Pediatric Thoracic Outlet Syndrome

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ATTENDING PEDIATRIC SURGEON

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Disclosures

- Nothing to disclose

Objectives

- Define Thoracic Outlet Syndrome (TOS) and subtypes
- Discuss what types of patients are more likely to have TOS
- Identify what diagnostic modalities are used
- Discuss treatment options and recovery considerations

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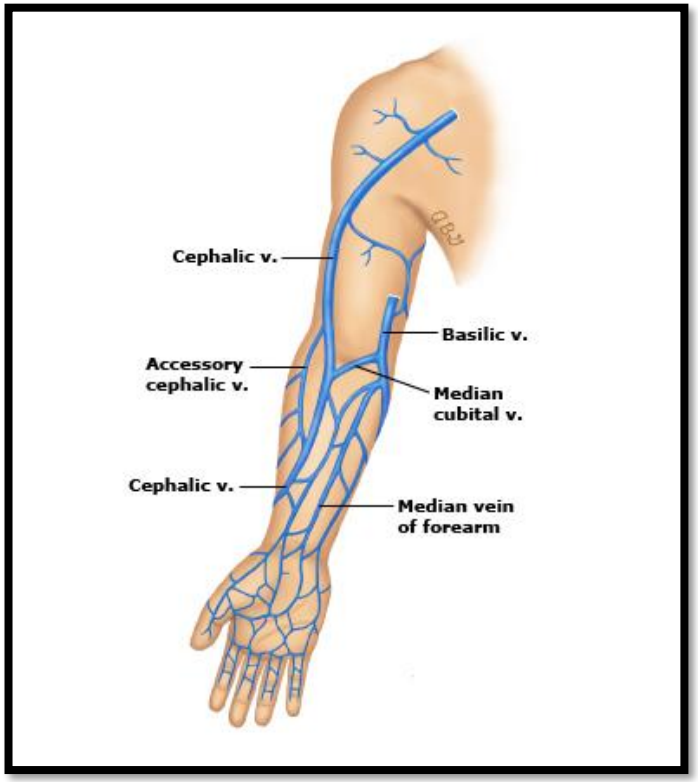
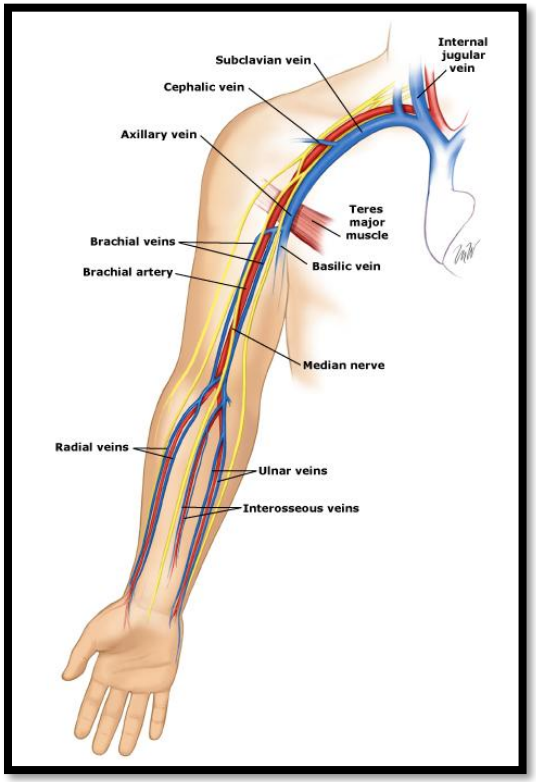
Types of Thoracic Outlet Syndrome (TOS)

