary care provider on behalf of identified specialist who has seen the patient.
• For evaluation of trauma with lab or physical findings of intra-abdominal bleeding limited to the abdomen.

Pre-operative evaluation [surgery scheduled within next thirty (30) days]:
• For abdominal surgery or procedure ordered by identified specialists for pre-operative evaluation: Oncologist, Urologist, Nephrologist, Gynecologist, Gastroenterologist, or Surgeon or primary care provider on behalf of identified specialist who has seen the patient.

Post-operative evaluation:
• Follow-up of suspected or known post-operative complication involving only the abdomen.

Other Indications for an Abdomen CT:
• 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.
• Persistent abdominal pain not explained by multiple imaging studies where at least two (2) of the following have been performed: plain film, ultrasound, endoscopy including capsule endoscopy, colonoscopy, sigmoidoscopy or IVP.
• Unexplained abdominal pain in patients seventy-five (75) years or older.
• Suspected complete or high-grade partial small bowel obstruction limited to the abdomen.
• Hernia with suspected complications.
• Ischemic bowel.
• Diabetic patient with gastroparesis.

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Ultrasound should precede any request for Abdomen or Pelvis CT for the following evaluations:
  o Possible gallstones or abnormal liver function tests with gall bladder present.
  o Evaluation of cholecystitis.
  o Repeat CT studies of renal or adrenal mass.
  o Repeat CT Hepatic mass follow-up.
  o Repeat CT for aortic 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 urothelia tumors.

**CT Imaging for Abdominal Aortic Aneurysms** – Abdominal aortic aneurysms are usually asymptomatic and most are discovered during imaging studies ordered for other indications or on physical examination as a pulsatile abdominal 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.

**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.

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**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.

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**REFERENCES**


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.

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.
- For evaluation of suspected abdominal aortic disease when findings on ultrasound are indeterminate.
- Evaluation of hematoma/vascular trauma.
- Arterial entrapment syndromes.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis.
- Evaluation of suspected large vessel diseases
  - after ultrasound/doppler or ankle/brachial index has indicated significant disease
  - an indeterminate conclusion about whether the condition would be amenable to surgery AND
  - when evaluation of arterial sufficiency to the legs is NOT part of the evaluation. (Note: if runoff to the lower extremities is requested, Abdominal Arteries CTA should be done instead.)

Pre-operative evaluation:
- When surgery or vascular procedure scheduled within the next 30 days.

Post-operative evaluation:
- Evaluation of endovascular/interventional abdominal vascular procedures due to conditions such as atherosclerosis, thromboembolism, intimal hyperplasia, etc.
- 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.
- 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.

When Abdomen/Pelvis CTA is NOT the preferred study:
- Renal artery stenosis or renal artery hypertension. Abdomen CTA (limiting evaluation to the aorta above the bifurcation and including the abdominal arteries) is the preferred study.
- Suspected renal vein thrombosis in patient with known renal mass. Abdomen CTA (limiting evaluation to the aorta above the bifurcation and including the abdominal arteries) is the preferred study.
Kidney failure or renal insufficiency. **Abdomen CTA** (limiting evaluation to the aorta above the bifurcation and including the abdominal arteries) is the preferred study.

- Documented uncontrolled hypertension unresponsive to medical therapy. **Abdomen CTA** (limiting evaluation to the aorta above the bifurcation and including the abdominal arteries) is the preferred study.
- Significant ischemia that could be related to the presence of ulcers/gangrene or significant claudication. **Abdominal Arteries CTA** (including runoff to the lower extremities) is the preferred study.
- Aortic aneurysm (known or documented on prior imaging study such as an ultrasound). **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.

**ADDITIONAL INFORMATION RELATED TO ABDOMEN/PELVIS CTA:**

*Intravascular administration of contrast material may* be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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, 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**

**Artery Entrapment Syndrome** – The syndrome usually results in manifestations of calf pain during exercise and intermittent or progressive claudication. CTA aids in the diagnosis, characterization and classification of the syndrome, providing high-spatial-resolution images of a large anatomic range and high soft-tissue contrast. Axial images provided by CTA can help assess arterial stenoses or occlusions and to evaluate surrounding muscular anomalies.

**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 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.

REFERENCES


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.

INDICATIONS FOR ABDOMINAL CTA:

- For evaluation of:
  - Renal artery stenosis or renal artery hypertension
  - Suspected renal vein thrombosis in patient with known renal mass.
  - Kidney failure or renal insufficiency.
  - Documented uncontrolled hypertension unresponsive to medical therapy
  - Aortic aneurysm (known or documented on prior imaging study such as an ultrasound).

- Post-operative or post-procedure follow-up:
  - Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA).
  - 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 CTA:

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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.

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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. Abdomen/pelvis imaging begins at the diaphragmatic dome 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. Screening for pregnancy as part of a work-up is suggested to minimize the number of unexpected radiation exposures for women of childbearing age.

INDICATIONS FOR ABDOMEN/PELVIS CT:

For evaluation of hematuria:
- Hematuria - gross or microscopic

For evaluation of known or suspected kidney or ureteral stones:
- Delineation of known or suspected renal calculi or ureteral calculi with completion of initial work-up.

For evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer):
- Initial evaluation of suspicious abdomen/pelvis masses/tumors found by physical exam or imaging study and both the abdomen and pelvis are likely affected.
- Follow-up of known abdomen/pelvis masses/tumors, undergoing active treatment within the past year, which can not be imaged by an abdomen CT or pelvis CT alone.
- Suspected tumor size increase or recurrence based on a sign, symptom or abnormal lab value that can not be imaged by an abdomen CT or pelvis CT alone.
- Surveillance: One follow-up exam to ensure no suspicious change has occurred. No further surveillance CT unless tumor(s) are specified as highly suspicious, or change was found on last follow-up CT.

For evaluation of known cancer:
- Initial staging of known cancer
  - All cancers, excluding the following:
    - Excluding Basal Cell Carcinoma of the skin,
    - Excluding Melanoma without symptoms or signs of metastasis.
    - Excluding 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 two (2) years.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected abdomen/pelvis metastasis based on a sign, symptom or an abnormal lab value.
• Surveillance after known cancer: Once per year (last test must be over ten (10) months ago before new approval) for surveillance of known cancer.

For evaluation of an organ enlargement:
• For the evaluation of an organ enlargement such as hydronephrosis, splenomegaly, hepatomegaly, uterus, ovaries, or prostate 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, with 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 with abnormal elevation of amylase or lipase results.
• Suspected complications of diverticulitis (known to be limited to the abdomen/pelvis by prior imaging) with abdominal 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 with recent equivocal ultrasound.
• Suspected infection ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

For evaluation of known infection or inflammatory disease follow up:
• Complications of diverticulitis with severe abdominal pain or severe tenderness, 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 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.
• Known infection in the abdomen/pelvis region ordered by Surgeon, Infectious Disease Specialist, Urologist, Nephrologist, Gynecologist, Gastroenterologist or primary care provider on behalf of identified specialist who has seen the patient.

For evaluation of known or suspected vascular disease (e.g., aneurysms, hematomas)
• Evidence of vascular abnormality seen on imaging studies.
• Evaluation of suspected or known aorta aneurysm:
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
Suspected complications of known aneurysm as evidenced clinical findings such as new onset of abdominal pain
Scheduled follow-up evaluation of aorto/iliac endograft.
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:**
- Follow up for trauma ordered by Gastroenterologist, Urologist, Nephrologist, Surgeon or primary care provider on behalf of identified specialist who has seen the patient.
- For evaluation of trauma with lab or physical findings of intra-abdominal bleeding.
- Suspected retroperitoneal hematoma or hemorrhage.

**Pre-operative evaluation (surgery scheduled within next thirty (30) days):**
- For abdominal/pelvic surgery or procedure ordered by identified specialists for pre-operative evaluation: Oncologist, Urologist, Nephrologist, Gynecologist, Gastroenterologist, or Surgeon or primary care provider on behalf of identified specialist who has seen the patient.

**Post-operative evaluation:**
- Follow-up of suspected or known post-operative complication.

**Other indications for Abdomen/Pelvic CT Combo:**
- Suspected adrenal mass or pheochromocytoma based on diagnostic testing/imaging results, and/or a suspicious clinical presentation.
- 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.
- Persistent abdomen/pelvic pain not explained by multiple imaging studies where at least two (2) of the following have been performed: plain film, ultrasound, endoscopy including capsule endoscopy, colonoscopy, sigmoidoscopy or IVP.
- 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 (*evidence by a surgical abdominal scar*) when ordered as a pre-operative study by a surgeon OR when surgery scheduled within thirty (30) days.
- Hernia with suspected complications.
- Ischemic bowel.
- Diabetic patient with gastroparesis.

**ADDITIONAL INFORMATION RELATED TO ABDOMEN/PELVIS CT:**
Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Ultrasound should precede any 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 or adrenal mass.
- Repeat CT Hepatic mass follow-up.
- Repeat CT for aortic 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 urothelia tumors.

CT Imaging for Abdominal Aortic Aneurysms – Abdominal aortic aneurysms are usually asymptomatic and most are discovered during imaging studies ordered for other indications or on physical examination as a pulsatile abdominal 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.

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.

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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


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.

INDICATIONS FOR ABDOMINAL MRI:

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer):
- Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study.
- 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.

Evaluation of known cancer:
- To evaluate known or suspected abdominal metastases.
- Known cancer with suspected abdomen metastasis based on a sign, symptom or abnormal lab value.
- Surveillance after known cancer: Once per year [last test must be over ten (10) months ago before new approval] for surveillance of known cancer.

Evaluation of suspected or known vascular disease (e.g., aneurysms or hematomas):
- To evaluate abdominal aortic aneurysm.

Other Indications for an Abdominal MRI:
- To evaluate and determine location of undescended testes in an adult
- To evaluate and determine location of undescended testes in a child where ultrasound has been done previously.
- To provide alternative to abdominal CT when CT would be limited due to allergy to radiographic contrast material.
- To provide an alternative to abdomen CT when previous MRI was needed to clarify a finding a CT could not.
- Suspected adrenal mass or pheochromocytoma based on diagnostic testing/imaging results, and/or a suspicious clinical presentation.
- Known Crohn’s disease needing evaluation in a pregnant woman.
ADDITIONAL INFORMATION RELATED TO ABDOMINAL 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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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). Extracellular 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 clear suppression of the signals.

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. Rapid breath hold MRI, a more recent development, 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.

**MRI to locate and evaluate undescended testes (UDT) in a child**– When the testis is not located during the clinical examination (preferably by a physician with experience in small genital examination), tests such as US, CT or MRI imaging studies are considered to locate and evaluate the UDT. Ultrasound is the method of choice as it does not use ionizing radiation and is cost effective, child-friendly and easily available. MRI is used to locate and evaluate UDT after the US has been done.

**REFERENCES**


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. MRA is not used as a screening tool, e.g. evaluation of asymptomatic patients without a previous diagnosis.

INDICATIONS FOR ABDOMINAL MRA:

- For evaluation of renal artery stenosis or renal artery hypertension.
- For evaluation of suspected renal vein thrombosis in patient with known renal mass.
- For evaluation of kidney failure or renal insufficiency.
- For evaluation of documented uncontrolled hypertension.
- For evaluation of aortic aneurysm.

ADDITIONAL INFORMATION RELATED TO ABDOMINAL MRA:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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.

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, Coarctation of aorta.

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.
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.

Uncontrolled Hypertension - Defined as failure to control blood pressure with at least two and up to 3 medications. Most often blood pressure is uncontrolled due to inadequate medications (a single blood pressure agent, for example) or inadequate dosing (medications given but not titrated to full blood pressure effect or limitation of further dosing due to side effects). Please document current medication list and any medications that are at maximum dose effective dose or have had maximum dose limited by side effects.

REFERENCES:


INTRODUCTION:

Computed tomographic (CT) colonography, also referred to 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.

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.

ADDITIONAL INFORMATION RELATED TO CT COLONOSCOPY (VIRTUAL COLONOSCOPY):

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

REFERENCES


INTRODUCTION:

CT colonography can be an effective screening test for colorectal neoplasia. However, it is more expensive and generally less effective than optical or conventional colonoscopy. The role of CTC is still being investigated as a screening modality for colorectal cancer.

INDICATIONS FOR CT COLONOSCOPY (VIRTUAL COLONOSCOPY):

- No proven indications for CT colonography for use as a screening test in the detection of colorectal cancer.

REFERENCES:


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.

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2010 APPROPRIATE USE CRITERIA for Heart MRI:

Where there is other ACCF reviewed imaging modalities, a crosswalk shows the relative appropriate use score between the two equivalent elements.

<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk Stress Echo (SE), Chest CTA, and CCTA (Appropriate ACCF et al. Criteria # with Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9)</td>
<td>U=Uncertain (4-6)</td>
<td>Detection of CAD: Symptomatic</td>
</tr>
<tr>
<td>Evaluation of Chest Pain Syndrome (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2 U(4) | ● Intermediate pre-test probability of CAD*  
● ECG interpretable AND able to exercise | SE 116 A(7) |
| 3 A(7) | ● Intermediate pre-test probability of CAD*  
● ECG uninterpretable OR unable to exercise | SE 117 A(9) |
| 4 U(5) | ● High pre-test probability of CAD* | SE 118 A(7) |
| Evaluation of Intra-Cardiac Structures (Use of MR Coronary Angiography) | | |
| 8 A(8) | ● Evaluation of suspected coronary anomalies | CCTA 46 A(9) |
| Acute Chest Pain (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR) | | |
| 9 U(6) | ● Intermediate pre-test probability of CAD  
● No ECG changes and serial cardiac enzymes negative | CCTA 6 A(7) |
| Risk Assessment With Prior Test Results (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR) | | |
| 12 U(6) | ● Intermediate CHD risk (Framingham)  
● Equivocal stress test (exercise, stress SPECT, or stress echo) | SE 153 A(8) |
<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
<th>INDICATIONS</th>
<th>Other imaging modality crosswalk Stress Echo (SE), Chest CTA, and CCTA (Appropriate ACCF et al. Criteria # with Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9)</td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
<tr>
<td>U=Uncertain (4-6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 13 A(7)                                                        | • Coronary angiography (catheterization or CT)         | SE 141 A(8)                                                                 |
| • Stenosis of unclear significance                           |                                                         |                                                                                  |

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

| 15 U(6)                                                        | • Intermediate perioperative risk predictor            |                                                                                  |

| Structure and Function                                         |                                                         |                                                                                  |
| Evaluation of Ventricular and Valvular Function                |                                                         |                                                                                  |

| Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and delayed contrast enhancement | |                                                                                  |

| 18 A(9)                                                        | • Assessment of complex congenital heart disease including anomalies of coronary circulation, great vessels, and cardiac chambers and valves | CCTA 47 A(8)                                                                 |
| • Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and contrast enhancement | |                                                                                  |

| 19 U(6)                                                        | • Evaluation of LV function following myocardial infarction OR in heart failure patients |                                                                                  |

| 20 A(8)                                                        | • Evaluation of LV function following myocardial infarction OR in heart failure patients |                                                                                  |
| • Patients with technically limited images from echocardiogram | |                                                                                  |

| 21 A(8)                                                        | • Quantification of LV function                        |                                                                                  |
| • Discordant information that is clinically significant from prior tests | |                                                                                  |

| 22 A(8)                                                        | • Evaluation of specific cardiomyopathies (infiltrative [amyloid, sarcoid], HCM, or due to cardiotoxic therapies) |                                                                                  |
| • Use of delayed enhancement                                   | |                                                                                  |

| 23 A(8)                                                        | • Characterization of native and prosthetic cardiac valves—including planimetry of stenotic disease and quantification of regurgitant disease |                                                                                  |
| • Patients with technically limited images from echocardiogram or TEE | |                                                                                  |

