Introduction to Chest CT Interpretation

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Objectives

• Basic Principles
• Thoracic Anatomy
• Approach to CT Interpretation
• Review common pathologies

Basic Principles

• Identification of patient
• Planes of imaging
• Orientation
• Image attainment
Recognizing Different Mediums

- Air: Black
- Fluid: Gray
- Soft tissue: Various shades of gray
- Bone: Dense white
- Blood: White
- Contrast: Dense white
Types of CT Imaging

- **Standard**
  - Contrast can be given to highlight structures and improve diagnostic accuracy
  - Specifically to look at mediastinal vasculature and soft tissue, and chronic pulmonary diseases
- **High Resolution**
  - Very thin cuts
  - Excellent spatial resolution
  - Good for detection of interstitial lung disease
- **CT angiography**
  - Detection of pulmonary emboli
- **Low radiation dose**

3 Windows of CT Imaging

- **Lung**
  - Lung
  - Airways
  - Lung parenchyma
- **Soft Tissue**
  - Mediastinal structures
    - Heart
    - Thyroid
    - Muscles
    - Lymph nodes
- **Bone**

Windows of CT Imaging

- (a) Lung
- (b) Soft Tissue
- (c) Bone
Identifying Chest Anatomy

1. Coracoid
2. Right clavicle
3. Right common carotid
4. Thyroid
5. Internal jugular vein
6. Left clavicle
7. Left subclavian vein
8. Left humeral head
9. Scapular spine
10. Spinous process

Identifying Chest Anatomy

1. Right humeral head
2. Esophagus
3. Trachea
4. Left subclavian vein
5. Left scapular spine
6. Right glenohumeral joint

Anatomical Landmarks

1. Esophagus
2. Rib
3. Trachea
4. Superior vena cava
5. Brachiocephalic artery
6. Left common carotid artery
7. Aorta
8. Scapula
9. Spinal canal
More Anatomical Landmarks
1. Right Pulmonary Artery
2. Right Lung
3. Superior vena cava
4. Thoracic Ascending Aorta
5. Pulmonary Arterial Trunk
6. Left Pulmonary Vein
7. Left Pulmonary Artery
8. Scapula
9. Rib
10. Left Lung

More Anatomical Landmarks
1. Right Atrium
2. Aortic Root
3. Pulmonary Arterial Root
4. Left Atrium
5. Descending Thoracic Aorta

Sagittal Landmarks
1. Right Upper Lobe
2. Right Middle Lobe
3. Right Lower Lobe
4. Black arrows: minor fissure (horizontal fissure)
5. Red arrows: major fissure (oblique fissure)
Sagittal Landmarks

1. Left Upper Lobe
2. Major Fissure (Oblique Fissure)
3. Left Lower Lobe

Coronal Views

1. Trachea
2. Left Mainstem Bronchus
3. Right Mainstem Bronchus
4. Apical Segment Bronchus of Right Upper Lobe
5. Right Lower Lobe Bronchus
6. Red arrows: Oblique Fissures

Basic Approach to CT
Step 1: Identifying the level using anatomical landmarks

- Sternoclavicular joint—T1
- Sternal angle of Louis, second rib, aortic arch—T4
- Carina of the trachea—T5
- Bifurcation of the Pulmonary trunk—T5/T6
- Inferior pulmonary veins enter the Left atrium—T7/T8

Step 2: Systematic Assessment

- A: air
- B: bone
- C: cardiac and great vessels
- D: digestive
- E: extras
- S: soft tissue
Step 2: Systematic Assessment

- **Air:**
  - Is airway patent?
  - Look for nodules, masses, calcifications, consolidations or fluid in the lungs
- **Bone:**
  - Look for fractures (bones, ribs, scapulae)
  - Look for visible bony metastases

Step 2: Systematic Assessment

- **Cardiac and Great Vessels:**
  - Normal appearing anatomy (SVC, ascending/descending thoracic aorta, pulmonary trunk)
  - Look for clots in the pulmonary vasculature
- **Digestive:**
  - Esophagus patent
  - Evaluate for surrounding masses

Step 2: Systematic Assessment

- **Extras:**
  - Evaluate for foreign bodies or placement of medical equipment such as thoracostomy tubes, nasogastric tubes, central venous catheters, etc
- **Soft Tissue:**
  - No abnormalities of musculature or fat
Common Thoracic Pathologies

- Airway Obstruction
- Pneumonia
- Pleural Effusions
- Pericardial Effusion
- Pulmonary Emboli
- Pneumothorax
- Pneumomediastinum
- Lung masses
- Rib Fracture

