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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)

<u>Superior</u>	<u>Anterior</u>	<u>Middle</u>	<u>Posterior</u>
Thymoma	Teratoma	Pericardial cyst	Neurogenic tumor
Thyroid (Substernal)	Lymphoma	Bronchogenic cyst	Esophageal disease
	Germ cell tumor	Enteric Cyst	
 <u>Thyroid</u>	 <u>Lymphoma</u>	 <u>Pericardial Cyst</u>	 <u>Neurogenic tumors</u>
1. Thoracic Inlet	1. Anterosuperior	1. Usually right-	1. Obtain MR image
2. Smooth, frequently symmetric	2. Smooth, Homogeneous	sided	2. Look for intraspinal extension
	3. Frequently surrounds great vessels		
	 <u>Teratoma</u>	 <u>Bronchogenic Cyst</u>	
	1. Lower superior or anterior compartment	1. Frequently subcarinal	
	2. May contain calcium		
		 <u>Enteric Cyst</u>	
		1. Differential diagnosis with bronchogenic cyst; need pathology	



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.

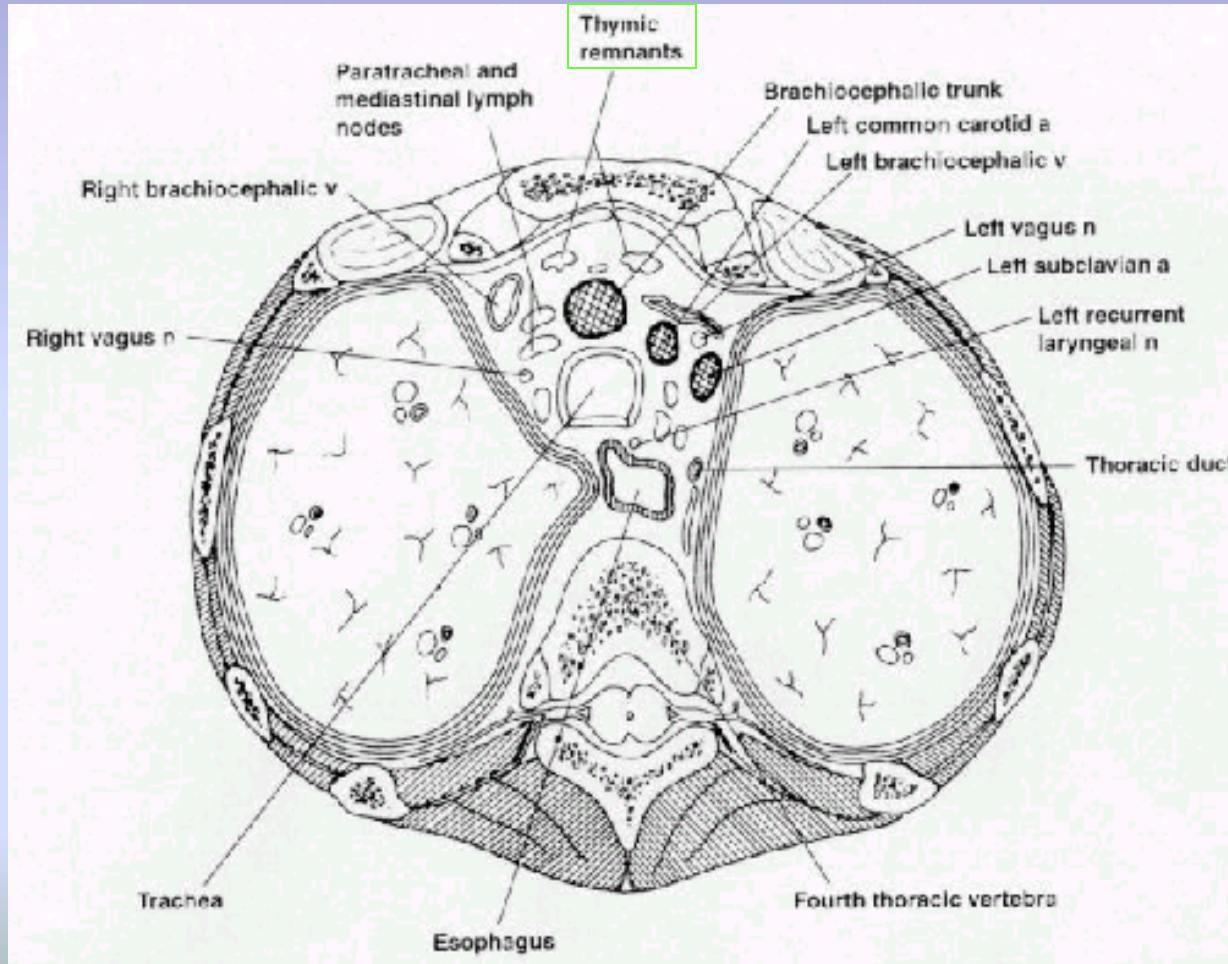
	CXR	CT
#1 dx correct	36%	48%
Correct in top 3 dxs	59%	72%
Highly confident	9%	34%
Correct when high confidence	58%	80%

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



Normal Mediastinal Anatomy at T4 level

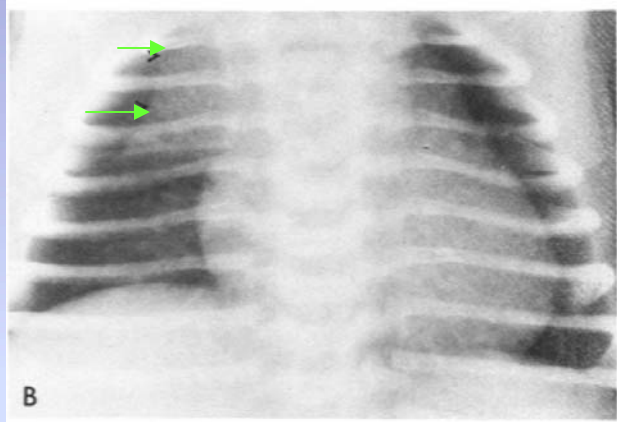
- Note: Thymic expansion rarely causes tracheal or esophageal displacement because of its soft density and very anterior position.