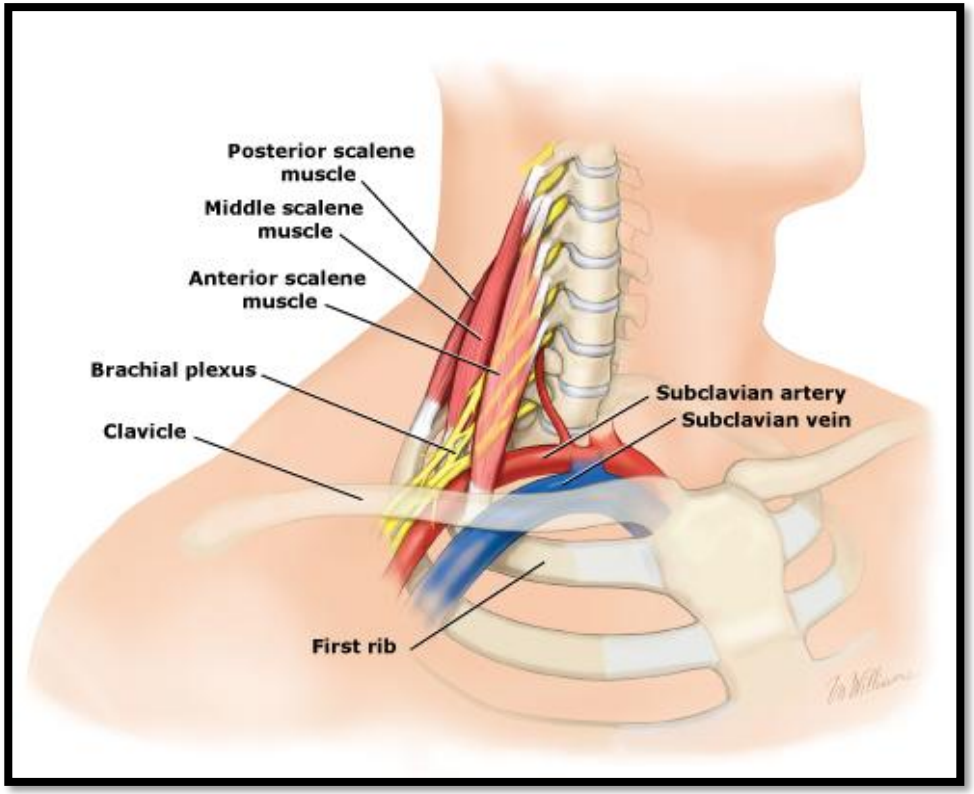
- Neurogenic Thoracic Outlet Syndrome
  - (95%)
- Venous Thoracic Outlet Syndrome
  - (3%)
- Arterial Thoracic Outlet Syndrome
  - (1%)