Airway Obstruction

Airway Obstruction
Pneumonia

T. Franquet Eur Respir J 2001;18:196-208

Pneumonia

Pleural Effusions

Atelectasis

Pleural effusion
Hemorrhagic Effusion

Pericardial Effusion

Pulmonary Emboli
Pneumomediastinum

Lung masses

Pulmonary Mets
Rib Fracture

Case Reviews
Case #1

- 62 y/o man 1 year s/p pneumonectomy w/pericardectomy for lung cancer
- D0: fevers, sepsis; possible infected post pneumonectomy fluid
- CT placed for drainage of pneumonectomy fluid
- Post CT placement, ~1L old bloody drainage
- Clamped

Case #1 Cont’d

- D#1: CT unclamped
- 1L dark bloody drainage
- Rapid Response Activated: syncope, hypotension, tachycardia
- CT clamped, 1L Fluid
- Hemodynamics improved
- Labs: 1gram/dL drop in hgb

What Do You See?
Case #2
- 23 y/o man; untreated metastatic neuroendocrine tumor
- D#1 s/p Kyphoplasty
- New Hypoxia: RA-> 6L NC

What Do You See?

Case #3
- 79 y/o M; pancreatic cancer w/ hepatic mets
- Progressive fatigue x 2 weeks
- Near syncopal episode in AM, admit to hospital
- Hgb 6.1 on admission
- Transfused 2 units PRBCs w/ repeat Hgb 8.2
- No obvious source of bleed
- CT C/A/P obtained
What Do You See?

Case #3 Cont’d

• D#2 RRT called for near syncope, hypoxia
• Tx w IVF, supplemental O2 (4L NC)
• Repeat Hgb 7.2 (from 8.1)
• Transfused 1 unit PRBCs
• Thoracentesis 900 mL dark bloody fluid
• CXR: decreased effusion, no pneumothorax
• Weaned back to room air

Case #3 Cont’d

• 2nd Rapid Response call: syncope
• Hgb 5.8, hyperlactatemia and metabolic acidosis
• Repeat CT performed
What Do You See?

Case #3 Cont’d

- Transfused
- Chest tube placed
- Brought to ICU for further care and IR for source of bleed/embolization of bleeding vessel
- Patient did well

Case #4

- 53 y/o man PMHx TB s/p Rx
- Metastatic Renal Cell Cancer (lungs, pleura, liver, pancreas, mediastinum, R kidney) despite L nephrectomy and multiple tx regimens
- Recently diagnosed with LUL cavitary lesion (necrotizing granuloma)
- Tumor or fungal cavitary lesion
- Some improvement in symptoms w/ antifungal Rx
Case #4 Cont’d

- 8/1: progressive dyspnea attributed to recurrent afib tx w/ metoprolol
- 08/4: admitted to ward with febrile sepsis, cough, dyspnea, uncontrolled afib tx w/ abx, antiarrhythmics
- CT performed

What Do You See?

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Radiologist Read

1. **LUNGS:** ↑ size/wall thickness of LUL cavitation mass. ↑ left upper lobe nodule occluding LUL bronchus. Post-obstructive pneumonia and trace left pleural effusion.

2. **MEDIASTINUM/THORACIC NODES:** Unchanged mediastinal LAD. Persistent paratracheal ill-defined soft tissue encasing the left mainstem bronchus, a portion of the soft tissue invades the left superior pulmonary vein and extends into the left atrium.

3. **IMPRESSION:**
   1. ↑ size and wall thickness of the cavitating LUL mass; LUL post obstructive pneumonia.
   2. Unchanged mediastinal adenopathy and soft tissue mass encasing the left mainstem bronchus and invading left pulmonary vein and left atrium.
   3. Trace left pleural effusion.

Case #4 Cont’d

- 8/5:
  - Rapid Response: Hemoptysis
  - Admit to ICU: massive hemoptysis w/ clots
  - Angiography and unsuccessful embolization
  - During the attempts at embolization, the proximal part of the target vessel was likely dissected and flow across subsequently decreased
  - Tx: R mainstem intubation for bleeding from the L lung, vasopressors, protamine, massive transfusion, and deep sedation
  - Made DNR, extubated a week later.

What Do You See?
Coronal View

What Do You See?

Summary

• Correct Patient, Correct Study
• Be systematic in your approach
  – Correct orientation
  – Use landmarks to identify where you are
  – Follow ABCDES
Thank You

“The value of experience is not in seeing much, but seeing wisely.”
- William Osler