

Cardiothoracic Radiology Resident Rotations Academic Year 2016-2017

Goals and Objectives based on Core Competencies

Introduction:

Components of a cardiothoracic radiology curriculum may occur during one or more organ-specific or technology-specific rotations during residency, including rotations in chest radiology, cardiac radiology, pediatric radiology, nuclear medicine, magnetic resonance imaging, computed tomography, fluoroscopy (e.g. sniff test) and interventional radiology (e.g. lung biopsy procedure skills) and include training and experience in plain film interpretation, computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography, angiography, and nuclear radiology examinations related to pulmonary, pleural, mediastinal and cardiovascular disease.

Cardiothoracic radiology rotations at DHMC combine chest radiography (CXR) and CT and cardiac CT and MRI. This structure reflects the proposed guidelines for diagnostic radiology core curriculum as laid out by the Residency Restructuring Committee of the Association of Program Directors in Radiology (*J Am Coll Radiol* 2010;7:507-511) which DHMC Radiology Chair Dr. Jocelyn Chertoff co-authored.

Non-cardiac chest MR are typically covered by the Body MR service. Chest interventional procedures, e.g. lung biopsies and pleural fluid drainage, are services provided by Interventional Radiology and Body CT. Body CT also helps read Chest CTs, depending on volumes, but may defer certain CTs to chest imagers based on diagnosis and/or findings that would benefit from cardiothoracic specialist interpretation.

General Clinical Responsibilities and Workload:

Cardiothoracic radiology at DHMC consists of at least three rotations, usually four weeks in length. During the first rotation, emphasis is primarily on CXR but also with significant exposure to the entire gamut of chest CT examinations. During the second rotation, greater emphasis is placed on chest CT and an introduction to cardiac MR and CT. During the third rotation greater emphasis is placed on cardiac MR and CT, but CXR and chest CT will still represent the bulk of the cases seen. A typical daily workload is approximately 90 CXRs, 15 chest CTs, and 1-3 cardiac imaging studies.

Resident Responsibilities:

Case Review and Interpretation:

Residents on the cardiothoracic rotation should begin review of cases by 8 a.m. (unless there is a preceding conference which does not permit an 8 a.m. start time). Although most work is completed by approximately 5 pm, it is expected that the resident (unless on-call beginning at 5 pm or unless approved in advance by the attending on duty that afternoon, the chief resident, and

the residency program director) stays until all work is complete, including review, editing, and signage of dictated reports.

All pertinent previous imaging studies shall be reviewed thoroughly but quickly when available. If prior examinations exist, but are not immediately available for review, the resident will request Reading Room/Outreach Coordinator or File Room personnel retrieve those prior examinations.

Clinical information needed for examination interpretation (e.g. smoking history) can be retrieved quickly from the electronic medical record. For Cardiac examinations, pertinent clinical information should be reviewed before protocolling the study and at the time of image interpretation, including prior test results (echocardiography, cardiac catheterization/coronary angiography, stress myocardial perfusion scintigraphy, etc) as well as prior interventions (stenting, coronary bypass, valve repair, etc).

Report generation:

Resident draft and preliminary reports are reviewed with the diagnostic images together by the attending and resident, then edited and signed. Although the attending staff is ultimately responsible for the production and content of all cardiothoracic imaging reports, it is expected that the resident not offer a report to the responsible attending for review, unless the reports has been proofread and edited as needed so that the draft or preliminary report constitutes the resident's "best work".

It is understood that a first-year radiology resident cannot be expected to produce a report equivalent to a senior resident or attending on their first rotation, but that all residents make steady, significant, and documentable progress in report accuracy and quality, using the appropriate lexicon.

Protocolling:

Cross-sectional imaging study protocol selection ("protocolling") is performed electronically. Studies requested from outside the DH system should have imaging requisitions and supporting faxed documents (e.g. office notes, reports of prior non-DH imaging studies) scanned into the electronic medical record. Junior resident-protocolled CTs and MRs must be reviewed by the attending.

STAT/wet reads:

Any and all Critical Tests and Critical Findings (see departmental lists of Critical Tests and Findings), will be brought to the attention of an attending radiologist for review and results verbally communicated directly to the referring clinician as quickly as possible. Documentation of communication in dictated reports is required for Critical Tests and Findings. Unexpected findings that are not deemed major/of immediate concern can be communicated according to our departmental follow-up protocol. Wet read requests with urgent, but non-critical findings may be called or ask a Reading Room Coordinator to call for you. Wet read requests, if results are normal or non-urgent finding may be text-paged for on-site physicians or ask a Reading Room Coordinator to call for you. Off-site physicians will be called with Wet Read results per departmental protocol.

