Chest Hybrid Imaging: Anatomy, Variants, Urgent Findings

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You are reading PET-CT and see this...
Or this…
Is it abnormal?

And what is it?
First review:

Slice by Slice
Correlative Anatomy
Sternocleidomastoid  Pectoralis
Sternohyoid (medial) and Sternothyroid (lateral)

- Deltoid
- Supraspinatus
- Infraspinatus and teres minor
- Serratus anterior
- Subscapularis
Right common carotid artery
Left common carotid artery
Right subclavian artery
Left subclavian artery
Left common carotid artery
Station 1: Highest mediastinal - Cranial to brachiocephaalic vein crossing trachea
3: Prevascular: anterior to great vessel branches and cranial to aortic arch.
3: Retrotracheal - behind trachea between thoracic inlet and azygous vein
Right and left brachiocephalic veins
Claviculomanubrial articulation

2: Upper paratracheal – below station 1 and cranial to aortic arch
Esophagus
Note normal vascular activity
Azygous vein

4: Lower paratracheal right (R) and left (L) of trachea midline between superior aspect aortic arch and superior aspect upper lobe bronchus. (can also be subdivided into superior and inferior – above and below the azygous vein.

Calcified ligamentum arteriosum
5: Subaortic or AP window – lateral to ligamentum arteriosum and medial to origin of first branches of left pulmonary artery
6: Paraaortic – anterior and lateral to aortic arch below superior aspect of aortic arch
7: Subcarinal (if they involve this area even if they extend anteriorly or posteriorly)

10: Hilar – caudal to right upper lobe bronchus and adjacent to main bronchus (anterior and posterior)
8: Paraesophageal – adjacent to wall of the esophagus
Main pulmonary artery branching to right and left PA

Ascending aorta

Descending aorta

SVC
11,12,13: Interlobar, distal lobar, segmental – adjacent to respective bronchi – (may lump together as bronchovascular)

Left superior/middle pulmonary veins
Right superior/middle pulmonary veins
Left inferior pulmonary vein
Right inferior pulmonary vein
Descending aorta
Esophagus
Descending aorta
Descending aorta
Descending aorta
Descending aorta
Lung Segments

- **Right**
  - Upper Lobe
    - anterior
    - apical
    - posterior
  - Middle Lobe
    - lateral
    - medial
  - Lower Lobe
    - superior basal
    - medial basal
    - anterior basal
    - posterior basal
    - lateral basal

- **Left**
  - Upper Lobe (upper division)
    - anterior
    - apicoposterior
  - Upper (lingular division)
    - superior
    - inferior
  - Lower Lobe
    - superior
    - anteromedial basal
    - posterior basal
    - lateral basal
Right upper lobe apical

Carina
Right mainstem bronchus
Posterior segment
Right upper lobe anterior
Left upper lobe apicoposterior
Left upper lobe anterior
Right major fissure

Lingular

Lower lobe and superior segment
Minor fissure

Middle lobe

Lower lobe with superior segment
Middle lobe lateral and medial
Normal Uptake and Variants - Myocardial

- Myocardial
  - Variable at 4-18 hours fasting
  - Decreases with fasting as cardiac muscle shifts to fatty acid source of energy
    - In fed state, glucose metabolism prevails
  - Can be non-uniform
  - Base of left ventricle last to lose uptake
  - Atrial tissue variable and may be focal
  - Right ventricle low uptake but can be intense with RVH
Normal Uptake and Variants - Myocardial

spectrum of LV uptake
Normal Uptake and Variants - Myocardial

4 chamber uptake
Normal Uptake and Variants – Mediastinal and Blood Pool

- Mediastinal and great vessel blood pool
  - Uptake dependent on FDG incorporation into organs and tissues of the body
  - Poor uptake due to hyperglycemia or other factors such as steroids will result in higher blood pool activity
- Atheromatous disease in vessels
Normal Uptake and Variants – Mediastinal and Blood Pool
Normal Uptake and Variants - Diaphragm

Patient Coughing Throughout Uptake and Study
Normal Uptake and Variants – Diaphragm
Brown Fat