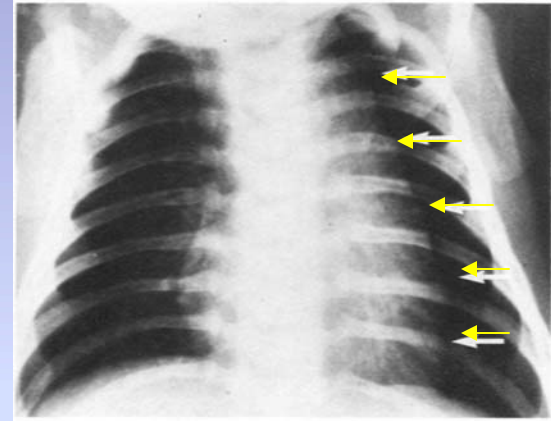


Characteristic Thymic Features on CXR

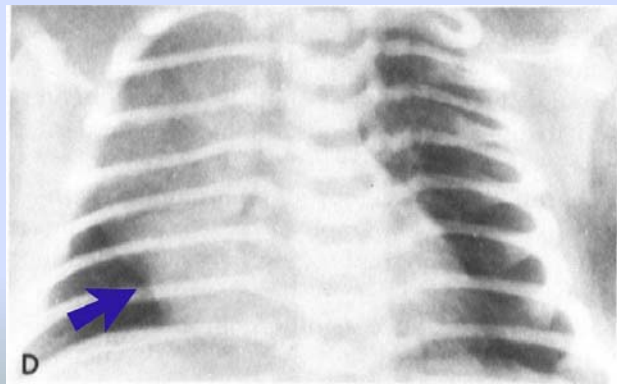
Sail sign



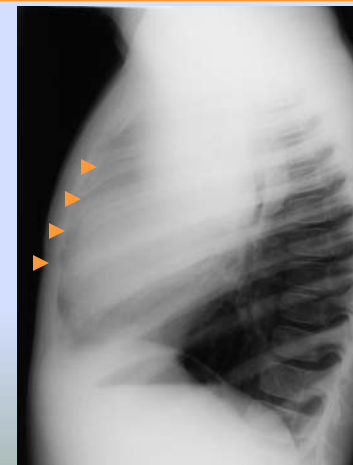
Thymic wave



Thymic notch



Loss of Retrosternal Clear Space



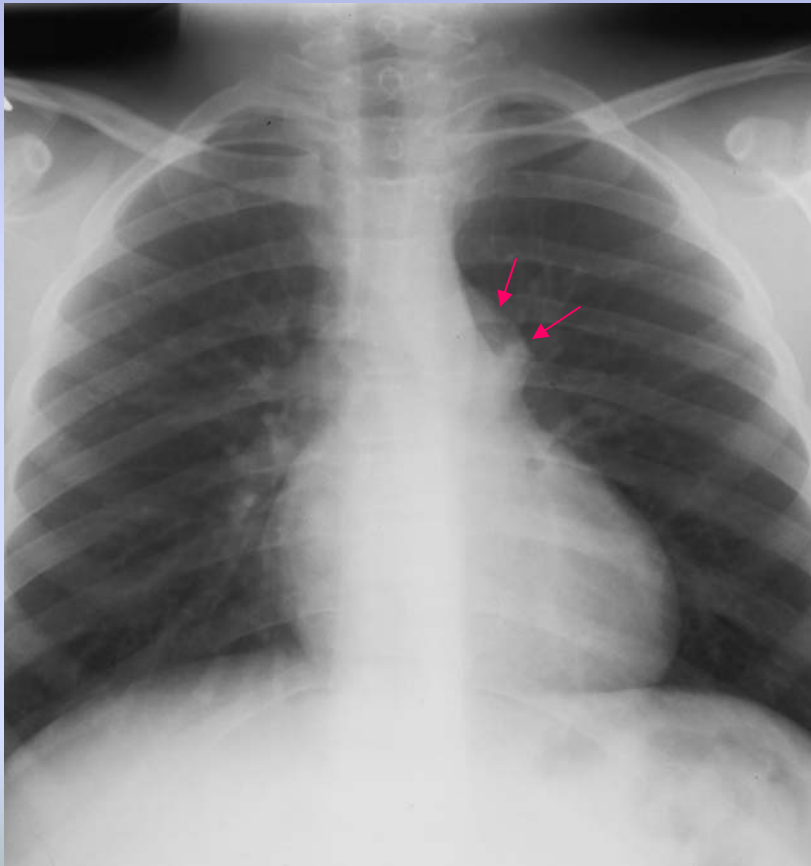
From Day DL and E Gedgudas. *The Radiologic Clinics of North America* 1984; 22(3): 520-1.

