Thoracic Outlet Syndrome (TOS)

- Divided into 3 types
  - Neurogenic 85-90%
    - Pain
    - Numbness and tingling
    - Weakness
  - Vasculogenic
    - Venous 10-15%
      - Paget-Schroetter
      - Congestion and color change
    - Arterial 1-2%
      - Ischemia / chronic embolization
      - Fatigue / upper extremity effort ischemia
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3 anatomical spaces that can cause TOS:

1- Scalene muscle space:
- Bounded by anterior scalene, middle scalene and first rib.
- Most common site for neurogenic TOS
- Contents: Brachial plexus and subclavian artery

2- Costoclavical space:
- Bordered by clavicle, subclavius muscle and 1st rib
- all 3 structures pass in this space
- Vein most commonly compressed

3- Pectoralis minor space:
- Pectoralis minor anteriorly and chest wall posteriorly
- Least common site

TOS

- Neurovascular compression at the thoracic outlet
- Common initiating events
  - Repetitive motion injury
  - Whiplash/lifting injury
  - Sports related activities
  - “Unknown”

Pathogenesis of TOS

A) Hyperextension neck injuries:
- Scalene muscle inflammation/swelling
- Whiplash injuries
- Stability/hyperextension
- Neurogenic TOS

B) Activity / Occupation-related:
- Static postures
- Chronic heavy lifting
- Occupations requiring repetitive arm movement
- Sports
- Neurogenic / Venous TOS

C) Abnormal 1st rib / Cervical rib:
- Arterial TOS

TOS

- CXR / Cervical spine series
  - Cervical rib
  - Elongated transverse process C7
  - Degenerative changes
Abnormal 1st rib / Cervical rib

- Occur in 1% of population, women 2x
- 10x more likely to develop TOS
- 50% are bilateral.
- Although most cervical ribs are incomplete or rudimentary, most have ligamentous attachments to the first rib.
- Most cervical ribs are commonly embedded in fibers of middle scalene muscle and displace both subclavian artery and brachial plexus
- Rationale for 1st rib resection: abnormal ligamentous and muscular attachments to the 1st rib.

Adson Maneuver

- Ablation of radial pulse with deep inspiration and turning of the neck away from the affected extremity
- Associated but NOT diagnostic of TOS

TOS Imaging Work Up

- Duplex
- CXR/C spine series
- Venogram
- MRI or CT Scan
  - Assessment of vascular anatomy
  - “Functional anatomy”
    - Costoclavicular space
Venous TOS - VTOS
(Effort Thrombosis; Paget-Schroetter Syndrome)

- Mechanical compression of the subclavian vein within the costoclavicular space causing:
  - Venous stenosis
  - Venous thrombosis
Venous Symptoms

- Effort thrombosis, Paget von Schroetter syndrome
- Hand and arm edema
- Cyanosis
- Enlarged subcutaneous collateral veins
- Forearm fatigue

VTOS: Current Standard of Care

Consensus: most patients are best treated with a combination of:

- Early thrombolysis
- 1st rib resection
- Correction of vein stenosis
- Period of post-op anticoagulation

Treatment

- Acute DVT (Effort Thrombosis):
  - Thrombolysis
  - Anticoagulation
  - Surgical Decompression with venous reconstruction +/- AVF
  - Temporary Anticoagulation
- Chronic Symptoms:
  - Surgical Decompression with venous reconstruction +/- AVF
  - Temporary Anticoagulation
Venous TOS – Case Study

- 25 y.o. woman presents with RUE edema
- Doppler: RSCV thrombosis
- VIR: thrombolysis
- Hypercoagulable workup negative
- Vascular Surgery Evaluation: VTOS

Paget-Schroetter Syndrome

“Effort Thrombosis”
Complication of a venous wallstent

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Failure of stents as primary therapy

Controversies in Treatment of VTOS

- Thrombolytic therapy without TOD
- Anticoagulation vs. surgery
- Management of subclavian vein stenosis
- Management of chronic subclavian vein occlusion

- Operative approach:
  - Transaxillary
  - Supraclavicular
  - Infraclavicular

Multiple treatment algorithms for successful outcomes in venous thoracic outlet syndrome

Background: We sought to determine the outcomes in patients presenting with venous thoracic outlet syndrome.

Methods: Prospectively-collected data from 67 patients between October 2003 and December 2007. The average age was 31 years (range, 16-54). The initial treatment algorithm was utilized. Results: In group 1, 3 patients presented with acute occlusion and received tissue plasminogen activator (tPA) and immediate first rib resection with scalenectomy (FRRS). One vein re-thrombosed and was treated with intravenous tPA postoperatively. In group 2, 39 patients presented with stenotic subclavian veins an average of 22 weeks after their initial thrombosis; all of whom underwent FRRS followed by a venogram 2 weeks postoperatively: 25 had a tight stenosis and underwent venoplasty with anticoagulation; 13 had patent, nonstenotic subclavian veins, and 1 patient required tPA and venoplasty owing to rethrombosis. Two patients had their subclavian vein thrombose after venoplasty and were treated with anticoagulation, tPA, and venoplasty. In group 3, 11 patients presented with intermittent venous obstruction without thrombosis and underwent FRRS; 3 underwent venograms because of concerns of residual stenosis, 2 of whom required venoplasty postoperatively. Finally, in group 4, 14 patients presented with occluded subclavian veins and underwent FRRS with long-term anticoagulation. Eleven have recanalized at an average of 6 months (range, 2-12). Conclusion: Overall, 66 of 67 patients have present-subclavian veins with a median follow-up of 30 months, and all patients are asymptomatic for a success rate of 98%. Tailored treatment algorithms including FRRS, postoperative venography with or without intervention, and the use of long-term anticoagulation seems to be required in this complicated group of young patients to achieve optimal results.
Surgical Decompression
- Supraclavicular exploration
- Anterior and middle radical scalenectomy
- First rib resection
- Brachial plexus neurolysis
- Venolysis
- Vascular reconstruction using autogenous conduit: OR post op angioplasty
  - GSV Patch Angioplasty
  - SCV Bypass with GSV
- Adjunctive AVF
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Complete 1st rib resection

Subclavian Vein

Hyperplasia/stenosis

Trans axillary 1st Rib Resection
Infraclavicular Rib Resection & Venolysis

Advantages of Infraclavicular Approach for VTOS

- Direct access (to vein within the costoclavicular space)
- Focused approach (no unnecessary exposure of brachial plexus and subclavian artery)
- Avoids disruption of venous collateral pathways
- Facilitates vein reconstruction when necessary

Combination treatment of venous thoracic outlet syndrome: Open surgical decompression and intraoperative angioplasty

Schneider, et al. JVS 2004
Intermittent Vein Obstruction - McCrery Syndrome -

- 11/67 (16%) patients presented on average 57 weeks after onset of symptoms
- All presented with swelling but no thrombosis
- All demonstrated vein occlusion with abduction
- All underwent first rib resection and scalenectomy
- Post-operative venograms in 3 patients for persistent symptoms
  - 2 required PTA
- All are currently asymptomatic

Imaging of Intermittent Vein Obstruction

Complications/Outcomes

- No vascular injury
- No brachial plexus or long thoracic nerve injury
- 10/67 (15%) pneumothorax
- 64/67 (96%) patients have patent subclavian veins and are asymptomatic