

Chest Curriculum

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General

Chest rotations should begin early in the first year of residency. They will vary in length from two to four weeks, but should total 12 to 16 weeks by the end of the fourth year. The purpose of these rotations, in conjunction with conferences, is to educate the resident in the detection, description, work-up, management, and diagnosis of lung, mediastinal, pleural, chest wall, and diaphragmatic disease.

During the rotation residents will be required to:

Report to the work space promptly after the completion of conferences

Understand standard patient positioning in chest radiology

Review films (ICU/ inpatient and outpatient), list findings, and formulate an interpretation prior to staff review.

Review old studies, prior interpretations and pertinent cross-sectional imaging.

Obtain pertinent patient history, clinical and lab data from clinicians and appropriate computerized resources (CIS, CHCS).

Provide accurate concise grammatically correct radiological report in a timely fashion.

Participate in departmental quality assurance efforts. Recognize and discuss inadequate examinations with technologists.

Each day of the rotation will include, whenever possible, review of teaching file cases and other materials appropriate to the level of the resident.

At the end of each rotation of two weeks or more, the resident should anticipate a "mock oral board" quiz, usually administered by the section head. The quiz will be discussed in detail with the resident, and it will be used as a method for judging the resident's progress in completing this curriculum. In addition, there will be a discussion of the resident's overall performance and progress during the rotation.

FIRST ROTATION

Goals

Demonstrate learning of knowledge based objectives
Accurately and concisely dictate a report
Communicate effectively with referring clinicians and supervisory staff
Understand standard positioning in chest radiology
Obtain pertinent patient information relative to radiologic examinations
Demonstrate the learning of the clinical indications for obtaining chest radiographs and when CT or MR may be necessary
Demonstrate a responsible work ethic

Objectives

Patient Care

The first rotation will emphasize plain film chest studies, but will include an introduction to, and correlation with, chest HRCT.

Residents must review old films and old reports to provide optimal patient care.

Residents must demonstrate a willingness and ability to obtain history, lab, and pathological data in appropriate clinical setting to optimize patient care.

Residents should be able to demonstrate ability to perform chest fluoroscopy.

Residents should interpret and dictate 40 chest x-rays per day with at least 75% accuracy and no major errors.

Residents must clear their radiology report queue every day.

Medical Knowledge

Residents must demonstrate learning of at least one-third of the knowledge based objectives listed at the end of this section. The emphasis during the first rotation will be on normal anatomy and recognition of common and emergent chest disease. After the first rotation, residents must demonstrate the ability to recognize and correctly interpret the following conditions:

The normal chest film

Normal CT of the chest

ICU appliances and associated malpositions and complications

Pneumonia

Pulmonary edema: cardiogenic and noncardiogenic
Congestive heart failure
Pleural effusion
Chest trauma including vascular injury, lung trauma, diaphragmatic injury, etc.
Aortic dissection, aneurysms, intramural hematoma and penetrating ulcer
Pneumomediastinum
Pneumothorax and mimics
Causes of cardiac enlargement
Fractures of spine, shoulders and ribs
Causes and recognition of acute and chronic infiltrative lung disease

Residents are expected to demonstrate an increased knowledge of disease processes encountered while on the rotation or during teaching file sessions. Knowledge of learned material will be assessed with an oral examination at the end of the rotation.

Practice-Based Learning

Residents are required to read the following:

McLoud T. Thoracic Radiology: The Requisites. Mosby, 1999.

Felsen, B. Chest Roentgenology, Saunders, 1973

Residents are encouraged to use internet sources for references to specific topics of interest, but it must be kept in mind that internet sources are not edited nor refereed and are thus considerably less reliable and authoritative than published texts and articles.

Residents may be required to perform literature searches on disease topics encountered during the work day.

Interpersonal Communication Skills

Residents are required to demonstrate respectful communication with staff, patients and technologists

Residents are required to provide concise, accurate summaries of findings and conclusions during read-out sessions

Residents are required to provide concise summaries of findings, differential diagnosis and radiologic management of cases during teaching file review sessions.

Residents are required to contact clinical staff by telephone immediately with urgent or emergent results.

Residents must begin to demonstrate the ability to effectively present chest radiology cases to other residents including brief discussion of the findings, differential diagnosis and radiologic management.

Professionalism

Residents are expected to be in the work place on time and to not leave until their clinical responsibilities are adequately completed

Residents must conduct themselves with the highest ethical standards and appropriate military bearing at ALL times.

Residents must clear their radiology report queue every day.

Reading and teaching file assignments must be completed on time.

