The authors declare no financial disclosures.
Learning objectives

- To revisit the basics of approach to mediastinal masses with focus on Felson’s classification and anatomical basis of lines and stripes in the chest.
- To achieve a higher degree of confidence in localizing mediastinal masses on conventional radiographs and follow up cross-sectional imaging.
- To be aware of certain pitfalls and mimics of true mediastinal masses.
Mediastinal masses occur in **PREDICTABLE LOCATIONS** based on tissue of origin in that compartment. Hence….

LOCATION of mass is the single most important criteria for coming to a diagnosis.

Antero-superior masses are most common.

Divided into 3 main compartments according to Felson’s classification:

<table>
<thead>
<tr>
<th>Anterior Mediastinum</th>
<th>Middle Mediastinum</th>
<th>Posterior Mediastinum</th>
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</thead>
</table>
**Mediastinal Compartments**

- **Superior** - imaginary line traversing the manubriosternal joint and the lower surface of the fourth thoracic vertebra (T4).
- **Inferior** – Anterior
  - Middle
  - Posterior

- **Felson’ method** - line extending from the diaphragm to the thoracic inlet along the back of the heart and anterior to the trachea separates the anterior and middle mediastinum.
- A line that connects points 1 cm behind the anterior margins of the vertebral bodies separates the middle and posterior mediastinal compartments.
Most cases are asymptomatic and finding of mediastinal mass is incidental!

**Step by step approach:**

1. Posteroanterior and lateral chest radiograph
   - from which compartment does mass arise
   - appearance of mass e.g. fat, fluid, calcification
   - “lines and stripes” the mass displaces

2. CT (or MRI) to better characterize nature and extent of lesion. (MRI especially good at looking for spinal canal invasion in masses of posterior mediastinum.)

3. Tissue biopsy for definitive diagnosis
Anatomy:
- Formed by anterior apposition of the lungs and consists of the four layers of pleura separating the lungs behind the upper two-thirds of the sternum.
- Runs obliquely from upper right to lower left and does not extend above the manubriosternal junction.

Displacement suggests:
- anterior mediastinal disease such as thyroid masses, lymphadenopathy, neoplasms, thymic masses, or lipomatosis.
- Volume loss and hyperinflation of the surrounding lung.
Anatomy:
- Apposition of the visceral and parietal pleura of the posteromedial portion of the lungs posterior to the esophagus and anterior to the third through the fifth thoracic vertebrae.
- Appears as a straight or mildly leftward convex line, typically projecting through the trachea
- Demonstrates more cranial extension than the anterior junction line and, unlike its counterpart, is seen above the clavicles.

Abnormal bulging or convexity suggests:
- Posterior mediastinal abnormality such as esophageal masses, lymphadenopathy, aortic disease, or neurogenic tumors.
- As with the anterior junction line, volume loss or hyperinflation of the surrounding lung can also displace the line
Anatomy:
- Seen projecting through the SVC.
- Formed by the trachea, mediastinal connective tissue, and paratracheal pleura and is visible due to the air–soft tissue interfaces on either side.
- Should be uniform in width with a normal width ranging from 1 to 4 mm.

Disease affecting:
- Paratracheal lymphadenopathy, thyroid or parathyroid neoplasms and tracheal carcinoma or stenosis.
- Pleural disease such as effusion or thickening is among the most common causes for widening of the right paratracheal stripe.
Anatomy:
- Seen less commonly than right paratracheal stripe
- Formed by contact between the left upper lobe and either the mediastinal fat adjacent to the left tracheal wall or the left tracheal wall itself.

Diseases affecting:
- Large left-sided pleural effusions.
- Left paratracheal lymphadenopathy, neoplasm or mediastinal hematoma.
Anatomy:
> mediastinal reflection or interface formed by the pleura of the anterior left lung coming in contact with and tangentially reflecting over the mediastinal fat anterolateral to the left pulmonary artery and aortic arch.
> The stripe is straight or mildly convex, crossing laterally over the aortic arch and the main pulmonary artery

Disease affecting:
> Anterior mediastinal disease such as thyroid or thymic masses or prevascular lymphadenopathy may alter the normal appearance of the stripe, causing increased convexity laterally
Anatomy:
- Interface between lung and the pleural reflections over the vertebral bodies.
- The left paraspinal line is much more commonly seen than the right.

