Common symptoms and symptom complexes are addressed by this tool. Imaging requests for patients with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician may provide additional insight.

This version incorporates MSI accepted revisions prior to 11/30/06
ABBREVIATIONS for CHEST GUIDELINES

AAA: abdominal aortic aneurysm
ACE: angiotensin-converting enzyme
AVM: arteriovenous malformation
BI-RADS: Breast Imaging Reporting and Database System
BP: blood pressure
BRCA: tumor suppressor gene
CAD: computer-aided detection
CT: computed tomography
CTA: computed tomography angiography
CTV: computed tomography venography
DCIS: ductal carcinoma in situ
DVT: deep venous thrombosis
EKG: electrocardiogram
EM: electromagnetic
EMG: electromyogram
FDG: fluorodeoxyglucose
FNA: fine needle aspiration
ger reflux disease
GI: gastrointestinal

HRCT: high resolution computed tomography
MRA: magnetic resonance angiography
MRI: magnetic resonance imaging
MRV: magnetic resonance venography
NCV: nerve conduction velocity
PE: pulmonary embolus
PEM: positron-emission mammography
PET: positron emission tomography
PFT: pulmonary function tests
PPD: purified protein derivative of tuberculin
RODEO: Rotating Delivery of Excitation Off-resonance MRI
SPN: solitary pulmonary nodule
SVC: superior vena cava
TAA: thoracic aortic aneurysm
TB: tuberculosis
TOS: Thoracic Outlet Syndrome
TSH: thyroid-stimulating hormone
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CHEST IMAGING GUIDELINES

CH-1~GENERAL GUIDELINES

- Chest x-rays should be overread by a radiologist prior to request for advanced imaging.
- Intrathoracic abnormalities found on chest x-ray, fluoroscopy, abdominal CT scan, or other imaging modalities can be further evaluated with chest CT with contrast (CPT 71260).
- Non-contrast chest CT (CPT 71250) can be used for the following:
  - Patient has contraindication to contrast
  - Follow-up of pulmonary nodule(s)
  - High Resolution CT (HRCT)
  - Noncontrast CT is specifically requested by pulmonary specialist
  - Other circumstances as specified in the guidelines
- Chest CT without and with contrast (CPT 71270) does not add significant diagnostic information above and beyond that provided by chest CT with contrast, unless a question regarding calcification needs to be resolved.

Pediatric Chest imaging guidelines:
- Although there are a number of congenital disorders that affect the thorax (e.g. congenital lobar emphysema, bronchogenic cyst, cystic adenomatoid malformation, pulmonary sequestration, lung aplasia and hypoplasia, diaphragmatic hernia, pericardial cyst), imaging guidelines for the chest in the pediatric population are the same as for adults.
  - Chest x-ray should be performed as the initial imaging study, and results of the chest x-ray will then dictate the need for subsequent diagnostic studies such as CT, MRI, ultrasound, or bronchoscopy.
  - MRI, if requested, can be considered rather than CT due to concerns regarding radiation exposure.
  - CT of the chest without contrast (CPT 71250) can be performed for preoperative planning in patients with pectus excavatum (depression of the sternum), pectus carinatum (anterior protrusion deformities of the chest wall), or other deformities of the chest wall or sternum.
  - Chest MRA (CPT 71555) or CTA (CPT 71275) can be performed to evaluate possible vascular anomalies or to evaluate the blood supply to certain anomalies such as pulmonary sequestration.
- Reference:

Pediatric guidelines: The Chest guidelines are the same for both the pediatric population and the adult population, unless there are specific Pediatric guidelines (highlighted in yellow).
SYMPTOM-BASED GUIDELINES (ALPHABETICAL ORDER)

CH-2~CHRONIC COUGH

- Information provided for patients with chronic cough should include a complete list of current medications, smoking history, history of recent upper respiratory infection, and history of cancer.
- All patients must first be evaluated with a recent chest x-ray (overread by a radiologist).
- Current or past cigarette smokers with a history of chronic smoker’s cough should be asked if the cough has changed. If no change in cough and chest x-ray is unremarkable, no further imaging is indicated.
- Chest CT with contrast (CPT 71260) is indicated in a current or past smoker with a change in cough or a new onset cough lasting greater than 4 weeks.
- Patients taking medications known to cause coughing (e.g. ACE inhibitors) should have medication discontinued. If cough persists > 4 weeks, chest CT with contrast (CPT 71260) or without contrast (CPT 71250) is indicated.
- Patients with no history of smoking and clear chest x-ray should undergo the following algorithm.1,2
  - A 3 week trial of antihistamine and decongestant treatment should be performed initially.
  - If chronic cough persists after treatment of upper airway cough syndrome, asthma should be ruled out with bronchoprovocation challenge (e.g. methacholine challenge, exhaled nitric oxide test) and spirometry should be performed.
  - If bronchoprovocation challenge is not available, an empiric trial of corticosteroids should be performed.
  - If cough persists, treatment of gastroesophageal reflux disease should be started and referral to a cough specialist is helpful.
  - If cough persists, chest CT (either with contrast [CPT 71260] or without contrast [CPT 71250]) can be performed.

2. Chest 2006;129:1S-23S

CH-3~CHRONIC NON-CARDIAC CHEST PAIN

- Defined as recurrent episodes of unexplained retrosternal pain in patients lacking a cardiac abnormality after a reasonable evaluation.*
  *Chiropractic and Osteopathy 2005;13:18
- This guideline addresses all types of chronic non-cardiac chest pain (chest wall pain, pleuritic pain, retrosternal pain, etc.).
- Chronic pain generally persists for 6 months or more.
- More than half of patients with no organic cause for chest pain continue to experience chest pain one year after discharge from the hospital.*
• Common etiologies include musculoskeletal, esophageal (e.g. reflux disease), and panic disorder.
  o Esophageal angina: Approximately 10%-20% of patients with GERD present with symptoms that are clinically indistinguishable from angina pectoris.
    ➢ Clinical features that may suggest the esophagus as the source of the atypical pain include: posturally aggravated symptoms, history of dysphagia, substernal pain limited to the midline and radiating to the interscapular area.
    ➢ Reference:  
  • 25%-50% of chest pain presentations in ambulatory settings may be musculoskeletal.
    o Musculoskeletal pain is a diagnosis of exclusion.
    o Some patients with Thoracic Outlet Syndrome can present with anterior chest wall or parascapular pain.
    o Also see CH-23 Thoracic Outlet Syndrome
• Chest x-ray should be performed initially and overread by a radiologist.
• Abnormalities present on chest x-ray that were not present on previous imaging studies (if available) can be further evaluated with chest CT with contrast (CPT 71260).
• If chest x-ray is unremarkable, a thorough cardiac (EKG, echocardiogram, stress test), GI (trial of anti-reflux medication, possible upper endoscopy, pH probe, esophageal manometry), and pulmonary (PFT’s) evaluation should be performed at least once.
• If the above evaluations have not yielded an explanation for the chest pain, the chest pain has been present for greater than 6 months, and the patient has had a recent chest x-ray (within 2 to 4 weeks), then chest CT with contrast (CPT 71260) can be performed.
• Repeat advanced imaging of the chest in patients with unchanged symptoms is not appropriate.

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**CH-4~HEMOPTYSIS**

• The patient’s history should help determine the amount of blood and differentiate between hemoptysis, pseudohemoptysis, and hematemesis.
• Most common etiologies for hemoptysis:
  o Adults: Bronchitis, bronchogenic carcinoma, pneumonia
  o Children: Lower respiratory tract infections, foreign body aspiration, bronchiectasis secondary to cystic fibrosis
In addition, bleeding caused by suffocation, deliberate or accidental, should be considered.

- Work up:
  - Careful history and physical examination and chest x-ray.
  - **Low risk patient with normal chest x-ray**: treat on an outpatient basis with close monitoring and antibiotics if indicated.
  - **Patients with risk factors for malignancy** (e.g. male sex, age >40, smoking, duration of hemoptysis >1 week): chest CT with contrast (CPT 71260) should be performed even if chest x-ray is normal.