Systems Based Practice

Residents are expected to be aware of the principles of cost effective, quality health care by being aware of the ACR appropriateness criteria for evaluating patients.

Residents are expected to participate in departmental quality assurance efforts including:

Providing feedback to technologists

Documentation of incident reports

Residents must be aware of departmental standard operating procedure

SECOND ROTATION

Goals

Demonstrate learning of knowledge based learning objectives

Continue to build on chest radiograph interpretive skills.

Demonstrate an understanding of the ACR Appropriateness Criteria for chest radiography

Objectives

Patient Care

The resident will demonstrate an improvement in patient care skills in comparison to the first rotation.

Residents will demonstrate an improved ability to act as a radiology consultant.

Residents will be conversant with the principles and practice of chest fluoroscopy including the assessment of diaphragmatic disease

The resident should be able to dictate at least 50 chest radiographs and 7 HRCT studies per day.

Interpretation should have no major discrepancies and should be totally accurate 80% of the time.

The resident should be able to protocol and interpret high resolution chest CT.

Residents must be able to interpret and dictate 50 cases per day with at least 80% accuracy and miss no major findings.

Medical Knowledge

The resident will demonstrate learning of at least two-thirds of the knowledge based objectives listed at the end of this section.

Residents must demonstrate knowledge in:

Work-up, staging and diagnosis of pulmonary neoplasm

Evaluation and diagnosis of mediastinal masses.

Practice Based Learning

Residents are required to use the following:

Hansell, Armstrong, et.al., **Imaging of Diseases of the Chest**, fourth edition, Mosby, 2005.

Reed, J.C. **Chest Radiology: Plain Film Patterns and Differential Diagnosis**, fifth edition, , Mosby, 2003.

Muller, et.al., **Radiologic Diagnosis of Diseases of the Chest**, Saunders, 2001.

Webb WR and Higgins CB, **Thoracic Imaging**, Lippincott, 2005.

Residents will be required to perform literature searches on disease topics encountered during the work day.

Residents are encouraged to use internet sources for references to specific topics of interest, but it must be kept in mind that internet sources are not edited nor refereed and are thus considerably less reliable and authoritative than published texts and articles.

Interpersonal Communication Skills

Residents are required to demonstrate respectful communication with staff, patients and technologists

Residents are required to provide concise, accurate summaries of findings and conclusions during read-out sessions

Residents are required to provide concise summaries of findings, differential diagnosis and radiologic management of cases during teaching file review sessions.

Residents are required to contact clinical staff by telephone immediately with urgent or emergent results.

Residents are required to submit two teaching file cases to MEDPIX with accurate and concise history, findings, differential diagnosis, discussion and captions.

Residents must begin to demonstrate the ability to effectively present chest radiology cases to other residents including brief discussion of the findings, differential diagnosis and radiologic management.

Professionalism

Residents are expected to be in the work place on time and to not leave until their clinical responsibilities are adequately completed

Residents must conduct themselves with the highest ethical standards and appropriate military bearing at ALL times.

Residents must clear their radiology report queue every day.

Reading and teaching file assignments must be completed on time.

Systems Based Practice

Residents are expected to be aware of the principles of cost effective, quality health care by being aware of the ACR appropriateness criteria for evaluating patients.

Residents are expected to participate in departmental quality assurance efforts including:

Providing feedback to technologists

Documentation of incident reports

Residents must be aware of departmental standard operating procedure

THIRD ROTATION

Goals

After completion of the third chest rotation, the resident will:

Demonstrate learning of all knowledge-based objectives

Refine skills in interpretation of radiographs and chest CT scans

Develop skills in protocoling, monitoring, and interpreting HRCT scans

Develop skills in protocoling, monitoring and interpreting chest MR studies

Become a more autonomous consultant and teacher

Correlate pathologic and clinical data with radiographic and chest CT findings

Objectives

Patient Care

The resident will continue to improve patient care skills introduced during rotations one and two.

The resident should be able to dictate at least 70 chest radiographs and 10 HRCT studies per day.

Interpretation should have no major discrepancies and should be totally accurate 90% of the time.

The resident should be able to protocol and interpret high resolution chest CT.

Medical Knowledge

At the end of the third chest rotation or senior year of radiology residency, the resident will demonstrate knowledge of all of the knowledge-based objectives introduced in Year 1.

The resident should demonstrate knowledge of pneumoconiosis and interstitial lung disease.

The resident will be able to describe the indications for chest MR.

Practice Based Learning

The resident will demonstrate an increased knowledge of the current literature.