Cardiothoracic Imaging Division Conferences:

Attendance is expected at the following clinical and academic conferences:

- Comprehensive Thoracic Oncology Conference (CTOP) – chest tumor board (weekly, Tuesdays 8-9 am, Auditorium E or Radiology large conference room)
- Didactic resident Chest lecture series (monthly noon conference, Radiology large conference room)
- Didactic resident Cardiac lecture series (monthly noon conference, Radiology large conference room)
- Pulmonary-Radiology Conference (monthly, second Thursday, 8-9 am, Radiology large conference)

Assessment of performance on rotation:

Performance assessment will consist of global ratings by division faculty (using MedHub software) as a group (rather than individual attending assessments) for all of the Core Competencies.

Global Goals:

To acquire the knowledge, technical skills, and judgment necessary to successfully perform, interpret and communicate the results of CXR and CT, as well as cardiac CT and MRI, it is expected that the radiology resident by the end of residency, through clinical training, didactic conferences, and self-directed learning, will:

- have gained a thorough knowledge of normal anatomy and be able to recognize normal variants of the: lungs, airways, pleura, other mediastinal structures, heart, aorta, pulmonary arteries, coronary arteries, and thoracic osseous structures
- be proficient in the recognition of pulmonary, cardiovascular, and other thoracic pathology and be able to formulate a differential diagnosis
- learn how to generate a concise diagnostic radiology report
- communicate effectively with referring physicians, medical students, house-staff, patients and their family members
- understand the appropriate indications, limitations, and contraindications to cardiac MR and CT and be able to advise referring physicians as to their appropriate use
- obtain pertinent patient information relative to chest and cardiac imaging examinations
- be able to protocol chest CT and cardiac CT and MR examinations
- understand technical imaging standards, such as proper patient positioning, for all chest and cardiac examinations
- understand radiation and MR safety principles as they apply to chest and cardiac imaging for proper study selection and protocolling, including discussion with referring physicians
- be able to recognize and communicate problems with study quality (including problems with general image quality and with technical performance of examinations)

Introduction to Goals and Objectives based on Core Competencies:

What follows is a partial list, rather than an exhaustive list, showing the depth and breadth of skills and knowledge representative of the rotations. Knowing that residents attain knowledge and skills at different levels and that the variety and volume of cases fluctuate, residents cannot accomplish each objective during a single rotation. Rather, the listed items serve as milestones of progress.

First Rotation

Patient Care

Skills/Goals

- Demonstrate basic knowledge of PACS, RIS, and (when available) VR utilization
- Demonstrate ability to select the correct protocol for diagnostic chest CTs based on clinical information (signs, symptoms, and medical history; renal function; allergy history; and other clinical considerations) and prior imaging results; this includes accurate data-gathering
- Demonstrate knowledge of the items on the departmental lists of Critical Tests and Critical Findings pertinent to cardiothoracic imaging
- Understand indications for thoracic interventional procedures
- Demonstrate ability to recognize image quality problems for Quality Assurance and when images should be repeated /patient re-called due to technical inadequacy of images

Education/Objectives

- Interactive participation with faculty in examination interpretation
- Aid technologist in performing the following safely and responsibly, using the ALARA principle
- Accompany radiologic technologist for portable chest radiography
- View chest radiography in the Core
- View chest CT at the operator console
- Attend weekly CTOP conference and monthly Pulmonary-Radiology conference, and be prepared to discuss chest imaging findings and their relevance to patient care

Medical Knowledge

Skills/Goals

- Demonstrate understanding of the physical principles of chest radiography and CT
- Demonstrate ability to identify normal and normal-variant radiographic and cross-sectional chest anatomy, including cardiovascular structures
- Demonstrate understanding of normal physiology and pathophysiology of pulmonary and cardiovascular systems
- Demonstrate ability to recognize appropriate positions for tubes, catheters, and other medical devices on chest radiography

- Demonstrate ability to recognize common conditions (e.g. collapsed lobe) and life-threatening conditions (e.g. tension pneumothorax) on chest radiographs
- Demonstrate ability to select special radiographic views (e.g. decubitus, lordotic, etc) and select special CT series (e.g. expiratory, prone, etc) when clinically appropriate for diagnosis and management.
- Demonstrate ability to properly protocol non-contrast and contrast-enhanced chest CT examinations
- Understand how to estimate CT radiation dose from dose report.