Diseases affecting:
- disrupted by paravertebral disease—which commonly includes diseases originating in the intervertebral disks and vertebrae—and by neurogenic tumors.
Anatomy:

- Interface between the right lung and the mediastinal reflection, with the esophagus lying anteriorly and the azygos vein posteriorly within the mediastinum.
- On X-ray, it appears as a line in its upper 1/3, it deviates to the right at the level of the carina to accommodate the azygos vein arching forward.
- Middle 1/3, the line has a variable appearance: usually straight.
- Lower 1/3, usually straight. (air in esophagus)
Anterior mediastinum

Borders:
- Anterior – sternum
- Posterior – ventral cardiac surface/pericardium, aorta, and brachiocephalic vessels
- Superior - Thoracic inlet
- Inferior - Diaphragm.

Contents:
- Thymus
- Fat
- Lymph nodes
- Sternum, anterior ribs
Borders
- Anterior - ventral heart border
- Posterior - anterior surface of spine

Contents
- heart and pericardium
- ascending aorta and arch of aorta
- vena cavae
- brachiocephalic vessels
- main pulmonary artery and vein.
- trachea and bronchi
- esophagus
- lymph nodes
Borders
- Anterior - anterior surface of spine
- Posterior - posterior ribs
- Anteroinferiorly - diaphragm
- Superiorly - thoracic inlet

Contents:
- descending aorta
- spine and posterior ribs
- nerves, ganglia, roots and spinal cord
- lymph nodes
- azygous and hemiazygous vv.
## TABLE OF MEDIASTINAL MASSES BY TISSUE OF ORIGIN

<table>
<thead>
<tr>
<th>LESIONS</th>
<th>FLUID</th>
<th>FAT</th>
<th>VASCULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTERIOR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 ‘T’</td>
<td>Thymic carcinoma</td>
<td>Thymolipoma</td>
<td>Aortic aneurysm</td>
</tr>
<tr>
<td>Thymic Lymphoma</td>
<td></td>
<td>Fat pad</td>
<td>Cardiac</td>
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<tr>
<td>Germ cell tumor</td>
<td>Thymoma</td>
<td>Diaphragmatic hernia</td>
<td>Coronary</td>
</tr>
<tr>
<td>Goiter</td>
<td>Germ cell Lymphoma</td>
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<tr>
<td><strong>MIDDLE</strong></td>
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<td></td>
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<tr>
<td>Lymph nodes</td>
<td>Duplication cyst</td>
<td>Lipoma</td>
<td>Arch anomaly</td>
</tr>
<tr>
<td>Duplication cyst</td>
<td>Necrotic nodes</td>
<td></td>
<td>Azygous vein</td>
</tr>
<tr>
<td>Arch anomaly</td>
<td>Pericardiac recess</td>
<td></td>
<td>Vascular nodes</td>
</tr>
<tr>
<td>Hernia</td>
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<tr>
<td><strong>POSTERIOR</strong></td>
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<td></td>
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</tr>
<tr>
<td>Neurogenic</td>
<td>Neuroenteric cyst</td>
<td>Extramedullary hematopoiesis</td>
<td>Descending aorta</td>
</tr>
<tr>
<td>Schwannoma</td>
<td>Schwannoma</td>
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<td></td>
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<tr>
<td>Meningocele</td>
<td>Meningocele</td>
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<tr>
<td><strong>More than 1 compartment</strong></td>
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<tr>
<td>Infection</td>
<td>Lymphangioma</td>
<td>Liposarcoma</td>
<td>Hemangioma</td>
</tr>
<tr>
<td>Lung cancer</td>
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</tbody>
</table>
Most serendipitously discovered on CXR

Some present w/ vague chest complaints or signs/Sx of compression/invasion

Most common are the “FOUR T’S”
- thymoma
- teratoma
- thyroid
- “terrible” lymphoma

… all others lesions are extremely rare!!
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**MIDDLE** = “**A** + **B**”

1. **A**denopathy
   - infection (TB, Histoplasmosis, Coccidioidomycosis)
   - inflammatory (Sarcoid, Silicosis)
   - neoplasm (leukemia/ lymphoma, metastases)

2. **B**ronchopulmonary (foregut) malformations
# POSTERIOR = “3 N’s”

1. **Neurogenic masses**
   - nerve root tumors (schwannoma, neurofibroma)
   - sympathetic ganglion tumors (neuroblastoma, ganglioneuroma, ganglioneuroblastoma)
   - paragangliomas (pheochromocytoma)
   - neurenteric cysts

2. **Nodes**

3. **aNeurysm** (of descending aorta)
Antero-Superior mediastinal masses

Things to look for in conventional radiograph

- Displaced anterior junctional line
- Preservation of posterior mediastinal lines
- Obliterated cardiophrenic angles
- Obliterated retrosternal clear spaces
- Hilum overlay sign
- Effacement / dense ascending aorta

Middle mediastinal masses

Things to look for in conventional radiograph

- Widened paratracheal stripes
- AP window mass
- Obliterated left SCA reflection
- Displaced azygosoesophageal recess on the right
- Pseudoparavertebral line on the left
- Mass on posterior trachea
- Lateral ‘doughnut’

Summary slide of things to look out for...