- Reference:
  - *Am Fam Physician 2005;72(7):1253-1260*

- In the non-trauma patient with a history of clinically documented hemoptysis, chest CT (either with contrast [CPT 71260] or without contrast [CPT 71250] depending on physician preference) is indicated prior to bronchoscopy.*
  - *AJR 2002;179:1217-1224*

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**LUNG PARENCHYMA (ALPHABETICAL ORDER)**

### CH-5~ASBESTOS EXPOSURE

- Chest x-ray must be performed initially in patients with suspected asbestos-related lung disease.
- In patients with stable calcified pleural plaques seen on chest x-ray, no advanced imaging of the chest is indicated.
- If a change is seen on chest x-ray, high resolution chest CT (HRCT) (CPT 71250) can be performed.
- Patients with progressive pleural and parenchymal changes are at particularly high risk of developing malignant mesothelioma and should have HRCT (CPT 71250) every 3 to 6 months.

### CH-6~INTERSTITIAL DISEASE

- High resolution chest CT scan (HRCT) without contrast (CPT code 71250) is the diagnostic modality of choice to evaluate for interstitial changes in patients with pulmonary symptoms and abnormal pulmonary function studies (PFT’s). Chest x-ray may be normal in some cases of interstitial lung disease and PFT’s are the best indicator of the need for HRCT.
- Evaluation by a Pulmonologist is helpful in determining the need for advanced imaging.
CH-7~MULTIPLE PULMONARY NODULES

- More than 6 nodules usually indicates inflammatory lung disease, and this has been confirmed after years of follow-up.*
  *Chest 2004;125:1522-1529
- Clustering of multiple nodules in a single location in the lung tends to favor an infectious process, although a dominant nodule with adjacent small satellite nodules can be seen in primary lung cancer.*
  *Radiology 2005;237:395-400
- In patients with multiple pulmonary nodules, the largest nodule should be imaged based on Ch-11 Solitary Pulmonary Nodule guidelines listed below.
- If infection is highly suspected in a patient with multiple pulmonary nodules, the first follow-up chest CT (CPT 71250 or 71260) can be performed sooner than 3 months.

CH-8~PNEUMONIA

- Chest x-ray (overread by a radiologist) must be performed initially in all patients with suspected pneumonia prior to considering advanced imaging.
- Chest CT with contrast (CPT 71260) may be helpful in evaluating a patient with pneumonia that has shown no improvement by chest x-ray after two weeks or has not cleared by chest x-ray after four weeks.
- Chest CT with contrast (CPT 71260) is indicated when chest x-ray shows a possible complication of pneumonia (e.g. abscess, effusion) or possible lung mass associated with the infiltrate.

CH-9~POSITIVE PPD or TUBERCULOSIS (TB)

- Chest CT with contrast (CPT 71260) can be performed in patients with positive PPD skin test or other positive tuberculin skin tests and normal chest x-ray who have not had a previous normal chest CT.
- Chest CT can show evidence of tuberculosis (e.g. primary complexes, mediastinal or hilar lymphadenopathy) in up to 20% of patients with unremarkable chest x-rays.*
  *AJR 1997 Apr;168(4):1005-1009
  *Eur J Radiol 2003 Dec;48(3):258-262
  o Evidence of tuberculosis on chest CT will alter clinical management and result in full multi-drug treatment for these patients rather than single drug treatment for positive PPD.
- If chest CT is unremarkable, there is insufficient data to support performing subsequent chest CT scans unless symptoms develop or chest x-ray shows a new abnormality.
• Follow-up chest CT with contrast (CPT 71260) can be used to re-evaluate patients undergoing active treatment for tuberculosis who had abnormalities seen only on chest CT.
  o The frequency of the follow-up chest CT scans should be at the discretion of the pulmonary specialist following the patient, as there are no published guidelines or evidence-based data addressing this issue.
• Patients with suspected complications or progression of tuberculosis (e.g. pleural tuberculosis, empyema, mediastinitis) can be evaluated with chest CT with contrast (CPT 71260).

**CH-10~SARCOID**

• Also see ONC-28.5 Sarcoidosis in the Oncology guidelines.
• CT of the chest either with contrast (CPT 71260) or without contrast (CPT 71250) is superior to chest x-ray in establishing the diagnosis of sarcoid. CT scan helps differentiate sarcoid from other granulomatous disorders, especially tuberculosis, and allows follow-up for the detection of complications, especially fibrosis.*
• Patients with suspected sarcoid should have chest CT either with contrast (CPT 71260) or without contrast (CPT 71250) to establish or rule out the diagnosis.
• Chest CT (either with or without contrast) is indicated in patients with worsening symptoms, new symptoms after a period of being asymptomatic, or if a treatment change is being considered.
• There is currently insufficient evidence-based data to support the routine use of PET in evaluating sarcoidosis.

**CH-11~SOLITARY PULMONARY NODULE (SPN)**

• A solitary pulmonary nodule (SPN) can be imaged by chest CT without contrast (CPT 71250) or with contrast (CPT 71260) (depending on physician preference) if there has been an increase in size on chest x-ray, if there are no old films for comparison, or if the lesion does not have classically benign characteristics by chest x-ray or previous CT (e.g. benign calcification pattern typical for a granuloma or hamartoma).
• If the SPN was identified on a prior CT, then CT without contrast (CPT 71250) or with contrast (CPT 71260) (with thin cuts through the nodule) can be performed as follows:1-5
  o Nodules less than 5 mm: repeat CT scan at 1 year
  o Nodules <7 mm: repeat CT scan at 6, 12, 24 months
  o Nodules ≥7 mm: repeat CT scan at 3, 6, 12, 24 months
  1Radiology 2004;231:164-168
  2Radiology 2005;237:395-400
  3National Lung Screening Trial
  4American College of Chest Physicians guidelines 2003
• Children with a malignant solid tumor of other sites who are found to have pulmonary nodules of any size can have repeat chest imaging at 3, 6, 12 and 24 months, since in this population, pulmonary nodules ≤5 mm were as likely to be malignant as larger nodules.*
  *Radiology 2006; 239:514-520

• A nodule that grows at a rate consistent with cancer (doubling time 30 to 360 days) should be sampled for biopsy or resected.*
  *Chest 2004;125:1522-1529

• No further imaging is necessary if a nodule has been stable for 2 years.

• A linear or essentially two-dimensional opacity that does not have an approximately spherical component is not a nodule.

• Purely linear or sheet like lung opacities are unlikely to represent neoplasms and do not require follow-up, even when the maximum dimension exceeds 8 mm.*
  *Radiology 2005;237:395-400

• Nodular opacities that are typical of scarring do not require follow-up advanced imaging.*
  *Radiology 2005;237:395-400

• Lesions that have a ground glass opacity component may require longer follow-up time than 2 years to exclude indolent adenocarcinoma.¹ These cases should be sent for Medical Director review.
  o Approximately 34% of nonsolid nodules are due to malignancy.²
  o Although most cancerous nodules are solid, partly solid nodules are most likely to be malignant.²
    - Likelihood of malignancy is 63% for partly solid nodule, 18% for nonsolid nodule, and 7% for solid nodule.³
      ¹Radiology 2005;237:395-400
      ²Radiology 2006;239:34-49
      ³AJR 2002 May;178(5):1053-1057

• PET scan (CPT 78812 or 78815) is appropriate for the characterization of an SPN if the lesion is a distinct parenchymal lung nodule (not an infiltrate, ground glass opacity, or hilar enlargement) measuring greater than or equal to 7 mm on chest CT scan.