Education/Objectives

- Required reading [residents are expected to have their own copies]
 - Collins J, Stern RJ. Chest Radiology: the Essentials. 3rd ed. 2015.
 - Boxt L, Abbhara S. Cardiac Imaging: the Requisites. 4th ed. 2016.
 - Both of these books come in hardcover and Kindle versions
- Review articles related to cardiothoracic imaging in journal. If you read no other journal as a resident, read every issue of Radiographics.
- Didactic lecture series (approximately 40 over 2 years)

Practice-Based Learning and Improvement

Skills/Goals

- Engage in self-directed education via a variety of available resources above and beyond assigned materials
- Synthesize assigned educational materials and discuss accrued knowledge with students and health care professionals in both formal presentation and informal venues, such as read-out session
- demonstrate critical assessment of the scientific literature pertaining to chest radiology
- demonstrate knowledge of and apply principles of evidence-based medicine

Education/Objectives

- Use textbooks, peer-reviewed literature, on-line sources, and other media such as DVDs, as well as on-line sources of knowledge
- Share good learning cases and missed diagnoses with others in the department
- Use the PACS based radiologic technologist QA folders to submit cases
- Consider doing a cardiac or thoracic imaging related QI project
- Demonstrate ability to search the literature according to the “EBM pyramid”
- Active participation in monthly journal club and “at-the-workstation” medical student teaching

Interpersonal and Communication

Skills/Goals

- Generate a clear and concise report, containing all relevant information and properly structured, reviewed and edited in a timely manner, and promptly revised based on attending feedback

- Provide direct and rapid communication to referring providers or their appropriate representatives for critical, emergent, and important unexpected findings with supporting documentation in the dictated report (preferably) or in a separate eD-H note.
- Demonstrate verbal and non-verbal skills for effective listening to and speaking with physicians, families, and support personnel.
- Demonstrate effective teaching of medical students and other trainees and/or observers

Education/Objectives

- Review formal dictation evaluations
- Direct observation
- Feedback from technologists, providers, other staff

Professionalism

Skills/Goals

- Demonstrate altruism, compassion, honesty, integrity, confidentiality, and ethical behavior
- Demonstrate positive work habits, including punctuality, timely report editing and signage
- Demonstrate sensitivity and responsiveness to the cardiac imaging needs and concerns of the individual patient
- Understand the broader societal ramifications and ethical principles surrounding decision-making with respect to the utilization and application of cardiac imaging examinations
- Demonstrate HIPAA compliance

Education/Objectives

- Direct observation
- Feedback from technologists, providers, other staff

Systems-Based Practice Skills

Skills/Goals

- Demonstrate ability to plan cost-effective imaging diagnostic workup and to plan cost-effective imaging surveillance

Education/Objectives

- Review consensus statements on Cardiac CT and MR
- Review ACR Appropriateness Criteria Cardiac and Thoracic imaging sections

Second and Third Rotations

All of the Skills/Goals and Education/Objectives of the First Rotation as well as the following:

Patient Care

Skills/Goals

- Gather essential and accurate information regarding patients scheduled for cardiac MR and CT imaging examinations
- Demonstrate knowledge of the clinical indications, contraindications
- Demonstrate competency in protocolling, supervising, and interpreting cardiac MR and CT imaging examinations, including high-resolution CT
- Demonstrate knowledge and application of principles of CT radiation safety and MR safety during planning and performance of examinations
- Demonstrate competency in performing post-processing of cardiac MR and CT imaging data on post-processing software
- Integrate cardiac MR and CT examination results into a management strategy

Education/Objectives

- Case log of Cardiac MR and CT cases: important for future post-training hospital privileging
 - “live” cases: direct supervision at the time of the examination in the MR or CT suite, followed by post-processing and interpretation
 - “non-live cases”: e.g. PACS-based teaching file, on-line/web-based cases, other resources/media
 - Place case log in portfolio
- Review current articles related to cardiac imaging , especially in Radiographics