<p>| 24 (A9)                                                        | • Evaluation for arrhythmogenic right ventricular cardiomyopathy (ARVC) |                                                                                  |
| • Patients presenting with syncope or ventricular              | |                                                                                  |</p>
<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score) A= Appropriate (7-9) U=Uncertain (4-6)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk Stress Echo (SE), Chest CTA, and CCTA (Appropriate ACCF et al. Criteria # with Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrhythmia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 (A8)</td>
<td>● Evaluation of myocarditis or myocardial infarction with normal coronary arteries ● Positive cardiac enzymes without obstructive atherosclerosis on angiography</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Evaluation of Intra- and Extra-Cardiac Structures</strong></td>
<td></td>
</tr>
<tr>
<td>26 A(9)</td>
<td>● Evaluation of cardiac mass (suspected tumor or thrombus) ● Use of contrast for perfusion and enhancement</td>
<td></td>
</tr>
<tr>
<td>27 A(8)</td>
<td>● Evaluation of pericardial conditions (pericardial mass, constrictive pericarditis)</td>
<td></td>
</tr>
<tr>
<td>28 A(8)</td>
<td>● Evaluation for aortic dissection</td>
<td></td>
</tr>
<tr>
<td>29 A(8)</td>
<td>● Evaluation of pulmonary veins prior to radiofrequency ablation for atrial fibrillation ● Left atrial and pulmonary venous anatomy including dimensions of veins for mapping purposes</td>
<td>Chest CTA 38 A(8)</td>
</tr>
<tr>
<td></td>
<td><strong>Detection of Myocardial Scar and Viability</strong></td>
<td></td>
</tr>
<tr>
<td>30 A(7)</td>
<td>● To determine the location, and extent of myocardial necrosis including ‘no reflow’ regions ● Post acute myocardial infarction</td>
<td></td>
</tr>
<tr>
<td>31 U(4)</td>
<td>● To detect post PCI myocardial necrosis</td>
<td></td>
</tr>
<tr>
<td>32 A(9)</td>
<td>● To determine viability prior to revascularization ● Establish likelihood of recovery of function with revascularization (PCI or CABG) or medical therapy</td>
<td></td>
</tr>
<tr>
<td>33 A(9)</td>
<td>● To determine viability prior to revascularization ● Viability assessment by SPECT or dobutamine echo has provided &quot;equivocal or indeterminate&quot; results</td>
<td></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 2006 APPROPRIATE USE CRITERIA for Heart MRI:

<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>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (1-3); I= Inappropriate</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>-------------</td>
<td>------------------------------------------</td>
</tr>
</tbody>
</table>
| 1. Evaluation of Chest Pain Syndrome (Use of MR Coronary Angiography) | Low pre-test probability of CAD  
ECG interpretable AND able to exercise | I(2) |
| 5. Intermediate pre-test probability of CAD  
ECG interpretable AND able to exercise | | I(2) |
| 6. Intermediate pre-test probability of CAD  
ECG uninterpretable OR unable to exercise | | I(2) |
| 7. High pre-test probability of CAD | | I(1) |
| 10. High pre-test probability of CAD  
ECG - ST segment elevation and/or positive cardiac enzymes | | I(1) |
| 11. Normal prior stress test (exercise, nuclear, echo, MRI)  
High CHD risk (Framingham)  
Within 1 year of prior stress test | | I(2) |
| 14. Intermediate perioperative risk predictor | | I(2) |
| 16. Evaluation of bypass grafts | | I(2) |
| 17. History of percutaneous revascularization with stents | | I(1) |

**ADDITIONAL INFORMATION RELATED TO HEART MRI:**

**Abbreviations**
- ACS = acute coronary syndrome
- CAGB = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- 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)

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

*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>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

**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%.

***Perioperative Risk Predictors (As defined by the ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation of Non-Cardiac Surgery)

- Major risk predictors
  - Unstable coronary syndromes, decompensated heart failure (HF), significant arrhythmias, and severe valve disease.

- Intermediate risk predictors
  - Mild angina, prior myocardial infarction (MI), compensated or prior HF, diabetes, or renal insufficiency.

- Minor risk predictors
  - Advanced age, abnormal electrocardiogram (ECG), rhythm other than sinus, low functional capacity, history of cerebrovascular accident, and uncontrolled hypertension.

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.

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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**


INTRODUCTION:

The use of Electron Beam CT/Coronary Artery Calcium Scoring (EBCT) for patients at risk for Coronary Artery Disease is considered *unproven* for the purpose of assessing cardiac risk stratification. Other modalities of risk assessment should be pursued, including but not limited to, standard stress testing, stress echocardiography, myocardial perfusion imaging/SPECT (MPI) or CCTA.

INDICATIONS FOR EBCT:

- No proven indications for EBCT for use in coronary artery disease.

REFERENCES:


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 #29, assessment of right ventricular morphology or suspected arrhythmogenic right ventricular dysplasia.

For indications in which there are one or more alternative tests appropriate use score rating (appropriate, uncertain) noted, for example indication #30 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.

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 2010 Appropriate Use Criteria for Cardiac (Heart) Computed Tomography:

<table>
<thead>
<tr>
<th>ACCF et al. Criteria # Heart CT (Indication and Appropriate Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk, TTE, Stress Echo (SE) and Heart MRI (ACCF et.al. Criteria # Indication with Appropriate Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate; U=Uncertain</td>
<td>Evaluation of Cardiac Structure and Function</td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria # Heart CT (Indication and Appropriate Use Score) A= Appropriate; U=Uncertain</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
<td>Other imaging modality crosswalk, TTE, Stress Echo (SE) and Heart MRI (ACCF et.al. Criteria # Indication with Appropriate Use Score)</td>
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<tr>
<td><strong>Adult Congenital Heart Disease</strong></td>
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</tbody>
</table>
| 25 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) | |
| 26 A (8) | • Further assessment of complex adult congenital heart disease after confirmation by echocardiogram  
  Footnote – reference ACCF Guideline for Stress Echocardiogram indications #92 and #94) | |
| **Evaluation of Ventricular Morphology and Systolic Function** | | |
| 27 A (7) | • Evaluation of left ventricular function  
  • Following acute MI or in HF patients  
  • Inadequate images from other noninvasive methods | |
| 28 A (7) | • Quantitative evaluation of right ventricular function | TTE 15 A(9) |
| 29 A (7) | • Assessment of right ventricular morphology  
  • Suspected arrhythmogenic right ventricular dysplasia | |
| 30 U (5) | • Assessment of myocardial viability  
  • Prior to myocardial revascularization for ischemic left ventricular systolic dysfunction  
  • Other imaging modalities are inadequate or contraindicated | SE 176 A(8) |
| **Evaluation of Intra- and Extracardiac Structures** | | |
| 31 A (8) | • Characterization of native cardiac valves  
  • Suspected clinically significant valvular dysfunction  
  • Inadequate images from other noninvasive methods | Heart MRI 23 A(8) |
| 32 A (8) | • Characterization of prosthetic cardiac valves  
  • Suspected clinically significant valvular dysfunction  
  • Inadequate images from other noninvasive methods | Heart MRI 23 A(8) |
<p>| 33 A (8) | • Evaluation of cardiac mass (suspected tumor or | Heart MRI 26 A(9) |</p>
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # Heart CT (Indication and Appropriate Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk, TTE, Stress Echo (SE) and Heart MRI (ACCF et.al. Criteria # Indication with Appropriate Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate; U=Uncertain</td>
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<td></td>
<td>thrombus)</td>
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<td></td>
<td>• Inadequate images from other noninvasive methods</td>
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<tr>
<td>34 A (8)</td>
<td>• Evaluation of pericardial anatomy</td>
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</tbody>
</table>
| 35 A (8) | • Evaluation of pulmonary vein anatomy  
| | • Prior to radiofrequency ablation for atrial fibrillation | |
| 36 A (8) | • Noninvasive coronary vein mapping  
| | • Prior to placement of biventricular pacemaker | |
| 37 A (8) | • Localization of coronary bypass grafts and other retrosternal anatomy♦  
| | • Prior to reoperative chest or cardiac surgery | (*for “localization of coronary bypass grafts” CCTA preferred and for “other retrosternal anatomy” Heart CT preferred) |

**INDICATIONS FOR HEART CT:**
Where Stress Echocardiography (SE) is noted as an appropriate substitute for a Heart CT indication #30 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**
- 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 Use Score for inappropriate indications (median score 1-3) noted below **OR** one or more of the following:
  - For same imaging tests less than six weeks apart unless specific guideline criteria states otherwise.
  - 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.
  - For re-imaging of repeat or poor quality studies.
  - 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:
  - As the first test in evaluating symptomatic patients (e.g. chest pain)
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.

- 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
- 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 or Nuclear Cardiac Imaging
- PCI = percutaneous coronary intervention
- SE = Stress Echocardiogram
- TTE = Transthoracic Echocardiography

**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>
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<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
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<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
<td>Very low</td>
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<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
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<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
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<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
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<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 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
- 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.

**Intravascular administration of contrast material** may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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 than 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


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.

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.

For indications in which there are one or more alternative tests that are equally appropriate use score rating (appropriate, uncertain) noted, for example indication #1 Intermediate pretest probability of CAD, ECG interpretable AND able to exercise, additional factors should be considered when determining the preferred test (Stress Echocardiogram if there are no contra-indications).

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2010 APPROPRIATE USE SCORE CRITERIA for CCTA:

<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>CCTA (Indication and Appropriate Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of CAD in Symptomatic Patients Without Known Heart Disease Symptomatic</td>
<td>Nonacute Symptoms Possibly Representing an Ischemic Equivalent</td>
<td></td>
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<tr>
<td>1 U(5)</td>
<td>• Low pretest probability of CAD* • ECG interpretable and able to exercise</td>
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<tr>
<td>1 A(7)</td>
<td>• Intermediate pretest probability of CAD* • ECG interpretable AND • Able to exercise</td>
<td>SE 116 A(7)</td>
<td></td>
</tr>
<tr>
<td>2 A(7)</td>
<td>• Low pretest probability of CAD* • ECG uninterpretable or unable to exercise</td>
<td>SE 115 A(7)</td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>CCTA (Indication and Appropriate Use Score)</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
<td>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</td>
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<tr>
<td>2 A(8)</td>
<td>• Intermediate pretest probability of CAD*</td>
<td>SE 117 A(9)</td>
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<tr>
<td>2 U(4)</td>
<td>• High pretest probability of CAD*</td>
<td>SE 118 A(7)</td>
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<tr>
<td><strong>Acute Symptoms With Suspicion of ACS (Urgent Presentation)</strong></td>
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<tr>
<td>4 U(6)</td>
<td>• Persistent ECG ST-segment elevation following exclusion of MI</td>
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<tr>
<td>5 U(6)</td>
<td>• Acute chest pain of uncertain cause (differential diagnosis includes pulmonary embolism, aortic dissection, and ACS [&quot;triple rule out&quot;])</td>
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<tr>
<td><strong>Pretest Probability of CAD</strong></td>
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<tr>
<td>6 Low/Int Risk* A(7)</td>
<td>• Non-acute symptoms Possibly Representing an Ischemic Equivalent</td>
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<tr>
<td>High Risk* U(4)</td>
<td>• Normal ECG and cardiac biomarkers (Troponin and CPK/CPK-MB)</td>
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<tr>
<td>7 Low/Int Risk* A(7)</td>
<td>• Non-acute symptoms Possibly Representing an Ischemic Equivalent</td>
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<tr>
<td>High Risk* U(4)</td>
<td>• ECG uninterpretable</td>
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<tr>
<td>8 Low/Int Risk* A(7)</td>
<td>• Non-acute symptoms Possibly Representing an Ischemic Equivalent</td>
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<tr>
<td>High Risk* U(4)</td>
<td>• Nondiagnostic ECG or equivocal cardiac biomarkers</td>
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<tr>
<td><strong>Detection of CAD/Risk Assessment in Asymptomatic Individuals Without Known CAD</strong></td>
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<tr>
<td>9 A(7)</td>
<td>• Low global CHD risk estimate**</td>
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<tr>
<td>High Risk* U(4)</td>
<td>• Family history of premature CHD</td>
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<tr>
<td>10 Int Risk** A(7)</td>
<td>• Risk assessment in Asymptomatic Patients</td>
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<tr>
<td>High Risk** U(4)</td>
<td>• No known CAD</td>
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<tr>
<td><strong>Coronary CTA</strong></td>
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<tr>
<td>11 High Risk** U(4)</td>
<td>• Asymptomatic</td>
<td>SE 127 U(5)</td>
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<tr>
<td><strong>Coronary CTA Following Heart Transplantation</strong></td>
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<tr>
<td>12 U(6)</td>
<td>• Routine evaluation of coronary arteries</td>
<td></td>
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<tr>
<td><strong>Detection of CAD in Other Clinical Scenarios</strong></td>
<td></td>
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<tr>
<td>13 Low/Int Risk* A(7)</td>
<td>• Reduced left ventricular ejection fraction (&lt;40% EF)</td>
<td></td>
<td></td>
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<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS</td>
<td>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</td>
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<tr>
<td>CCTA (Indication and Appropriate Use Score)</td>
<td>(*Refer to Additional Information section)</td>
<td>SE 128 A(7)</td>
<td></td>
</tr>
<tr>
<td>High Risk* U(4)</td>
<td>Normal left ventricular ejection fraction</td>
<td></td>
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</tr>
<tr>
<td>Low/Int Risk* U(5) High Risk* U(4)</td>
<td>• Normal left ventricular ejection fraction</td>
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<tr>
<td>Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery</td>
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<tr>
<td>Low Risk* U(6) Int Risk* A(7)</td>
<td>• Coronary evaluation before noncoronary cardiac surgery</td>
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<tr>
<td>Arrhythmias—Etiology Unclear After Initial Evaluation</td>
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<tr>
<td>17 U(6)</td>
<td>Nonsustained ventricular tachycardia</td>
<td>SE 130 A(7)</td>
<td></td>
</tr>
</tbody>
</table>
| 18 U(4) | Syncope  
• Low global CAD risk** initial evaluation includes echocardiogram  
• Intermediate and High global CAD risk** initial evaluation includes echocardiogram | SE 134 A(7) |
| Elevated Troponin of Uncertain Clinical Significance | | |
| 19 U(6) | Elevated Troponin without additional evidence of ACS or symptoms suggestive of CAD | SE 135A(7) |
| Use of CTA in the Setting of Prior Test Results | | |
| Prior ECG Exercise Testing | | |
| 20 A(7) | Normal ECG exercise test  
• Continued symptoms | |
| 21 A(7) | Prior ECG exercise testing  
• Intermediate risk*** Duke Treadmill Score— | SE 149 A(7) |
| Sequential Testing After Stress Imaging Procedures | | |
| 22 A(8) | Discordant ECG exercise and imaging results | |
| Prior CCS | | |
| 24 U(4) | Zero Coronary Calcium Score >5 y ago | |
| 26 U(6) | Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients  
• Coronary Calcium Score 401–>1000 | |
<p>| 26 A(8) | Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients | |</p>
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>CCTA (Indication and Appropriate Use Score)</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Coronary Calcium Score &lt;100-400</td>
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<tr>
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<td>Evaluation of New or Worsening Symptoms in the Setting of Past Stress Imaging Study</td>
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<tr>
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<td>29 U(6) • Previous stress imaging study abnormal</td>
<td>SE 151 A(7)</td>
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<tr>
<td></td>
<td></td>
<td>29 A(8) • Previous stress imaging study normal</td>
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<td>Risk Assessment Preoperative Evaluation of Noncardiac Surgery Without Active Cardiac Conditions</td>
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<td></td>
<td>Intermediate-Risk Surgery</td>
<td></td>
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<td>33 U(5) • Functional capacity &lt;4 METs with 1 or more clinical risk predictors</td>
<td>SE 157 U(6)</td>
</tr>
<tr>
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<td>Vascular Surgery</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>37 U(6) • Functional capacity &lt;4 METs with 1 or more clinical risk predictors</td>
<td>SE 161 A(7)</td>
</tr>
<tr>
<td></td>
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<td>Risk Assessment Postrevascularization (PCI or CABG)</td>
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<td></td>
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<td>Symptomatic (Ischemic Equivalent)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>39 A(8) • Evaluation of graft patency after CABG</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>41 U(6) • Prior coronary stent with stent diameter ≥3 mm</td>
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<td></td>
<td>Asymptomatic—CABG</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>42 U(5) • Prior coronary bypass surgery ≥5 y ago</td>
<td>SE 172 U(6)</td>
</tr>
<tr>
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<td></td>
<td>Asymptomatic—Prior Coronary Stenting</td>
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<tr>
<td></td>
<td></td>
<td>43 A(7) • Prior left main coronary stent with stent diameter ≥3 mm</td>
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<td></td>
<td></td>
<td>45 U(4) • Stent diameter ≥3 mm</td>
<td>Greater than or equal to 2 y after PCI</td>
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<td></td>
<td>Evaluation of Cardiac Structure and Function</td>
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<td></td>
<td>Adult Congenital Heart Disease</td>
<td></td>
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<td></td>
<td></td>
<td>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)</td>
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<tr>
<td></td>
<td></td>
<td>Evaluation of Intra- and Extracardiac Structures</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>60 A(8) • Localization of coronary bypass grafts and other retrosternal anatomy*</td>
<td>Prior to reoperative chest or cardiac surgery</td>
</tr>
</tbody>
</table>
INDICATIONS FOR CORONARY CT ANGIOGRAPHY (CCTA):

Where Stress Echocardiography (SE) is noted as an appropriate substitute for a Coronary CT Angiography (CCTA) indication (#’s 1, 2, 11, 14, 17, 18, 19, 21, 23, 33, 37, and 42) 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
- CCTA 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)
  - 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.