• If PET scan is negative, chest CT should be performed at 3, 6, 12, and 24 months.*
  *Radiology 2006; 239:34-49

• Serial PET scans to evaluate lung nodules are not appropriate: if the original PET is positive, biopsy should be performed. If the original PET is negative but subsequent chest CT shows increase in size of the nodule, biopsy should be performed.*
  *Radiology 2006; 239:34-49
CH-12~PLEURAL EFFUSION

- Chest x-ray (including lateral decubitus films) should be performed initially in patients with suspected pleural effusion.
- In patients with large pleural effusions, thoracentesis and analysis of the pleural effusion (cytology, culture, cell count, biochemical studies) to distinguish transudative vs exudative should be performed prior to considering advanced imaging.
- The most common causes of pleural effusions in the United States are congestive heart failure, bacterial pneumonia, malignancy (esp. lung cancer, breast cancer, and lymphoma), and pulmonary emboli.
- If the pleural effusion is transudative and the etiology has been established (e.g. congestive heart failure, cirrhosis, nephrotic syndrome, peritoneal dialysis), advanced imaging of the chest is rarely indicated.
- If the pleural effusion is exudative, chest CT with contrast (CPT 71260) can be performed after as much fluid as possible has been removed by thoracentesis.
  - There is little utility to obtaining chest CT in a patient with a large effusion prior to thoracentesis, since the fluid will obscure the underlying lung parenchyma.
- Reference:

CH-13~PNEUMOTHORAX/HEMOTHORAX

- Advanced imaging of the chest is rarely indicated in the diagnosis or management of pneumothorax.
- If the diagnosis of a small pneumothorax is in doubt, and the presence of a pneumothorax will affect patient treatment decisions, then noncontrast chest CT (CPT 71250) can be performed.
- Patients with trauma significant enough to raise suspicion for hemothorax should be evaluated in the Emergency Department.
- There is no data supporting the use of serial chest CT scans to follow patients with known hemothorax who are asymptomatic or have stable symptoms.
- Chest CT with contrast (CPT 71260) can be performed in patients with suspected complications from hemothorax (e.g. empyema).
- Chest CT with contrast (CPT 71260) can be performed as a preoperative study in patients undergoing surgical evacuation for hemothorax.
MEDIASTINUM

CH-14~MEDIASTINAL LYMPHADENOPATHY

- See PET-17 Generalized Lymphadenopathy and Mediastinal abnormalities in the PET guidelines.
- Mediastinal abnormalities detected on chest x-ray (overread by a radiologist) can be further evaluated by chest CT with contrast (CPT 71260).
- Mediastinal masses identified on screening chest CT scans should be approached conservatively.
  - In the I-ELCAP study which involved almost 30,000 individuals who received screening chest CT scans, 123 (1%) had a mediastinal lesion, but only 4 were cancers.*
    *Imaging Economics 2005 Feb, p.37
- If chest CT shows one or two enlarged lymph nodes in the mediastinum with no other abnormalities in a patient at low risk for malignancy and with no clinical suspicion for malignancy, follow up chest CT (CPT 71260) at 4 to 8 weeks can be performed.
  - Requests for additional CT scans or for PET should be sent for Medical Director review.
- If chest CT shows multiple enlarged lymph nodes in the mediastinum, then either follow up chest CT (CPT 71260) can be performed at 4 to 8 weeks, or lymph node biopsy should be considered to obtain a histologic diagnosis.
- Lymphadenopathy from neoplasms as well as from benign sources of inflammation can result in a positive PET scan. Therefore, the use of PET may not be helpful prior to histologic diagnosis.
- If biopsy can only be accomplished by mediastinoscopy or thoracoscopy/thoracotomy (i.e. percutaneous biopsy, transbronchial biopsy, transbronchial biopsy using endobronchial ultrasound, and endoscopic ultrasound-guided FNA cannot be performed), and a negative PET scan will allow the patient to be observed, then PET can be considered to confirm the likelihood of yielding a pathologic diagnosis and to determine if a more favorable site for biopsy exists.
- PET may be helpful in characterizing anterior mediastinal abnormalities, especially since the thymus gland has a characteristic uptake pattern on most PET scans, and the study may differentiate normal or benign hypertrophic thymus tissue from pathologic mediastinal lesions.

CH-15~MEDIASTINAL MASS

- Chest CT with contrast (CPT 71260) is the imaging study of choice to evaluate mediastinal abnormalities.
- Chest CT with contrast (CPT 71260) is indicated to evaluate a widened mediastinum on a chest x-ray (overread by a radiologist).
• Chest CT (either with contrast [CPT 71260] or without contrast [CPT 71250]) is indicated in patients diagnosed with myasthenia gravis in order to rule out a thymoma. Note: iodinated contrast has been reported to provoke myasthenia crisis.
  o Also see PN-6.1 Neuromuscular Disease in the Peripheral Nerve Disorders guidelines and Thymoma in ONC-9 Other Thoracic Tumors in the Oncology guidelines
• Patients with a suspected substernal goiter should have a neck ultrasound or radionuclide study first to confirm extension of the thyroid to the sternum.
• In patients who present with dysphagia and no history of prior malignancy, barium swallow should be performed initially (see NECK-3 Dysphagia in the Neck guidelines).

CHEST WALL

CH-16~CHEST WALL MASS

• Chest x-ray should be performed initially to rule out intrathoracic pathology, evaluate the presence of calcification in the mass and rule out bony destruction of the chest wall.
• If chest x-ray shows a suspicious intrathoracic abnormality, chest CT with contrast (CPT 71260) can be performed.
• If chest x-ray does not show a suspicious intrathoracic abnormality, but there is a palpable chest lesion that is not clinically consistent with a lipoma or simple skin lesion, then chest MRI without and with contrast (CPT 71552) is the advanced imaging modality of choice. Chest CT with contrast (CPT 71260) is acceptable if MRI cannot be performed.
• If lipoma or simple skin lesion is high on the differential diagnosis list, then evaluation by a surgeon or dermatologist is helpful in determining the need for advanced imaging.

BREAST

CH-17~BREAST ABNORMALITIES

• Mammography, ultrasound, and percutaneous biopsy should be used to screen for breast cancer in the general population.
• Ultrasound should be used to differentiate cysts from solid lesions.

CH-17.1 Breast MRI
• For 2007, the previous breast MRI CPT codes (CPT 76093 and 76094) have been replaced with the CPT codes 77058 (unilateral breast MRI) and 77059 (bilateral breast MRI).
• Computer-aided detection (CAD) for breast MRI:
The new T code 0159T went into effect July 2006 and covers CAD. It is to be used in conjunction with 77058 or 77059.

CAD is intended to improve the specificity of MRI in detecting or measuring malignant tissue and in reducing the time needed to interpret breast MRI images.

Although preliminary studies appear promising, there have been no large, prospective studies showing that CAD definitively improves the sensitivity, specificity, and recall rates of breast MRI.

Therefore, the use of CAD with breast MRI should be considered investigational at this time.

**Indications for MRI of the breast** (can be unilateral [CPT 77058] or bilateral [CPT 77059] per physician request):

- Evaluate or confirm breast implant rupture
- Screening study for patients with dense breasts confirmed by at least one mammogram
- Screening study for patients with BRCA 1 or BRCA 2 mutation
- Screening study for patients at high risk for breast cancer, defined as those with a family history suggestive of hereditary breast cancer:*  
  - Two or more first degree relatives (parent, sibling, child) with breast cancer
  - One first degree relative with breast cancer or ovarian cancer diagnosed before age 50
  - One first degree relative with bilateral breast cancer
  - History of breast cancer in a male relative
  - Ashkenazi Jewish women from families with onset of breast cancer before age 40


- Patients in whom mammography, ultrasound, and clinical findings are inconclusive and no focal finding is apparent (e.g. spontaneous single duct nipple discharge, diffuse microcalcifications, extensive cysts or fibroadenomas, silicone injections, subtle architectural distortions, etc.)*


- Preoperative staging in patients with biopsy-proven breast cancer, particularly infiltrating lobular cancer and tumors with extensive intraductal component
- Assess response to neoadjuvant chemotherapy for locally advanced breast cancer
- Assessment of residual tumor load in patients who have undergone lumpectomy and have close or positive margins for residual disease
- Detect tumor recurrence in the lumpectomy site to differentiate post-operative scar versus tumor recurrence
- Evaluate suspected cancer recurrence in reconstructed breast tissue
- Rule out chest wall recurrence
- Guide biopsy of lesions seen only on MRI
- Evaluate patients who present with axillary metastases suspicious for primary breast cancer with negative physical exam and negative mammogram (MRI detects breast cancer in 90%-100% of cases if tumor is indeed present)

- Breast MRI should not be used for routine surveillance in patients with a history of breast cancer unless the patient has dense breasts or extensive scar tissue that causes the mammogram to be uninterpretable. Breast MRI may be indicated when there is suspicion of recurrence and clinical and/or mammographic and ultrasound findings are inconclusive.