Medical Knowledge

Skills/Goals

- Demonstrate knowledge of physical principles and technical aspects of cardiac imaging studies
- Exhibit sound reasoning and analysis of cardiac imaging literature, including application to image interpretation and patient management
- Demonstrate advanced knowledge of congenital heart disease, including pathophysiology, imaging findings, and palliative and/or corrective surgeries
- Discuss and recognize differences and similarities between aortic atheromatous plaque, dissection, intramural hematoma, and penetrating ulcer
- Identify and describe the imaging evolution and differential features of airspace processes and interstitial processes on chest radiography and CT
- Describe the imaging evaluation and management of the solitary pulmonary nodule
- Demonstrate the ability to staging lung cancer with CT (in conjunction with PET) via the revised TNM system
- Describe features of large and small airways disease on CT, including inspiratory and expiratory imaging
- Describe and differentiate the morphologic subtypes of emphysema versus cystic lung disease

Education/Objectives

- AAPM physics modules

- Required reading:
 - UyBico SJ, et al. Lung Cancer Staging Essentials: The New TNM Staging System and Potential Imaging Pitfalls. RadioGraphics 2010;30:1163-1181.

Practice-Based Learning and Improvement

Skills/Goals

- Demonstrate ability to select contemporary peer-reviewed pulmonary and cardiac imaging literature that results in self-directed learning
- Analyze and develop improvement plans in the clinical practice, including knowledge, observation, and procedural skills

Education/Objective

- Assist other residents with Journal Club presentation if Chest or Cardiac topic that month
- Start or continue a scholarly project in cardiothoracic radiology, such as a case report, research project, or poster exhibit with faculty and , if appropriate, interested medical student
- Start or continue a QA/QI project that directly affects cardiothoracic imaging practice

Interpersonal and Communication

Skills/Goals

- Supervise cardiac MR and CT examinations via effective communication with performing technologists
- Effectively communicate with patients and referring physicians during both information sharing before imaging examination performance and results communication after imaging examination interpretation
- Demonstrate ability to present cases or other materials at conferences in other departments/settings (e.g. ED)

Education/Objectives

- Act as contact person for radiologic, CT, and MR technologists for managing patient and imaging issues
- Perform consultations for pulmonologists, thoracic oncologists, thoracic surgeons, cardiologists, cardiac surgeons, and other health care providers
- Teach junior residents, medical students, other trainees/observers
- Conduct daily ICU rounds
- Provide cross-sectional imaging consultation
- Give at least one Grand Rounds –style presentation on a thoracic or cardiac topic to a mixed audience (e.g. Radiology and Cardiology or Pulmonary or Oncology)

Professionalism

Skills/Goals

- Demonstrate sensitivity and responsiveness to the cardiac imaging needs and concerns of the individual patient

- Understand the broader societal ramifications and ethical principles surrounding decision-making with respect to the utilization and application of cardiac imaging examinations

Education/Objectives

- Direct observation
- Feedback from technologists, providers, other staff

Systems-Based Practice Skills

Skills/Goals

- Apply evidence-based imaging principles and methodology, such as appropriateness criteria, in the analysis of utilization of cardiac imaging technologies
- Select cardiac imaging modality in a manner consistent with the most cost-effective health care delivery without jeopardizing the quality of care.
- Demonstrate knowledge of funding sources and reimbursement methods.

Education/Objectives

- Review ACR appropriateness criteria and multi-society expert consensus statements
- Review ACR/APDR Initiative for Residents in Diagnostic Radiology Modules

Third+ Rotation

All of the Skills/Goals and Education/Objectives of the Second and Third Rotations and:

Patient Care:

Skills/Goals

Education/Objectives

Medical Knowledge

Skills/Goals

Education/Objectives

Practice-Based Learning and Improvement

Skills/Goals

Education/Objectives

Interpersonal and Communication

Skills/Goals

Education/Objectives

Professionalism

Skills/Goals

Education/Objectives

Systems-Based Practice Skills

Skills/Goals

Education/Objectives

Appendix:

Knowledge-based objectives

At the end of the first chest rotation, the resident will demonstrate learning of at least one-third of the following knowledge-based objectives

Normal anatomy

Name and identify the three zones of the airways

Define a secondary pulmonary lobule

Define an acinus

List the lobar and segmental bronchi of both lungs

Identify the following structures on the PA chest radiograph

Lungs

Right upper lobe

Right middle lobe

Right lower lobe

(azygoesophageal recess)

Left upper lobe

Lingula

Left lower lobe

Fissures

Minor

(superior accessory)

(inferior accessory)

(azygous)

(posterior junction line)

(anterior junction line)