Interpersonal and Communication skills

In addition to improving skills from first and second rotations, residents should also demonstrate ability to effectively teach other residents and medical students.

Professionalism

Same standards as first two rotations

Systems Based Practice

Same standards as first two rotations

FOURTH AND SUBSEQUENT ROTATIONS

Goals

The fourth rotation should be spent reviewing and refining skills already learned on the first three rotations. The resident is expected to perform at the level of a junior staff radiologist.

Objectives

The resident upon completion of the fourth rotation must:

Demonstrate medical knowledge of all the material addressed in the thoracic radiology curriculum.

Demonstrate continuing improvement in clinical, academic, and administrative performance related to previously achieved goals and objectives.

Demonstrate ability to generate appropriate and complete differential diagnosis for abnormal findings on chest radiographs, chest CT, HRCT, and cardiothoracic MRI.

Demonstrate ability to dictate accurate chest radiographs, chest CT, HRCT, thoracic and cardiac MR reports with at least 95% accuracy and NO major interpretive errors.

Demonstrate ability to competently function in the role of consultant and teacher.

Demonstrate efficient interpretation of all ICU and inpatient chest radiographs and all cross sectional imaging studies of the chest.

Knowledge Based Criteria

Normal Anatomy

1. Name and define the three zones of the airways
2. Define a secondary pulmonary lobule
3. Define an acinus
4. List the lobar and segmental bronchi of both lungs
5. Identify the following structures on the posteroanterior (PA) chest radiograph:
 - Lungs -right, left, right upper, middle and lower lobes, left upper and lower lobes, lingula
 - Fissures- minor, superior accessory, inferior accessory, azygous
 - Airway -trachea, carina, main bronchi
 - Heart -right atrium, left atrial appendage, left ventricle, location of the four cardiac valves
 - Pulmonary arteries -main, right, left, interlobar -Aorta -ascending, arch, descending
 - Veins -superior vena cava, azygous, left superior intercostal ("aortic nipple")
 - Bones -spine, ribs, clavicles, scapulae, humerus
 - Right paratracheal stripe
 - Junction lines -anterior, posterior
 - Aortopulmonary window
 - Azygoesophageal recess -Paraspinal lines
 - Left subclavian artery
6. Identify the following structures on the lateral chest radiograph:
 - Lungs -right, left, right upper, middle and lower lobes, left upper and lower lobes, lingula
 - Fissures- major, minor, superior accessory
 - Airway -trachea, upper lobe bronchi, posterior wall of bronchus intermedius
 - Heart -right ventricle, right ventricular outflow stripe, left atrium, left ventricle, the location of the four cardiac valves
 - Pulmonary arteries -right, left
 - Aorta- ascending, arch, descending
 - Veins -SVC, IVC, left brachiocephalic (innominate), pulmonary vein confluences
 - Bones -spine, ribs, scapulae, humerus
 - Retrosternal line
 - Posterior tracheal stripe
 - Right and left hemidiaphragms
 - Raider's triangle
 - Brachiocephalic (innominate) artery

Signs in Chest Radiology

1. Be able to define, identify and state the significance of the following on a radiograph:

- air bronchogram -indicates a parenchymal process, including non-obstructive atelectasis, as distinguished from pleural or mediastinal processes
- air crescent sign -indicates a lung cavity, often due to fungal infection
- deep sulcus sign on a supine radiograph -indicates pneumothorax -
- continuous diaphragm sign -indicates pneumomediastinum
- ring around the artery sign (around pulmonary artery on lateral chest radiograph) -indicates pneumomediastinum
- fallen lung sign -indicates a fractured bronchus -flat waist sign- indicates left lower lobe collapse
- gloved finger sign -indicates bronchial impaction, which can be seen in allergic bronchopulmonary aspergillosis
- Golden S sign -indicates lobar collapse with a central mass, suggesting an obstructing bronchogenic carcinoma in an adult
- luftsichel sign -indicates upper lobe collapse, potentially due to an obstructing bronchogenic carcinoma in an adult
- Hampton's hump -indicates a pulmonary infarct
- silhouette sign -loss of the contour of the heart or diaphragm used to localize a parenchymal process (e.g. a process involving the medial segment of the right middle lobe obscures the right heart border; a lingula process obscures the left heart border; a basilar segmental lower lobe process obscures the diaphragm)
- cervicothoracic sign -a mediastinal opacity that projects above the clavicles is retrotracheal and posteriorly situated while an opacity effaced along its superior aspect and projecting at or below the clavicles is situated anteriorly
- tapered margins sign -a lesion in the chest wall, mediastinum or pleura will have smooth tapered borders and obtuse angles with the chest wall or mediastinum while parenchymal lesions usually form acute angles
- figure 3 sign -abnormal contour of the descending aorta, indicating coarctation of the aorta
- fat pad sign a sandwich sign -indicates pericardial effusion on lateral chest radiograph
- scimitar sign -an abnormal pulmonary vein in venolobar syndrome
- double-density sign -contour projecting over the right side of the heart, indicating enlargement of the left atrium
- hilum overlay sign and hilum convergence sign -used to distinguish a hilar mass from a non-hilar mass