- Currently, there is insufficient data to support the use of breast MRI for breast cancer screening in women with previous chest irradiation, lobular carcinoma in situ, atypical hyperplasia, or mutations other than BRCA.*


- There is insufficient data to support using serial MRI studies to follow patients with mammographic abnormalities. MRI should be able to characterize a lesion as probably benign or as suspicious. The probably benign lesions should undergo repeat mammography in 6 months. The suspicious lesion should be biopsied.

- A solid lesion found on mammogram/ultrasound can be observed and followed with repeat mammogram/ultrasound in 6 months if the lesion is a low-risk, probably benign lesion (includes the following: <15 mm, three or fewer lobulations, more than 50% of the lesion margin appears well-circumscribed in any view).

  - Lesions not fitting all of the above criteria should be considered indeterminate and the patient should be referred for surgical evaluation for biopsy.*


- In the evaluation of BI-RADS category 3 lesions, MRI did not provide additional information (low positive predictive value [33.3%]) and was similar to that of short interval (6-month) mammography follow-up.*

  *Eur J Radiol 2006 Mar;57(3):436-444

- Ultrasound of the involved breast quadrant and axilla is recommended for patients who have BI-RADS 4 or 5 abnormalities. If additional suspicious breast lesions or more extensive malignant breast disease is detected by ultrasound, the extent of disease can be mapped with ultrasound-guided biopsies.*


- A breast mass categorized as BI-RADS 4 or 5 should be biopsied.*

  *ACR Appropriateness Criteria, Nonpalpable Breast Mass, Updated 2005

- The sensitivity of MRI in evaluating mammographically detected suspicious microcalcifications was only 87% with specificity 68%. The sensitivity of MRI for DCIS was 79%.* Therefore, biopsy of these lesions is warranted rather than MRI.

  *AJR 2006 Jun;186(6):1723-1732

- A report from The Agency for Healthcare Research and Quality (AHRQ) Effective Health Care Program concluded that none of the four commonly used noninvasive tests for breast abnormalities (MRI, ultrasound, PET,
scintimammography) are sufficiently accurate to preclude breast biopsy in average risk women with nonpalpable breast lesions. The data were insufficient to estimate the accuracy of these tests in women with only palpable lesions.*


- Also see ONC-10 Breast Cancer in the Oncology guidelines
- **RODEO MRI:** Rotating Delivery of Excitation Off-resonance MRI
  - High resolution 1.5T MRI system designed specifically for the breast. Utilizes a unique fat suppression technology which provides greater detail about a lesion including distance, length/width, area, surface area, and volume without the distraction of fat tissue in the image. This reduces signal from normal ductal tissue and avoids false positive enhancement from benign lesions and dense fibroglandular tissue.
  - There is no unique CPT code for breast MRI scans performed using the RODEO system, and the indications for breast MRI are no different (see Indications for MRI of the Breast above).

**CH-17.2 Nipple Discharge/Galactorrhea**

- Mammogram should be obtained. Ultrasound may be helpful to locate an intraductal nodule or dilated duct.
- The appearance of the fluid generally correlates with the etiology:
  - Yellow, brown, green, or gray fluid is associated with fibrocystic change in most patients.
  - Purulent discharge can result from duct ectasia or partial duct obstruction.
  - Pathologic discharges are usually bloody, blood-containing, or sometimes watery and usually are unilateral and involve a single duct.
  - Physiologic discharges are usually bilateral, involve multiple ducts, are multicolored or milky, sticky, and are stimulated rather than occurring spontaneously.
- Prolactin and TSH levels should be obtained. A prolactinoma typically causes a milky or clear discharge bilaterally.
  - Imaging of the pituitary is not necessary in patients with galactorrhea and normal prolactin levels.
  - See HD-28.1 Prolactinomas in the Head guidelines
- Bloody or, less commonly, watery discharge raises the possibility of cancer (cancer accounts for 8%-15% of bloody nipple discharges), although most hemoccult-positive discharges are due to a benign etiology such as intraductal papilloma (45%), duct ectasia (36%), and infection and other causes (5%-10%).
  - Ductogram and duct excision can be considered
- If mammography and endocrine studies are normal, observation and clinical re-evaluation should be performed. If clinical evaluation at the time of follow-up does not reveal any palpable or visible abnormalities, the patient should return to routine screening interval studies with mammogram or clinical exam.
- Reference:
CH-17.3 Breast Pain

Three classifications:
- Cyclic mastalgia: occurs in premenopausal women and is clearly related to the menstrual cycle.
- Non-cyclic mastalgia: intermittent or continuous pain that is not related to the menstrual cycle. Usually occurs in older women.
- Non-mammary pain: may present with the symptom of breast pain. History and physical exam should help differentiate breast pain from pain radiating from the chest wall or another site.

Evaluation of breast pain:
- Careful history and physical exam
- Pregnancy test is generally the only laboratory study that is needed
- Mammogram/ultrasound

Advanced imaging is not routinely indicated in patients with breast pain and negative evaluation as outlined above.
- The risk of malignancy following a negative examination has been estimated to be only 0.5%.

Reference:

CH-17.4 Newer breast imaging techniques

- Positron-Emission Mammography (PEM) or Naviscan: See CH-27
- Breast MR Spectroscopy: See CH-28

THORACIC VASCULAR DISORDERS (ALPHABETICAL ORDER)

CH-18~PULMONARY ARTERIOVENOUS FISTULA (AVM)

- Definition: abnormal connection between pulmonary arteries and veins.
- Etiology:
  - Acquired: penetrating or blunt trauma to the chest; bronchiectasis
  - Congenital:
    - Most congenital AVM’s are associated with hereditary hemorrhagic telangiectasia (Rendu-Osler-Weber syndrome).
    - 50%-60% of patients with pulmonary AVM are affected by Rendu-Osler-Weber syndrome.
    - Pulmonary AVM’s are usually discovered in third or fourth decade of life.
    - Patients present with dyspnea, hemoptysis, cyanosis (due to left to right shunting), extra-cardiac bruits, and rarely with epistaxis and hematemesis.
    - Multiple AVM’s occur in 30% of cases, and bilateral AVM’s occur in 10% of cases.
Patients at risk for Rendu-Osler-Weber syndrome should also have brain imaging to rule out cerebral AVM (present in 10%-20% of patients with Rendu-Osler-Weber).