From BIDMC teaching files

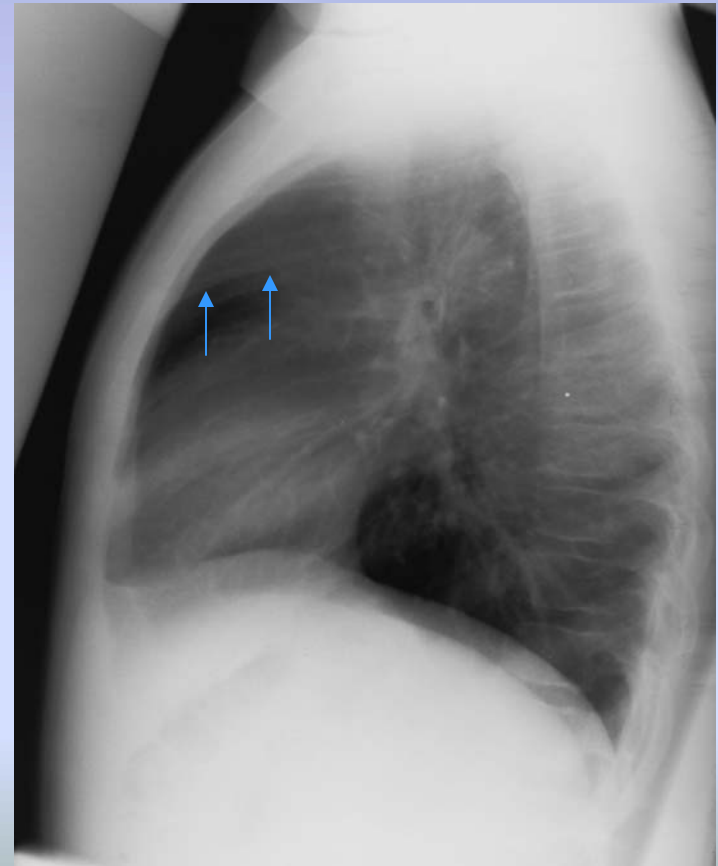


Normal Thymus in a 10-year-old boy

Sail sign



Retrosternal opacity





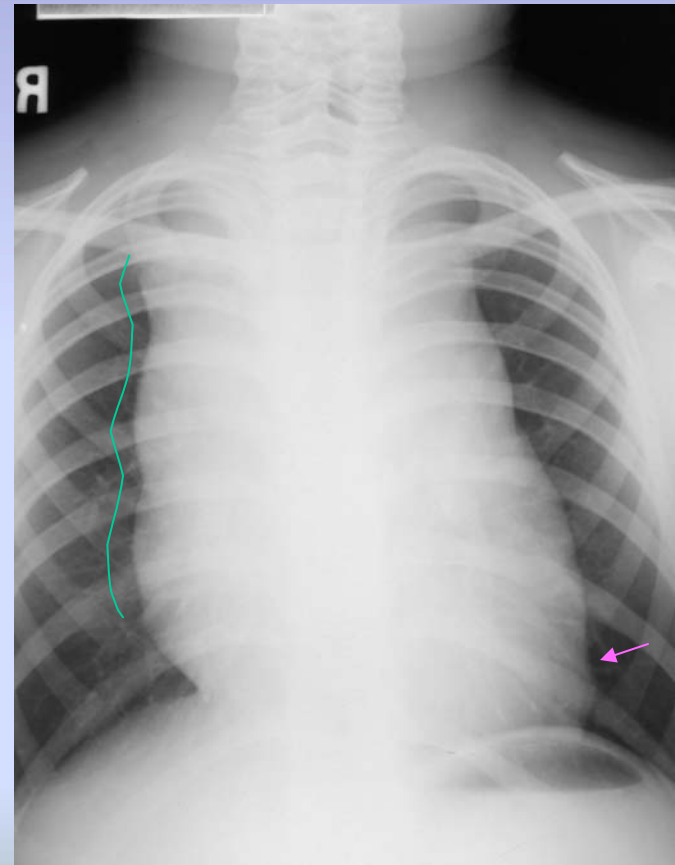
Thymoma

- **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

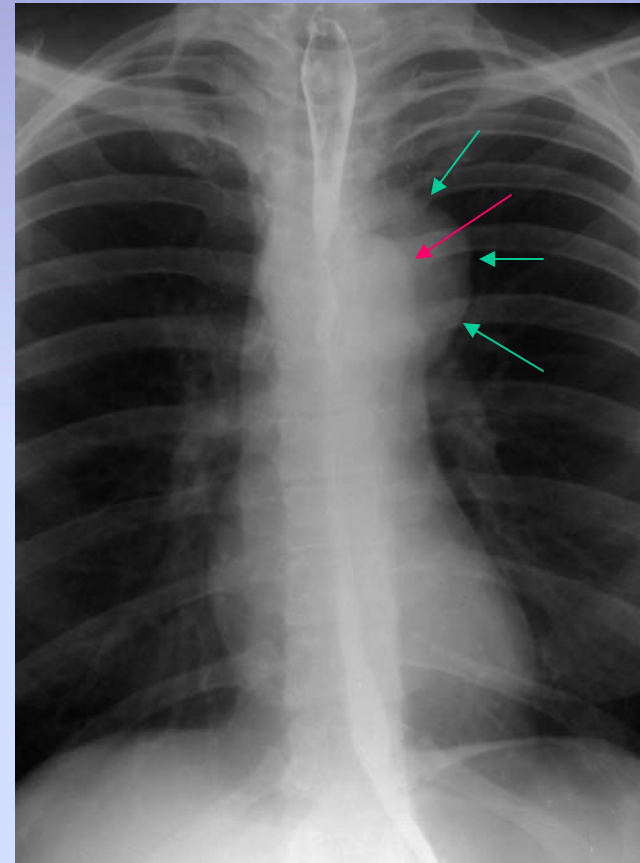
- Grossly widened mediastinum subclavicularly
- Note presence of **thymic wave** and **thymic notch**





