“a mass in my chest”
Exploring the Anterior Mediastinum

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Agenda

• Introduction, based on our patient
• Differential diagnosis
• Re-examination of our patient upon re-presentation
• Complications (local, systemic)
• Staging and Treatment (surgical, medical)
• Summary of the approach to a patient with an anterior mediastinal mass
• Acknowledgements
• References
Our patient: Widened Mediastinum on CXR

- AB is a 27 y/o previously healthy woman with a complex medical course which began 3 years prior to her most recent scans with a cholecystectomy for abd pain, followed by ERCP for a retained stone and post-ERCP pancreatitis, subsequent ARDS, abdominal abscesses, bilateral UE DVTs and PE

- Incidentally, at that time, a widened mediastinum was noted on CXRs

- A mass was then identified in the anterior mediastinum on CT

- The mass was bx

(image from BIDMC PACS)
Our patient: Ddx of an anterior mediastinal mass

- **Lymphoma** (NHL, non-NHL)
- **Germ Cell Tumors**
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- **Thyroid tissue**
- **Parathyroid tissue**
- **Thoracic aorta aneurysm**
- **Thymus**
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

(Ddx and image from UpToDate, Anterior Mediastinal Mass Lesions)
Companion Patient #1: Lymphoma on CT

- **Lymphoma** (NHL, non-NHL)
- Germ Cell Tumors
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- **Thyroid tissue**
- Parathyroid tissue
- **Thoracic aorta aneurysm**
- Thymus
  - Thymic hyperplasia
  - **Thymoma**
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

Large anterior mediastinal mass, w/o evidence of obstruction or invasion of the great vessels. Not shown at this level, left hilar and supraclavicular lymphadenopathy

(BIDMC PACS, thanks to Dr. Pahade)
Companion Patient #2: Teratoma on CT

- **Lymphoma** (NHL, non-NHL)
- **Germ Cell Tumors**
  - **Teratoma**
  - Seminoma
  - Non seminomatous germ cell tumors
- **Thyroid tissue**
- **Parathyroid tissue**
- **Thoracic aorta aneurysm**
- **Thymus**
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

(Axial C+ Chest CT)

Large anterior mediastinal mass with heterogeneous attenuation
Centrally, appears c/w fat
Rim and central calcifications

(BIDMC PACS, thanks to Dr. O’Donnell)
Companion Patient #3: Thoracic Aortic Aneurysm on CT

- Lymphoma (NHL, non-NHL)
- Germ Cell Tumors
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- Thyroid tissue
- Parathyroid tissue
- Thoracic aorta aneurysm
- Thymus
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

Companion Patient #4: Thymic Cyst on CT

- Lymphoma (NHL, non-NHL)
- Germ Cell Tumors
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- Thyroid tissue
- Parathyroid tissue
- Thoracic aorta aneurysm
- Thymus
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma


Small, homogenous, smooth-bordered mass in the anterior mediastinum with soft tissue attenuation and no evidence of invasion of surrounding structures.
Companion Patient #5: Thymic hyperplasia on CT

- Lymphoma (NHL, non-NHL)
- Germ Cell Tumors
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- Thyroid tissue
- Parathyroid tissue
- Thoracic aorta aneurysm
- Thymus
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

(BIDMC PACS, thanks to Dr. Pahade)
Background: Thymic involution on CT

Location of thymic tissue is highlighted in each patient

(Axial C+ Chest CT)

(Bogot and Quint Cancer Imaging (2005))
Companion Patient #6: Thymic epithelial tumors on CT

- Lymphoma (NHL, non-NHL)
- Germ Cell Tumors
  - Teratoma
  - Seminoma
  - Non seminomatous germ cell tumors
- Thyroid tissue
- Parathyroid tissue
- Thoracic aorta aneurysm
- Thymus
  - Thymic hyperplasia
  - Thymoma
  - Thymic Carcinoma
  - Thymic Cyst
  - Thymic Carcinoid
  - Thymolipoma

(Axial C+ Chest CT)

large, heterogenous, lobulated mass in the anterior mediastinum with soft tissue attenuation and no evidence of invasion of surrounding structures

(BIDMC PACS, thanks to Dr. O’Donnell)
Thymic Carcinoma v. Thymoma: A comparison

- Thymic epithelial tumors account for 50% of anterior mediastinal masses (0.05/100,000 person-years) and ~20% of all mediastinal masses.

