Anterior Mediastinal Masses: The 4 T’s

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Mediastinal Compartments

3 arbitrary divisions that do not correlate with anatomic planes:

**Anterior**
- sternum to line anterior to heart and great vessels
- thymus, fat, lymph nodes

**Middle**
- heart, pericardium, ascending and transverse aorta, brachiocephalic vessels, SVC, IVC, main PAs and PVs, trachea, bronchi, lymph nodes

**Posterior**
- from posterior border of heart and trachea to anterior surface of thoracic spine and ribs
- descending aorta, esophagus, azygous vein, autonomic ganglia and nerves, thoracic duct, lymph nodes, fat

## Evaluation of mediastinal mass by location

**Chest Radiograph**

↓

**Mediastinal Mass**

↓

**Dynamic CT Scan**

### Differential Diagnosis (based on mediastinal compartment)

<table>
<thead>
<tr>
<th>Superior</th>
<th>Anterior</th>
<th>Middle</th>
<th>Posterior</th>
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</thead>
<tbody>
<tr>
<td>Thymoma</td>
<td>Teratoma</td>
<td>Pericardial cyst</td>
<td>Neurogenic tumor</td>
</tr>
<tr>
<td>Thyroid (Substernal)</td>
<td>Lymphoma</td>
<td>Bronchogenic cyst</td>
<td>Esophageal disease</td>
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</table>

**Thyroid**

1. Thoracic Inlet
2. Smooth, frequently symmetric

**Lymphoma**

1. Anterosuperior
2. Smooth, Homogeneous
3. Frequently surrounds great vessels

**Teratoma**

1. Lower superior or anterior compartment
2. May contain calcium

**Pericardial Cyst**

1. Usually right-sided

**Bronchogenic Cyst**

1. Frequently subcarinal

**Enteric Cyst**

1. Differential diagnosis with bronchogenic cyst; need pathology

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Differential Diagnosis of Anterior Mediastinal Masses

1. Thymus
   a. Thymoma
   b. Thymic Cyst
   c. Thymic Hyperplasia
   d. Thymolipoma
   e. Thymic Carcinoma
   f. Thymic Carcinoid

2. Teratoma & other germ cell tumors

3. Thyroid (intrathoracic goiter)

4. “Terrible” Lymphoma (can be middle or posterior mediastinal)

**These are often difficult to differentiate radiographically!**

(the presence of fat or fluid or the use of nuclear scanning can help in some situations)
Ability to discriminate different pathologies based on radiography

- Two independent radiologists were shown CXRs and CTs from 128 patients with anterior mediastinal masses and asked to list their top 3 differential diagnoses and their level of confidence in those diagnoses. Results were compared with histologic dxs.

<table>
<thead>
<tr>
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<th>CXR</th>
<th>CT</th>
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<tbody>
<tr>
<td>#1 dx correct</td>
<td>36%</td>
<td>48%</td>
</tr>
<tr>
<td>Correct in top 3 dxs</td>
<td>59%</td>
<td>72%</td>
</tr>
<tr>
<td>Highly confident</td>
<td>9%</td>
<td>34%</td>
</tr>
<tr>
<td>Correct when high confidence</td>
<td>58%</td>
<td>80%</td>
</tr>
</tbody>
</table>

- CT interpretation most often correct for benign germ cell tumors, thymolipoma, and omental hernias.

Normal Mediastinal Anatomy at T4 level

• Note: Thymic expansion rarely causes tracheal or esophageal displacement because of its soft density and very anterior position.

Characteristic Thymic Features on CXR

- **Sail sign**
- **Thymic wave**
- **Thymic notch**
- **Loss of Retrosternal Clear Space**