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/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2010 APPROPRIATE USE SCORE CRITERIA:**

<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>CCTA</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
</table>
| Detection of CAD in Symptomatic Patients Without Known Heart Disease Symptomatic | Nonacute Symptoms Possibly Representing an Ischemic Equivalent | 1 | • High pretest probability of CAD*  
• ECG interpretable and able to exercise | I(3) |
| Acute Symptoms With Suspicion of ACS (Urgent Presentation) | 3 | • Definite MI | I(1) |
| Detection of CAD/Risk Assessment in Asymptomatic Individuals Without Known CAD | Noncontrast CT for CCS | 10 | • Low global CHD risk estimate** | I(2) |
| Coronary CTA | 11 | • Low or Intermediate global CHD risk estimate** | I(2) |
| Detection of CAD in Other Clinical Scenarios | Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery | 15 | • High pretest probability of CAD*  
• Coronary evaluation before noncoronary cardiac surgery | I(3) |
| Arrhythmias—Etiology Unclear After Initial Evaluation | 16 | • New-onset atrial fibrillation (atrial fibrillation is underlying rhythm during imaging) | I(2) |
| Use of CTA in the Setting of Prior Test Results | ECG Exercise Testing | 21 | • Prior ECG exercise testing  
• Duke Treadmill Score***—low risk findings | I(2) |
| 21 | • Prior ECG exercise testing  
• Duke Treadmill Score***—high risk findings | I(3) |
<p>| Sequential Testing After Stress Imaging Procedures | 23 | • Stress imaging results: moderate or severe ischemia | I(2) |
| Prior CCS | 25 | • Positive Coronary Calcium Score &gt;2 y ago | I(2) |
| Periodic Repeat Testing in Asymptomatic OR Stable Symptoms With Prior Stress Imaging or Coronary Angiography |</p>
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCTA</td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
</tbody>
</table>
| 27                    | • No known CAD  
                        • Last study done <2 y ago | I(2) |
| 27                    | • No known CAD  
                        • Last study done ≥2 y ago | I(3) |
| 28                    | • Known CAD  
                        • Last study done <2 y ago | I(2) |
| 28                    | • Known CAD  
                        • Last study done ≥2 y ago | I(3) |

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

**Low-Risk Surgery**

| 30                    | • Preoperative evaluation for noncardiac surgery risk assessment, irrespective of functional capacity | I(1) |

**Intermediate-Risk Surgery**

| 31                    | • No clinical risk predictors | I(2) |
| 32                    | • Functional capacity ≥4 METs | I(2) |
| 34                    | • Asymptomatic <1 y following a normal coronary angiogram, stress test, or a coronary revascularization procedure | I(1) |

**Vascular Surgery**

| 35                    | • No clinical risk predictors | I(2) |
| 36                    | • Functional capacity ≥4 METs | I(2) |
| 38                    | • Asymptomatic <1 y following a normal coronary angiogram, stress test, or a coronary revascularization procedure | I(2) |

**Risk Assessment Postrevascularization (PCI or CABG)**

**Symptomatic (Ischemic Equivalent)**

| 40                    | • Prior coronary stent with stent diameter <3 mm or not known | I(3) |

**Asymptomatic—CABG**

| 42                    | • Prior coronary bypass surgery <5 y ago | I(2) |

**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  
                        • Less than 2 y after PCI | I(3) |

**Evaluation of Cardiac Structure and Function**

**Evaluation of Ventricular Morphology and Systolic Function**
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCTA</td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
</tbody>
</table>
| 48                     | • Initial evaluation of left ventricular function  
                        | • Following acute MI or in HF patients         | I(2)                                          |
|                        | **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

**Chest pain** - Treat symptoms of angina, chest pressure or chest discomfort as chest pain under 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.

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

**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>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>Low</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 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.

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

\[ DTS = \text{exercise time} - (5 \times \text{ST deviation}) - (4 \times \text{exercise angina}) \]

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 ≥ +5), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of ≤ -11) categories.
REFERENCES


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).

INDICATIONS FOR ABDOMINAL ARTERIES CTA:

- For known or suspected thoracic aortic aneurysm.
- For suspected aortic dissection.
- For known or suspected peripheral arterial disease.

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.

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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.

INDICATIONS FOR BRAIN MRS:

- For the evaluation of a recurrent or residual brain tumor from post-treatment changes e.g., radiation necrosis.

ADDITIONAL INFORMATION RELATED TO BRAIN MRS:

**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 O\textsubscript{2} tanks may also be contraindicated.

**Intravascular administration of contrast material** may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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.
REFERENCES


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

Another CPT code should be selected that describes the specific service being requested otherwise this procedure can not be approved.
The CPT code that has been selected is considered to be an “unlisted code”.

Another CPT code should be selected that describes the specific service being requested otherwise this procedure can not be approved.
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 women 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.

INDICATIONS FOR BREAST MRI FOR WOMEN:

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:
- 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).
- One or more first degree relatives (parents, siblings, and children) have history of breast cancer and/or positive breast cancer gene test results.
- Women 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:
- One or more first degree relatives (parents, siblings, and children) have history of breast cancer and/or positive breast cancer gene test results.
- 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 mammogram due to breast characteristics limiting the sensitivity of mammography (e.g., extremely 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, Cowden syndrome or Bannayan-Riley-Ruvalcaba syndrome.

**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.

**Pre-operative:**
• 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:**

**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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**MRI as First-Line Screening Modality** – Only recently has the use of MRI for screening been encouraged. It is now used for screening in women 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 woman tests negative for BRCA mutations, she may still be at risk for breast cancer if she has first degree relatives with a history of breast cancer or positive BRCA mutations.

**MRI in Women 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:**


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.

INDICATIONS FOR CT BONE DENSITOMETRY:

For first time baseline screening in female patient over 40 years of age with suspected osteoporosis or osteopenia and one of the following:
- Patient is more than 65 years old.
- Patient is on medications associated with development of osteoporosis, e.g., steroids or glucocorticosteroids, anticonvulsants, heparin, lithium.
- Patient is a current cigarette smoker and has a low body weight (<127 lbs.).
- Patient is Caucasian with estrogen deficiency and low calcium intake.
- Patient is Caucasian with estrogen deficiency and alcoholism.
- Patient is Caucasian with adult history of fracture.
- Patient has evidence of osteoporosis or osteopenia from x-ray or ultrasound.
- Patient’s parents or siblings have adult history of fracture.

For first time baseline screening in male patient with suspected osteoporosis or osteopenia and meets one of the following risk factors below:
- Steroid therapy equivalent to 7.5 mg of Prednisone or greater per day for more than 3 months.
- Initiation of selective estrogen receptor modulators (SERMs), calcitonin, or biphosphonates, e.g., Actonel, Etidronate, Calcimar, Didronel, Evista, Fosamax, Micacalcin 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 in female patient with known osteoporosis or osteopenia:
- Patient has not had a bone mineral density study within the past 23 months.
• Patient had bone density within past 23 months AND meets any one of the following risk factor criteria:
  ▪ Hormone replacement therapy (females only)
  ▪ SERMs, calcitonin, or biphosphonates within the past 6 months (Actonel, Etidronate, Calcinmar, Calcitonin, Didronel, Evista, Fosamax, Miacalcin)
  ▪ Steroid therapy equivalent to 7.5 mg of Prednisone or greater per day for more than 3 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. Metabolic bone disease, i.e. osteomalacia and vitamin D deficiency.
  ▪ Hyperparathyroidism.
  ▪ Hypogonadism (males only)
  ▪ Thyroid hormone therapy or hyperthyroidism.
  ▪ Chemotherapy
  ▪ Long term Heparin therapy
  ▪ Spinal deformities
  ▪ Renal osteodystrophy

For screening in **male patient with known osteoporosis or osteopenia**
• Patient had bone mineral density study more than six (6) months ago and meets any one of the risk factor criteria listed above.

ADDITIONAL INFORMATION RELATED TO CT BONE DENSITOMETRY:

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**QCT** – Quantitative computed tomography measures trabecular bone density and can detect trabecular loss early. It is not as readily available as DXA and it is more expensive. Radiation exposure is also higher than in DXA.

REFERENCES:


Binkley, N.C., Schmeer, P., Wasnich, R.D., et al. (2002). What are the criteria by which a densitometric diagnosis of osteoporosis can be made in males and non-caucasians? *Journal of Clinical Densitometry, 5*(3), s19-s27.


Clinical Indications same as those required for CT Bone Density
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.

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.

ADDITIONAL INFORMATION RELATED TO BONE MARROW 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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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


INDICATIONS FOR A LIVER SPECT SCAN:

- Evaluation of hepatic artery catheter placement AND the ordering physician is a surgeon, Hematologist or Gastrointestinal specialist.
- Detection of accessory splenic tissue or asplenia AND patient has not had a previous Nuclear Liver or Spleen scan.
- Evaluation of focal nodular hyperplasia AND the ordering physician is a surgeon, Hematologist or Gastrointestinal specialist.
- Evaluation of patients with suspected liver or spleen rupture or hematoma and an Abdominal CT or MRI is contraindicated AND patient has not had a previous Nuclear Liver or Spleen scan within the past three (3) months.
- Evaluation of size, shape, and position of liver and spleen and an Abdominal CT or MRI is contraindicated AND patient has not had a previous Nuclear Liver or Spleen scan within the past three (3) months.
- Detection of space-occupying lesions: abscesses, cysts, and primary tumors and an Abdominal CT or MRI is contraindicated AND patient has not had a previous Nuclear Liver or Spleen scan within the past three (3) months.
- Evaluation of hepatic metastasis (pre and post-therapy) AND patient has a contraindication to a PET scan or a PET scan is unavailable.

ADDITIONAL INFORMATION RELATED TO A LIVER 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:

INDICATIONS FOR A BONE/JOINT SPECT SCAN:

- Evaluation of high risk patients with 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, ordered by an Orthopedist or an infectious disease specialist, with documented history of having a plain x-ray AND an MRI of the area performed.
- Detection of early avascular necrosis and patient has had a plain x-ray or a CT of the suspicious area.
- 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, results should be positive or inconclusive.)
- Resolution of questionable abnormal skeletal radiographs.

ADDITIONAL INFORMATION RELATED TO BONE/JOINT SPECT SCAN:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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

ACR Practice Guideline for the Performance of Adult and Pediatric Skeletal Scintigraphy (Bone Scan). (2007). Retrieved from:  
INTRODUCTION:

Stress tests are done to assess cardiac function in terms of heart’s ability to respond to increased work. Stress testing can be done without imaging including Standard Exercise Treadmill Testing (ETT) or with imaging including Stress Echocardiography (SE) and nuclear myocardial perfusion imaging (MPI).

Exercise Treadmill Testing (ETT) is often an appropriate first line test in many patients with suspected CAD. However, there are patients in whom the test is not the best choice, for example those with resting ECG abnormalities, inability to exercise, and perimenopausal women.

Stress Echocardiography is an initial imaging modality for the evaluation of coronary artery disease/ischemic heart disease when stress testing with imaging is indicated. It has similar sensitivity and superior specificity to MPI for evaluation of ischemic heart disease and avoids radiation. In addition to diagnostic capabilities stress echocardiography is useful in risk stratification and efficacy of therapy.

Myocardial perfusion imaging is also often used as an initial test to evaluate the presence, and extent of coronary disease. Like stress echocardiography it is also used to risk stratify patients with and without significant disease. Similar to all stress testing MPI can be used for monitoring the efficacy of therapy and may have a more powerful role in the assessment of myocardial viability in patients who have had a myocardial infarction in whom interventions are contemplated. Perhaps it’s most important distinction lies in the tests ability to obtain useful information in patients who are unable to exercise. In such cases drugs such as, dipyridamole, dobutamine, or adenosine, are administered to mimic the physiological effects of exercise.

The common approach for stress testing by American College of Cardiology and American Heart Association indicates the following:

- Treadmill test: sensitivity 68%, specificity 77%
- Stress Echocardiogram: sensitivity 76%, specificity 88%
- Nuclear test: sensitivity 88%, specificity 77%

Stress echo and MPI have been evaluated by the American College of Cardiology (ACC) and found to be similar in rating across a number of indicators for cardiac stress testing. As part of NIA efforts to curb unneeded radiation exposure whenever possible, this guideline emphasizes the use of stress echocardiography for cardiac evaluation whenever the two modalities are found to be equivalent in “Acceptable” and “Uncertain” ranking status. Where the indicator shows a difference in ranking between MPI and Echocardiographic Stress testing, the MPI will be allowed as the preferential test. All pertinent indicators are marked with a (large check mark in the table below).
### ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 APPROPRIATE USE CRITERIA:

#### INDICATIONS

(*) Refer to Additional Information section

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”

#### APPROPRIATE USE SCORE

(4-9);

A= Appropriate;

U=Uncertain (MPI / Stress Echo)

---

### Detection of CAD/Risk Assessment: Symptomatic

**Evaluation of Ischemic Equivalent (Non-Acute)**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
</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)

**Asymptomatic**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
</table>
| 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**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 / 128</td>
<td>• No prior CAD evaluation AND no planned coronary angiography</td>
<td>A(8) / A(7)</td>
</tr>
</tbody>
</table>

**New-Onset Atrial Fibrillation ♦**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 / 132</td>
<td>• Part of evaluation when etiology unclear</td>
<td>U(6) / U(6)</td>
</tr>
</tbody>
</table>

**Ventricular Tachycardia ♦**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 / NA</td>
<td>• Low CHD risk (ATP III risk criteria)***</td>
<td>A(7) / NA</td>
</tr>
<tr>
<td>19 / NA</td>
<td>• Intermediate or high CHD risk (ATP III risk criteria)***</td>
<td>A(8) / NA</td>
</tr>
</tbody>
</table>

**Syncope**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 / 134</td>
<td>• Intermediate or high CHD risk (ATP III risk criteria)***</td>
<td>A(7) / A(7)</td>
</tr>
</tbody>
</table>

**Elevated Troponin**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 / 135</td>
<td>• Troponin elevation without additional evidence of acute coronary syndrome (with ischemia present patient is not subject to Stress Echocardiogram contraindications) ✓</td>
<td>A(7) / A(7) ✓</td>
</tr>
</tbody>
</table>

---

Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI / Stress Echo</td>
<td>(*Refer to Additional Information section) 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>(4-9); A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
</tbody>
</table>

### Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
</table>
| 26 / 145 | Intermediate to high CHD risk (ATP III risk criteria)  
Last stress imaging study done more than or equal to 2 years ago  
If known CAD, not subject to Stress Echo contraindications | U(6) / U(4) |

### Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
</table>
| 28 / 147 | Known CAD on coronary angiography OR prior abnormal stress imaging study  
Last stress imaging study done more than or equal to 2 years ago | U(5) / U(5) |

### Prior Noninvasive Evaluation

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 / 153</td>
<td>Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern</td>
<td>A(8) / A(8)</td>
</tr>
</tbody>
</table>

### New or Worsening Symptoms

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 / 151</td>
<td>Abnormal coronary angiography OR abnormal prior stress imaging study</td>
<td>A(9) / A(7)</td>
</tr>
<tr>
<td>31 / 152</td>
<td>Normal coronary angiography OR normal prior stress imaging study</td>
<td>U(6) / U(5)</td>
</tr>
</tbody>
</table>

### Coronary Angiography (Invasive or Noninvasive)

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 / 141</td>
<td>Coronary stenosis or anatomic abnormality of uncertain significance</td>
<td>A(9) / A(8)</td>
</tr>
</tbody>
</table>

### Asymptomatic Prior Coronary Calcium Agatston Score

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
</table>
| 34 / 137 | Low to intermediate CHD risk  
Agatston score between 100 and 400 | U(5) / U(5) |
| 35 / 138 | High CHD risk  
Agatston score between 100 and 400 | A(7) / U(6) |
| 36 / 139 | Agatston score greater than 400 | A(7) / A(7) |

### Duke Treadmill Score

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 / 149</td>
<td>Intermediate-risk Duke treadmill score</td>
<td>A(7) / A(7)</td>
</tr>
<tr>
<td>39 / 150</td>
<td>High-risk Duke treadmill score</td>
<td>A(8) / A(7)</td>
</tr>
</tbody>
</table>

### Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions

#### Intermediate-Risk Surgery

<table>
<thead>
<tr>
<th>Score</th>
<th>INDICATIONS</th>
<th>Appropriate Use Score</th>
</tr>
</thead>
</table>
| 43 / 157 | Greater than or equal to 1 clinical risk factor  
Poor or unknown functional capacity (less than 4 METs) | A(7) / U(6) |
<table>
<thead>
<tr>
<th>INDICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(*Refer to Additional Information section)</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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4-9); A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
</tbody>
</table>

### Vascular Surgery

<table>
<thead>
<tr>
<th>47 / 161</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than or equal to 1 clinical risk factor</td>
</tr>
<tr>
<td>Poor or unknown functional capacity (less than 4 METS)</td>
</tr>
<tr>
<td>A(8) / A(7)</td>
</tr>
</tbody>
</table>

### Risk Assessment: Within 3 Months of an Acute Coronary Syndrome

#### STEMI

<table>
<thead>
<tr>
<th>50 / 164</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF</td>
</tr>
<tr>
<td>To evaluate for inducible ischemia</td>
</tr>
<tr>
<td>No prior coronary angiography</td>
</tr>
<tr>
<td>A(8) / A(7)</td>
</tr>
</tbody>
</table>

#### UA/NSTEMI

<table>
<thead>
<tr>
<th>52 / 166</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor perioperative risk predictor</td>
</tr>
<tr>
<td>Normal exercise tolerance (greater than or equal to 4 METS)</td>
</tr>
<tr>
<td>Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF</td>
</tr>
<tr>
<td>To evaluate for inducible ischemia</td>
</tr>
<tr>
<td>No prior coronary angiography</td>
</tr>
<tr>
<td>A(9) / A(8)</td>
</tr>
</tbody>
</table>

### Risk Assessment: Postrevascularization (Percutaneous Coronary Intervention or Coronary Artery Bypass Graft)

#### Symptomatic

<table>
<thead>
<tr>
<th>55 / 169</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of ischemic equivalent</td>
</tr>
<tr>
<td>A(8) / A(8)</td>
</tr>
</tbody>
</table>

#### Asymptomatic

<table>
<thead>
<tr>
<th>56 / 170</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete revascularization</td>
</tr>
<tr>
<td>Additional revascularization feasible</td>
</tr>
<tr>
<td>A(7) / A(7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years after CABG AND</td>
</tr>
<tr>
<td>No MPI for 2 years or more unless most recent MPI showed reversible ischemia</td>
</tr>
<tr>
<td>U(5) ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>58 / 172</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than or equal to 5 years after CABG AND</td>
</tr>
<tr>
<td>No MPI for 2 years or more unless most recent MPI showed reversible ischemia</td>
</tr>
<tr>
<td>A(7) / U(6) ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>60 / 174</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than or equal to 2 years after PCI</td>
</tr>
<tr>
<td>U(6) / U(5)</td>
</tr>
</tbody>
</table>

### Assessment of Viability/Ischemia

#### Ischemic Cardiomyopathy/Assessment of Viability

<table>
<thead>
<tr>
<th>62 / 176</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known severe LV dysfunction</td>
</tr>
<tr>
<td>Patient eligible for revascularization</td>
</tr>
<tr>
<td>A(9) / A(8)</td>
</tr>
</tbody>
</table>

### Evaluation of Ventricular Function

#### Evaluation of Left Ventricular Function
### ACCF et al. Criteria # MPI / Stress Echo

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
</table>
| 63 | Assessment of LV function with radionuclide angiography (ERNA or FP RNA)  
| | In absence of recent reliable diagnostic information regarding ventricular function obtained with another imaging modality | A(8) |
| 64 | Routine* use of rest/stress ECG-gating with SPECT or PET MPI  
| | *Performed under most clinical circumstances, except in cases with technical inability or clear-cut redundancy of information. | A(9) |
| 66 | Selective use of stress FP RNA in conjunction with rest/stress gated SPECT MPI  
| | Borderline, mild, or moderate stenoses in 3 vessels OR moderate or equivocal left main stenosis in left dominant system | U(6) |

#### Use of Potentially Cardiotoxic Therapy (e.g., Doxorubicin)

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
</table>
| 67 | Serial assessment of LV function with radionuclide angiography (ERNA or FP RNA)  
| | Baseline and serial measures after key therapeutic milestones or evidence of toxicity | A(9) |

### 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.

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

Patients that meet ACCF/ASNC Inappropriate use score of (1-3) noted below OR meets any one of the following:

- Heart transplant recipients OR
- Follow-up to a previous Nuclear Cardiac Imaging (MPI) not meeting above indications

**ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 APPROPRIATE USE CRITERIA:**

<table>
<thead>
<tr>
<th>#</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Detection of CAD/Risk Assessment: Symptomatic</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Evaluation of Ischemic Equivalent (Non-Acute)</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>• Low pretest probability of CAD</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable OR able to exercise</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Acute Chest Pain</strong></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>• Definite ACS*</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
<td><strong>Acute Chest Pain (Rest Imaging only)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Detection of CAD: Asymptomatic (Without Ischemic Equivalent)</strong></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>• Low CHD risk (ATP III risk criteria)***</td>
<td>I (1)</td>
</tr>
<tr>
<td>13</td>
<td>• Intermediate CHD risk (ATP III risk criteria)***</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Syncope</strong></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>• Low CHD risk (ATP III risk criteria)***</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td><strong>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD</strong></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>• Low CHD risk (ATP III risk criteria)***</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
<td>• Last stress imaging study done less than 2 years ago</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>• Intermediate to high CHD risk (ATP III risk criteria)***</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td>• Last stress imaging study done less than 2 years ago</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (1-3);</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>• Low CHD risk (ATP III risk criteria)***&lt;br&gt;• Last stress imaging study done more than or equal to 2 years ago</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td><strong>Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization</strong></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>• Known CAD on coronary angiography OR prior abnormal stress imaging study&lt;br&gt;• Last stress imaging study done less than 2 years ago</td>
<td>I (3)</td>
</tr>
<tr>
<td>33</td>
<td>• Agatston score less than 100</td>
<td>I (2)</td>
</tr>
<tr>
<td>37</td>
<td><strong>Duke Treadmill Score</strong></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>• Preoperative evaluation for noncardiac surgery risk assessment</td>
<td>I (1)</td>
</tr>
<tr>
<td>41</td>
<td>• Moderate to good functional capacity (greater than or equal to 4 METs)</td>
<td>I (3)</td>
</tr>
<tr>
<td>42</td>
<td>• No clinical risk factors</td>
<td>I (2)</td>
</tr>
<tr>
<td>44</td>
<td>• Asymptomatic up to 1 year post normal catherization, noninvasive test, or previous revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td>45</td>
<td>• Moderate to good functional capacity (greater than or equal to 4 METs)</td>
<td>I (3)</td>
</tr>
<tr>
<td>46</td>
<td>• No clinical risk factors</td>
<td>I (2)</td>
</tr>
<tr>
<td>48</td>
<td>• Asymptomatic up to 1 year post normal catherization, noninvasive test, or previous revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td>49</td>
<td><strong>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td><strong>Low-Risk Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td><strong>Intermediate-Risk Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td><strong>Vascular Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td><strong>Risk Assessment: Within 3 Months of an Acute Coronary Syndrome</strong></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td><strong>STEMI</strong></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td><strong>ACS – Asymptomatic Postrevascularization (PCI or CABG)</strong></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td><strong>Cardiac Rehabilitation</strong></td>
<td></td>
</tr>
<tr>
<td>#</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>54</td>
<td>• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)</td>
<td>I (3)</td>
</tr>
</tbody>
</table>

**Risk Assessment: Postrevascularization (Percutaneous Coronary Intervention or Coronary Artery Bypass Graft)**

**Asymptomatic**

| 59 | • Less than 2 years after PCI | I (3) |

**Cardiac Rehabilitation**

| 61 | • Prior to initiation of cardiac rehabilitation (as a stand-alone indication) | I (3) |

**Evaluation of Ventricular Function**

**Evaluation of Left Ventricular Function**

| 65 | • Routine* use of stress FP RNA in conjunction with rest/stress gated SPECT MPI  
*Performed under most clinical circumstances, except in cases with technical inability or clear-cut redundancy of information. | I (3) |

**ADDITIONAL INFORMATION:**

**Abbreviations**

- ACS = acute coronary syndrome
- CABG = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- CHD = coronary heart disease
- CT = computed tomography
- 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
- PCI = percutaneous coronary intervention
- PET = positron emission tomography
- RNA = radionuclide angiography
Aortic valve dysfunction*

- **Severe Aortic Stenosis (AS)** is defined as
  - Jet velocity (m per second) - Greater than 4.0
  - Mean gradient (mm Hg) - Greater than 40
  - Valve area (cm2) - Less than 1.0
  - Valve area index (cm2 per m2) - Less than 0.6

- **Severe Aortic Regurgitation (AR)** is defined as
  - **Qualitative**
    - Angiographic grade - 3–4 +
    - Color Doppler jet width - Central jet, width greater than 65% LVOT
    - Doppler vena contracta width (cm) - Greater than 0.6
  - **Quantitative (cath or echo)**
    - Regurgitant volume (ml per beat) - Greater than or equal to 60
    - Regurgitant fraction (%) - Greater than or equal to 50
    - Regurgitant orifice area (cm2) - Greater than or equal to 0.30

- **Additional essential criteria**
  - Left Ventricular size – Increased

* Referred to ACC/AHA Practice guidelines for Classification of the Severity of Valve Disease in Adults. [http://circ.ahajournals.org/cgi/reprint/114/5/e84](http://circ.ahajournals.org/cgi/reprint/114/5/e84)

**Electrocardiogram (ECG) – Uninterpretable**

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

♦ **Use of class IC antiarrhythmic agents:**
Flecainide (Tambo) and propafenone (Rythmol) are class IC antiarrhythmic 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.

**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 probabilities of CAD can be calculated from the risk algorithms as follows:

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<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>Low</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

**TIMI Risk Score:**
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

**Coronary Heart Disease (CHD) Risk** (Based on the ACC/AHA Scientific Statement on Cardiovascular Risk Assessment): Absolute risk is defined as the probability of developing CHD, including myocardial infarction or CHD death over a given time period. The ATP III report specifies absolute risk for CHD over the next 10 years. CHD risk refers to 10-year risk for any hard cardiac event.

- **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 in a patient 40 years of age or older, peripheral arterial disease or other coronary risk equivalents, or a 10-year absolute CHD risk of greater than 20%.

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

\[
DTS = \text{exercise time} - (5 \times \text{ST deviation}) - (4 \times \text{exercise angina}), \text{ with } 0 = \text{none}, 1 = \text{non limiting}, \text{ and } 2 = \text{exercise-limiting.}
\]
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.

**Perioperative Clinical Risk Factors:**
- History of ischemic heart disease
- History of compensated or prior heart failure
- History of cerebrovascular disease
- Diabetes mellitus (requiring insulin)
- Renal insufficiency (creatinine >2.0)

**REFERENCES**


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.

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.

◊ ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 APPROPRIATE USE CRITERIA for Nuclear Cardiac Imaging / Myocardial Perfusion Study:

<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain (MPI / Stress Echo)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MPI / Stress Echo</strong></td>
<td><em>(Refer to Additional Information section)</em> 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>
</tr>
<tr>
<td><strong>Detection of CAD/Risk Assessment: Symptomatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 / 115</td>
<td>• Low pretest probability of CAD &lt;br&gt; • ECG uninterpretable OR unable to exercise</td>
<td>A(7) / A(7)</td>
</tr>
<tr>
<td>3 / 116</td>
<td>• Intermediate pretest probability of CAD* &lt;br&gt; • ECG interpretable AND able to exercise</td>
<td>A(7) / A(7)</td>
</tr>
<tr>
<td>4 / 117</td>
<td>• Intermediate pretest probability of CAD* &lt;br&gt; • ECG uninterpretable OR unable to exercise</td>
<td>A(9) / A(9)</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>(*Refer to Additional Information section)</td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
<tr>
<td><strong>5 / 118</strong></td>
<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>
</tr>
<tr>
<td></td>
<td>• High pretest probability of CAD*</td>
<td>A(8) / A(7)</td>
</tr>
<tr>
<td></td>
<td>• Regardless of ECG interpretability and ability to exercise</td>
<td></td>
</tr>
<tr>
<td>Detection of CAD: Asymptomatic (Without Ischemic Equivalent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asymptomatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 / 126</td>
<td>• Intermediate CHD risk (ATP III risk criteria)***</td>
<td>U(5) / U(5)</td>
</tr>
<tr>
<td></td>
<td>• ECG uninterpretable</td>
<td></td>
</tr>
<tr>
<td>15 / 127</td>
<td>• High CHD risk (ATP III risk criteria)*** ✓</td>
<td>A(8) / U(5) ✓</td>
</tr>
<tr>
<td>New-Onset or Newly Diagnosed Heart Failure With LV Systolic Dysfunction Without Ischemic Equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>16 / 128</strong></td>
<td>• No prior CAD evaluation AND no planned coronary angiography</td>
<td>A(8) / A(7)</td>
</tr>
<tr>
<td>New-Onset Atrial Fibrillation ♦</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 / 132</td>
<td>• Part of evaluation when etiology unclear</td>
<td>U(6) / U(6)</td>
</tr>
<tr>
<td>Ventricular Tachycardia ♦</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 / NA</td>
<td>• Low CHD risk (ATP III risk criteria)***</td>
<td>A(7) / NA</td>
</tr>
<tr>
<td>19 / NA</td>
<td>• Intermediate or high CHD risk (ATP III risk criteria)***</td>
<td>A(8) / NA</td>
</tr>
<tr>
<td>Syncope</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 / 134</td>
<td>• Intermediate or high CHD risk (ATP III risk criteria)***</td>
<td>A(7) / A(7)</td>
</tr>
<tr>
<td>Elevated Troponin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 / 135</td>
<td>• Troponin elevation without additional evidence of acute coronary syndrome (with ischemia is not subject to Stress Echocardiogram contraindications) ✓</td>
<td>A(7) / A(7) ✓</td>
</tr>
<tr>
<td>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 / 145</td>
<td>• Intermediate to high CHD risk (ATP III risk criteria)*** ✓</td>
<td>U(6) / U(4) ✓</td>
</tr>
<tr>
<td></td>
<td>• Last stress imaging study done more than or equal to 2 years ago</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If known CAD, not subject to Stress Echo contraindications</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 / 147</td>
<td>• Known CAD on coronary angiography OR prior abnormal stress imaging study</td>
<td>U(5) / U(5)</td>
</tr>
<tr>
<td></td>
<td>• Last stress imaging study done more than or equal to 2 years</td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (4-9);</td>
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<tr>
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<td>(<em>Refer to Additional Information section</em>)</td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
</tbody>
</table>

