More Than Just the 4 T’s: A Comprehensive Review of Anterior Mediastinal Masses

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• The authors have nothing to disclose
Normal Mediastinal Anatomy

Based on lateral chest radiograph

**Anterior mediastinum**
- Posterior to sternum
- Anterior to tracheal wall in upper mediastinum and posterior border of heart in lower mediastinum

**Contents:**
- Heart
- Ascending aorta and great vessels anterior portion of main pulmonary artery
- Pericardium
- Thymus
- Lymph nodes
- Adipose tissue

*Fig. 1: Lateral chest radiograph demonstrates boundaries of anterior mediastinum*
Anterior Mediastinal Masses

Clinical presentation
- Often asymptomatic, discovered incidentally
- Compression or local invasion
  - Nerves
  - Vascular structures
  - Airways
  - Bone
- Systemic symptoms
  - Hormones, cytokines, antibodies

Imaging of anterior mediastinal masses
- Radiography
  - Identify mass
  - Mass effect - compression/displacement of adjacent structures
  - Localization
- CT, MRI
  - Tissue characteristics
  - Location, morphology, enhancement

Teaching point: Keys to narrowing the differential diagnosis
- Consider patient sex and age
- Consider characteristic mass components
Localizing Anterior Mediastinal Pathology

**Hilum overlay sign**
- Normal hilar structures project through a mass
- Suggests mass is anterior or posterior to hilum

**Silhouette sign**
- Loss of heart borders

Fig. 2: Chest x-ray in 20-year old male with Hodgkin’s lymphoma, opacity overlies left hilum (arrow), no bronchovascular displacement, silhouette of heart

Fig. 3: Chest x-ray in 65-year old female post lung transplant. Round mass obscures right heart border (arrow), loculated pleural effusion.
Narrowing the differential diagnosis

Characteristics to narrow the differential diagnosis:

- **FAT**
  - Lipoma
  - Liposarcoma
  - Thymolipoma
  - Morgagni hernia
  - Mediastinal lipomatosis
  - Teratoma

- **WATER**
  - Thymic cysts
  - Lymphangioma
  - Pericardial cysts
  - Neurogenic tumors
  - Foregut duplication cysts
  - Cystic degeneration of solid mass

- **SOFT-TISSUE**
  - Thymic hyperplasia
  - Thymoma
  - Thymic carcinoma
  - Goitre
  - Ectopic parathyroid adenoma
  - Germ cell tumor
  - Mediastinitis
  - Abscess

- **CALCIFICATION**
  - Treated malignancy
  - Thyroid masses
  - Goitre
  - Granulomatous lymphadenopathy
  - Sarcoidosis-silicosis
Fig. 4: Mediastinal liposarcoma in a 41-year old female. T1 VIBE (b) and fat sat T1 (c) MRI demonstrates large heterogeneous fat containing mass with mild enhancing soft tissue (d). There is left lower lobe collapse and mild cardiac displacement to the right. No direct cardiac invasion identified.
Fatty Masses: Thymolipoma

- Rare, benign encapsulated tumor arising from thymus
- Grows slowly, often large at presentation
- Location: pedunculated or within thymus
- Young adults, M=F
- Association: myasthenia gravis, aplastic anemia, pure red cell aplasia, hypogammaglobulinemia, Hodgkin lymphoma, Graves disease

✔ Radiography
  ✔ Large, palpable mass
  ✔ May conform to heart borders to mimic cardiomegaly or diaphragmatic elevation

✔ CT
  ✔ Well-defined, encapsulated mass
  ✔ Contains solid, linear non-enhancing thymus tissue

✔ MRI
  ✔ Fat component has high T1 and T2 signal intensity and low signal on fat-suppressed

Fig. 5: Thymolipoma in a 43-year old male with atypical chest pain, cardiac CTA demonstrates a soft tissue and fatty density anterior mediastinal lesion with mild convexity of the right margin.
Fig. 6: Teratoma in 54-year old female. T1 VIBE (b &c) demonstrate heterogeneous signal, fat (arrow) is identified on the fat sensitive HASTE sequence (d) and there is mild heterogeneous enhancement (arrow, e)
Other Fatty Masses