Thoracic Outlet Anatomy

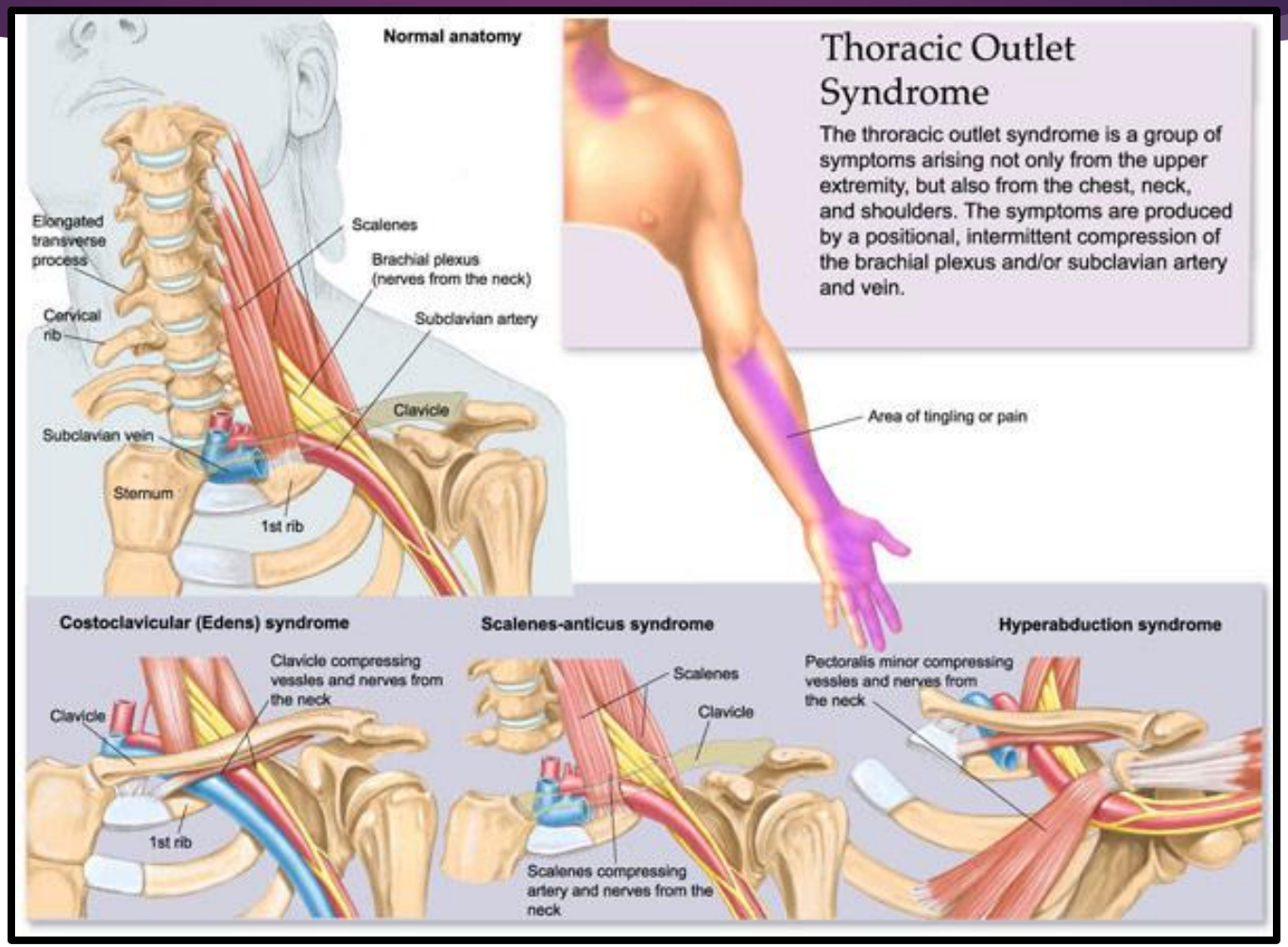




Anatomy

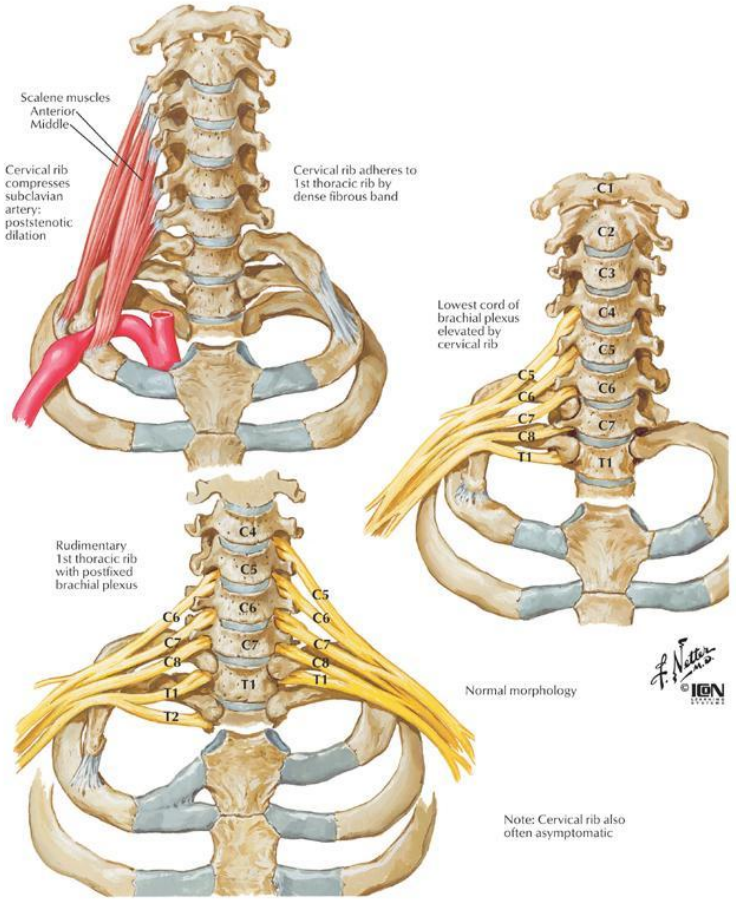

Posterior scalene muscle
Middle scalene muscle
Anterior scalene muscle
Brachial plexus
Clavicle
Subclavian artery
Subclavian vein
First rib

