2014 NIA Radiology Standard Clinical Guidelines
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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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 for at least four (4) weeks with bite block or splint and anti-inflammatory medicine.
- For pre-operative evaluation of dysfunctional temporomandibular joint in candidates for orthognathic surgery.
- For evaluation of locked or frozen jaw.

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 symptoms or deficits:
- Acute, new or fluctuating neurologic symptoms or 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
  - Headache
  - Signs of increases intracranial pressure
- Skull fracture by physical exam and/positive x-ray

For evaluation of headache:
- Chronic headache with a change in character/pattern (e.g. more frequent, increased severity or duration) and MRI is contraindicated or cannot be performed.
- New onset (< 48 hours) of “worst headache in my life” or “thunderclap” headache. Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes.
- New headache in occipitomuchal region in individual > 55 years old and MRI is contraindicated or cannot be performed.
- New temporal headache in person > 55, with Sedimentation Rate (ESR) > 55 and tenderness over the temporal artery and MRI is contraindicated or cannot be performed.
- Patient with history of cancer or HIV with new onset headache and MRI is contraindicated or cannot be performed.

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

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

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

**For evaluation of known or suspected stroke:**

• 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) and MRI is contraindicated or cannot be performed:**

• With history of known aneurysm or AVM with new onset headache.
• With history or suspicion of aneurysm or AVM with family history (brother, sister, parent or child) of aneurysm or AVM.

**For evaluation of known or suspected inflammatory disease or infection, (e.g., meningitis, or abscesses) and MRI is contraindicated or cannot be performed:**

• With positive lab findings.

**For evaluation of known or suspected congenital abnormalities and MRI is contraindicated or cannot be performed:**

• To evaluate patient for suspected or known hydrocephalus or congenital abnormality.
• To evaluate patient for prior treatment OR treatment planned for congenital abnormality.

**Pre-operative evaluation for brain surgery:**

• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

**Post-operative/procedural evaluation:**

• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
• 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.

**Indication for Brain CT/Cervical CT combination studies:**

• 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.
- For screening and assessment of known or suspected optic neuritis if MRI is contraindicated or is unable to be performed.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital Pseudotumor.

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

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

REFERENCES:


INTRODUCTION:

Temporal bone/mastoid computed tomography (CT) is a unique study performed for problems such as conductive hearing loss, chronic otitis media, mastoiditis, cholesteatoma, congenital hearing loss and cochlear implants. It is a modality of choice because it provides 3D positional information and offers contrast for different tissue types.

INDICATIONS FOR TEMPORAL BONE, MASTOID CT:

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

ADDITIONAL INFORMATION RELATED TO TEMPORAL BONE, MASTOID 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.

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:**


INTRODUCTION:

The sella Turcica is a saddle-shaped depression in the sphenoid bone at the base of the human skull which holds the pituitary gland. Computed tomography (CT) is useful in the delineation of the osseous margins of the sella. It is particularly helpful in evaluating the bony changes related to pathologic processes. The most frequent finding is a change in the size of the sella Turcica such as an enlargement unaccompanied by bone erosion. The most common causes are the presence of interstellar adenomas and empty sella syndrome. The shape of the sella may also be affected by pathological conditions, such as Down syndrome, Williams’ syndrome, Sickle syndrome, and lumbosacral myelomenigocele.

INDICATIONS FOR SELLA 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, pituitary adenoma and parasellar bony structures for the evaluation of certain sellar tumors.
- For screening and assessment of known or suspected optic neuritis if MRI is contraindicated or is unable to be performed.
- For evaluation of unilateral visual deficit.
- For screening and evaluation of suspected orbital Pseudotumor.

ADDITIONAL INFORMATION RELATED TO SELLA 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 sclero-uveal layer. It may be seen as a well defined mass if it is more than 3 mm thick.

**REFERENCES:**


INTRODUCTION:

Computed tomography (CT) primarily provides information about bony structures, but may also be useful in evaluating some soft tissue masses. It helps document the extent of facial bone fractures secondary to facial abscesses and diagnosing parotid stones. Additionally, CT may be useful in identifying tumor invasion into surrounding bony structures of the face and may be used in the assessment of chronic osteomyelitis.

INDICATIONS FOR FACE CT:

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

ADDITIONAL INFORMATION RELATED TO FACE 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.

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

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

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

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

REFERENCES:


INTRODUCTION:

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

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, or brain MRI, etc.) demonstrates an abnormality or is indeterminate.

For evaluation of known or suspected tumor:
- 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 opaque 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 opaque sinuses visualized on x-ray.

Pre-operative evaluation:
- Planned maxillo-facial surgery.
- 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 opaqueness 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.
- For presence of polyposis on imaging or direct visualization that may be causing significant airway obstruction.
• For deviated nasal septum or structural abnormality seen on imaging or direct visualization that may be causing significant airway obstruction.
• For new onset of anosmia (lack of sense of smell) or significant hyposmia (diminished sense of smell).
• Other conditions such as Granulomatosis with polyangiitis (Wegener’s) 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 air flow 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. ISSN: 1080-0549.


INTRODUCTION:

High resolution CT can visualize both normal and pathologic anatomy of the neck. It is used in the evaluation of neck soft tissue masses, abscesses, and lymphadenopathy. For neck tumors, it defines the extent of the primary tumor and identifies lymph node spread. CT provides details about the larynx and cervical trachea and its pathology. Additional information regarding airway pathology is provided by 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 tumor, cancer or mass:
- Evaluation of neck tumor, mass or history of cancer with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Evaluation of skull base tumor, mass or cancer.
- Evaluation of tumors of the tongue, larynx, nasopharynx, pharynx, or salivary glands.
- Evaluation of parathyroid tumor when:
  - CA> normal and PTH > normal WITH
    - Previous nondiagnostic ultrasound or nuclear medicine scan AND
    - Surgery planned.

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

For evaluation of suspected tumor, cancer or mass:
- Evaluation of neck tumor, mass or cancer with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Evaluation of palpable lesions in mouth or throat.
- Evaluation of non-thyroid masses in the neck when present greater than one month, noted to be ≥1 cm or associated with generalized lymphadenopathy

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

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation (e.g. post neck dissection):
• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

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

**Other indications for a Neck CT:**

• For evaluation of vocal cord lesions or vocal cord paralysis.

• For evaluation of stones of the parotid and submandibular glands and ducts.

• For evaluation of tracheal stenosis.

**ADDITIONAL INFORMATION RELATED TO NECK 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 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.

**CT and Parotid and Submandibular Gland and Duct Stones** – The sensitivity of CT to minimal amounts of calcific salts makes it well suited for the imaging of small, semi calcified 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:**


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 BRAIN CTA:

For evaluation of known intracranial vascular disease:
- To evaluate known intracranial aneurysm or arteriovenous malformation (AVM).
- To evaluate known vertebral basilar insufficiency (VBI).
- To re-evaluate vascular abnormality visualized on previously brain MRI.
- For evaluation of known vasculitis.

For evaluation for suspected intracranial vascular disease:
- To screen for suspected intracranial aneurysm in patient whose parent or sibling has history of intracranial aneurysm. Note: If there is a first degree familial history, repeat study is recommended every 5 years.
- Screening for aneurysm in polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, neurofibromatosis, or known aortic coarctation.
- To evaluate suspected vertebral basilar insufficiency (VBI).
- To evaluate suspected arteriovenous malformation (AVM).
- For evaluation of suspected venous thrombosis.
- For evaluation of pulsatile tinnitus for vascular etiology.
- For evaluation of suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.

Pre-operative evaluation for brain surgery:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for Brain CTA/Neck CTA combination studies:
• For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
• For evaluation of patients with a sudden onset of one-sided weakness, inability to speak, vision defects or severe dizziness.
• For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

ADDITIONAL INFORMATION RELATED TO BRAIN 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.

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:

For evaluation of vascular disease:
- For evaluation of patients with an abnormal ultrasound of the neck or carotid duplex imaging.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

For evaluation of known or suspected tumor/mass:
- For evaluation of carotid body tumors, also called paragangliomas.
- For evaluation of pulsatile neck mass.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

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

Indications for Neck CTA/Brain CTA combination studies:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of patients with a sudden onset of one-sided weakness, inability to speak, vision defects or severe dizziness.
- For suspected vertebral basilar insufficiency with symptoms such as vision changes, vertigo, abnormal speech.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

ADDITIONAL INFORMATION RELATED TO NECK 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.

**CTA and Carotid Body Tumor**—Carotid body tumors are found in the upper neck at the branching of the carotid artery. Although most of them are benign they may be locally aggressive with a small malignant potential. Computed tomography angiography of carotid arteries may be performed using a multislice 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:**


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

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

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 known tumor, cancer or mass:
- For evaluation of neck tumor, mass or cancer 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 skull base tumor, mass or cancer.
- Evaluation of tumors of the tongue, larynx, nasopharynx pharynx, or salivary glands.
- Evaluation of parathyroid tumor when:
  - CA> normal and PTH > normal WITH
    - Previous nondiagnostic ultrasound or nuclear medicine scan AND
    - Surgery planned.

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

For evaluation of suspected tumor, cancer or mass:
- Evaluation of neck tumor, mass or with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
- Evaluation of palpable lesions in mouth or throat.
- Evaluation of non-thyroid masses in the neck when persistent, greater than one month, and >/= to 1 cm.

For evaluation of known or suspected inflammatory disease or infections:
- Evaluation of lymphadenopathy in the neck when greater than one month, and >/= to 1 cm or associated with generalized lymphadenopathy.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation (e.g. post neck dissection/exploration):
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

**Other indications for a Neck MRI:**
- For evaluation of vocal cord lesions or vocal cord paralysis.
- For evaluation of stones of the parotid and submandibular glands and ducts.
- Brachial plexus dysfunction (Brachial plexopathy/Thoracic Outlet Syndrome).

**ADDITIONAL INFORMATION RELATED TO NECK 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.

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 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.

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

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

MRI and 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:

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

INDICATIONS FOR SINUS MRI:

- Evidence of tumor from a physical exam, plain sinus x-ray or previous CT.
- Cerebrospinal Fluid (CSF) leak.
- Unresolved sinusitis after four (4) consecutive weeks of medication, e.g., antibiotics, steroids or anti-histamines.
- Osteomyelitis (rare) of the facial bone.

ADDITIONAL INFORMATION RELATED TO SINUS 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.

Sinusitis - 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.

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

REFERENCES:


INTRODUCTION:

Magnetic resonance angiography (MRA) or magnetic resonance venography (MRV) can be used as a first line investigation of intracranial vascular disease. It is an alternative to invasive intracatheter 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/MRV:

For evaluation of known intracranial vascular disease:
- To evaluate known intracranial aneurysm or arteriovenous malformation (AVM).
- To evaluate known vertebral basilar insufficiency (VBI).
- To re-evaluate vascular abnormality visualized on previously brain MRI.
- For evaluation of known vasculitis.

For evaluation for suspected intracranial vascular disease:
- To screen for suspected intracranial aneurysm in patient whose parent or sibling has history of intracranial aneurysm. Note: If there is a first degree familial history, repeat study is recommended every 5 years.
- Screening for aneurysm in polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, neurofibromatosis, or known aortic coarctation.
- To evaluate suspected vertebral basilar insufficiency (VBI).
- To evaluate suspected arteriovenous malformation (AVM).
- For evaluation of suspected venous thrombosis.
- For evaluation of pulsatile tinnitus for vascular etiology.
- For evaluation of suspected vasculitis with abnormal lab results suggesting acute inflammation or autoimmune antibodies.

Pre-operative evaluation for brain surgery:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
Indications for Brain MRA/Neck MRA combination studies:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of patients with a sudden onset of one-sided weakness, inability to speak, vision defects or severe dizziness.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

ADDITIONAL INFORMATION RELATED TO BRAIN (HEAD) MRA

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

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

REFERENCES:


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 evaluation of vascular disease:
- For evaluation of patients with an abnormal ultrasound of the neck or carotid duplex imaging.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

For evaluation of known or suspected tumor/mass:
- For evaluation of carotid body tumors, also called paragangliomas.
- For evaluation of pulsatile neck mass.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

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

Indications for Neck MRA/Brain MRA combination studies:
- For evaluation of patients who have had a stroke or transient ischemic attack (TIA) within the past 2 weeks.
- For evaluation of patients with a sudden onset of one-sided weakness, inability to speak, vision defects or severe dizziness.
- For suspected vertebral basilar insufficiency with symptoms such as vision changes, vertigo, abnormal speech.
- For evaluation of head trauma in a patient with closed head injury for suspected carotid or vertebral artery dissection.

ADDITIONAL INFORMATION RELATED TO NECK MRA:

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

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

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.

Evaluation of known multiple sclerosis (MS):
• Stable condition with no prior imaging within the past ten (10) months.
• Exacerbation of symptoms or change in symptom characteristics such as frequency or type and demonstrated compliance with medical therapy.
• 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:
• New onset of a seizure.
• 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 symptoms or deficits:
• Acute, new or fluctuating neurologic symptoms or 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
- Headache

- Skull fracture by physical exam and positive x-ray.

For evaluation of headache:
- Chronic headache with a change in character/pattern (e.g. more frequent, increased severity or duration).
- 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.
- Evaluation of metastatic melanoma (not all melanomas).

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**
- ≤ 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

For evaluation of known or suspected stroke:
- 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.

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), sarcom 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 abnormality (such as placement of shunt or problems with shunt; surgery).

• Known or rule out congenital abnormality 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.

**Pre-operative evaluation for brain surgery:**

• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

**Post-operative/procedural evaluation:**

• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

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

**Indications for a Brain MRI with Internal Auditory Canal (IAC):**

• Tinnitus (constant ringing in one or both ears), hearing loss and an abnormal audiogram.

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

• Suspected cholesteotoma ordered by ENT, Neurologist or Neurosurgeon or primary care provider on behalf of specialist who has seen the patient.

• Suspected glomus tumor.

• Acute onset or asymmetrical sensory neurological hearing loss.

**Other indications for a Brain MRI:**

• Evaluation of suspected acute Subarachnoid Hemorrhage (SAH).

• 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.
• 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.