Thymoma in patient with MG

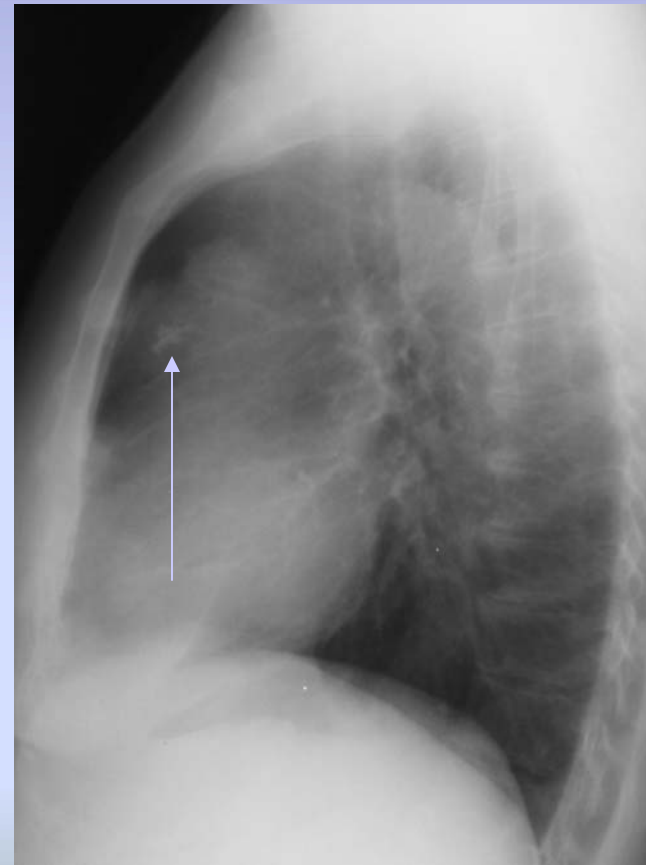
- Smooth, lobulated **mass**
- Preservation of **aortic knob** indicates that mass is not encompassing the aortic arch
- **Lateral** confirms anterior location





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

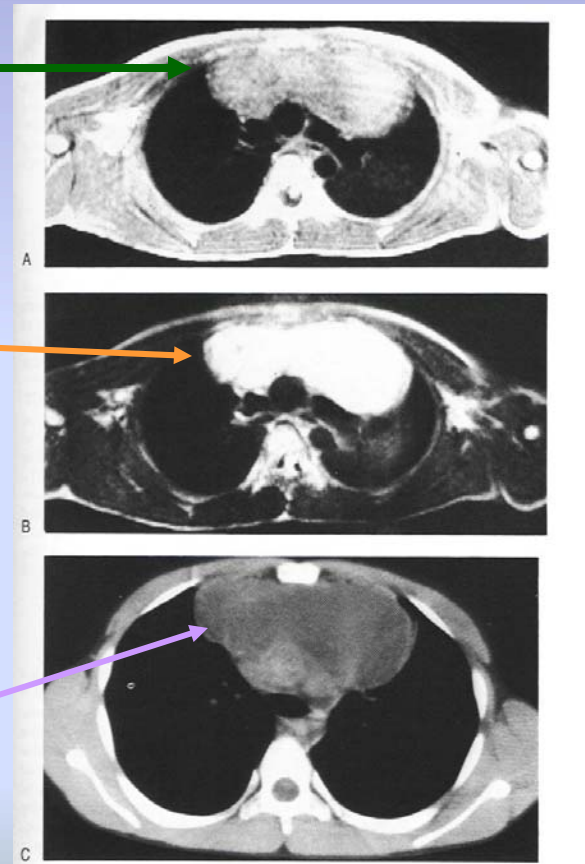




Thymic Cyst: Looking for fluid

3% of anterior mediastinal masses

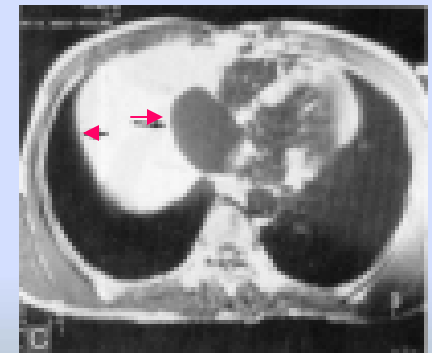
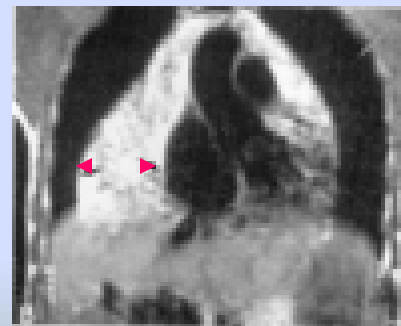
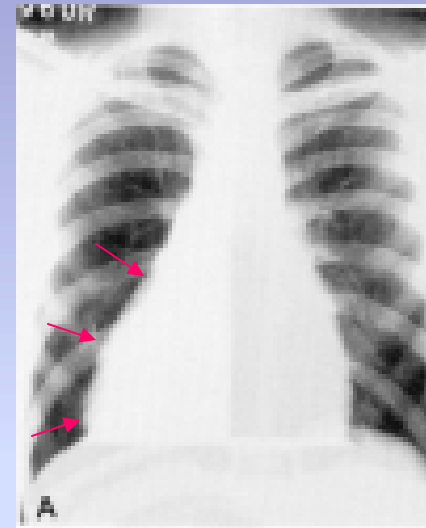
- Anterior Mass is indeterminate on T1
- Mass is hyperintense on T2
- Mass on CT, with attenuation similar to that of water (10 HU)