Posterior mediastinal Masses

Things to look out for in conventional radiograph

- Cervico-thoracic sign
- Thickened, distorted or disrupted paravertebral stripes
- Obliteration of the posterior junctional line with preservation of anterior junction line
- Abnormal contour of para-aortic line
History: Middle aged patient presents with occasional stridor and neck swelling?
Findings:
- Anterior mediastinal mass with mass effect on vessels and trachea
- Displaced anterior junctional line
- Aggressive radiologic appearance and differentials include thymic tumour, germ cell tumour, or less likely a lymphoma.
Diagnosis: Thymoma / thymolipoma (Anterior mediastinal mass)
History: Middle aged person presents with shortness of breath and neck swelling

Findings:
- Large, lobulated heterogeneous thyroid gland with areas of necrosis and calcifications. The right lobe in particular is extending into superior and middle mediastinum causing significant narrowing of the trachea.
- Displaced anterior junction line
- Effaced ascending aorta

Diagnosis: Goiter (Antero-superior mediastinal mass)
History: Mediastinal mass vs. pericardial fat pad?

Findings:
- Obliteration of right cardio-phrenic angle / space
- Prominent opacity on the frontal chest radiograph (not shown here); corresponds to a fat containing Morgagni Hernia on CT

Diagnosis: Morgagni hernia (Anterior mediastinal mass)
History: Night sweats

Findings:
- Lobulated bilateral hilar masses
- Widened left para-tracheal stripe> right

Diagnosis: Bilateral hilar lymphadenopathy (Middle mediastinal mass)
Findings:
- Widened right paratracheal stripe
  (CXR not shown)

Diagnosis:
Right paratracheal lymphadenopathy

PITFALL
- Right-sided aortic arch, seen in 0.5% of the general population, may mimic paratracheal lymphadenopathy because it obliterates the right paratracheal stripe.
- Absence of the aortic knuckle on the left should help correctly identify this variant.
- Left sided SVC.
History: Anterior mediastinal mass

Findings:
- Smooth, well defined uniform density mass lesion in the superior mediastinum right paratracheal region
- Thickened right paratracheal stripe
- No mass effect on trachea

Diagnosis: Bronchogenic cyst (Middle mediastinal mass)
History: early satiety

Findings:
- Soft tissue opacity in left retrocardiac region
- Pseudoparavertebral line on the left

Diagnosis: Esophageal GIST (Middle mediastinal mass)
History: Cough
Findings:
- Widened paratracheal stripes
- AP window mass
- Displaced azygoesophageal recess on the right
- Large lobulated heterogeneously enhancing mass in the middle mediastinum encasing and compressing the retrosternal trachea, carina and main bronchi and compressing the right and left pulmonary artery. Thoracic oesophagus is also compressed posteriorly. Subcarinal region and aortopulmonary window region as well as left para-aortic region.

Diagnosis: Lymphoma (Middle mediastinal mass) D/D lung cancer
History: Left lower zone mass on chest radiograph
Findings:
Solitary left sided mass between the left eighth and ninth ribs; no invasive features or spinal canal extension.

Diagnosis: Neurogenic Tumor (Posterior mediastinal mass)
History: None
Findings:
- Cervical and chest X-Ray demonstrate a margined and round opacity disrupting the left paravertebral stripe.
- Cervico-thoracic sign. CT scan confirms a left hypodense and homogeneous paravertebral mass.

Diagnosis: Schwannoma (posterior mediastinal mass).
History: Middle aged female presents with weight loss

Findings:
- Displaced anterior junction line
- Widened right paratracheal stripe and obliterated aorto-pulmonary window
- Heterogeneous mass in the middle and posterior mediastinum, separate from the retrosternal extension of the right lobe of thyroid gland.

Diagnosis: Multi-compartment disease - LYMPHOMA
History: Mediastinal mass

Findings:
- Large para-aortic necrotic mass, likely a primary lung malignancy - Mediastinal lymphadenopathy
- Obliterated retrosternal space

Diagnosis:
- Multi-compartment – anterior and middle mediastinal mass
- Lung tumour with mediastinal lymphadenopathy
References and Suggested readings


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