Airways

Trachea

(paratracheal stripe)

Carina

Main bronchi

Hemidiaphragms

Right

Left

Heart

Right atrium

Left atrial appendage

Left ventricle

Location of cardiac valves

Pulmonary arteries

Main pulmonary artery

Right pulmonary artery

Left pulmonary artery

Interlobar

Aorta

- Ascending
- Arch
- (left subclavian artery)
- Descending
- (aorticopulmonary window)
- Veins
 - Superior vena cava
 - Azygous
 - (left superior intercostals: “aortic nipple”)
- Bones
 - Spine
 - Pedicles
 - Transverse processes
 - Intervertebral disc space
 - (paraspinal lines)
 - Ribs
 - Posterior
 - Anterior
 - Clavicles
 - (companion shadow)
 - (nutrient foramen)

Identify the following on the left lateral chest radiograph:

- Lungs
 - Right upper lobe
 - Right middle lobe
 - Right lower lobe
 - Left upper lobe
 - Lingula
 - Left lower lobe
 - (retrosternal clear space)
 - (retrocardiac clear space)
 - (Raider’s triangle)
- Fissures
 - Major
 - Minor
 - (superior accessory)
- Airways
 - Trachea
 - Posterior tracheal stripe
 - Upper lobe bronchi
 - Posterior wall of bronchus intermedius
- Hemidiaphragms
 - Right
 - Left
- Heart
 - Right ventricle
 - Right ventricle outflow

- Left atrium
- Left ventricle
- Location of cardiac valves
- Pulmonary arteries
 - Right pulmonary artery
 - Left pulmonary artery
- Aorta
 - Ascending
 - Arch
 - (brachiocephalic/innominate artery)
 - Descending
- Veins
 - Superior vena cava
 - Inferior vena cava
 - Left brachiocephalic (innominate)
 - Pulmonary vein confluences
- Bones
 - Spine
 - Pedicles
 - Intervertebral disc space
 - Ribs
 - Lateral
 - Sternum
 - Retrosternal line
 - Scapulae
 - Humeri

Signs in Chest Radiology

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 a left lower lobe collapse

Gloved finger sign

Indicates bronchial impaction

Golden S sign

Indicates lobar collapse with a central mass, suggesting an obstructing bronchogenic carcinoma in an adult

Luftsichel sign

Indicates left 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 lingual process obscures the left heart border; a basilar segmental lower lobe process obscuring 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 or sandwich sign

Indicates pericardial effusion on lateral chest radiograph

Hilum overlay sign and hilum convergence sign

Used to distinguish a hilar mass from a non-hilar mass

Be able to define, identify and state the significance for 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 leukemic patients

Split pleura sign

A sign of empyema

Cardiac Radiology Core Curriculum

1. cardiac anatomy
 - a. normal anatomy and variants
 - b. chamber relationships
 - c. epicardial coronary arteries
 - d. valve planes and relationships
2. embryology of the heart
 - a. development of the bilaminar plate
 - b. development of the mesoderm
 - c. cardiac looping
 - d. development of the AV valves
 - e. development of the interatrial septum
 - f. development of the interventricular septum
 - g. development of the semilunar valve
3. cardiac situs and position
 - a. determination of thoracic and abdominal situs
 - b. levocardia, mesocardia, dextrocardia
 - c. situs solitus
 - d. situs inversus
 - e. indeterminate situs
 - a. left heterotaxy
 - b. right heterotaxy
4. cardiac physiology
 - a. in utero physiology
 - b. change from in utero to ex utero environment
 - c. changes in the first month of life
5. aorta
 - a. congenital malformation
 - a. right aortic arch
 1. with aberrant left subclavian artery
 2. with mirror-image branching
 - b. left aortic arch with aberrant right subclavian artery
 - c. double aortic arch
 - d. coarctation
 1. left heart obstruction
 2. bicuspid aortic valve and aortic stenosis
 3. mitral atresia and hypoplastic left heart syndrome
 4. Shone's syndrome
 5. Parachute mitral valve
 - e. interrupted aortic arch
 - b. atherosclerotic disease
 - a. the atherosclerotic process
 - b. aortic arch calcification