Lipoma: Looking for fat

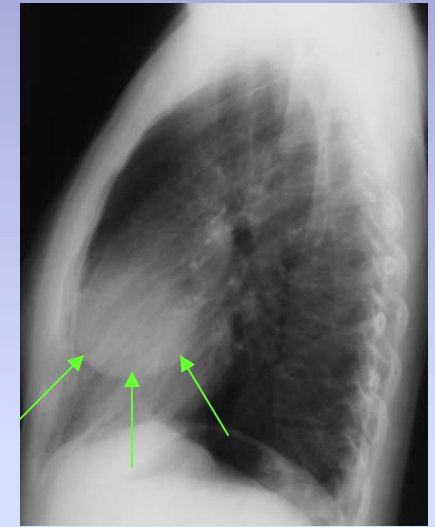
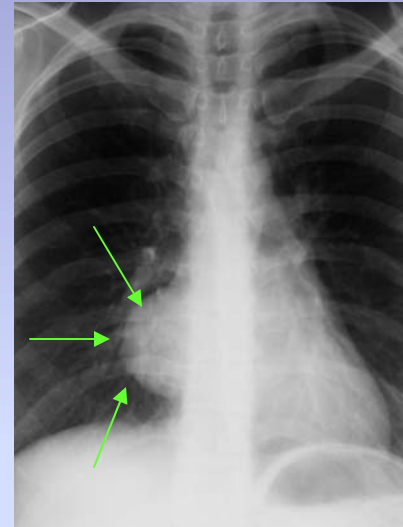
- **Mass** obscuring right heart border, simulating cardiomegaly
- MR shows hyperintense **mass** (indicating high fat content) and demonstrates close application of mass to cardiac structures



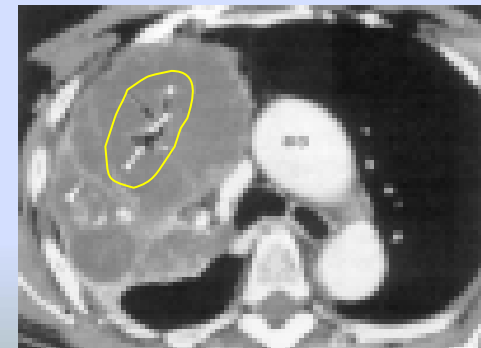


Teratoma (60-70% mediastinal germ cell tumors)

- 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

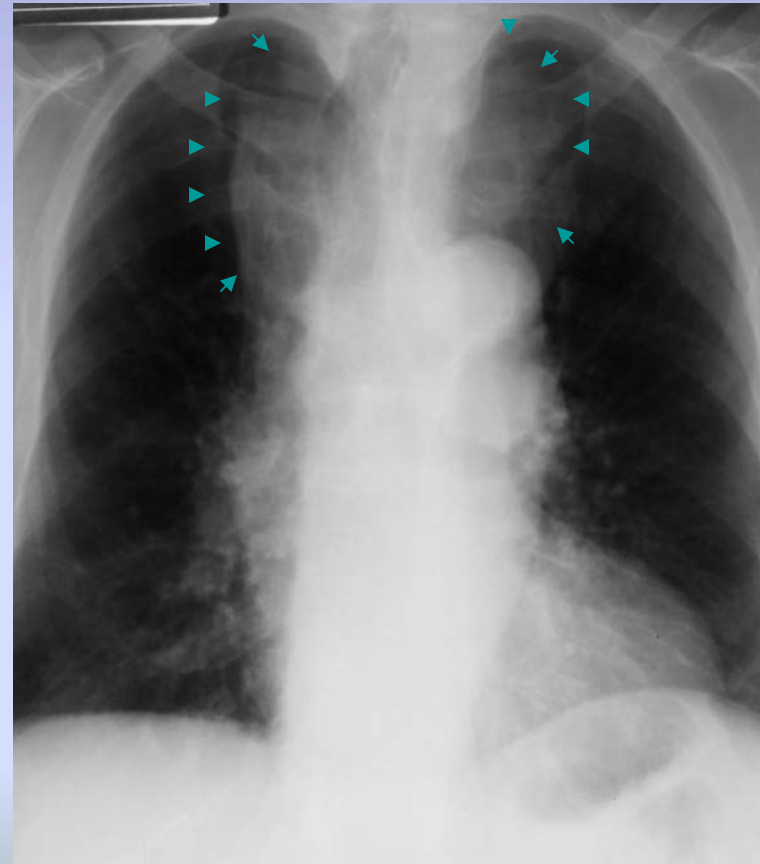
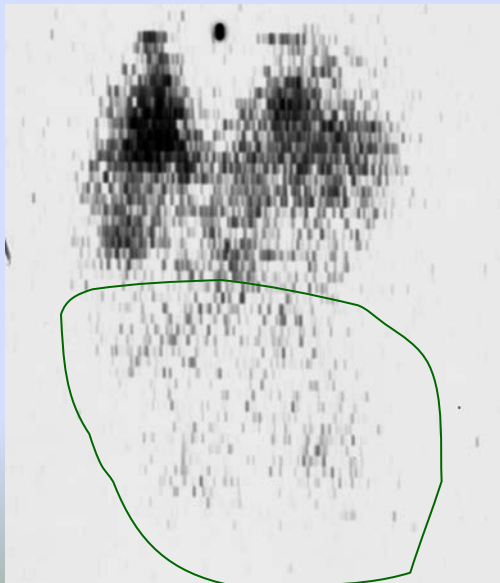


Strollo DC, et al. *Chest* 1997; 112(2): 517.