2. Be able to define, identify and state the significance of the following on a chest CT:

-CT angiogram sign -enhancing pulmonary vessels against a background of low attenuation material in the lung

-halo sign -suggesting invasive pulmonary aspergillosis in a leukemic patients

-split pleura sign -a sign of empyema

Interstitial lung disease

1. List and identify on a chest radiograph and chest CT four patterns of interstitial lung disease (ILD)

2. Make a specific diagnosis of ILD when supportive findings are present in the history or on radiologic imaging (e.g. dilated esophagus and ILD in scleroderma, enlarged heart and a pacemaker or defibrillator in a patient with prior sternotomy and ILD suggesting amiodarone drug toxicity)

3. Identify Kerley A and B lines on a chest radiograph and explain their etiology

4. Recognize the changes of congestive heart failure on a chest radiograph - enlarged cardiac silhouette, pleural effusions, vascular redistribution, interstitial and/or alveolar edema, Kerley lines

5. Define the terms "asbestos-related pleural disease" and "asbestosis;" identify each on a chest radiograph and chest CT

6. Describe what a "B" reader is as related to the evaluation of pneumoconiosis

7. Identify honeycombing on a radiograph and high resolution chest CT (HRCT), state the significance of this finding (end-stage lung disease), and list the common causes of honeycomb lung

8. State the radiographic classification of sarcoidosis

9. Recognize progressive massive fibrosis/conglomerate masses secondary to silicosis or coal worker's pneumoconiosis on radiography and chest CT

10. Recognize the typical appearance of irregular lung cysts and/or nodules on chest CT of a patient with Langerhan's cell histiocytosis

11. List four causes of unilateral ILD

12. List three causes of lower lobe predominant ILD 13. List two causes of upper lobe predominant ILD 14 .Identify a secondary pulmonary lobule on HRCT

15. Identify Lymphangiomyomatosis on a chest radiograph and HRCT

16. Identify and give appropriate differential diagnoses when the patterns of septal thickening, perilymphatic nodules, bronchiolar opacities ("tree-in-bud"), air trapping, cysts, and ground glass opacities are seen on HRCT

Alveolar lung disease

1. List four broad categories of acute alveolar lung disease (ALD)
2. List five broad categories of chronic ALD
3. Name three pulmonary-renal syndromes
4. List five of the most common causes of adult respiratory distress syndrome
5. Name four predisposing causes of bronchiolitis obliterans organizing pneumonia (BOOP)
6. Suggest a specific diagnosis of ALD when supportive findings are present in the history or on the chest radiograph (e.g. broken femur and ALD in fat embolization syndrome, ALD and renal failure in a pulmonary-renal syndrome, ALD treated with bronchoalveolar lavage in alveolar proteinosis)
7. Recognize a pattern of peripheral alveolar lung disease on radiography or chest CT and give an appropriate differential diagnosis, including a single most likely diagnosis when supported by associated radiologic findings or clinical information (e.g. peripheral lung disease associated with paratracheal and bilateral hilar adenopathy in an asymptomatic patient with "alveolar" sarcoidosis, peripheral lung disease associated with a markedly elevated blood eosinophil count in a patient with eosinophilic pneumonia, peripheral opacities associated with multiple rib fractures and pneumothorax in a patient with acute chest trauma and pulmonary contusions)

Atelectasis, Airways and Obstructive Lung Disease

1. Recognize partial or complete atelectasis of the following on a chest radiograph:
 - right upper lobe
 - right middle lobe -right lower lobe
 - right upper and middle lobe -right middle and lower lobe -left upper lobe -left lower lobe
2. Recognize complete collapse of the right or left lung on a chest radiograph and list an appropriate differential diagnosis for the etiology of the collapse
3. Distinguish lung collapse from massive pleural effusion on a frontal chest radiograph
4. Name the 4 types of bronchiectasis and identify each type on a chest CT
5. Name 5 common causes of bronchiectasis
6. Recognize the typical appearance of cystic fibrosis on a radiograph and chest CT
7. Name the important things to look for on a chest radiograph when the patient history is "asthma"
8. Define tracheomegaly
9. Recognize tracheal and bronchial stenosis on chest CT and name the most common causes