- While thymomas are generally indolent, thymic carcinomas have a much worse prognosis and account for 0.06% of thymic tumors
  - While thymomas are often associated with paraneoplastic syndromes, including myasthenia gravis, thymic carcinomas are not.
  - Features consistent with high-risk thymoma and thymic carcinoma (vs. low-risk thymoma) include lobulated mass, great vessel or mediastinal fat invasion
  - Features consistent with increased likelihood of recurrence and metastasis include lobulated mass, great vessel or mediastinal fat invasion and pleural spread.

(Rajan and Giaccone, 2008; Nishino et al, 2006)
Our patient: Anterior Mediastinal Mass on CT

(Axial C+ Chest CT)

Prevascular LN
Pleural Effusion
Preserved SVC and aorta
4x3cm heterogenous, lobulated,
  anterior mediastinal mass (5-50 HU)
Our patient: FNA of anterior mediastinal mass

The biopsy was found to be consistent with cyst contents, with many macrophages and small lymphocytes identified.
Our patient: Returns to ED after two years

- Pt presented two years later (one year ago) with two weeks of SOB and chest pain, w/o fevers, night sweats or weight loss and mentions that she has a “mass in my chest”

- Given hx of PE, CTA ordered

- Core bx performed of anterior mediastinal mass
Our patient: SVC compression and anterior mediastinal mass on CT

Collaterals
Ant. Med. Mass (posterior component)
Not visualized on this section: new calcifications
BCV, SVC Compression
Our patient: Complications of anterior mediastinal mass--SVC syndrome

**Symptoms** *early:* asymptomatic; *later:* SOB, venous distention of the neck and chest wall, facial edema, plethora, UE edema, chest pain, hoarseness

**Causes:** majority due to malignant mediastinal tumors

(UptoDate, Malignancy related superior vena cava syndrome)
Our patient: Core biopsy of anterior mediastinal mass

The biopsy was found to be consistent with poorly differentiated thymic carcinoma within fibrous tissue
Our patient: Differential for a thymic mass

- Thymic epithelial tumors: esp. the continuum of thymoma → thymic carcinoma
- Neuroendocrine tumors
- Germ cell tumors
- Lymphoid tumors
- Tumor-like lesions (thymic hyperplasia, lymphoid hyperplasia, multilocular thymic cyst, hematoma, infection)
- Metastatic tumors

(Nishino et al, 2006; Tecce et al, 1994)
Our patient: staging and therapy for thymic carcinoma

Based on histology

<table>
<thead>
<tr>
<th>WHO type</th>
<th>Synonyms</th>
</tr>
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<tbody>
<tr>
<td>Type A</td>
<td>Spindle cell thymoma; medullary thymoma</td>
</tr>
<tr>
<td>Type AB</td>
<td>Mixed thymoma</td>
</tr>
<tr>
<td>Type B1</td>
<td>Lymphocyte-rich thymoma; lymphocytic thymoma;</td>
</tr>
<tr>
<td></td>
<td>predominantly cortical thymoma</td>
</tr>
<tr>
<td>Type B2</td>
<td>Cortical thymoma</td>
</tr>
<tr>
<td>Type B3</td>
<td>Well-differentiated thymic carcinoma; epithelial</td>
</tr>
<tr>
<td></td>
<td>thymoma; squamoid thymoma</td>
</tr>
<tr>
<td>Type C</td>
<td>Thymic carcinoma (heterogeneous)</td>
</tr>
</tbody>
</table>

Based on local/distant spread (surgical)

(Masaoa staging system.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Macroscopically and microscopically completely encapsulated</td>
</tr>
<tr>
<td>II A</td>
<td>Microscopic transcapsular Invasion</td>
</tr>
<tr>
<td>II B</td>
<td>Macroscopic invasion into the surrounding mediastinal fat tissue or grossly</td>
</tr>
<tr>
<td></td>
<td>adherent to but not through the mediastinal pleura</td>
</tr>
<tr>
<td>III</td>
<td>Invasion into the neighbouring organs</td>
</tr>
<tr>
<td>IVA</td>
<td>Pleural or pericardial dissemination</td>
</tr>
<tr>
<td>IV B</td>
<td>Lymphogenous or haematogenous metastases</td>
</tr>
</tbody>
</table>
Our patients: patterns of spread of thymic carcinoma