**Prior Noninvasive Evaluation**

| 29 / 153               | • Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern | A(8) / A(8) |

**New or Worsening Symptoms**

| 30 / 151               | • Abnormal coronary angiography OR abnormal prior stress imaging study | A(9) / A(7) |
| 31 / 152               | • Normal coronary angiography OR normal prior stress imaging study | U(6) / U(5) |

**Coronary Angiography (Invasive or Noninvasive)**

| 32 / 141               | • Coronary stenosis or anatomic abnormality of uncertain significance | A(9) / A(8) |

**Asymptomatic Prior Coronary Calcium Agatston Score**

| 34 / 137               | • Low to intermediate CHD risk***
• Agatston score between 100 and 400 | U(5) / U(5) |
| 35 / 138               | • High CHD risk***
• Agatston score between 100 and 400 | A(7) / U(6) ✓ |
| 36 / 139               | • Agatston score greater than 400 | A(7) / A(7) |

**Duke Treadmill Score**

| 38 / 149               | • Intermediate-risk Duke treadmill score**** | A(7) / A(7) |
| 39 / 150               | • High-risk Duke treadmill score***** | A(8) / A(7) |

**Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions**

**Intermediate-Risk Surgery**

| 43 / 157               | • Greater than or equal to 1 clinical risk factor ✓
• Poor or unknown functional capacity (less than 4 METs) | A(7) / U(6) ✓ |

**Vascular Surgery**

| 47 / 161               | • Greater than or equal to 1 clinical risk factor
• Poor or unknown functional capacity (less than 4 METS) | A(8) / A(7) |

**Risk Assessment: Within 3 Months of an Acute Coronary Syndrome**

**STEMI**
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # MPI / Stress Echo</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9);</th>
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</thead>
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<tr>
<td><em>(Refer to Additional Information section)</em></td>
<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>
</tr>
</tbody>
</table>
| 50 / 164 | • Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF  
• To evaluate for inducible ischemia  
• No prior coronary angiography | A(8) / A(7) |
| **UA/NSTEMI** | | |
| 52 / 166 | • Minor perioperative risk predictor  
• Normal exercise tolerance (greater than or equal to 4 METS)  
Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF  
• To evaluate for inducible ischemia  
• No prior coronary angiography | A(9) / A(8) |
| **Risk Assessment: Postrevascularization (Percutaneous Coronary Intervention or Coronary Artery Bypass Graft)** | | |
| **Symptomatic** | | |
| 55 / 169 | • Evaluation of ischemic equivalent | A(8) / A(8) |
| **Asymptomatic** | | |
| 56 / 170 | • Incomplete revascularization  
• Additional revascularization feasible | A(7) / A(7) |
| 57 | • Less than 5 years after CABG ✔ | U(5) ✔ |
| 58 / 172 | • Greater than or equal to 5 years after CABG | A(7) / U(6) |
| 60 / 174 | • Greater than or equal to 2 years after PCI | U(6) / U(5) |
| **Assessment of Viability/Ischemia** | | |
| **Ischemic Cardiomyopathy/Assessment of Viability** | | |
| 62 / 176 | • Known severe LV dysfunction  
• Patient eligible for revascularization | A(9) / A(8) |

◊ 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)
- 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:

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.

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<td>Very low</td>
</tr>
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<td>40–49</td>
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<td>Intermediate</td>
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<td>Women</td>
<td>Intermediate</td>
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<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**


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.

INDICATIONS FOR MULTIPLE-GATED ACQUISITION (MUGA) SCAN:

- To establish a baseline or for restaging to follow-up on patient receiving chemotherapy to evaluate possible chemotoxicity.
- To evaluate ejection fraction in a patient with congestive heart failure (CHF).
- To evaluate patient, who is obese or who has chronic obstructive pulmonary disease, for coronary artery disease.

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:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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:


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, ordered by a neurologist, neurosurgeon or psychiatrist, 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)
- For pre-surgical localization of epileptic foci, patient has had either a Brain CT or Brain MRI AND surgery is 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.

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 and FLD patterns, most notably brain injury that affects the prefrontal cortex pole and anterior temporal lobes (like FLD) 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.
REFERENCES:


INTRODUCTION:

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.

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 reoccurrence of cancer.
- Brain tumor follow-up after surgery and/or after treatment recently completed.

For pre-operative evaluation:
- Pre-surgical evaluation for refractory epilepsy.

ADDITIONAL INFORMATION RELATED TO BRAIN PET:

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) of requested imaging.

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. It is useful in identifying tumors in the brain after surgery, radiation or chemotherapy. With the sensitivity and specificity of the radiotracer 18-F FDG, PET is able to evaluate recurrent tumor and treatment-induced changes.

REFERENCES:


INDICATIONS FOR A CEREBROSPINAL FLUID FLOW (CSF) SPECT SCAN:

- Evaluation of hydrocephalus, ordered by a neurologist or neurosurgeon and the patient has NOT had a previous Nuclear CSF Scan with the past three (3) months.
- Detection of CSF leak, ordered by a neurologist or neurosurgeon and the patient has had a recent surgical procedure.
- Detection of CSF leak, ordered by a neurologist or neurosurgeon AND patient experienced recent trauma.
- Evaluation of the function of a CSF shunt and is ordered by a neurologist or neurosurgeon.

ADDITIONAL INFORMATION RELATED TO CSF SPECT SCAN:

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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:

INDICATIONS FOR A KIDNEY SPECT SCAN:

- Evaluation of renal perfusion and function, ordered by a surgeon or nephrologist **and** patient has NOT had a previous nuclear renal scan within the past three (3) months.
- Evaluation of renal trauma, ordered by a surgeon or nephrologist **and** patient has NOT had a previous nuclear renal scan within the past three (3) months.
- For diagnosis of renal-vascular hypertension, ordered by a surgeon or nephrologist **and** patient has NOT had a previous nuclear renal scan within the past three (3) months.
- Detection and evaluation of renal collecting system obstruction.
- Diagnosis of acute tubular necrosis, ordered by a nephrologist or an infectious disease specialist.

ADDITIONAL INFORMATION RELATED TO KIDNEY SPECT SCAN:

**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.

**Intravascular administration of contrast material may** be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

**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:

INTRODUCTION:

Positron emission tomography (PET) is a rapidly developing technology that is able to detect biochemical reactions, e.g., metabolism, within body tissues. A radioactive tracer, e.g., fluorine 18 fluorodeoxyglucose (FDG), is used during the procedure. Unlike other nuclear medicine examinations, PET measures metabolic activity of the cells of body tissues, providing information about the functionality and structure of the particular organ or tissue examined. PET may detect biochemical changes that help to evaluate malignant tumors and other lesions.

The degree of uptake of FDG may indicate increased metabolism in the cells of body tissues. Cancer cells show increased metabolism of glucose and amino acids which can be monitored with FDG and llC-L-methionine (MET) respectively. The most commonly used radionuclide is FDG for tumor cells. FDG uptake is higher in fast-growing tumors; PET is not useful or beneficial for slow growing tumors. FDG 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 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.

IMPORTANT NOTE:

- 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 A PET SCAN:

Brain cancer or tumors:
- Initial treatment strategy (including diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Breast cancer (For females and males):
- Initial treatment strategy (Initial staging) of patient with known breast cancer for distant mets. (Does not include axillary lymph nodes).
- Subsequent treatment strategy (Re-staging) of known breast cancer patient with local regional recurrence or distant metastasis.
Subsequent treatment strategy (Monitoring response to treatment when a change in treatment is anticipated) for known (diagnosed) breast cancer patient’s response to treatment initiated within the last 8 weeks AND has completed a course of treatment and no PET scans have been obtained after treatment.

Cervical cancer:
- Initial treatment strategy (Initial staging) as an adjunct test for the detection of pre-treatment metastasis in newly diagnosed cervical cancers following conventional imaging studies (such as CT, MRI) that is negative for extra-pelvic metastasis.
- Subsequent treatment strategy (Re-staging or monitoring response to treatment when a change in treatment is anticipated) for known cervical cancer/tumor for patient who has recently completed a course of treatment and no PET scans have been obtained after treatment.
- Subsequent treatment strategy (Re-staging or monitoring response to treatment when a change in treatment is anticipated) for known cervical cancer/tumor AND has new signs or symptoms indicative of a reoccurrence of cancer.

Colorectal cancer
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.
- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known (diagnosed) colorectal cancer/tumor for patient who recently completed a course of treatment.
- Subsequent treatment strategy (Restaging) for known colorectal cancer/tumor AND has new signs or symptoms indicative of a reoccurrence of cancer.
- Subsequent treatment strategy (Restaging) for known colorectal cancer/tumor and has a rising CEA.

Esophageal cancer:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.
- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known (diagnosed) esophageal cancer/tumor and patient’s response to treatment was initiated within the last 8 weeks AND course of treatment completed AND no PET scan obtained after treatment.
- Subsequent treatment strategy (Restaging) when there is physical, laboratory and/or evidence of recurrent esophageal cancer/tumor.
Head and neck cancer:
(NOTE: Do not use below criteria for Thyroid, Brain cancer/tumor or CNS conditions (such as seizures, dementia, Alzheimer’s).

- Initial treatment strategy (Diagnosis) to rule out head and/or neck cancer with evidence of mets or other tumor in the body.
- Initial treatment strategy (Diagnosis) to rule out head and/or neck cancer in a tumor that has been clinically apparent and persistent in the head and/or neck region.
- Initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Subsequent treatment strategy (Restaging) of known head and/or neck cancer with history of cancer surgery, chemotherapy or radiation therapy and has new signs or symptoms indicative of a reoccurrence of cancer.

Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known head and/or neck cancer with history of cancer surgery, chemotherapy or radiation therapy and evaluation for possible presence of residual tumor after treatment completed, AND no PET scan obtained after treatment.

Lung cancer (covering all lung cancers including SPN, small cell and non-small cell lung cancer):
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Lung cancer for non-small lung cancer only:
- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known non-small cell lung cancer/tumor for patient who has recently completed a course of treatment and no PET scan obtained after treatment. (Must be for known Non Small Cell Lung Cancer).
- Subsequent treatment strategy (Restaging) for known non-small cell lung cancer AND has new signs or symptoms indicative of a reoccurrence of cancer.

Lymphoma:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
2. To determine the optimal anatomic location for an invasive procedure, or
3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known lymphoma for patient who has recently completed treatment AND no PET scan obtained after treatment.
- Subsequent treatment strategy (Restaging) for known lymphoma AND has new signs or symptoms indicative of a reoccurrence of cancer.

**Melanoma:**
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy *(Does not include evaluation of regional lymph nodes)*:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.
- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known melanoma for patient who has recently completed treatment AND no PET scan obtained after treatment.
- Subsequent treatment strategy (Restaging) for known melanoma and has new signs or symptoms indicative of a reoccurrence of cancer.

**Myeloma:**
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.
- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known (diagnosed) myeloma for patient who has recently completed treatment AND no PET scan obtained after treatment.
- Subsequent treatment strategy (Restaging) for known (diagnosed) myeloma AND has new signs or symptoms indicative of a reoccurrence of cancer.

**Ovarian cancer:**
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

- Subsequent treatment strategy (monitoring response to treatment when a change in treatment is anticipated) for known ovarian cancer for patient who has recently completed treatment AND no PET scan obtained after treatment.
- Subsequent treatment strategy (Restaging) for known (diagnosed) ovarian cancer AND has new signs or symptoms indicative of a reoccurrence of cancer.

Pancreatic cancer:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Soft tissue sarcoma:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Solitary Pulmonary Nodule(s):
- Refer to the Lung Cancer section of this guideline; Initial Treatment Strategy only.

Testicular cancer:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

Thyroid cancer:
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
2. To determine the optimal anatomic location for an invasive procedure, or
3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

- Subsequent treatment strategy (monitoring response to treatment) for thyroid cancer of follicular cell origin AND patient has ALL of the following:
  - Had a thyroidectomy and radioiodine ablation.
  - Has a serum thyroglobulin > 10ng/mL.
  - Has a negative whole body I-131 scan.

**All other solid tumors:**
- Initial treatment strategy (Diagnosis) of solid tumors that are biopsy proven or strongly suspected based on other diagnostic testing to determine the location and/or extent of the tumor for the following therapeutic purposes related to the initial treatment strategy:
  1. To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
  2. To determine the optimal anatomic location for an invasive procedure, or
  3. To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor.

**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 with CT Attenuation** – In contrast to the simple PET scan which requires a complex process of evaluation of body habitus to adjust for tissue density, newer scanners have the capacity to obtain a preliminary, general assessment of a patient’s habitus through the use of CT technology. Automatic adjustments (attenuation) are made. This is one study, not a combination study.

**PET/CT** – PET/CT fusion examination provides the sharp anatomical detail of a high performance 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 and Breast Cancer** - PET provides important qualitative and quantitative metabolic information that is important in the initial staging and re-staging of breast cancer. 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 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 patient 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 hidden metastasis. PET identifies areas of hypermetabolic sites such as neoplasia or inflammation and reveals occult metastases. The detection of hidden or unsuspected metastasis prevents unnecessary surgery or treatments.

PET and Lymphoma – FDG-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 FDG 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.

PET and Melanoma – FDG-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 Solitary Pulmonary Nodule – FDG-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. FDG PET is used to evaluate DTC patients with negative radioiodine scans and elevated thyroglobulin (Tg) levels to detect recurrent or metastatic DTC.

REFERENCES:


Quint, LE. PET; other thoracic malignancies. Cancer Imaging 2006; 6:S82-S88.


Wei C, Daniel HS, Silverman SD, et al. $^{18}$F-FDOPA PET Imaging of Brain Tumors: Comparison Study with $^{18}$F-FDG PET and Evaluation of Diagnostic Accuracy J Nucl Med 2006; 47: 904-911.

INTRODUCTION:

Echocardiography also known as ‘cardiac ultrasound’ is a diagnostic test that uses ultrasound waves to create an image of the heart muscle. Ultrasound waves that rebound or echo off the heart can show the size, shape, and movement of the heart’s valves and chambers as well as the flow of blood through the heart.

Transthoracic Echocardiograms (TTE) are used to evaluate structural heart disease, ventricular function and valve function. Transesophageal echocardiogram (TEE) is an alternative way to perform an echocardiogram where the probe is passed into patient’s esophagus.