10. Name the 3 types of pulmonary emphysema and identify each type on a chest CT
11. Recognize alpha-1-antitrypsin deficiency on a chest radiograph and chest CT
12. Recognize Kartagener's syndrome on a chest radiograph and name the 3 components of the syndrome
13. Define the term giant bulla, differentiate giant bulla from pulmonary emphysema and state the role of imaging in patient selection for bullectomy
14. State the imaging findings used to identify surgical candidates for giant bullectomy and for lung volume reduction surgery

Mediastinal Masses and Mediastinal/Hilar Lymph Node Enlargement

1. State the anatomic boundaries of the anterior, middle, posterior and superior mediastinum
2. Name the four most common causes of an anterior mediastinal mass and localize a mass to the anterior mediastinum on a radiograph, chest CT and chest MRI
3. Name the three most common causes of a middle mediastinal mass and localize a mass in the middle mediastinum on a radiograph, chest CT and chest MRI
4. Name the most common cause of a posterior mediastinal mass and localize a mass in the posterior mediastinum on a radiograph, chest CT and chest MRI
5. Name two causes of a mass that straddles the thoracic inlet and localize a mass to the thoracic inlet on a radiograph, chest CT and chest MRI
6. Identify normal vessels or vascular abnormality on chest CT and chest MRI that may mimic a solid mass
7. Name five etiologies of bilateral hilar lymph node enlargement
8. State the three most common locations (Garland's triad) for lymph node enlargement to occur in the chest of patients with sarcoidosis
9. List the four most common etiologies of "egg-shell" calcified, lymph nodes in the chest
10. Recognize a cystic mass in the mediastinum and suggest the possible diagnosis of a bronchogenic, pericardial, thymic or esophageal duplication cyst

Solitary and Multiple Pulmonary Nodules

1. State the definition of a solitary pulmonary nodule and a pulmonary mass
2. Name the three most common causes of a solitary pulmonary nodule
3. Name four important considerations in the evaluation of a solitary pulmonary nodule
4. Name six causes of cavitary pulmonary nodules
5. Name four causes of multiple pulmonary nodules
6. State the indications for percutaneous biopsy of a solitary pulmonary nodule
7. State the indications for percutaneous biopsy when there are multiple pulmonary nodules
8. State the complications and the frequency with which complications occur due to percutaneous lung biopsy using CT or fluoroscopic guidance
9. State the indications for chest tube placement as a treatment for pneumothorax related to percutaneous lung biopsy
10. State the role of positron emission tomography (PET) in the evaluation of a solitary pulmonary nodule

Benign and Malignant Neoplasms of the Lung and Esophagus

1. Name the four major histologic types of bronchogenic carcinoma, and state the difference between non-small cell and small cell lung cancer
2. Name the type of non-small cell lung cancer that most commonly cavitates
3. Name the types of bronchogenic carcinoma that are usually central
4. Describe the TNM classification for staging non-small cell lung cancer, including the components of each stage (I, II, III, IV, and substages), and the definition of each component (T1-4, N0-3, M0-1)
5. State the staging of small cell lung cancer
6. Name the four most common extrathoracic sites for non-small cell lung cancer and small cell lung cancer to metastasize
7. State which stages of non-small cell lung cancer are potentially resectable
8. Recognize abnormal contralateral mediastinal shift on a post-pneumonectomy chest radiograph and state five possible etiologies for the abnormal shift
9. Name the most common location for adenoid cystic and carcinoid tumors to occur
10. Suggest the possibility of radiation change as a cause of new apical opacification on a chest radiograph of a patient with evidence of mastectomy and/or axillary node dissection

11. Describe the acute and chronic radiographic and CT appearance of radiation injury in the thorax (lung, pleura, pericardium, esophagus) and the temporal relationship to radiation therapy
12. State the role of MR in lung cancer staging (e.g. chest wall invasion, superior sulcus or Pancoast tumor)
13. State the role of positron emission tomography (PET) in lung cancer staging
14. Describe the TNM classification for staging esophageal carcinoma, including the components of each stage (I, II, III, IV) and the definition of each component (T, N and M)
15. State the role of imaging in the staging of esophageal carcinoma
16. State which stages of esophageal carcinoma are potentially resectable
17. State the classification of lymphoma, the role of imaging in the staging of lymphoma, and the typical and atypical manifestations of thoracic lymphoma
18. Define primary pulmonary lymphoma
19. Describe the typical chest radiograph and chest CT appearances of Kaposi sarcoma