Indications for combination studies:
• 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 –
  o For evaluation of Arnold Chiari Malformation when ordered by Neurosurgeon or Neurologist or primary care provider on behalf of specialist who has seen the patient.
  o For follow-up of known Multiple Sclerosis (MS).
• 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:

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 a patient 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 known tumor, cancer or mass:
- Initial evaluation of diagnosed cancer.
- 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 or history of prior cancer presenting with new signs (i.e., physical, laboratory, or imaging findings) or new symptoms.
- Cancer surveillance excluding small cell lung cancer: Every 6 months for the first two years then annually thereafter.
- Cancer surveillance – small cell lung cancer: Up to every 3 months for the first two years then annually thereafter.

Evaluation of suspicious mass/tumor (unconfirmed cancer diagnosis):
- Initial evaluation of suspicious mass/tumor found on an imaging study and needing clarification or found by physical exam and remains non-diagnostic after x-ray or ultrasound is completed.
- Known distant cancer with suspected chest/lung metastasis based on a sign, symptom, imaging study or abnormal lab value.
- For the follow-up evaluation of a nodule with a previous CT (follow-up intervals approximately 3, 6, 12 and 24 months).

Known or suspected interstitial lung disease (e.g. idiopathic interstitial lung diseases, idiopathic pulmonary fibrosis, hypersensitivity pneumonitis, pneumoconiosis, sarcoidosis, silicosis and asbestosis) and initial x-ray has been performed:
- With abnormal physical, laboratory, and/or imaging findings requiring further evaluation.

Known or suspected infection or inflammatory disease (i.e., complicated pneumonia not responding to treatment, abscess, T.B., empyema) and initial x-ray has been performed:
- With abnormal physical, laboratory, and/or imaging findings. Requiring further evaluation.
- For evaluation of known inflammatory disease:
  - Initial evaluation
  - During treatment
  - With new signs and symptoms
- For evaluation of non-resolving pneumonia documented by at least two imaging studies:
  - Unimproved with 4 weeks of antibiotic treatment OR
  - Not resolved at 8 weeks
• For evaluation of lung abscess, cavitary lesion, or empyema, demonstrated or suggested on prior imaging.

**Suspected vascular disease, (e.g., aneurysm, dissection):**
• For evaluation of widened mediastinum on x-ray
• For evaluation of known or suspected superior vena cava (SVC) syndrome
• Suspected thoracic/thoracoabdominal aneurysm or dissection (documentation of clinical history may include hypertension and reported “tearing or ripping type” chest pain).

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

**Hemoptysis:**
• For evaluation of hemoptysis and prior x-ray performed.

**Post-operative/procedural evaluation:**
• When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
• 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.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**
• < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

**Other indications for Chest CT:**
• Pre-operative evaluation.
• For further evaluation after abnormal imaging within past 30 - 60 days and with no improvement on x-ray, (not indicated with known rib fractures).
• For evaluation of persistent unresolved cough with at least four 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 vocal cord paralysis.
• For suspected thymoma with myasthenia gravis.
• Chest and Sinus CT combo for Wegener's (granulomatosis with polyangiitis) disease.

**COMBINATION OF STUDIES WITH CHEST CT:**
• Sinus CT/Chest CT - Asthma when ordered by a Pulmonologist.

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

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

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

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

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

REFERENCES:


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 (excludes Low risk*)

For evaluation of suspected or known vascular abnormalities:
- Thoracic aortic aneurysm or thoracic aortic dissection.
- Congenital thoracic vascular anomaly, (e.g., coarctation of the aorta or evaluation of a vascular ring suggested by GI study).
- Signs or symptoms of vascular insufficiency of the neck or arms (e.g., subclavian steal syndrome with abnormal ultrasound).
- Follow-up evaluation of progressive vascular disease when new signs or symptoms are present.
- Pulmonary hypertension.

Preoperative evaluation
- Known vascular disease and patient has not had a catheter angiogram within the last month.
- Proposed ablation procedure for atrial fibrillation.

Postoperative or post-procedural evaluation
- Known vascular disease with physical evidence of post-operative bleeding complication or re-stenosis.
- 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.

ADDITIONAL INFORMATION RELATED TO CHEST 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.

CTA and Coarctation of the Aorta – Coarctation of the aorta is a common vascular anomaly characterized by a constriction of the lumen of the aorta distal to the origin of the left subclavian artery near the insertion of the ligamentum arteriosum. The clinical sign of coarctation of the aorta is a disparity in the pulsations and blood pressures in the legs and arms. Chest CTA may be used to evaluate either suspected or known aortic coarctation and patients with significant coarctation should be treated surgically or interventionally.
CTA and Pulmonary Embolism (PE) – Note: D-Dimer blood test in patients at low risk* for DVT is indicated to prior to CTA imaging. Negative D-Dimer suggests alternative diagnosis in these patients.

*Low risk defined as NO to any of the following questions: 1) evidence of current or prior DVT; 2) HR > 100; 3) cancer diagnosis; 4) recent surgery or prolonged immobilization; 5) hemoptysis; 6) history of PE; 7) other diagnosis more likely.

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

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

**REFERENCES:**


Romano, M., Mainenti, P.P., Imbriaco, M., Amato, B., Markabaowi, K., Tamburrini, O., & Salvatore, M. (2004). Multidetector row CT angiography of the abdominal aorta and lower

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

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

For evaluation of suspected or known vascular abnormalities:
- Thoracic aortic aneurysm or thoracic aortic dissection.
- Congenital thoracic vascular anomaly, (e.g., coarctation of the aorta or evaluation of a vascular ring suggested by GI study).
- Signs or symptoms of vascular insufficiency of the neck or arms (e.g., subclavian steal syndrome with abnormal ultrasound).
- Follow-up evaluation of progressive vascular disease when new signs or symptoms are present.
- Pulmonary hypertension.

Preoperative evaluation
- Known vascular disease and patient has not had a catheter angiogram within the last month.
- Proposed ablation procedure for atrial fibrillation.

Postoperative or post-procedural evaluation
- Known vascular disease with physical evidence of post-operative bleeding complication or restenosis.
- 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.

ADDITIONAL INFORMATION RELATED TO CHEST MRA:

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

*Low risk defined as NO to any of the following questions: 1) evidence of current or prior DVT; 2) HR > 100; 3) cancer diagnosis; 4) recent surgery or prolonged immobilization; 5) hemoptysis; 6) history of PE; 7) other diagnosis more likely

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

**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:


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; abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Cervical Spine MRI is contraindicated:
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of new onset of neck pain when Cervical Spine MRI is contraindicated:
- Failure of conservative treatment*, for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of trauma or acute injury within past 72 hour:
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

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

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

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
• < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma when Cervical Spine MRI is contraindicated:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.
• For post-operative / procedural evaluation: A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

For post-operative / procedural evaluation for surgery or fracture occurring within the past six (6) months:
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.
Other indications for a Cervical Spine CT:

- For preoperative evaluation and Cervical Spine MRI is contraindicated
- CT myelogram or discogram.
- Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes.
- Known Arnold-Chiari syndrome and Cervical Spine MRI is contraindicated.
- Syringinx or syringomyelia 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 – any combination of these for spinal survey in patient with metastases.
Cervical MRI/CT – unstable cranio cervical junction.
Brain CT/Cervical CT – for evaluation of Arnold Chiari formation.

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

**Home Exercise Program - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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; abnormal reflexes; or new onset of abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Thoracic MRI is contraindicated:
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of new onset of back pain when Thoracic Spine MRI is contraindicated:
- Failure of conservative treatment* for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

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

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

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**
• ≤ 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma when Thoracic MRI is contraindicated:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

**For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:**
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Thoracic Spine CT:
• For pre-operative evaluation and **Thoracic MRI is contraindicated**
• CT myelogram or discogram.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes and Thoracic Spine MRI is contraindicated.
• Syrinx or syringomyelia and Thoracic Spine MRI is contraindicated.

**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:**

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

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

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason- i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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

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

**REFERENCES**


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; abnormal reflexes; abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease when Lumbar Spine MRI is contraindicated:
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of new onset of back pain when Lumbar Spine MRI is contraindicated:
- Failure of conservative treatment*, for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes [along a particular dermatome (nerve distribution)].
- With progression or worsening of symptoms during the course of conservative treatment*.

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

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

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**
• ≤ 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

**For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma and Lumbar Spine MRI is contraindicated:**
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

**For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:**
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

**Other indications for a Lumbar Spine CT:**
• For preoperative evaluation and Lumbar Spine MRI is contraindicated
• CT myelogram or discogram.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes and Lumbar Spine MRI is contraindicated.
• Tethered cord, known or suspected spinal dysraphism and Lumbar Spine MRI is contraindicated.
• Ankylosing Spondylitis- For diagnosis when suspected as a cause of back or sacroiliac pain and completion of the following initial evaluation and Lumbar Spine MRI is contraindicated:
  o History of back pain associated with morning stiffness
  o Sedimentation rate and/or C-reactive protein
  o HLA B27
• Non-diagnostic or indeterminate x-ray

**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:**

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

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

- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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

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

**CT and Degenerative Disease of the Lumbar Spine** – Stenosis of the lumbar canal may result from degenerative changes of the discs, ligaments and facet joints surrounding the lumbar canal. Compression of the microvasculature of the bundle of nerve roots in the lumbosacral spine may lead to transient compression of the cauda equina. This is a surgical emergency and CT may be performed to help assess the problem. CT scans provide visualization of the vertebral canal and may demonstrate encroachment of the canal by osteophytes, facets, pedicles or hypertrophied lamina. The anatomy of the vertebral canal is demonstrated by three-dimensional CT.
CT and Low Back Pain – Low back pain by itself is a self-limited condition which does not warrant any imaging studies. One of the “red flags” signifying a more complicated status is focal neurologic deficit with progressive or disabling symptoms. When magnetic resonance imaging (MRI) is contraindicated, CT of the lumbar spine with or without contrast is indicated for low back pain accompanied by a “red flag” symptom. Myelography combined with post-myelography CT is accurate in diagnosing disc herniation and may be useful in surgical planning.

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

- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale (a delicate filament near the tailbone)
- History of spine trauma/surgery

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

REFERENCES


INTRODUCTION:

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

INDICATIONS FOR CERVICAL SPINE MRI:

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

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

**For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:**
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

**For evaluation of new onset of neck pain:**
- Failure of conservative treatment*, for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

**For evaluation of trauma or acute injury within past 72 hours:**
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

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

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

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
• < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.
• For post-operative / procedural evaluation: A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

For post-operative / procedural evaluation for surgery or fracture occurring within the past six (6) months:
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Cervical Spine MRI:
• For preoperative evaluation.
• Suspected cord compression with any of the following neurological deficits: extremity weakness; abnormal gait; asymmetric reflexes.
• 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 evaluation of Arnold Chiari malformation.
  • For follow-up of known Multiple Sclerosis (MS).

ADDITIONAL INFORMATION RELATED TO CERVICAL SPINE MRI:

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

**Home Exercise Program - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
  • Information provided on exercise prescription/plan AND
  • Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

MRI for Evaluation of Discitis – Discitis is a known complication of cervical discography. Postoperative discitis in the cervical spine does not occur frequently but result from accidental inoculation of bacteria into the disc space intra-operatively by a contaminated spinal needle being used as a radiological marker. There may be other causes for postoperative discitis, e.g., esophageal perforation, hematogenous spread, inoculation of bacteria during surgery. Patients with an alteration in the nature of their symptoms after cervical discectomy and fusion may have discitis. Symptoms may include complaints of mild paresthesia in extremities and neck pain. MRI may be performed to reveal feature of discitis with associated abscesses and may help to confirm the diagnosis and decide on the further management.

MRI for Cervical Radiculopathy – MRI is a useful test to evaluate the spine because it can show abnormal areas of the soft tissues around the spine; it addition to the bones, it can also show pictures of the nerves and discs and is used to find tumors, herniated discs or other soft-tissue disorders. MRI has a role both in the pre-operative screening and post-operative assessment of radicular symptoms due to either disc or osteophyte.
MRI and Multiple Sclerosis (MS) – MRI is a sensitive method of detecting the white matter lesions of MS. These plaques on MRI generally appear as multiple, well demarcated, homogenous, small ovoid lesions which lack mass effect and are oriented perpendicular to the long axis of the lateral ventricles. Sometimes they present as large, space occupying lesions that may be misinterpreted as tumors, abscesses or infarcts.

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

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: extremity weakness; abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of new onset of back pain:
- Failure of conservative treatment* for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

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

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

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
• ≤ 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Thoracic Spine MRI:
• For preoperative evaluation
• Suspected cord compression with any of the following neurological deficits: extremity weakness; abnormal gait; asymmetric reflexes.
• Syrinx or syringomyelia.

COMBINATION OF STUDIES WITH THORACIC 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.

ADDITIONAL INFORMATION RELATED TO THORACIC SPINE MRI

MRI imaging – Metal devices or foreign body fragments within the body, such as indwelling pacemakers and intracranial aneurysm surgical clips that are not compatible with the use of MRI, may be contraindicated. Other implanted metal devices in the patient as well as external devices such as portable O₂ tanks may also be contraindicated.
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*: (spine) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program**, and/or chiropractic care.

**Home Exercise Program** - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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

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

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

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; abnormal reflexes; abnormal sensory changes along a particular dermatome (nerve distribution) as documented on exam; evidence of Cauda Equina Syndrome; bowel or bladder dysfunction; new foot drop.

For evaluation of chronic or degenerative changes, e.g., osteoarthritis, degenerative disc disease:
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of new onset of back pain:
- Failure of conservative treatment*, for at least six (6) weeks.
- With progression or worsening of symptoms during the course of conservative treatment*.
- With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.

For evaluation of trauma or acute injury within past 72 hours:
- Presents with radiculopathy, muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution).
- With progression or worsening of symptoms during the course of conservative treatment*.

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

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
• ≤ 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

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

For evaluation of immune system suppression, e.g., HIV, chemotherapy, leukemia, lymphoma:
• As evidenced by signs/symptoms, laboratory or prior imaging findings.