Thoracic Outlet Anatomy



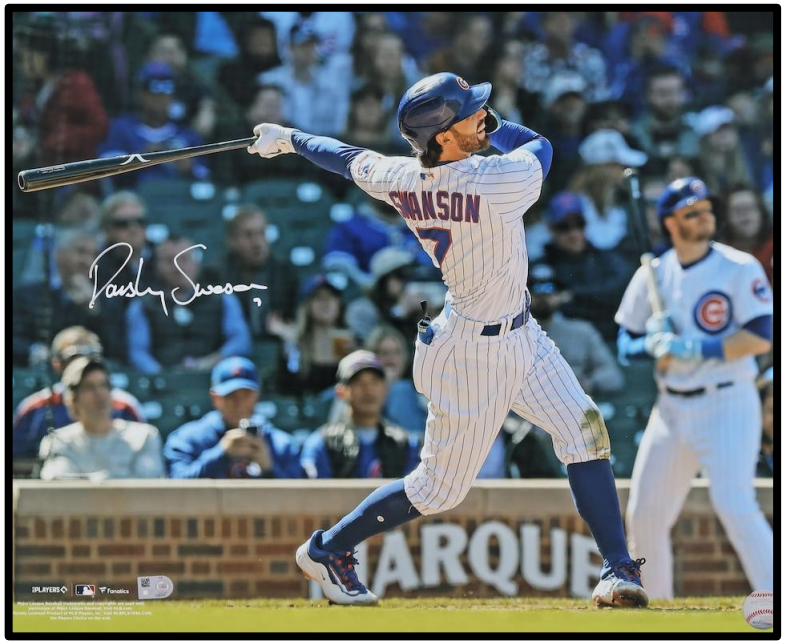
TOS abnormalities—Congenital

- Anomalous ribs (cervical or 1st)
- Cervical fibrocartilaginous bands
- Muscular anomalies
  - Insertion sites,
  - Fusion of anterior and middle scalene
  - Supernumerary muscles

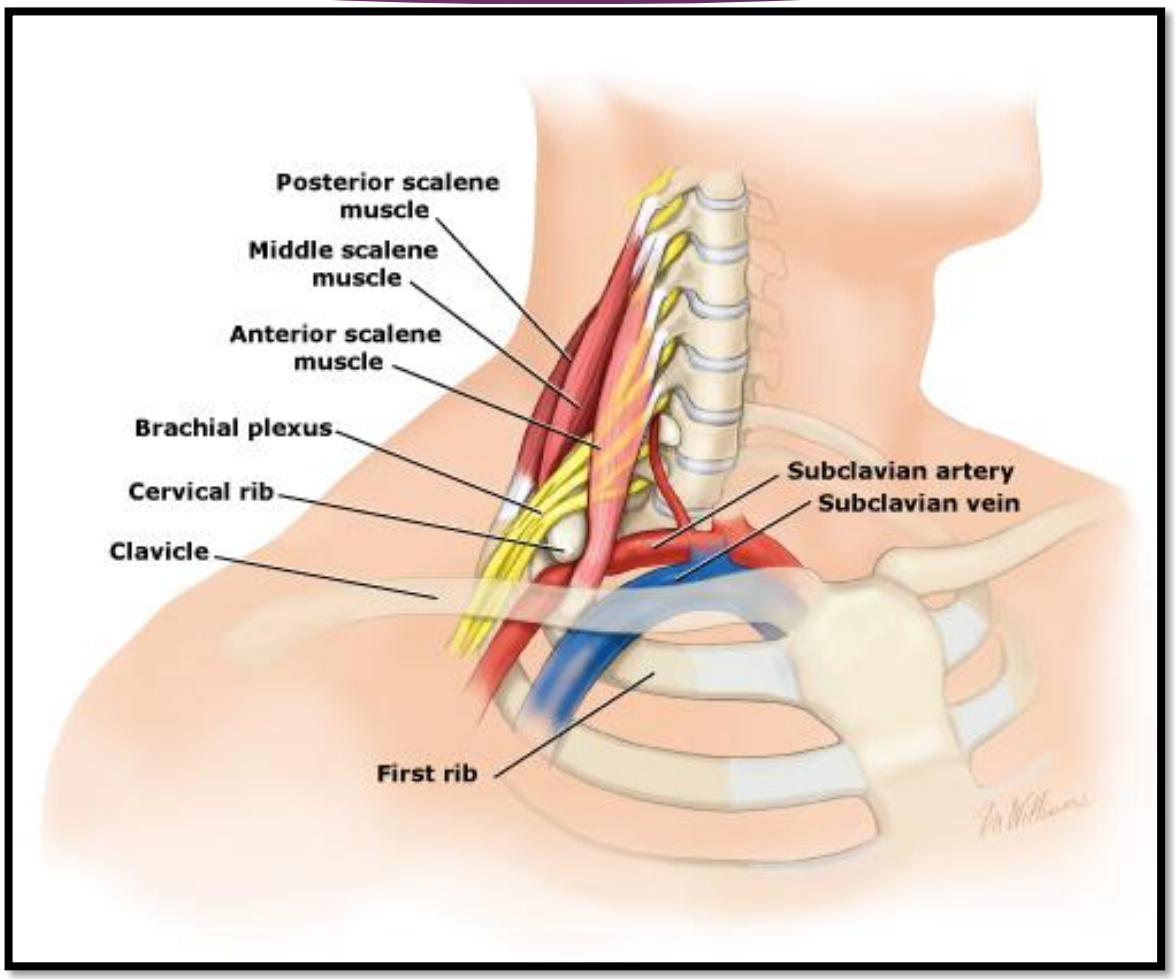


TOS abnormalities—Acquired

- Muscle hypertrophy (weight lifting)
- Trauma with chronic inflammation i.e.: MVA or post-op following spine surgery
- Repetitive neck/ arm movements



