Mediastinal Tumors: Imaging
References

• Imaging in Oncology,
  Husband and Reznek

• Computed Tomography and Magnetic Resonance of the thorax,
  Naidich, Zerhouni, Siegelman,
Mediastinal compartments

- Anterior: posterior to sternum – anterior cardiac and tracheal borders
- Posterior: posterior to a line 1cm dorsal to anterior edge of vertebral bodies
- Middle: between the two
Anterior mediastinum

- Thymic masses
- Lymphoma
- Germ cell tumors
- Thyroid masses
- Ectopic parathyroid masses
- Tumors of vessels, fat, mesenchymal Tu
Middle mediastinum

- Metastases to middle mediastinal nodes
- Most metastases arise from intrathoracic tumors, primarily lung
- Extrathoracic- include genito-urinary, melanoma, head and neck
Posterior mediastinum

- Neurogenic tumors
- Tumors of esophagus
- Primary and secondary tumors of the spine
Imaging modalities

- CXR – initiates the evaluation, rarely diagnostic
Imaging modalities

- CT – delineates anatomic location
- Extent
- Tissue density
- Tissue invasion
- Iodinated contrast should be used
- Associated findings in the thorax
Imaging modalities

- MRI – problem solving modality
- When radiation or iodinated contrast are contraindicated
- Superior for imaging nerve plexus
- Distinguishing tissue planes
- Imaging posterior mediastinal masses
- Assessing tissue, vascular, cardiac invasion
Imaging modalities

- PET – CT – metabolic activity
- Malignant nature of tumor
- Whole body staging or re-staging
- Response to therapy
Diagnostic procedures

- Mediastinoscopy
- Mediastinostomy
- Thoracoscopy
- Thoracotomy
- Video-assisted thoracic surgery (VATS)
- Bronchoscopy with needle aspiration biopsy
- Endoscopic US guided transesophageal biopsy
- CT-guided percutaneous biopsy
Myasthenia gravis

- Antibodies bind to Ach receptors, preventing muscle contractions
- Myasthenia gravis is associated with thymoma
Thymus and myasthenia gravis

- Thymoma occurs in 15% of patients with Myasthenia gravis
- 65% of patients with myasthenia gravis have thymic hyperplasia
- Distinguishing hyperplasia from thymoma can be difficult
Thymus and myasthenia gravis

- Surgical removal is indicated in all patients since 30% of thymomas are invasive
- The role of the radiologist is to identify patients with thymomas
The thymus

- The thymus demonstrates unique changes over time

- Differentiation of a normal thymus from a thymic disorder can be problematic for the radiologist
Thymic morphology changes with aging

Birth to puberty:
• Triangular or bilobed
• CT density similar or slightly higher than muscle
• Fat is notably lacking
Thymic morphology changes with aging

Puberty to 25y:

• Phase of involution - fat appears in mediastinum
• Shape - triangular or bilobed
• CT density – decreases to less than muscle
Thymic morphology changes with aging

Over 25 y:

• Well defined soft tissue density will no longer be seen
• Islands of soft-tissue densities
• More fat in mediastinum

Thymus may be still recognized up to the age of 40
Thymoma

- Older patients
- Rarely before 20 y
- 20-50% asymptomatic
- Symptoms: cough, dyspnea, hoarseness, chest pain
- Myasthenia gravis
- SVC syndrome
Thymoma

- A thymic mass
- Homogeneous soft-tissue density
- Oval, round, lobulated
- Sharply demarcated
- Rarely cystic
- Enhances homogeneously
- May contain calcium
Malignant Thymoma

- 30% of thymomas are malignant
- Presence of tumor growth into or through the capsule
- “Invasive” thymoma – a more appropriate designation than “malignant”
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Invasive thymoma - CT

- Bulky, nonhomogeneous soft tissue mass
- Invades superior vena cava, vessels, airways
- Invades adjacent lung or chest wall
Invasive thymoma - CT

- Growing along pleural surface can reach posterior mediastinum
- Extend downward along the aorta
- Involve the crus of diaphragm
- Extend to retroperitoneum
- CT should include the upper abdomen
Thymic masses: differential diagnosis

- Lymphoma
- Neuroendocrine tumors (carcinoid)
- Lymphangiomatisa
- Hemangioma
- Thymolipoma
Lymphoma - CT

- Nodes greater than 1cm in diameter - enlarged on CT, MRI

- Multiple nodes smaller than 1cm – suspicious
Lymphoma - CT

• Enlarged nodes- discrete or fuse to form a single larger mass
Lymphoma - CT

- Minor enhancement
- Low density areas
- Calcifications
  - prior to therapy rare
  - commoner in more aggressive subtypes
  - seen occasionally following therapy
Extra-nodal Disease: Thorax

- Lung: secondary involvement more frequent; usually associated with mediastinal adenopathy