For post-operative / procedural evaluation of surgery or fracture occurring within past six (6) months:
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.
• Changing neurologic status post-operatively.
• With an abnormal electromyography (EMG) or nerve conduction study if radicular symptoms are present.
• Surgical infection as evidence by signs/symptoms, laboratory or prior imaging findings.
• Delayed or non-healing as evidence by signs/symptoms, laboratory or prior imaging findings.
• Continuing or recurring symptoms of any of the following neurological deficits: Lower extremity weakness, lower extremity asymmetric reflexes.

Other indications for a Lumbar Spine MRI:
• For preoperative evaluation.
• Suspected cord compression with any of the following neurologic deficits, e.g., extremity weakness, abnormal gait, asymmetric reflexes.
• Tethered cord, known or suspected spinal dysraphism.
• Ankylosing Spondylitis - For diagnosis when suspected as a cause of back or sacroiliac pain and completion of the following initial evaluation:
  o History of back pain associated with morning stiffness
  o Sedimentation rate and/or C-reactive protein
  o HLA B27
  o Non-diagnostic or indeterminate x-ray

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

**Home Exercise Program** - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with documentation provided regarding completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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

**Tethered spinal cord syndrome** - a neurological disorder caused by tissue attachments that limit the movement of the spinal cord with the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is myelomeningocele and lipomyelomeningocele; the following are other causes that vary in severity of symptoms and treatment.
- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale (a delicate filament near the tailbone)
- History of spine trauma/surgery

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


INTRODUCTION:

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:
- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of suspected or known aortic aneurysm:
  - 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 by signs/symptoms such as new onset of abdominal or pelvic pain.
- Suspected retroperitoneal hematoma or hemorrhage.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis.
- For evaluation of suspected pelvic vascular disease when findings on ultrasound are indeterminate.

Pre-operative evaluation:
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative or post-procedural evaluation:
- Evaluation of endovascular/interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

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**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.

**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.

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.

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- Initial evaluation of suspicious masses/tumors found only in the pelvis by physical exam or imaging study, such as Ultrasound (US).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious, or change was found on last follow-up CT, new/changing sign/symptoms or abnormal lab values.

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as Ultrasound (US):
- Initial staging of known cancer
  - All cancers, excluding the following:
    - Excluding Basal Cell Carcinoma of the skin,
    - Excluding Melanoma without symptoms or signs of metastasis.
- Three (3) month follow-up of known pelvic cancer undergoing active treatment within the past year.
- Six (6) month follow-up of known pelvic cancer undergoing active treatment within the past year.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected 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 or ovaries as evidenced by physical examination or confirmed on any previous imaging study.

For evaluation of suspected infection or inflammatory disease:
• Suspected acute appendicitis (or severe acute diverticulitis) if pelvic pain and tenderness to palpation is present, with at LEAST one of the following:
  o WBC elevated
  o Fever
  o Anorexia or
  o Nausea and vomiting.
• Suspected complications of diverticulitis (known to be limited to the pelvis by prior imaging) with pelvic pain or severe tenderness, not responding to 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 pelvic 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 aortic aneurysm limited to the pelvis
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
  o Suspected complications of known aneurysm as evidenced clinical findings such as new onset of pelvic pain.
• Scheduled follow-up evaluation of aorto/iliaal endograft.
  o Asymptomatic at six (6) month intervals, for two (2) years
  o Symptomatic/complications related to stent graft – more frequent imaging may be needed.
• Suspected retroperitoneal hematoma or hemorrhage.
For evaluation of trauma:
- For evaluation of trauma with lab or physical findings of pelvic bleeding.
- For evaluation of physical or radiological evidence of pelvis fracture.

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

For post-operative/procedural evaluation:
- Follow-up of known or suspected post-operative complication involving only the pelvis.
- A follow-up study to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
- < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

Other indications for Pelvic CT:
- Persistent pelvic pain not explained by multiple previous imaging studies 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 additional 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 necessarily 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 10 ng/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 known or suspected prostate cancer for recurrence workup:
- Initial treatment by radical prostatectomy:
  - Failure of PSA to fall to undetectable levels or PSA detectable and rising on at least 2 subsequent determinations
- Initial treatment radiation therapy:
  - Post-RT rising PSA or positive digital exam and is candidate for local therapy

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- Initial evaluation of suspicious pelvic masses/tumors found only in the pelvis by physical exam or imaging study, such as Ultrasound (US).
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance unless tumor(s) are specified as highly suspicious, or change was found on last follow-up new/changing sign/symptoms or abnormal lab values.

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as Ultrasound (US) and CT:
- 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 pelvic cancer undergoing active treatment within the past year.
  - Six (6) month follow-up of known pelvic cancer undergoing active treatment within the past year.
  - Follow-up of known cancer of patient undergoing active treatment within the past year.
  - Known cancer with suspected pelvic metastasis based on a sign, symptom or an abnormal lab value.
  - 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 suspected infection or inflammatory disease:
- Suspected acute appendicitis (or severe acute diverticulitis) if pelvic pain and tenderness to palpation is present, with at LEAST one of the following:
• WBC elevated
• Fever
• Anorexia or
• Nausea and vomiting.

• Suspected complications of diverticulitis (known to be limited to the pelvis by prior imaging) with pelvic pain or severe tenderness, not responding to 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 aortic aneurysm limited to the pelvis
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
  o Suspected complications of known aneurysm as evidenced clinical findings such as new onset of pelvic pain.
• Scheduled follow-up evaluation of aorto/iliacl endograft.
  o Asymptomatic at six (6) month intervals, for two (2) years
  o Symptomatic/complications related to stent graft – more frequent imaging may be needed.
• Suspected retroperitoneal hematoma or hemorrhage.

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

For post-operative/procedural evaluation:
• Follow-up of known or suspected post-operative complication involving only the pelvis.
• A follow-up study to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Other Indications for a Pelvic MRI:
• For location or evaluation of undescended testes in adults and in children, including
determination of location of testes, where ultrasound has been done previously.
• To provide an alternative to follow-up of an indeterminate pelvic CT when previous
CT/Ultrasound was equivocal and needed to clarify a finding a CT could not.
• For evaluation and characterization of uterine and adnexal masses, (e.g., fibroids, ovaries, tubes
and uterine ligaments), where ultrasound has been done previously.
• For evaluation of uterus prior to embolization.
• For evaluation of endometriosis.
• Prior to uterine surgery if there is abnormality suspected on prior US ex: spinal bifida.
• 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.

ADDITIONAL INFORMATION RELATED TO PELVIC 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

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 additional 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 necessarily 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 than 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 known or suspected pelvic vascular disease:
- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of suspected or known aortic aneurysm:
  - 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 by signs/symptoms such as new onset of abdominal or pelvic pain.
- Suspected retroperitoneal hematoma or hemorrhage.
- For evaluation of suspected pelvic vascular disease when findings on ultrasound are indeterminate.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- Pelvic vein thrombosis or thrombophlebitis.

Pre-operative evaluation:
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative or post-procedural evaluation:
- Evaluation of endovascular/interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
- Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

**ADDITIONAL INFORMATION RELATED TO PELVIS MRA:**

**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**s: blowing vascular sounds heard over partially occluded blood vessels. Abdominal bruises 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 for preoperative evaluation, or to evaluate specific abnormalities of the bones, joints and soft tissues of the upper extremities.

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

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

Evaluation of known cancer:
- Initial staging of known cancer in the upper extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected upper extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Prior cancer surveillance: Once per year (last test must be over 10 months ago before new approval) for surveillance of known cancer.

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

For evaluation of suspected (AVN) avascular necrosis (e.g., aseptic necrosis, Legg-Calve-Perthes disease in children) and MRI is contraindicated or cannot be performed:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.

For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis) and MRI is contraindicated or cannot be performed:
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist and non-diagnostic findings on prior imaging.
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain, initial imaging (e.g. x-ray) has been performed and MRI is contraindicated or cannot be performed:
- Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which include medical therapy (may include physical therapy or chiropractic treatments) and/or physician supervised home exercise of at least four (4) weeks.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural 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 an Upper Extremity (Hand, Wrist, Arm, Elbow, or Shoulder) CT:
- Abnormal bone scan and x-ray is non-diagnostic or requires further evaluation.
- CT arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist and MRI is contraindicated or cannot be performed.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence and MRI is contraindicated or cannot be performed.

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

When additional indications for Wrist CT and MRI are contraindicated or cannot be performed:
• For evaluation of suspected ligament injury with evidence of wrist instability on examination or evidence of joint space widening on x-ray
• For suspected TFCC (triangular fibrocartilage complex) injury when ordered by orthopedic specialist or primary care physician on behalf of the specialist.

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) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program, and/or chiropractic care. NOTE: for joint and extremity injuries, part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

**Home Exercise Program - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
• Information provided on exercise prescription/plan AND
• Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

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

Shoulder Dislocation – Glenoid bone loss occurs in anterior shoulder dislocation. Severe degrees of glenoid bone loss are shown on axial radiography, but it can be quantified more definitively using CT. This information is important as it helps to predict the likelihood of further dislocation and the need for bone augmentation surgery. The number of dislocations 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 needed preoperatively. CT can show the complexity of the fracture, and the displacement and angulation.

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

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

**CT and Scaphoid Fractures** – CT is accurate in depicting occult cortical scaphoid fractures. It may be used as a second choice diagnostic method when patients are clinically suspected of having a scaphoid fracture but radiographs are negative or equivocal.

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

Upper Extremity Osteomyelitis and Septic Arthritis – CT helps to distinguish among the types of musculoskeletal infections. Its specific imaging features help identify the forms of infection in the bones and soft tissue. Osteomyelitis, a bone infection most commonly associated with an open fracture 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 assessment/evaluation of known or suspected vascular disease/condition:
- For evaluation of suspected vascular disease aneurysm, arteriovenous malformation, fistula, vasculitis, or intramural hematoma.
- For evaluation of Raynaud’s syndrome.
- For evaluation of vascular invasion or displacement by tumor.
- For evaluation of complications of interventional vascular procedures, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents, or stent-grafts.

Preoperative evaluations:
- For preoperative evaluation from known vascular disease/condition.

Post-operative/procedural evaluations:
- When ordered by surgeon/specialist or primary care provider on behalf of the surgeon/specialist.
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

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

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY CTA:

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:

Magnetic resonance imaging shows the soft tissues and bones. With its multiplanar capabilities, high contrast and high spatial resolution, it is an accurate diagnostic tool for conditions affecting the joint and adjacent structures. MRI has the ability to positively influence clinicians’ diagnoses and management plans for patients with conditions such as primary bone cancer, fractures, abnormalities in ligaments, tendons/cartilages, septic arthritis, and infection/inflammation.

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

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

Evaluation of known cancer:
- Initial staging of known cancer in the upper extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected upper extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Prior cancer surveillance: Once per year (last test must be over 10 months ago before new approval) for surveillance of known cancer.

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

For evaluation of suspected (AVN) avascular necrosis (i.e. aseptic necrosis, Legg-Calve-Perthes disease in children):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.

For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis):
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist and non-diagnostic findings on prior imaging.

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

**For evaluation of persistent pain and initial imaging (e.g. x-ray) has been performed:**
- Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which include - medical therapy (may include physical therapy or chiropractic treatments) and/or - physician supervised home exercise of at least four (4) weeks.

**Pre-operative evaluation:**
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

**Post-operative/procedural evaluation:**
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural 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 an Upper Extremity (Hand, Wrist, Arm, Elbow, or Shoulder) MRI:**
- Abnormal bone scan and x-ray is non-diagnostic or requires further evaluation.
- MR arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence.

**Additional indications for 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, Hawk'n's sign or drop sign.
- Status post prior rotator cuff repair with suspected re-tear and findings on prior imaging are indeterminate.
- For evaluation of brachial plexus dysfunction (brachial plexopathy/thoracic outlet syndrome).
- For evaluation of recurrent dislocation.
**Additional indications for Wrist MRI:**
- For evaluation of suspected ligament injury with evidence of wrist instability on examination or evidence of joint space widening on x-ray
- For suspected TFCC (triangular fibrocartilage complex) injury when ordered by orthopedic specialist or primary care physician on behalf of the specialist.

**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) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program, and/or chiropractic care. **NOTE:** for joint and extremity injuries, part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

**Home Exercise Program** - (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

**Rotator Cuff Tears** – 3.0 Tesla MRI has been found valuable for the detection of partial thickness rotator cuff tendon tears and small rotator cuff tendon tears. It is especially useful in detecting the partial tears due to increased spatial resolution. Increased spatial resolution results in precise measurements of rotator cuff tendon tears in all 3 planes and it also reduces acquisition time which reduces motion artifacts. 3.0 Tesla makes it possible to adequately evaluate tendon edges and avoid 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.

**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 assessment/evaluation of known or suspected vascular disease/condition:
- For evaluation of suspected vascular disease aneurysm, arteriovenous malformation, fistula, vasculitis, or intramural hematoma.
- For evaluation of vascular invasion or displacement by tumor.
- For evaluation of complications of interventional vascular procedures, e.g., pseudoaneurysms related to surgical bypass grafts, vascular stents, or stent-grafts.
- For evaluation of suspected upper extremity embolism or venous thrombosis.

Preoperative evaluations:
- For preoperative evaluation from known vascular disease/condition.

Post-operative/procedural evaluations:
- When ordered by surgeon/specialist or primary care provider on behalf of the surgeon/specialist.
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

ADDITIONAL INFORMATION RELATED TO UPPER EXTREMITY MRA/MRV:

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.

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/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 typically used as the first-line modality for assessment of lower extremity conditions. Computed tomography (CT) is used for evaluation of tumors, metastatic lesions, infection, fractures and other problems. Magnetic resonance imaging (MRI) is the first-line choice for imaging of many conditions, but CT may be used in these cases if MRI is contraindicated or unable to be performed.

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

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

Evaluation of known cancer:
- Initial staging of known cancer in the lower extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected lower extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Prior cancer surveillance: Once per year (last test must be over 10 months ago before new approval) for surveillance of known cancer.

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

For evaluation of suspected (AVN) avascular necrosis (e.g., aseptic necrosis, Legg-Calve-Perthes disease in children) and MRI is contraindicated or cannot be performed:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.