- Pulmonary AVM's are most commonly found in the lower lobes.
- Chest x-rays are abnormal in approximately 98% of patients with pulmonary AVM.
  - Chest x-ray usually shows a peripheral, circumscribed, non-calcified lesion connected by blood vessels to the hilum of the lung.
- Chest CT (contrast as requested) and chest MRA (CPT 71555) or chest CTA (CPT 71275) can be obtained for evaluation of possible pulmonary AVM.
- First degree relatives of a patient with a pulmonary AVM (not due to trauma or bronchiectasis) can undergo screening with chest CT (CPT 71260).
- Treatment of pulmonary AVM is by surgery (usually lobectomy) or embolization of the feeding artery using platinum coils or detachable balloons.
- References:
  - Australasian Radiology 2005;49:242-245

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CH-19~PULMONARY EMBOLISM (PE)

- Patients who present with severe findings and dyspnea (including heart rate >100 beats/minute along with systolic BP<90, syncope, new onset right heart failure) should be referred to the Emergency Department for immediate evaluation and treatment.
- The clinical probability of PE is important in making an accurate diagnosis. An often cited point system includes the following:*  
  - Thromb Haemost 2000;83:416-420
  - Clinical signs/symptoms of DVT (at minimum: leg swelling and pain with palpation of the deep veins) (3 points)
  - No alternate diagnosis likely or more likely than pulmonary emboli (3 points)
  - Heart rate >100 beats/minute (1.5 points)
  - Immobilization (>3 days) or surgery in last 4 weeks (1.5 points)
  - Previous history of DVT or PE (1.5 points)
  - Hemoptysis (1 point)
  - Cancer actively treated in last 6 months or receiving palliative treatment (1 point)
  - Low probability <2 points; moderate 2 to 6 points; high>6 points
  - Using the above criteria, only 3% of patients with a low pretest probability had PE versus 63% of those with a high pretest probability.
  - Patients with a score higher than 4 points can undergo chest CT (CPT 71260) or chest CTA (CPT 71275)*  
  - JAMA 2006; 295:172-179
- Pleuritic chest pain can also be a symptom of PE.
- Evaluation of outpatients with suspected pulmonary embolism should include a consideration for clinical probability of PE using the point chart above and results
of a quantitative D-dimer study. If the clinical score is ≤4 and D-dimer is negative, imaging for PE is generally not indicated.*

*JAMA 2006; 295:172-179

- Patients with an abnormal D-dimer test should have chest CT with contrast (PE protocol) (CPT 71260) or chest CTA (CPT 71275).
  - **NOTE:** recent surgery, injury, malignancy, sepsis, diabetes, pregnancy, or other conditions where fibrin products are likely to be present can give a false positive D-dimer result.
- Patients with a normal D-dimer test and low or moderate clinical probability of PE require no advanced imaging, since the negative predictive value approaches 100%.
- In patients with a high clinical probability of PE, chest CT with contrast (PE protocol) (CPT 71260) or chest CTA (CPT 71275) is appropriate.
- Pregnant patients with suspected PE should have D-dimer performed.
  - If there is low clinical pre-test probability for PE and D-dimer is negative, no further work-up is needed.
  - If D-dimer is positive (D-dimer is normally increased in pregnancy and the levels tend to increase as pregnancy goes to term), or if clinical pre-test probability is intermediate or high, lower extremity Doppler study should be performed.
    - If Doppler study is positive, the patient should be treated for PE.
    - If Doppler study is negative, chest CTA (CPT 71275) or chest MRA (CPT 71555) can be performed.
    - If CTA is performed, neonates need to have thyroid functions tested in the first week of life to rule out contrast-induced hypothyroidism.
- Although the use of CTA combined with venous phase imaging (CTA-CTV) for diagnosing PE was found to have a higher sensitivity (90%) than CTA alone (sensitivity 83%),* there is insufficient data at this time to justify routinely performing CTA-CTV in patients with suspected PE.
  - If routine diagnostic testing (including CTA) is inconclusive, and clinical suspicion remains high, then CTA-CTV can be considered.

PULMONARY HYPERTENSION—See PVD-4 Pulmonary Artery Hypertension in the Peripheral Vascular Disease guidelines

<table>
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<tr>
<th>CH-20~SUBCLAVIAN STEAL SYNDROME</th>
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- Definition: reversal of flow in the ipsilateral vertebral artery distal to a stenosis or occlusion of the proximal subclavian or innominate artery. Blood flows up the contralateral vertebral artery to the basilar artery and retrograde down the ipsilateral vertebral artery to supply collateral circulation to the arm on the side of the subclavian lesion.
• Symptoms include vertebral basilar artery insufficiency, vertigo, limb paresis, and paresthesias. Bilateral cortical visual disturbances, ataxia, syncope, and dysarthria occur less frequently.
  o Also see HD-31.1 Vertebrobasilar ischemia in the Head guidelines.
• Patients have a difference in the brachial systolic blood pressure of at least 30 mmHg between the two arms associated with a bruit in the supraclavicular area on the affected side.
• Symptoms of cerebral ischemia may be produced by exercise of the affected arm.
• Carotid duplex study should be the initial imaging study in patients with suspected Subclavian Steal Syndrome.
  o Duplex study will show reversal of flow in the ipsilateral vertebral artery.
• Neck and chest MRA (CPT 70548 and 71555) or CTA (CPT 70498 and 71275) can be performed for diagnosis if the clinical exam and duplex study are indeterminate, or as preoperative studies if they will substitute for invasive angiography.
• Upper extremity MRA (CPT 73225) or CTA (CPT 73206) can be performed if needed to exclude pathology distal to the subclavian artery and if they will substitute for invasive angiography.
• Treatment options include ligation of the ipsilateral vertebral artery, aorta-subclavian artery bypass graft, or subclavian endarterectomy.
• Reference:

CH-21~SUPERIOR VENA CAVA (SVC) SYNDROME

• Chest x-ray and CT of the chest with contrast (CPT 71260) are the initial imaging studies of choice for the evaluation of suspected SVC syndrome.
• MRV (CPT 71555) or CTV (CPT 71275) of the chest may be indicated when stenting of the SVC is being considered.

CH-22~THORACIC AORTIC DISSECTION OR ANEURYSM

• Suspicion of acute dissection should be handled as a medical emergency. Patients typically present with sharp, severe retrosternal or interscapular chest pain with subsequent migration down the back. This occurs in 90% of patient with aortic dissections and usually causes patients to seek medical attention within minutes or hours of onset.
• In patients with aortic dissection, CTA or MRA of the entire aorta (including arch branches) and extending through the femoral arteries is indicated.
• Thoracic aortic aneurysms (TAA) greater than 3 cm can be followed every year by chest CT (contrast as requested), chest MRA (CPT 71555), or chest CTA
(CPT 71275). The normal size of the aortic arch and descending thoracic aorta is 3 cm. The aortic root is normally 3.5 cm.

- TAA greater than 4 cm can be followed every 6 months by chest CT (contrast as requested), chest MRA (CPT 71555), or chest CTA (CPT 71275). Consultation with a thoracic surgeon is helpful in determining the frequency of imaging.
- Patients with TAA should be screened for AAA using the Abdominal Guidelines (see AB-18 Abdominal Aortic Aneurysm).
- Patients with known TAA who present with chest pain or back pain should have chest CT (contrast as requested), chest MRA (CPT 71555), or chest CTA (CPT 71275).

**MISCELLANEOUS**

### CH-23~THORACIC OUTLET SYNDROME (TOS)

- Refers to compression of the subclavian vessels and/or brachial plexus at the thoracic outlet of the chest (the area bounded by the two scalene muscles and the first rib).
- Three types of TOS:
  - **Neurogenic TOS** (80% of TOS):
    - Etiologies include an injury causing tearing and spasm in the scalene muscles which then irritate the adjacent nerves.
    - Symptoms include pain and paresthesias (95% of patients) as well as motor weakness and sometimes atrophy of the hypothenar and interosseous muscles (10% of patients).
    - Generally occurs in patients < age 45.
    - Almost never occurs bilaterally.
    - EMG/NCV studies should be performed initially in the evaluation of patients with suspected neurogenic TOS in order to exclude carpal tunnel syndrome.
    - Also see PN-4 Brachial Plexus in the Peripheral Nerve Disorders guideline.
  - **Arterial TOS** (5% of TOS cases):
    - Symptoms include coldness, weakness, easy fatigability of the arm and hand.
    - Emboli from thrombosis in the proximal subclavian artery may travel to the hand, causing distal ischemia.
    - Generally occurs in patients < age 25.
  - **Venous TOS** (also called “effort thrombosis”) (15% of TOS cases):
    - Due to compression of the subclavian vein between the rib and clavicle.
    - Symptoms include arm edema, discoloration of the arm, distention of the superficial veins of the limb and shoulder, and arm pain.
    - Competitive athletes and individuals who repeatedly use their arms overhead are susceptible.
    - Generally occurs in patients < age 25.
- Neck and chest MRA (CPT 70548 and 71555) or CTA (CPT 70498 and 71275) can be performed to evaluate for arterial or venous TOS.
- Since true TOS is a rare entity and diagnosis is difficult, specialist evaluation by a Vascular surgeon or Thoracic surgeon is helpful in determining the appropriate imaging pathway.
- Reference:

### CH-24~ LIFESCAN

- Life scan or whole body CT or MRI for screening of asymptomatic patients is not a covered benefit of any of the current health plans who have delegated utilization review to MedSolutions.
- The performance of screening CT examinations in healthy patients does not meet any of the current validity criteria for screening studies and there is no clear documentation of benefit versus radiation risk.

