Rotation: Chest CT Imaging
VGH

899 West 12th Ave , Vancouver BC V5Z 1M9

Level: PGY 2-5

Rotation Supervisor: Dr. Ana-Maria Bilawich

During the course of the four years, residents will receive one month of chest CT training as a junior resident and one month of chest CT training as a senior resident. Residents are expected to develop graded responsibility as they rise from junior to senior resident level. Each resident will be given guidance at the beginning of a rotation, an interim evaluation will occur mid rotation, and a final evaluation will be given at the end of each rotation. Each final evaluation will be submitted to the residency training program director.

All residents are expected to arrive in the department by 0800 hours and stay until the conclusion of the working day. Ongoing teaching and interaction with the staff occurs throughout the day.

If a resident is absent from his/her Chest CT rotation for any reason, he/she should give ample warning to Dr. Mayo (Radiology Department Head) or Dr. Bilawich (Cardiothoracic Section Head and rotation supervisor).

Vacation and conference requests must be booked with Dr. Mayo or Dr. Bilawich in advance, at least two weeks prior to any planned absence from the rotation.

Medical Expert:

1. Basic Science:

a) Knowledge of cross sectional and multi-planar anatomy

At the end of first Chest CT rotation, the junior resident (PGY2/3) will demonstrate learning all of the following cross sectional and multi-planar anatomy on CT chest.

At the end of the second Chest CT rotation, the senior resident (PGY4/5) will demonstrate learning all of the following cross sectional and multi-planar anatomy on CT chest.

1. Identify the following structures on chest CT:

a. Lungs: right, left, right upper lobe, right middle lobe, right lower lobe, left upper lobe, lingual and left lower lobe, and corresponding segments

b. Pleura and extrapleural fat

c. Airway: trachea, main bronchi, carina, lobar and segmental bronchi

d. Heart: left ventricle, right ventricle, moderator band, left atrium, left atrial appendage, right atrium, right atrial appendage, mitral valve, aortic valve, tricuspid valve, pulmonary valve, coronary arteries (left main, left anterior desceding, left circumflex, right, posterior descending), coronary veins, coronary sinus

e. Pericardium: including pericardial recesses

f. Pulmonary arteries: main, right left, interlobar, segmental

g. Aorta: asceding, sinuses of Valsalva, arch, descending

h. Arteries: brachiocephalic (innominate), common carotid, subclavian, axillary, vertebral, internal mammary, intercostal

i. Veins: pulmonary, superior vena cava, inferior vena cava, brachiocephalic, subclavian, axillary, internal jugular, external jugular, azygos, hemiazygos, left superior intercostals, internal mammary

j. Bones: ribs and costochondral cartilages, clavicles, scapulae, sternum, spine

k. Esophagus

l. Thymus

m. Thyroid gland

n. Muscles: sternocleidomastoid, anterior and middle scalene, pectoralis major and minor, deltoid, trapezius, infraspinatus, supraspinatus, subscapullaris, latissimus dorsi, serratus anterior

o. Aortopulmonary window

p. Azygoesophageal recess

q. Gastrohepatic ligament, celiac axis

r. Diaphragm

s. Secondary pulmonary lobule: identify on CT and define.

t. *Fissures: major, minor, azygos, accessory (superior and inferior).*

b) At the end of the second Chest CT rotation, the senior resident (PGY4/5) will demonstrate knowledge of CT physics, technical parameters of image acquisition and artifacts.

2. Diagnostic CT:

a) Knowledge of clinical radiology and pathology

At the end of first Chest CT rotation, the junior resident (PGY2/3) will demonstrate learning the following knowledge-based objectives written in italics:

At the end of the second Chest CT rotation, the senior resident (PGY4/5) will demonstrate learning all of the following knowledge-based objectives (written in italics and normal typeface):

- *Define an acinus*

- *Define 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 patient*

** Split pleura sign: a sign of empyema and other inflammatory pleural processes.*

- Interstitial lung disease

1. Make a specific diagnosis of ILD when supportive findings are present in the history or on radiologic imaging.

2. Define the terms 'asbestos-related pleural disease' and 'asbestosis' and identify each on a chest CT.

3. Identify honeycombing on chest CT, state the significance of this finding (end-stage lung disease), and list the common causes of honeycomb lung.

4. Recognized progressive massive fibrosis/conglomerate masses secondary to silicosis or coal worker's pneumoconiosis on chest CT.

5. List causes of lower lobe predominant ILD.

6. List causes of upper lobe predominant ILD.

7. Recognize findings of lymphangioleiomyomatosis and Langerhans cell histiocytosis on chest CT.

8. Identify and give appropriate differential diagnosis when the patterns of septal thickening, perilymphatic nodules, bronchiolar opacities ('tree-in-bud'), air trapping, cysts and ground glass opacities are seen on CT.

- Alveolar Lung Disease

1. List four broad categories of acute alveolar lung disease (ALD).

2. List five broad categories of chronic ALD.

3. Recognize a pattern of peripheral ALD on chest CT and give an appropriate differential diagnosis, including a single most likely diagnosis when supported by associated radiologic findings or clinical information.