For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis) and MRI is contraindicated or cannot be performed:
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist and non-diagnostic findings on prior imaging.
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain, initial imaging (e.g. x-ray) has been performed and MRI is contraindicated or cannot be performed:
- Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which include medical therapy (may include physical therapy or chiropractic treatments) and/or physician supervised home exercise of at least four (4) weeks.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural 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 Lower Extremity (Foot, Ankle, Knee, Leg, or Hip) CT:
- Abnormal bone scan and x-ray is non-diagnostic or requires further evaluation.
- For evaluation of leg length discrepancy when ordered by a specialist (orthopedic, sports medicine, physical medicine & rehabilitation) or a primary care provider on behalf of a specialist who has seen the patient when physical deformities of the lower extremities would prevent standard modalities such as x-rays or a Scanogram from being performed. (Scanogram (CPT code 77073); bone length study is available as an alternative to lower extremity CT evaluation for leg length discrepancy).
- CT arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist and MRI is contraindicated or cannot be performed.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence and MRI is contraindicated or cannot be performed.

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

Additional indications specific for KNEE CT and MRI is contraindicated or cannot be performed:
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- Presence of a joint effusion.
- Accompanied by physical findings of a meniscal injury determined by physical examination tests (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.

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

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

**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) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program, and/or chiropractic care. NOTE: for joint and extremity injuries, part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

**Home Exercise Program - (HEP)** – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4 week period), or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

**CT and Ankle Fractures** – One of the most frequently injured areas of the skeleton is the ankle. These injuries may include ligament sprains as well as fractures. A suspected fracture is first imaged with conventional radiographs in anteroposterior, internal oblique and lateral projections. CT is used in patients with complex ankle and foot fractures after radiography.
**CT and Hip Trauma** – Computed tomography is primarily used to evaluate acute trauma, e.g., acetabular fracture or hip dislocation. It can detect intraarticular fragments and associated articular surface fractures and it is useful in surgical planning.

**CT and Knee Fractures** – CT is used after plain films to evaluate fractures to the tibial plateau. These fractures occur just below the knee joint, involving the cartilage surface of the knee. Soft tissue injuries are usually associated with the fractures. The meniscus is a stabilizer of the knee and it is very important to detect meniscal injury in patients with tibial plateau fractures. CT of the knee with two-dimensional reconstruction in the sagittal and coronal planes may be performed for evaluation of injuries with multiple fragments and comminuted fractures. Spiral CT has an advantage of rapid acquisition and reconstruction times and may improve the quality of images of bone. Soft tissue injuries are better demonstrated with MRI.

**CT and Knee Infections** – CT is used to depict early infection which may be evidenced by increased intrasosseous density or the appearance of fragments of necrotic bone separated from living bone by soft tissue or fluid density. Contrast-enhanced CT may help in the visualization of abscesses and necrotic tissue.

**CT and Knee Tumors** – CT complements arthrography in diagnosing necrotic malignant soft-tissue tumors and other cysts and masses in the knee. Meniscal and ganglion cysts are palpable masses around the knee. CT is useful in evaluations of the vascular nature of lesions.

**CT and Legg-Calve-Perthes Disease (LPD)** – This childhood condition is associated with an insufficient blood supply to the femoral head which is then at risk for osteonecrosis. Clinical signs of LPD include a limp with groin, thigh or knee pain. Flexion and adduction contractures may develop as the disease progresses and eventually movement may only occur in the flexion-extension plane. This condition is staged based on plain radiographic findings. CT scans are used in the evaluation of LPD and can demonstrate changes in the bone trabecular pattern. They also allow early diagnosis of bone collapse and sclerosis early in the disease where plain radiography is not as sensitive.

**CT and Osteolysis** – Since computed tomography scans show both the extent and the location of lytic lesions, they are useful to guide treatment decisions as well as to assist in planning for surgical intervention, when needed, in patients with suspected osteolysis after Total Hip Arthroplasty (THA).

**CT and Tarsal Coalition** – This is a congenital condition in which two or more bones in the mid-foot or hind-foot are joined. It usually presents during late childhood or late adolescence and is associated with repetitive ankle sprains. Mild pain, deep in the subtalar joint and limited range of motion 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.

**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 assessment/evaluation of suspected or known vascular disease/condition:
- Significant ischemia in the presence of ulcers/gangrene.
- Large vessel diseases, e.g. aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome, e.g. Peripheral artery disease (PAD).
- 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:
- 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 / procedural evaluation:
- Post-operative or interventional vascular procedure for luminal patency versus re-stenosis (due to atherosclerosis, thromboembolism, intimal hyperplasia and other causes) as well as complications such as pseudoaneurysms related to surgical bypass grafts and vascular stents and stent-grafts.
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY CTA:

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: 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 aneurismal changes. It can reveal both vascular and extravascular complications.

**REFERENCES:**


INTRODUCTION:

Magnetic resonance imaging shows the soft tissues and bones. With its multiplanar capabilities, high contrast and high spatial resolution, it is an accurate diagnostic tool for conditions affecting the joint and adjacent structures. MRI has the ability to positively influence clinicians’ diagnoses and management plans for patients with conditions such as primary bone cancer, fractures, and abnormalities in ligaments, tendons/cartilages, septic arthritis, and infection/inflammation.

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

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

Evaluation of known cancer:
- Initial staging of known cancer in the lower extremity.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected lower extremity metastasis based on a sign, symptom, imaging study or abnormal lab value.
- Cancer surveillance: Once per year (last test must be over 10 months ago before new approval) for surveillance of known cancer.

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

For evaluation of suspected (AVN) avascular necrosis (i.e. aseptic necrosis, Legg-Calve-Perthes disease in children):
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.

For evaluation of suspected or known Auto Immune Disease, (e.g. Rheumatoid arthritis):
- Known or suspected auto immune disease and ordered by an orthopedist or rheumatologist and non-diagnostic findings on prior imaging.
For evaluation of known or suspected fracture and/or injury:
- Further evaluation of an abnormality or non-diagnostic findings on prior imaging.
- Suspected fracture when imaging is negative or equivocal.
- Determine position of known fracture fragments/dislocation.

For evaluation of persistent pain and initial imaging (e.g. x-ray) has been performed:
- Chronic pain and/or persistent tendonitis unresponsive to conservative treatment, which include medical therapy (may include physical therapy or chiropractic treatments) and/or physician supervised home exercise of at least four (4) weeks.

Pre-operative evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.

Post-operative/procedural evaluation:
- When ordered by surgeon/specialist or a primary care provider on behalf of the surgeon/specialist.
- When imaging, physical or laboratory findings indicate joint infection, delayed or non-healing or other surgical/procedural 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 Lower Extremity (Foot, Ankle, Knee, Leg or Hip) MRI:
- Abnormal bone scan and x-ray is non-diagnostic or requires further evaluation.
- MR arthrogram when ordered by orthopedic specialist, surgeon or primary care provider on behalf of specialist.
- To assess status of osteochondral abnormalities including osteochondral fractures, osteochondritis dissecans, treated osteochondral defects where physical or imaging findings suggest its presence.

Additional indication specific for FOOT or ANKLE MRI
- Chronic pain in a child or adolescent with painful rigid flat foot where imaging is unremarkable or equivocal or on clinician’s decision to evaluate for known or suspected tarsal coalition.
- Accompanied by physical findings of ligament damage such as an abnormal drawer test of the ankle or significant laxity on valgus or varus stress testing and/or joint space widening on x-rays.

Additional indications specific for KNEE MRI:
- Accompanied by blood in the joint (hemarthrosis) demonstrated by aspiration.
- Presence of a joint effusion.
- For evaluation of suspected Baker’s cyst or posterior knee swelling with ultrasound requiring further evaluation.
- 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.

**Additional indications specific for HIP MRI:**

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

**ADDITIONAL INFORMATION RELATED TO A LOWER EXTREMITY MRI:**

**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) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (such as crutches, immobilizer, metal braces, orthotics, rigid stabilizer or splints, etc and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program, and/or chiropractic care. NOTE: for joint and extremity injuries, part of this combination may include the physician instructing patient to rest the area or stay off the injured part.

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

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

**MRI and Knee Trauma** - MRI is an effective means of evaluating internal derangements of the knee with a very high accuracy for detection of meniscal injury. On MRI of the knee, meniscal injury may appear “free-floating”, corresponding to a meniscal avulsion or detachment from the tibial plateau. The floating meniscus seen on MRI is a result of significant trauma. It may also be associated with significant ligamentous injury. The results of the MRI are valuable to the surgeon as he plans to reattach the meniscus to the tibial plateau.

**MRI and Osteonecrosis** – Osteonecrosis is a complication of knee surgery which may be accompanied by new or persistent pain after meniscal surgery. It can be detected by MRI with...
subcortical low signal intensity of T1-weighted images with or without central high signal intensity on T2-weighted images. Osteonecrosis can result in collapse of the articular surface.

**MRI and Legg-Calve-Perthes Disease (LPD)** – This childhood condition is associated with an insufficient blood supply to the femoral head which is then at risk for osteonecrosis. Clinical signs of LPD include a limp with groin, thigh or knee pain. Flexion and adduction contractures may develop as the disease progresses and eventually movement may only occur in the flexion-extension plane. This condition is staged based on plain radiographic findings. MRI is used in identifying the early stage of LPD when normal plain films are normal. It is also used in preoperative planning to diagnose “hinge abduction” (lateral side of the femoral head contacts the acetabular margin and femoral head does not slide as it should). However, MRI is not used as a standard diagnostic tool.

**MRI and Septic Arthritis** – Young children and older adults are the most likely to develop septic arthritis in the hip joint. Early symptoms include pain in the hip, groin, or thigh along with a limping gait and fever. It is sometimes hard to differentiate this condition from transient synovitis, a less serious condition with no known long-term sequelae. MRI may help in the differential diagnosis of these two conditions. Coronal T1-weighted MRI, performed immediately after contrast administration, can evaluate blood perfusion at the femoral epiphysis.

**MRI and Slipped Capital Femoral Epiphysis** – This condition, where the femoral head is displaced in relation to the femoral neck, is the most common hip disorder in adolescents and it is more common in obese children. Its symptoms include a limping gait, groin pain, thigh pain and knee pain. Most cases are stable and the prognosis is good with early diagnosis and treatment. Unstable slipped capital femoral epiphysis may lead to avascular necrosis. MRI is used for diagnosis of slipped capital femoral epiphysis. Its image can be oriented to a plane orthogonal to the plane of the 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 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. 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:

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 assessment/evaluation of suspected or known vascular disease/condition:

- Significant ischemia in the presence of ulcers/gangrene.
- Large vessel diseases, e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Arterial entrapment syndrome e.g. Peripheral artery disease (PAD).
- 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:

- 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 / procedural evaluation:

- Post-operative or interventional vascular procedure for luminal patency versus re-stenosis (due to atherosclerosis, thromboembolism, intimal hyperplasia and other causes) as well as complications such as pseudoaneurysms related to surgical bypass grafts and vascular stents and stent-grafts
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

ADDITIONAL INFORMATION RELATED TO LOWER EXTREMITY MRA/MRV:

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.

**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.

**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 ABDOMEN CT:

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:

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

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as Ultrasound (US):

- Initial staging of known cancer
  - All cancers, excluding the following:
    - 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 year.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected abdominal metastasis based on a sign, symptom or an abnormal lab value.
- 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 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 inflammatory bowel disease (Crohn’s or Ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.
- 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.
- 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) and equivocal ultrasound results.
- Known 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 or suspected vascular disease (e.g., aneurysms or hematomas):

- Evidence of vascular abnormality seen on imaging studies.
- Evaluation of suspected or known aortic aneurysm limited to 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/ilia endograft.
  o Asymptomatic at six (6) month intervals, for two (2) years
  o Symptomatic/complications related to stent graft – more frequent imaging may be needed
• Suspected retroperitoneal hematoma or hemorrhage.

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

**Pre-operative evaluation:**
• For abdominal surgery or procedure.

**Post-operative/procedural evaluation:**
• Follow-up of known or suspected post-operative complication involving only the abdomen.
• A follow-up study to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**
• < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

**Other Indications for an Abdomen CT:**
• 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.
• 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.

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):**
  o Combined abdomen CT and pelvis CT is usually ordered
  o 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:**
- 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.

**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 patients (<5%). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 74.2%, 97%, 88%, 93%, and 92%, respectively and comparable to CT.

Appropriate and timely diagnosis of acute appendicitis is needed. Negative laparotomy rates can range from 16% to 47% when based on clinical and laboratory data alone, while perforation rate can reach 35% when surgery is delayed. Appropriate initial imaging can lower the negative laparotomy rate to 6-10%. Ultrasound has a higher non-diagnostic rate (4%) vs. 0.8% for MDCT. In a prospective study operator experience and patient BMI did not affect diagnostic accuracy.

**Consider the role of barium contrast studies**
Effective doses for fluoroscopic SBFT (small bowel follow through) imaging ranged between 1.37-3.83 mSv for the right lower quadrant, central abdomen and pelvis, respectively. The findings by Jaffe, et al suggest a modified examination for Crohn’s disease indications would have lower effective doses than these. For MDCT the effective dose was 16.1 mSv. This indicates a 5 fold increase in the use of MDCT over SBFT. For patients with Crohn’s disease, efforts should be made to minimize the number of CT examinations, decrease the CT dose or consider MR Enterography. Limitations of SBFT include partial evaluation of extramucosal and extraluminal disease, impaired evaluation of small-bowel loops, especially those inaccessible in the deep pelvis.

**Consider the role of capsule endoscopy**
Retrospective comparison of capsule endoscopy (CE) to CT in patients with no evidence of a small-bowel stricture at barium examination was the focus of the article by Hara, et al. Studies were done for bleeding of unknown origin after colonoscopy and/or Gastroenterologist, inflammatory bowel disease or chronic abdominal pain. CE was found to be more sensitive than CT examination in the 19 patients that underwent both. CE provides a complimentary and sensitive approach to the evaluation of the small bowel without radiation exposure. A negative examination does not completely rule out pathology.