Mediastinal lipomatosis
• Deposition of unencapsulated mediastinal fat
• Associations: exogenous steroid intake, obesity, Cushing syndrome

✓ Radiography
  ✓ Smooth mediastinal widening
  ✓ ± enlarged epicardial fat pad and extrapleural fat

✓ CT
  ✓ Diffuse homogeneous fat attenuation structures without invasion, compression

Morgagni hernia
• Hernia of omental fat ± bowel, liver
• Location: retrosternal or parasternal, usually on the right
• Usually asymptomatic, incidental

✓ Radiography:
  ✓ Well-defined increased density along heart border, cardiophrenic angle

✓ CT and MRI
  ✓ Fat-containing lesion
  ✓ Linear opacities that correspond to omental vessels

Fig. 7: Mediastinal lipomatosis in a 57-year old male. (a) PA chest radiograph demonstrates widening of the right paratracheal stripe. (b) Coronal reformat CT image demonstrates mediastinal fat but no lymphadenopathy or suspicious lesions.
Cystic masses: Thymic Cyst

Congenital subtype

• Derived from thyropharyngeal duct remnant
• Location: anywhere along course of thymic descent from neck during development

✓ CT
  ✓ Simple, unilocular, thin-walled lesions

✓ MR
  ✓ Low T1 and high T2 signal intensity

Acquired subtype

• Associations: myasthenia gravis, SLE, aplastic anemia, radiation therapy, Hodgkin disease, thoracotomy, other thymic tumors

✓ CT
  ✓ Multilocular, variable wall thickness, associated inflammatory changes
  ✓ May be complicated by hemorrhage or infection

✓ MR
  ✓ Variable, high T1 and T2 signal intensity if complicated

Fig. 8: Thymic cyst in a 79-year old male. Well-circumscribed, unilocular fluid attenuation lesion in the prevascular space, stable over several years, consistent with thymic cysts.
Fig. 9: Pericardial cyst in a 33-year old female. (b) Axial non-contrast chest CT demonstrates a well-defined, cystic mass. Axial T2-weighted MRI (c) confirmed high signal fluid and T1 post-gadolinium fat sat images (d) do not identify any soft tissue enhancement.
Cystic masses: Lymphangioma

Fig. 10: Longstanding thymic cystic lesion in a 57-year old asymptomatic female. Fat sat T1 VIBE (b) and T2 HASTE images (c) demonstrates fluid signal with no soft tissue component, suggestive of unilocular thymic cyst.
Soft-tissue Masses: Normal Thymus, Thymic Hyperplasia

Normal Thymus

- Site of maturation of lymphocytes
- Shape: bilobed, inverted V or triangular, quadrilateral
- Straight or concave borders
- Progressive fatty involution following puberty
  - Soft tissue in children, young adults
  - Primarily fat-replaced in adults
- Size on CT:
  - Children < 5yrs: ~1.4cm
  - Adults < 20yrs: ~1.8cm
  - Older adults: ~1.3cm

Thymic Hyperplasia: two main subtypes

- True hyperplasia
  - Increase in size and weight with normal histology
  - Reactive from recent stress, corticosteroids, radiation, chemotherapy, surgery or burns
- Radiography
  - Usually normal
- CT
  - Enlarged thymus
- Lymphofollicular hyperplasia
  - Presence of hyperplastic lymphoid germinal centre in thymic medulla
  - Association: myasthenia gravis (50%), various autoimmune disorders
- Radiography
  - Usually normal
- CT
  - Varies: normal appearance, symmetric diffuse enlargement, fatty thymic mass
Soft-tissue Masses: Thymic Rebound

• Thymic involution during periods of stress up to 40%
  – Secondary to including illness, burns, chemotherapy
• Regrows to original size or up to 50% larger within months
• May be difficult to distinguish from recurrent mediastinal tumor

Teaching point: CT findings to distinguish thymic rebound from recurrent mediastinal tumor
✓ Presence of lymphadenopathy suggests recurrent tumor
✓ Isolated thymic enlargement suggests rebound

