

CHEST IMAGING GUIDELINES
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MedSolutions, Inc. Clinical Decision Support Tool
for Advanced Diagnostic Imaging

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 11/30/08

ABBREVIATIONS for CHEST GUIDELINES

AAA	abdominal aortic aneurysm
ACE	angiotensin-converting enzyme
AIDS	acquired immune deficiency syndrome
AVM	arteriovenous malformation
BI-RADS	Breast Imaging Reporting and Database System
BP	blood pressure
BRCA	tumor suppressor gene
CAD	computer-aided detection
COPD	chronic obstructive pulmonary disease
CT	computed tomography
CTA	computed tomography angiography
CTV	computed tomography venography
DCIS	ductal carcinoma in situ
DVT	deep venous thrombosis
ECG	electrocardiogram
EM	electromagnetic
EMG	electromyogram
FDA	Food and Drug Administration
FDG	fluorodeoxyglucose
FNA	fine needle aspiration
GERD	gastroesophageal reflux disease
GI	gastrointestinal
HRCT	high resolution computed tomography
IPF	idiopathic pulmonary fibrosis
LCIS	lobular carcinoma in situ
LFTP	localized fibrous tumor of the pleura
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

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CHEST IMAGING GUIDELINES

CH-1~GENERAL GUIDELINES

- A recent complete history and physical examination should be performed prior to considering advanced imaging of the chest.
- 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.
- Chest CT is indicated in the majority of cases to evaluate pathology in the chest when advanced imaging is appropriate. Indications for chest MRI are much less common.
 - MRI chest is appropriate when there are concerns about CT contrast as in renal insufficiency or contrast allergy.
 - MRI chest may be appropriate in order to clarify equivocal findings on previous imaging studies. Appropriateness will need to be determined on a case by case basis.

ANATOMIC GUIDELINES

CH-2~SUPRACLAVICULAR REGION

- Also see NECK-1 General Guidelines in the Neck guidelines
 - A complete history and physical examination, including palpation of the supraclavicular region, should be performed initially in the evaluation of a suspected supraclavicular mass or abnormality.
 - The sensitivity of palpation, CT, and ultrasound for detecting supraclavicular metastases were 33%, 83%, and 100%, respectively.¹
 - In one study, lymph nodes had to have a diameter of 22.3 mm or greater to be palpated in 50% of cases.¹
- ¹ *Radiology 2004;232:75-80*
- Given the high false positive and false negative results of palpation alone, ultrasound should be performed in order to confirm the presence of enlarged lymph nodes or other mass prior to considering advanced imaging.
 - Ultrasound has the added advantage of allowing ultrasound-guided fine

needle aspiration (FNA) for histologic diagnosis of a suspicious lymph node or mass.*

**Radiology* 2004;232:75-80

- If ultrasound is indeterminate, soft tissue neck CT with contrast (CPT 70491) or chest CT with contrast (CPT 71260) can be performed. Either study images the supraclavicular region equally well if done correctly.*
*Eliot Fishman. "Ask the Fish" e-mail communication. Johns Hopkins Medicine, <http://www.ctisus.com>. Accessed July 2, 2007
- Definitive diagnosis of a supraclavicular abnormality requires biopsy (FNA or open biopsy).

SYMPTOM-BASED GUIDELINES (ALPHABETICAL ORDER)

CH-3~CHRONIC COUGH

- Chronic cough is defined as a cough that lasts at least eight weeks.
- 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 (other than improvement) 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.

¹*Can Fam Physician* 2002 Aug;48:1311-1316

²*Chest* 2006;129:1S-23S

CH-4~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. *European J of Emergency Medicine 1997;4:72-80*
- Common etiologies include musculoskeletal, esophageal (e.g. reflux disease), and panic disorder.
 - 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**: Hiebert CA. Clinical Features.In Pearson FG, Deslauriers J, Ginsberg RJ, et al. (Eds.). *Thoracic Surgery*. New York, Churchill Livingstone, Inc., 1995, pp.68-69
- 25%-50% of chest pain presentations in ambulatory settings may be musculoskeletal.
 - Musculoskeletal pain is a diagnosis of exclusion.
 - Some patients with Thoracic Outlet Syndrome can present with anterior chest wall or parascapular pain. *
 - Also see CH- 32 Thoracic Outlet Syndrome
**Mackinnon S, Patterson GA, Urschel HC, Jr. Thoracic Outlet Syndromes.*In Pearson FG, Deslauriers J, Ginsberg RJ, et. al. (Eds.). *Thoracic Surgery*. New York, Churchill Livingstone, Inc., 1995, p.1221
- 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.

CH-5~HEMOPTYSIS

- The patient's history should help determine the amount of blood and differentiate between hemoptysis, pseudohemoptysis, and hematemesis.
- Most common etiologies for hemoptysis:
 - Adults: Bronchitis, bronchogenic carcinoma, pneumonia
- 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

BRONCHIAL TREE

CH-6~BRONCHIECTASIS

- Bronchiectasis is defined as localized, irreversible dilatation of bronchi >2 mm in diameter. Patients have excessive mucus production.
- Bronchiectasis is associated with a wide range of disorders, including cystic fibrosis, AIDS, alpha1-antitrypsin deficiency, rheumatoid arthritis, obstruction of the bronchi, and necrotizing bacterial infections.
- Chest x-ray and PFT's should be performed initially in patients with known or suspected bronchiectasis, but may be normal.
- High resolution chest CT scan (HRCT) without contrast (CPT 71250) is the advanced imaging study of choice to confirm the diagnosis of bronchiectasis and/or evaluate patients with known bronchiectasis who have worsening symptoms or worsening PFT's.
- There is no published data to support performing routine follow-up advanced imaging of the chest in the absence of new or worsening symptoms or worsening lung function studies in patients with known bronchiectasis.
- MRI is not used to evaluate patients with bronchiectasis.
- Patients with bronchiectasis who present with hemoptysis should undergo chest CTA (CPT 71275).
- **Reference:**
 - Hassan I. *Bronchiectasis*. eMedicine, Dec 8, 2006. <http://www.emedicine.com>. Accessed October 31, 2007