### NEWER IMAGING TECHNIQUES

#### CH-25~ VIRTUAL BRONCHOSCOPY

- Virtual bronchoscopy uses multidetector CT with 3D reconstruction (CPT 71260 and 76377) to generate an image of the tracheobronchial tree down to the level of the sixth- to seventh-generation bronchi, and can visualize areas inaccessible to the flexible bronchoscope.
- There is insufficient data currently to generate appropriateness criteria for the use of virtual bronchoscopy, and this procedure should be considered investigational at this time.

#### CH-26~ EM-GUIDED PERIPHERAL BRONCHOSCOPY

- Peripheral bronchoscopy using electromagnetic (EM) guidance on a CT road map is a technology for performing biopsies of peripheral lesions of the lungs. A 3D image of the lungs is generated using CT and transferred to the peripheral bronchoscopy system. The target nodule position is marked by the physician. The next day, the patient is placed on a location board in the procedure room. The location board detects an EM sensor inserted through the working channel of the bronchoscope. When the bronchoscope reaches the target, the working channel is locked in place and the location sensors removed, allowing the physician to biopsy the suspect tissue using the system’s steerable flexible catheter.
• EM-guided bronchoscopy enables biopsies to be performed on regions of the lungs that were formerly very difficult or dangerous to reach.
• Clinical trials are currently underway to evaluate this technique for mediastinal lymph node biopsies.
• Currently this procedure should fall under the classification of CT-guided biopsy, and MedSolutions does not currently preauthorize any imaging studies used for CT-guided biopsy for any of the current health plans who have delegated utilization review to MedSolutions.

CH-27~ POSITRON-EMISSION MAMMOGRAPHY (PEM) OR NAVISCAN

• High-resolution positron-emission mammography (PEM) by Naviscan PET Systems, also referred to as Naviscan or PET mammography, performs high-resolution metabolic imaging of breast cancer using FDG tracer. The PEM detectors are integrated into a conventional mammography system, allowing acquisition of the emission images immediately after the mammogram.
• Requesting providers often code requests for PEM as CPT 78811 or “PET scan of the breast.”
• The spatial resolution of this technique is at the individual duct level (1.5 mm) and allows visualization of intraductal as well as invasive breast cancers. This technique is especially adept at detecting ductal carcinoma in situ.
• Early clinical trials have shown high clinical accuracy in characterizing lesions identified as suspicious on conventional imaging or physical examination, as well as detecting incidental breast cancers not seen on other imaging modalities.
• There is currently insufficient data to generate appropriateness criteria for this modality, and this procedure should be considered investigational at this time.
• References:

CH-28~ BREAST MR SPECTROSCOPY

• Breast MR Spectroscopy identifies the presence of choline, which is a strong indicator of malignancy.
• Preliminary studies show that breast MR Spectroscopy can help reduce breast MRI false positives.
• A clinical study from Memorial Sloan-Kettering Cancer Center in New York showed that imaging suspicious breast lesions with both MRI and MR spectroscopy reduced the need for biopsy by 58% without missing any of the resultant cancers. However, only 56 patients were included in the study.*
  *Radiology 2006 June;239(3):686-692
There is currently insufficient data to generate appropriateness criteria for breast MR Spectroscopy, and this procedure should be considered investigational at this time.
• The American College of Chest Physicians has updated their evidence-based guidelines on cough*
  *Chest 2006;129:1S-23S
• Chronic cough is defined as a cough that lasts at least eight weeks. One percent of the population is affected by chronic cough, and it is the fifth most common reason for consultation with a primary care physician.
• The most common cause of chronic cough is upper airway cough syndrome which usually follows a viral infection of the upper respiratory tract and usually resolves by 8 weeks.
• In 95% of immunocompetent persons, chronic cough is caused by one of the following: cough variant asthma, upper airway cough syndrome, eosinophilic bronchitis, reflux disease, chronic bronchitis from cigarette smoking, bronchiectasis, or medication side effect (especially ACE inhibitors).
• In the remaining 5%, cough is caused by lung cancer, carcinomatosis, sarcoidosis, left ventricular failure, or aspiration.
• A normal chest x-ray in an immunocompetent patient rules out carcinoma, tuberculosis, sarcoidosis, or bronchiectasis in the majority of patients.
• The cause of chronic cough can be determined in 88%-100% of cases with treatment for specific causes yielding a success rate from 84%-98%.*
• Cough variant asthma occurs in almost 50% of all asthma cases, and chronic cough is the only symptom. Methacholine challenge test has a positive predictive value of 88% and negative predictive value of 100%. Cough resolves in 6 to 8 weeks after treatment with beta agonists and steroids.
• Resolution of cough after smoking cessation or stopping medications with cough as a known side effect may take 4 weeks.
• The character of the cough (productive vs dry), timing (night, with meals, etc.) has not been shown to be diagnostically useful.

• Asbestos-related benign and neoplastic diseases of the lung and pleura include pleural effusion, pleural plaques, lung cancer, and malignant mesothelioma.
• Asbestosis is a well-recognized risk factor for developing lung cancer.
• The risk of developing pleural disease (mesothelioma) increases with increasing intensity and duration of exposure.
• Rales and low diffusion capacity on PFT’s support the diagnosis of asbestosis.
• The sensitivity and specificity of chest x-ray and high resolution chest CT (HRCT) in detecting pleural lesions are 64.9% and 98.5%, respectively.* However, out of
2,080 patients exposed to asbestos without chest x-ray signs of asbestosis or pleural changes, 13 (0.6%) developed malignant mesothelioma.*


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**CH-10—SARCOID**  
**Evidence Based Clinical Support**

- Sarcoidosis is a systemic disease of unknown etiology that commonly affects young and middle aged patients with a higher prevalence in women, African Americans, Swedes and Danes.
- Symptoms commonly include dyspnea and dry cough. Half of patients are asymptomatic.
- Clinical signs include fatigue, weight loss, general malaise, and fever. Treatment can include steroids, Methotrexate, and/or cyclophosphamide.
- Ninety percent of patients with sarcoidosis have pulmonary involvement (usually asymptomatic mediastinal lymphadenopathy). 50% of patients present with lymphadenopathy only.
- Bilateral hilar lymphadenopathy is the most common radiologic finding and there is frequently an associated pulmonary infiltrate. Mediastinal adenopathy without hilar involvement is rare and sometimes seen in older patients.
- Lung involvement occurs in 20% of patients and can include multiple small perivascular nodules, miliary nodules, bronchial wall thickening, or ground glass attenuation.
- Sarcoidosis can have spontaneous resolution or progress to fibrosis of lung or other organs.
- Sarcoid can involve the heart, eyes (uveitis or lacrimal glands), parotid glands, liver, spleen, kidney and paraaortic lymph nodes (rare).