INDICATIONS FOR A TRANSTHORACIC ECHOCARDIOGRAPHY (TTE):


<table>
<thead>
<tr>
<th>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</th>
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</thead>
<tbody>
<tr>
<td>General Evaluation of Cardiac Structure and Function</td>
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<tr>
<td>Suspected Cardiac Etiology—General With TTE</td>
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<tr>
<td>1</td>
<td>Symptoms or conditions potentially related to suspected cardiac etiology including but not limited to chest pain, shortness of breath, palpitations, TIA, stroke, or peripheral embolic event</td>
<td>A(9)</td>
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<tr>
<td>2</td>
<td>Prior testing that is concerning for heart disease or structural abnormality including but not limited to chest X-ray, baseline scout images for stress echocardiogram, ECG, or cardiac biomarkers</td>
<td>A(9)</td>
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<tr>
<td>Arrhythmias With TTE</td>
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<tr>
<td>4</td>
<td>Frequent VPCs or exercise-induced VPCs</td>
<td>A(8)</td>
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<tr>
<td>5</td>
<td>Sustained or nonsustained atrial fibrillation, SVT, or VT</td>
<td>A(7)</td>
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<td>Lightheadedness/Presyncope/Syncope With TTE</td>
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<tr>
<td>7</td>
<td>Clinical symptoms or signs consistent with a cardiac diagnosis known to cause lightheadedness / presyncope / syncope (including but not limited to aortic stenosis, hypertrophic cardiomyopathy,</td>
<td>A(9)</td>
</tr>
</tbody>
</table>
### ACCF et al. Criteria
#### # TTE (Indication and Appropriate Use Score)

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</th>
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<tbody>
<tr>
<td>or HF)</td>
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<tr>
<td>9</td>
<td>• Syncope when there are no other symptoms or signs of cardiovascular disease</td>
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<tr>
<td><strong>Perioperative Evaluation With TTE</strong></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>• Routine perioperative evaluation of cardiac structure and function prior to noncardiac solid organ transplantation</td>
</tr>
<tr>
<td><strong>Pulmonary Hypertension With TTE</strong></td>
<td></td>
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<tr>
<td>15</td>
<td>• Evaluation of suspected pulmonary hypertension including evaluation of right ventricular function and estimated pulmonary artery pressure</td>
</tr>
<tr>
<td>17</td>
<td>• Routine surveillance (≥1 y) of known pulmonary hypertension without change in clinical status or cardiac exam</td>
</tr>
<tr>
<td>18</td>
<td>• Re-evaluation of known pulmonary hypertension if change in clinical status or cardiac exam or to guide therapy</td>
</tr>
<tr>
<td><strong>TTE for Evaluation of Valvular Function</strong></td>
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<tr>
<td><strong>Murmur or Click With TTE</strong></td>
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</tr>
<tr>
<td>34</td>
<td>• Initial evaluation when there is a reasonable suspicion of valvular or structural heart disease</td>
</tr>
<tr>
<td>37</td>
<td>• Re-evaluation of known valvular heart disease with a change in clinical status or cardiac exam or to guide therapy</td>
</tr>
<tr>
<td><strong>Native Valvular Stenosis With TTE</strong></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>• Routine surveillance (≥3 y) of mild valvular stenosis without a change in clinical status or cardiac exam</td>
</tr>
<tr>
<td>41</td>
<td>• Routine surveillance (≥1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam</td>
</tr>
<tr>
<td><strong>Native Valvular Regurgitation With TTE</strong></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>• Routine surveillance (≥3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam</td>
</tr>
<tr>
<td>45</td>
<td>• Routine surveillance (&lt;1 y) of moderate or severe valvular regurgitation without a change in clinical status or cardiac exam</td>
</tr>
<tr>
<td>46</td>
<td>• Routine surveillance (≥1 y) of moderate or severe valvular regurgitation without change in clinical</td>
</tr>
<tr>
<td>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</td>
<td>INDICATIONS</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>status or cardiac exam</td>
<td></td>
</tr>
</tbody>
</table>

**Prosthetic Valves With TTE**

| 47 | Initial postoperative evaluation of prosthetic valve for establishment of baseline | A(9) |
| 49 | Routine surveillance (≥3 y after valve implantation) of prosthetic valve if no known or suspected valve dysfunction | A(7) |
| 50 | Evaluation of prosthetic valve with suspected dysfunction or a change in clinical status or cardiac exam | A(9) |
| 51 | Re-evaluation of known prosthetic valve dysfunction when it would change management or guide therapy | A(9) |

**Infective Endocarditis (Native or Prosthetic Valves) With TTE**

| 52 | Initial evaluation of suspected infective endocarditis with positive blood cultures or a new murmur | A(9) |
| 55 | Re-evaluation of infective endocarditis at high risk for progression or complication or with a change in clinical status or cardiac exam | A(9) |

**TTE for Evaluation of Intracardiac and Extracardiac Structures and Chambers**

| 57 | Suspected cardiac mass | A(9) |
| 58 | Suspected cardiovascular source of embolus | A(9) |
| 59 | Suspected pericardial conditions | A(9) |
| 61 | Re-evaluation of known pericardial effusion to guide management or therapy | A(8) |
| 62 | Guidance of percutaneous noncoronary cardiac procedures including but not limited to pericardiocentesis, septal ablation, or right ventricular biopsy | A(9) |

**TTE for Evaluation of Aortic Disease**

<p>| 63 | Evaluation of the ascending aorta in the setting of a known or suspected connective tissue disease or genetic condition that predisposes to aortic aneurysm or dissection (e.g., Marfan syndrome) | A(9) |
| 64 | Re-evaluation of known ascending aortic dilation | A(9) |</p>
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>or history of aortic dissection to establish a baseline rate of expansion or when the rate of expansion is excessive</td>
<td></td>
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</tr>
<tr>
<td>65</td>
<td>• Re-evaluation of known ascending aortic dilation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management or therapy</td>
<td>A(9)</td>
</tr>
<tr>
<td><strong>TTE for Evaluation of Hypertension, HF, or Cardiomyopathy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>• Initial evaluation of suspected hypertensive heart disease</td>
<td>A(8)</td>
</tr>
<tr>
<td>69</td>
<td>• Re-evaluation of known hypertensive heart disease without a change in clinical status or cardiac exam</td>
<td>U(4)</td>
</tr>
<tr>
<td><strong>HF With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>• Initial evaluation of known or suspected HF (systolic or diastolic) based on symptoms, signs, or abnormal test results</td>
<td>A(9)</td>
</tr>
<tr>
<td>71</td>
<td>• Re-evaluation of known HF (systolic or diastolic) with a change in clinical status or cardiac exam without a clear precipitating change in medication or diet</td>
<td>A(8)</td>
</tr>
<tr>
<td>72</td>
<td>• Re-evaluation of known HF (systolic or diastolic) with a change in clinical status or cardiac exam with a clear precipitating change in medication or diet</td>
<td>U(4)</td>
</tr>
<tr>
<td>73</td>
<td>• Re-evaluation of known HF (systolic or diastolic) to guide therapy</td>
<td>A(9)</td>
</tr>
<tr>
<td>75</td>
<td>• Routine surveillance (≥1 y) of HF (systolic or diastolic) when there is no change in clinical status or cardiac exam</td>
<td>U(6)</td>
</tr>
<tr>
<td><strong>Device Evaluation (Including Pacemaker, ICD, or CRT) With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>• Initial evaluation or re-evaluation after revascularization and/or optimal medical therapy to determine candidacy for device therapy and/or to determine optimal choice of device</td>
<td>A(9)</td>
</tr>
<tr>
<td>77</td>
<td>• Initial evaluation for CRT device optimization after implantation</td>
<td>U(6)</td>
</tr>
<tr>
<td>78</td>
<td>• Known implanted pacing device with symptoms possibly due to device complication or suboptimal</td>
<td>A(8)</td>
</tr>
<tr>
<td>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>-------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Ventricular Assist Devices and Cardiac Transplantation With TTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>• To determine candidacy for ventricular assist device</td>
<td>A(9)</td>
</tr>
<tr>
<td>82</td>
<td>• Optimization of ventricular assist device settings</td>
<td>A(7)</td>
</tr>
<tr>
<td>83</td>
<td>• Re-evaluation for signs/symptoms suggestive of ventricular assist device-related complications</td>
<td>A(9)</td>
</tr>
<tr>
<td>84</td>
<td>• Monitoring for rejection in a cardiac transplant recipient</td>
<td>A(7)</td>
</tr>
<tr>
<td>85</td>
<td>• Cardiac structure and function evaluation in a potential heart donor</td>
<td>A(9)</td>
</tr>
<tr>
<td>Cardiomyopathies With TTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>• Initial evaluation of known or suspected cardiomyopathy (e.g., restrictive, infiltrative, dilated, hypertrophic, or genetic cardiomyopathy)</td>
<td>A(9)</td>
</tr>
<tr>
<td>87</td>
<td>• Re-evaluation of known cardiomyopathy with a change in clinical status or cardiac exam to guide therapy</td>
<td>A(9)</td>
</tr>
<tr>
<td>89</td>
<td>• Routine surveillance (≥1 y) of known cardiomyopathy without a change in clinical status or cardiac exam</td>
<td>U(5)</td>
</tr>
<tr>
<td>90</td>
<td>• Screening evaluation for structure and function in first-degree relatives of a patient with an inherited cardiomyopathy</td>
<td>A(9)</td>
</tr>
<tr>
<td>91</td>
<td>• Baseline and serial re-evaluations in a patient undergoing therapy with cardiotoxic agents</td>
<td>A(9)</td>
</tr>
<tr>
<td>TTE for Adult Congenital Heart Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>• Initial evaluation of known or suspected adult congenital heart disease</td>
<td>A(9)</td>
</tr>
<tr>
<td>93</td>
<td>• Known adult congenital heart disease with a change in clinical status or cardiac exam</td>
<td>A(9)</td>
</tr>
<tr>
<td>94</td>
<td>• Re-evaluation to guide therapy in known adult congenital heart disease.</td>
<td>A(9)</td>
</tr>
</tbody>
</table>
| 96                                                            | • Routine surveillance (≥2 y) of adult congenital heart disease following complete repair  
  o without residual structural or hemodynamic abnormality  
  o without a change in clinical status or cardiac exam | U(6)          |
| 97                                                            | • Routine surveillance (<1 y) of adult congenital heart disease following incomplete or palliative repair | U(5)          |
## ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Routine surveillance (≥1 y) of adult congenital heart disease following incomplete or palliative repair</td>
<td>A(8)</td>
</tr>
<tr>
<td>o with residual structural or hemodynamic abnormality</td>
<td></td>
</tr>
<tr>
<td>o without a change in clinical status or cardiac exam</td>
<td></td>
</tr>
</tbody>
</table>

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

Patients that meet ACCF/ASNC Inappropriate use score of (1-3) noted above OR meets any one of the following:

- For same imaging test less than 52 weeks (1 year) apart unless specific guideline criteria states otherwise.
- For different imaging tests of same anatomical structure but different imaging type less than six (6) weeks (such as Heart MRI/CT) unless specific guideline criteria states otherwise (i.e. CT/MRI and now wants Echocardiogram) without high level review to evaluate for medical necessity.
- Additional images for same-study (poor quality, etc).

### ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Transthoracic Echocardiography (TTE):

<table>
<thead>
<tr>
<th>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arrhythmias With TTE</strong></td>
<td>General Evaluation of Cardiac Structure and Function</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>• Infrequent APCs or infrequent VPCs without other evidence of heart disease</td>
<td>I(2)</td>
</tr>
<tr>
<td>6</td>
<td>• Asymptomatic isolated sinus bradycardia</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>Lightheadedness/Presyncope/Syncope With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>• Lightheadedness/presyncope when there are no other symptoms or signs of cardiovascular disease</td>
<td>I(3)</td>
</tr>
<tr>
<td><strong>Evaluation of Ventricular Function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>• Initial evaluation of ventricular function (e.g., screening) with no symptoms or signs of</td>
<td>I(2)</td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (1-3); I= Inappropriate</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>TTE (Indication and Appropriate Use Score)</td>
<td>cardiovascular disease</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>• Routine surveillance of ventricular function with known CAD and no change in clinical status or cardiac exam</td>
<td>I(3)</td>
</tr>
<tr>
<td>12</td>
<td>• Evaluation of LV function with prior ventricular function evaluation showing normal function (e.g., prior echocardiogram, left ventriculogram, CT, SPECT MPI, CMR) in patients in whom there has been no change in clinical status or cardiac exam</td>
<td>I(1)</td>
</tr>
<tr>
<td>13</td>
<td>• Routine perioperative evaluation of ventricular function with no symptoms or signs of cardiovascular disease transplantation</td>
<td>I(2)</td>
</tr>
<tr>
<td>16</td>
<td>• Routine surveillance (&lt;1 y) of known pulmonary hypertension without change in clinical status or cardiac exam</td>
<td>I(3)</td>
</tr>
<tr>
<td>35</td>
<td>• Initial evaluation when there are no other symptoms or signs of valvular or structural heart disease</td>
<td>I(2)</td>
</tr>
<tr>
<td>36</td>
<td>• Re-evaluation in a patient without valvular disease on prior echocardiogram and no change in clinical status or cardiac exam</td>
<td>I(1)</td>
</tr>
<tr>
<td>38</td>
<td>• Routine surveillance (≥3 y) of mild valvular stenosis without a change in clinical status or cardiac exam</td>
<td>I(3)</td>
</tr>
<tr>
<td>40</td>
<td>• Routine surveillance (≥1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam</td>
<td>I(3)</td>
</tr>
<tr>
<td>42</td>
<td>• Routine surveillance of trace valvular regurgitation</td>
<td>I(1)</td>
</tr>
<tr>
<td>43</td>
<td>• Routine surveillance (&lt;3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam</td>
<td>I(2)</td>
</tr>
<tr>
<td>48</td>
<td>• Routine surveillance (&lt;3 y after valve implantation) of prosthetic valve if no known or</td>
<td>I(3)</td>
</tr>
<tr>
<td>ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (1-3); I= Inappropriate</td>
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<tr>
<td>---------------------------------------------------------------</td>
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<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>suspected valve dysfunction</td>
<td></td>
</tr>
<tr>
<td><strong>Infective Endocarditis (Native or Prosthetic Valves) With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>• Transient fever without evidence of bacteremia or a new murmur</td>
<td>I(2)</td>
</tr>
<tr>
<td>54</td>
<td>• Transient bacteremia with a pathogen not typically associated with infective endocarditis and/or a documented nonendovascular source of infection</td>
<td>I(3)</td>
</tr>
<tr>
<td>56</td>
<td>• Routine surveillance of uncomplicated infective endocarditis when no change in management is contemplated</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>TTE for Evaluation of Intracardiac and Extracardiac Structures and Chambers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>• Routine surveillance of known small pericardial effusion with no change in clinical status</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>TTE for Evaluation of Aortic Disease</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>• Routine re-evaluation for surveillance of known ascending aortic dilation or history of aortic dissection without a change in clinical status or cardiac exam when findings would not change management or therapy</td>
<td>I(3)</td>
</tr>
<tr>
<td><strong>TTE for Evaluation of Hypertension, HF, or Cardiomyopathy</strong></td>
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</tr>
<tr>
<td><strong>Hypertension With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>• Routine evaluation of systemic hypertension without symptoms or signs of hypertensive heart disease</td>
<td>I(3)</td>
</tr>
<tr>
<td><strong>HF With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>• Routine surveillance (&lt;1 y) of HF (systolic or diastolic) when there is no change in clinical status or cardiac exam</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>Device Evaluation (Including Pacemaker, ICD, or CRT) With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>• Routine surveillance (&lt;1 y) of implanted device without a change in clinical status or cardiac exam</td>
<td>I(1)</td>
</tr>
<tr>
<td>80</td>
<td>• Routine surveillance (≥1 y) of implanted device without a change in clinical status or cardiac exam</td>
<td>I(3)</td>
</tr>
<tr>
<td><strong>Cardiomyopathies With TTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>• Routine surveillance (&lt;1 y) of known cardiomyopathy without a change in clinical status or cardiac exam</td>
<td>I(2)</td>
</tr>
<tr>
<td><strong>TTE for Adult Congenital Heart Disease</strong></td>
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</tbody>
</table>
### ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>Routine surveillance (&lt;2 y) of adult congenital heart disease following complete repair without a residual structural or hemodynamic abnormality or without a change in clinical status or cardiac exam</td>
</tr>
</tbody>
</table>

### ADDITIONAL INFORMATION:

**Abbreviations**

- ACS = acute coronary syndrome
- APC = atrial premature contraction
- CABG = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- CMR = cardiovascular magnetic resonance
- CRT = cardiac resynchronization therapy
- CT = computed tomography
- ECG = electrocardiogram
- HF = heart failure
- ICD = implantable cardioverter-defibrillator
- LBBB = left bundle-branch block
- LV = left ventricular
- MET = estimated metabolic equivalents of exercise
- MI = myocardial infarction
- PCI = percutaneous coronary intervention
- RNI = radionuclide imaging
- SPECT MPI = single-photon emission computed tomography myocardial perfusion imaging
- STEMI = ST-segment elevation myocardial infarction
- SVT = supraventricular tachycardia
- TEE = transesophageal echocardiogram
- TIA = transient ischemic attack
- TIMI = Thrombolysis In Myocardial Infarction
- TTE = transthoracic echocardiogram
- UA/NSTEMI = unstable angina/non–ST-segment elevation myocardial infarction
- VPC = ventricular premature contraction
- VT = ventricular tachycardia

In general, transthoracic echocardiography (TTE) is adequate for diagnosing IE and for identifying vegetations in cases where cardiac structures-of-interest are well visualized. Contemporary TTE has improved the diagnostic accuracy of infective endocarditis by ameliorating image quality; it provides an accurate assessment of endocarditis and may reduce the need for TEE. However accuracy may be
reduced because of technical difficulties like obesity, chronic obstructive pulmonary disease, chest-wall deformities etc.