**Work up for distant metastasis in the initial evaluation of melanoma**
Multiple studies, including the two authored by Miranda and Yancovitz below indicate that imaging studies, including Chest x-ray, Chest CT, Abdomen/Pelvis CT, Brain CT or Brain MRI in the absence of symptoms or findings of metastatic disease have extremely low yields (<1%) in the survey evaluation of newly diagnosed melanoma, even in the presence of a positive sentinel node biopsy. The further work-up of the more common benign incidental finding (5-7%) on these studies lead to many more diagnostic tests, including surgery, which are seldom warranted.

**Initial evaluation of abdominal aortic aneurysm (AAA)**
Initial evaluation of AAA is accurately made by ultrasound. Risk of rupture in 6 years for an AAA < 4 cm is 1%. For a 4-5 cm AAA the risk of rupture increases to 1-3% per year and becomes 6-11% per year for AAA 5-7 cm in cross sectional diameter. >7% the risk of rupture goes to 7% per year.
Chronic contained ruptures should meet the following criteria—known abdominal aortic aneurysm, previous pain symptoms that may have resolved: stable hemodynamic status with a normal HCT, CT scans showing retroperitoneal hemorrhage, and pathologic confirmation of organized hematoma.

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

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

**Pre-operative evaluation of primary rectal cancer** - Abdomen CT may detect hepatic and extrahepatic 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:

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.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of suspected or known aortic aneurysm:
  - 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 by sign/symptoms such as new onset of abdominal or pelvic pain.
- Suspected retroperitoneal hematoma or hemorrhage.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.

Pre-operative evaluation:
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative or post-procedural evaluation:
- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
• Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

**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**

**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 ABDOMEN CTA:

For evaluation of known or suspected abdominal vascular disease:

- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
- For suspected aortic dissection.
- Evaluation of suspected or known aortic aneurysm:
  - 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 by signs/symptoms such as new onset of abdominal or pelvic pain.
- Suspected retroperitoneal hematoma or hemorrhage.
- Suspected renal vein thrombosis in patient with known renal mass.
- For evaluation of suspected chronic mesenteric ischemia.
- Venous thrombosis if studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- For evaluation of portal venous system (hepatic portal system).
- For evaluation of kidney failure or renal insufficiency if initial evaluation performed with Ultrasound is inconclusive.
- For evaluation of known or suspected renal artery stenosis or resistant hypertension demonstrated by any of the following:
  - Unsuccessful control after treatment with 3 or more anti-hypertensive medication at optimal dosing.
  - Acute elevation of creatinine after initiation of an ACE inhibitor or ARB.
  - Asymmetric kidney size noted on ultrasound.
  - Onset of hypertension in a person younger than age 30 without any other risk factors or family history of hypertension.
  - New onset of hypertension after age 55 (>160/100).
  - Acute rise in blood pressure in a person with previously stable blood pressures.
  - Flash pulmonary edema without identifiable causes.
Malignant hypertension.

**Pre-operative evaluation:**
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

**Post-operative or post-procedural evaluation:**
- Evaluation of endovascular/interventional abdominal vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in the peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurym (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

**ADDITIONAL INFORMATION RELATED TO ABDOMEN CTA:**

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**CTA and Renal Artery Stenosis** – Renal artery stenosis is the major cause of secondary hypertension. It may also cause renal insufficiency and end-stage renal disease. Atherosclerosis is one of the common causes of this condition, especially in older patients with multiple cardiovascular risk factors and worsening hypertension or deterioration of renal function. CTA is used to evaluate the renal arteries and detect renal artery stenosis.

**REFERENCES:**


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

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.

Evaluation of suspicious known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings:
- Initial evaluation of suspicious masses/tumors found by physical exam or imaging study, such as Ultrasound (US) and both the abdomen and pelvis are likely affected.
- Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen and pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious or change was found on last follow-up CT, new/changing sign/symptoms or abnormal lab values.

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as Ultrasound (US):
- Initial staging of known cancer
  - All cancers, excluding the following:
    - 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 year.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected abdominal/pelvic metastasis based on a sign, symptom or an abnormal lab value.
- 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 splenomegaly, hepatomegaly, uterus or ovaries as evidenced by physical examination or confirmed on any previous imaging study.

**For evaluation of suspected infection or inflammatory disease:**
- Suspected acute appendicitis (or severe acute diverticulitis) if abdominal pain and tenderness to palpation is present, 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/pelvis by prior imaging) with abdominal/pelvic pain or severe tenderness, not responding to antibiotics treatment.
- Suspected inflammatory bowel disease (Crohn’s or ulcerative colitis) with abdominal pain, and persistent diarrhea, or bloody diarrhea.
- Suspected cholecystitis with recent equivocal ultrasound.
- Suspected infection in abdomen/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/pelvic 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/pelvic pain and tenderness to palpation is present, and at LEAST one of the following: rebound, rigid abdomen, or severe tenderness to palpation present over entire abdomen.
• 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 aortic aneurysm:
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
  o Suspected complications of known aneurysm as evidenced clinical findings such as new onset of abdominal or pelvic pain
• Scheduled follow-up evaluation of aorto/iliac endograft.
  o Asymptomatic at six (6) month intervals, for two (2) years
  o Symptomatic/complications related to stent graft – more frequent imaging may be needed.
• Suspected retroperitoneal hematoma or hemorrhage

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

Pre-operative evaluation:
• For abdominal/pelvic surgery or procedure.

Post-operative/procedural evaluation:
• Follow-up of known or suspected post-operative complication.
• A follow-up study to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
• < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

Other indications for Abdomen/Pelvic CT Combo:
• Suspected adrenal mass or pheochromocytoma based on diagnostic testing/imaging results, and/or a suspicious clinical presentation.
• Persistent abdomen/pelvic pain not explained by 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
  o Related History and Abdominal exam.
  o Chest x-ray
  o Abdominal Ultrasound
  o Lab tests, must include TSH
  o 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.

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  o Possible gallstones or abnormal liver function tests with gall bladder present.
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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.

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**REDDUCING RADIATION EXPOSURE:**

**CT urography** - Utilization of appropriate imaging techniques can reduce radiation exposure in performance of CT urography. Some protocols may result in 15-35 mSv of exposure. In the article by Chow, et al. a technique involving administration of IV contrast in two boluses separated by a suitable time delay, allows nephrographic and excretory phases to be acquired in a single imaging pass. This allows for full non-contrast and contrast imaging to be obtained with two imaging passes.

**Evaluation for appendicitis following clinical and laboratory evaluation** - Sonography of the right upper quadrant and pelvis followed by graded compression and color Doppler sonography of the right lower quadrant was used by Gaitini and colleagues as the initial imaging study in 420 consecutive patients referred for emergency evaluation of acute appendicitis. This method correctly diagnosed acute appendicitis in 66 of 75 patients (88%) and excluded it correctly in 312 of 326 patients (96%). It was inconclusive in 19 patient (<5%). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 74.2%, 97%, 88%, 93%, and 92%, respectively and comparable to CT. Appropriate and timely diagnosis of acute appendicitis is needed. Negative laparotomy rates can range from 16% to 47% when based on clinical and laboratory data alone, while perforation rate can reach 35% when surgery is delayed. Appropriate initial imaging can lower the negative laparotomy rate to 6-10%. Ultrasound has a higher non-diagnostic rate (4%) vs. 0.8% for MDCT. In a prospective study operator experience and patient BMI did not affect diagnostic accuracy.

**Consider the role of barium contrast studies** - Effective doses for fluoroscopic SBFT (small bowel follow through) imaging ranged between 1.37-3.83 mSv for the right lower quadrant, central abdomen and pelvis, respectively. The findings by Jaffe, et al suggest a modified examination for Crohn’s disease indications would have lower effective doses than these. For MDCT the effective dose was 16.1 mSv. This indicates a 5 fold increase in the use of MDCT over SBFT. For patients with Crohn’s disease, efforts should be made to minimize the number of CT examinations, decrease the CT dose or consider MR Enterography. Limitations of SBFT include partial evaluation of extramucosal and extraluminal disease, impaired evaluation of small-bowel loops, especially those inaccessible in the deep pelvis.

**Consider the role of capsule endoscopy** - Retrospective comparison of capsule endoscopy (CE) to CT in patients with no evidence of a small-bowel stricture at barium examination was the focus of the article by Hara, et al. Studies were done for bleeding of unknown origin after colonoscopy and/or Gastroenterologist, inflammatory bowel disease or chronic abdominal pain.
CE was found to be more sensitive than CT examination in the 19 patients that underwent both. CE provides a complimentary and sensitive approach to the evaluation of the small bowel without radiation exposure. A negative examination does not completely rule out pathology.

**Work up for distant metastasis in the initial evaluation of melanoma** - Multiple studies, including the two authored by Miranda and Yancovitz below indicate that imaging studies, including Chest x-ray, Chest CT, Abdomen/Pelvis CT, Brain CT or Brain MRI in the absence of symptoms or findings of metastatic disease have extremely low yields (< 1%) in the survey evaluation of newly diagnosed melanoma, even in the presence of a positive sentinel node biopsy. The further work-up of the more common benign incidental finding (5-7%) on these studies lead to many more diagnostic tests, including surgery, which are seldom warranted.

**Initial evaluation of abdominal aortic aneurysm (AAA)** - Initial evaluation of AAA is accurately made by ultrasound. Risk of rupture in 6 years for an AAA < 4 cm is 1%. For a 4.5 cm AAA the risk of rupture increases to 1-3% per year and becomes 6-11% per year for AAA 5-7 cm in cross-sectional diameter. >7% the risk of rupture goes to 7% per year.

Chronic contained ruptures should meet the following criteria- known abdominal aortic aneurysm, previous pain symptoms that may have resolved; stable hemodynamic status with a normal HCT, CT scans showing retroperitoneal hemorrhage, and pathologic confirmation of organized hematoma.

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

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

**Pre-operative evaluation of primary rectal cancer** - Abdomen CT may detect hepatic and extrahepatic 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 ABDOMEN MRI:

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

Evaluation of known cancer for further evaluation of indeterminate or questionable findings, identified by physical examination or imaging exams such as Ultrasound (US) and CT:
- Initial staging of known cancer
  - All cancers, excluding the following:
    - 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 year.
- Follow-up of known cancer of patient undergoing active treatment within the past year.
- Known cancer with suspected abdominal metastasis based on a sign, symptom or an abnormal lab value.
- 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 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:
  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 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) and equivocal ultrasound results.
• 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.

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 aortic aneurysm limited to abdomen
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
  o Suspected complications of known aneurysm as evidenced clinical findings such as new onset of abdominal pain.
• Scheduled follow-up evaluation of aorto/iliac endograft.
  o Asymptomatic at six (6) month intervals, for two (2) years
  o Symptomatic/complications related to stent graft – more frequent imaging may be needed
• Suspected retroperitoneal hematoma or hemorrhage.

Pre-operative evaluation:
• For abdominal surgery or procedure.
Post-operative/procedural evaluation:
- Follow-up of suspected or known post-operative complication involving only the abdomen.
- A follow-up study to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed.

Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:
- < 5 studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.

Other Indications for an Abdominal MRI:
- For location or evaluation of undescended testes in adults and in children, including determination of location of testes, where ultrasound has been done previously.
- To provide an alternative to abdominal CT when CT would be limited due to allergy to radiographic contrast material.
- To provide an alternative to follow-up of an indeterminate abdomen CT when previous CT/Ultrasound was equivocal and 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.

ADDITIONAL INFORMATION RELATED TO ABDOMINAL 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.

MRI of the liver – The liver is a common site of metastatic spread. Patients with a history of known or suspected malignancy, especially tumors from the colon, lung, pancreas and stomach, are at risk for developing hepatocellular carcinoma. Patients with chronic liver disease are also at risk for developing liver cancer and undergo periodic liver screening for focal liver lesion detection, usually with ultrasonography (US). Extra-cellular gadolinium chelate contrast-enhanced MRI is used for evaluating patients with an abnormal US. Patients with hepatic metastases being considered for metastasectomy undergo contrast-enhanced MRI using tissue-specific contrast agents.

MRI of the adrenal glands – The adrenal glands are susceptible for metastases from various tumors, especially of lung or breast. Adrenal lesions may also represent primary tumors of the adrenal cortex of medulla, both benign and malignant. MRI may be done to distinguish between benign and malignant lesions. Metastases are predominantly hypointense on T1-weighted images and hyperintense on T2-weighted images. Benign lesions, which have high lipid content, exhibit 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. A rapid breath holds 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:

http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=7&hid=15&sid=8030bc9d-c7f9-4a62-981c-4bba83b2c027%40sessionmgr13


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 ABDOMEN MRA:

For evaluation of known or suspected abdominal vascular disease:

- For known large vessel diseases (abdominal aorta, inferior vena cava, superior/inferior mesenteric, celiac, splenic, renal or iliac arteries/veins), e.g., aneurysm, dissection, arteriovenous malformations (AVMs), and fistulas, intramural hematoma, and vasculitis.
- Evidence of vascular abnormality seen on prior imaging studies.
- Evaluation of suspected or known aortic aneurysm:
  o Suspected or known aneurysm < four (4) cm AND equivocal or indeterminate ultrasound results OR
  o Prior imaging demonstrated aneurysm ≥ four (4) cm in diameter OR
  o Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain.
- Suspected retroperitoneal hematoma or hemorrhage.
- Suspected renal vein thrombosis in patient with known renal mass.
- For evaluation of mesenteric ischemia/ischemic colitis.
- Venous thrombosis if previous studies have not resulted in a clear diagnosis.
- Vascular invasion or displacement by tumor.
- For evaluation of hepatic blood vessel abnormalities (aneurysm, hepatic vein thrombosis, stenosis post transplant).
- For evaluation of splenic artery aneurysm.
- Kidney failure or renal insufficiency if initial evaluation performed with Ultrasound is inconclusive.
- For evaluation of known or suspected renal artery stenosis or resistant hypertension demonstrated by any of the following:
  o Unsuccessful control after treatment with three (3) or more anti-hypertensive medications at optimal dosing.
  o Acute elevation of creatinine after initiation of an ACE inhibitor or ARB.
  o Asymmetric kidney size noted on ultrasound.
  o Onset of hypertension in a person younger than age 30 without any other risk factors or family history of hypertension.
  o New Onset of hypertension after age 55 (>160/100).
  o Acute rise in blood pressure in a person with previously stable blood pressures.
- Flash pulmonary edema without identifiable causes.
- Malignant hypertension.