Thyroid: Intrathoracic Goiter

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





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%)



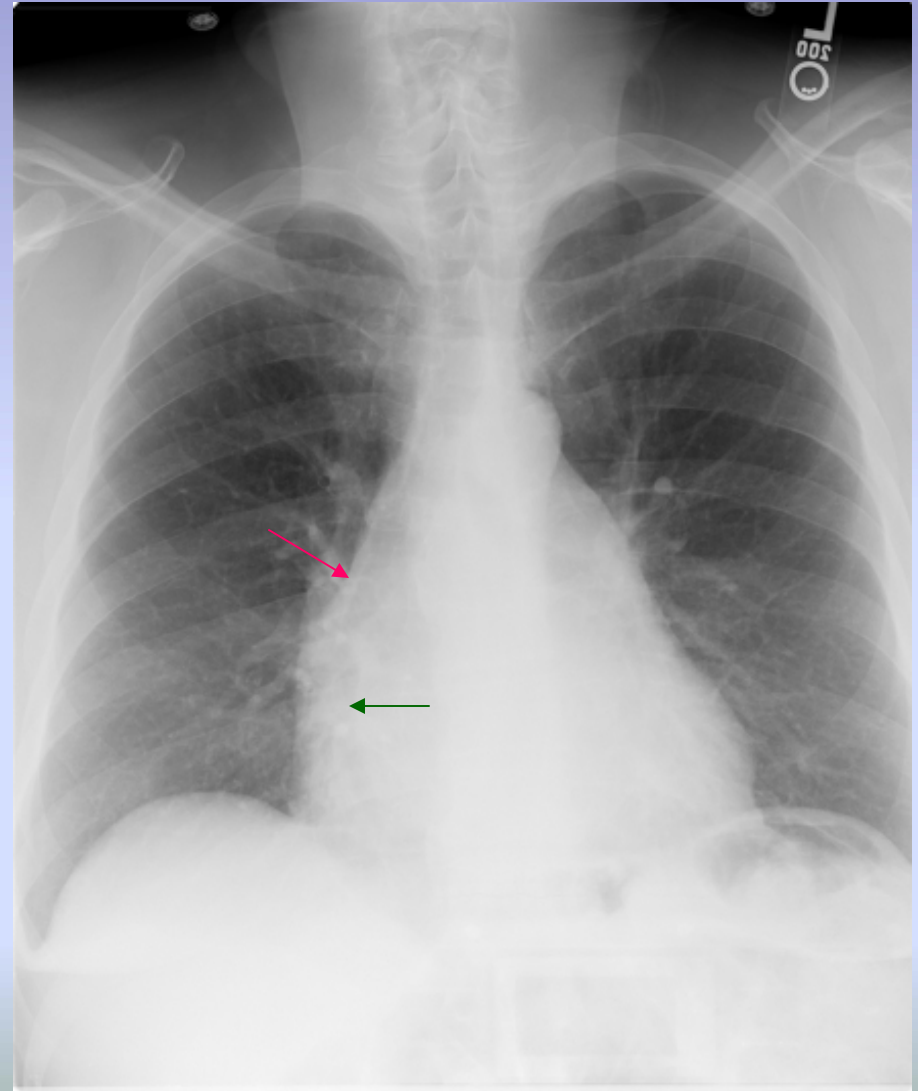
The Consult: Hem/Onc Fellow

- 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

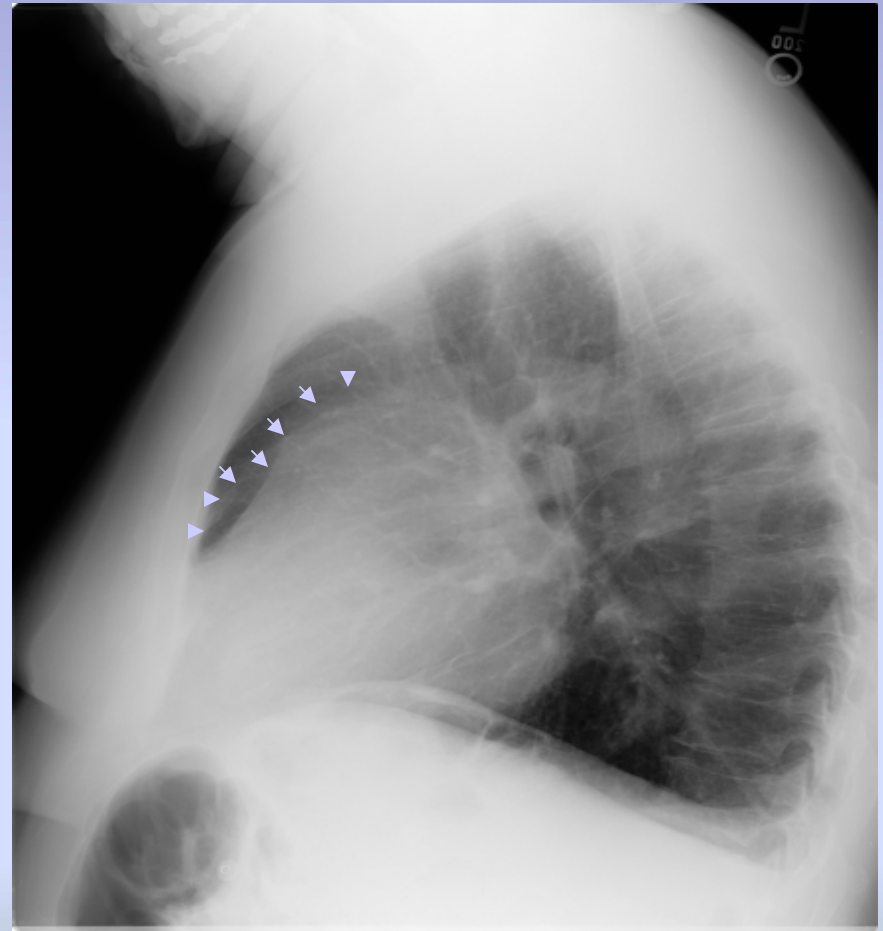
- Largely unremarkable
- BUT, contour of right heart border is unusual
- **Hilar vessels** and **right bronchus** can be seen through mass, implying anterior mediastinal location





