What Do I Need to Know?

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Objectives

• Learn the anatomy of the thoracic inlet (TI)
• Review the clinical and radiographic findings of common lesions encountered in this region
• Encourage the use of a systematic approach "Road Rules" for the evaluation of pathology in the TI

Where does it begin?

Thoracic Inlet Boundaries

Posterior - 1st thoracic vertebra
Lateral 1st rib
Anterior - Manubrium

Thoracic Inlet Sagittal View

Anterior scalene
Subclavian vein
Subclavian artery
Brachial plexus
Lung

ANTERIOR SCALENE
Thoracic Inlet Nerves

- Vagus
- Recurrent laryngeal
- Phrenic
- Sympathetic Chain
- Brachial Plexus – does not cross

Cervical Sympathetic Chain

- Stellate ganglion
  - Fusion of the first thoracic and inferior cervical ganglion
  - Found in 80% of the population
- Location
  - Level of C7 anterior to the first rib
  - Posterior to the vertebral artery at origin from the subclavian artery

Will use the term inferior cervical ganglion during this presentation
Thoracic Inlet – Contents

- **Neural structures** – Vagus nerve, recurrent laryngeal nerve, cervical sympathetic, phrenic nerve and brachial plexus
- **Vascular** – Subclavian and brachiocephalic artery and vein, common carotid artery and internal jugular vein
- **Lymphatics** – Thoracic and right lymphatic duct
- **Esophagus**
- **Trachea**
- **Thyroid**

**Road Rules**

*The thoracic inlet is a busy anatomic intersection.*
- Certain disease processes have predictable patterns of disease spread *“traffic patterns”*
- A knowledge of these patterns aid in imaging interpretation
- The “Road Rules” outlined in this lecture will help you remember the location and appearance of common lesions and their patterns of spread. This knowledge will increase your diagnostic accuracy.

**Thoracic Duct (TD)**

- The TD travels posterior to the left CS and terminates in the posterolateral aspect of the venous angle (junction of the left IJV and subclavian vein).
- Contrast refluxing into the TD posterior to the CS.
- Fluid filled TD posterior to the left IJV.
Thoracic Duct (TD)

Increased T2 signal posterior to the CS in the TD on this T2WI.

Aberrant Right Subclavian Artery

Associated with non-recurrent laryngeal nerve

Non-recurrent Laryngeal Nerves

- Rare anatomical variants
- Associated with aberrant vessels
- Important surgical implications
- Right NRLNs (0.3-1.6%) associated with aberrant RSA
- Left NRLNs (0.04%) associated with situs inversus and aberrant LSA

Carotid Space

- Formed by all three layers of the deep cervical fascia (DCF)
- Extends from the skull base to the level of the aortic arch
- In the lower neck contains jugular vein, carotid artery, and vagus nerve
- Major pathology is vascular or neural in origin
**Internal Jugular Vein Thrombosis**

- Artery
- Vein
- Node
- Abscess

**Aortic Dissection**

- CTA
- Look up and down
- Look down and up

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**Venous Thrombosis - Etiologies**

- Trauma
- Infection
- Mass compressing the vein
- Tumors that cause distant venous thrombosis (renal cell and pancreatic Ca)
- Indwelling catheter
- Birth control medications

**Takayasu’s Arteritis**

- Inflammatory disease affects large elastic arteries
- F:M ratio is 8:1, age 15-30
- Commonly involves the aorta and its major branches
- Radiographs - aortic calcifications in later stage
- Findings on CTA: stenoses, occlusions, aneurysms and concentric arterial wall thickening
- MR similar findings + enhancement of the vascular wall

32 y/o F with c/o pleuritic chest pain.

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**Carotid Artery Thrombosis**

- Artery
- Vein
- Node
- Abscess

**Visceral Space Divisions**

- PRETRACHEAL aka Visceral Space Extends from the hyoid bone to the anterior mediastinum
- RETROPHARYNGEAL extends from the base of the skull to anywhere between C6 and T4 where the alar fascia fuses with the visceral fascia (MLDCF)

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**Subdivisions**

- "Express Lane"
Visceral Space
Pretracheal Component

- Thyroid gland
- Parathyroid glands
- Larynx
- Trachea
- Esophagus
- Recurrent laryngeal nerve

Thyroid Lesions

- Most common lesion crossing the TI
- Inferior extent needs to be determined for surgical planning

72F 3 month h/o hoarseness and coughing

- Right VCP
- Poorly differentiated thyroid carcinoma

Tracheal Lesions

- Tracheal stenosis
- Saber sheath trachea
- Tracheal diverticulum
Tracheal Stenosis

- **Congenital** - ring shaped cartilage
- **Acquired** - prior intubation or tracheostomy
- Edema of the tracheal wall → intramural granulation tissue → fibrosis
- **Location** - Extra-thoracic
- Short segment concentric wall thickening (fixed) - hourglass shaped

Saber Sheath Trachea

- **Transverse diameter**
- **AP diameter**

Tracheal Stenosis

40 y/o M S/P intubation presented with increasing dyspnea

Saber Sheath Trachea

- COPD
- Trachomalacia from chronic coughing or increased intrathoracic pressure
- **Intrathoracic trachea**
  - ↓ Transverse diameter
  - ↑ AP diameter
  - Normal wall thickness
  - Narrowing ↑ expiration

Tracheoceles

- Aka right paratracheal air cyst
- COPD
- Focal herniation of the tracheal mucosa through the tracheal wall between the cartilaginous and mucosal portion of the trachea
- Asymptomatic
- Reservoir for secretions - cough, dyspnea and stridor secondary to chronic infection

Dilated Esophagus

- Motility disorder
- Carcinoma
- Strictures
- Achalasia
- Scleroderma
- Foreign bodies

Look down
Achalasia

- Etiology: unknown
- Neuropathy of the myenteric plexus
- Incomplete relaxation of the lower esophageal sphincter
- 2nd esophageal Ca, metastasis, Chagas disease and vagotomy
- Stasis – esophagitis

Congenital Lesions

- Lymphatic venous malformations
- Thymic cysts
- Cervical bronchogenic cyst

Scleroderma

Lymphatic Venous Malformation

- Most common lesion involving the thoracic inlet in children
- Locations
  - 75% neck
  - 20% axilla
  - 5% mediastinum, retroperitoneum, pelvic and groin
- 10% extend into the mediastinum

Esophageal Carcinoma

Thymic Cyst

This is a remnant of the thymopharyngeal duct (TPD). Fifty percent of these cystic are located medial to the CS on the left side of the lower neck deep to the thyroid gland and sternocleidomastoid muscle.

Path: Thymic tissue and Hassell's corpuscles
**Thymus - Cervical Extensions**

Newborn with a palpable mass in the lower neck.

Thymic tissue is found in the neck in 21-42% of infants.

**Apical Mass**

- Pancoast (Superior Sulcus) Tumors
- Neural Tumors
- Thyroid Lesions
- Vascular Lesions

**Cervical Bronchogenic Cyst**

- Rare in neck
- Anomalous foregut development
- Unilocular, non-enhancing
- Mimic other cyst
- Histopathology for diagnosis

Path: Pseudostratified ciliated columnar epithelium

**Nerves in the Pervertebral Space**

<table>
<thead>
<tr>
<th>Nerves</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical Nerve Root</td>
<td>Between the anterior and middle scalene muscles</td>
</tr>
<tr>
<td>Brachial Plexus Trucks</td>
<td>Anterior to the longus colli and capitis muscles</td>
</tr>
<tr>
<td>Cervical Sympathetic</td>
<td>Anterior to the anterior scalene muscle at this level</td>
</tr>
<tr>
<td>Chain</td>
<td></td>
</tr>
<tr>
<td>Phrenic</td>
<td></td>
</tr>
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**Visceral Space Abscess**

Pretracheal

**Brachial Plexus and IC Ganglion**
Vertebral Artery and Sympathetic Ganglion

Brachial Plexus Schwannoma

Asymptomatic 25 y/o M with an abnormal CXR.

Pancoast Tumor

Recurrent Laryngeal Nerve (RLN)

Recurrence Laryngeal Nerve (RLN)

45 y/o F with a Lt vocal cord paralysis.
Heterogenously enhancing mass is splaying the CCA and IJV.
Mass is anterior to the subclavian artery on sagittal image. This is where the vagus nerve is located.

Vagal Schwannoma
Lesion Involving the RLN
Lung Cancer

Subclavian artery
Paraspinal mass
Lung Ca invading mediastinum

Vagus and Phrenic Nerve Palsy
Metastatic Disease

Rt. VCP Mass
Subclavian artery
Elevated Rt. diaphragm

Vagus and Phrenic Nerves
Thoracic Inlet

Phrenic Nerve

Summary
- Anterior scalene muscle
- Vertebral artery
- Spaces – carotid, visceral (pretracheal and retropharyngeal), danger and perivertebral
- Neural structures (location)
- Lesion

Traffic Patterns
- Most lesions grow down not up
- Vascular lesions are the exception to the rule
- Pancoast tumors can grow into the base of the neck
Traffic Patterns

Look up and look down (neck and chest) especially when evaluating:
- Vascular lesions
- Infection
- Thyroid lesions
- Thymic lesions in children

Traffic Patterns

- Dilated esophagus – look down
- Look right and left
- Look left
- Look up

Traffic Patterns

Lesions in the perivertebral (paraspinal) region and posterior cervical space
- Look medially

Traffic Patterns

- Lung Ca
- Neural Tumors
- Vascular Lesions
- Thyroid Lesion

STOP

The anterior scalene muscle can be used to aid in the location of which of the following structures

A. Recurrent laryngeal nerve
B. Cervical sympathetic chain
C. Spinal Accessory nerve
D. Brachial plexus
An abscess in which of the following location with not cross the thoracic inlet

A. Carotid space
B. Superficial cervical space
C. Retropharyngeal space
D. Visceral space

A lesion located in which of the following locations will produce a vocal cord paralysis

A. Right hilum
B. Anterior to the carotid space
C. Tracheoesophageal sulcus
D. Carotid canal