- c. coronary artery calcification
 - d. natural history of the atherosclerotic plaque
 - e. aortic aneurysm
 - f. aortic dissection
 - c. primary aortic disease
 - a. Marfan's syndrome (Ehler-Danlos, Loeys-Dietz syndrome)
 - b. Aortoannular ectasia
 - c. Supravalvular aortic stenosis
 - d. Takayasu's arteritis
6. Pulmonary arteries
- a. Dilated central pulmonary arteries
 - a. Increased pulmonary blood flow
 - 1. Shunt
 - a. Ventricular septal defect
 - b. Atrial septal defect
 - c. Patent ductus arteriosus
 - d. Endocardial cushion defect
 - e. Peripheral arteriovenous fistula
 - 2. High output cardiac failure
 - a. Sickle cell disease
 - b. AV fistula
 - b. Increased pulmonary arterial pressure
 - 1. Chronic obstructive lung disease
 - 2. Restrictive lung disease
 - a. Interstitial fibrosis
 - b. Cystic fibrosis
 - 3. Chronic pulmonary thromboembolism
 - 4. Mitral stenosis
 - 5. Chronic left ventricular ischemia
 - 6. Shunt (see 6.a.i.1 above)
 - 7. Primary pulmonary hypertension and pulmonary vein stenosis
 - a. Effect on the right ventricle
 - i. Right ventricular hypertrophy
 - ii. Tricuspid regurgitation
 - b. Effect on the left ventricle
 - i. Decreasing right ventricular cardiac output
 - ii. Role of the interventricular septum
 - c. Increased pressure and flow
 - 1. Ventricular septal defect
 - 2. Natural history of atrial septal defect
 - d. Valvular pulmonic stenosis
 - b. Decreased pulmonary artery caliber
 - a. Decreased pulmonary blood flow
 - b. Abnormal position of the main pulmonary artery
 - 1. To the left of the aorta and posterior
 - a. D-transposition of the great arteries
 - 2. To the right of the aorta
 - a. L-transposition of the great arteries
 - i. L-TGA with double inlet ventricle

3. No pulmonary artery
 - a. Pulmonary atresia
 - b. Truncus arteriosus
 - c. Right ventricular outflow obstruction
 1. Tetralogy of Fallot
 2. Tetralogy with pulmonary atresia
 3. Pulmonary atresia with ventricular septal defect
 4. Anomalous right ventricular muscle bundles with ventricular septal defect
 5. Double outlet right ventricle
 6. Tricuspid atresia
 7. Ebstein's malformation
7. Left atrial enlargement
- a. Signs of left atrial enlargement
 - b. Increased left atrial pressure
 - a. Signs of left atrial hypertension
 - b. Interaction of left and right heart across the pulmonary bed
 - c. Effect of left atrial hypertension on right heart function
 - d. Mitral stenosis
 1. Etiology
 2. Mimics
 - a. Prolapsing left atrial myxoma
 - b. Cor triatriatum
 - e. Left heart failure
 - c. Increased left atrial volume
 - a. Mitral regurgitation
 - b. Left-to-right shunt
 1. Ventricular septal defect
 2. Patent ductus arteriosus
 - c. Right-to-left shunt
 1. Tricuspid atresia
 - d. Unusual causes of left atrial enlargement
 - a. Pericardial defect
 - b. Cor triatriatum
 - c. L-TGA with left-sided Ebstein's malformation
8. Abnormal left ventricular contour
- a. Focal
 - a. Left ventricular aneurysm
 1. True aneurysm
 - a. Radiologic appearance of acute myocardial infarction
 - b. Natural history of infarcted myocardium
 2. False aneurysm
 - b. Cyst
 1. Pericardial
 2. Bronchogenic
 3. Neurenteric
 4. Thyroid, etc
 - c. Pleural mass
 - d. Cardiac mass

1. Metastatic malignant
 - a. Breast in women
 - b. Lung in men
 - c. Direct extension from esophagus
 2. Primary benign
 - a. Lipoma
 - b. Fibroma
 - c. Angioma
 - d. Rhabdomyoma
 3. Primary malignant
 - a. sarcoma
- b. Global
- a. Increased left ventricular volume
 - b. Increased left ventricular pressure
 - c. Left ventricular ischemia
 - d. Cardiomyopathy
 1. Hypertrophic cardiomyopathy
 2. Dilated cardiomyopathy
 3. Right ventricular cardiomyopathy
 - a. Arrhythmogenic right ventricular dysplasia
 - b. Right ventricular outflow tract tachycardia
 - c. Brugada's syndrome
 4. Restrictive cardiomyopathy
 - a. Differentiation from constrictive pericarditis
9. Widened superior mediastinum
- a. Aortic aneurysm
 - b. Enlarged superior vena cava
 1. Increased venous flow
 - a. Head and neck arteriovenous malformation
 2. Increased pressure
 - a. SVC obstruction
 - b. Interrupted IVC with azygous continuation
 - c. Mediastinal lipomatosis
10. Dilated ascending aorta
- a. Focal enlargement
 - a. Aortic stenosis
 - b. Aortic aneurysm
 - b. Global enlargement
 - a. Increased volume
 1. Aortic regurgitation
 2. Aortic aneurysm
 - b. Aortic dissection
11. Dilated right heart border
- a. Right heart enlargement
 - b. Pericardial disease
 - a. Pericardial effusion
 1. Loculated
 - b. Pericardial cyst
 - c. Pericardial mass