- Benign finding
- Increased post-chemotherapy or with cold weather
- More common if patient cold during uptake phase
- Can be asymmetric
- May be reduced with propranolol or reserpine, or just keeping patient warm
Normal Uptake and Variants – 
Brown Fat

6 year old osteosarcoma 
s/p chemo
Normal Uptake and Variants – Asymmetric Brown Fat

18 year old female carotid space sarcoma, no chemotherapy

Can also be seen in mediastinum and chest wall, peri-diaphragm, and even down to perirenal
Normal Uptake and Variants – Breast Activity

- Breast activity
  - Especially in younger and lactating women
- Gynecomastia
- Breast implants
- Periareolar
Normal Uptake and Variants – Breast Activity
Normal Uptake and Variants – Breast Activity

Lactation
Normal Uptake and Variants – Breast Activity

Implants
Normal Uptake and Variants – Breast Activity

Periareolar uptake
Normal Uptake and Variants - Thymus

- Thymus activity
  - Before puberty
  - Post-chemotherapy patients with thymic hyperplasia
  - Reported in Graves disease with thymic hyperplasia
  - Delta triangular configuration
  - Some report decreased thymus uptake in child during chemotherapy

10 year old girl lymphoma s/p recent chemotherapy SUV 3.5
Normal Uptake and Variants - Thymus

35 year old female. Stomach MALT. S/p chemo. stable thymus uptake over 6 months
Normal Uptake and Variants - Thymus

Thymus in young person above (and brown fat) at baseline.
Thymus shrinks and non-FDG avid below on chemo for unrelated cancer.
Normal Uptake and Variants - Thymus

- Thymic extension into superior mediastinum
- Above brachiocephalic vein
- May appear as isolated focus
- Look at MIP and coronals for overall view
- Similar SUV to main thymus
Normal Uptake and Variants - Thymus
Normal Uptake and Variants - Esophageal

- Esophagus
  - Usually low level normal variant throughout esophagus
  - Esophagitis will cause more intense and fusiform uptake
  - More focal GE junction common
  - Hiatal hernia
Normal Uptake and Variants - Esophageal
Normal Uptake and Variants - Esophageal

7 weeks post-radiation therapy - esophagitis
Normal Uptake and Variants - Esophageal

EG junction
Normal Uptake and Variants – Ports, Lines, and Tubes

CT attenuation corrected
Normal Uptake and Variants – Ports, Lines, and Tubes

corrected.

“uptake” resolved.
Normal Uptake and Variants – Extravasation

Right axillary lymph node uptake from extravasation.

Lymph node had fatty hilum.
Knowing CT anatomy can help you with other Nuclear Medicine Studies
Can we tie together substernal mass on CT and I-123 study?
When we increase intensity can see substernal goiter uptake
Knowing what unilateral hyperinflation looks like helps explain PET
• Squamous cell carcinoma
• Unilateral hyperinflation
• “Ball-valve” mechanism
You may also come across other urgent/emergent findings on CT or PET/CT
Pneumonia
Another Pneumonia
PE on PET-CT
Another Pulmonary Embolus

Filling defect in the contrast of the pulmonary artery
PE is Common with Cancer Patients
Pulmonary Artery Aneurysm
Pneumothorax
Pneumothorax

Air in the pleural space
Pleural Effusion

Fluid in the pleural space with associated atelectatic lung
Pericardial Effusion
Pneumomediastinum
Pneumopericardium
Aortic Dissection

Separation of aorta into two channels by an intimal flap

Channels may be different density
Injected air in line not noticed by technologist
Left Shoulder Pain

• Sometimes what is not there is more important....
PET Ordered

Diffuse Large B Cell Lymphoma
Be Aware: Ground Glass
Only mild uptake on PET. May just be inflammatory but followup needed.
Grew One Year Later: BAC/Low Grade Adenocarcinoma
Sometimes the problem may be outside area of interest

- Elderly female
- History of lung cancer post left pneumonectomy with metastasis to right upper lobe treated with chemotherapy
- PET for restaging
Lung metastasis resolved but…
New activity in GB wall: Acute Cholecystitis
On that note....

Stay tuned for Abdomen...