Fig. 11: 22 year old male with metastatic osteosarcoma. (a) Axial contrast enhanced chest CT performed following chemotherapy demonstrates normal thymus. (b) Follow up chest CT 4 months later demonstrates new anterior mediastinal tissue, which likely represents thymic rebound.
Fig. 12: Invasive thymoma in a 65-year old female with a history of metastatic thymoma. Axial IV-contrast enhanced chest CT demonstrates lobulated soft tissue mass in the prevascular space, increased in size from the previous study. There is an enhancing left pleural nodule (arrow, b) and bilateral pleural effusions.
Figure 13: Thymic carcinoma in a 38-year old female. (b, c) IV-contrast enhanced chest CT demonstrates a heterogeneous soft tissue obscuring the adjacent perivascular and mediastinal fat planes consistent with an aggressive lesion.
Figure 14: 69-year old female with thyroid goitre. (b) axial IV-contrast enhanced chest CT demonstrates a large enhancing mass that contains calcification and exhibits mass effect on the trachea and esophagus. (c) Sagittal and (d) coronal reformatted images confirm extension of the mass from the thyroid.
Other Soft-tissue masses

Seminoma

- Most common malignant germ cell tumor (30%)
- Mean age 29 years, M > F

- **Radiography**
  - Large, lobulated mass

- **CT**
  - Large, smooth or lobulated homogeneous mass
  - Associated obliteration of fat planes
  - Mildly enhancing post-contrast
  - ± pleural, pericardial effusion

Fig. 15: (a, b) IV-contrast enhanced chest CT in 30-year old male with biopsy-proved mediastinal seminoma. Lobulated soft tissue attenuation mass containing focal areas of low attenuation with posterior displacement of the great vessels and associated effacement of the left superior pulmonary vein (arrow, a) and encasement of the arch vessels (b).
Soft-tissue masses: Nodal Origin

- Lymphoma
  - Hodgkin disease: 50-70% of mediastinal lymphomas
  - Bimodal distribution: young adults, >50 years
  - M=F
  - Consider reactive lymphadenopathy in the differential diagnosis

✓ Radiography
  ✓ Bulky mediastinal, hilar enlargement

✓ CT
  ✓ Homogeneous mass with lobulated borders
  ✓ Mild-to-moderate contrast enhancement
  ✓ ± Cystic changes, necrosis
  ✓ Calcification uncommon unless treated

Figure 16: Lymphoma in a 45-year-old female. (a) Supine AP radiograph demonstrates large mediastinal mass.
Figure 17: (a, b) Lymphoma in a 22-year old male. PA and lateral chest radiographs demonstrate cardiomegaly due to pericardial effusion, small bilateral pleural effusions and elevation of the right hemidiaphragm due to phrenic nerve involvement. Thickening of the right paratracheal stripe and fullness of the AP window (arrow) consistent with mediastinal lymphadenopathy.
Figure 17. Lymphoma in a 26-year old male. (c, d) IV-contrast enhanced axial CT further demonstrates the anterior mediastinal soft tissue mass encasing and narrowing the left brachiocephalic vein (arrow) as well as a pericardial effusion and pleural effusion.
Soft-tissue masses: Nodal Origin

- Reactive lymphadenopathy
  - Secondary to infection (including TB), autoimmune or inflammatory disease

✓ Radiography
  ✓ Abnormal mediastinal contours, lines and stripes

✓ CT
  ✓ Lymph node enlargedment >10mm
  ✓ Low attenuation, calcified or necrotic appearance

Fig. 18: 63-year old male with amyloidosis. PA chest radiograph (a) demonstrates paratracheal widening suspicious for lymphadenopathy. Contrast enhanced CT demonstrates calcified mediastinal lymphadenopathy.
Mimics of anterior mediastinal masses

- Broad differential diagnosis, which includes
  - Vascular abnormalities, including ascending aortic aneurysm
  - Bronchogenic malignancy
  - Thoracic metastatic disease
  - Mediastinal abscess
  - Fibrosing mediastinitis
  - Traumatic injuries, including mediastinal hematoma
Mimics of Anterior Mediastinal Masses

Fig. 21: 59-year old male with metastatic melanoma. Axial IV-contrast enhanced chest CT (a, b) demonstrates mediastinal and hilar metastatic lymphadenopathy (arrow) as well as pleural effusion (arrow heads) and pulmonary nodules (not shown).
References

- Bogot NR, Quint LE. Cancer Imaging 2005;5:139–49.