Neurogenic TOS (nTOS) due to cervical rib



Cervical rib

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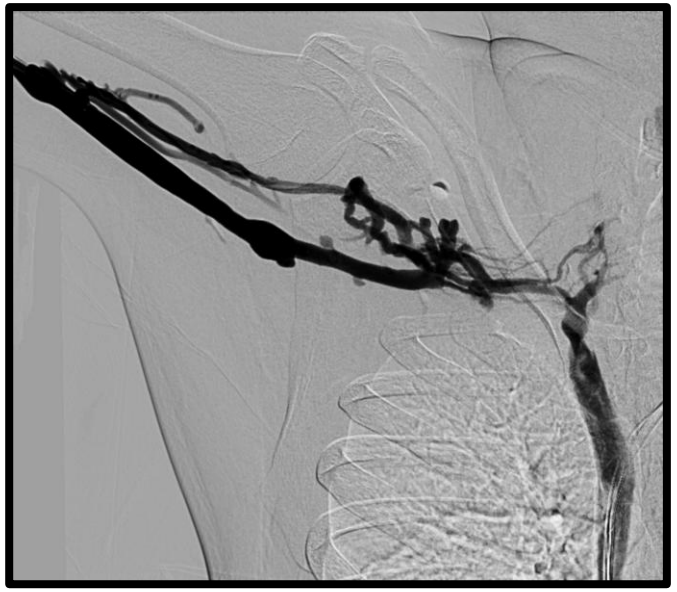
Neurogenic TOS: Symptoms/Presentation

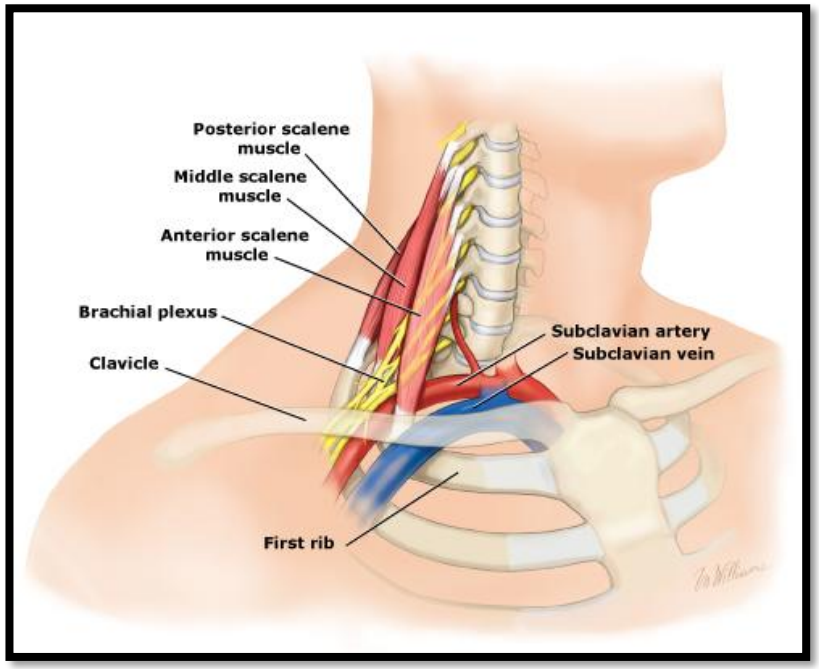
- **nTOS**
  - Often reproducible with provocative activities, such as reaching overhead
  - Upper extremity numbness/tingling, with distribution into the 4th and 5th digits commonly
  - Non-specific Pain, numbness, tingling, burning
  - Weakness
  - I.e: doing hair, writing, computer/school work, lifting

Venous TOS

- Unilateral Extremity
- Symptoms/Presentation:
  - Pain
  - Swelling
  - Color changes
  - Paresthesia and
  - Collateral vein engorgement, maybe be intermittent or acute
- DVT



Arterial TOS: Symptoms/Presentation



- Claudication (arm pain with exertion), pain, pallor, paresthesias, poikilothermia
- Arterial thrombosis/Distal thromboembolism–rare