The Chest X-ray: Lateral

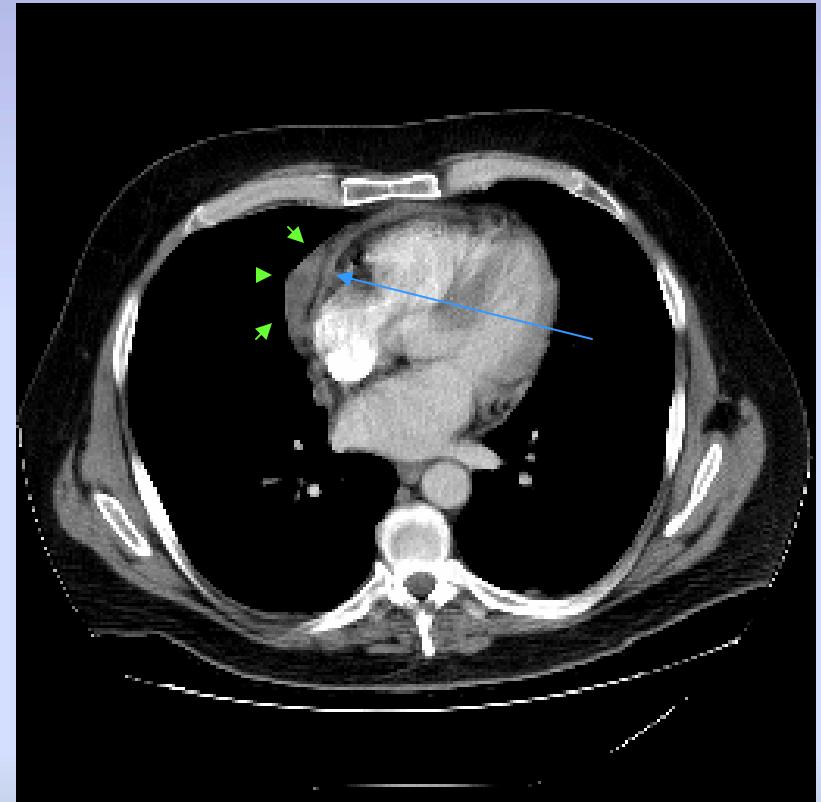
- Confirms anterior location
- Opacification of retrosternal clear space





The Chest CT-Level of the Mitral & Tricuspid Valves

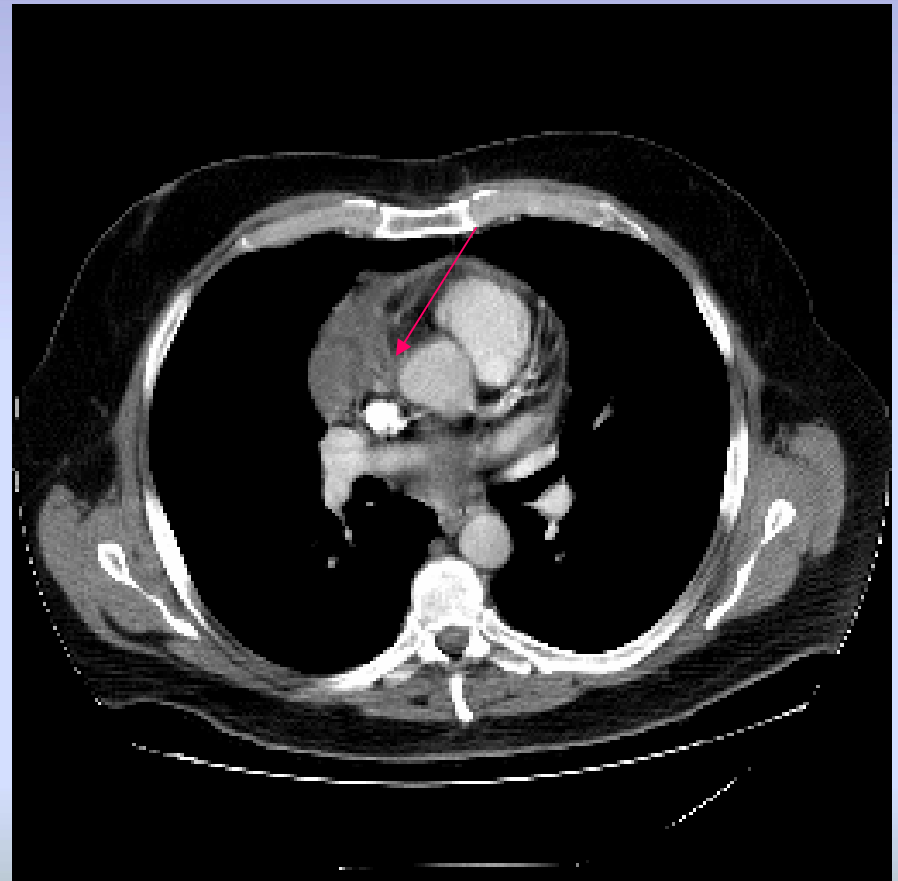
- Note **density** applied to anteriolateral surface of the heart
- **Pericardium** can be identified as dark line outlined by mass and pericardial fat
- Pericardium is intact at this level