From BIDMC teaching files.
Normal Thymus in a 10-year-old boy

Sail sign

Retrosternal opacity

From BIDMC Teaching files
Thymoma

- Most common anterior mediastinal primary tumor; 20% of adult mediastinal neoplasms
- Presentation between ages 30-50 (most patients are >40 years old)
- 50% are asymptomatic
- Symptoms secondary to compression: chest pain, cough, dyspnea, SVC syndrome (obstructed SVC → head and neck venous congestion, facial edema)
- Parathymic syndromes (approx. 40% of patients)
  - Myasthenia Gravis: seen in 30-50% of thymoma patients; 8-20% of MG patients have a thymoma (although 90% have some sort of thymic abnormality); may develop post thymectomy
  - Pure Red Cell Aplasia: seen in 5% of thymoma patients, but 50% of patients with red cell aplasia have a thymoma
  - Others: hypogammaglobulinemia (10%), endocrine disorders, connective tissue disorders
- Usually arise in the midline and extend unilaterally
- Grading: invasive vs. non-invasive (histologically identical)
- Staging
  - I: within intact capsule
  - II: extension through capsule into surrounding fat, pleura, or pericardium
  - III: intrathoracic metastasis (including pleural seeding)
  - IV: extrathoracic metastasis
Thymoma in a 10-year-old boy

• Grossly widened mediastinum subclavicularly

• Note presence of thymic wave and thymic notch

From BIDMC Teaching files
Thymoma in patient with MG

- Smooth, lobulated mass
- Preservation of aortic knob indicates that mass is not encompassing the aortic arch
- Lateral confirms anterior location

From BIDMC Teaching files
Calcifications in a Thymoma

- Nonspecific finding as thymomas, teratomas, germ cell tumors, and carcinomas can all calcify
- Note also the lobulated contour of the mass

From BIDMC Teaching files
Thymic Cyst: Looking for fluid

3% of anterior mediastinal masses

- Anterior Mass is indeterminate on T1
- Mass is hyperintense on T2
- Mass on CT, with attenuation similar to that of water (10 HU)

Lipoma: Looking for fat

- **Mass** obscuring right heart border, simulating cardiomegaly
- MR shows hyperintense mass (indicating high fat content) and demonstrates close application of mass to cardiac structures

Teratoma (60-70% mediastinal germ cell tumors)

- Germ cell tumors account for 15% adult anterior mediastinal masses; 24% in children
- Well-circumscribed mass in lower anterior mediastinum
- May contain calcifications visible on CXR or CT, even well-formed teeth or bone

From BIDMC teaching files

Thyroid: Intrathoracic Goiter

- 10% mediastinal masses
- Superior mass that extends above the clavicles
- Nuclear scan with radioactive iodine may show expanded area of uptake

From BIDMC Teaching files
The Patient: KL

- **CC**: A 56-year old man with fever, cough, and fatigue for about 1 month, presents 4/21/01 with dizziness and ↑ weakness

- **ER**: Hct of 22.7 (1/02 baseline: 40); CXR notes unusual R heart border contour, but report “doubts any significance” to this finding

- In hospital, hematologic evaluation was obtained given inappropriately low reticulocyte count (3.5%)
The Consult: Hem/Onc Fellow

• Bone marrow biopsy showed only deficiency of erythroid precursors. Viral serologies were negative.
• Suggested thymoma in differential of red cell aplasia in the absence of bone marrow pathology.
• Recommended chest CT evaluation
The Chest X-ray

• Largely unremarkable

• BUT, contour of right heart border is unusual

• Hilar vessels and right bronchus can be seen through mass, implying anterior mediastinal location
The Chest X-ray: Lateral

- Confirms anterior location
- Opacification of retrosternal clear space

From PACS, BIDMC
The Chest CT-Level of the Mitral & Tricupsid Valves

- Note **density** applied to anteriolateral surface of the heart
- **Pericardium** can be identified as dark line outlined by mass and pericardial fat
- **Pericardium** is intact at this level

From PACS, BIDMC
The Chest CT- Higher Level

• At this level, the smooth line of pericardium is disrupted, indicating invasion by the mass near right atrial appendage.

• Findings were confirmed on MRI.
Comparison of Levels on CT

From PACS, BIDMC
The Surgery

• Complete thymectomy was performed two weeks later.
• Involvement of pericardium was noted at surgery, but gross tissue planes were still identifiable.
• Histologically, tumor cells were identified to within 2-3 cell layers from the pericardial specimen margin.
• Pathologic analysis of the surgical specimen was somewhat controversial. There was some disagreement as to the etiology of the tumor: primary thymoma vs. metastatic lymphoma. CT imaging of head, abdomen, and pelvis did not reveal any other tumor sites.
• Pure red cell aplasia supports the diagnosis of thymoma.
References


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