**Pre-operative evaluation:**
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- For pretransplant evaluation of either liver or kidney.

**Post-operative or post-procedural evaluation:**
- Evaluation of endovascular/interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts in peritoneal cavity.
- Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA). Routine, baseline study (post-op/intervention) is warranted within 1-3 months.
  - Asymptomatic at six (6) month intervals, for two (2) years.
  - Symptomatic/complications related to stent graft – more frequent imaging may be needed.
- Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

**ADDITIONAL INFORMATION RELATED TO ABDOMEN MRA:**

**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.

**Resistant Hypertension** - Defined as failure to control blood pressure with 3 or more 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:
  o Patient had failed colonoscopy due to conditions such as hypotension secondary to the sedation; adhesions from prior surgery; excessive colonic tortuosity.
  o Patient has obstructive colorectal cancer.
  o 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.
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:

The crosswalk provides the relative appropriate use score between the two equivalent elements when there are other ACCF reviewed imaging modalities.

<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>Evaluation of Chest Pain Syndrome (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td>Detection of CAD: Symptomatic</td>
<td></td>
</tr>
<tr>
<td>2 U(4)</td>
<td>• Intermediate pre-test probability of CAD*</td>
<td>SE 116 A(7)</td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable AND able to exercise</td>
<td></td>
</tr>
<tr>
<td>3 A(7)</td>
<td>• Intermediate pre-test probability of CAD*</td>
<td>SE 117 A(9)</td>
</tr>
<tr>
<td></td>
<td>• ECG uninterpretable OR unable to exercise</td>
<td></td>
</tr>
<tr>
<td>4 U(5)</td>
<td>• High pre-test probability of CAD*</td>
<td>SE 118 A(7)</td>
</tr>
<tr>
<td>Evaluation of Intra-Cardiac Structures (Use of MR Coronary Angiography)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 A(8)</td>
<td>• Evaluation of suspected coronary anomalies</td>
<td>CCTA 46 A(9)</td>
</tr>
<tr>
<td>Acute Chest Pain (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 U(6)</td>
<td>• Intermediate pre-test probability of CAD</td>
<td>CCTA 6 A(7)</td>
</tr>
<tr>
<td></td>
<td>• No ECG changes and serial cardiac enzymes negative</td>
<td></td>
</tr>
<tr>
<td>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</td>
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<tr>
<td>A= Appropriate (7-9)</td>
<td>U=Uncertain (4-6)</td>
<td></td>
</tr>
<tr>
<td>Risk Assessment With Prior Test Results (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 12 U(6) | • Intermediate CHD risk (Framingham)  
• Equivocal stress test (exercise, stress SPECT, or stress echo) | SE 153 A(8) |
| 13 A(7) | • Coronary angiography (catheterization or CT)  
• Stenosis of unclear significance | SE 141 A(8) |
| 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  
• Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and contrast enhancement | CCTA 47 A(8) |
| 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 | |
<table>
<thead>
<tr>
<th>Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>A= Appropriate (7-9) U=Uncertain (4-6) 23 A(8)</td>
<td>• 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</td>
<td></td>
</tr>
<tr>
<td>24 (A9)</td>
<td>• Evaluation for arrhythmogenic right ventricular cardiomyopathy (ARVC) • Patients presenting with syncope or ventricular arrhythmia</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>
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<tr>
<td></td>
<td>Evaluation of Intra- and Extra-Cardiac Structures</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>Detection of Myocardial Scar and Viability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluation of Myocardial Scar (Use of Late Gadolinium Enhancement)</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>
</tbody>
</table>
### Heart MRI (Appropriate ACCF et al. Criteria # with Use Score)

<table>
<thead>
<tr>
<th>A= Appropriate (7-9)</th>
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<th>Other imaging modality crosswalk Stress Echo (SE), Chest CTA, and CCTA (Appropriate ACCF et al. Criteria # with Use Score)</th>
</tr>
</thead>
</table>
| 32 **A(9)**          | • To determine viability prior to revascularization  
  • Establish likelihood of recovery of function with revascularization (PCI or CABG) or medical therapy |                              | |
| 33 **A(9)**          | • To determine viability prior to revascularization  
  • Viability assessment by SPECT or dobutamine echo has provided "equivocal or indeterminate" results |                              | |

### 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](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. Flecaainide 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>
</tbody>
</table>
| 1 | • Low pre-test probability of CAD  
• ECG interpretable AND able to exercise | I(2) |
| Evaluation of Chest Pain Syndrome (Use of MR Coronary Angiography) | 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) |
| Acute Chest Pain (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR) | 10 | • High pre-test probability of CAD  
• ECG - ST segment elevation and/or positive cardiac enzymes | I(1) |
<p>| Risk Assessment With Prior Test Results (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR) | | |</p>
<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>
</table>
| 11                                                            | • Normal prior stress test (exercise, nuclear, echo, MRI)  
• High CHD risk (Framingham)  
• Within 1 year of prior stress test | I(2)                                        |
| Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery – Low Risk Surgery (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR) |                                                        |                                             |
| 14                                                            | • Intermediate perioperative risk predictor | I(2)                                        |
| Detection of CAD: Post-Revascularization (PCI or CABG)        |                                                        |                                             |
| Evaluation of Chest Pain Syndrome (Use of MR Coronary Angiography) |                                                        |                                             |
| 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  
CABG = 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>
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<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
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<td>Women</td>
<td>Intermediate</td>
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<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
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<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
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<td>Intermediate</td>
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<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

- **Very low:** Less than 5% pretest probability of CAD
- **Low:** Less than 10% pretest probability of CAD
- **Intermediate:** Between 10% and 90% pretest probability of CAD
- **High:** Greater than 90% pretest probability of 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 documented 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:
### ACCF et al. Criteria # Heart CT (Indication and Appropriate Use Score) A= Appropriate; U=Uncertain

### INDICATIONS
(*Refer to Additional Information section)

<table>
<thead>
<tr>
<th>Evaluation of Cardiac Structure and Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Congenital Heart Disease</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>25 A (9)</strong></th>
<th><strong>26 A (8)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels*</td>
<td>Further assessment of complex adult congenital heart disease after confirmation by echocardiogram</td>
</tr>
</tbody>
</table>

*for “anomalies of coronary arterial vessels” CCTA preferred and for “other thoracic arteriovenous vessels” Heart CT preferred  |

Footnote – reference ACCF Guideline for Stress Echocardiogram indications #92 and #94

### Evaluation of Ventricular Morphology and Systolic Function

<table>
<thead>
<tr>
<th><strong>27 A (7)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of left ventricular function</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>28 A (7)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative evaluation of right ventricular function</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>29 A (7)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of right ventricular morphology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>30 U (5)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of myocardial viability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>31 A (8)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of native cardiac valves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>32 A (8)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of prosthetic cardiac valves</td>
</tr>
</tbody>
</table>

### Evaluation of Intra- and Extracardiac Structures

<table>
<thead>
<tr>
<th><strong>33 A (8)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of native cardiac valves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Heart MRI 23 A(8)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization of prosthetic cardiac valves</td>
</tr>
</tbody>
</table>

Other imaging modality crosswalk, TTE, Stress Echo (SE) and Heart MRI (ACCF et.al. Criteria # Indication with Appropriate Use Score)
<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>• Inadequate images from other noninvasive methods</td>
<td></td>
</tr>
</tbody>
</table>
| 33 A (8) | • Evaluation of cardiac mass (suspected tumor or thrombus)  
• Inadequate images from other noninvasive methods | Heart MRI 26 A(9) |
| 34 A (8) | • Evaluation of pericardial anatomy | |
| 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 preoperative 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:
  o For same imaging tests less than six weeks apart unless specific guideline criteria states otherwise.
  o For different imaging tests, such as CT and MRI, of same anatomical structure less than six weeks apart without high level review to evaluate for medical necessity.
  o For re-imaging of repeat or poor quality studies.
  o For imaging of pediatric patients twelve years old and younger under prospective authorizations.

• Contraindications - There is insufficient data to support the routine use of Heart CT for the following:
  o As the first test in evaluating symptomatic patients (e.g. chest pain)
  o To evaluate chest pain in an intermediate or high risk patient when a stress test (exercise treadmill, stress echo, MPI, cardiac MRI, cardiac PET) is clearly positive or negative.
  o Preoperative assessment for non-cardiac, nonvascular surgery
  o Preoperative imaging prior to robotic surgery (e.g. to visualize the entire aorta)
  o Evaluation of left ventricular function following myocardial infarction or in chronic heart failure.
  o Myocardial perfusion and viability studies.
  o 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:

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<tr>
<th>Age (Years)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
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<th>Asymptomatic</th>
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<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
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<td>&gt;60</td>
<td>Men</td>
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<td></td>
<td>Women</td>
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</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 of 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:**

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


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 contraindications).

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>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>
</tr>
<tr>
<td>1 U(5)</td>
<td>• Low pretest probability of CAD*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ECG interpretable and able to exercise</td>
<td></td>
</tr>
<tr>
<td>ACCF et al. Criteria # 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>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<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>
</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>
</tr>
<tr>
<td>2 A(8)</td>
<td>• Intermediate pretest probability of CAD* • ECG uninterpretable or unable to exercise</td>
<td>SE 117 A(9)</td>
</tr>
<tr>
<td>2 U(4)</td>
<td>• High pretest probability of CAD* • ECG uninterpretable or unable to exercise</td>
<td>SE 118 A(7)</td>
</tr>
</tbody>
</table>

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

| 4 U(6) | • Persistent ECG ST-segment elevation following exclusion of MI |
| 5 U(6) | • Acute chest pain of uncertain cause (differential diagnosis includes pulmonary embolism, aortic dissection, and ACS ["triple rule out"]) |

### Pretest Probability of CAD

| 6 Low/Int Risk* A(7) | • Non-acute symptoms Possibly Representing an Ischemic Equivalent • Normal ECG and cardiac biomarkers (troponin and CPK/CPK-MB) |
| 7 Low/Int Risk* A(7) | • Non-acute symptoms Possibly Representing an Ischemic Equivalent • ECG uninterpretable |
| 8 Low/Int Risk* A(7) | • Non-acute symptoms Possibly Representing an Ischemic Equivalent • Nondiagnostic ECG or equivocal cardiac biomarkers |

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

| 9 A(7) | • Low global CHD risk estimate** • Family history of premature CHD |
| 10 Int Risk** A(7) | • Risk assessment in Asymptomatic Patients • No known CAD |

*ACCF et al.* Criteria #

**INDICATIONS**

(*Refer to Additional Information section)

Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coronary CTA</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 11 High Risk** U(4)   | • Asymptomatic  
• No known CAD | SE 127 U(5)                                                                                                       |
| **Coronary CTA Following Heart Transplantation** |             |                                                                                                                  |
| 12 U(6)               | • Routine evaluation of coronary arteries                                                                      |                                                                                                              |
| **Detection of CAD in Other Clinical Scenarios** |             |                                                                                                                  |
| 13 Low/Int Risk* A(7) | • Reduced left ventricular ejection fraction (<40% EF)                                                     |                                                                                                              |
| High Risk* U(4)      |                                                           |                                                                                                                |
| 14 Low/Int Risk* U(5) | • Normal left ventricular ejection fraction                                                                    | SE 128 A(7)                                                                                                    |
| High Risk* U(4)      |                                                           |                                                                                                                |
| **Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery** |             |                                                                                                                  |
| 15 Low Risk* U(6) Int Risk* A(7) | • Coronary evaluation before noncoronary cardiac surgery |                                                                                                              |
| **Arrhythmias—Etiology Unclear After Initial Evaluation** |             |                                                                                                                  |
| 17 U(6)               | • Nonsustained ventricular tachycardia                                                                       | SE 130 A(7)                                                                                                    |
| 18 U(4)               | • Syncope  
  o Low global CAD risk**- initial evaluation includes echocardiogram  
  o 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 135 A(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)                                                                                                    |
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>Other imaging modality crosswalk Stress Echo (SE) (ACCF et al. Criteria # Indication with Appropriate Use Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCTA (Indication and Appropriate Use Score)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sequential Testing After Stress Imaging Procedures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 A(8)</td>
<td>• Discordant ECG exercise and imaging results</td>
<td></td>
</tr>
<tr>
<td>23 Equivocal A(8) Mild Ischemia U(6)</td>
<td>• Prior stress imaging results:</td>
<td>SE 153 A(8)</td>
</tr>
<tr>
<td><strong>Prior CCS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 U(4)</td>
<td>• Zero Coronary Calcium Score &gt;5 years ago</td>
<td></td>
</tr>
<tr>
<td>26 U(6)</td>
<td>• Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients</td>
<td>• Coronary Calcium Score 401–1000</td>
</tr>
<tr>
<td>26 A(8)</td>
<td>• Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients</td>
<td>• Coronary Calcium Score &lt;100-400</td>
</tr>
<tr>
<td><strong>Evaluation of New or Worsening Symptoms in the Setting of Past Stress Imaging Study</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 U(6)</td>
<td>• Previous stress imaging study abnormal</td>
<td>SE 151 A(7)</td>
</tr>
<tr>
<td>29 A(8)</td>
<td>• Previous stress imaging study normal</td>
<td></td>
</tr>
<tr>
<td><strong>Risk Assessment Preoperative Evaluation of Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 U(5)</td>
<td>• Functional capacity &lt;4 METs with 1 or more clinical risk predictors</td>
<td>SE 157 U(6)</td>
</tr>
<tr>
<td><strong>Vascular Surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 U(6)</td>
<td>• Functional capacity &lt;4 METs with 1 or more clinical risk predictors</td>
<td>SE 161 A(7)</td>
</tr>
<tr>
<td><strong>Risk Assessment Post revascularization (PCI or CABG)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39 A(8)</td>
<td>• Evaluation of graft patency after CABG</td>
<td></td>
</tr>
<tr>
<td>41 U(6)</td>
<td>• Prior coronary stent with stent diameter ≥3 mm</td>
<td>Asymptomatic—CABG</td>
</tr>
<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>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>CCTA</td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
<tr>
<td>42 U(5)</td>
<td>• Prior coronary bypass surgery ≥5 y ago</td>
<td>SE 172 U(6)</td>
</tr>
</tbody>
</table>

Asymptomatic—Prior Coronary Stenting

| 43 A(7)               | • Prior left main coronary stent with stent diameter ≥3 mm | |
| 45 U(4)               | • Stent diameter ≥3 mm                                     |
|                       | • Greater than or equal to 2 y after PCI                   |

Evaluation of Cardiac Structure and Function

Adult Congenital Heart Disease

| 46 A(9)               | • Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels* |
|                       | (*for “anomalies of coronary arterial vessels” CCTA preferred and for “other thoracic arteriovenous vessels” Heart CT preferred) |

Evaluation of Intra- and Extracardiac Structures

| 60 A(8)               | • Localization of coronary bypass grafts and other retrosternal anatomy* |
|                       | • Prior to preoperative chest or cardiac surgery |
|                       | (*for “localization of coronary bypass grafts” CCTA preferred and for “other retrosternal anatomy” Heart CT preferred) |

INDICATIONS FOR CORONARY CT ANGIOGRAPHY (CCTA):

- CCTA may be appropriately used when evaluating chest pain syndromes with low to intermediate risk CAD profiles such as in emergency room or observation unit situations.
- CCTA maybe an appropriate substitution exam for a left heart catheterization.