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**CH-11—SOLITARY PULMONARY NODULE**  
**Evidence Based Clinical Support**

- A solitary pulmonary nodule (SPN) is a lesion less than 3 cm in diameter that is completely surrounded by pulmonary parenchyma. Lesions larger than 3 cm are called lung masses and are often malignant.
- An estimated 150,000 SPN’s are identified on chest imaging each year.
- The malignancy rate in nodules 1 cm or smaller in the Early Lung Cancer Action Project study was 8%. This study did not include patients with known primary malignancies.*

*Lancet 1999;354:99-105  
In a Mayo Clinic study, three year follow-up detected lung cancer in 1.4% of all lung nodules found. In nodules less than 7 mm in size, less than 1% were malignant.*

*Radiology 2005;235:259-265
In ELCAP II which screened 2,897 subjects, there were zero cancers among 378 subjects whose largest detected nodule was <5mm at baseline. There were 14 cancers among 238 subjects (5.9%) whose largest nodule was 5 mm to 9 mm.*

*Radiology 2004;231:164-168

- Patients with known primary malignancies have a higher rate of malignancy of SPN’s (between 12% and 58% depending on the study).
- New nodules discovered on a 1 year repeat CT more frequently contain cancer and at smaller size than on the baseline CT scan.
- Infectious granulomas constitute about 80% of the benign lesions, and hamartomas 10%.
- A lung nodule that doubles in volume in less than 1 month is uncharacteristic of lung cancer.
- Nodules are considered benign if they resolve, decrease in size, or demonstrate no perceptible growth over 2 years. However, only biopsy with pathological diagnosis can give a definitive diagnosis.
- If a nodule does not grow in volume in 6 months, the risk of malignancy is <10%.*
  *Chest 2004;125:1522-1529
- Malignant nodules have a doubling time of 40 to 360 days. Therefore, CT scan will detect nodule growth in virtually all patients with malignant lesions within 12 months.*
  *Radiology 2003;226:489-493
- The National Lung Screening Trial is an ongoing trial to determine whether there is a mortality benefit from x-ray or CT lung screening.
  - Protocol: If lung nodule <4 mm, annual screening; Lung nodules 4-10 mm, follow up scan at 6, 12, 24 months.
  
- A false-negative PET scan occurred in 27% of cancers that were 1cm or smaller, in 10% of cancers between 1 to 2 cm, and in 12% of cancers >2cm.*
  *AJR 2005;185:126-131
- Current PET technology is likely inaccurate in discriminating nodules smaller than 7 mm.*
  *AJR 2005;185:126-131

CH-15-MEDIASTINAL MASS
Evidence Based Clinical Support

- The most common primary mediastinal tumors are lymphoma, thymus gland neoplasia, thymus cysts/hyperplasia, and endocrine tumors (mainly goiters).
- Other tumors include germ cell tumors such as mature teratomas, seminomas, and nonseminomatous germ cell tumors. Overall, 43% of mediastinal tumors are malignant and 57% benign.
• MRI has an 80%-100% sensitivity for detecting breast cancers, but positive predictive value is only 26%-75%. Therefore, MRI has a high false-positive rate (i.e. low specificity).
• This makes MRI a poor screening device for the general population.
• Dense breasts lower the sensitivity of mammography to detect breast cancer because the cancers are obscured. There is also an independent increased risk (1.8 to 6 times higher) of malignancy in dense breasts.
• In a study of 11,130 women undergoing 27,825 screening exams for breast cancer, mammography was shown to have 98% sensitivity in detecting breast cancer in patients with fatty breasts. The sensitivity decreased to 48% in grade 4 breasts (defined as having tissue that can obscure cancer in >75% of the breast).*
  *Radiology 2002;225:165-175
• In the same study cited above, the sensitivity of ultrasound in detecting breast cancer was 75% in patients with dense breasts. The combined sensitivity of mammography and ultrasound in patients with minimally (grade 2) to extremely dense breasts (grade 4) was 97%. (grade 2: having at least one area of tissue that could obscure cancer; grade 3: having tissue that can obscure cancer in 50% to 75% of the breast).
• In several studies, MRI showed no additional lesions in patients with fatty breasts, but showed additional true positive lesions in 28% of grade 2, 57% of grade 3, and 14% of grade 4 breasts.
• Numerous studies have shown the usefulness of breast MRI in the preoperative staging of breast cancer:
  o MRI detects intraductal spread more accurately than mammography or ultrasound. Intraductal spread is a principal risk factor for local recurrence.
  o In women with biopsy-proven unilateral breast cancer who were considered candidates for breast conservation surgery and had MRI of the ipsilateral breast preoperatively, MRI identified mammographically and clinically occult cancer other than the index lesion in 27% of women.*
    *AJR 2003 April;180(4):901-910
  o Screening MRI of both breasts in patients with newly diagnosed breast cancer demonstrated that 15 out of 182 patients (8.2%) had suspicious lesions in the contralateral breast. 7 patients (3.8%) had malignant results on biopsy (7 true positives, 8 false positives).*
    *Radiology 2003 March;226(3):773-778
  o In 26%-30% of cases, preoperative breast MRI resulted in a change from the planned surgical procedure (e.g. re-excision of the lumpectomy site or planned conservation therapy) to mastectomy, neoadjuvant chemotherapy, biopsy of an additional lesion in the ipsilateral breast or contralateral breast.*
    *AJR 2004 Feb;182:473-480
MRI is especially useful in predicting the extent of disease in patients with invasive lobular cancer (ILC) which accounts for 15% of all breast cancers and is more likely to occur in multiple sites and in both breasts.

MRI is more sensitive in detecting residual cancer in patients who have undergone lumpectomy. Sensitivity 61.2%, specificity 69.7%, positive predictive value 75%, negative predictive value 54.8%.*

Tumor recurrence in the lumpectomy site occurs at a rate of 1%-2% per year. In one study, MRI had 100% sensitivity and 88.8% specificity in detecting recurrent breast cancer in patients who had undergone breast conservation surgery and had completed at least one year of radiation therapy. Dynamic MRI is accurate in differentiating post-treatment changes from recurrent carcinoma.*

MRI can assess the response to neoadjuvant chemotherapy better than physical exam and mammography.

There is still controversy regarding which patients should be screened with MRI only rather than mammography, given the high false positive rate of MRI. Most experts agree that MRI should be used as an adjunct to mammography and ultrasound rather than replacing these studies.

The American Society of Breast Disease statement June 2004 (found at [http://www.guideline.gov](http://www.guideline.gov)): “At this time there are no data on the use of MRI for breast cancer screening of women at high risk based on personal history of breast cancer, previous chest irradiation, lobular carcinoma in situ, atypical hyperplasia, or mutations other than BRCA”.

American Society of Breast Surgeons Consensus Statement on Use of MRI in Breast Oncology December 2004:
MRI should be used as part of breast cancer screening in patients at very high risk for developing breast cancer.

American College of Radiology Guideline for the Performance of MRI of the Breast:
“Breast MRI may be indicated in the surveillance of women with a genetic predisposition to breast cancer. Patients should be referred for surveillance breast MRI only after genetic counseling by experts in hereditary breast cancer.”

**CH-19~PULMONARY EMBOLISM (PE)**

- It is estimated that 600,000 episodes of pulmonary embolism (PE) occur each year in the U.S. resulting in 100,000 to 200,000 deaths.
- The most common signs/symptoms of PE include unexplained dyspnea (>80% of patients with PE), unexplained tachycardia, and pleuritic chest pain either with or without dyspnea. Also, SaO2 <95% in a nonsmoker with no asthma or COPD.
• 25%-65% of patients with suspected PE have a low clinical probability of embolism.

• The clinical probability of PE is important in making an accurate diagnosis. An often cited point system includes the following*

  *Thromb Haemost 2000;83:416-420

  o Clinical signs/symptoms of DVT (at minimum: leg swelling and pain with palpation of the deep veins) (3 points)
  o No alternate diagnosis likely or more likely than pulmonary emboli (3 points)
  o Heart rate >100 beats/minute (1.5 points)
  o Immobilization or surgery in last 4 weeks (1.5 weeks)
  o Previous history of DVT or PE (1.5 points)
  o Hemoptysis (1.0 point)
  o Cancer actively treated in last 6 months (1.0 point)
  o Low probability <2 points; moderate 2-6 points; high>6 points
  o Using the above criteria, only 3% of patients with a low pretest probability had PE versus 63% of those with a high pretest probability.
  o In patients with a low pretest probability and a negative D-dimer study, the 3 month follow up rate of PE was 0%.*

  *Arch Intern Med 2002;162:1631-1635

• D-dimer level has a high sensitivity and low specificity for diagnosing PE.

