Diagnosis and Treatment of Thoracic Outlet Syndrome

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Thoracic Outlet Syndrome

- A complex peripheral and central nervous system condition
- Progressive or static and lifelong
- Includes muscle pathology and emotional components, risk of suicide

Three Types
- Neurogenic (NTOS) – 95%
- Venous (VTOS) – 4%
- Arterial (ATOS) – 1%

I will primarily cover NTOS

Incidence – 80 of every 1000 patients
- 3000 1\textsuperscript{st} rib resections annually
- Male - Female ratio is 1 to 4
Obstacles to Diagnosis and Treatment

- “Disputed” diagnosis of TOS

- Inadequate training, motivation and interest in medical community

- Insurance Industry

- Reliance on “evidence based” medicine

- Pain is first sign - war on drugs

- Testing not allowed – MACN, and MRI
Anatomy

- Outlet is between the central and peripheral nervous system

- Between the neck, axilla, shoulders and thorax, includes brachial plexus nerve roots, nerves, and branches plus surrounding muscles

- Palpation area: supra and infraclavicular, subcoracoid

- C8-T1 – Last branch and mostly T1 yielding MACN as the best test
Fig. 3.2 Thoracic outlet and pectoralis minor areas. Left arm is down, at the side. Note the subclavian and axillary artery and vein are essentially the same vessels one above and one below the clavicle. Right arm is elevated. This raises the axillary neurovascular bundle against the pectoralis minor muscle. This can constrict the axillary artery causing loss of the radial pulse and hand pallor and also pressure on the nerves of the brachial plexus causing paresthesia in the hand.

Fig. 3.3 Costoclavicular Space. Between the clavicle above and first rib below, all structures in the thoracic outlet area are seen. Note the subclavian vein is surrounded by costoclavicular ligament medially, subclavius muscle superiorly, anterior scalene muscle posteriorly, and first rib inferiorly. The subclavian vein is the structure most often compressed in this area and most often by costoclavicular ligament and/or subclavius muscle tendon.
Fig. 3.7 Brachial plexus. Above the clavicle where the scalene triangle lies, the plexus is present as five nerve roots (C5 through T1) forming three trunks. Just below the clavicle in the costoclavicular space the trunks are starting to form divisions. Where the plexus travels through the pectoralis minor space the cords and branches appear (Reprinted from Grant [11]. With permission from Lippincott Williams & Wilkins).
Fig. 3.8  Relationship of subclavian vein between clavicle and first rib. Subclavian vein can easily be compressed by costoclavicular ligament, subclavius tendon, or anterior scalene muscle (Reprinted with permission from Sanders and Haug [2], p. 236. With permission from Lippincott Williams & Wilkins)
Fig. 3.9 Prevascular (anterior) phrenic nerve obstructing the subclavian vein (Reprinted with permission from Sanders and Haug [2], p. 237. With permission from Lippincott Williams & Wilkins)
Signs and Symptoms

- Pain commonest
- Neck- chest – occipital
- Upper extremities – fingers 4 and 5
- Migraine
- Numbness, tingling, weakness. Fatigue
- Clumsiness of arms and hands
Differential Dx

- Cervical Radiculopathy:
  - HM and EAST negative
  - No Headaches
  - Spurlings - positive

- HNP – no HNP possible at C8-T1

- CRPS – more bilateral, no headaches

- May coexist with NTOS
Etiology

- Environmental stressors superimposed on vulnerable nerve, muscle, bone and cartilage tissue.

- Preexisting bony anomalies – developmental
  - Cervical ribs (C7)
  - Anomalous 1\(^{st}\) thoracic rib
  - Congenital bands and fibro-muscular masses
  - Pre and Post fixed plexi

- Trauma
  - Repetitive activity – ie. computer usage, data entry
  - Cervical hyperextension – MVA’s, whiplash
  - Ergonomics – poor posture control – assembly line – office workers
  - Overhead throwing in athletes – pitchers, quarterbacks and swimmers
Pathophysiology

- Muscles lengthen or shorten and distort
- Atrophy of fast twitch and hypertrophy of slow twitch lead to hard taut muscles which act as compressive weapons against plexus nerve roots, nerves and branches
- Outlet narrows increasing percentage of nerve fibers involved over time
- “Double crush” may occur and can lead to CRPS – from compression of nerve tissue at multiple levels leading to more problems with axonal flow than would be expected with the number of areas injured
- Intraneural damage progresses over time if untreated
Physical Exam and Laboratory