LUNG PARENCHYMA (ALPHABETICAL ORDER)

CH-7~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-8~CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

- COPD includes a spectrum of diseases: asthmatic bronchitis, chronic bronchitis, and emphysema.
- Typical presenting symptoms include cough, excess mucus, dyspnea on exertion, and/or wheezing.
- Diagnosis is best made by performing spirometry (PFT's).¹
 - In addition, chest x-ray and arterial blood gas measurement should be performed.¹

¹*Chronic Obstructive Pulmonary Disease (COPD).*
Pulmonology Channel, June 1, 2000,
<http://www.pulmonologychannel.com>.
Accessed October 31, 2007
 - Chest CT without contrast (CPT 71250), high resolution chest CT without contrast (CPT 71250), or chest CT with contrast (CPT 71260) can be performed if emphysema is suspected and the above initial studies are indeterminate.
 - Chest MRI is generally not indicated in the evaluation of COPD.
 - Patients with a family history of emphysema or chronic bronchitis should have a spirometry test as part of their initial evaluation.*

**Making the Diagnosis of COPD.* National Lung Health Education Program,
<http://www.nlhep.org>. Accessed October 31, 2007
- An exacerbation of COPD is characterized by a change in baseline dyspnea, cough, and/or sputum that is acute in onset and beyond normal day-to-day variations.
 - Advanced imaging of the chest is not typically indicated in the evaluation of COPD exacerbation.
 - Evaluation of COPD exacerbation should include arterial blood gas measurement, chest x-ray, ECG, sputum culture, and blood work to measure electrolytes and complete blood count.*

**Buist AS, Rodriguez-Roisin R, Anzueto A, et al. Global Initiative for Chronic Obstructive Lung Disease: Pocket guide to COPD diagnosis, management, and prevention.* National Institutes of Health, National

Heart, Lung, and Blood Institute; April 2001 (updated 2007).
<http://www.goldcopd.com>. Accessed October 13, 2008

- There is no published data to support performing routine follow-up advanced imaging of the chest in patients with COPD.
- **Lung Volume Reduction Surgery**
 - Chest CT either without contrast (CPT 71250) or with contrast (CPT 71260) can be performed for preoperative evaluation in patients who are being considered for lung volume reduction surgery.*
**Radiology 1999;212:1-3*
 - There is insufficient data to support obtaining routine follow-up advanced imaging of the chest in patients who have had lung volume reduction surgery.
 - New or worsening signs/symptoms in patients who have had lung volume reduction surgery should be evaluated with chest x-ray prior to considering advanced imaging of the chest

CH-9~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.
- HRCT can be performed in patients with known interstitial pneumonia, idiopathic pulmonary fibrosis, or other interstitial lung disease if there are new or worsening pulmonary symptoms or worsening PFT's.
- HRCT can be performed once a year in patients with known idiopathic pulmonary fibrosis (IPF) who are asymptomatic or have stable symptoms and PFT's, if imaging results showing progression or regression of disease will change patient management.*

**Proceedings of the American Thoracic Society 2006;3:307-314*

CH-10~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-14 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-11~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-12~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
- 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.
 - 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-13~SARCOID

- Also see ONC-28.5 Sarcoidosis in the Oncology guidelines and HD-33.3 Sarcoidosis in the Head 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.*
**Rev Mal Respir 2003;20 (2 pt 1):207-213*
- 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-14~SOLITARY PULMONARY NODULE (SPN)

- A nodule is any pulmonary or pleural lesion represented in a radiograph by a sharply defined, discrete, nearly circular opacity 2-30 mm in diameter.
 - 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 (0.8 cm).*
**Radiology 2005;237:395-400*
 - Nodular opacities and/or thickening that are typical of scarring do not require follow-up advanced imaging and do not require imaging with contrast for further delineation.*
**Radiology 2005;237:395-400*
- A pulmonary nodule seen on an imaging study other than a dedicated chest CT (e.g. nodule seen on abdominal CT, spine MRI, chest or coronary artery CTA, etc.) can be further evaluated with one chest CT without contrast (CPT 71250) or with contrast (CPT 71260).
 - Follow-up imaging should proceed based upon the following guidelines in CH-14 Solitary pulmonary nodule.
- 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

- Nodules less than 5 mm (0.5 cm): repeat CT scan at 1 year
- Nodules 5 to 6 mm (0.5 to 0.6 cm): repeat CT scan at 6, 12, 24 months
- Nodules >7 mm (0.7 cm): repeat CT scan at 3, 6, 12, 24 months

¹*Radiology 2004;231:164-168*

²*Radiology 2005;237:395-400*

³*National Lung Screening Trial*

⁴*American College of Chest Physicians guidelines 2003*

⁵*International Symposium on Multidetector-Row CT, San Francisco, 2005*

- No further imaging is necessary if a nodule has been stable for 2 years.
- 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.
 - Ground glass lesions that are greater than 2cm should be resected.²
 - Although most cancerous nodules are solid, partly solid nodules are most likely to be malignant (usually bronchioalveolar cancer).³
 - Likelihood of malignancy is 63% for partly solid nodule, 18% for nonsolid nodule, and 7% for solid nodule.⁴
 - ¹*Radiology 2005;237:395-400*
 - ²*Siegelman SS. Hot Topics in Chest CT. Presented at: 24th Annual Computed Body Tomography: The Cutting Edge, February 14-17, 2008, Orlando, FL.*
 - ³*Radiology 2006;239:34-49*
 - ⁴*AJR 2002 May;178(5):1053-1057*
- Patients with a personal history of malignancy that would reasonably metastasize to the lungs or mediastinum who are found to have pulmonary nodules of any size can have repeat chest imaging at 3, 6, 12, and 24 months.
- 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*
- 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 (0.7 cm) on chest CT scan.
 - **NOTE:** Certain payers consider PET scan investigational for evaluating pulmonary nodules ≤1 cm or lung masses >4 cm. Their coverage policies will take precedence over MedSolutions' guidelines. Prior authorization does not guarantee payment of the study.
 - **Reference:**
 - *J Nucl Med 2008;49:179-185*
- 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*