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

**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 Post revascularization (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           | I(3)                                          |
| 45                    | • Less than 2 y after PCI                                  |                                               |

**Evaluation of Cardiac Structure and Function**

**Evaluation of Ventricular Morphology and Systolic Function**
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>CCTA</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(*Refer to Additional Information section)</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
<td>• Initial evaluation of left ventricular function</td>
<td>I(2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Following acute MI or in HF patients</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td>• Initial evaluation of cardiac mass (suspected tumor or thrombus)</td>
<td>I(3)</td>
</tr>
</tbody>
</table>

Evaluation of Intra- and Extracardiac Structures

### 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>
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<td>&gt;60</td>
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<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
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</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 = exercise time · (5 * ST deviation) · (4 * exercise angina), with 0 = none, 1 = non limiting, and 2 = exercise-limiting. The score typically ranges from -25 to +15. These values correspond to low-risk (with a score of >= +5), intermediate risk (with scores ranging from -10 to +4), and high-risk (with a score of <= -11) categories.

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

Pre-operative evaluation:
- Evaluation of interventional vascular procedures for luminal patency versus restenosis due to conditions such as atherosclerosis, thromboembolism, and intimal hyperplasia.

Post-operative or post-procedural evaluation:
- Evaluation of post-operative complications, e.g. pseudoaneurysms, related to surgical bypass grafts, vascular stents and stent-grafts.
- Follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

ADDITIONAL INFORMATION RELATED TO ABDOMINAL ARTERIES CTA:

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

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 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.

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:


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).
- Two or more first degree relatives (parents, siblings, and children) have history of breast cancer.
- 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:
- Two or more first degree relatives (parents, siblings, and children) have history of breast cancer.
- Evaluation of suspected breast cancer when other imaging examinations, such as ultrasound and mammography, and physical examination are inconclusive for the presence of breast cancer, and biopsy could not be performed (e.g. seen only in single view mammogram without ultrasound correlation).
- Previous positive breast biopsy within the previous four (4) months and no intervening previous breast MRI.
- Inconclusive 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 Li-Fraumeni syndrome (TP53 mutation), Cowden syndrome (PTEN) or Bannayan-Riley-Ruvalcaba syndrome (BRRS).

**History of Known Breast Cancer**

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

**For evaluation of identified lesion, mass or abnormality in breast in any of the following situations:**
• For evaluation of breast lesion, identifying whether single or multi-focal, in patient with diagnosed breast cancer.
• For evaluation of suspicious mass, lesion, distortion or abnormality of breast in patient with history of breast cancer.

**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 DENSITY STUDY:

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

- 65 years of age or older.
- 40 years of age or older AND at least ONE of the following risk factors:
  - Currently on medications associated with development of osteoporosis, e.g., steroids or glucocorticosteroids, anticonvulsants, heparin, lithium.
  - Currently a cigarette smoker and has a low body weight (<127 lbs.).
  - Caucasian with estrogen deficiency and low calcium intake or alcoholism.
  - Caucasian with adult history of fracture.
  - Evidence of osteoporosis or osteopenia from x-ray or ultrasound.
  - Patient’s parents or siblings have adult history of fracture.

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 three (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 of an individual with known osteoporosis or osteopenia:
- Has not had a bone mineral density study within the past 23 months.
- Had bone density within past 23 months AND meets any one of the following risk factor criteria:
  - Hormone replacement therapy (females only)
  - SERMs, calcitonin, or biphosphonates within the past 6 months (Actonel, Etidronate, Calcimar, Calcitonin, Didronel, Evista, Fosamax, Micacaln)
  - 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
- In the following situations, follow-up imaging may be required in less than 23 months:
  - Glucocorticoid or anticonvulsant therapy greater than 3 months duration
  - Uncorrected hyperparathyroidism

ADDITIONAL INFORMATION RELATED TO CT BONE DENSITOMETRY:

**DXA** – Dual energy x-ray absorptiometry (DXA) is most often used to measure bone mineral density due to its low radiation exposure, low precision error, and capacity to measure multiple skeletal sites (spine, hip or total body).

**Axial DXA** – This provides the “gold standard”. Axial DXA predicts fracture risk at the site being measured.

**Peripheral DXA** – This device measures BMD at peripheral sites, generally at the heel or wrist. It is relatively cheap and portable and is an option when there is limited access to axial DXA.

REFERENCES


Binkley, N.C., Schmeer, P., Wasnich, R.D., & Lenchik, L. (2002). What are the criteria by which a densitometric diagnosis of osteoporosis can be made in males and non-caucasians? *Journal of*


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:


INTRODUCTION:

Stress tests are done to assess cardiac function in terms of the 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 Coronary Artery Disease (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 stratify the risk for 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:

<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9);</th>
<th>A= Appropriate; U=Uncertain (MPI / Stress Echo)</th>
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<tbody>
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<td>MPI / Stress Echo</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Detection of CAD/Risk Assessment: Symptomatic</td>
<td>Evaluation of Ischemic Equivalent (Non-Acute)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2 / 115               | • Low pretest probability of CAD*  
                       |   • ECG uninterpretable OR unable to exercise | A(7) / A(7) | |
| 3 / 116               | • Intermediate pretest probability of CAD*  
                       |   • ECG interpretable AND able to exercise | A(7) / A(7) | |
| 4 / 117               | • Intermediate pretest probability of CAD*  
                       |   • ECG uninterpretable OR unable to exercise | A(9) / A(9) | |
| 5 / 118               | • High pretest probability of CAD*  
                       |   • Regardless of ECG interpretability and ability to exercise | A(8) / A(7) | |
| Detection of CAD: Asymptomatic (Without Ischemic Equivalent) | | | |
| Asymptomatic          | | | |
| 14 / 126              | • Intermediate CHD risk (ATP III risk criteria)***  
                       |   • ECG uninterpretable | U(5) / U(5) | |
| 15 / 127              | • High CHD risk (ATP III risk criteria)*** ✓ | A(8) / U(5) ✓ | |
| New-Onset or Newly Diagnosed Heart Failure With LV Systolic Dysfunction Without Ischemic Equivalent | | | |
| 16 / 128              | • No prior CAD evaluation AND no planned coronary angiography | A(8) / A(7) | |
| New-Onset Atrial Fibrillation ♦ | | | |
| 17 / 132              | • Part of evaluation when etiology unclear | U(6) / U(6) | |
| Ventricular Tachycardia ♦ | | | |
| 18 / NA               | • Low CHD risk (ATP III risk criteria)*** | A(7) / NA | |
| 19 / NA               | • Intermediate or high CHD risk (ATP III risk criteria)*** | A(8) / NA | |
| Syncope               | | | |
| 21 / 134              | • Intermediate or high CHD risk (ATP III risk criteria)*** | A(7) / A(7) | |
| Elevated Troponin     | | | |
| 22 / 135              | • Troponin elevation without additional evidence of acute coronary syndrome (with ischemia present patient is not | A(7) / A(7) ✓ | |
### ACCF et al. Criteria # MPI / Stress Echo

**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”

subject to Stress Echocardiogram contraindications)

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

<table>
<thead>
<tr>
<th>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD</th>
</tr>
</thead>
</table>

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

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

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

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)


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<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>Indications</th>
<th>Appropriate Use Score (4-9)</th>
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<tbody>
<tr>
<td>MPI / Stress Echo</td>
<td>(<strong>Refer to Additional Information section</strong>)</td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
<tr>
<td></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>
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</tbody>
</table>

### Duke Treadmill Score

<table>
<thead>
<tr>
<th>36 / 139</th>
<th>Agatston score greater than 400</th>
<th>A(7) / A(7)</th>
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</table>

<table>
<thead>
<tr>
<th>38 / 149</th>
<th>Intermediate-risk Duke treadmill score****</th>
<th>A(7) / A(7)</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>39 / 150</th>
<th>High-risk Duke treadmill score****</th>
<th>A(8) / A(7)</th>
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</thead>
</table>

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

#### Intermediate-Risk Surgery

<table>
<thead>
<tr>
<th>43 / 157</th>
<th>Greater than or equal to 1 clinical risk factor ✓</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Poor or unknown functional capacity (less than 4 METs)</td>
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<tr>
<td></td>
<td>A(7) / U(6) ✓</td>
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</tbody>
</table>

#### Vascular Surgery

<table>
<thead>
<tr>
<th>47 / 161</th>
<th>Greater than or equal to 1 clinical risk factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor or unknown functional capacity (less than 4 METS)</td>
</tr>
<tr>
<td></td>
<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>
<th>Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To evaluate for inducible ischemia</td>
</tr>
<tr>
<td></td>
<td>No prior coronary angiography</td>
</tr>
<tr>
<td></td>
<td>A(8) / A(7)</td>
</tr>
</tbody>
</table>

#### UA/NSTEMI

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

#### Asymptomatic

<table>
<thead>
<tr>
<th>56 / 170</th>
<th>Incomplete revascularization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Additional revascularization feasible</td>
</tr>
<tr>
<td>57</td>
<td>Less than 5 years after CABG ✓ AND</td>
</tr>
<tr>
<td></td>
<td>No MPI for 2 years or more unless most recent MPI</td>
</tr>
<tr>
<td></td>
<td>U(5) ✓</td>
</tr>
</tbody>
</table>
### ACCF et al. Criteria # MPI / Stress Echo

(*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”

<table>
<thead>
<tr>
<th><strong>INDICATIONS</strong></th>
<th><strong>APPROPRIATE USE SCORE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>showed reversible ischemia</td>
<td>A(7) / U(6) ✓</td>
</tr>
<tr>
<td>58 / 172</td>
<td>Greater than or equal to 5 years after CABG ✓ AND No MPI for 2 years or more unless most recent MPI showed reversible ischemia</td>
</tr>
<tr>
<td>60 / 174</td>
<td>Greater than or equal to 2 years after PCI</td>
</tr>
<tr>
<td><strong>Assessment of Viability/Ischemia</strong></td>
<td></td>
</tr>
<tr>
<td>62 / 176</td>
<td>Known severe LV dysfunction Patient eligible for revascularization</td>
</tr>
<tr>
<td><strong>Evaluation of Ventricular Function</strong></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>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</td>
</tr>
<tr>
<td>64</td>
<td>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.</td>
</tr>
<tr>
<td>66</td>
<td>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</td>
</tr>
<tr>
<td><strong>Use of Potentially Cardiotoxic Therapy (e.g., Doxorubicin)</strong></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Serial assessment of LV function with radionuclide angiography (ERNA or FP RNA) Baseline and serial measures after key therapeutic milestones or evidence of toxicity</td>
</tr>
</tbody>
</table>

### INDICATIONS FOR A NUCLEAR CARDIAC IMAGING/MYOCARDIAL PERFUSION STUDY:

- To qualify for SPECT MPI, the patient must meet ACCF/ASNC Appropriateness criteria for appropriate indications above and meets any one of the following conditions:
  - Stress echocardiography is not indicated: OR
• Stress echocardiography has been performed however findings were inadequate, there were technical difficulties with interpretation, or results were discordant with previous clinical data; OR
• MPI is preferential to stress echocardiography including but not limited to following conditions:
  ▪ Ventricular paced rhythm
  ▪ Evidence of ventricular tachycardia
  ▪ Severe aortic valve dysfunction
  ▪ Severe Chronic Obstructive Pulmonary Disease, (COPD) as defined as FEV1 < 30% predicted or FEV1 < 50% predicted plus respiratory failure or clinical signs of right heart failure. (GOLD classification of COPD access http://www.pulmonaryreviews.com/jul01/pr_jul01_copd.html
  ▪ 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</th>
<th>APPROPRIATE USE SCORE (1-3); I= Inappropriate:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Detection of CAD/Risk Assessment: Symptomatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Evaluation of Ischemic Equivalent (Non-Acute)</strong></td>
</tr>
<tr>
<td>1</td>
<td>- Low pretest probability of CAD* &lt;br&gt; - ECG interpretable OR able to exercise</td>
<td>I (3)</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>Detection of CAD: Asymptomatic (Without Ischemic Equivalent)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Asymptomatic</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)***  &lt;br&gt; - ECG interpretable</td>
<td>I (3)</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></td>
<td><strong>Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study</strong></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>- Low CHD risk (ATP III risk criteria)***  &lt;br&gt; - Last stress imaging study done less than 2 years ago</td>
<td>I (1)</td>
</tr>
<tr>
<td>24</td>
<td>- Intermediate to high CHD risk (ATP III risk criteria)***  &lt;br&gt; - Last stress imaging study done less than 2 years ago</td>
<td>I (3)</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></td>
<td><strong>Asymptomatic Prior Coronary Calcium Agatston Score</strong></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>- Agatston score less than 100</td>
<td>I (2)</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></td>
<td><strong>Duke Treadmill Score</strong></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Low-risk Duke treadmill score****</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td><strong>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Low-Risk Surgery</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></td>
<td><strong>Intermediate-Risk Surgery</strong></td>
<td></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 postnormal catheterization, noninvasive test, or previous revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td><strong>Vascular Surgery</strong></td>
<td></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 postnormal catheterization, noninvasive test, or previous revascularization</td>
<td>I (2)</td>
</tr>
<tr>
<td></td>
<td><strong>Risk Assessment: Within 3 Months of an Acute Coronary Syndrome</strong></td>
<td></td>
</tr>
<tr>
<td>49</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>51</td>
<td>Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
<td><strong>ACS – Asymptomatic Postrevascularization (PCI or CABG)</strong></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Evaluation prior to hospital discharge</td>
<td>I (1)</td>
</tr>
<tr>
<td></td>
<td><strong>Cardiac Rehabilitation</strong></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>
<tr>
<td></td>
<td><strong>Risk Assessment: Postrevascularization (Percutaneous Coronary Intervention or Coronary Artery Bypass Graft)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Asymptomatic</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>59</td>
<td>Less than 2 years after PCI</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td><strong>Cardiac Rehabilitation</strong></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Prior to initiation of cardiac rehabilitation (as a stand-alone indication)</td>
<td>I (3)</td>
</tr>
<tr>
<td></td>
<td><strong>Evaluation of Ventricular Function</strong></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>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.</td>
<td>I (3)</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  
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 (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.