- Atelectasis, Airways and Obstructive Lung Disease

1. Name the four types of bronchiectasis and identify each type on chest CT.

2. Name common causes of bronchiectasis.

3. Recognize the typical appearance of cystic fibrosis on CT.

4. Define tracheomegaly.

5. Recognize tracheal and bronchial stenosis on chest CT and name the most common causes.

6. Name the three types of pulmonary emphysema and identify each type on a chest CT.

7. Recognize alpha-1-antitrypsin deficiency on chest CT.

8. State the imaging findings used to identify surgical candidates for giant bulectomy and for lung volume reduction surgery.

9. Recognize and describe the significance of a pattern of mosaic lung attenuation on chest CT.

- 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 chest CT.

3. Name the three most common causes of a middle mediastinal mass and localize a mass in the middle mediastinum on a chest CT.

4. Name the most common cause of a posterior mediastinal mass and localize a mass in the posterior mediastinum on a chest CT.

5. Name two causes of a mass that straddles the thoracic inlet and localize a mass to the thoracic inlet on a chest CT.

6. Name five etiologies of bilateral hilar lymph node enlargement.

7. State the three most common locations (Garland's triad) of thoracic lymph node enlargement in sarcoidosis.

8. List the four most common etiologies of 'egg-shell' calcified lymph nodes in the thorax.

9. Recognize a cystic mass in the mediastinum and suggest the possible diagnosis of a bronchogenic, pericardial, thymic or esophageal duplication cyst.

10. Recognize the findings of mediastinal fibrosis on chest CT.

- Solitary and Multiple Pulmonary Nodules

1. Define the terms pulmonary nodule and pulmonary mass.

2. Name the three most common causes of a solitary pulmonary nodule.

3. Name six causes of cavitary pulmonary nodules

4. Name four causes of multiple pulmonary nodules.

5. Describe an appropriate imaging algorithm to evaluate a solitary pulmonary nodule.

6. Describe the indications for percutaneous biopsy for a solitary or multiple pulmonary nodules.

7. Describe the complications and the frequency with which complications occur because of percutaneous lung biopsy using CT guidance.

- Benign and Malignant Neoplasms of the Lung and Esophagus

1. Name the four major histologic types of bronchogenic carcinoma.

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.

5. Describe the staging of small-cell lung cancer.

6. Name the most common extrathoracic sites of metastases for non-small-cell and small-cell lung cancer.

7. Name the stages of non-small-cell lung cancer that are portentially resectable.

8. Name the most common thoracic locations for adenoid cystic carcinoma and carcinoid tumors to occur.

9. Describe the TNM classification for staging esophageal carcinoma, the role of imaging in staging esophageal carcinoma and the stages of esophageal carcinoma that are potentially resectable.

10. Describe the classification of lymphoma, the role of imaging in staging of lymphoma and the typical and atypical imaging findings of thoracic lymphoma.

11. Define primary pulmonary lymphoma.

12. Describe the typical chest CT appearances of Kaposi sarcoma.

- Chest Wall, Pleura and Diaphragm

1. *Recognize and name causes of a large unilateral pleural effusion on a chest CT*.

2. Recognize a pleural based mass with bone destruction or infiltration of the chest wall on a chest CT and name likely causes.

3. Recognize pleural calcification on a chest CT and suggest the diagnosis of asbestos exposure (bilateral involvement) or old tuberculosis or trauma (unilateral involvement).

4. Recognize imaging findings suggesting a tension pneumothorax and understand the acute clinical implications.

5. Recognize diffuse pleural thickening, as seen in fibrothorax, malignant mesothelioma and pleural metastases.

6. Describe and recognize the CT findings of malignant mesothelioma.

7. Describe the difference in appearance of a pulmonary abscess and empyema on chest CT and how the two are differently managed.

8. Distinguish pleural from intraperitoneal fluid on chest CT.

- Infection and Immunity

1. *Name the most common segmental sites of involvement of postprimary tuberculosis in the lung*.

2. Define a Ghon lesion (calcified pulmonary parenchymal granuloma) and Ranke complex (calcified node and Ghon lesion); recognize both on a chest CT and describe their significance.

3. Name and describe the types of pulmonary aspergillus disease.

4. Identify an intracavitary fungus ball on chest CT.

5. Describe the radiographic appearances of PCP and CMV pneumonia.

6. Other than bacterial infection, name two important infections and two important neoplasms to consider in patients with AIDS and chest CT abnormalities.

7. Name most important etiologies of hilar and mediastinal lymphadenopathy in patients with AIDS.

8. Describe the chest CT appearance of a military pattern and provide a differential diagnosis.

9. Describe the chest CT findings of posttransplant lymphoproliferative disorder.

- Unilateral Hyperlucent Hemithorax

1. Recognize a unilateral hyperlucent hemithorax on a chest CT.

- Pulmonary Vasculature.

1. Name the common causes of pulmonary arterial hypertension.

2. Recognize lobar and segmental pulmonary emboli on chest CT.

3. Recognize variations in pulmonary venous anatomy.

- Thoracic Aorta and Great Vessels

1. Describe the classification of aortic dissection (DeBakey and Stanford) and implications for classification on medical vs. surgical management.