- Chest wall: more common in HD, better demonstrated on MRI
Lymphoma - imaging

• 10% of patients with HD and a normal CXR have enlarged nodes on CT
• CT will change clinical stage in 16% of patients
• Bulky mediastinal mass (on CXR) – diameter of mediastinal mass is greater than a third of the transthoracic diameter at the level of T5-T6
Monitoring response to therapy

- CXR – will show response early in treatment
- Changes due to radiation
- Rebound thymic hyperplasia
- PET/CT
Post-treatment Evaluation

- Complete remission on imaging when no abnormality is seen at the site of previously demonstrated disease
- Masses larger than 1.5 cm on CT are considered residual masses
- CT cannot distinguish fibrosis from residual active disease
Rebound thymic hyperplasia

- The thymus involutes during stress, chemotherapy, steroids
- Will re-acquire its size several months following the stressful episode
- May exhibit “rebound” growth to a size larger than baseline
- Marked in children and seen in young adults
Rebound thymic hyperplasia

- Difficult to differentiate from recurrent disease by CT

- FDG may accumulate in lymphoma, in rebound thymic hyperplasia and in the normal thymus
Rebound thymic hyperplasia

Evaluation with chemical shift MRI may help differentiate thymic hyperplasia from tumor

Tsutomu Inaoka et al, Radiology 2007
Germ cell tumors (GCTs)

- Rest cells that remain within or related to the thymus
- Develop during second to fourth decade

- Majority - benign
teratoma and dermoid cysts
equal frequency males and females
- Malignant - (fewer than 30%)
seminoma and nonseminomatomous
male predominance
Teratoma

- Elements of three germinal layers
- Dermoid cysts: only ectodermal
- Tumors grow slowly, may be asymptomatic
Teratoma

- A sharply marginated, round or oval mass
- Cystic and solid densities
- Fat
- Calcifications, a tooth is rare
Malignant GCT

- Grow rapidly, patients are more symptomatic
- May secrete: $\beta$-human chorionic gonadotropin
  $\alpha$- fetoprotein
  lactic dehydrogenase
- Markers for diagnosis and follow-up
- There is no evidence of testicular tumor
Seminoma

- A large bulky soft tissue mass
- well-marginated,
- homogeneous

- calcification is rare
- a cystic component is rare
Nonseminomatous GCT

- A large mass
- Irregular margins
- Heterogeneous
- Ill-defined low-attenuation areas
- Invades mediastinal structures

5% of GCTs in posterior mediastinum
Posterior mediastinal masses

• Neurogenic tumors – 30%

• Can arise from peripheral nerves, intercostal nerves, or thoracic spinal roots

  • From the sympathetic ganglia
  • Neuroblastic tumors
Malignant neurogenic tumors

- Larger masses
- Infiltrating
- Irregular

These findings are not sufficiently reliable to obviate histologic evaluation
Neuroblastic tumors

- A posterior mediastinal mass
- Calcifications
- Spreading or erosion of adjacent ribs
- Pedicle erosion from intraspinal extension
- MRI – invasion of the neural foramina or the epidural space
Neuroblastic tumors

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Neurofibroma and schwannoma

- Round masses
- Well – marginated
- Low CT density
- Associated rib notching or rib scalloping
- Dumbbell – shaped mass that widens the neural foramina
- Larger lesions – heterogeneous
Neurogenic tumors - MRI

- Slightly hyperintense to muscle on T1WIs
- Markedly hyperintense on T2WIs
- Assess intraspinal extension
- Presence of associated spinal cord pathology
- Not more specific in differentiating benign from malignant lesions
Superior vena cava syndrome

- Gradual compression/obstruction of the SVC
- Facial or upper extremity edema
- Venous distention
- Facial plethora
Superior vena cava syndrome

- Bronchogenic Ca – 80%
- Lymphoma – 15%
- Other mediastinal tumors
- Infectious and catheter related

Wilson et al, NEJM, 2007
Middle mediastinum - CT

- Adenopathy:
  calcifications
  low density / cystic
  vascular nodes
Nodal calcifications

- granulomatous sarcoidosis
- silicosis
- PCP
- HD (following treatment)

- metastatic amyloidosis
- scleroderma
- Castleman disease
Low – density nodes

- Infections – TB, fungal
- Metastases
- Lymphoma
Vascular lymph nodes

- Metastases - RCC, lung, thyroid, carcinoid
- Castleman disease
- Sarcoidosis
- Angioimmunoblastic lymphadenopathy
Summary

- CT of the chest allows a precise radiographic classification of mediastinal pathology
- CT is occasionally diagnostic and usually sufficient for preoperative evaluation of mediastinal tumors
- FDG-PET is useful in lymphoma, thymoma, GCT, and lung and esophageal cancers
Summary

• MRI is a problem-solving modality when CT has proven equivocal or is limited
• MRI is superior to CT in assessing posterior mediastinal tumors
• Future indications for the use of MRI can almost surly be anticipated