PLEURA (ALPHABETICAL ORDER)

CH-15~PLEURAL-BASED NODULES and OTHER ABNORMALITIES

- An indeterminate pleural-based nodule or lesion seen on an imaging study other than a dedicated chest CT (e.g. nodule or lesion seen on chest x-ray overread by a radiologist, abdominal CT, spine MRI, chest or coronary artery CTA, etc.) can be further evaluated with one chest CT without contrast (CPT 71250) or with contrast (CPT 71260).
 - If CT scan shows findings consistent with a benign process (round atelectasis, scarring, apical thickening, etc.), no follow-up advanced imaging is indicated.
 - “Round atelectasis”: twisting or folding of the lung which becomes adherent to the adjacent pleura.
 - If the abnormality cannot be read as benign, repeat chest CT (CPT 71250 or 71260) can be performed using the guidelines for SPN:
 - Nodules less than 5 mm (0.5 cm): repeat CT scan at 1 year
 - Nodules 5 to 6 mm (0.5 to 0.6 cm): repeat CT scan at 6, 12, 24 months
 - Nodules ≥ 7 mm (0.7 cm): repeat CT scan at 3, 6, 12, 24 months
- Nodular opacities and/or thickening that are typical of scarring do not require follow-up advanced imaging and do not require imaging with contrast for further delineation.*

**Radiology 2005;237:395-400*
- There is no evidence-based data to support performing PET scan in patients with pleural-based nodules or lesions.

CH-16~PLEURAL THICKENING

- Pleural thickening may be the residual effect of inflammatory processes, including pneumonia with parapneumonic effusion, empyema, hemothorax, asbestos exposure, talc exposure, rheumatoid lung disease, radiation therapy, and drugs.
- May occur due to infiltration of the pleura by malignant tumors such as mesothelioma or metastatic adenocarcinoma.
- May occur due to localized fibrous tumor of the pleura (LFTP)
 - LFTP's exist in benign and malignant forms with the benign form occurring seven times more frequently than the malignant form.
 - Etiology of LFTP's is unknown.
 - If LFTP is suspected due to a chest x-ray abnormality, chest CT with contrast (CPT 71260) or chest MRI without and with contrast (CPT 71552) can be performed.
 - Histologic examination is needed for a definitive diagnosis.
 - Treatment is resection.
 - **Reference:**
 - Meziane M. Localized Fibrous Tumor of the Pleura. eMedicine, August 2, 2007, <http://www.emedicine.com>. Accessed November 1, 2007
- Localized pleural thickening often occurs at the lung apices with increasing age,

forming a pleural cap. Unless the patient is at high risk for malignancy or tuberculosis, no advanced imaging is indicated.

- Patients with suspected pleural thickening seen on chest x-ray (overread by a radiologist) can have chest CT with contrast (CPT 71260) or high resolution chest CT without contrast (CPT 71250) for further evaluation.
 - If the chest CT shows pleural plaques or findings consistent with asbestosis, follow-up imaging guidelines described in CH-7 Asbestos exposure should be followed.
 - If CT scan shows findings consistent with a benign process (round atelectasis, scarring, apical thickening, etc.), no follow-up advanced imaging is indicated.
 - If there is concern for malignancy or a definitive diagnosis is desired, then pleural biopsy should be performed by thoracoscopy or open biopsy.
 - Serial advanced imaging of pleural thickening is not indicated unless patients have a known diagnosis such as asbestos-related disease, silicosis, or tuberculosis that is causing progressive pleural changes.

DISORDERS INVOLVING THE PLEURAL SPACE (ALPHABETICAL ORDER)

CH-17~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.
 - Pleural biopsy is indicated for unexplained exudative effusions, most of which are found to result from malignancy or tuberculosis.
- **References:**
 - Rubins J. *Pleural Effusion*. eMedicine, Feb 15, 2007, <http://www.emedicine.com>. Accessed October 31, 2007
 - Sriram PS, Antony VB, Holm KA. *Pleural Effusions: How to confirm the cause and manage effectively*. Consultant, Sept 15, 2007, <http://www.consultantlive.com>. Accessed November 1, 2007

- Rusch VW. *Pleural Effusion: benign and malignant*. In Pearson FG, Deslauriers J, Ginsberg RJ, et. al. (Eds.). *Thoracic Surgery*. New York, Churchill Livingstone, Inc., 1995, pp.1003-1008

CH-18~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.
- There is no data supporting the use of serial chest CT scans to follow patients with known pneumothorax who are asymptomatic or have stable symptoms.
- Patients with trauma significant enough to raise suspicion for hemothorax should be evaluated in the Emergency Department.
- Chest CT with contrast (CPT 71260) can be performed as a preoperative study in patients undergoing pleurodesis or other invasive procedure for pneumothorax.
- 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-19~MEDIASTINAL LYMPHADENOPATHY

- See PET-17.3 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 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, one 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.
 - Lymph node biopsy should be considered in cases of persistent lymphadenopathy in order 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-20~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.
 - 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 AND RIBS (ALPHABETICAL ORDER)

CH-21~CHEST TRAUMA

- **Rib Fracture**
 - A complete history and physical examination, including palpation of the chest, should be performed initially in patients with chest trauma and suspected rib fracture.
 - A recent chest x-ray, including erect posteroanterior (PA) and oblique views should be performed prior to considering advanced imaging.
 - Suspicion of an occult rib fracture is not an indication for chest CT.
 - If the patient remains symptomatic, repeat plain x-rays of the ribs should be