Chest Trauma

1. Identify a widened mediastinum on a trauma radiograph and state the differential diagnosis (including aortic/arterial injury, venous injury, fracture of sternum or spine)
2. Identify the indirect and direct signs of aortic injury on contrast-enhanced chest CT scan
3. Identify and state the significance of chronic traumatic pseudoaneurysm on a chest radiograph, CT or MRI
4. Identify fractured ribs, clavicle, spine and scapula on a chest radiograph or chest CT
5. Name five common causes of abnormal lung opacity on a trauma radiograph or CT
6. Identify an abnormally positioned diaphragm or loss of definition of a diaphragm on a trauma chest radiograph and suggest the diagnosis of a ruptured diaphragm
7. Identify a pneumothorax and pneumomediastinum on a trauma chest radiograph
8. Identify the fallen lung sign on a radiograph or chest CT scan and suggest the diagnosis of tracheobronchial tear
9. Identify a cavitary lesion on a post-trauma radiograph or chest CT and suggest the diagnosis of laceration with pneumatocele formation, hematoma or abscess secondary to aspiration

10. Name the three most common causes of pneumomediastinum in the setting of trauma
11. Recognize and distinguish between pulmonary contusion, laceration and aspiration

Chest Wall, Pleura and Diaphragm

1. Recognize and name four causes of a large unilateral pleural effusion on a radiograph or chest CT
2. Recognize a pneumothorax on an upright and supine chest radiograph
3. Recognize a pleural based mass with bone destruction or infiltration of the chest wall on a radiograph or Chest CT and name four likely causes.
4. Recognize pleural calcification on a radiograph or chest CT and suggest the diagnosis of asbestos exposure (bilateral involvement) or old TB or trauma (unilateral involvement)
5. Recognize the typical chest radiographic appearance of pleural effusion accounting for patient positioning
6. Recognize apparent elevation of a hemidiaphragm on a chest radiograph and suggest a specific etiology with supportive history and associated chest radiograph findings (e.g. subdiaphragmatic abscess after abdominal surgery, diaphragm rupture after trauma, and phrenic nerve involvement with lung cancer)
7. Recognize a tension pneumothorax and understand the acute clinical indications.
8. Recognize diffuse pleural thickening, as seen in fibrothorax, malignant mesothelioma and pleural metastases
9. State and recognize the radiographic and CT findings of malignant mesothelioma.

Infection (Immunocompetent, Immunocompromised and Post-transplant Patients)

1. Name the radiographic manifestations of primary pulmonary tuberculosis
2. Name the three most common segmental sites of involvement for reactivation tuberculosis in the lung
3. Define Ranke complex and Ghon lesion; recognize both on a radiograph and CT
4. Name and describe the four types of pulmonary Aspergillus disease
5. Identify an intracavitary fungus ball on chest radiography and chest CT
6. State the radiographic appearances of Cytomegalovirus pneumonia

7. Name the major categories of disease causing chest radiograph or chest CT abnormalities in the immunocompromised patient
8. Other than bacterial infection, name 2 important infections and 2 important neoplasms to consider in patients with AIDS and chest radiograph or chest CT abnormalities
9. Describe the chest radiograph and chest CT appearances of Pneumocystis carinii pneumonia
10. Name the 4 most important etiologies of hilar and mediastinal adenopathy in patients with AIDS
11. Describe the time course and chest radiographic appearance of a blood transfusion reaction
12. State the radiographic appearances of mycoplasma pneumonia
13. Describe the radiographic and CT appearance of a miliary pattern and provide a differential diagnosis
14. Name the diagnostic considerations in a patient who presents with recurrent or persistent pneumonias
15. Name the endemic mycoses, the specific geographic regions where they are found, and their radiographic manifestations
16. State the most common pulmonary infections seen after solid-organ (i.e. liver, renal, cardiac) transplantation
17. Describe the radiographic and CT findings of post-transplant lymphoproliferative disorders

Unilateral Hyperlucent Lung (or hemithorax)

1. Recognize a unilateral hyperlucent lung on a radiograph or chest CT
2. Identify the common causes for unilateral hyperlucent lung on a chest radiograph
3. Give an appropriate differential diagnosis when a hyperlucent lung is seen on a chest radiograph, and suggest a specific diagnosis when certain associated findings are seen (i.e. absence of breast in a patient after mastectomy for breast cancer, absence of a pectoralis muscle in a patient with Poland's syndrome, unilateral bullous disease/emphysema, or air trapping on expiration in a patient with Swyer-James syndrome or an endobronchial foreign body)