Physical Exam

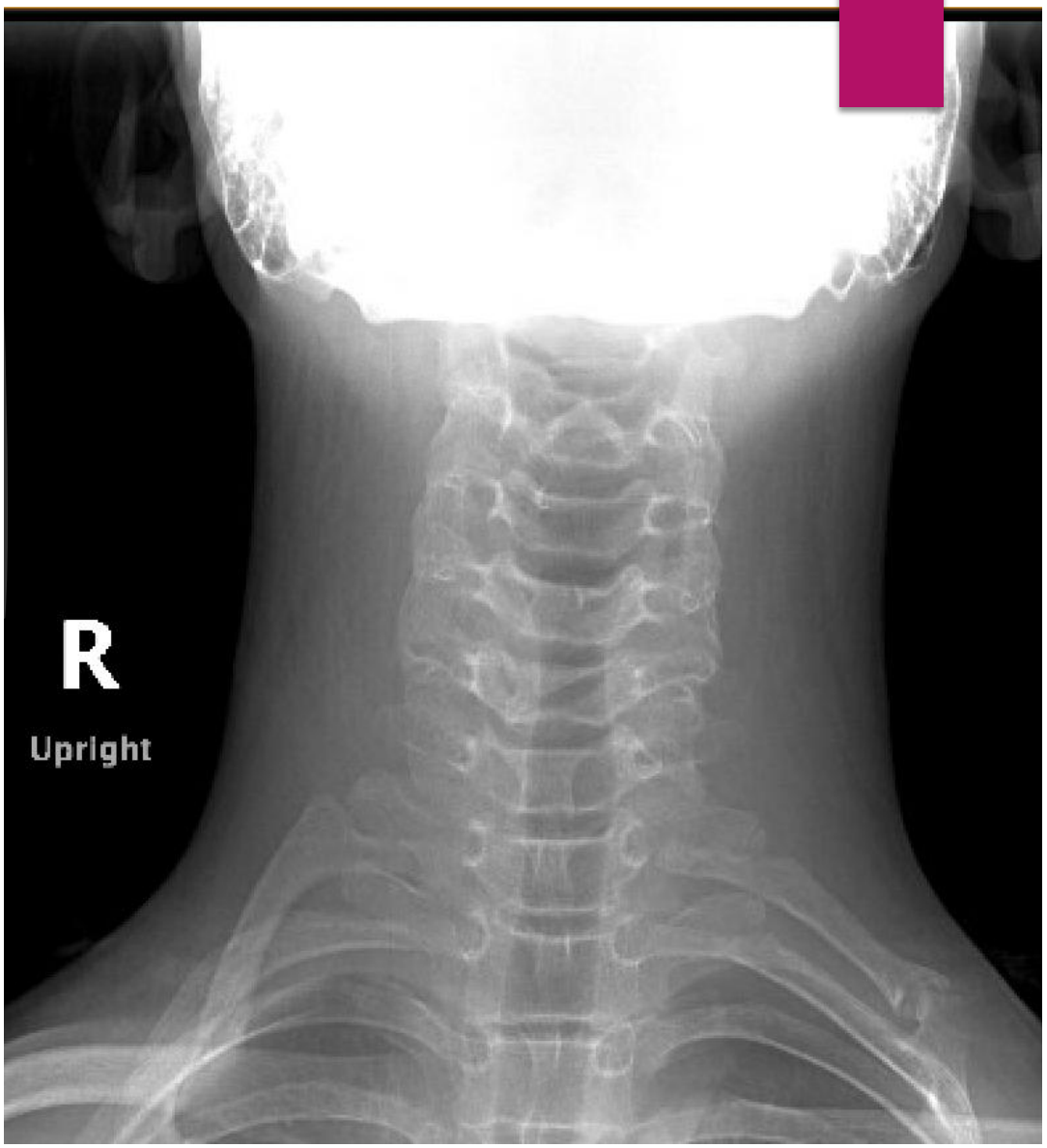
- Muscle weakness and atrophy because of severe compression of brachial plexus (atrophy in thenar aspect of hand)
- Forearm fatigue with using arm
- Hand/arm swelling/edema/discoloration or cyanosis
- Collateral venous patterning in shoulder, neck and chest wall
- Hand ischemia with pain, pallor, paresthesia and coldness, pain with activity
- Tender scalene muscles
- Adson's test or other Provocative maneuvers--Elevated Arm Stress Test (EAST) or Upper Limb Tension Test (ULTT)

Tests/Imaging

- Electrodiagnostic testing (EMG)
- Xrays
- US
- CTA
- MRA with provocative arm positioning
- Arteriography/Venography

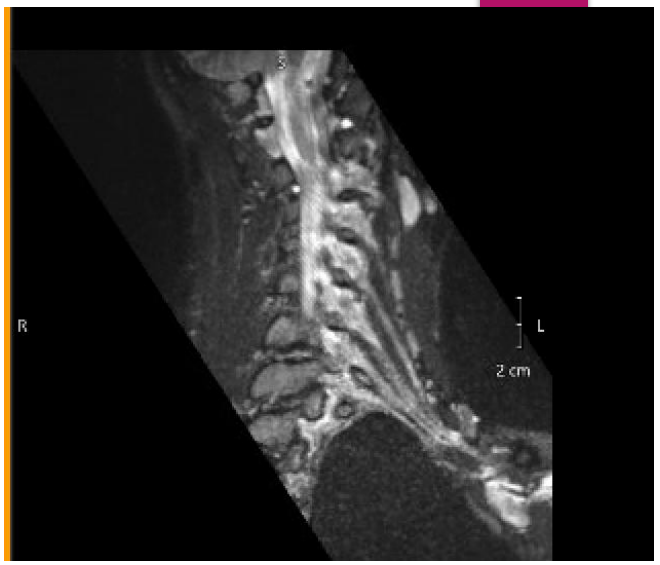
XR c-spine

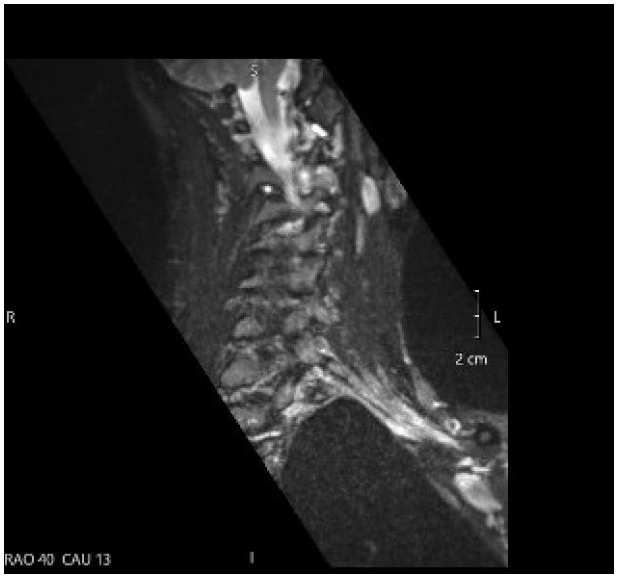
- 14 y/o male, swimmer on swim team for 4-5 years
- Ambidextrous
- Bilateral arm discoloration(red) and numbness for 1 year,
- Right slightly worse than left



MRI/MRA

- 16 y/o female s/p Right TOS decompression in 2022 with new symptoms on left side of pain, weakness, and numbness in shoulder and occasionally near elbow
- Needs to take breaks doing her hair





Venography

vTOS example→ED presentation

- 16 y/o male with acute left arm swelling presenting to ED in 2022,
- Found to have left subclavian, axillary, brachial and basilic vein thrombosis; right-handed but started to lift weights for 2 hours every day for 3 months straight

vTOS post angioplasty

- Same 16 y/o male s/p balloon angioplasty and thrombolysis on 8/17/22

Management/Treatment

- Physical therapy
  - Exercised aiming to strengthen muscles surrounding shoulder and postural exercises to lessen pressure on neurovascular structures, relaxation exercises
  - Reportedly about 50% resolve with PT
- Medical therapy (short term relief)
  - Targeted injection of anesthetic agents or steroids (scalene muscle block)
  - Botox injections
- Anticoagulation
- Thrombolysis/PTA
- **Thoracic Outlet Decompression**

Acute thrombus presentation

1) Initiation of thrombolysis/balloon angioplasty followed by immediate surgery
2) Initiation of thrombolysis/angioplasty followed by outpatient anticoagulation and surgery
3) Initiation of anticoagulation with outpatient scheduling for surgery

- Current literature supports differences in treatment with no clear difference in outcomes

Surgical Approaches

- **Infraclavicular**
  - Advantages: Great subclavian vein exposure and soft tissues; direct exposure of subclavius muscle and tendon
  - Disadvantages: limited visualization of scalene muscles and brachial plexus; difficult to get to posterior segment of first rib; easy to injure pectoral nerves; worst cosmetically

Surgical Approaches

- **Transaxillary**
  - **Advantages:** cosmetically appealing; good exposure for rib and intercostal muscles
  - **Disadvantages:** challenging to learn because window narrow and difficult for two people; cannot excise scalene muscles or fibrous bands; cannot perform full neurolysis; difficult to repair intraoperative bleeding