- obtained. These may show signs of early healing of a rib fracture.
- If the diagnosis is still uncertain, bone scan is indicated. A delay of several days should be allowed after an acute trauma to increase the sensitivity of bone scan to detect rib fracture(s).
- Patients with multiple new rib fractures can undergo chest CT without contrast (CPT 71250) or with contrast (CPT 71260) to rule out any associated intrathoracic pathology.
- Routine follow-up advanced imaging of rib fractures is not indicated.
- **Fracture of the Sternum**
 - Injury to the sternum or suspected fracture of the sternum should be evaluated initially with lateral and oblique x-rays centered on the sternum.
 - If the diagnosis is still uncertain, chest CT without (CPT 71250) or with contrast (CPT 71260) can be performed.
 - If a new sternal fracture is found, cardiac evaluation with ECG, cardiac enzymes, and rhythm monitoring should be performed to rule out significant arrhythmia due to blunt cardiac trauma.
 - Routine follow-up advanced imaging of sternal fractures is not indicated.
- **Reference:**
 - Nadalo LA and Jones K. Rib, Fractures. eMedicine, May 16, 2003. <http://www.emedicine.com>. Accessed November 1, 2007
- **Imaging of the Abdomen and Pelvis in Patients with Chest Trauma**
 - If there was no significant trauma involving the abdomen or pelvis, and a careful physical examination, laboratory studies, and urinalysis do not raise suspicion for abdominal or pelvic pathology, no advanced imaging of the abdomen or pelvis is indicated.

CH-22~COSTOCHONDRITIS

- Inflammatory process of the costochondral or costosternal joints that causes localized pain and tenderness. More than one site is affected in 90% of cases.
- The 2nd to 5th costochondral junctions are most commonly involved.
- Pain is usually described as follows:
 - Worse with movement of the trunk, deep breath, and/or exertion
 - Decreases with change of position
 - Sharp, nagging, aching, or pressure-like
 - Usually localized but may radiate extensively
 - May wax and wane
- Physical examination with palpation of the chest should be performed initially.
 - Pain with palpation of the affected costochondral joints is a constant finding in costochondritis.
 - The diagnosis should be reconsidered if there is absence of local tenderness to palpation.
- Chest x-ray should be the initial imaging study to rule out other pathology.
- Bone scan is sometimes performed to confirm the diagnosis of costochondritis or if infection of the costochondral joint is suspected.
- If signs, symptoms, and physical examination are consistent with costochondritis,

advanced imaging is not indicated.

- If pain persists despite treatment with rest and anti-inflammatory medication, work-up should proceed as described in CH-4 Chronic Non-cardiac Chest Pain.
- **Reference:**
 - Flowers LK and Wippermann BD. *Costochondritis*. eMedicine, August 9, 2007. <http://www.emedicine.com>. Accessed October 31, 2007

CH-23~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.
 - Lipomas are one of the most common chest wall lesions.
 - The preferred imaging technique for evaluating lipomas depends on the clinical question.
 - If the study is being performed to diagnose a mass as a lipoma, noncontrast chest CT (CPT 71250) is sufficient and enables specific recognition of fat and is faster than MRI.
 - If surgical removal of the lesion is planned and the lesion is large, infiltrating, or near important neurovascular structures, chest MRI (contrast as requested) can be performed.
 - **Reference:**
 - *RadioGraphics* 1994 May;14(3):571-595

CH-24~PECTUS EXCAVATUM and PECTUS CARINATUM

- See also PACCH-12 in the Pediatric Chest guidelines
- Initial evaluation of patients with suspected or known pectus excavatum (ribs and sternum grow abnormally producing a concave or caved-in appearance in the anterior chest wall), pectus carinatum (anterior protrusion of the chest wall), or other deformities of the chest wall or sternum should include a complete history and physical examination and plain chest x-rays.
- Chest CT without contrast (CPT 71250) can be performed in selected cases of asymmetric pectus excavatum if significant cardiac displacement and rotation is suspected, or for preoperative planning.
- ECG and echocardiography should be performed initially in patients with cardiac

symptoms or evidence of abnormalities of cardiac function.

- Recent chest x-ray and PFT's should be performed initially in patients with known pectus who present with increasing shortness of breath.
- **Reference:**
 - Hebra A. *Pectus Excavatum*. eMedicine, August 8, 2007. <http://www.emedicine.com>. Accessed November 2, 2007

BREAST

CH-25~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-25.1 Breast MRI

- **Computer-aided detection (CAD) for breast MRI:**
 - Certain payers consider computer-aided detection (CAD) for breast MRI investigational, and their coverage policies will take precedence over MedSolutions' guidelines. Prior authorization does not guarantee payment of the study.
 - The Category III code 0159T went into effect July 2006 and covers CAD. It is to be used in conjunction with 77058 (unilateral breast MRI) or 77059 (bilateral breast MRI).
 - It is not appropriate to report 3D rendering (CPT 76376 or CPT 76377) when requesting breast MRI with CAD, since 3D rendering is included in the CPT code for CAD (CPT 0159T).
 - The American College of Radiology advises that CPT 0159T be used to report any type of MRI CAD rather than the 3D rendering codes, which were used prior to 2006.
 - 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
 - Patients with silicone breast implants can have a surveillance breast MRI at 1, 2, 4, 6, 8, and 10 years after the silicone implant(s) were placed to rule out leakage per the current FDA recommendations.
 - If leakage is detected on MRI, the implant(s) should be removed.
 - Once the implant(s) have been removed, no further surveillance MRI of

the affected breast(s) is indicated.

- **NOTE:** Certain payers do not include breast implants in their coverage policies if the breast implants were placed as part of purely cosmetic surgery. Thus, surveillance MRI scans in these patients would also not be included in the coverage policy. Their coverage policies will take precedence over MedSolutions' guidelines. Prior authorization does not guarantee payment of the study.
- Annual screening study starting at age 30 for patients with BRCA 1 or BRCA 2 mutation.
- Annual screening study for patients with a first degree relative with BRCA mutation (if patient has not been tested).
 - Screening studies for the patient should start 10 years before the relative with BRCA was diagnosed with cancer.
 - If the relative with BRCA was not diagnosed with cancer, then screening studies for the patient should start at age 30.
- Annual screening study beginning at age 30 for high risk patients, defined as 20%-25% or greater lifetime risk of developing breast cancer:
 - Clinical lifetime risk estimated at greater than 20% using clinical risk estimator such as the Gail, Claus, or BRCAPRO models
 - Two or more first degree relatives (parent, sibling, child) with breast or ovarian cancer
 - One first degree relative with breast cancer or ovarian cancer diagnosed before age 50
 - One first degree relative with bilateral breast cancer or both breast and ovarian cancer
 - History of breast cancer in a male relative
 - Ashkenazi Jewish women from families with onset of breast cancer before age 40
 - Li-Fraumeni Syndrome and first degree relatives
 - Cowdan and Bannayan-Riley-Ruvaloabe Syndromes and first degree relatives
 - Women with history of radiation to the chest between ages 10 and 30. (If history of Hodgkin's Disease, breast screening should start 8 to 10 years post-therapy, or at age 40, whichever comes first)
 - The American Cancer Society, the Society of Breast Imaging, and the National Comprehensive Cancer Network (NCCN) Clinical Guidelines in Oncology recommend that breast MRI be performed in facilities that have the capability to perform MRI-guided breast biopsies.
 - **References:**
 - *CA Cancer J Clin* 2007;57:75-89
 - *Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease*. Nov 2005 and *Genetic Screening for Breast Cancer*. <http://www.icsi.org>. Accessed October 13, 2008
 - *Invasive Breast Cancer. NCCN Practice Guidelines in Oncology v.2.2008*
 - *Hodgkin's Disease/Lymphoma. NCCN Practice Guidelines in Oncology v.2.2009*

- Patients in whom mammography, ultrasound, and clinical findings are inconclusive or conflicting.*
 - **J Am Coll Surg* 2005 Oct;201(4):586-597
- Preoperative evaluation in patients with newly-diagnosed, biopsy-proven breast cancer (including DCIS, LCIS, and papillary carcinoma), particularly infiltrating lobular cancer and tumors with extensive intraductal component
 - A recent study found that breast MRI detected cancers in the contralateral breast that were not detected by clinical exam or mammogram in 30 of 969 women*
 **N Engl J Med* 2007 March;356(13):1295-1303
- Assess response to neoadjuvant chemotherapy for locally advanced breast cancer
 - If no pre-chemotherapy breast MRI was performed, then a post-chemotherapy MRI should not be performed, as the findings will be too confusing.*
 *Huff JG. *Clinical Applications of Breast MRI: Current Indications and Examples*. Presented at: *Identification and Management of Breast Cancer*, October 6, 2007; Nashville, TN
- Assessment of residual tumor load in patients who have undergone lumpectomy and have close or positive margins, when the findings may indicate a significant change in surgical management.
- Evaluate suspicion of recurrence in a treated breast, when clinical and/or mammographic and ultrasound findings are inconclusive, especially to differentiate post-operative scar versus tumor recurrence.
 - **NOTE:**
 - Breast MRI in the first 12 months after surgery has poor sensitivity and specificity due to post surgical edema, hemorrhage, inflammation, scarring, and fat necrosis.*
 - It is advisable to wait 6 to 12 months after chemotherapy before performing breast MRI. MRI prior to this time may give misleading results, as cancers may exhibit benign appearing kinetics.*
 - It is advisable to wait 6 to 12 months after radiation before performing breast MRI. MRI prior to this time may give misleading results due to edema, architectural distortion, and cancers may exhibit benign appearing kinetics.*
 - Hormonal replacement (other than low dose) may have a significant effect on breast MRI enhancement patterns and specificity. If there is an unacceptable amount of physiologic enhancement on MRI, it may be necessary to stop hormone replacement for several months and repeat the MRI.*
 - It is unknown how hormonal therapy for breast cancer affects breast MRI.*
 *Huff JG. *Clinical Applications of Breast MRI: Current Indications and Examples*. Presented at: *Identification and Management of Breast Cancer*, October 6, 2007; Nashville, TN

- Evaluate suspected cancer recurrence in reconstructed breast tissue
 - See **NOTE** in previous bullet point.
- Rule out chest wall recurrence
 - See **NOTE** in previous bullet point
- Guide biopsy of lesions seen only on MRI
 - A diagnostic breast MRI (CPT 77058 or 77059) often needs to be performed prior to MRI-guided breast biopsy, especially if the biopsy is being performed at a different facility than the original breast MRI.
 - However, if breast MRI is being performed solely to guide a breast biopsy (i.e. a diagnostic breast MRI is not being performed), then the breast MRI portion of the procedure is included in the CPT code for the MRI-guided procedure (CPT 77021) and requests for CPT 77058 or 77059 are inappropriate.
- 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 is not indicated in the following circumstances:**
 - Breast MRI should not be used for routine surveillance in patients with a history of breast cancer, including DCIS and including premenopausal women with a history of breast cancer, unless the patient has dense breasts or extensive scar tissue that causes the mammogram to be uninterpretable, or the patient satisfies the criteria for annual screening with breast MRI outlined under Indications for MRI of the breast above.
 - If a BI-RADS category other than zero has been given on a mammogram report, then the mammogram can be interpreted and surveillance breast MRI is not indicated, even if the mammogram report states the presence of dense breasts.
 - Currently, there is insufficient data to support the use of breast MRI for breast cancer screening in women with lobular carcinoma in situ, atypical hyperplasia, dense breasts, mutations other than BRCA, or breast implants other than silicone implants unless the patient satisfies the criteria for annual screening with breast MRI outlined under Indications for MRI of the breast above.*
 - If a BI-RADS category other than zero has been given on a mammogram report, then the mammogram can be interpreted and screening breast MRI is not indicated, even if the mammogram report states the presence of dense breasts.
 - **References:**
 - *CA Cancer J Clin* 2007;57:75-89
 - *American Society of Breast Disease Policy Statement, *The Use of Magnetic Resonance Imaging of the Breast for Screening of Women at High Risk of Breast Cancer*, June 28, 2004. <http://www.asbd.org>. Accessed November 27, 2006
 - 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.*

*Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease* Nov 2005. <http://www.icsi.org>. Accessed October 13, 2008

- BI-RADS category 3 lesion means “probably benign finding”
- In the evaluation of BI-RADS category 3 lesions, MRI did not provide additional information (low positive predictive value [33%]) and was similar to that of short interval (6 month) mammography follow-up.*

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

- Bilateral total breast ultrasound and bilateral axillary ultrasound are 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.*

**J Am Coll Surg* 2005 Oct;201(4):586-597

- A breast mass categorized as BI-RADS 4 or 5 should be biopsied.*
- **ACR Appropriateness Criteria, Nonpalpable Breast Mass, Updated 2005*
- Biopsy of microcalcifications seen on mammogram in order to rule out malignancy (including DCIS) should be performed rather than breast MRI.
 - 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.
 - Some DCIS is only seen on MRI, therefore MRI-guided biopsy is appropriate in these cases.

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

- There is insufficient data to support using serial breast MRI studies to follow patients with mammographic abnormalities or abnormalities seen on other imaging studies.
 - Breast MRI should be able to characterize a lesion as benign, probably benign, or as suspicious.
 - If breast MRI was obtained because a mammogram or ultrasound was unclear, then a probably benign lesion on MRI (MRI BI-RADS 3) should undergo repeat mammography and one repeat breast MRI in 6 months.
 - If a probably benign lesion is clearly seen on mammogram and/or ultrasound, then repeat mammography and/or ultrasound should be performed at 6 months. Follow-up breast MRI is not indicated.*
 - Any suspicious lesion or indeterminate lesion should be biopsied.

*Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease*. Nov 2005 and *Genetic Screening for Breast Cancer*, <http://www.icsi.org>. Accessed October 13, 2008

- 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) is 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.*

*Barclay L and Vega C. *Noninvasive Tests May Be Insufficiently Accurate to Preclude Breast Biopsy.* Medscape Medical News, Feb.10, 2006. <http://www.medscape.com>. Accessed November 27, 2006

- 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.
 - RODEO MRI is a particular software sequence for breast MRI. With current MRI techniques on a non-RODEO MRI, multiple MRI sequences give similar results to those obtained on a RODEO MRI
 - There is no unique CPT code or different reimbursement 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-25.2 Nipple Discharge/Galactorrhea

- Mammogram should be obtained. Ultrasound may be helpful to locate a duct papilloma, 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.
 - Patients with bloody or unilateral discharge or palpable abnormality should have a mammogram, with or without an ultrasound and referral to a surgeon for open biopsy is recommended.*
- *Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease.* Updated 2007. <http://www.icsi.org>. Accessed October 14, 2008
- 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

hemocult-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. A papilloma should be resected by lumpectomy or vacuum-assisted lumpectomy.
- Breast MRI is not indicated*

*Lawson LL. *State of the Art Diagnosis of Breast Abnormalities: From Clinical Exam to MRI*. Presented at: *Identification and Management of Breast Cancer*, October 6, 2007; Nashville, TN

- 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:**
 - Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease* Nov 2005. <http://www.icsi.org>. Accessed October 14, 2008

CH-25.3 Breast Pain (Mastodynia)

- 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:**
 - Institute for Clinical Systems Improvement (ICSI), *Diagnosis of Breast Disease* Nov 2005. <http://www.icsi.org>. Accessed October 14, 2008

CH-25.4 Newer breast imaging techniques

- Positron-Emission Mammography (PEM) or Naviscan: See CH-35
- Breast MR Spectroscopy: See CH- 36
- Breast Tomosynthesis
 - Uses conventional mammographic x-ray tubes, but the x-ray source is movable and swings over the breast in a 50-degree arc, creating 11 discrete images that can be combined or analyzed in many different ways to provide a three-dimensional data set or to create cross-sectional images.
 - There is insufficient data currently to generate appropriateness criteria for the

- use of breast tomosynthesis, and this procedure should be considered investigational at this time.
- Scintimammography
 - Nuclear medicine study that uses a radioisotope such as Tc-99m tetrofosmin to image the breast. Breast cancer typically shows increased uptake of the radioisotope compared to benign lesions.
 - Acts as a “poor man’s MRI”.
 - Scintimammography does not require preauthorization by MedSolutions at this time.

THORACIC VASCULAR DISORDERS (ALPHABETICAL ORDER)

CH-26~PULMONARY ARTERIOVENOUS FISTULA (AVM)

- Definition: abnormal connection between pulmonary arteries and veins.
- Etiology:
 - Acquired: penetrating or blunt trauma to the chest; bronchiectasis
- 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
 - *Current Pharmaceutical Design* 2006;12:1243-1248

CH-27~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 (Wells criteria) 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.
 - PE is found in 5%-20% of patients who present to the Emergency Department with pleuritic pain.*

**Am Fam Physician 2007 May;75(9):1357-1364*

- Recent history of a long airplane flight or use of birth control pills also increases the risk for PE.
- Evaluation of outpatients with suspected pulmonary embolism should include a consideration for clinical probability of PE using the point chart above as well as the urgent nature of the request, 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, ventilation/perfusion (V/Q) scan is preferred due to the much lower dose of radiation absorbed by the maternal breast than with CTA.
 - Chest CTA (CPT 71275) or chest MRA (CPT 71555) can be performed if V/Q scan is not available.

- If CTA is performed, neonates need to have thyroid functions tested in the first week of life to rule out contrast-induced hypothyroidism.
- **Reference**
 - *Radiology* 2007 Jan;242(1):15-21
- 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.
 - **N Eng J Med* 2006;354:2317-2327
- **Follow-up imaging in patients with known PE:**
 - The duration of treatment with anticoagulation in patients with known DVT or PE is based upon the patient's history and risk factors and is **NOT** based upon advanced imaging studies (see CH-27 Pulmonary Embolism Evidence Based Clinical Support section).*
 - **Am Fam Physician* 2004 June;69(12):2841-2848
 - There is insufficient evidence-based data to support routine follow-up advanced imaging in asymptomatic patients or patients with stable symptoms who have known DVT or PE, including advanced imaging prior to discontinuing anticoagulation therapy.

PULMONARY HYPERTENSION—See PVD-5~Pulmonary Artery Hypertension in the Peripheral Vascular Disease Imaging Guidelines

CH-28~SUBCLAVIAN STEAL SYNDROME

- 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.
 - 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.
 - 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:**

- Whittemore AD and Mannick JA. *Subclavian Steal Syndrome*. In Sabiston DC and Lyerly HK. *Textbook of Surgery*. 15th Ed. Philadelphia, WB Saunders, 1997, pp.1685-1688

CH-29~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-30~THORACIC AORTIC DISSECTION OR ANEURYSM

- **Aortic Dissection**

- 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 (ripping or tearing sensation). 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.
- Patients with Type A dissection (involving the ascending aorta) require urgent surgical intervention with placement of an aortic graft or endovascular stent graft.
 - **Follow-up imaging after repair of Type A dissection:**
 - In the small number of patients with pure, truly isolated ascending aortic dissection that has been completely repaired, there is no evidence-based data to support routine follow-up imaging.
 - Many patients with Type A dissection also have an aortic arch and descending aortic component to the dissection. In these patients, follow-up imaging should proceed as in patients with Type B dissection.
- Patients with Type B dissection (involves the descending aorta; usually originates distal to the origin of the left subclavian artery) can usually be treated medically with careful blood pressure control. Surgery is reserved for distal dissections that are leaking, ruptured, or compromising blood flow to a vital organ, or if there is inability to control the blood pressure
 - **Follow-up imaging in patients with Type B dissection who are being treated medically:**

- If false lumen is <4.5 cm, routine imaging can be performed every 12 months
 - If false lumen is \geq 4.5 cm, routine imaging can be performed every 6 months
 - **Follow-up imaging in patients with Type B dissection who underwent surgical procedure:**
 - Routine imaging can be performed at 1 month, 6 months, 12 months, and then every 12 months for patients who have had stent grafts placed or other types of surgical procedures for dissection
 - The preferred imaging is CTA of chest, abdomen and pelvis (CPT 71275, 74175, and 72191). Alternative advanced imaging studies can be considered based on the thoracic or vascular specialist's preference.
 - The purpose of routine follow-up imaging is due to the fact that 30%-40% of chronic dissections will become aneurysmal in 5 years and will require intervention. Patency of the false lumen is an independent risk-factor for secondary dilatation of the aorta.*
 - **European Journal of Cardio-thoracic Surgery* 2005;27:654-657
- **Thoracic Aortic Aneurysm (TAA)**
 - The normal size of the aortic arch and descending thoracic aorta is 3 cm. The aortic root is normally 3.5 cm.
 - **Suspicion for TAA:**
 - Widened mediastinum or other abnormalities on chest x-ray (overread by a radiologist) that raise the suspicion for TAA can be further evaluated with chest CT with contrast (CPT 71260)
 - Suspicion for TAA based on other previous imaging studies such as fluoroscopy, spine MRI, abdominal CT, etc. can be further evaluated with chest CT (contrast as requested), chest MRA (CPT 71555), or chest CTA (CPT 71275).
 - **Follow-up imaging of known TAA:**
 - 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).
 - 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-22.1 Abdominal Aortic Aneurysm).
 - There is insufficient evidence-based data to support using advanced imaging to screen for thoracic aortic aneurysm (TAA) in patients with known 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).
 - **Follow-up imaging in patients who have had open repair or**

endovascular stent graft repair of TAA:

- If open repair was performed, routine chest imaging can be performed every 3 to 5 years.
- If endovascular graft was placed, routine chest imaging can be performed at 1 month, 6 months, 12 months, and then every 12 months. An additional study can be performed at 3 months if there was evidence of endoleak on the 1 month study
- Chest imaging can be chest CT (contrast as requested), chest MRA (CPT 71555), or chest CTA (CPT 71275).
- **Screening guidelines for familial thoracic aortic aneurysm:**
 - In one study of 520 patients with TAA, an inherited pattern for TAA was present in 21.5% of non-Marfan syndrome patients. The predominant inheritance pattern was autosomal dominant (76.9%) with varying degrees of penetrance and expressivity. Familial TAA's have a relatively early age of onset. Aortic growth rate was highest for the familial group (0.21 cm/year).¹
 - There is no general consensus statement regarding screening of relatives of patients with TAA. The Thoracic Aortic Center at Massachusetts General Hospital recommends that whenever a patient less than 70 years old has an ascending thoracic aortic aneurysm that is otherwise unexplained, all first-degree relatives (parents, siblings, children) should be screened for TAA.²
 - Screening studies should include echocardiogram and chest x-ray initially. If these studies are equivocal or do not visualize the ascending aorta adequately, chest CT with contrast (CPT 71260) can be performed.

¹ *Annals of Thoracic Surgery* 2006 Oct;82(4):1400-1405

² <http://www.clinicalanswers.nhs.uk>. Accessed November 19, 2007

MISCELLANEOUS

CH-31~ELEVATED HEMIDIAPHRAGM

- The right hemidiaphragm usually sits 1-2.5 cm higher than the left.
- The most common cause of a significant discrepancy between the two hemidiaphragms is focal or diffuse eventration of the higher diaphragm, which occurs more commonly on the left.
- Eventration occurs when the muscular sheet of the diaphragm is replaced by a thin membranous sheet causing elevation of the diaphragm due to upward pressure from the adjacent abdominal viscera.
- **Work-up of an elevated hemidiaphragm includes the following:**
 - Comparison with previous chest x-rays should be performed initially.
 - If the elevation is an old finding, further evaluation is not indicated.
 - If the elevation is a new finding, work-up to rule out phrenic nerve pathology is indicated.

- **Work-up to rule out phrenic nerve pathology:**
 - Interruption of the phrenic nerve anywhere between the neck and the diaphragm results in paralysis of the ipsilateral hemidiaphragm.
 - Fluoroscopic examination (“sniff test”) should be performed initially to evaluate whether there is true diaphragmatic paralysis versus diaphragmatic weakness.
 - Common causes of diaphragmatic paralysis include:
 - Phrenic nerve injury
 - Malignancy involving the phrenic nerve such as lung carcinoma (usually involving the mediastinum or mediastinal lymph nodes) or other mediastinal tumors such as thymoma, lymphoma, or germ cell tumors.
 - Other thoracic causes of elevated hemidiaphragm include lobar pneumonia, tuberculosis, empyema, substernal thyroid, pulmonary infarction, rib fracture, atelectasis, aortic aneurysm, and radiation treatment
 - Elevated hemidiaphragm can also be idiopathic
 - Chest CT with contrast (CPT 71260) can be performed in patients with new diaphragmatic paralysis
 - If chest CT does not reveal the etiology of the elevated hemidiaphragm, CT abdomen with contrast (CPT 74160) can be performed to rule out liver pathology, subphrenic abscess, or intraabdominal mass
 - Repeat advanced imaging studies in the absence of new signs or symptoms are not indicated.
- **Reference:**
 - Meyers BF and Kozower BD. *Paralyzed Diaphragm: Evaluation of Elevated Hemidiaphragm*. Medscape, June 6, 2006, <http://www.medscape.com>. Accessed November 1, 2007

CH-32~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:**
 - MacKinnon S, Patterson GA, Urschel HC. *Thoracic Outlet Syndromes*. In Pearson FG, Deslauriers J, Ginsberg RJ, et al. (Eds.). *Thoracic Surgery*. New York, Churchill Livingstone, Inc., 1995, pp.1211-1235

NEWER IMAGING TECHNIQUES

CH-33~VIRTUAL BRONCHOSCOPY

- Virtual bronchoscopy uses multidetector CT with 3D rendering (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-34~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 Guidance (CPT 77012).

CH-35~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 an ongoing prospective multi-center clinical trial for women with newly diagnosed breast cancer anticipating breast-conservation surgery. These women will undergo both high-resolution PEM imaging and breast MRI to determine changes in surgical management resulting from PEM or MRI imaging as compared to conventional imaging. The expected completion date of the study is December 2008.*

**Study the role of positron emission mammography in pre-surgical planning for breast cancer. <http://www.clinicaltrials.gov>. Accessed October 13, 2008*

- There is currently insufficient data to generate appropriateness criteria for this modality, and this procedure should be considered investigational at this time.
- **References:**
 - *Technol Cancer Res Treat* 2005 Feb;4(1):55-60
 - *Am J Surg* 2005 Oct;190(4):628-632
 - *J Nucl Med* 2000 Nov;41(11):1851-1858

CH-36~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.

Evidence Based Clinical Support

Evidence Based Clinical Support CH-3~CHRONIC COUGH

- The American College of Chest Physicians has updated their evidence-based guidelines on cough*
**Chest 2006;129:1-25*
- 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%.*
**New Eng J Med 2000 Dec;343(23):1715-1721*
- 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.

Evidence Based Clinical Support CH-7~ASBESTOS EXPOSURE

- 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.*

**Croat Med J 2003;44(5):618-625*

**Scand J Work Environ Health 2003;29(5):388-395*

Evidence Based Clinical Support CH-13~SARCOID

- 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).

Evidence Based Clinical Support CH-14~SOLITARY PULMONARY NODULE

- 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

Evidence Based Clinical Support CH-20~MEDIASTINAL MASS

- 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.

Evidence Based Clinical Support CH-25~BREAST ABNORMALITIES

- 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;224:165-175*

- 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:
 - MRI detects intraductal spread more accurately than mammography or ultrasound. Intraductal spread is a principal risk factor for local recurrence.
 - 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*

- 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*

- Another study found that breast MRI detected cancers in the contralateral breast that were not detected by clinical exam or mammogram in 30 of 969 women with newly diagnosed breast cancer.*

**N Engl J Med 2007 March;356(13):1295-1303*

- 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*

**Cancer 2003 Aug;98(3):468-473*

- 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%.*
 - *AJR 2004 Feb;182:473-480*
- 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.*
 - *J Am Coll Surg 2004 Feb;198(2):190-197*
- MRI can assess the response to neoadjuvant chemotherapy better than physical exam and mammography.
- The American Society of Breast Disease statement June 2004 (found at <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”. However, the latest recommendations from the American Cancer Society do recommend screening breast MRI in women who have had chest radiation between the ages of 10 and 30 years old.*

**CA Cancer J Clin 2007;57:75-89*

Evidence Based Clinical Support CH-27~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.
- 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 care givers. 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%-78% 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.
 - **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.*

**N Eng J Med* 2006;354:2317-2327

- American College of Chest Physicians Recommendations for Long-Term Anticoagulation in Patients with DVT or PE:

TABLE 5 ACCP Recommendations for Long-Term Anticoagulation with DVT or PE (INR goal: 2.0 to 3.0)			
<i>Thromboembolism</i>	<i>Duration of anticoagulation</i>	<i>Strength of recommendation*</i>	<i>Reference</i>
First event with a reversible or time-limited risk factor for venous disease (e.g. trauma, surgery)	At least 3 months	A	4
First episode of idiopathic venous thromboembolic disease	At least 6 months	A	4
Recurrent idiopathic venous thromboembolic disease or continuing risk factor (e.g. thrombophilia)	At least 12 months	B	4
Symptomatic isolated calf-vein thrombosis	6-12 weeks †	A	17

ACCP= American College of Chest Physicians; DVT = deep venous thrombosis; PE = pulmonary embolism; INR = International Normalized Ratio.
 *-ACCP ratings have been converted to American Family Physician's strength-of-recommendation taxonomy.
 †-Serial noninvasive studies of the lower extremities to assess for extension are an option.
Adapted with permission from Hyers TM, Agnelli G, Hull RD, Morris TA, Samama M, Tapson V, et al. Antithrombotic therapy for venous thromboembolic disease. Chest 2001; 119 (1 suppl): 184S, with additional information from reference 17.

**Evidence Based Clinical Support
CH-29~SUPERIOR VENA CAVA (SVC) SYNDROME**

- 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.

<p>Evidence Based Clinical Support CH-30 ~THORACIC AORTIC DISSECTION OR ANEURYSM</p>

- 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. *Ann Thorac Surg 2002;74:S1877-S1880*
- 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.

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