Monitoring and support devices -"tubes and lines"

1. Be able to identify, state the preferred placement of, complications associated with malposition and identify the location on chest radiography for each of the following :

- endotracheal tube
- central venous catheter -Swan-Ganz catheter -feeding tube
- nasogastric tube
- chest tube . -intra-aortic balloon pump
- pacemaker and pacemaker leads
- automatic implantable cardiac defibrillator
- left ventricular assist device
- atrial septal defect closure device ("clamshell device")
- pericardial drain
- extracorporeal life support cannulae
- intraesophageal manometer, temperature probe or pH probe ,
- tracheal or bronchial stent

2. Explain how an intra-aortic balloon pump works

Post-operative chest

1. Identify normal post-operative findings and complications of the following procedures, on chest radiography, CT and MRI:

- wedge resection, lobectomy, pneumonectomy
- coronary artery bypass graft surgery
- cardiac valve replacement
- aortic graft aortic stent
- transhiatal esophagectomy
- lung and or lung transplant
- lung volume reduction surgery

Pulmonary Vascular Disease

1. Recognize enlarged pulmonary arteries on a chest radiograph and distinguish them from enlarged hilar lymph nodes
2. Recognize enlargement of the central pulmonary arteries with diminution of the peripheral pulmonary arteries as pulmonary arterial hypertension and suggest the possible diagnosis of primary pulmonary artery hypertension
3. Name five of the most common causes of pulmonary artery hypertension
4. Recognize lobar and segmental pulmonary emboli on chest CT and chest MRI (including MR angiography)

5. Define the role of ventilation-perfusion scintigraphy, chest CT, chest MRI/MRA and lower extremity venous studies in the evaluation of a patient with suspected venous thromboembolic disease, including the advantages and limitations of each modality depending on patient presentation.

Pericardial disease

1. Recognize pericardial calcification on a radiograph and chest CT and list the most common causes
2. Describe and identify two chest radiographic signs of a pericardial effusion
3. State five causes of a pericardial effusion
4. State and recognize the findings of each of the following on radiography, CT and MR:
 - pericardial cyst
 - constrictive pericarditis
 - pericardial hematoma
 - pericardial metastases
 - partial absence of the pericardium
 - pneumopericardium

Congenital Heart Disease in the Adult

1. Recognize increased vascularity, decreased vascularity and shunt vascularity on a chest radiograph and state the common causes of each
2. Recognize the following on imaging examinations of the chest, including radiographs, CT and/or MRI:
Heart disease presenting during adulthood
 - Left-to-right shunts and Eisenmenger physiology
 - Atrial septal defect
 - Ventricular septal defect
 - Partial anomalous pulmonary venous connection
 - Patent ductus arteriosus .
 - Coarctation of aorta
 - Tetralogy of Fallot and pulmonary atresia with ventricular septal defect
 - Congenitally corrected transposition of the great arteries
 - Persistent left superior vena cava
 - Truncus arteriosus
 - Ebstein anomaly
 - Cardiac malposition, including abnormal situsHeart disease originally treated in childhood
 - Coarctation of the aorta
 - Tetralogy of Fallot and Pulmonary atresia with ventricular septal defect

- Complete transposition of the great arteries
 - Congenitally corrected transposition of the great arteries
 - Truncus arteriosus
 - Commonly performed surgical corrections for congenital heart disease
3. Define the role of angiography, echocardiography, chest CT, and chest MRI in the evaluation of an adult patient with congenital heart disease, including the advantages and limitations of each modality depending on patient presentation

Cardiovascular Correlation Knowledge

(covered in Pediatrics, Vascular-Intervention and Cardiac Rotations)

Congenital Lung Disease

1. Name the components of the pulmonary venolobar syndrome
2. Recognize venolobar syndrome on a frontal chest radiograph, chest CT and chest MRI, and explain the etiology of the retrosternal band of opacity seen on the lateral view
3. Recognize a mass in the posterior segment of a lower lobe on a chest radiograph and chest CT, and suggest the possible diagnosis of pulmonary sequestration
4. Explain the differences between intralobar and extralobar sequestration
5. Recognize bronchial atresia on a radiograph and chest CT, and state the most common lobes of the lungs in which it occurs

Thoracic Aorta and Great Vessels

1. State the normal dimensions of the thoracic aorta
2. Describe the classifications of aortic dissection (DeBakey I, II, III; Stanford A, B), and implications for classification on medical versus surgical management
3. State and recognize the findings of, and distinguish between each of the following on CT and MR:
 - aortic aneurysm
 - aortic dissection
 - aortic intramural hematoma
 - penetrating atherosclerotic ulcer.