Specific situations where transesophageal echocardiography (TEE) is preferred over TTE and may be an appropriate initial study for evaluation of prosthetic device, suspected perianular complications, children with complex congenital cardiac lesions, selected patients with Staphylococcus aureus bacteremia, and certain pre-existing valvular abnormalities that make TTE interpretation problematic (e.g., calcific aortic stenosis).

Transthoracic echocardiography is a valuable tool in the perioperative period.

REFERENCES


INTRODUCTION:

Echocardiography also known as ‘cardiac ultrasound’ is a diagnostic test that uses ultrasound waves to create an image of the heart muscle. Ultrasound waves that rebound or echo off the heart can show the size, shape, and movement of the heart’s valves and chambers as well as the flow of blood through the heart.

Transesophageal Echocardiogram (TEE) is an alternative way to perform an echocardiogram where the probe is passed into patient’s esophagus and appropriately used as an adjunct or subsequent test to TTE when suboptimal TTE images preclude obtaining a diagnostic study.

INDICATIONS FOR A TRANSESOPHAGEAL ECHOCARDIOGRAPHY (TEE):


<table>
<thead>
<tr>
<th>ACCF et al. Criteria # TEE (Indication and Appropriate Use Score)</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. TEE as Initial or Supplemental Test—General Uses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99</td>
<td>• Use of TEE when there is a high likelihood of a nondiagnostic TTE due to patient characteristics or inadequate visualization of relevant structures</td>
<td>A(8)</td>
</tr>
<tr>
<td>101</td>
<td>• Re-evaluation of prior TEE finding for interval change (e.g., resolution of thrombus after anticoagulation, resolution of vegetation after antibiotic therapy) when a change in therapy is anticipated</td>
<td>A(8)</td>
</tr>
<tr>
<td>103</td>
<td>• Guidance during percutaneous noncoronary cardiac interventions including but not limited to closure device placement, radiofrequency ablation, and percutaneous valve procedures</td>
<td>A(9)</td>
</tr>
<tr>
<td>104</td>
<td>• Suspected acute aortic pathology including but not limited to dissection/transsection</td>
<td>A(9)</td>
</tr>
<tr>
<td><strong>B. TEE as Initial or Supplemental Test—Valvular Disease</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>• Evaluation of valvular structure and function to assess suitability for, and assist in planning of, an intervention</td>
<td>A(9)</td>
</tr>
<tr>
<td>108</td>
<td>• To diagnose infective endocarditis with a moderate or high pretest probability (e.g., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device)</td>
<td>A(9)</td>
</tr>
</tbody>
</table>
## TEE as Initial or Supplemental Test—Embolic Event

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>109 • Evaluation for cardiovascular source of embolus with no identified noncardiac source</td>
<td>A(7)</td>
</tr>
<tr>
<td>110 • Evaluation for cardiovascular source of embolus with a previously identified noncardiac source</td>
<td>U(5)</td>
</tr>
</tbody>
</table>

## TEE as Initial Test—Atrial Fibrillation/Flutter

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>112 • Evaluation to facilitate clinical decision making with regards to anticoagulation, cardioversion, and/or radiofrequency ablation</td>
<td>A(9)</td>
</tr>
</tbody>
</table>

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

Patients that meet ACCF/ASNC Inappropriate use score of (1-3) noted below OR meets any one of the following:

- For same imaging test less than 52 weeks (1 year) apart unless specific guideline criteria states otherwise.
- For different imaging tests of same anatomical structure but different imaging type less than six (6) weeks (such as Heart MRI/CT) unless specific guideline criteria states otherwise (i.e. CT/MRI and now wants Echocardiogram) without high level review to evaluate for medical necessity.
- Additional images for same-study (poor quality, etc).


### TEE as Initial or Supplemental Test—General Uses

<table>
<thead>
<tr>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 • Routine use of TEE when a diagnostic TTE is reasonably anticipated to resolve all diagnostic and management concerns</td>
<td>I(1)</td>
</tr>
<tr>
<td>102 • Surveillance of prior TEE finding for interval change (e.g., resolution of thrombus after anticoagulation, resolution of vegetation after antibiotic therapy) when no change in therapy is anticipated</td>
<td>I(2)</td>
</tr>
<tr>
<td>105 • Routine assessment of pulmonary veins in an asymptomatic patient status post pulmonary vein isolation</td>
<td>I(3)</td>
</tr>
<tr>
<td>ACCF et al. Criteria # TEE (Indication and Appropriate Use Score)</td>
<td>INDICATIONS</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td><strong>TEE as Initial or Supplemental Test—Valvular Disease</strong></td>
<td>• To diagnose infective endocarditis with a low pretest probability (e.g., transient fever, known alternative source of infection, or negative blood cultures/atypical pathogen for endocarditis)</td>
</tr>
<tr>
<td>107</td>
<td></td>
</tr>
<tr>
<td><strong>TEE as Initial or Supplemental Test—Embolic Event</strong></td>
<td>Evaluation for cardiovascular source of embolus with a known cardiac source in which a TEE would not change management</td>
</tr>
<tr>
<td>111</td>
<td></td>
</tr>
<tr>
<td><strong>TEE as Initial Test—Atrial Fibrillation/Flutter</strong></td>
<td>• Evaluation when a decision has been made to anticoagulate and not to perform cardioversion</td>
</tr>
<tr>
<td>113</td>
<td></td>
</tr>
</tbody>
</table>

**ADDITIONAL INFORMATION:**

**Abbreviations**

- ACS = acute coronary syndrome
- APC = atrial premature contraction
- CABG = coronary artery bypass grafting surgery
- CAD = coronary artery disease
- CMR = cardiovascular magnetic resonance
- CRT = cardiac resynchronization therapy
- CT = computed tomography
- ECG = electrocardiogram
- HF = heart failure
- ICD = implantable cardioverter-defibrillator
- LBBB = left bundle-branch block
- LV = left ventricular
- MET = estimated metabolic equivalents of exercise
- MI = myocardial infarction
- RNI = radionuclide imaging
- SPECT MPI = single-photon emission computed tomography myocardial perfusion imaging
- STEMI = ST-segment elevation myocardial infarction
- SVT = supraventricular tachycardia
- TEE = transesophageal echocardiogram
- TIA = transient ischemic attack
- TIMI = Thrombolysis in Myocardial Infarction
- TTE = transthoracic echocardiogram
- UA/NSTEMI = unstable angina/non-ST-segment elevation myocardial infarction
- VPC = ventricular premature contraction
- VT = ventricular tachycardia PCI = percutaneous coronary intervention
REFERENCES


INTRODUCTION:

Stress tests are done to assess cardiac function in terms of heart’s ability to respond to increased work. Stress testing can be done without imaging including Standard Exercise Treadmill Testing (ETT) or with imaging including Stress Echocardiography and nuclear Myocardial Perfusion Imaging (MPI).

Exercise Treadmill Testing (ETT) is the appropriate first line test in most patients with suspected CAD. However, there are patients in whom the test is not the best choice, for example those with resting electrocardiogram (ECG) abnormalities, inability to exercise, and perimenopausal women.

Stress Echocardiography is an initial imaging modality for the evaluation of coronary artery disease/ischemic heart disease when stress testing with imaging is indicated. It has similar sensitivity and superior specificity to MPI for evaluation of ischemic heart disease and avoids radiation. In addition to diagnostic capabilities stress echocardiography is useful in risk stratification and efficacy of therapy.

Myocardial perfusion imaging is also often used as an initial test to evaluate the presence, and extent of coronary disease. Like stress echocardiography it is also used to risk stratify patients with and without significant disease. Similar to all stress testing MPI can be used for monitoring the efficacy of therapy and may have a more powerful role in the assessment of myocardial viability in patients who have had a myocardial infarction in whom interventions are contemplated. Perhaps it’s most important distinction lies in the tests ability to obtain useful information in patients who are unable to exercise. In such cases drugs such as, dipyridamole, dobutamine, or adenosine, are administered to mimic the physiological effects of exercise.

The common approach for stress testing by American College of Cardiology and American Heart Association indicates the following:

- Treadmill test: sensitivity 68%, specificity 77%
- Stress Echocardiogram: sensitivity 76%, specificity 88%
- Nuclear test: sensitivity 88%, specificity 77%

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 APPROPRIATENESS CRITERIA for Stress Echocardiogram:

<table>
<thead>
<tr>
<th>ACCF et al. Criteria # MPI / Stress Echo</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain Stress Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of CAD/Risk Assessment: Symptomatic or Ischemic Equivalent</td>
<td><strong>Evaluation of Ischemic Equivalent (Nonacute) With Stress Echocardiography</strong></td>
<td></td>
</tr>
<tr>
<td>2/115</td>
<td>• Low pretest probability of CAD *</td>
<td>A(7)</td>
</tr>
</tbody>
</table>

*Refer to Additional Information section
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #MPI / Stress Echo</th>
<th>INDICATIONS (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain Stress Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• ECG uninterpretable or unable to exercise</td>
<td></td>
</tr>
<tr>
<td>3/116</td>
<td>• Intermediate pretest probability of CAD*</td>
<td>A(7)</td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable and able to exercise</td>
<td></td>
</tr>
<tr>
<td>4/117</td>
<td>• Intermediate pretest probability of CAD*</td>
<td>A(9)</td>
</tr>
<tr>
<td></td>
<td>• ECG uninterpretable or unable to exercise</td>
<td></td>
</tr>
<tr>
<td>5/118</td>
<td>• High pretest probability of CAD*</td>
<td>A(7)</td>
</tr>
<tr>
<td></td>
<td>• Regardless of ECG interpretability and ability to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>exercise</td>
<td></td>
</tr>
</tbody>
</table>

**Acute Chest Pain With Stress Echocardiography**

| 6/119                                 | • Possible ACS                                           | A(7)                                                            |
|                                       | • ECG: no ischemic changes or with LBBB or               |                                                                  |
|                                       |   electronically paced ventricular rhythm                |                                                                  |
|                                       | • Low-risk TIMI score**                                  |                                                                  |
|                                       | • Negative Troponin levels                               |                                                                  |
| 7/120                                 | • Possible ACS                                           | A(7)                                                            |
|                                       | • ECG: no ischemic changes or with LBBB or               |                                                                  |
|                                       |   electronically paced ventricular rhythm                |                                                                  |
|                                       | • Low-risk TIMI score**                                  |                                                                  |
|                                       | • Peak Troponin: borderline, equivocal, minimally         |                                                                  |
|                                       |   elevated                                              |                                                                  |
| 8/121                                 | • Possible ACS                                           | A(7)                                                            |
|                                       | • ECG: no ischemic changes or with LBBB or               |                                                                  |
|                                       |   electronically paced ventricular rhythm                |                                                                  |
|                                       | • High-risk TIMI score**                                 |                                                                  |
|                                       | • Negative Troponin levels                               |                                                                  |
| 9/122                                 | • Possible ACS                                           | A(7)                                                            |
|                                       | • ECG: no ischemic changes or with LBBB or               |                                                                  |
|                                       |   electronically paced ventricular rhythm                |                                                                  |
|                                       | • High-risk TIMI score**                                 |                                                                  |
|                                       | • Peak Troponin: borderline, equivocal, minimally         |                                                                  |
|                                       |   elevated                                              |                                                                  |

**Detection of CAD/Risk Assessment: Asymptomatic (Without Ischemic Equivalent)**

**General Patient Populations With Stress Echocardiography**

| 14 / 126                               | • Intermediate global CAD risk***                      | U(5)                                                            |
|                                       | • ECG uninterpretable                                  |                                                                  |
| 15/127                                | • High global CAD risk ***                             | U(5)                                                            |
|                                       |                                                        |                                                                  |

**Detection of CAD/Risk Assessment: Asymptomatic (Without Ischemic Equivalent) in Patient Populations With Defined**
<table>
<thead>
<tr>
<th>ACCF et al. Criteria # MPI / Stress Echo</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain Stress Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(*Refer to Additional Information section)</td>
<td></td>
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</tr>
<tr>
<td><strong>Comorbidities</strong></td>
<td></td>
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<tr>
<td>New-Onset or Newly Diagnosed HF or LV Systolic Dysfunction With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16/128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No prior CAD evaluation and no planned coronary angiography</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td><strong>Arrhythmias With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 &amp; 19/129</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sustained VT</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td>NA/130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Frequent PVCs, exercise induced VT, or nonsustained VT</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td>17/132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• New-onset atrial fibrillation</td>
<td>U(6)</td>
<td></td>
</tr>
<tr>
<td><strong>Syncope With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21/134</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Intermediate or high global CAD risk***</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td><strong>Elevated Troponin With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22/135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Troponin elevation without symptoms or additional evidence of ACS</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td>Stress Echocardiography following prior test results</td>
<td></td>
<td></td>
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<tr>
<td>Asymptomatic: Prior Evidence of Subclinical Disease With Stress Echocardiography</td>
<td></td>
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</tr>
<tr>
<td>34/137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Low to intermediate global CAD risk***</td>
<td>U(5)</td>
<td></td>
</tr>
<tr>
<td>• Coronary calcium 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 global CAD risk***</td>
<td>U(6)</td>
<td></td>
</tr>
<tr>
<td>• Coronary calcium Agatston score between 100 and 400</td>
<td></td>
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<tr>
<td>36/139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Coronary calcium Agatston score &gt;400</td>
<td>A(7)</td>
<td></td>
</tr>
<tr>
<td>NA/140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Abnormal carotid intimal medial thickness (≥0.9 mm and/or the presence of plaque encroaching into the arterial lumen)</td>
<td>U(5)</td>
<td></td>
</tr>
<tr>
<td>Coronary Angiography (Invasive or Noninvasive) With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32/141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Coronary artery stenosis of unclear significance</td>
<td>A(8)</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic or Stable Symptoms With Stress Echocardiography Normal Prior Stress Imaging Study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26/145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Intermediate to high global CAD risk***</td>
<td>U(4)</td>
<td></td>
</tr>
<tr>
<td>• Last stress imaging study ≥2 y ago</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic or Stable Symptoms With Stress Echocardiography; Abnormal Coronary Angiography or Abnormal Prior Stress Study;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria # MPI / Stress Echo</td>
<td>INDICATIONS (*Refer to Additional Information section)</td>
<td>APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain Stress Echo</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>No Prior Revascularization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28/147</td>
<td>Known CAD on coronary angiography or prior abnormal stress imaging study</td>
<td>U(5)</td>
</tr>
<tr>
<td></td>
<td>Last stress imaging study ≥2 y ago</td>
<td></td>
</tr>
<tr>
<td><strong>Treadmill ECG Stress Test With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38/149</td>
<td>Intermediate-risk treadmill score (e.g., Duke)*****</td>
<td>A(7)</td>
</tr>
<tr>
<td>39/150</td>
<td>High-risk treadmill score (e.g., Duke)****</td>
<td>A(7)</td>
</tr>
<tr>
<td><strong>New or Worsening Symptoms With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30/151</td>
<td>Abnormal coronary angiography or abnormal prior stress imaging study</td>
<td>A(7)</td>
</tr>
<tr>
<td>31/152</td>
<td>Normal coronary angiography or normal prior stress imaging study</td>
<td>U(6)</td>
</tr>
<tr>
<td><strong>Prior Noninvasive Evaluation With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29/153</td>
<td>Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern</td>
<td>A(8)</td>
</tr>
<tr>
<td><strong>Risk Assessment: Perioperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intermediate-Risk Surgery With Stress Echocardiography</strong></td>
<td></td>
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</tr>
<tr>
<td>43/157</td>
<td>≥1 clinical risk factor</td>
<td>U(6)</td>
</tr>
<tr>
<td></td>
<td>Poor or unknown functional capacity (&lt;4 METs)</td>
<td></td>
</tr>
<tr>
<td><strong>Vascular Surgery With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47/161</td>
<td>≥1 clinical risk factor</td>
<td>A(7)</td>
</tr>
<tr>
<td></td>
<td>Poor or unknown functional capacity (&lt;4 METs)</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Within 3 Months of an ACS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STEMI With Stress Echocardiography</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(7)</td>
</tr>
<tr>
<td></td>
<td>To evaluate for inducible ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No prior coronary angiography since the index event</td>
<td></td>
</tr>
<tr>
<td><strong>UA/NSTEMI With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52/166</td>
<td>Hemodynamically stable, no recurrent chest pain symptoms, or no signs of HF</td>
<td>A(8)</td>
</tr>
<tr>
<td></td>
<td>To evaluate for inducible ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No prior coronary angiography since the index event</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment: Post revascularization (PCI or CABG)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Symptomatic With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55/169</td>
<td>Ischemic equivalent</td>
<td>A(8)</td>
</tr>
</tbody>
</table>
### ACCF et al. Criteria # MPI / Stress Echo