Surgical Approaches

- **Supraclavicular**
  - **Advantages:** excellent visualization of the scalene muscles and brachial plexus; cosmetically superior to infraclavicular incision; best approach for neurogenic thoracic outlet
  - **Disadvantages:** learning curve steep due to complex anatomy; more nerve manipulation, higher incidence of lymphatic leak

Perioperative Risks (<1%)

- Intraoperative bleeding
- SSI (surgical site infection)
- Pneumothorax
- Hemothorax
- Lymphatic leak from thoracic duct (left)
- Neurological injury
- Persistent pain

Peri-operative follow-up

- **Peri-operative discharge instructions:**
  - No heavy lifting greater than 10 lbs
  - No sports/gym/PE
  - Return to school 2-3 days after surgery
  - No swimming for 1 week
  - Shower 24 hours after surgery
  - Tylenol/Ibuprofen alternating
  - Valium/Lyrica/Gabapentin sparingly as needed
  - If on anticoagulation, resumed 24 hours after surgery

Post-operative follow-up

- **2-4 weeks appointment**
  - Release to activities of daily living
  - Slow increase in activity to get back to normal state by 6 weeks
  - Return to contact sports by 8 weeks
  - If weightlifting, start around 8 weeks (low weights, higher reps)

Long-term follow-up

- **3 months follow-up appointment**
  - Anticoagulation stopped 1-3 months post-op
- **1 year follow-up appointment**
- **Physical therapy**—optional at discretion of family/child/medical team
  - Increase range of motion (passive, active)
  - Increase strength/endurance to gain back what has been lost with disuse or muscle loss

Bilateral symptoms

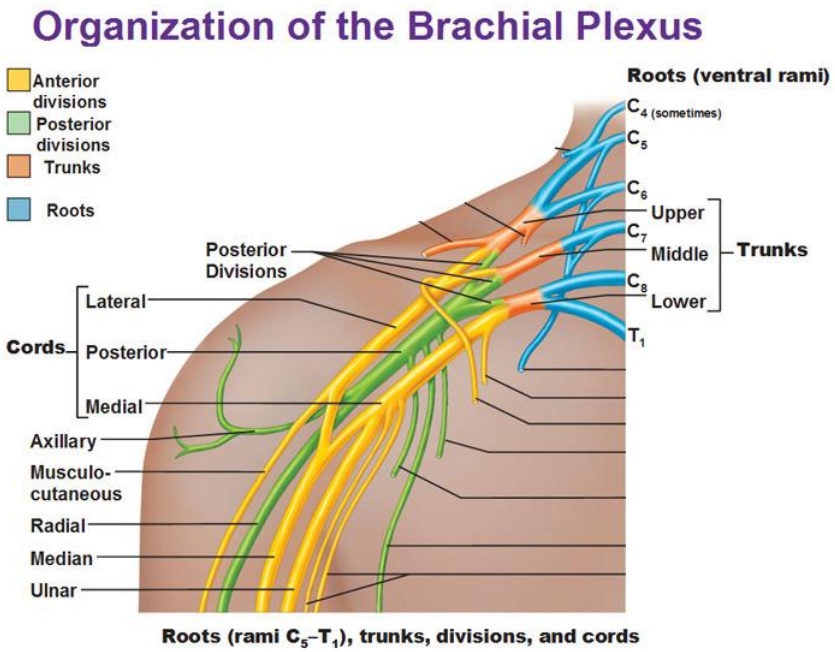
- **Bilateral symptoms**
  - One side done at a time to allow for mobility/use/recovery
  - More symptomatic side chosen first
  - addressed at minimum of 6 months after one side completed
  - Allows full use of contralateral arm prior to undertaking surgery on opposite side

Question 1

- A 17 y/o baseball pitcher presents with 2 days of right upper extremity swelling and discomfort. Duplex ultrasound demonstrates occlusion of the right subclavian vein.
  - What is the most appropriate initial management?
  - How should this patient be counseled regarding further interventions?

Question 2

- During first rib resection, what major nerves are most vulnerable to injury and how do they present clinically?
  - Phrenic nerve (C3, 4, 5)
  - Lower trunk of the brachial plexus (C8 and T1 nerve roots)



Conclusion

- Defined Thoracic Outlet Syndrome (TOS) and discussed subtypes
- Discussed typical patient presentations
- Diagnostic modalities
- Treatment and recovery after TOS decompression

Questions/Concerns?

References

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