" -ulcerated plaque "

-ruptured aortic aneurysm; J' -sinus of valsalva aneurysm

-subclavian or brachiocephalic artery aneurysm -aortic coarctation

-aortic pseudocoarctation

4. Recognize a right aortic arch and a double aortic arch on a radiograph, chest CT and chest MR

5. State the significance of a right aortic arch with mirror image branching versus with an aberrant subclavian artery

6. Recognize a cervical aortic arch on a radiograph and chest CT 7. Recognize an aberrant subclavian artery on chest CT

8. Recognize normal variants of aortic arch branching, including common origin of brachiocephalic and left common carotid arteries ("bovine arch"), separate origin of vertebral artery from arch

9. Define the terms aneurysm and pseudoaneurysm

10. State the common cardiac anomalies associated with aortic coarctation

11. State and identify the findings seen in Takayasu's arteritis on chest CT and chest MR

12. State the advantages and disadvantages of CT, MRI/MRA and transesophageal echocardiography in the evaluation of the thoracic aorta

Ischemic Heart Disease

1 .Describe the anatomy of the coronary arteries and identify the following on a coronary arteriogram and CT scan

-right coronary artery

-left main coronary artery

-left anterior descending coronary artery -left circumflex coronary artery

2. State the clinical significance of coronary arterial calcification on a chest radiograph

3. Recognize coronary arterial calcification on CT and state the current role of coronary artery calcium scoring with helical or electron beam CT

4. State which coronary artery is usually diseased when there is papillary muscle dysfunction

5. Describe the common acute complications of myocardial infarction, including left ventricular failure, myocardial rupture and papillary muscle rupture, and recognize radiologic findings that may indicate these

6. Describe the common late complications of myocardial infarction, including ischemic cardiomyopathy, left ventricular aneurysm, left ventricular pseudoaneurysm, coronary-cameral fistula, dyskinesia and akinesia and recognize radiologic findings that may indicate these

7. Identify left heart failure on a radiograph and chest CT 8. Recognize acute myocardial infarction on MR imaging

9. Define ejection fraction and state the normal left ventricular ejection fraction
10. Identify myocardial calcification on CT and state the etiology" and significance of this finding
- 11 .State the difference between a left ventricular aneurysm and pseudoaneurysm
12. Define and identify myocardial bridging on MR
13. Define the role of angiography, echocardiography, stress perfusion scintigraphy, chest CT, and chest MRI in the evaluation of a patient with suspected ischemic heart disease, including the advantages and limitations of each modality

Myocardial Disease

1. Define the types of cardiomyopathy (dilated, hypertrophic, restrictive) and list the common causes of each
2. Define right ventricular dysplasia and identify on MRI
3. State the most common benign primary cardiac tumors, including myxoma, lipoma, fibroma and rhabdomyoma
4. State the most common malignant primary cardiac tumors, including angiosarcoma, rhabdomyosarcoma, lymphoma
5. Distinguish cardiac tumor from thrombus on CT and MRI
6. State the most common malignancies to metastasize to the heart, and the appearance on a radiograph, chest CT and chest MR
7. State the advantages and disadvantages of echocardiography, CT, and MRI for evaluation of cardiomyopathy and cardiac tumors

Cardiac Valvular Disease

1. State the findings that indicate each of the following and identify each on chest radiographs:
 - enlarged right atrium
 - enlarged left atrium
 - enlarged right ventricle
 - enlarged left ventricle
2. Recognize an enlarged left atrium, vascular redistribution, and mitral valve calcification on a chest radiograph and suggest the diagnosis of mitral stenosis
3. Recognize an enlarged ascending aorta and aortic valve calcification on a chest radiograph and suggest the diagnosis of aortic stenosis
4. State the most common etiologies of the following:
 - aortic stenosis, : -aortic regurgitation

-mitral stenosis. , -mitral regurgitation

-tricuspid regurgitation -pulmonary stenosis

5. State the cardiac diseases associated with mitral annulus calcification"

6. Identify endocarditis and/or complications of endocarditis on radiographs, chest CT and chest MR

7. State the advantages and disadvantages of echocardiography and MRI for evaluation of valvular heart disease

Based on the Curriculum in Chest Radiology created and endorsed by the Society of Thoracic Radiology