**INDICATIONS**

(*Refer to Additional Information section *)

**APPROPRIATE USE**

SCORE (4-9);

A= Appropriate;

U=Uncertain Stress Echo

<table>
<thead>
<tr>
<th></th>
<th>Asymptomatic With Stress Echocardiography</th>
<th></th>
</tr>
</thead>
</table>
| 56/170 | - Incomplete revascularization  
- Additional revascularization feasible | A(7) |
| 58/172 | - ≥5 y after CABG | U(6) |
| 60/174 | - ≥2 y after PCI | U(5) |

<table>
<thead>
<tr>
<th></th>
<th>Assessment of Viability/Ischemia</th>
<th></th>
</tr>
</thead>
</table>
| 62/176 | - Known moderate or severe LV dysfunction  
- Patient eligible for revascularization  
- Use of dobutamine stress only | A(8) |

<table>
<thead>
<tr>
<th></th>
<th>Hemodynamics (Includes Doppler During Stress)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA/178</td>
<td>- Moderate mitral stenosis</td>
<td>U(5)</td>
</tr>
<tr>
<td>NA/179</td>
<td>- Severe mitral stenosis</td>
<td>A(7)</td>
</tr>
<tr>
<td>NA/181</td>
<td>- Moderate aortic stenosis</td>
<td>U(6)</td>
</tr>
<tr>
<td>NA/182</td>
<td>- Severe aortic stenosis</td>
<td>U(5)</td>
</tr>
<tr>
<td>NA/184</td>
<td>- Moderate mitral regurgitation</td>
<td>U(5)</td>
</tr>
</tbody>
</table>
| NA/185 | - Severe mitral regurgitation  
- LV size and function not meeting surgical criteria | A(7) |
| NA/187 | - Moderate aortic regurgitation | U(5) |
| NA/188 | - Severe aortic regurgitation  
- LV size and function not meeting surgical criteria | A(7) |

<table>
<thead>
<tr>
<th></th>
<th>Chronic Valvular Disease—Asymptomatic With Stress Echocardiography</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA/189</td>
<td>- Mild mitral stenosis</td>
<td>U(5)</td>
</tr>
<tr>
<td>NA/190</td>
<td>- Moderate mitral stenosis</td>
<td>A(7)</td>
</tr>
</tbody>
</table>
| NA/193 | - Evaluation of equivocal aortic stenosis  
- Evidence of low cardiac output or LV systolic dysfunction (“low gradient aortic stenosis”)  
- Use of dobutamine only | A(8) |
| NA/194 | - Mild mitral regurgitation | U(4) |
| NA/195 | - Moderate mitral regurgitation | A(7) |

<table>
<thead>
<tr>
<th></th>
<th>Pulmonary Hypertension With Stress Echocardiography</th>
<th></th>
</tr>
</thead>
</table>
| NA/198 | - Suspected pulmonary artery hypertension  
- Normal or borderline elevated estimated right ventricular systolic pressure on resting echocardiographic study | U(5) |
INDICATIONS FOR STRESS ECHOCARDIOGRAPHY:

To qualify for Stress Echo, the patient must meet ACCF/ASNC Appropriateness criteria for appropriate indications noted above.

INDICATIONS IN ACC GUIDELINES WITH “INAPPROPRIATE” DESIGNATION:

Patient meets ACCF/ASNC Appropriateness criteria for inappropriate indications score of (1-3) as noted below.
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate Stress Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI / Stress Echo</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arrhythmias With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>• Infrequent PVCs</td>
<td>I (3)</td>
</tr>
<tr>
<td><strong>Syncope With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>• Low global CAD risk***</td>
<td>I (3)</td>
</tr>
<tr>
<td><strong>Stress Echocardiography following prior test results</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asymptomatic: Prior Evidence of Subclinical Disease With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>• Coronary calcium Agatston score &lt;100</td>
<td>I (2)</td>
</tr>
<tr>
<td><strong>Asymptomatic or Stable Symptoms With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Normal Prior Stress Imaging Study</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>• Low global CAD risk***</td>
<td>I (1)</td>
</tr>
<tr>
<td>143</td>
<td>• Low global CAD risk***</td>
<td>I (2)</td>
</tr>
<tr>
<td>144</td>
<td>• Intermediate to high global CAD risk***</td>
<td>I (2)</td>
</tr>
<tr>
<td><strong>Asymptomatic or Stable Symptoms With Stress Echocardiography; Abnormal Coronary Angiography or Abnormal Prior Stress Study; No Prior Revascularization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>• Known CAD on coronary angiography or prior abnormal stress imaging study</td>
<td>I (3)</td>
</tr>
<tr>
<td><strong>Treadmill ECG Stress Test With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>148</td>
<td>• Low-risk treadmill score (e.g., Duke)****</td>
<td>I (1)</td>
</tr>
<tr>
<td><strong>Risk Assessment: Perioperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low-Risk Surgery With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>• Perioperative evaluation for risk assessment</td>
<td>I (1)</td>
</tr>
<tr>
<td><strong>Intermediate-Risk Surgery With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>• Moderate to good functional capacity (≥4 METs)</td>
<td>I (3)</td>
</tr>
<tr>
<td>156</td>
<td>• No clinical risk factors</td>
<td>I (2)</td>
</tr>
<tr>
<td>158</td>
<td>• Asymptomatic &lt; 1 year post normal catherization, noninvasive test, or previous revascularization</td>
<td>I (1)</td>
</tr>
<tr>
<td><strong>Vascular Surgery With Stress Echocardiography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>159</td>
<td>• Moderate to good functional capacity (≥4 METs)</td>
<td>I (3)</td>
</tr>
<tr>
<td>160</td>
<td>• No clinical risk factors</td>
<td>I (2)</td>
</tr>
<tr>
<td>ACCF et al. Criteria #</td>
<td>INDICATIONS</td>
<td>APPROPRIATE USE SCORE (1-3); I= Inappropriate Stress Echo</td>
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<td>------------------------</td>
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<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>MPI / Stress Echo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>162</td>
<td>• Asymptomatic ≤ 1 year post normal catheterization, noninvasive test, or previous revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk Assessment: Within 3 Months of an ACS</td>
</tr>
<tr>
<td></td>
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<tr>
<td>STEMI With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>163</td>
<td>• Primary PCI with complete revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td>• No recurrent symptoms</td>
<td></td>
</tr>
<tr>
<td>165</td>
<td>• Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>ACS – Asymptomatic Postrevascularization (PCI or CABG) with Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>• Prior to hospital discharge in a patient who has been adequately revascularized</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Rehabilitation with Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>• Prior to initiation of cardiac Rehabilitation (as a stand-alone indication)</td>
<td>I(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Risk Assessment: Post revascularization (PCI or CABG)</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Asymptomatic With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>171</td>
<td>• ≤ 5y after CABG</td>
<td>I (2)</td>
</tr>
<tr>
<td>173</td>
<td>• ≤ 2y after PCI</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Rehabilitation with Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>• Prior to initiation of cardiac Rehabilitation (as a stand-alone indication)</td>
<td>I(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hemodynamics (Includes Doppler During Stress)</td>
<td></td>
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<td></td>
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<tr>
<td>Chronic Valvular Disease—Asymptomatic With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>177</td>
<td>• Mild mitral stenosis</td>
<td>I (2)</td>
</tr>
<tr>
<td>180</td>
<td>• Mild aortic stenosis</td>
<td>I (3)</td>
</tr>
<tr>
<td>183</td>
<td>• Mild mitral regurgitation</td>
<td>I (2)</td>
</tr>
<tr>
<td>186</td>
<td>• Mild aortic regurgitation</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic Valvular Disease—Symptomatic With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>191</td>
<td>• Severe mitral stenosis</td>
<td>I (3)</td>
</tr>
<tr>
<td>192</td>
<td>• Severe aortic stenosis</td>
<td>I (1)</td>
</tr>
<tr>
<td>196</td>
<td>• Severe mitral regurgitation</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td>• Severe LV enlargement or LV systolic dysfunction</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Acute Valvular Disease With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>197</td>
<td>• Acute moderate or severe mitral or aortic regurgitation</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary Hypertension With Stress Echocardiography</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ADDITIONAL INFORMATION:  

**Abbreviations**

- ACS = acute coronary syndrome  
- CABG = coronary artery bypass grafting surgery  
- CAD = coronary artery disease  
- CHD = coronary heart disease  
- CT = computed tomography  
- 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  
- PCI = percutaneous coronary intervention  
- PET = positron emission tomography  
- RNA = radionuclide angiography  

**General Assumptions for Stress Echocardiography based on Appropriateness Criteria.** To prevent any nuances of interpretation, all indications were considered with the following important assumptions:

- All indications are assumed to apply to adult patients (18 years of age or older).  
- The test is performed and interpreted by qualified individuals in facilities that are proficient in the imaging technique.

**Electrocardiogram (ECG) – Uninterpretable:**  
Refers to ECGs with resting ST-segment depression ($\geq 0.10$ mV), complete LBBB, preexcitation Wolff-Parkinson-White Syndrome (WPW), 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:*  

<table>
<thead>
<tr>
<th>ACCF et al. Criteria # MPI / Stress Echo</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate Stress Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>199</td>
<td>• Routine evaluation of patients with known resting pulmonary hypertension</td>
<td>I (3)</td>
</tr>
</tbody>
</table>
| 201 | • Routine use of contrast  
|     | • All LV segments visualized on noncontrast images | I (1) |
- **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>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

**TIMI Risk Score:**
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**

**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.

  o **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.

**** Duke Treadmill Score

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

\[ DTS = \text{exercise time} - (5 \times \text{ST deviation}) - (4 \times \text{exercise angina}) \]

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.

**Perioperative Clinical Risk Factors:**

  o History of ischemic heart disease
  o History of compensated or prior heart failure
  o History if cerebrovascular disease
  o Diabetes mellitus (requiring insulin)
  o Renal insufficiency (creatinine >2.0)

**Use of Contrast with Stress Echo** – The routine use of contrast with stress echo is inappropriate. Contrast must be used selectively, and in instances when two or more contiguous segments are not seen on noncontrast images.

**REFERENCES**

doi:10.1016/j.jacc.2010.11.002. (Published online November 19, 2010)


INTRODUCTION:

Cerebral perfusion computed tomography (CT) is a relatively new imaging technique that provides quantitative evaluation of cerebral perfusion by generating maps of cerebral blood flow, cerebral blood volume and mean transit time. It may assist in the identification of ischemic regions of the brain. It is useful in the assessment not only of patients with acute stroke but also a wide range of patients with other cerebrovascular diseases. It may provide the information needed to assess the most effective procedures or treatments for the conditions. Cerebral perfusion CT is less invasive than CT angiography and is fast and available for most standard spiral CT scanners equipped with the appropriate software.

INDICATIONS FOR CEREBRAL PERFUSION CT:

- For noninvasive diagnosis of cerebral ischemia and infarction and for evaluation of vasospasm after subarachnoid hemorrhage.
- For assessment of cerebrovascular reserve by using acetazolamide challenge in patients with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment.
- For the evaluation of patients undergoing temporary balloon occlusion to assess collateral flow and cerebrovascular reserve.
- For the assessment of microvascular permeability in patients with intracranial neoplasms.
- For the assessment of cerebral blood flow after carotid artery stent placement in patients with severe carotid artery stenosis.
- For early detection of acute cerebral ischemia.

ADDITIONAL INFORMATION RELATED TO CEREBRAL PERFUSION CT:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

Cerebral Ischemia and Infarction and Evaluation of Vasospasm after Subarachnoid Hemorrhage – Cerebral perfusion CT measures cerebral blood flow, cerebral blood volume and mean transit time which can be useful in identifying patients at risk for cerebral ischemia or infarction and for evaluation of vasospasm after subarachnoid hemorrhage. This information may be useful in identifying urgent medical or endovascular treatment.

Cerebrovascular Reserve - Cerebral perfusion CT in conjunction with acetazolamide challenge in patients with intracranial vascular stenoses can evaluate cerebrovascular reserve capacity and help in
estimating the potential risk of stroke. It may help to identify candidates for bypass surgery and endovascular treatment to increase cerebral blood flow.

**Temporary Balloon Occlusion** – Temporary balloon occlusion along with a quantitative analysis of cerebral blood flow may be useful in identifying patient who may not tolerate permanent or prolonged occlusion.

**Intracranial tumors** – Cerebral perfusion CT generates permeability measurements in images of brain tumors depicting areas of different blood flow within tumors and the surrounding tissues. This may allow for diagnosis and grading of tumors and may help to monitor treatment.

**Carotid Artery Stent Placement** – Cerebral perfusion CT provides a quantitative evaluation of cerebral perfusion and helps in the assessment of the hemodynamic modifications in patients with severe carotid stenosis. It provides valuable information for a more thorough assessment in the follow-up of patients after they have undergone carotid stent placement.

**Acute Cerebral Ischemia (Stroke)** – Cerebral perfusion CT can quantitatively distinguish the extent of irreversibly infarcted brain tissue (infarct core) from the severely ischemic but salvageable tissue (penumbra), providing a basis for the selection of acute stroke patients that are most likely to benefit from thrombolytic treatment.

**REFERENCES:**


| 0159T – CAD Breast MRI | Last Review Date: September 2010 |

The CPT code that has been selected is auto-approved only if the member has an approved Breast MRI procedure.
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.

INDICATIONS FOR MRCP:

- For evaluation of patient with suspected congenital anomaly of the pancreaticobiliary tract, e.g., aberrant ducts, choledochal cysts, pancreas divisum.
- For evaluation of patient with complications of chronic pancreatitis.
- For evaluation of an enlarged liver (on USG, or prior CT/MR imaging) and/or liver inflammation w/non-diagnostic lab work up.

ADDITIONAL INFORMATION RELATED TO MRCP:

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.

Intravascular administration of contrast material may be contraindicated in patients who have a documented allergy from prior contrast administration or a history of atopy. Intravascular contrast agents may be contraindicated in patients who have impaired renal function.

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 postsurgical 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. 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.

REFERENCES:


