



# CLINICAL GUIDELINES

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## Chest Imaging Policy

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eviCore healthcare Clinical Decision Support Tool Diagnostic Strategies: This tool addresses common symptoms and symptom complexes. Imaging requests for individuals with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician, specialist and/or individual's Primary Care Physician (PCP) may provide additional insight.

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## Chest Imaging Guidelines

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## Abbreviations for Chest Guidelines

<b>AAA</b>	abdominal aortic aneurysm		
<b>ACE</b>	angiotensin-converting enzyme		
<b>AVM</b>	arteriovenous malformation		
<b>BI-RADS</b>	Breast Imaging Reporting and Database System		
<b>BP</b>	blood pressure	<b>BRCA</b>	tumor suppressor gene
<b>CAD</b>	computer-aided detection	<b>CBC</b>	Complete blood count
<b>COPD</b>	chronic obstructive pulmonary disease		
<b>CT</b>	computed tomography		
<b>CTA</b>	computed tomography angiography		
<b>CTV</b>	computed tomography venography		
<b>DCIS</b>	ductal carcinoma in situ	<b>DVT</b>	deep venous thrombosis
<b>ECG</b>	electrocardiogram	<b>EM</b>	electromagnetic
<b>EMG</b>	electromyogram	<b>FDA</b>	Food and Drug Administration
<b>FDG</b>	fluorodeoxyglucose	<b>FNA</b>	fine needle aspiration
<b>GERD</b>	gastroesophageal reflux disease		
<b>GI</b>	gastrointestinal		
<b>HRCT</b>	high resolution computed tomography		
<b>IPF</b>	idiopathic pulmonary fibrosis		
<b>LCIS</b>	lobular carcinoma in situ		
<b>LFTP</b>	localized fibrous tumor of the pleura		
<b>MRA</b>	magnetic resonance angiography		
<b>MRI</b>	magnetic resonance imaging		
<b>MRV</b>	magnetic resonance venography		
<b>NCV</b>	nerve conduction velocity		
<b>PE</b>	pulmonary embolus		
<b>PEM</b>	positron-emission mammography		
<b>PET</b>	positron emission tomography		
<b>PFT</b>	pulmonary function tests		
<b>PPD</b>	purified protein derivative of tuberculin		

<b>RODEO</b>	Rotating Delivery of Excitation Off-resonance MRI
<b>SPN</b>	solitary pulmonary nodule
<b>SVC</b>	superior vena cava

## CH-1: General Guidelines

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## **CH-1: General Guidelines**

- A current clinical evaluation (within 60 days) is required prior to considering advanced imaging.
  - ◆ A clinical evaluation should include the following:
    - A relevant history and physical examination.
    - Appropriate laboratory studies and non-advanced imaging modalities, such as plain x-ray or ultrasound.
  - ◆ Other meaningful contact (telephone call, electronic mail or messaging) by an established patient can substitute for a face-to-face clinical evaluation.
  - ◆ A Pulmonary or Thoracic Surgical Specialist can be helpful in evaluating thoracic disorders.

### **CH-1.1: General Guidelines – Chest X-Ray**

- A recent chest x-ray (generally within the last 60 days) that has been over read by a radiologist would be performed in many of these cases prior to considering advanced imaging.<sup>1,2</sup>
  - ◆ Identify and compare with previous chest films to determine presence and stability.
  - ◆ Chest x-ray can help identify previously unidentified disease and may direct proper advanced imaging for such conditions as:
    - Pneumothorax, (see **CH-19: Pneumothorax/Hemothorax**).
    - Pneumomediastinum, (see **CH-19: Pneumothorax/Hemothorax**).
    - Fractured ribs, (see **CH-22: Chest Wall Mass**).
    - Acute and chronic infections, and (see **CH-13: Pneumonia** and **CH-14: Other Chest Infections**).
    - Malignancies.
  - ◆ Exceptions to preliminary chest x-ray may include such conditions as:
    - Supraclavicular lymphadenopathy (see **CH-2.1: Supraclavicular Region**).
    - Known Bronchiectasis (see **CH-7: Bronchiectasis**).
    - Suspected Interstitial lung disease (see **CH-11: Interstitial Disease**).
    - Positive PPD or tuberculosis (see **CH-14: Other Chest Infections**).
    - Suspected Pulmonary AVM (see **CH-26: Pulmonary Hypertension**).

### **CH-1.2: General Guidelines – Chest Ultrasound**

- Chest ultrasound (CPT® 76604) includes transverse, longitudinal, and oblique images of the chest wall with measurements of chest wall thickness, and also includes imaging of the mediastinum.
  - ◆ Chest ultrasound: CPT® 76604.
  - ◆ Breast ultrasound.
    - CPT® 76641: unilateral, complete.
    - CPT® 76642: unilateral, limited.
  - ◆ CPT® 76641 and CPT® 76642 should be reported only once per breast, per imaging session.
  - ◆ Axillary ultrasound: CPT® 76882 (unilateral); if bilateral, can be reported as CPT® 76882 x 2.

### **CH-1.3: General Guidelines – Chest CT**

- Intrathoracic abnormalities found on chest x-ray, fluoroscopy, abdominal CT scan, or other imaging modalities may be further evaluated with chest CT with contrast (CPT® 71260).
  - ◆ “Abnormalities” through these guidelines may include suspected lung or pleural nodules or masses, pleural effusion, adenopathy or other findings that are not considered benign.
  - ◆ Lung nodule(s) identified incidentally on:
    - Chest CTA without and with contrast (CPT® 71275), or
    - Chest MRI without contrast (CPT® 71550), or
    - Chest MRI without and with contrast (CPT® 71552), or
    - Chest MRA without and with contrast (CPT® 71555) can replace Chest CT with contrast (CPT® 71260) or chest CT without contrast (CPT® 71250) as the initial dedicated study.
  - ◆ See also: **CH-16: Solitary Pulmonary Nodule (SPN)**.
  - ◆ See also: **CH-34: Lung Cancer Screening**.
- Chest CT without contrast (CPT® 71250) can be used for the following:
  - ◆ Patient has contraindication to contrast.
  - ◆ Follow-up of pulmonary nodule(s).
  - ◆ High Resolution CT (HRCT).
  - ◆ Low-dose chest CT (CPT® G0297) see **CH-34: Lung Cancer Screening**.
- 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, most often within a lung nodule, needs to be resolved.

#### **Chest CT Coding Notes:**

- High resolution chest CT should be reported only with an appropriate code from the set CPT® 71250-CPT® 71270.
  - ◆ No additional CPT® codes should be reported for the “high resolution” portion of the scan. The “high resolution” involves additional slices which are not separately billable.

### **CH-1.4: General Guidelines – Chest CTA (CPT® 71275)**

- Chest CTA (CPT® 71275) can be considered for suspected Pulmonary Embolism and Thoracic Aortic disease.
  - ◆ CTA prior to minimally invasive or robotic surgery (see: **CD-4.8: Transcatheter Aortic Valve Replacement (TAVR)** in the Cardiac Imaging Guidelines).

## **CH-1.5: General Guidelines – Chest MRI without and with Contrast (CPT® 71552)**

- Indications for chest MRI are infrequent and may relate to concerns about CT contrast such as renal insufficiency or contrast allergy. MRI may be indicated:
  - ◆ Clarification of some equivocal findings on previous imaging studies, which are often in the thymic mediastinal region or determining margin (vascular/soft tissue) involvement with tumor and determined on a case-by-case basis.
    - Certain conditions include:
      - Chest wall mass (**CH-22: Chest Wall Mass**).
      - Chest muscle tendon injuries (**MS-11: Muscle/Tendon Injuries**).
      - Brachial plexopathy (**PN-4: Brachial Plexus**).
      - Thymoma (**ONC-10.2 Thymoma**).

## **CH-1.6: General Guidelines – Nuclear Medicine**

78597	Quantitative differential pulmonary perfusion, including imaging when performed
78598	Quantitative differential pulmonary perfusion and ventilation (e.g., aerosol or gas), including imaging when performed

### ***References***

1. Raof, Suhail et al. Interpretation of Plain Chest Roentgenogram. *CHEST*, Volume 141, Issue 2, 545 – 558. February 2012. Accessed October 19, 2017. [http://journal.chestnet.org/article/S0012-3692\(12\)60096-8/fulltext](http://journal.chestnet.org/article/S0012-3692(12)60096-8/fulltext).
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## CH-2: Lymphadenopathy

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## **CH-2.1: Supraclavicular Region**

- Ultrasound (CPT® 76535) is the initial study for palpable or suspected lymphadenopathy.
  - ◆ Allows simultaneous ultrasound-guided fine needle aspiration (FNA) (CPT® 76942).
  - ◆ If ultrasound is indeterminate, neck CT with contrast (CPT® 70491) or chest CT with contrast (CPT® 71260) can be performed.
    - Also see: **NECK-1: General Guidelines** in the Neck Imaging Guidelines.

## **CH-2.2: Axillary Lymphadenopathy**

- There is no evidence-based support for advanced imaging of clinically evidenced axillary lymphadenopathy without biopsy. <sup>2,3</sup> Most axillary adenopathy is infectious in primary care settings. Metastatic axillary involvement from a lung or chest primary is highly unusual (CT chest not often warranted).
- Localized axillary lymphadenopathy should prompt:
  - ◆ Ultrasound directed core needle biopsy or surgical excisional biopsy of the most abnormal lymph node if condition persists or malignancy suspected.
  - ◆ Search for adjacent hand or arm injury or infection, and
  - ◆ 3-4 week observation if benign clinical picture, and
  - ◆ Excisional or ultrasound directed core needle biopsy of most abnormal lymph node if condition persists or malignancy suspected.
  - ◆ No advanced imaging indicated.
- Generalized axillary lymphadenopathy should prompt:
  - ◆ Ultrasound directed core needle biopsy or surgical excisional biopsy of the most abnormal lymph node if condition persists or malignancy suspected.
  - ◆ Diagnostic work-up, including serological tests, for systemic diseases, and
  - ◆ Excisional biopsy of most abnormal lymph node if uncertainty persists.
  - ◆ See: **ONC-27: Lymphomas** in the Oncology Imaging Guidelines.
- Occult Primary Cancer in axillary lymph node(s):
  - ◆ Breast MRI (CPT® 77059) can be performed if breast cancer is suspected, and if physical exam and mammography are negative. Otherwise, imaging of other possible primary sites are led by symptomatology, and risk factors.
    - See “Equivocal or Occult Findings” in: **BR-6: Breast MRI Indications**.
    - See also: **ONC-31: Metastatic Cancer and Carcinomas of Unknown Primary Site**.

### ***Axillary Lymphadenopathy – Practice Notes***

Adenocarcinoma is the most common histology, with breast cancer seen most often; non-palpable breast cancer and axillary metastases accounts for less than 0.5% of all breast cancers. Carcinomas of the lung, thyroid, stomach, colon, rectum, and pancreas have the potential to spread to axillary lymph nodes, but these metastases are rarely the first manifestations of disease.

## CH-2.3: Mediastinal Lymphadenopathy

- Chest CT with contrast (CPT® 71260) can be performed if mediastinal abnormalities are detected on a chest x-ray (over read by a radiologist) or other non-dedicated advanced chest imaging.
  - ◆ Follow-up chest CT (CPT® 71260) can be performed after 4 weeks if:
    - Enlarged lymph nodes are in the mediastinum with no other thoracic abnormalities; and
    - Low risk or no clinical suspicion for malignancy.
    - Thereafter, stability does not require further advanced imaging.
  - ◆ Further evaluations
    - Lymph node biopsy (see methods below) should be considered for:
      - Persistent lymphadenopathy on follow-up chest CT; or
      - Suspected malignancy.

### Practice Notes

- 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.
- Less invasive methods of mediastinal biopsies are CT or ultrasound directed percutaneous biopsy, transbronchial biopsy, transbronchial biopsy using endobronchial ultrasound, and endoscopic ultrasound-guided FNA.
- More invasive and traditional methods are mediastinoscopy or thoracoscopy/thoracotomy.

### References

1. Van Overhagen H, Brakel K, Heijenbrok MW, et al. Metastases in supraclavicular lymph nodes in lung cancer: assessment with palpation, US, and CT. *Radiology* 2004; 232: 75-8. Accessed October 20, 2017. <http://pubs.rsna.org/doi/abs/10.1148/radiol.2321030663>.
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5. English B, Ray C, Chang J, et al. Expert Panel on Interventional Radiology. ACR Appropriateness Criteria® radiologic management of thoracic nodules and masses. *Reston (VA): American College of Radiology (ACR)*; 2015. 14 p. Accessed October 20, 2017. <https://acsearch.acr.org/docs/69343/Narrative>.

## CH-3: Cough

### CH-3.1: Cough

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### CH-3.1: Cough

- Initial evaluation should include a recent chest x-ray after the current episode of cough started or changed.<sup>1, 2</sup>
  - ◆ Discontinue all medications known to cause coughing (e.g. ACE inhibitors).<sup>1, 2</sup>
- If the initial chest x-ray is without abnormalities, a chest CT (either with contrast [CPT® 71260] or without contrast [CPT® 71250]) can be performed for the following:
  - ◆ Cough in non-smoker after the following sequence for a total 3 week trial and investigation (all):
    - Antihistamine and decongestant treatment.<sup>1, 2</sup>
    - Bronchoprovocation challenge (e.g. methacholine challenge, exhaled nitric oxide test) and spirometry should be performed to rule out asthma.<sup>1</sup>
    - Empiric trial of corticosteroids.<sup>1, 2</sup>
    - Treatment of gastroesophageal reflux disease (GERD).<sup>1, 2</sup>
      - See: **HD-29: Sinusitis**.
  - ◆ Current or past cigarette smokers with either:
    - New cough lasting greater than 2 weeks (URI based cough can be prolonged).
    - Changed chronic cough in worsening frequency or character
      - See: **CH-6: Hemoptysis**.
  - ◆ For any abnormalities present on the initial chest x-ray, advanced chest imaging can be performed according to the relevant Chest Imaging Guidelines section 1.

#### Practice Notes

- The resolution of cough usually will occur at a median time of 26 days of stopping use of the angiotensin-converting enzyme (ACE) inhibitor drug.<sup>2</sup> Smoking cessation is “almost always effective” in resolving cough in smoker.<sup>2</sup>
- It should be realized that cough after URI (Upper Respiratory Infection) can typically last beyond 2-3 weeks.<sup>3</sup>

#### References

1. Gibson P, Wang G, McGarvey L, et al. CHEST Expert Cough Panel. Treatment of unexplained chronic cough: CHEST guideline and Expert Panel report. Online supplement. *Chest*. 2016 Jan; 149 (1): 27-44 Accessed October 19, 2017. [http://journal.chestnet.org/article/S0012-3692\(15\)00038-0/fulltext](http://journal.chestnet.org/article/S0012-3692(15)00038-0/fulltext).
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**CH-4: Non-Cardiac Chest Pain**

<b>CH-4: Non-Cardiac Chest Pain</b>	<b>15</b>
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<b>CH-4.2: Costochondritis/Other Musculoskeletal Chest Wall Syndrome</b>	<b>15</b>

## **CH-4: Non-Cardiac Chest Pain**

- See also the following guidelines:
  - ◆ **CH-25: Pulmonary Embolism.**
  - ◆ **CH-29.1: Aortic Dissection.**
  - ◆ **CD-1: General Guidelines.**
  - ◆ **CD-4: CT Heart and Coronary Computed Tomography Angiography (CCTA).**
- “Evidence is not conclusive whether Triple-rule-out CT (CAD, PE, and AD) will improve efficiency of patient management” with acute chest pain.<sup>1</sup>
- MRI is not supported in the evaluation of chest pain.

### **CH-4.1: Non-Cardiac Chest Pain - Imaging**

- Initial evaluation should include a chest x-ray.<sup>1,2</sup>
  - ◆ If x-ray is abnormal, chest CT with contrast (CPT® 71260) or CTA chest with contrast (CPT® 71275) can be performed.<sup>1,2,3,4</sup>
  - ◆ If x-ray is normal, patient should undergo evaluation of other possible causes of pain prior to advanced aging (CT chest with contrast or CTA chest with contrast) including:<sup>1,2,3,4</sup>
    - Cardiac (ECG, echocardiogram, stress test)<sup>1,2</sup> (see: **CD: 4- Cardiac CT, Coronary CTA, and CT for Coronary Calcium (CAC)**)
    - GI (trial of anti-reflux medication, possible upper endoscopy, pH probe, esophageal manometry)<sup>1</sup>
    - Either a barium swallow, esophageal pH monitoring, manometry, or endoscopy should be done in all after cardiac causes have been ruled out since GERD is the cause in almost 60%
    - Pulmonary (PFT's)<sup>1,2</sup>
  - ◆ Chest CT with contrast (CPT® 71260) can be performed if persistent:
    - The initial chest x-ray reveals no abnormalities; and either
      - Sickle cell disease<sup>2</sup>, or
      - Suspected lung mass in a patient with chest pain, cough, and weight loss.<sup>2</sup>

### **CH-4.2: Costochondritis/Other Musculoskeletal Chest Wall Syndrome**

- Costochondritis or other suggested musculoskeletal chest wall syndrome does not require advanced imaging (CT or MRI) unless it meets other criteria in these guidelines.
- Costochondritis can be readily diagnosed with palpation tenderness and/or hooking maneuver and imaging is non-specific.<sup>3</sup>

#### ***Practice Notes***

Differential diagnosis of non-cardiac nonspecific chest pain includes aortic, pulmonary, gastrointestinal (GI), or musculoskeletal pathologies. Chest x-ray could identify pneumothorax, pneumomediastinum, fractured ribs, acute and chronic infections, and malignancies.<sup>1</sup>

### References

1. Hoffman U, Venkatesh V, White R, et al. Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® acute nonspecific chest pain - low probability of coronary artery disease. *American College of Radiology (ACR)*; 2015. Accessed October 19, 2017. <https://acsearch.acr.org/docs/69401/Narrative/>.
2. Woodard PK, White RD, Abbara S, Araoz PA, Cury RC, et al., Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® chronic chest pain - low to intermediate probability of coronary artery disease. *American College of Radiology (ACR)*; 2012. Accessed October 19, 2017. [http://www.jacr.org/article/S1546-1440\(13\)00044-6/fulltext](http://www.jacr.org/article/S1546-1440(13)00044-6/fulltext).
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**CH-5: Dyspnea/Shortness of Breath**

<b>CH-5.1: Dyspnea/Shortness of Breath</b>	<b>18</b>
<b>CH-5.2: Pre-Operative Assessment</b>	<b>18</b>

## **CH-5.1: Dyspnea/Shortness of Breath**

- Dyspnea is the subjective experience of breathing discomfort. Initial evaluation should include a recent chest x-ray.<sup>1, 2</sup>
  - ◆ If x-ray is abnormal, chest CT without contrast (CPT® 71250) can be performed.<sup>1,2</sup>
  - ◆ If the initial chest x-ray is indeterminate, chest CT without contrast (CPT® 71250, including HRCT), or chest CT with contrast (CPT® 71260) can be performed if the following evaluations have been conducted and are indeterminate:<sup>2</sup>
    - ECG, echocardiogram or stress testing,<sup>2</sup> and
    - Pulse oximetry and pulmonary function studies (PFT's),<sup>2</sup> and/or
    - Blood work including CBC and thyroid function tests,<sup>2</sup> if appropriate.

## **CH-5.2: Pre-Operative Assessment**

- “Split Function Studies” (CPT® 78597-Quantitative Differential Pulmonary Perfusion, Including Imaging When Performed or CPT® 78598-Quantitative Differential Pulmonary Perfusion and Ventilation (e.g., Aerosol or Gas), Including Imaging When Performed) can be considered for pre-operative assessment prior to planned segmental, lobar or lung removal.<sup>3, 4</sup>
- If pulmonary embolus (PE) is suspected, see **CH-25: Pulmonary Embolism**.

### ***References***

1. Dyer D, Mohammed T, Kirsch J, et al, Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® chronic dyspnea - suspected pulmonary origin. American College of Radiology (ACR); 2012 Accessed October 19, 2017. <https://acsearch.acr.org/docs/69448/Narrative>.
2. Abbara S, Ghoshhajra B, White R, et al, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® dyspnea -- suspected cardiac origin. American College of Radiology (ACR); Revised 2016. Accessed October 19, 2017. <https://acsearch.acr.org/docs/69407/Narrative>.
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4. Thrall JH, Zeissman HA. Nuclear Medicine: The Requisites, *Mosby*, 2001, 145-165.

## CH-6: Hemoptysis

### CH-6.1: Hemoptysis

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## **CH-6.1: Hemoptysis**

- Chest CT with contrast (CPT<sup>®</sup> 71260) OR without contrast (CPT<sup>®</sup> 71250) OR CTA chest (CPT<sup>®</sup> 71275) may be performed after:
  - ◆ Abnormal chest x-ray, *or*
  - ◆ No chest x-ray needed if **any** of the following:
    - High risk for malignancy with >40 years of age and >30 pack-year smoking history, *or*
    - Persistent/recurrent with >40 years of age or >30 pack year smoking history, *or*
    - Massive hemoptysis ( $\geq 30$  cc per episode or unable protect airway).<sup>1</sup>

### ***Reference***

1. Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria<sup>®</sup> hemoptysis. Reston (VA): American College of Radiology (ACR); 2014. Accessed October 19, 2017. <https://acsearch.acr.org/docs/69449/Narrative>.

## CH-7: Bronchiectasis

### CH-7.1: Bronchiectasis - Imaging

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## **CH-7.1: Bronchiectasis – Imaging**

- High resolution chest CT scan (HRCT) without contrast (CPT® 71250):<sup>4, 5</sup>
  - ◆ To confirm suspected diagnosis of bronchiectasis after an initial x-ray<sup>1, 2</sup>; or
  - ◆ For known bronchiectasis with worsening symptoms or worsening PFT's<sup>2</sup>.
  - ◆ For hemoptysis with known or suspected bronchiectasis.<sup>3</sup>

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## CH-8: Bronchitis

### CH-8.1: Bronchitis

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## **CH-8.1: Bronchitis**

- Advanced imaging is not needed for bronchitis.<sup>1,2</sup>
- Chest x-ray to determine if any abnormality is present.

### ***References***

1. Braman S, Chronic cough due to acute bronchitis: ACCP evidence-based clinical practice guidelines, *Chest* 2006,129, 95S-103S. Accessed November 7, 2017. [http://journal.chestnet.org/article/S0012-3692\(15\)52837-7/fulltext](http://journal.chestnet.org/article/S0012-3692(15)52837-7/fulltext).
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## CH-9: Asbestos Exposure

### CH-9.1: Asbestos Exposure

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## **CH-9.1: Asbestos Exposure**

- Chest x-ray as radiographic screening for asbestos exposure.<sup>1,2</sup>
  - ◆ Stable calcified pleural plaques on chest x-ray do not require advanced imaging of the chest.<sup>2</sup>
- CT of the chest should not be used to screen populations at risk for asbestos-related diseases.<sup>2</sup>
- High resolution chest CT (HRCT) (CPT® 71250) is considered for:<sup>2</sup>
  - ◆ Any change seen on chest x-ray.
  - ◆ Progressive respiratory symptoms that may indicate the development or progression of asbestos related interstitial fibrosis.
  - ◆ Send requests for additional follow-up imaging to Medical Director for review.

### ***Practice Notes***

- Asbestosis and asbestos-related diseases include: pleural effusion, pleural plaques, lung cancer, and malignant mesothelioma. The risk of developing mesothelioma increases with increasing intensity and duration of exposure.

### ***References***

1. OSHA, Occupational Safety and Health Standards, Medical surveillance guidelines for asbestos, 1910.1001 App H. Accessed October 19, 2017. [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=9995](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995).
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# CH-10: Chronic Obstructive Pulmonary Disease (COPD)

## CH-10.1: COPD - Imaging

28

## **CH-10.1: COPD – Imaging**

- Chest x-ray should be performed initially.
  - ◆ Chest CT without contrast (CPT® 71250) or Chest CT with contrast (CPT® 71260)<sup>1,2</sup> can be performed if emphysema is suspected and either:
    - Pre-operative study for Lung Volume Reduction Surgery (LVRS).<sup>1</sup>
    - Definitive diagnosis is not yet determined by laboratory studies and chest x-ray and one on the following is suspected:
      - Bronchiectasis
      - Sarcoidosis
      - Emphysema
      - Pneumoconiosis
      - Idiopathic pulmonary fibrosis
      - Langerhans cell histiocytosis
      - Hypersensitivity pneumonitis
      - Bronchiolitis obliterans
      - Lipoid pneumonia
      - Drug toxicity
      - Lymphangitic cancer<sup>2</sup>
- Lung cancer screening is discussed in the following guideline:
  - ◆ See “Screening Indications” in **CH-34: Lung Cancer Screening**

### ***Practice Notes***

- COPD includes asthmatic bronchitis, chronic bronchitis, and emphysema. COPD is airflow reduction (FEV1/FVC ratio < 0.7 or FEV1 ≥ 80% predicted) in the presence of respiratory symptoms, such as dyspnea. Advanced chest imaging is not typically indicated in COPD exacerbation, which is an acute change in baseline dyspnea, cough, and/or sputum beyond normal day-to-day variations.<sup>2</sup>

### ***References***

1. Dyer D, Mohammed T, Kirsch J, et al., Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® chronic dyspnea - suspected pulmonary origin. *American College of Radiology (ACR)*; 2012. 5 p. Accessed October 19, 2017. <https://acsearch.acr.org/docs/69448/Narrative>.
2. Austin JHM. Pulmonary emphysema: Imaging assessment of lung volume reduction surgery. *Radiology* 1999; 212:1-3. Accessed October 19, 2017. <http://pubs.rsna.org/doi/10.1148/radiology.212.1.r99j1521>.

## CH-11: Interstitial Disease

### CH-11.1: Interstitial Disease

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## **CH-11.1: Interstitial Disease**

- High resolution chest CT (HRCT) without contrast (CPT® 71250) is the diagnostic modality of choice to evaluate for:
  - ◆ Interstitial changes identified on other imaging (including chest x-ray) in patients with pulmonary symptoms and abnormal pulmonary function studies (PFT'S) (see: **CH-5: Dyspnea/Shortness of Breath**)<sup>1-6</sup>
  - ◆ Initial request to identify interstitial disease with a connective tissue disease diagnosis, including:
    - Rheumatoid arthritis,
    - Scleroderma
    - The myopathies
  - ◆ As well as in occupational lung disease such as:
    - Asbestosis,
    - Silicosis
    - Coal miner's lung disease<sup>1-6</sup>
- New or worsening pulmonary symptoms or worsening PFT's in any type of interstitial disease, including connective tissue diseases<sup>1-6</sup>
  - ◆ Once a year in patients with known idiopathic pulmonary fibrosis (IPF) if showing progression or regression of disease will change patient management<sup>3</sup>

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6. Castelino F and Varga J. Interstitial lung disease in connective tissue diseases: evolving concepts of pathogenesis and management. *Arthritis Research & Therapy*. 2010. Accessed November 7, 2017. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2945045/>.

## CH-12: Multiple Pulmonary Nodules

### CH-12.1: Multiple Pulmonary Nodules

32

## **CH-12.1: Multiple Pulmonary Nodules**

- The largest of multiple pulmonary nodules should be imaged based on guideline:  
See **CH-16: Solitary Pulmonary Nodule (SPN)**<sup>1</sup>

### ***Practice Notes***

- Increased risk of primary cancer as the total nodule count increased from 1 to 4 but decreased risk in patients with 5 or more nodules, most of which likely resulted from prior granulomatous infection.<sup>1</sup>

### ***References***

1. MacMahon H, et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017, *Radiology*, Accessed on October 20, 2017. <http://pubs.rsna.org/doi/10.1148/radiol.2017161659>.



## CH-13: Pneumonia

### CH-13.1: Pneumonia

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## CH-13.1: Pneumonia

- Chest x-ray would be performed initially in all patients with suspected pneumonia, prior to considering advanced imaging.<sup>1, 2</sup>
  - ◆ Chest CT with contrast (CPT® 71260) if initial or repeat chest x-ray findings reveal:
    - Complication of pneumonia (e.g. abscess, effusion, hypoxemia, respiratory distress, necrotizing pneumonia, pneumothorax).<sup>1,2</sup>
    - Possible lung mass associated with the infiltrate.<sup>2</sup>

### References

1. Mandell L, Wunderink R, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin Infect Dis*. 2007 Mar 1; 44 Suppl 2: S27-72. Accessed November 7, 2017. <https://academic.oup.com/cid/article-lookup/doi/10.1086/511159>.
2. Kirsch J, Mohammed T, Kanne J, et al. Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® acute respiratory illness in immunocompetent patients. [online publication]. Reston (VA): American College of Radiology (ACR); 2013. Accessed November 7, 2017. <https://www.guideline.gov/summaries/summary/49078/acr-appropriateness-criteria--acute-respiratory-illness-in-immunocompromised-patients?q=Body+weight>.

**CH-14: Other Chest Infections**

<b>CH-14.1: PPD or TB</b>	<b>36</b>
<b>CH-14.2: Fungal Infections</b>	<b>36</b>
<b>CH-14.3: Wegener's Granulomatosis/Granulomatosis with Polyangiitis</b>	<b>36</b>
<b>CH-14.4: Suspected Sternal Dehiscence</b>	<b>37</b>

### **CH-14.1: PPD or TB<sup>1, 2</sup>**

- Chest CT with contrast (CPT<sup>®</sup> 71260) is appropriate for individuals 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
  - ◆ Clinical evidence of active tuberculosis or reactivated tuberculosis.<sup>10</sup>
  - ◆ Suspected complications or progression of tuberculosis (e.g. pleural tuberculosis, empyema, and mediastinitis).
- If chest CT is unremarkable, there is insufficient data to support performing subsequent chest CT unless symptoms develop or chest x-ray shows a new abnormality.
- Follow-up chest CT with contrast (CPT<sup>®</sup> 71260) with frequency at the discretion of the pulmonary specialist (not to exceed 3 studies in 3 months).
  - ◆ Re-evaluate individuals undergoing active treatment for tuberculosis who had abnormalities seen only on chest CT.

### **CH-14.2: Fungal Infections**

- Chest CT with contrast (CPT<sup>®</sup> 71260) or High resolution chest CT (HRCT) without contrast (CPT<sup>®</sup> 71250) is appropriate for individuals with:<sup>3,4</sup>
  - ◆ Initial diagnosis of any fungal pneumonia or chest infection.<sup>3,4</sup>
  - ◆ Suspected complications or progression of the fungal chest infection (e.g. worsening pneumonitis; pleural effusion, empyema, mediastinitis).
- Follow-up chest CT with contrast (CPT<sup>®</sup> 71260) or High resolution chest CT (HRCT) without contrast (CPT<sup>®</sup> 71250) with frequency at the discretion of the pulmonary specialist.

### **CH-14.3: Wegener's Granulomatosis/Granulomatosis with Polyangiitis**

- Chest CT without contrast (CPT<sup>®</sup> 71250)\* should be done in all patients who have pulmonary symptoms and are suspected of having an Antineutrophil cytoplasmic autoantibody (ANCA)-associated vasculitides (AAV) either when:<sup>5,6</sup>
  - ◆ Newly diagnosed, or <sup>5,6</sup>
  - ◆ Baseline prior to initiating immunosuppressive therapy.<sup>5,6</sup>
- Selective use of additional imaging is useful in evaluating patients who are suspected or known to have AAV, including a CT scan of the head (sinuses, orbits, mastoids) in patients with visual or upper respiratory track symptoms or signs, and a CT scan of the neck (subglottic region) in patients with symptoms or signs of subglottic stenosis.<sup>6</sup>

\*In most situations, CT scans in patients with AAV should be performed without an iodinated contrast agent administered.<sup>6</sup>

## **CH-14.4: Suspected Sternal Dehiscence**

- Sternal wound dehiscence is primarily a clinical determination.
- Chest x-ray is performed prior to advanced imaging to identify abnormalities in the sternal wire integrity and/or a midsternal stripe. Other findings include rotated, shifted or ruptured wires.
- CT chest without contrast can be considered if there is planned debridement and/or repair.

### ***References***

1. Kim W, Moon W, Kim I, et al. Pulmonary tuberculosis in children: evaluation with CT. *AJR* 1997 April; 168(4):1005-1009. Accessed November 7, 2017. <http://www.ajronline.org/doi/abs/10.2214/ajr.168.4.9124105>
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7. Ravenel J, Chung J, Ackman J, et al. Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® imaging of possible tuberculosis. *American College of Radiology (ACR)*; 2016. Accessed November 7, 2017. [http://www.jacr.org/article/S1546-1440\(17\)30202-8/fulltext](http://www.jacr.org/article/S1546-1440(17)30202-8/fulltext).

## CH-15: Sarcoid

### CH-15.1: Sarcoid

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## **CH-15.1: Sarcoid**

- Chest CT either with contrast (CPT® 71260) or without contrast (CPT® 71250) is appropriate for the following:<sup>1</sup>
  - ◆ Establish or rule out the diagnosis when suspected,
  - ◆ Development of worsening symptoms,
  - ◆ New symptoms appear after a period of being asymptomatic, or
  - ◆ Treatment change is being considered in known sarcoid.
- If CT is equivocal, definitive diagnosis can only be made by biopsy.<sup>2,3,4</sup>
- There is currently no evidence-based data to support performing serial PET scans to monitor disease activity while tapering steroid therapy.<sup>2,3,4</sup>
  - ◆ See: **CD-5.2: Cardiac MRI – Indication (excluding Stress MRI)**
  - ◆ and **HD-22: Cerebral: Vasculitis** in the Head Imaging Guidelines.

### ***References***

1. Hantous-Zannad S, Charrada L, Zidi A, et al. Value of CT scanning in the investigation of thoracic sarcoidosis. *Rev Mal Respir* 2003 April; 20 (2 pt 1):207-213. Accessed November 7, 2017. <https://www.ncbi.nlm.nih.gov/pubmed/12844018>.
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3. Barney J, Addrizzo-Harris D, Patel N, Sarcoidosis, *Chest Foundation*. Acquired 09182017. Accessed November 7, 2017. <https://foundation.chestnet.org/patient-education-resources/sarcoidosis/#diagnosis>.
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**CH-16: Solitary Pulmonary Nodule (SPN)**

<b>CH-16.1: Imaging</b>	<b>41</b>
<b>CH-16.2: Incidental Pulmonary Nodules Detected on CT Images</b>	<b>42</b>
<b>CH-16.3: Interval Imaging Outcomes</b>	<b>43</b>
<b>CH-16.4: PET</b>	<b>43</b>



- For Lung Cancer Screening (LDCT) including incidental findings from LDCT, see **CH-34: Lung Cancer Screening.**

### **CH-16.1: Imaging**

- Chest CT with contrast (CPT® 71260) or chest CT without contrast (CPT® 71250) (with contrast is preferred for initial evaluation) can be performed for discrete nodule(s) in the following scenarios:<sup>1,2,3</sup>
  - ◆ Lung nodule(s) seen on an imaging study other than a “dedicated” chest CT or MR. Examples of other studies:
    - Chest x-ray.
    - Abdominal CT.
    - Spine MRI.
    - Coronary CTA (see: **CH-1.3: General Guidelines - Chest CT.**)<sup>1</sup>
  - ◆ Lung nodule(s) identified incidentally on any of the following dedicated chest studies can replace Chest CT with contrast (CPT® 71260) or Chest CT without contrast (CPT® 71250) as the initial dedicated study: (See: **CH-1.3: General Guidelines - Chest CT**)
    - Chest CT without and with contrast (CPT® 71270).
    - Chest CTA without and with contrast (CPT® 71275).
    - Chest MRI without contrast (CPT® 71550).
    - Chest MRI without and with contrast (CPT® 71552).
    - Chest MRA without and with contrast (CPT® 71555).
  - ◆ Comparisons should include the earliest available study and the more recent previous chest CT scans to determine if nodule was present and stable.<sup>1</sup> Using largest measurement of multiple lung nodules.<sup>1</sup>
    - See: **CH-12: Multiple Pulmonary Nodules.**
    - Similar-sized pleural nodule(s) is treated as a pulmonary nodule(s) (see: **CH-12: Multiple Pulmonary Nodules.**)

## **CH-16.2: Incidental Pulmonary Nodules Detected on CT Images**

<b>SOLID NODULE SIZE (mm)*</b>	<b>CHEST CT INTERVAL (months)</b>
<6	Follow-up at 12; if unchanged, no further follow-up <sup>1</sup>
6-8	Follow-up at 6-12 <sup>**</sup> ; then at 18-24 (complete to 24) <sup>1</sup> <sup>**</sup> if multiple nodules first interval at 3-6; then at 18-24 (complete to 24) <sup>1</sup>
>8	Follow-up at 3-6, 18-24, consider PET or biopsy <sup>1</sup>
<b>SUBSOLID NODULE SIZE (mm)</b>	<b>CHEST CT INTERVAL (months)</b>
<6	Follow-up at 2 and 4 years <sup>1</sup>
>/= 6	Follow-up at 6-12; then annually for 5 years <sup>1</sup>
<b>GROUND GLASS SIZE (mm)</b>	<b>CHEST CT INTERVAL (months)</b>
<6	Follow-up at 2 and 4 years <sup>1</sup>
>/=6	Follow-up at 6-12; then annually for 5 years <sup>1</sup>
<b>SPECIAL SITUATIONS</b>	<b>CHEST CT INTERVAL (months)</b>
Negative PET	>/= 6 months after PET, and complete to 24 from the first CT Chest (2, Figure 1, 4,5 )
Previous or current malignancy and pulmonary nodule(s) that would reasonably metastasize to the lungs	See <b><u>ONC-31.1: Lung Metastases</u></b>

\*Following the Fleischner Society Guidelines for high risk which include American College of Chest Physicians intermediate and high risk categories.<sup>1,2</sup>

### **CH-16.3: Interval Imaging Outcomes**

- No further advanced imaging is necessary if a nodule has been
  - ◆ Stable for 2 years
    - Nodules(s) stable on chest x-ray.
    - Nodule(s)  $\geq$  6mm stable on CT chest.<sup>1</sup>
  - ◆ Stable for 1 year
    - Nodule(s)  $<$  6mm.<sup>1</sup>
  - ◆ At any time, if:
    - Classically benign characteristics by chest x-ray or previous CT (e.g. benign calcification pattern typical for a granuloma or hamartoma).
    - Decreasing or disappearing nodule(s).<sup>3</sup>
  - ◆ Lung nodule(s) which increases in size or number should no longer be considered for CT screening or surveillance, including resetting the 2 year. Fleischner interval based on a new size, since stability drives screening or surveillance.<sup>1,2,3,7</sup>
  - ◆ Instead, with an increasing nodule or number, PET (see below). Tissue sampling or other further diagnostic investigations should be considered.

### **CH-16.4: PET**

- PET/CT (CPT<sup>®</sup> 78812 or CPT<sup>®</sup> 78815) is appropriate for a distinct lung nodule  $\geq$  8 mm on chest CTA or MRA.
  - ◆ If there is a history of malignancy, refer to the appropriate Oncology restaging/recurrence guideline for indications for PET imaging.
    - Pleural nodule see **CH-17.1: Pleural-Based Nodules and Other Abnormalities.**
  - ◆ Serial PET studies are not considered appropriate.
  - ◆ Not appropriate for infiltrate, ground glass opacity, or hilar enlargement.

#### ***Practice Notes***

- A **nodule** is any pulmonary or pleural lesion that is a discrete, spherical opacity 2-30 mm in diameter surrounded by normal lung tissue. A larger nodule is called a mass. Entities that are not nodules, and are considered benign, include non-spherical linear, sheet-like, two-dimensional or scarring opacities.<sup>3</sup>
- **Malignant** nodule features can include spiculation, abnormal calcification, size greater than 7-10 mm, interval growth, history of a cancer that tends to metastasize to the lung or mediastinum, and/or smoking history.<sup>1,3</sup>
  - ◆ A nodule that grows at a rate consistent with cancer (doubling time 100 to 400 days) may be sampled for biopsy or resected.<sup>1</sup>
  - ◆ Less than 1% of  $<$ 6mm lung nodules are malignant.<sup>1</sup>
  - ◆ Three per cent of all 8 mm lung nodules are malignant.<sup>1</sup>
  - ◆ Only one follow-up at 6-12 months is sufficient for 6-8mm nodules and not all require traditional 2 year follow-up.<sup>1</sup>
  - ◆ The larger the solid component of a subsolid nodule, the greater the risk of invasiveness and metastases.<sup>1</sup>

- ◆ Increased risk of primary cancer as the total nodule count increased from 1 to 4 but decreased risk in patients with 5 or more nodules, most of which likely resulted from prior granulomatous infection.<sup>1</sup>
- ◆ A nodule that does not grow in 6 months has a risk of malignancy at <10%.
- **Benign** features can include benign calcification (80% granuloma, 10% hamartoma), multiple areas of calcification, small size, multiple nodules, negative PET, and stability of size over 2 years.<sup>3</sup>
- **Ground glass** or subsolid opacities, which can harbor indolent adenocarcinoma with average doubling times of 3–5 years.<sup>1</sup>
- **Repeat PET** is discouraged, since if the original PET is positive, biopsy may be performed. If the original PET is negative but subsequent chest CT shows increase in size of the nodule, biopsy may be performed.
- **False positive PET** can occur with infection or inflammation; false negatives can occur with small size nodule, ground glass lesions and indolent cancers such as bronchoalveolar or carcinoid.
- **False negative PET** can be seen in patients with adenocarcinoma in situ, carcinoid tumors, and mucinous adenocarcinomas. High pre-test likelihood of malignancy negative findings on the PET scan only reduce the likelihood of malignancy to 14%; while in a patient with a low pre-test likelihood (20%), a negative FDG PET scan reduces the likelihood of malignancy to 1%.<sup>6</sup>

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## **CH-17: Pleural-Based Nodules and Other Abnormalities**

### **CH-17.1 Pleural-Based Nodules and Other Abnormalities**

**46**

## **CH-17.1 Pleural-Based Nodules and Other Abnormalities**

- Chest CT with contrast (CPT® 71260) or chest CT without contrast (CPT® 71250) (with contrast is preferred for initial evaluation) can be performed for pleural nodule(s).<sup>1</sup>
  - ◆ Pleural nodule(s) seen on an imaging study other than a “dedicated” chest CT or MR.<sup>1</sup>(see: **CH-1.3: General Guidelines – Chest CT**)
  - ◆ Pleural nodule(s) identified incidentally on any of the following dedicated chest studies can replace Chest CT as the initial dedicated study.<sup>1</sup>(see: **CH-1.3: General Guidelines – Chest CT**)
  - ◆ After preliminary comparison with any available previous chest films to determine presence and stability.
  - ◆ Using largest measurement of multiple nodule(s). (see: **CH-12: Multiple Pulmonary Nodules**).
  - ◆ Following the Fleischner Society Guidelines for high risk. (See **CH-16.1: Solitary Pulmonary Nodule (SPN) - Imaging**)<sup>1</sup>
- PET can be considered if dedicated CT or MRI Chest identifies a pleural nodule/mass or defined area of pleural thickening that is >8 mm when there is a likelihood of malignancy including current or previous malignancy, pleural effusion, bone erosion, chest pain.<sup>1</sup>

### ***Practice Notes***

- Pleural nodule/mass or thickening without suggestion of malignancy would undergo surveillance or biopsy.

### ***Reference***

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## CH-18: Pleural Effusion

### CH-18.1: Pleural Effusion

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## **CH-18.1: Pleural Effusion**

- Chest CT with contrast (CPT® 71260) can be performed after both:<sup>1,2</sup>
  - ◆ Chest x-ray including lateral decubitus films; and
  - ◆ Thoracentesis to determine if fluid is exudative or transudative and remove as much as possible (this fluid can obscure the underlying lung parenchyma and possibly a mass).
- Chest ultrasound (CPT® 76604) can be used as an alternative to chest x-ray to evaluate for the presence of fluid within the pleural spaces and guide thoracentesis.

### ***Practice Notes***

- Bilateral effusions are more often systemic related transudates (congestive heart failure, renal failure, liver insufficiency, etc.), and advanced imaging is rarely needed. Large unilateral effusions can be malignant. Analysis of fluid may include: cytology, culture, cell count, and biochemical studies.

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**CH-19: Pneumothorax/Hemothorax**

<b>CH-19.1: Pneumothorax/Hemothorax</b>	<b>50</b>
<b>CH-19.2: Pneumomediastinum; Subcutaneous Emphysema</b>	<b>50</b>

## **CH-19.1: Pneumothorax/Hemothorax**

- Chest x-ray should be performed initially.
  - ◆ Chest CT with contrast (CPT® 71260) or without contrast (CPT® 71250) if:
    - Diagnosis of a small pneumothorax is in doubt, and the presence of a pneumothorax will affect patient treatment decisions.<sup>1</sup>
    - Preoperative study for treatment of pneumothorax.<sup>1</sup>
    - Pneumothorax associated with hemothorax.<sup>2</sup>
    - Suspected complications from hemothorax (e.g. empyema).<sup>2</sup>
    - Suspected Alpha-1-Antitrypsin Deficiency (even without pneumothorax).<sup>3</sup>

## **CH-19.2: Pneumomediastinum; Subcutaneous Emphysema**

- Chest x-ray should be performed initially.
  - ◆ Chest CT with contrast (CPT® 71260) or without contrast (CPT® 71250) if:
    - Recent vomiting and/or suspected esophageal perforation.<sup>4,5</sup>
    - Associated pneumopericardium.<sup>4,5</sup>
    - Associated pneumothorax.<sup>4,5</sup>
    - Preoperative study for treatment.<sup>4,5</sup>

### ***Practice Notes***

- An expiration chest x-ray can enhance the evaluation of equivocal plain x-ray. There is no data supporting the use of serial chest CT to follow patients with a known pneumothorax or hemothorax who are asymptomatic or have stable symptoms. With the exception of the indications above, advanced imaging of the chest is rarely indicated in the diagnosis or management of pneumothorax. Inspiratory/expiratory chest x-rays are helpful in defining whether a pneumothorax is present.

### ***References***

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# CH-20: Mediastinal Mass

CH-20.1: Mediastinal Mass	52
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## **CH-20.1: Mediastinal Mass**

- Chest CT with contrast (CPT® 71260) is the imaging study of choice to evaluate mediastinal abnormalities seen on chest x-ray or other non-dedicated chest imaging and can be done once initially if there is a concern for:<sup>1,2,3</sup>
  - ◆ Mediastinal cyst including bronchogenic, thymic, pericardial or esophageal in nature.
    - Subsequent evaluations either with CT Chest or MRI Chest can be performed for:
      - New signs or symptoms, or
      - Preoperative assessment.
- For Adenopathy; see **CH-2: Lymphadenopathy**.
- For Goiter; see **NECK-9.1: Thyroid Nodule**.
- For Myasthenia Gravis; see **PN-6.1: Neuromuscular Disease**.

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## CH-21: Chest Trauma

### CH-21.1: Chest Trauma

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## **CH-21.1: Chest Trauma**

- Chest X-ray should be performed initially.
  - ◆ Chest CT without contrast (CPT® 71250) or with contrast (CPT® 71260) is appropriate for the following situations:<sup>1</sup>
    - Rib 1 or Sternal 2 Fracture:
      - With associated complications identified clinically or by other imaging, including pneumothorax, hemothorax, pulmonary contusion, atelectasis, flail chest, cardiovascular injury and/or injuries to solid or hollow abdominal organs.<sup>1</sup>
      - Uncomplicated, single fractures, multiple fractures, non-acute fractures, or occult rib fractures are NOT an indication for chest CT unless malignancy is suspected as the etiology.<sup>1</sup>
    - Routine follow-up advanced imaging of rib or sternal fractures is not indicated.<sup>1</sup>
- Suspected Pathological Rib Fractures should undergo CT Chest without contrast (71250) or Tc-99m bone scan whole body.<sup>1</sup>
- Clavicle Fractures:
  - ◆ Proximal (medial) 1/3 fractures or sternoclavicular dislocations can undergo Computed tomography (CT) and magnetic resonance imaging of the chest or shoulder.<sup>3</sup>
  - ◆ X-ray is adequate for evaluation of middle and distal 1/3 fractures.<sup>3</sup>
- No advanced imaging of the abdomen or pelvis is indicated when there is chest trauma and no physical examination or laboratory evidence of abdominal and/or pelvic injury.

### ***References***

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## CH-22: Chest Wall Mass

### CH-22.1: Chest Wall Mass

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## **CH-22.1: Chest Wall Mass**

- Chest x-ray is useful in the workup of a soft-tissue mass and are almost always indicated as the initial imaging study.<sup>1</sup>
  - ◆ Chest ultrasound (CPT<sup>®</sup> 76604) may be useful as an initial imaging study in the setting of a suspected superficial or subcutaneous lipoma. This modality may also be valuable in differentiating cystic from solid lesions and has also been used to assess the vascularity of lesions.<sup>1</sup>
  - ◆ Chest CT with contrast (CPT<sup>®</sup> 71260) or chest CT without contrast (CPT<sup>®</sup> 71250) or MRI chest without and with contrast (CPT<sup>®</sup> 71552) or MRI chest without contrast (CPT<sup>®</sup> 71550) can be considered when the following are met:<sup>1,2</sup>
    - Chest x-ray completed and does not demonstrate any of the following:
      - Obvious lipomas<sup>1</sup> (see also **MS-10: Soft Tissue Mass or Lesion of Bone**).
      - Clearly benign entity<sup>1</sup> (see also **MS-10: Soft Tissue Mass or Lesion of Bone**).
      - No mass identified (radiographically or palpated).<sup>1</sup>

### ***Practice Notes***

- Chest x-rays of chest wall masses can detect calcification, ossification, or bone destruction as well as location and size.<sup>3</sup>

### ***References***

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2. Morrison W, Weissman B, Kransdorf M, et al, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria<sup>®</sup> primary bone tumors. [online publication]. Reston (VA): American College of Radiology (ACR); 2013 Accessed November 7, 2017. <https://acsearch.acr.org/docs/69421/Narrative>.



## **CH-23: Pectus Excavatum and Pectus Carinatum**

### **CH-23.1: Pectus Excavatum and Carinatum**

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## **CH-23.1: Pectus Excavatum and Carinatum**

- Chest CT without contrast (CPT® 71250) or MRI chest without and with contrast (CPT® 71552) and 3-D reconstruction (CPT® 76377) if requested can be considered if:
  - ◆ Candidates for surgical correction.<sup>1, 2</sup>
    - Cosmetic repairs requests without physiological disability or severe deformities may not meet certain payers policies.
  - ◆ Cardiac or pulmonary dysfunction has been identified<sup>1, 2</sup>
    - ECG and echocardiography are indicated if there are cardiac symptoms or evidence of cardiac function abnormalities.
    - Chest x-ray and PFT's are indicated if there is increasing shortness of breath.<sup>1</sup>
- Chest measurements derived from Chest CT, such as the Haller Index, are helpful to the thoracic surgeon in pre-operative assessment of chest wall deformities to assess for the appropriateness of operative repair prior to the development of symptomatic precuts deformities.
  - ◆ See also **PEDCH-11: Pectus Deformities** in the Pediatric Chest Imaging Guidelines.

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# **CH-24: Pulmonary Arteriovenous Fistula (AVM)**

## **CH-24.1: Pulmonary AVM**

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## **CH-24.1: Pulmonary AVM**

- Chest CT with contrast, chest CTA (preferred modality) (CPT® 71275), or chest MRA (CPT® 71555) can be obtained for evaluation of:<sup>1,2,3</sup>
  - ◆ Suspected pulmonary AVM.
  - ◆ First degree relatives of a patient with a primary pulmonary AVM.
  - ◆ Evaluation of patients with paradoxical embolus/stroke and no evidence of patent foreman ovale on echocardiogram.

### ***Practice Notes***

- Pulmonary AVMs are abnormal connections between pulmonary arteries and veins, usually found in the lower lobes, that can be either primary or acquired (such as trauma, bronchiectasis). They can be identified in up to 98% of chest x-rays by a peripheral, circumscribed, non-calcified lesion connected by blood vessels to the hilum of the lung. Treatment is often by surgery or embolization of the feeding artery using platinum coils or detachable balloons.

### ***References***

1. De Cillis E, Burdi N, Bortone A, et al. Endovascular treatment of pulmonary and cerebral arteriovenous malformations in patients affected by hereditary haemorrhagic teleangiectasia. *Current Pharmaceutical Design* 2006; 12 (10):1243-1248. Accessed November 7, 2017. <http://www.eurekaselect.com/56022/article>.
2. Gossage J and Kanj G. Pulmonary Arteriovenous Malformations a State of the Art Review, *Am. J. Respir. Crit. Care Med.* August 1, 1998 vol. 158 no. 2 643-661. Accessed November 7, 2017. <http://www.atsjournals.org/doi/abs/10.1164/ajrccm.158.2.9711041>.
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## CH-25: Pulmonary Embolism (PE)

### CH-25.1: Pulmonary Embolism

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## **CH-25.1: Pulmonary Embolism**

- Chest CT with contrast with PE protocol (CPT® 71260) or chest CTA (CPT® 71275) would be appropriate if at least one symptom, clinical/laboratory finding or risk factor from each of the lists below are present.
  - ◆ With any one of the 3: 6,7,8
    - Dyspnea, new onset and otherwise unexplained;
    - Chest Pain, pleuritic;
    - Tachypnea
  - AND**, with any one of the 3: 6,7,8
    - Abnormal **D-dimer** test;
    - Wells Criteria score\* higher than 4 points;
    - One Risk Factor\*\* or Symptom\*\* of new onset demonstrating high clinical probability of PE

RISK FACTORS** 6,7,8	SYMPTOMS ATTRIBUTED TO PE** 6,7,8
Immobilization at least 3 days or surgery in last 4 weeks or recent trauma	Signs or symptoms of DVT
Previous history of DVT or PE	Hemoptysis
Cancer actively treated in last 6 months or receiving palliative treatment	Right heart strain or failure
Recent history of a long airplane flight	Systolic BP<90
Use of estrogen-based contraceptives (birth control pills, the patch, and vaginal ring)/Oral estrogen (1)	Syncope
Advanced age (>/=70)	Cough
Congestive heart failure	Heart Rate >100
Obesity (BMI >/= 35)	Palpitations

Well's Criteria for Clinical Probability of PE* 6	
Clinical signs/symptoms of DVT (at minimum: leg swelling and pain with palpation of the deep veins)	3
PE is likely or equally likely diagnosis	3
Heart rate >100	1.5
Immobilization at least 3 days or surgery in last 4 weeks	1.5
Previous history of DVT or PE	1.5
Hemoptysis	1
Cancer actively treated in last 6 months or receiving palliative treatment	1
Calculate Probability:    Low <2    Moderate 2 to 6    High >6	
Using the above criteria, only 3% of patients with a low pretest probability had PE versus 63% of those with a high pretest probability.	

- ◆ Non-urgent cases which do not meet above 2-step criteria, should undergo prior to advanced imaging: <sup>9</sup>
  - Chest x-ray (to rule out other causes of acute chest pain).
  - Primary cardiac and pulmonary etiologies should be eliminated.
- ◆ Pregnant women with suspected PE are suggested to proceed with<sup>1,9</sup>
  - D-dimer and/or;
  - Doppler studies of the lower extremities;
  - V/Q preferred if Doppler negative; Chest CTA (CPT® 71275) or chest MRA (CPT® 71555) can be performed if V/Q scanning is not available.
- ◆ Ventilation-perfusion scans, also called V/Q, scans (CPT® 78580-Pulmonary Perfusion Imaging; CPT® 78582-Pulmonary Ventilation (e.g., Aerosol or Gas) and Perfusion Imaging.
  - Is not a replacement for CTA Chest<sup>9</sup>
  - Can be considered in any of the following:
    - Suspected pulmonary embolism if there is a contraindication to CT or CTA of the chest (ventilation-perfusion scans CPT® 78582).
    - Suspected pulmonary embolism when a Chest x-ray is negative and CTA Chest is not diagnostic (CPT® 78580 or CPT® 78582).
    - Follow-up of an equivocal or positive recent ventilation-perfusion lung scan to evaluate for interval change (CPT® 78580).
- ◆ Follow-up Imaging in Stable or Asymptomatic Patients with Known PE is not warranted<sup>2,3,4,10</sup>

- ◆ Chest CT with contrast with PE protocol (CPT® 71260) or chest CTA (CPT® 71275) can be performed for any of the following indications:
  - Recurrent signs or symptoms such as dyspnea, or
  - Elevated d-dimer which is persistent or recurrently elevated, or
  - Right heart strain or failure identified by EKG, ECHO or Heart catheterization.

### *Practice Notes*

- Pulmonary embolism is found in approximately 10% of all those that present with suspicion of PE. Dyspnea, pleuritic chest pain and tachypnea occur with about 50% incidence with leg swelling or pain just over 50%.
- D-dimer level has a high sensitivity and low specificity for diagnosing PE.
  - ◆ A negative D-dimer in combination with low or moderate PE risk classification has a negative predictive value approaching 100%.
  - ◆ D-dimer can be falsely elevated with recent surgery, injury, malignancy, sepsis, diabetes, pregnancy, or other conditions where fibrin products are likely to be present.
- CT imaging has supplanted V/Q scanning since the latter is difficult to obtain quickly, does not provide a substantial cost savings, and does not diagnose other pulmonary pathology.
- The decision to terminate anticoagulation treatment after previous pulmonary embolism (PE) with absent or stable symptoms is based on clinical evaluation and risk factors.
- Repeat studies do not allow one the ability to distinguish new from residual clot, with luminal diameter and clot character poorly correlated to symptoms and ECHO findings.
- Two thirds after primary thromboembolism have residual pulmonary artery clot at 6 months and 50% remains at one year.
- Subsequent persistence or elevation of D-dimer is associated with increased risk of recurrent PE. ECHO and Right Heart Catheterization (RHC) can identify those with pulmonary hypertension. Yet, 1/2 of all have persistent or new pulmonary hypertension after primary thromboembolism and only half of this latter group has dyspnea at rest or exercise intolerance.



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## CH-26: Pulmonary Hypertension

- See **PVD-5:Pulmonary Artery Hypertension** in the Peripheral Vascular Disease Imaging Guidelines.

## CH-27: Subclavian Steal Syndrome

### CH-27.1: Subclavian Steal Syndrome

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- Occurs from blood flowing up the contralateral vertebral artery to the basilar artery and retrograde down the ipsilateral vertebral artery (reversal of flow) to supply collateral circulation to the arm on the side and past the stenotic or occluded proximal subclavian or innominate artery to perfuse that arm.

### **CH-27.1: Subclavian Steal Syndrome**

- Initial evaluation should include clinical findings satisfying the symptom complex and initial imaging with carotid duplex study (CPT® 93882).
  - ◆ Satisfying the symptom complex.
    - Physical examination findings suggestive of subclavian stenosis include a discrepancy of >15 mmHg in blood pressure readings taken in both upper extremities, delayed or decreased amplified pulses in the affected side, and a bruit in the supraclavicular area on the affected side.
    - Symptoms include vertebral basilar artery insufficiency, vertigo, limb paresis, and paresthesias. Bilateral cortical visual disturbances, ataxia, syncope, and dysarthria occur less frequently.
    - Symptoms of cerebral ischemia may be produced by exercise of the affected arm.
  - ◆ Carotid duplex study (CPT® 93882) is the initial and definitive imaging study
    - Reversal of flow in the ipsilateral vertebral artery.
    - If the carotid duplex is not diagnostic for reversal of flow in the ipsilateral vertebral artery, then neurological symptoms should be evaluated according to the Head guidelines.
- Neck and chest MRA (CPT® 70548 and CPT® 71555) or CTA (CPT® 70498 and CPT® 71275) can be performed for diagnosis in patients with symptoms of vertebro-basilar ischemia if the clinical exam and duplex study are positive, indeterminate, or as preoperative studies if they will substitute for invasive angiography.
- Upper extremity MRA (CPT® 73225) or CTA (CPT® 73206) can be performed in symptomatic patients if needed to exclude pathology distal to the subclavian artery and if they will substitute for invasive angiography.
- See also **HD-21.1: Stroke/TIA** (for vertebrobasilar stroke) in the Head Imaging Guidelines.
- Treatment options include ligation of the ipsilateral vertebral artery, aorta-subclavian artery bypass graft, or subclavian endarterectomy.

#### ***Practice Note:***

- While MRA does not expose the patient to radiation, CTA should be considered the test of choice for subclavian steal syndrome given its superior spatial and temporal resolution.

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## **CH-28: Superior Vena Cava (SVC) Syndrome**

### **CH-28.1: SVC Syndrome**

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## **CH-28.1: SVC Syndrome**

- Chest CT with contrast (CPT® 71260) is the initial imaging studies of choice for the evaluation of suspected SVC syndrome based on the facial cyanosis and UE swelling without anasarca.<sup>1,2</sup>
- MRV (CPT® 71555) or CTV (CPT® 71275) of the chest may be indicated when stenting of the SVC is being considered.<sup>1,2</sup>

### **Practice Notes**

- SVC syndrome is caused by acute or subacute, intrinsic or extrinsic obstruction of the SVC, most commonly from lung cancer (80-85%) and less often benign (fibrosis, mediastinitis, indwelling devices). Other symptoms include dyspnea, headache and dizziness.

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**CH-29: Thoracic Aorta**

<b>CH-29: Thoracic Aorta</b>	<b>73</b>
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## CH-29: Thoracic Aorta

- Thoracic aortic diseases are variable and critical; selected imaging procedures are dependent upon the physicians' preference and expertise. As a result, all thoracic imaging in this section (**CH-29**) can be **one** of the following studies listed in the table below:

Table of Thoracic Aorta Imaging Options
CT of chest, and/or abdomen, and/or pelvis (contrast as requested);
MRI of the chest, and/or abdomen, and/or pelvis without contrast OR without and with contrast;
CTA of chest, and/or abdomen, and/or pelvis (CPT® 71275, CPT® 74175, CPT® 72191, CPT® 74174);
MRA of chest, and/or abdomen, and/or pelvis (CPT® 71555, CPT® 74185, CPT® 72198)

### CH-29.1: Aortic Dissection

- Classic symptoms of sharp, severe acute onset of retrosternal or interscapular chest pain is seen in 96% and is best adapted to the emergent setting. CXR is imprecise; any suspicion should be considered since up to 10% of patients with aortic dissection present without classic symptoms.
- For suspected aortic dissection, conduct CTA or MRA of the entire aorta (including arch branches) and extending through the femoral arteries. <sup>1, 2, 3, 4, 5</sup>
- For follow-up, any requested imaging from the "Table of Thoracic Aorta Imaging Options" can be performed. <sup>1,2,3,4,5,7,9</sup>
  - ◆ "Medically" treated (usually type B) patients.
    - Every 6 months if total aortic diameter is  $\geq 4.5$  cm.
    - Annually if total aortic diameter is  $< 4.5$  cm.
  - ◆ Surgery or Stent treatment for any type dissection (A or B).
    - First Year: 1 month, 3 months, 6 months, 12 months, then annually.

#### Practice Note

- CTA is the test of choice given its superior spatial resolution, ease of monitoring the patient in the CT scanner, availability and speed of imaging. MRI can be performed as well but has limitations.

## **CH-29.2: Thoracic Aortic Aneurysm (TAA)**

- For suspected TAA, any requested imaging from the “Table of Thoracic Aorta Imaging Options” above:
  - ◆ Abnormalities identified on Chest –x-ray (abnormality including widened mediastinal) or other imaging studies (fluoroscopy, spine MRI, etc.) abnormality.  
1,2,3,4,5
- For known TAA and chest pain or back pain, any requested imaging from the “Table of Thoracic Aorta Imaging Options” above.<sup>1, 2,3,4,5</sup>
- For planning for pre–thoracic endovascular repair (TEVAR) of thoracic aorta disease.<sup>9</sup>
  - ◆ CTA of chest, and/or abdomen, and/or pelvis (CPT® 71275, CPT® 74175, CPT® 72191, CPT® 74174 ); or MRA of chest, and/or abdomen, and/or pelvis (CPT® 71555, CPT® 74185, CPT® 72198)
- For follow-up, any requested imaging from the “Table of Thoracic Aorta Imaging Options” above for the following: <sup>4,5,7,9</sup>
  - ◆ “Medically” treated/observation.
  - ◆ 3.5 to 4.4 cm TAA can be followed annually.
  - ◆  $\geq$  4.5 cm TAA can be followed every 6 months.
  - ◆  $\geq$  3.0 cm TAA when there is concern for growth can have a one-time 3 month interval advanced imaging.
  - ◆ Surgery or Stent treatment.
    - Preoperative open or endovascular (stent) repair imaging is appropriate.
      - Suspicion of endoleaks.
    - Open Repair imaging every 3 to 5 years.
  - ◆ Endovascular graft/stent.
    - First year: 1 month, 3 months, 6 months, 12 months, then annually.
- Screening with Abdominal Aortic Aneurysm (AAA).
  - ◆ Known TAA can be screened for AAA using Abdominal Imaging Guidelines (usually US) See: **AB-17.1: Abdominal Aortic Aneurysm**.
  - ◆ Known AAA screening for TAA is not supported by sufficient evidence.

For educational information on the normal size of the aortic arch and descending thoracic, see **Practice Notes**.

## **CH-29.3: Screening Guidelines for Familial Syndromes**

- Screening for Familial Syndromes and Genetic Syndromes. <sup>4,5,6,8,9</sup>
  - ◆ Suspected Familial Thoracic Aortic Aneurysm.
    - ECHO (CPT® 93306, CPT® 93307, or CPT® 93308) and CXR for all First-degree relatives (parents, siblings, children) of patients with TAA and/or dissection.
  - ◆ Any imaging listed can be performed if these studies identify a TAA or are equivocal or do not visualize the ascending aorta adequately.
  - ◆ Follow-Up per TAA Follow-Up guidelines.

- Screening for Marfan Syndrome or Ehlers-Danlos Syndrome, Vascular form or Type IV<sup>4, 5,6,8,9</sup>
  - ◆ Suspected, ECHO (CPT® 93306, CPT® 93307, or CPT® 93308) at the time of diagnosis.
  - ◆ Follow-up:
    - Annual ECHO (CPT® 93306, CPT® 93307, or CPT® 93308) or per TAA Follow-Up guidelines.
      - For educational information on familial TAA, see **Practice Notes**.

#### **CH-29.4: Thoracic Aorta in Individuals with Bicuspid Aortic Valve**

- Screening for Bicuspid Aortic Valve.<sup>8,10</sup>
  - ◆ Suspected, any requested imaging from the “Table of Thoracic Aorta Imaging Options” and/or ECHO (CPT® 93306, CPT® 93307, or CPT® 93308).
    - Additional imaging such as cardiac MRI, cardiac CT, or CCTA is NOT generally indicated.
    - There is no evidence-based data to support screening relatives of patients with bicuspid aortic valve.
  - ◆ Follow-up per TAA Follow-Up guidelines.
    - If no dilatation of the aortic root or ascending thoracic aorta is found, there is no evidence-based data to support continued surveillance imaging.

For more educational information on the Bicuspid Aortic Valve, see **Practice Notes**

For Coarctation; see **PEDPVD-4.1: Thoracic Aortic Disease**, **PEDAB-14: Renovascular Hypertension and Other Secondary Causes of Hypertension**, **PEDCD-2.3: Congenital Heart Disease Modality Considerations**, **PEDCD-2.4: Congenital Heart Disease Timing Considerations**

#### **CH-29.5: Calcified Ascending Aorta**

- Prior to open-heart operations.<sup>11,12,13</sup>
  - ◆ Transesophageal echocardiography (TEE), Intraoperative ultrasonography and/or open direct aortic palpation are used to detect atherosclerotic changes in the aortic wall.<sup>10,11</sup>
- Prior to TAVR/I (Transcatheter Aortic Valve Replacement/Implantation).<sup>3</sup>
  - ◆ See CT and CTA in CD-4.8: Transcatheter Aortic Valve Replacement (TAVR).

#### ***Practice Notes: Aortic Dissection***

- There are two general types of aortic dissection:
  - ◆ **Type A:** Those that begin in the ascending aorta.
  - ◆ **Type B:** Those that begin from just distal to the left subclavian artery branch of the aorta.
- **Type A** often requires urgent surgical intervention with placement of an aortic graft or endovascular stent graft.
- **Type B** 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. Transesophageal echo may be equally diagnostic compared to CT or MRI.

- Routine follow-up imaging is important because 30%-40% of chronic dissections will become aneurysmal in 5 years and will require intervention, with less patent false lumen at higher risk.
- Penetrating ulcer (through the intima) and intramural hematoma (no intimal tear) are variant forms of aortic dissection and should follow that of aortic dissection, since they are considered precursors of aortic dissection.

## **TAA**

- The normal size of the aortic arch and descending thoracic aorta is 3 cm. The aortic root is normally 3.5 cm. <sup>4,5</sup>
  - ◆ TAA occurs most often in the descending (50%) and then equally likely in the ascending or arch aorta.
  - ◆ Risk factors include atherosclerosis, prolonged hypertension and trauma with mean age 65.
  - ◆ Risk of rupture is 0% if < 4 cm and 31% if > 6 cm, which is when surgery is often recommended.

## **Familial TAA**

- Familial TAA presents at an earlier age, has a faster aortic growth rate, is seen in about 20% of non-Marfan TAA and has autosomal dominant inheritance, when compared to non-familial TAA.
- Bicuspid Aortic Valve.
- Since 20% of individuals who underwent bicuspid aortic valve surgery had concurrent ascending aortic aneurysms that needed repair. All patients with bicuspid aortic valve should have both the aortic root and ascending thoracic aorta evaluated for evidence of aortic dilatation

## **Bicuspid Aortic Valve.**

- Since 20% of individuals who underwent bicuspid aortic valve surgery had concurrent ascending aortic aneurysms that needed repair. All patients with bicuspid aortic valve should have both the aortic root and ascending thoracic aorta evaluated for evidence of aortic dilatation.

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## CH-30: Elevated Hemidiaphragm

### CH-30.1: Elevated Hemidiaphragm

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## **CH-30.1: Elevated Hemidiaphragm**

- Chest CT with contrast (CPT® 71260) and neck CT with contrast (CPT® 70491) (if requested) with new diaphragmatic paralysis after.<sup>1,2</sup>
  - ◆ Previous chest x-rays are available and reviewed to determine if the diaphragmatic elevation is a new finding, and/or
  - ◆ Fluoroscopic examination (“sniff test”) to differentiate true paralysis from weakness.
- CT abdomen with contrast (CPT® 74160) to rule out liver or abdominal process if Chest CT is negative.<sup>1,2</sup>
- Repeat advanced imaging studies in the absence of new signs or symptoms are not indicated.

### **Practice Notes**

- The right hemidiaphragm sits about 2 cm higher than the left.
- “Eventration” is thin membranous replacement of muscle, usually on the right, as the most common cause of elevation.
- Any injury to the phrenic nerve from neck to diaphragm can lead to paralysis.
- Common phrenic causes are traumatic or surgical injury or malignancy involving the mediastinum.
- Any loss of lung volume or increased abdominal pressure can lead to diaphragm elevation.

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## **CH-31: Thoracic Outlet Syndrome (TOS)**

### **CH-31.1: Thoracic Outlet Syndrome**

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## **CH-31.1: Thoracic Outlet Syndrome**

- Chest X-ray should be performed initially in all cases, after the onset of symptoms or if there has been a change in symptoms, since it can identify bony abnormalities or other causes of right upper extremity pain.<sup>1,2</sup>
- MR imaging is the preferred imaging modality in patients with suspected TOS.<sup>1,2</sup>
  - ◆ Chest MRI (CPT® 71550) or upper extremity other than joint MRI (CPT® 73218).
  - ◆ Neck and chest MRA (CPT® 70548 and CPT® 71555) can be used in place of MRI with suspected arterial or venous TOS.
  - ◆ CT Chest with contrast or CT Neck with contrast can be used in place of MRI for:
    - Suspected anomalous ribs or fractures, as bone anatomy is more easily definable with CT.
    - Postoperative patients in whom there is a question regarding a remnant first rib.
    - Dialysis-dependent renal failure, claustrophobia, or implanted device incompatibility.
- Also see **PN-4: Brachial Plexus** in the Peripheral Nerve Disorders Guidelines.

### ***Practice Notes***

- 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).
- There are 3 types, with neurogenic causes seen in 80%, venous causes (also called effort thrombosis) found in 15% and the remaining 5% being arterial in etiology.
- Since this is such a rare entity and diagnosis is difficult, specialist evaluation by a vascular surgeon or thoracic surgeon is helpful in determining the appropriate imaging pathway.

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## CH-32: Newer Imaging Techniques

<b>CH-32.1: Virtual Bronchoscopy</b>	<b>83</b>
<b>CH-32.2: Navigational/EM - Guided Peripheral Bronchoscopy</b>	<b>83</b>
<b>CH-32.3: Positron Emission Mammography</b>	<b>83</b>

### **CH-32.1: Virtual Bronchoscopy**

- There is insufficient data currently available to generate appropriateness criteria for the use of virtual bronchoscopy, and this procedure should be considered investigational at this time.<sup>1</sup>
- Virtual bronchoscopy uses multidetector CT with 3D rendering (CPT® 71260 and CPT® 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.<sup>1</sup>

### **CH-32.2: Navigational/EM– Guided Peripheral Bronchoscopy**

- EM Guided Peripheral Bronchoscopy is not a covered benefit for all health plans.
  - ◆ Peripheral bronchoscopy technology uses electromagnetic (EM) navigational guidance with a CT road map for performing biopsies of peripheral lung lesions.<sup>2</sup>
    - Supplemental imaging See **Preface-4.3**.

#### **Coding Notes**

- ◆ Planning is included in the navigational bronchoscopy code (CPT® 31627).
- ◆ Neither separate unlisted codes, (CPT® 76499 or CPT® 76497), nor other diagnostic CT codes should be reported for the planning phase and pre-procedure imaging acquisition.
- ◆ 3D Rendering, (CPT® 76376 and CPT® 76377), is not reported in conjunction with CPT® 31627.

### **CH-32.3: Positron Emission Mammography<sup>3, 4, 5</sup>**

- There is currently insufficient data available to generate appropriateness criteria for this modality, and this procedure should be considered investigational at this time.
  - ◆ High-resolution positron-emission mammography (PEM) by Naviscan™ PET Systems, also referred to as Naviscan™ or PET mammography, performs high-resolution metabolic imaging for breast cancer using an 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 ask 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 in detecting incidental breast cancers not seen on other imaging modalities.
  - ◆ A prospective multi-center clinical trial for women with newly diagnosed breast cancer anticipating breast-conservation surgery was performed. These women underwent both high-resolution PEM imaging and breast MRI. Results showed that PEM and MRI had comparable breast-level sensitivity, although MRI had greater lesion-level sensitivity and more accurately depicted the need for

mastectomy. PEM had greater specificity at the breast and lesion levels. Of these, 3.6% of the women had tumors seen only with PEM.

- ◆ The radiation exposure from a PEM study is 23 times higher than for digital mammography.

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## CH-33: Lung Transplantation

### CH-33.1: Pre-Transplant Imaging Studies

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### **CH-33.1: Pre-Transplant Imaging Studies**

- Individuals on the waiting list or being considered for the lung transplant can undergo advanced imaging per that institution's protocol as long as the studies do not exceed the following:
  - ◆ Chest CT with and without contrast (CPT® 71270), chest CT with (CPT® 71260), or chest CT without contrast (CPT® 71250),
  - ◆ ECHO
  - ◆ Imaging Stress Test (MPI, SE, MR) or Heart Catheterization (Right and Left); Heart catheterization can also be done after a positive stress test.
- Other studies that will be considered include V/Q scan, Six Minute Walk Test.
- Initial post-transplant follow-up: CT chest with and without contrast (CPT® 71270), CT chest with (CPT® 71260), or CT chest without contrast (CPT® 71250).
  - ◆ Requests for subsequent follow-up imaging will go to Medical Director review.
- See: **CD-1.6: Transplant Patients**.

#### ***Reference***

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**CH-34: Lung Cancer Screening**

<b>CH-34.1:U.S. Preventative Services Task Force: Lung Cancer Screening (Commercial and Medicaid)</b>	<b>88</b>
<b>CH-34.2: National Coverage Determination (NCD) for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14) (Medicare)</b>	<b>89</b>
<b>CH-34.3: Incidental Pulmonary Nodules Detected on Low Dose CT Chest (LDCT) Images</b>	<b>91</b>

**CH-34.1: U.S. Preventative Services Task Force: Lung Cancer Screening (Commercial and Medicaid) <sup>1</sup>**

- Low-dose chest CT (CPT® G0297) may be approved for lung cancer screening if all of the following criteria are met:

Screening Indications – Commercial and Medicaid	Imaging Study
<ul style="list-style-type: none"> <li>➤ All criteria below must be met for approval:</li> <li>➤ Patient has not received a low-dose CT lung screening in less than 12 months; and</li> <li>➤ Patient has NO health problems that substantially limit life expectancy or the ability or willingness to have curative lung surgery*; and</li> <li>➤ Patient is between 55 and 80 years of age; and</li> <li>➤ Patient has at least a 30 pack-year history of cigarette smoking; and</li> <li>➤ Currently smokes or quit within the past (&lt;/=) 15 years</li> </ul>	<p>Low-Dose Chest CT without contrast CPT® G0297</p>

\*This is based on a range of chest or other organ signs, symptoms or conditions which would question the member’s ability to undergo surgical or non-surgical treatment if a lung cancer was discovered. For example, congestive heart failure, advanced cancer from another site or a member with COPD who uses oxygen when ambulating, would be examples of conditions that would “substantially limit life expectancy.” Conversely, stable COPD and its symptoms, including cough, shortness of breath would not “substantially limit life expectancy.”



## CH-34.2: National Coverage Determination (NCD) for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14) (Medicare)<sup>2</sup>

### ➤ Lung-RADS Assessment Categories

Screening Indications - Medicare	Imaging Study
<ul style="list-style-type: none"> <li>➤ All criteria below must be met for approval:</li> <li>➤ Patient has not received a low-dose CT lung screening in less than 12 months; and</li> <li>➤ Patient has NO signs or symptoms suggestive of underlying lung cancer<sup>**</sup>; and</li> <li>➤ Patient is between 55 and 77 years of age; and</li> <li>➤ Patient has at least a 30 pack-year history of cigarette smoking; and</li> <li>➤ Currently smokes or quit within the past (&lt;/=) 15 years</li> <li>➤ A written order for LDCT lung cancer screening that includes counseling and shared decision making<sup>***</sup></li> </ul>	<ul style="list-style-type: none"> <li>◆ Low-Dose Chest CT without contrast CPT<sup>®</sup> G0297</li> </ul>

- <sup>\*\*</sup>The Medicare Decision Memo and NCD 210.14 consider lung cancer screening if “asymptomatic” with “no signs or symptoms of lung cancer.” Stable COPD and its symptoms, including cough, shortness of breath are not considered “signs or symptoms of lung cancer” and if other criteria meet, would allow LDCT approval. Conversely, signs or symptoms that would be more concerning for lung cancer could include hemoptysis, weight loss, soft tissue or bony masses and lymphadenopathy.
- <sup>\*\*\*</sup>A written order for LDCT lung cancer screening that meets the following criteria:
  - ◆ For the initial LDCT lung cancer screening service: the beneficiary must receive a written order for LDCT lung cancer screening.
    - <sup>\*</sup>A written order for LDCT lung cancer screening that meets the following criteria:
      - For the initial LDCT lung cancer screening service: the beneficiary must receive a written order for LDCT lung cancer screening during a lung cancer screening counseling and shared decision making visit, furnished by a physician [as defined in Section 1861(r)(1) of the Social Security Act (the Act)] or qualified non-physician practitioner (physician assistant, nurse practitioner, or clinical nurse specialist as defined in §1861(aa)(5) of the Act).
    - ◆ For subsequent LDCT lung cancer screenings: the beneficiary must receive a written order, which may be furnished during any appropriate visit (for example: during the Medicare annual wellness visit, tobacco cessation counseling

services, or evaluation and management visit) with a physician (as defined in Section 1861(r)(1) of the Act) or qualified non-physician practitioner (physician assistant, nurse practitioner, or clinical nurse specialist as defined in Section 1861(aa)(5) of the Act).

- A lung cancer screening counseling and shared decision making visit includes the following elements (and is appropriately documented in the beneficiary's medical records):
  - ◆ Determination of beneficiary eligibility including age, absence of signs or symptoms of lung disease, a specific calculation of cigarette smoking pack-years; and if a former smoker, the number of years since quitting;
  - ◆ Shared decision making, including the use of one or more decision aids, to include benefits, harms, follow-up diagnostic testing, over-diagnosis, false positive rate, and total radiation exposure;
  - ◆ Counseling on the importance of adherence to annual LDCT lung cancer screening, impact of comorbidities and ability or willingness to undergo diagnosis and treatment;
  - ◆ Counseling on the importance of maintaining cigarette smoking abstinence if former smoker, or smoking cessation if current smoker and, if appropriate, offering additional Medicare-covered tobacco cessation counseling services; and
  - ◆ If appropriate, the furnishing of a written order for lung cancer screening with LDCT. Written orders for both initial and subsequent LDCT lung cancer screenings must contain the following information, which must also be documented in the beneficiaries' medical records:
    - Beneficiary date of birth,
    - Actual pack-year smoking history (number);
    - Current smoking status, and for former smokers, the number of years since quitting smoking;
    - Statement that the beneficiary is asymptomatic; and NPI of the ordering practitioner

\*Patients that present with the following symptoms are not eligible for screening, rather, they should be considered symptomatic for lung cancer: unexplained cough, hemoptysis, or unexplained weight loss of more than 15 pounds in the past year.

### **CH-34.3: Incidental Pulmonary Nodules Detected on Low Dose CT Chest (LDCT) Images** <sup>3</sup>

- Additional intervening CT Chest or LDCT can be approved based on a LDCT Lung-RADS Version-1.0 designation 3 or 4, as indicated in the chart below: <sup>3</sup>

Primary Category/Category Descriptor*	Management
3 : Probably benign finding(s) -short term follow up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	6 month LDCT
4A : Suspicious - Findings for which additional diagnostic testing and/or tissue sampling is recommended	3 month LDCT PET/CT may be used when there is a $\geq 8$ mm solid component
4B : Suspicious - Findings for which additional diagnostic testing and/or tissue sampling is recommended	Chest CT with or without contrast, PET/CT and/or tissue sampling depending on the probability of malignancy and. PET/CT may be used when there is a $\geq 8$ mm solid component.

- Category 3 and 4A nodules that are unchanged on interval CT should be coded as category 2, and individuals returned to screening in 12 months.<sup>3</sup>
- For example, if the first LDCT was done January 1<sup>st</sup> and designated Lung-RADS 3 with an interval LDCT done on July 1<sup>st</sup> – the LDCT annual screening would resume January 1<sup>st</sup> of the following year.
- Category 4B is intended to direct the individual out of screening and into a diagnosis based on a larger, growing or increasingly suspicious nodule.<sup>3</sup>

Category	Category Descriptor	Category	Findings	Management	Probability of Malignancy	Estimated Population Prevalence
Incomplete	-	0	prior chest CT examination(s) being located for comparison	Additional lung cancer screening CT images and/or comparison to prior chest CT examinations is needed	n/a	1%
			part or all of lungs cannot be evaluated			
Negative	No nodules and definitely benign nodules	1	no lung nodules			
			odule(s) with specific calcifications: complete, central, popcorn, concentric rings and fat containing nodules			
Benign Appearance or Behavior	Nodules with a very low likelihood of becoming a clinically active cancer due to size or lack of growth	2	solid nodule(s): < 6 mm new < 4 mm	Continue annual screening with LDCT in 12 months	< 1%	90%
			part solid nodule(s): < 6 mm total diameter on baseline screening			
			non solid nodule(s) (GGN): < 20 mm OR ≥ 20 mm and unchanged or slowly growing			
			category 3 or 4 nodules unchanged for ≥ 3 months			
Probably Benign	Probably benign finding(s) - short term follow up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	3	solid nodule(s): ≥ 6 to < 8 mm at baseline OR new 4 mm to < 6 mm	6 month LDCT	1-2%	5%
			part solid nodule(s)			
			≥ 6 mm total diameter with solid component < 6 mm OR new < 6 mm total diameter			
			non solid nodule(s) (GGN) ≥ 20 mm on baseline CT or new			

Suspicious	Findings for which additional diagnostic testing and/or tissue sampling is recommended	4A	solid nodule(s): ≥ 8 to < 15 mm at baseline OR growing < 8 mm OR new 6 to < 8 mm	3 month LDCT; PET/CT may be used when there is a ≥ 8 mm solid component	5-15%	2%
			part solid nodule(s): ≥ 6 mm with solid component ≥ 6 mm to < 8 mm OR with a new or growing < 4 mm solid component			
			endobronchial nodule			
Suspicious	Findings for which additional diagnostic testing and/or tissue sampling is recommended	4B	solid nodule(s) ≥ 15 mm OR new or growing, and ≥ 8 mm	Chest CT with or without contrast, PET/CT and/or tissue sampling depending on the *probability of malignancy and comorbidities. PET/CT may be used when there is a ≥ 8 mm solid component.	> 15%	2%
			part solid nodule(s) with: a solid component ≥ 8 mm OR a new or growing ≥ 4 mm solid component			
		4X	Category 3 or 4 nodules with additional features or imaging findings that increases the suspicion of malignancy			
Other	Clinically Significant or Potentially Clinically Significant Findings (non lung cancer)	S	modifier - may add on to category 0-4 coding	As appropriate to the specific finding	n/a	\10%
Prior Lung Cancer	Modifier for patients with a prior diagnosis of lung cancer who return to screening	C	modifier - may add on to category 0-4 coding	-	-	-

**Practice notes**

\*The full description of the LUNG-RADS categories

[https://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/LungRAD S/AssessmentCategories.pdf](https://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/LungRAD%20S/AssessmentCategories.pdf)

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