• A number of conditions in which fibrin products are likely to be present often lead to false positive D-dimer exams including: patients with recent surgery or trauma, malignancy, sepsis, diabetes, GI problems, certain liver and blood disorders, pregnancy, and Alzheimer caregivers. The exam specificity in these situations is approx. 50%.

• Highly sensitive D-dimer assays based on ELISA safely rule out PE in outpatients presenting with low clinical probability. However, low sensitivity assays based on latex agglutination or whole blood agglutination cannot be used in isolation to rule out PE. There is a lack of standardization among assays, which makes them less useful. However, newer automated ELISA assays and quantitative latex-agglutination assays compare favorably with the manual ELISA. The whole blood agglutination assay is a qualitative study.

• 90% of CT angiograms obtained in one hospital were negative for PE. A study was then performed with 419 patients evaluated by both quantitative D-dimer and pulmonary CTA.

  Conclusion: If the D-dimer was <1.0 micrograms/ml, no CTA should be performed unless there is a high clinical suspicion. A 3 month follow up of all patients with D-dimer <1.0 micrograms/ml showed that none of the 247 patients had a subsequent acute PE. Therefore, if a D-dimer <1.0 micrograms/ml had been used, 60% of the CTA’s could have been avoided. If a positive D-dimer threshold is defined as ≥1.0 micrograms/ml, the sensitivity and negative predictive value are 100%, specificity is 62% and positive predictive value is 17%.*

  *AJR 2004;182:1377-1381
• CT pulmonary angiography (which is largely equivalent to contrasted chest CT scan with PE protocol—120cc of i.v. contrast and slice thicknesses of 1.25 mm) has a sensitivity of 60%-100% and specificity of 78%-100% in diagnosing PE.*
  *AJR 2004;182:499-504
• CT scan also showed additional potentially significant findings in 30%-76% of patients that provided alternative diagnoses to PE. 47% of these findings were not suspected on chest x-ray.*
  *AJR 2004;182:499-504
• Most clinical studies predict patients with a high probability of PE based on physical exam, chest x-ray, EKG, and ABG. However, these studies are not readily available in physicians’ offices.
• The most cost-effective strategies for PE diagnosis are D-dimer level (provided there are no risk factors for a false positive exam) followed by spiral CT if the D-dimer is positive, or leg ultrasound followed by spiral CT if the ultrasound is negative.* However, this study estimated that as the sensitivity of CT scan approached 100% and the specificity approached 96%, the most cost-effective strategy became the spiral CT alone. With the advent of multidetector CT scanners, these high sensitivity and specificity levels are being realized.
  *Chest 2001;119:1791-1800
• Although V/Q scan is an accurate study in patients in whom there is a clinical suspicion for PE, a normal chest x-ray, and no known chronic pulmonary disease, this study is difficult to obtain quickly, does not provide a substantial cost savings, and does not diagnose other pulmonary pathology if the diagnosis of PE is negative. Thus, many of the patients with low probability V/Q scan would potentially go on to have a chest CT to rule out other pathology.
• The Prospective Investigation of Pulmonary Embolism Diagnosis II trial (PIOPED II) was a prospective, multicenter investigation of the accuracy of CTA alone combined with venous-phase imaging (CTA-CTV) for the diagnosis of acute PE.
  o Results: Among 824 patients, sensitivity of CTA was 83%, specificity was 96%. Positive predictive values were 96% with a concordantly high or low probability on clinical assessment, and 92% with an intermediate probability on clinical assessment. Sensitivity of CTA-CTV for PE was 90%, specificity 95%. Both CTA and CTA-CTV were nondiagnostic with a discordant clinical probability.*

CH-21~SUPERIOR VENA CAVA (SVC) SYNDROME
Evidence Based Clinical Support

• SVC syndrome is caused by intrinsic or extrinsic obstruction of the SVC and can be acute or subacute.
• Symptoms of SVC syndrome include head fullness, dyspnea/orthopnea, headache, and dizziness.
• Signs include head swelling, enlarged collateral vessels on the chest wall, facial cyanosis, and arm swelling.
- Malignancies are the etiology in 80%-85% of cases, and lung cancer is the most common cause.
- 15%-20% of cases are due to nonmalignant causes such as mediastinal fibrosis, sclerosing mediastinitis, indwelling central venous catheter, or transvenous pacemaker electrodes.

**CH-22~THORACIC AORTIC DISSECTION OR ANEURYSM**

**Evidence Based Clinical Support**

- For confirming or ruling out thoracic aortic dissection, transesophageal echo (TEE), CT, and MRI have equally reliable diagnostic values.*
  *Arch Intern Med 2006;166(13):1350-1356
- Thoracic aortic aneurysms (TAA) occur in the ascending aorta (25%), aortic arch (25%) or descending aorta (50%).
- Risk factors include connective tissue disorders (e.g. Marfan’s or Ehlers-Danlos), atherosclerosis, previous aortic dissection, prolonged hypertension, and trauma.
- Mean age is 65 years old.
- Most patients are asymptomatic until the aneurysm begins to leak or expand. Chest or back pain may indicate acute expansion or leakage.
- 25% of patients with TAA also have AAA.
- The normal diameter of the aorta is 2.5 cm to 3 cm.
- The normal diameter of the aortic root is 3.5 cm.
- The usual size of a TAA is 4 to 5 cm.
- Risk of rupture at 5 years is 0% for TAA less than 4 cm, 16% for diameter 4-5.9 cm, and 31% for aneurysms greater than 6 cm.
- The critical point for rupture or dissection of an ascending TAA is 6 cm (31% risk) and for a descending TAA, 7 cm (43% risk).
- Surgery is usually recommended if the aneurysm is 5.5 cm in the ascending aorta or 6.5 cm in the descending aorta.*
- Surgery is recommended earlier (when aneurysm is 5 cm) in Marfan’s patients.
- The median size of an ascending aortic or arch aneurysm at rupture or dissection is 5.9 cm.
- All symptomatic TAA’s require surgery or intervention regardless of size.
CH-1~General Guidelines

CH-2~Chronic Cough

CH-3~Chronic Non-Cardiac Chest Pain

CH-4~Hemoptysis

CH-7~Multiple Pulmonary Nodules

CH-9~Positive PPD or Tuberculosis (TB)

**CH-10~Sarcoid**

**CH-11~Solitary Pulmonary Nodule (SPN)**
- *National Lung Screening Trial*
- *American College of Chest Physicians guidelines 2003*
- *International Symposium on Multidetector-Row CT*, San Francisco, 2005

**CH-12~Pleural Effusion**

**CH-14~Mediastinal Lymphadenopathy**

**CH-17~Breast Abnormalities**


CH-18~Pulmonary Arteriovenous Fistula (AVM)


CH-19~Pulmonary Embolism (PE)


CH-20~Subclavian Steal Syndrome


CH-23~Thoracic Outlet Syndrome (TOS)


CH-27~Positron-Emission Mammography (PEM) or Naviscan

CH-28~Breast MR Spectroscopy

CH-2~Chronic Cough, Evidence Based Clinical Support

CH-5~Asbestos Exposure, Evidence Based Clinical Support

CH-11~Solitary Pulmonary Nodule, Evidence Based Clinical Support

CH-17~Breast Abnormalities, Evidence Based Clinical Support


CH-19~Pulmonary Embolism, Evidence Based Clinical Support


Abcarian PW, Sweet JD, Watabe JT, Yoon HC. Role of a quantitative D-dimer assay in determining the need for CT angiography of acute pulmonary embolism. AJR 2004;182:1377-1381.

Kavanagh EC, O'Hare A, Hargaden G, Murray JG. Risk of pulmonary embolism after negative MDCT pulmonary angiography findings. AJR 2004;182:499-504.


CH-22~Thoracic Aortic Dissection or Aneurysm, Evidence Based Clinical Support
