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)
- Lymphangioma
- 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 nonseminomatous
  - 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: ß-human chorionic gonadotropin
  α- fetoprotein
  lacticdehydrogenase
- 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

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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