**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:
<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

**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,

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

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.

**Perioperative Clinical Risk Factors:**
- 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)

**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 (*Refer to Additional Information section)</th>
<th>APPROPRIATE USE SCORE (4-9);</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI / Stress Echo</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>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
<tr>
<td>Detection of CAD/Risk Assessment: Symptomatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of Ischemic Equivalent (Non-Acute)</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>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><em>(Refer to Additional Information section)</em></td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
<tr>
<td>□ Not subject to Stress Echocardiogram contraindications as noted in section “Indications for a Nuclear Cardiac Imaging / Myocardial Perfusion Study”. Please see explanation in Introduction, paragraph “6”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 4 / 117                | - Intermediate pretest probability of CAD*  
- ECG uninterpretable OR unable to exercise | A(9) / A(9) |
| 5 / 118                | - High pretest probability of CAD*  
- Regardless of ECG interpretability and ability to exercise | A(8) / A(7) |
| **Detection of CAD: Asymptomatic (Without Ischemic Equivalent)** |
| 14 / 126               | - Intermediate CHD risk (ATP III risk criteria)***  
- ECG uninterpretable | U(5) / U(5) |
| 15 / 127               | - High CHD risk (ATP III risk criteria)*** ✓ | A(8) / U(5) ✓ |
| **New-Onset or Newly Diagnosed Heart Failure With LV Systolic Dysfunction Without Ischemic Equivalent** |
| 16 / 128               | - No prior CAD evaluation AND no planned coronary angiography | A(8) / A(7) |
| **New-Onset Atrial Fibrillation ♦** |
| 17 / 132               | - Part of evaluation when etiology unclear | U(6) / U(6) |
| **Ventricular Tachycardia ♦** |
| 18 / NA                | - Low CHD risk (ATP III risk criteria)*** | A(7) / NA |
| 19 / NA                | - Intermediate or high CHD risk (ATP III risk criteria)*** | A(8) / NA |
| **Syncope**            |
| 21 / 134               | - Intermediate or high CHD risk (ATP III risk criteria)*** | A(7) / A(7) |
| **Elevated Troponin**  |
| 22 / 135               | - Troponin elevation without additional evidence of acute coronary syndrome (with ischemia is not subject to Stress Echocardiogram contraindications) ✓ | A(7) / A(7) ✓ |
| **Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD** |
| **Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study** |
| 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) ✓ |
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9);</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI / Stress Echo</td>
<td></td>
<td>A= Appropriate; U=Uncertain (MPI / Stress Echo)</td>
</tr>
</tbody>
</table>

- **Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization**
  - 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**
  - 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**
<table>
<thead>
<tr>
<th>ACCF et al. Criteria #</th>
<th>INDICATIONS</th>
<th>APPROPRIATE USE SCORE (4-9);</th>
</tr>
</thead>
<tbody>
<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>□ Not subject to Stress Echocardiogram contraindications as noted in section “Indications for a Nuclear Cardiac Imaging / Myocardial Perfusion Study”. Please see explanation in Introduction, paragraph “6”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 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                | 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.

*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>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

**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 evaluate left ventricular (LV) function at baseline before chemotherapy or cardiotoxic therapy; may be repeated prior to subsequent chemotherapy cycles until a total cardiotoxic dose has been reached.
- To evaluate ejection fraction in a patient with congestive heart failure (CHF).
- To evaluate patient, who is obese or who has chronic obstructive pulmonary disease (COPD), for coronary artery disease (CAD).

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:


IMPORTANT NOTE: This PET scan applies to the fluorodeoxyglucose (FDG) imaging agent only.

INTRODUCTION:

The basis of fluorodeoxyglucose (FDG)-PET imaging is the differential utilization of glucose by tissues based on their metabolic activity. 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. In the evaluation of dementia, studies with fluorodeoxyglucose (FDG)-PET indicate that diseases resulting in impairment of cognitive function (memory, learning and problem solving) are associated with reduced use of glucose in brain areas important in these functions.

INDICATIONS FOR BRAIN PET SCAN:

For evaluation of known brain tumor or cancer:
- Known brain tumor or cancer with new signs or symptoms indicative of a recurrence of cancer.
- Brain tumor follow-up after surgery and/or after treatment recently completed.

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

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

For patients with Dementia:
- A scan is reasonable and necessary in patients (who meet all 3 bullets below) with:
  1. A recent diagnosis of dementia or fronto-temporal dementia (FTD) AND have documented cognitive decline of at least six months (request date of onset of symptoms).
  2. Who have had more than one assessment done of patient’s mental status - documented by MMSE or other neuro-diagnostic testing, such as:
     - For MMSE, a score of 23 or lower is indicative of cognitive impairment
     - EEG and long-term EEG monitoring
     - Transcranial Dopplers
     - Evoked Potentials
     - Intraoperative Monitoring
  3. Has had an appropriate baseline work-up for other treatable causes, including appropriate medication restriction or reduction to test for reversibility. (Refer to the Additional Information section of this document).
ADDITIONAL INFORMATION RELATED TO BRAIN PET:

Information applicable to Dementia/Alzheimer’s:

- Cognition is the act or process of thinking, perceiving, and learning.
- Symptoms develop when the underlying condition affects areas of the brain involved with learning, memory, decision-making, and language.
- Memory impairment is often the first symptom to be noticed. Someone with dementia may be unable to remember ordinary information, such as their birth date and address, and may be unable to recognize friends and family members.
- There is progressive decline in these cognitive functions as well:
  - Decision making
  - Judgment
  - Orientation in time and space
  - Problem solving
  - Verbal communication
- Behavioral changes may include the following:
  - Eating, dressing, toileting (e.g., unable to dress without help; becomes incontinent)
  - Interests (e.g., abandons hobbies)
  - Routine activities (e.g., unable to perform household tasks)
  - Personality (e.g., inappropriate responses, lack of emotional control).
- Frontotemporal dementia diagnostic criteria:
  - Behavioral symptoms that should be recorded include apathy, aspontaneity, or, oppositely, disinhibition.
  - Executive function should also be assessed- patients would show impairment in ability to perform skills that require complex planning or sequencing (multi-step commands, drawing the face of a clock).
  - Primitive reflexes showing frontal release should be assessed including palomomental reflex, rooting reflex and palmar grasp.
- Alzheimer’s criteria:
  - Memory impairment (assessed as part of mini-mental status exam MMSE)
  - Cognitive disturbance (one or more) evidenced by
    - Aphasia (language disturbance)
    - Apraxia (impaired ability to carry out motor activities despite intact motor function)
    - Agnosia - failure to recognize or identify objects despite intact sensory (vision, touch, etc) function
  - Disturbance in executive function- patients would show impairment in ability to perform skills that require complex planning or sequencing (multi-step commands, drawing the face of a clock).
- Metabolic testing (in addition to neurologic examination, MMSE):
  - Urinalysis (to r/o urinary tract infection as a cause of dementia)
  - CBC (to r/o infection or anemia as a cause of impaired mental function)
  - Serum electrolytes, including magnesium
  - Serum chemistries, including liver function testing
  - Thyroid function tests (TSH or super sensitive (ss) TSH)
  - Vitamin B12
  - Erythrocyte Sedimentation Rate (ESR, “Sed Rate”, etc)
  - Serologic test for syphilis (to r/o tertiary syphilis)
- Possibly toxicology tests to r/o poisoning or overdose: salicylates, alcohol, other
- Medicines that may be causing cognitive impairment:
  - Anti-diarrheals
  - Anti-epileptic medications
  - Antihistamines, cold and flu medications
  - Lithium
  - Sleeping pills
  - Tricylic antidepressants
  - Opiates
  - Salicylates

**PET in Seizure Disorders** – Refractory epilepsy is defined as epilepsy that does not respond to medical treatment. These patients struggle with recurrent seizures even while undergoing treatment with antiepileptic drugs (AEDs). However, the definition is unclear as some of these patients will partially respond to treatment or will worsen when AEDs are discontinued. PET is helpful in locating the area of the brain causing seizures and is used in the preoperative evaluation of patients who have failed to respond to conventional medical treatment of epilepsy.

**PET and Known Brain Tumor/Cancer** – Studies have shown that PET is useful in patients who have undergone surgery. PET, a biochemical and physiologic technology, provides precise information about brain tumors which helps to distinguish between brain tumors and other anatomic structures or surgical scars. 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:**


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 lIC-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 AN ONCOLOGICAL PET SCAN:

Initial Treatment Strategy

All solid tumors, including myeloma, with biopsy proven cancer or strongly suspected based on other diagnostic testing:

Including
- CLL – chronic lymphocytic leukemia
- SPN – solitary pulmonary nodule ≥ to 8mm in size (may have non-suspicious nodules in the lung)

Excluding
- ALL – acute lymphoblastic leukemia
- AML – acute myelogenous leukemia
- BCC – basal cell carcinoma (of the skin)
Prostate cancer

- To determine the anatomic extent of tumor when the recommended anti-tumor treatment reasonably depends on the extent of the tumor, or
- To determine if patient is an appropriate candidate for an invasive diagnostic or therapeutic procedure, or
- To determine the optimal anatomic location for an invasive procedure.

**Subsequent Treatment Strategy**

Restaging or monitoring response to active treatment, and/or a single evaluation after completion/cessation of therapy not to be performed within 4 weeks of completion of therapy, and/or evaluation for suspicion of recurrence due to new or changing signs/symptoms. (Asymptomatic surveillance is not approvable.)

- Breast cancer (female and males)
- Cervical cancer
- Colorectal cancer (including colon, rectal, appendiceal or anal cancer)
- Esophageal cancer
- Head and neck cancer (not including Brain cancer/tumor; thyroid noted below)
- Lung cancer - Non-small cell
- Lymphoma
- Melanoma
- Myeloma
- Ovarian cancer

**Subsequent Treatment Strategy (Continued)**

Subsequent PET Scans may be performed only if other imaging (US, CT, MRI) is inconclusive in determining a treatment plan or unable to be performed:

- Brain cancer: (with metastasis to non-head areas)
  - Refer to Brain PET Scan Guidelines to image the brain
- Lung cancer - Small cell
- Neuroendocrine cancer (e.g. carcinoid, pheochromocytoma, etc)
- Pancreatic cancer
- Soft tissue sarcoma
- Testicular cancer
- Tumors of unknown origin

**Prostate cancer:**

- PET scan is not indicated for subsequent treatment strategy.

**Thyroid cancer:**

- Subsequent treatment strategy for recurrence or distant metastasis for thyroid cancer of Papillary, Follicular, or Hurthle cell origin AND patient has the following:
• a thyroidectomy and radioiodine ablation initially, and
• current serum thyroglobulin > 10ng/mL, and
• current whole body I-131 scan is negative.

Medullary Thyroid cancer when calcitonin levels are elevated post-operatively.

**Surveillance/Remission**

Surveillance/remission PET scan testing to assess for possible changes in status with no signs or symptoms of active cancer changes and not on any active treatment. Unless otherwise specified above, PET scan is not indicated for surveillance/remission.

**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 Pancreatic Cancer – In difficult cases, the presence of diffuse uptake of FDG by the pancreas or concomitant extrapancreatic uptake by the salivary glands on PET/CT can be used to aid in differentiation of autoimmune pancreatitis and pancreatic cancer.

PET and Solitary Pulmonary Nodule – 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 radiiodine scans and elevated thyroglobulin (Tg) levels to detect recurrent or metastatic DTC.

REFERENCES:


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**


INTRODUCTION:

There is no evidence that the use of CAD systems would maintain or increase the sensitivity, specificity, and recall rates of MRI of the breast and is therefore impossible to evaluate the impact of CAD on health outcomes such as treatment success and survival of patients with breast cancer.

INDICATIONS FOR CAD BREAST MRI:

"No proven indications for use of CAD with/without an approved Breast MRI".
IMPORTANT NOTE:

PET scan for whole body; melanoma for non-covered indications is considered to be **not medically necessary** and is therefore a non-covered study.
**IMPORTANT NOTE:**

PET imaging, any site, not otherwise specified, is a non-covered CPT code.
IMPORTANT NOTE:

PET scan for the initial diagnosis of Breast Cancer is considered to be **not medically necessary and** is therefore a non-covered study.
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 US, or prior CT/MR imaging) and/or liver inflammation w/non-diagnostic lab work up.
- For the evaluation of the complications of congenital anomalous pancreaticobiliary disease.

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 post-surgical biliary and/or surgical anastomoses.

**Magnetic resonance Cholangiopancreatography (MRCP)** – MRCP is a noninvasive method for depicting biliary and pancreatic ducts and assessing the level of obstruction. It is also used to evaluate congenital anomalies of these structures. 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:


IMPORTANT NOTE:

Low Field MRI services are not considered to be medically necessary, are not approvable for payment and cannot be approved.

All guidelines

Reviewed/Approved by Michael Pentecost MD, Associate Chief Medical Officer