- Observe for forward head position, plus scapular elevation, and retraction and visible swelling in supra cavicular fossa
- Side bending of neck away from affected side leads to increase pain
- Hyperabduction Maneuver (HM) – full hyperabduction of arms one at a time for 1 to 3 minutes looking for assymetries in function, fatigue, numbness and pain in 4\textsuperscript{th} and 5\textsuperscript{th} fingers. Patient’s hand grip may weaken in NTOS
- EAST is another option
- Palpation – tender, supra and infra clavicular and scalenes – with scalenes use light pressure to avoid evoking acute severe pain in TOS
- Dangling with heavy weight in affected hand; if it depresses shoulder, pain will increase

Laboratory
- MACN – reduced voltage
- Increased sensory latencies – ulnar and median – despite normal NCV’s
- CRS hard to do and less consistent
- Plain cervical spine X-rays for bony anomalies
- MRI, MRA of plexus and outlet
Pectoralis Minor Syndrome

- Pectoralis Minor Syndrome – the newest component of NTOS seen in pure form in post op recurrences. Reversible with tenectomy.

- Test for it with arm in 90% AER position and add resistance to forward movement of shoulder and arm.

- No headaches – tender in axilla and over pectoralis minor tendon and insertion – scalenes non tender
Movers and Stabilizers

- Movers equals all three scalene muscles, subclavius, pectoralis minor, levator scapula and upper fibers of trapezius
- Stabilizers equals lower fibers of trapezius and abdominal corset
- Ergonomic problems and trauma can produce an imbalance between movers and stabilizers leading to over usage of accessory respiratory, instead of diaphragm for breathing
Cervical dystonia can coexist with TOS and/or simulate (scalene muscle fibers when severely involved) – Botulinum helps both

Complex Regional Pain Syndrome (CRPS) easy to differentiate, non-focal, involves sympathetic overflow, responds to cervical sympathetic blocks

Facet nerve disease can coexist with TOS, and become one of the reversible causes of recurrences post op. Facets must be blocked pre-op.
Treatment

- **Medications** – NSAIDS, non-sedative mm relaxants, and Methadone – all give partial relief

- **Physical Therapy**
  - Experienced therapist in TOS
  - Breathing – revert back from chest to diaphragmatic
  - Movers and Stabilizers
  - Avoid aggressive stretching and strengthening
  - Home exercises are key
  - Avoid hyperextension
  - Standard PT may worsen
Treatment (continued)

- **Scalene blocks**
  - may give temporary relief
  - predicts surgical results

- **Botulinum Toxin**
  - Single site or movers only yields 68% success for 3 months
  - Multi site – movers and stabilizers yields 91% success for 5.4 months
Surgery

- Success Rate – good and fair up to 87%
- Do ASAP – but always after trial of PT and Botulinum
- Includes resection of scalenes and 1st ribs and plexus neurolysis
- Approach can be trans-axillary or supra-clavicular
- Recurrences may occur
  - Pectoralis minor syndrome – response to tenectomy
  - Resumption of poor posture control in this life long condition
- Intraneural damage may be permanent
Alternative Care

- Physical Therapy – Edgelow’s protocol – increased self-awareness plus gentle appropriate movements
- Occupational Therapy – ergonomics
- Heparin – for neural inflammation
- Erythropoetin – acts on hyper-excitable neurons as does Methadone – more trials needed – AE’s may be serious
- Nalbuphine – a Kappa receptor agonist – must be injected subcu BID and nausea common
- Acupuncture - CNS and PNS response to local injury vs endorphine release or placebo effect
- Hypnosis – deep, difficult, followed by training in auto hypnosis
- VNS – TNS – Sphenopalatine blocks
- Chiropractic Care – manipulation and gentle stretching
What you can do!

- Diagnose early – S/S and exam findings are unique.
- Failure rate increases with time lapse from onset to treatment. Incidence is increasing steadily.
- Look for combination of headaches, pain in shoulders, neck, upper back and upper extremities, especially when fingers 4 and 5 are involved and hyperabduction maneuver exacerbates.
- Treat with or without lab or imaging evidence - evidence may be delayed, vague or unobtainable.
- Watch for signs of ischemia, embolization, thrombosis in arms suggesting vascular TOS – refer to vascular surgeon.
- Read the textbook.
References

Taken from textbook:

Thoracic Outlet Syndrome,
edited by: Springer – Verlag, London