• It is important to examine regions of most likely spread/recurrence in thymic carcinoma
  – Local structures, including:
    • great vessels
    • pericardium
    • pleura
  – Directly through diaphragm (sometimes near crura) into abdomen to liver, spleen, etc
  – Via hematogenous spread
• MRI and FDG-PET CT can be very helpful in assessing metastasis and vascular involvement

Our patient: PET CT for Staging

New 15mm lesion in liver segment IV, SUV max 11

(Not shown: new subpleural nodule, not FDG avid)

(BIDMC PACS thanks to Dr. Kang) (left: Abdominal FDG-PET, center: CT and right: fusion)
Our patient: Core liver bx

• The biopsy was found to be consistent with focal nodular hyperplasia, with bile duct proliferation
• It was not possible to rule out the presence of a tumor adjacent to the biopsy site
• Radiology commented that FNH should not be FDG avid
Our patient: Treatment for thymic carcinoma

• Surgical resection is the most effective therapy for thymic tumors, but can be difficult with invasive tumors.
• With invasive disease, multimodality therapy is needed
  – Thymic carcinoma is aggressive, has a worse prognosis than thymoma, and is usually not fully resectable at time of dx
  – Neoadjuvant chemotherapy ± XRT can improve pot’l for surgical cure

• Most commonly spreads to pleural cavity and locally in mediastinum
  – Trials ongoing for recurrent and/or metastatic thymic carcinoma

• Our patient, given her youth and equivocal liver bx, received:
  – Chemo/XRT (Cisplatin/Etoposide; 45-55 Gy total) throughout last year as neoadjuvant therapy
  – Resection of mass (and part of SVC) with SVC patch using autologous pericardium was performed late last year

Our patient: Metastasis on f/u chest CT 6 mo after surgery

- Increase in size of pleural nodule
- New pulmonary nodules, LUL + LLL
- Diffuse right pleural thickening
- Anterior mediastinal thickening at surgical site
- New liver hypodensities, increase in size of known hypodensity
- Increase in size of splenic hypodensity
- Chronic SVC occlusion with collateralization
Our patient: pleural nodule enlarged on CT

Small 1.5cm pleural nodule, increased in size from 6mo prior when it was 0.5cm
Our Patient: new liver hypodensities on CT

- New liver hypodensity, ~1cm in diameter
- New liver hypodensity, ~2cm in diameter
Our patient: Outcome CT guided liver bx confirmed liver metastasis

Intra-procedural core needle biopsy of liver lesion

Currently considering palliative chemotherapy versus entering trials of new therapeutic protocols
Companion Patient #7: Examine CXR for anterior mediastinal mass

81yo female with cough, pedal edema, ?CHF→CXR

(Lateral CXR)
Mass anterior to (or connected to) thoracic aorta
(BIDMC PACS)

(Frontal CXR)
Right perhilar mass, parallel to thoracic aorta
Summary of Approach to Anterior Mediastinal Masses

• Evaluation of an anterior mediastinal mass
  – Major differential diagnosis: thymic tumor, lymphoma, teratoma, thyroid cancer, thoracic aortic aneurysm
  – Imaging techniques: CT for initial assessment, (MRI and PET-CT in f/u as appropriate)
  – Biopsy: CT or U/S guided FNA or core bx, as appropriate

• Thymic carcinoma specifically
  – Treatment: surgery ± chemo/XRT
  – Local spread or increase in size of mass can cause chest pain, SOB, SVC syndrome
  – Metastasis: most often pleural or hematogenous spread

(UptoDate, Clinical presentation and mgmt of thymoma and thymic ca; Venuta, 2010; Nishino, 2006)
Right perihilar prominence on CXR due to deviation of thoracic aorta and SVC, perhaps partially attributable to mild thoracic scoliosis and positioning.

Companion Patient #7: Outcome of f/u imaging with thoracic aortic and SVC deviation on CT

(Needham Hospital PACS)
Thanks!

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• Mai-Lan Ho M.D.
• David O’Donnell, M.D.
• Jay Pahade, M.D.
References

11. Up-to-Date (Anterior mediastinal mass lesions, Clinical presentation and management of thymoma and thymic carcinoma and Malignancy-related superior vena cava syndrome), accessed May 2010.