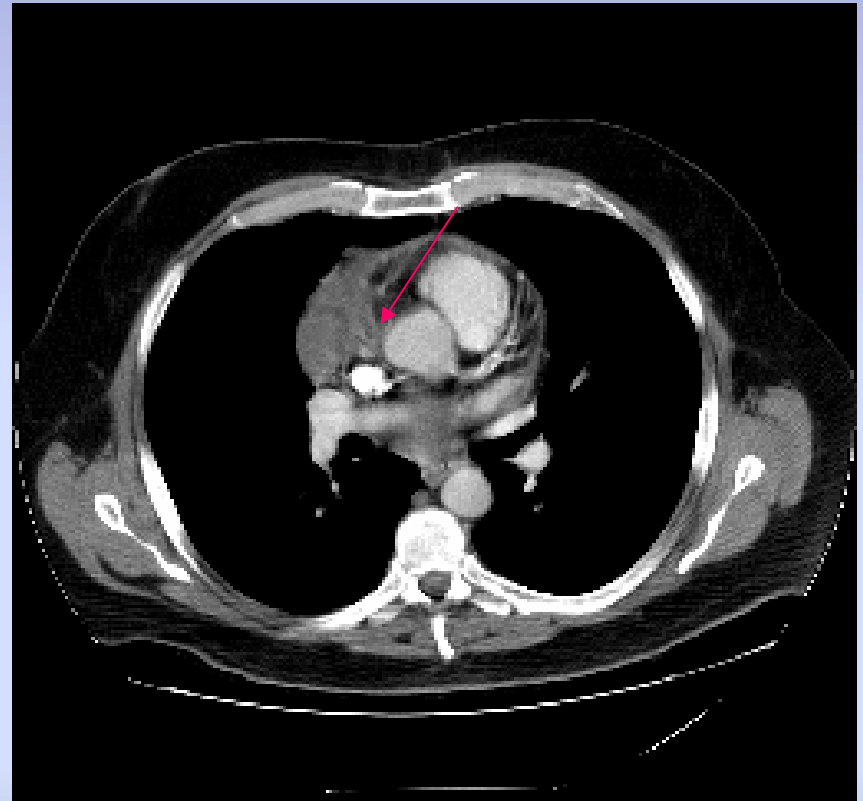
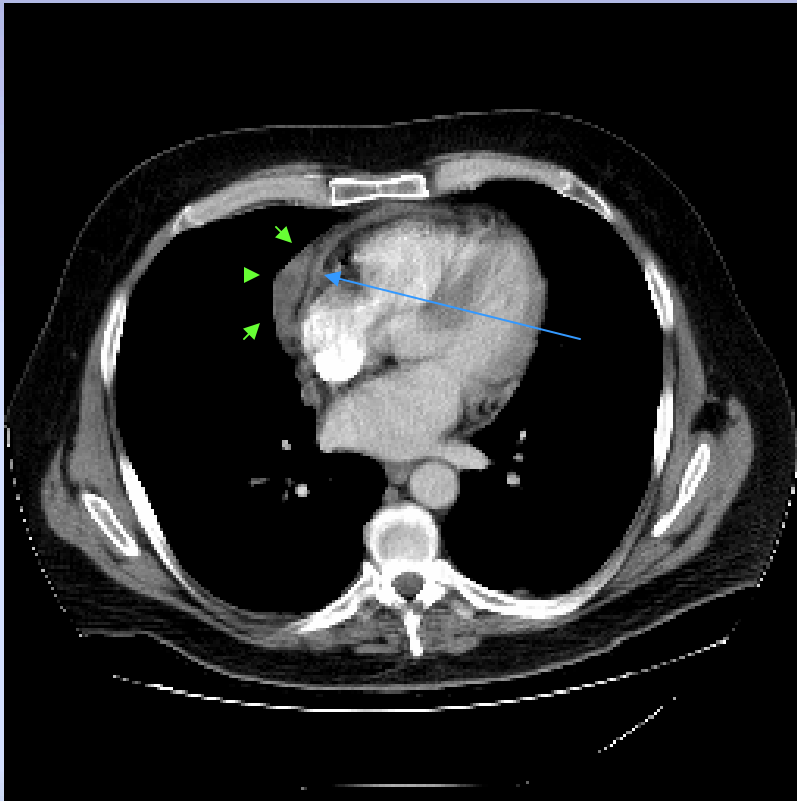
The Chest CT- Higher Level

- 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.



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