Thoracic Outlet Syndrome: An Often Overlooked Cause of Upper Arm Pain

Angela Cavanna, DO, FAOASM
College Physician Bard College
Assistant Clinical Professor of Medicine
Touro College of Osteopathic Medicine
Middletown, NY
angela.cavanna@touro.edu
Disclosures - NONE
Thoracic Outlet Syndrome: Definition

Thoracic outlet syndrome (TOS) refers to a constellation of signs & symptoms that arise from compression of the neurovascular bundle by various structures in the area just above the first rib and behind the clavicle, within the confined space of the thoracic outlet.

- *cervical rib syndrome*
- *scalene anticus syndrome*
- *costoclavicular syndrome*
- *hyperabduction syndrome*
- *Paget-Schroetter syndrome*
- *effort vein thrombosis*
- *shoulder-hand syndrome*
Types of TOS

1. Neurogenic (nTOS) from brachial plexus compression (95%)
   • “true” vs “disputed”
2. Venous (vTOS) from subclavian vein compression (3%)
3. Arterial (aTOS) from subclavian artery compression (1%)
Understanding the anatomy & biomechanics of the thoracic outlet is key to understanding the symptoms!!
Why do we care?

Recent:

• Tyson Ross, Matt Harvey, Mike Foltyniewicz, Luke Hochevar, Phil Hughes, Josh Beckett, Jaime Garcia, Kyle Zimmer, Chris Carpenter, Matt Harrison, Chris Young, Clayton Richard, Noah Lowry and Shaun Marcum

• Older cases:
  • 1980 J.R. Richard

TOS: Baseball

Late cocking & acceleration phases:

- Shoulder:
  - Abducted
  - Horizontal extension & external rotation

- Scapula & clavicle maximally retracted

- Space between first rib and clavicle decreased ~50%

https://www.anatomy.tv/html5ui/#/product/ifa3/type/Views/id/44438/layer/13/angle/35/structureID/-1
And not just baseball!!
Thoracic Outlet Syndrome

- Estimated incidence is 10 in 100,000, but cadaveric studies have suggested that up to 90% of the population may have what is considered abnormal anatomy of the thoracic outlet¹
- 4:1 female to male ratio¹
- 2017 Otoshi et al concluded that about one-third (32.8%) of 1288 high school baseball players screened had symptomatic thoracic outlet syndrome (TOS)²

1. Buller et al, Thoracic Outlet Syndrome: Current concepts, imaging Features, and Therapeutic Strategies, AMJOrthopedica, August 2015, 376-382
Thoracic Outlet Syndrome
Etiology¹

• Congenital
  • Cervical ribs
  • Anomalous 1\textsuperscript{st} rib

• Repetitive Activities
  • Overhead
  • Closed chest: keyboard

• Acute trauma
  • Most common!
  • Hyperextension of the neck

Thoracic Outlet Syndrome: Symptoms

Neurogenic Forms of TOS:

- Pain
- Dysesthesia
- Numbness
- Weakness

• Symptoms are reproducibly aggravated by any activity that requires elevation or sustained use of the arms or hands

• Prolonged, severe compressions of brachial plexus can lead to muscle weakness and atrophy, but this finding is extremely rare.
  - Slowly progressive unilateral atrophic weakness of the intrinsic hand muscles that is more evident on the thenar aspect of the hand rather than the hypothenar aspect
  - Sensory abnormalities in the T1 distribution are common
Thoracic Outlet Syndrome: Symptoms

• Venous Forms of TOS:
  • More common in overhead activities
    • “effort thrombosis”
  • Swelling, pain, or cyanosis of extremity
  • Paraesthesia in fingers
  • Collateral venous changes over shoulder, neck or chest wall

• Arterial Forms of TOS:
  • Young patient without risk factors for vascular disease
  • Ischemic symptoms of hand
  • Pain, pallor, paraesthesia, cold, decreased pulses
  • Bruit or thrill in supraclavicular region
Thoracic Outlet Syndrome: Physical Exam

• Most forms of TOS are diagnosed based on history and physical exam findings

• Palpate for areas of tenderness:
  • Anterior scalene; biceps & rotator cuff tendons; trapezius & rhomboids; pectoralis minor; axilla

• Tinel’s sign may be present:
  • Anterior scalene; carpal tunnel, medial epicondyle, pronator tunnel, radial tunnel

• Provocative maneuvers
Adson’s Test

• Anterior Scalene
• Positive test = decrease in the STRENGTH of the radial pulse


Wright’s Test

- Hyperabduction test
- Pectoralis minor syndrome
- Positive test = decrease in the STRENGTH of the radial pulse

https://www.youtube.com/watch?v=17Ala8SztE
Eden’s Test

- Military brace test
- Costoclavicular syndrome
- Positive test = decrease in the STRENGTH of the radial pulse


https://www.semanticscholar.org/paper/Thoracic-outlet-syndrome.-Ozoa-Alves/50cb335961304333f3147b43f4fe0e438d6da9fecd
Roos or “EAST”
(Elevated Arm Stress Test)

• Most accurate clinical test!
• Patient seated, shoulders 90° abducted, elbow flexed 90°, examiner instructs patient to open & close fists ~2x/sec for 3 minutes
• Positive test = reproduction of the patient’s symptoms

https://medisavvy.com/shoulder-roos-test/
Upper Limb Tension Test

- Position 1:
  - Arms at 90 degrees, elbows extended
- Position 2:
  - Wrists dorsi-flexed
- Position 3:
  - Head tilt
- Positive test = reproduction of symptoms
- False negatives are rare

TOS: Diagnosis

- Mostly clinical
- Rule out other etiologies of pain/symptoms
- X-ray of cervical spine and chest to look for cervical/anomalous rib
- Ultrasound of supraclavicular region
- MRA or CTA if vascular symptoms present
- EMG
  - Helpful only if “true” neurogenic TOS
  - Often normal
- Muscle blocks
  - Pectoralis minor or anterior scalene
  - Only done over tender muscles
TOS: Treatment

• Anticoagulation for thrombosis

• Conservative Treatment:
  • Preferred modalities:
    • Osteopathic manipulation (OMM)
    • Neck stretching
    • Pectoralis minor stretching
    • Posture correction
    • Nerve glides
    • Abdominal breathing
    • Dry needling
  • Ineffective modalities:
    • Strengthening exercises
    • Resistance exercises
    • Therabands
Thoracic Outlet Syndrome (TOS): Treatment

• Operative:
  • Surgery indicated when conservative treatment fails or vascular symptoms progress
  • Several techniques/approaches are available and are dependent upon the experience of the surgeon and the clinical presentation of the patient
    • e.g. ATOS may require removal of clot if thrombosis present and repair of an aneurysm if the syndrome has been relatively asymptomatic and long term
  • 2017 Thompson et al reported a reported that 77% of pitchers returned to play with little to no changes in their performance metrics after surgical decompression for NTOS

• Review the anatomy of the thoracic outlet.
• Most common form of TOS is caused by trauma!
• Think of TOS in any athlete complaining of upper extremity pain.
• Consider adding provocative maneuvers to your exam.
References

- [http://aclandanatomy.com/](http://aclandanatomy.com/)
- [https://www.anatomy.tv/html5ui/#/product/har_shoulder_2014/type/Movies/id/9083619](https://www.anatomy.tv/html5ui/#/product/har_shoulder_2014/type/Movies/id/9083619)
- Buller et al, Thoracic Outlet Syndrome: Current concepts, imaging Features, and Therapeutic Strategies, AMJOrthopedica, August 2015, 376-382