d. pericarditis

CHEST RADIOLOGY LECTURE SERIES (2-year cycle)

Closely follows Collins and Stern text.

Intro to chest radiology – technique and anatomy

Normal anatomy

Signs in chest radiology

HRCT of lung parenchyma

Airspace/alveolar lung disease

Diffuse

Upper lung zone

Peripheral

Pneumonia

Atelectasis

Diffuse interstitial lung disease

Idiopathic interstitial pneumonia

SPN: Diagnosis and management

Multiple pulmonary nodules

Benign and Malignant neoplasms of the lung

Pulmonary emboli

Mediastinal masses

Congenital lung disease

Critical care radiology

ICU/lines and tubes/monitoring and support devices

Chest wall, pleura, and diaphragm

Pulmonary infection in normal and immunocompromised host

Airways

Chest trauma

Thoracic aorta and great vessels

CARDIAC RADIOLOGY CURRICULUM

1. Cardiac anatomy (including coronary arteries)
 - a. radiographic and cross-sectional
 - b. AHA nomenclature and segmentation
 - c. variants
2. Cardiac physiology
 - a. functional evaluation
 - i. Qualitative
 - ii. Quantitative
 - b. cardiac cycle, flow dynamic, contraction, conduction
- 3-6. Congenital heart disease: divided over 4 lectures
 - a. cardiac embryology
 - b. congenital lesions
 - i. pathologic anatomy
 - ii. pathophysiology
 - c. surgical palliation and repair
 - d. post-operative complications
 - e. multi-modality imaging appearance of the above
- 7-8. Valvular heart disease: divided over two lectures
- 9-12. Ischemic heart disease: divided over 4 lectures
 - a. Risk stratification: coronary calcium scoring
 - i. Technique
 - ii. Scoring systems
 - iii. Role vis-à-vis Framingham risk score, et al.
 - iv. Reporting
 - b. Coronary artery imaging
 - i. Atherosclerotic disease
 - ii. Anomalies
 - iii. Post-stent and post-CABG
 - b. Rest and stress perfusion and function
 - c. Viability and scar mapping
13. Heart failure
 - a. etiologies
 - b. imaging evaluation
14. Non-ischemic cardiomyopathies
15. Pericardial disease
16. Cardiac and paracardiac masses
17. Cardiac CT – specific considerations
 - a. indications, emphasis on appropriateness
 - b. patient preparation

- c. heart rate and arrhythmia
- d. gating and reconstruction
- e. radiation reduction methods
- f. reporting

18. Cardiac MR – specific considerations

- a. indications, emphasis on appropriateness
- b. magnetohydrodynamic effect
- c. real-time imaging
- d. pacemakers
- e. reporting

19. Cardiac imaging for electrophysiology

Pulmonary vein isolation/pre-ablation mapping

- a. contrast-timing
- b. measurements
- c. reporting

Left atrial appendage ligation

20. Thoracic aorta (emphasis on root-to-arch)

- a. anatomy
- b. measurements
- c. pathology
- d. surgical repair
- e. post-op complications
- f. reporting

* NOTE: Other sections with lectures that do or may cover complimentary material include: Chest/Thoracic, Pediatric, Nuclear Medicine (Nuclear Cardiology), Body Imaging (CT and MR), and Interventional.

Adapted from the following references:

1. Society of Thoracic Radiology: Collins J, et al. Revised curriculum on cardiothoracic radiology for diagnostic radiology residency with goals and objectives related to general competencies. Acad Radiol 2005; 12:210-223.
2. North American Society for Cardiac Imaging: Cardiac Radiology Curriculum Guide. www.nasci.org