2. Describe and recognized the findings of, and distinguish between each of the following on CT:

a. Aortic aneurysm

b. Aortic dissection

c. Aortic intramural hematoma

d. Penetrating atherosclerotic ulcer

e. *Ulcerated plaque*

f. Ruptured aoric aneurysm

g. Sinus of Valsalva aneurysm

h. Subclavian or brachiocephalic artery aneurysm

i. Aortic coarctation

j. Aortic pseudocoarctation

3. Recognize a right aortic arch and double aortic arch on a chest CT.

4. State the significance of right aortic arch with mirror image branching vs. with an aberrant subclavian artery.

5. Recognize a cervical aortic arch on a chest CT.

6. Recognize an aberrant subclavian artery on chest CT

7. Recognize normal variants of aortic arch branching.

8. Define the term aneurysm and pseudoaneurysm.

9. Identify and describe findings of Takayasu arteritis on chest CT.

- Pericardial Disease

1. Recognize pericardial calcification on a chest CT and name the most common causes.

2. Name common causes of a pericardial effusion.

3. Describe findings of each of the following on a chest CT: pericardial cyst, constrictive pericarditis, absence of the pericardium, pneumopericaridum.

- Postoperative thorax

1. Identify the normal postoperative findings and complications of the following procedures on chest CT:

a. Wedge resection, lobectomy, pneumonectomy

b. Coronary artery bypass graft surgery

c. Cardiac valve replacement

d. Aortic graft

e. Aortic stent

f. Transhiatal esophagectomy

g. Lung transplantation

h. Lung volume reduction surgery.

At the end of the second Chest CT rotation, the resident will be expected to function in the capacity of a fellow/junior staff. The senior resident is expected to develop a more advanced approach to interpretation of CT examinations, and be able to integrate clinical, laboratory data and the results of complementary imaging modalities in dealing with more complicated Cases.

b) Understands imaging protocols, including use of intravenous contrast

c) Detects findings

d) Interprets findings into an appropriate differential diagnosis

e) Ability to summarize case, offer recommendations, understands treatment and clinical implications

Residents doing two months or more elective time in chest radiology in their final year will have the opportunity of doing lung biopsies. The goals and objectives for the optional CT guided intervention component are:

i) Demonstrates knowledge in performing CT guided intervention

ii) Demonstrates knowledge of the procedure: indications, complications, appropriate alternatives, use of conscious sedation, post procedure care

iii) Demonstrates technical ability, including knowledge in patient positioning, sterile technique, use of local anesthetic, performing simple or more difficult procedures

Communicator:

a) Communicates effectively with patients, families and other health professionals

b) Appropriate and timely communication of findings to referring physicians, including when results are urgent

c) Obtains appropriate informed consent

d) Accurate, concise, complete reports

Collaborator

a) Respects, recognizes the roles of, and effectively interacts with the health care team, including nurses and technologists

b) Fulfills consultant role (for level of training)

LEADER ROLE:

Implement processes to ensure personal practice improvement

Set priorities and manage time to integrate practice and personal life

Apply the science of quality improvement (ie discussion of potential audit) to contribute to improving systems of patient care

Contribute to a culture that promotes patient safety, including recognition of patient safety issues, and utilization of health informatics to improve patient safety

Demonstrate leadership skills to enhance health care

Health Advocate

a) Understands benefits and risks related to imaging studies

b) Understands the appropriate use of imaging studies and rationalization of use of imaging resources

Scholar

a) Effectively teaches others, including residents, medical students and patients

b) Demonstrates continuous self-directed learning (reads around cases and topics)

c) Demonstrates evidence based medical approach and critical appraisal with regards to radiology literature

d) Attends weekly Thoracic Surgery Rounds (7-8 am every Tuesday) and Radiologic-Clinical-Pathologic Rounds (1-2 pm every Friday from September to June)

e) The resident is responsible for submitting two teaching files to the MIRC server per rotation, and will present the two submitted teaching files to the chest radiology staff during the last week of the rotation.

Professional

a) Exhibits professional behaviour, displaying honesty, integrity and respect

b) Exhibits ethical behaviour, sensitivity to gender/culture diversity

c) Demonstrates punctuality

d) Demonstrates good work ethic, enthusiasm and motivation

e) Demonstrates reliability, responsibility and conscienciousness

f) Demonstrates insight with regards to own limitations, strength and weaknesses, asks for help when appropriate

g) Accepts constructive criticism

Reading List:

Recommended Textbooks:

1. Thoracic Imaging Pulmonary and Cardiovascular Radiology. By W. Richard Webb and Charles B. Higgins.

Radiologic Diagnosis of Diseases of the Chest. By NL Muller, R Fraser, N Colman and PD Pare and High-Resolution CT of the Lung. By W. Richard Webb, Nestor L. Muller and David P. Naidich are available as a reference in the reading room.

Reading around cases that the resident encounters during his/her rotation is mandatory. This can be done with StatDX and internet can provide many review articles (i.e. Radiographics).