THORACIC OUTLET SYNDROME AND THE OVERHEAD ATHLETE

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LEARNING OBJECTIVES

• Explain the etiologies of thoracic outlet syndrome.

• Differentiate between the types of vascular and neurologic thoracic outlet syndrome.

• Identify effective treatment and management strategies incorporating muscle strengthening and neuromuscular control of the upper extremity for patients presenting with thoracic outlet symptoms.

• Recommend a return to activity program for overhead athletes following conservative or non-conservative treatment.
WHAT IS THORACIC OUTLET SYNDROME (TOS)?

• Term outlines the location without defining what comprises the problem
• Compression of the neurovascular structures in the interscalene triangle
• Subcategorized as arterial or venous and neurogenic
  • NTOS subcategorized into true or disputed
    • True: condition with objective diagnostic findings
    • Disputed: condition without objective findings
• 90% of all cases are NTOS, <1% arterial, 3-5% venous
  • Combined TOS: vascular and neurological structures involvement
PATHOANATOMY

• 3 confined spaces from cervical spine to lower pec minor muscles
  1. Interscalene triangle
  2. Costoclavicular space
  3. Thoraco-coraco-pectoral (retropectoralis minor) space
BONY CAUSES

• Cervical ribs <1% of general population

• Abnormal 1st rib or clavicle
  • Exotosis, tumor, callus, fracture

• Clavicle fracture – malunion, fragmentation, retrosternal dislocation
  • Normal movement is essential – ACJ & SCJ
SOFT TISSUE CAUSES

• Abnormalities may create compression or tension of the neurovascular structures

• Congenital abnormalities with anatomic variation of scalene muscles
<table>
<thead>
<tr>
<th>Arterial</th>
<th>Venous</th>
<th>True Neurogenic</th>
<th>Disputed Neurogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young adults</td>
<td>Younger men</td>
<td>History of neck trauma</td>
<td>History of neck trauma</td>
</tr>
<tr>
<td>Hx of vigorous arm activity or spontaneous</td>
<td>Preceded by excessive activity in the arm or spontaneous</td>
<td>MVA or repetitive stress at work</td>
<td>MVA or repetitive stress at work</td>
</tr>
<tr>
<td>Pain in hand</td>
<td>Edema of the arm</td>
<td>Pain, paresthesia, numbness &amp;/or weakness in hand/arm/shld (C8-T1)</td>
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</tr>
<tr>
<td>Seldom in shld/neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pallor</td>
<td>Cyanosis</td>
<td>Occipital HA's</td>
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</tr>
<tr>
<td>Claudication</td>
<td>Feeling of heaviness</td>
<td>Cold intolerance – Raynaud phenomenon</td>
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<tr>
<td>Coldness and cold intolerance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parasthesias</td>
<td>Parasthesias in fingers and hand (secondary to edema)</td>
<td>Paresthesias, numbness during the day and at night “compressors”= sx day &gt; noc</td>
<td>Paresthesias, numbness during the day and at night “releasers”= sx noc &gt; day</td>
</tr>
<tr>
<td>Sxs spontaneously stem from aa emboli</td>
<td></td>
<td>Loss of dexterity</td>
<td>Loss of dexterity</td>
</tr>
<tr>
<td>Diagnosis by history</td>
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<td>Diagnosis by history and cluster of 2 provocation tests (+) and almost always (+) elevated arm stress test</td>
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</tr>
<tr>
<td></td>
<td>Diagnosis by history</td>
<td>Objectified weakness &amp;/or sensory = “true”</td>
<td>Subjective weakness &amp;/or sensory = “true”</td>
</tr>
<tr>
<td>Diagnosis confirmed through doppler US and angiography in seated position</td>
<td>Diagnosis confirmed through venous US, venous scintillation scans, venography and plethysmography</td>
<td>Diagnosis confirmed through (+) neurophysiological testing</td>
<td>No confirmation through objective testing neurophysiological testing are normal</td>
</tr>
</tbody>
</table>
SYMPTOMS

- Radicular vs. non radicular
- Paresthesia in upper limb
- Neck pain
- Trapezius pain
- Shoulder and/or arm pain
- Supraclavicular pain
- Chest pain
- Occipital headache
- Paresthesias of all 5 fingers or 4/5 only or 1-3 only
PRESENTATION

• Rounded shoulders
• Forward head
• Increased thoracic kyphosis
• Anterior tilt/downward rotation/depression scapulae

INCREASES TENSION LOADING OF THE BRACHIAL PLEXUS
CLINICAL TESTING

• Roos/elevated arm stress
• Supraclavicular pressure test
• Adson's test
• Costoclavicular maneuver/
  Military Brace
• Wright’s test/ hyperabduction test
• Cyriax release test
• Upper limb neural tension test**
DIAGNOSTIC TESTING

• Venous TOS
  • Venous US
  • Venous scintillation scans
  • Venography
  • Plethysmography

• Arterial TOS
  • Doppler US
  • Angiography

• True NTOS
  • Nerve conduction velocities
  • Electromyography
MANAGEMENT

SURGICAL
ARTERIAL TOS

• **Goal:** decompression of structures compression subclavian artery, repair artery, and restore distal blood flow

• Thrombolytic therapy or thrombolectomy for acute ischemia

• Distal bypass grafting or formal arterial reconstruction for chronic symptoms
VENOUS TOS

• Thrombolytic therapy is 1st line to dissolve acute thrombosis
• Angioplasty to decompress venous stenosis
• If unsuccessful
  • Vein patch angioplasty or venous bypass in order to restore normal circulation
NTOS: SURGICAL DECOMPRESSION

- Goal: relieve mechanical load on neurovascular structures
- Resection of 1\textsuperscript{st} rib, cervical ribs
- Anterior and middle scalenectomies
- Performed for those with true neurological symptoms
  - Weakness
  - Wasting of hand intrinsic muscles
  - NCV less than 60m/sec (norm: 85m/sec)
- Fail conservative therapy
MANAGEMENT

NONSURGICAL/CONSERVATIVE
DISCLAIMER: WE CAN MAKE THESE PATIENTS WORSE IF NOT MANAGED CORRECTLY!!!!!!
CONSERVATIVE

• Poor outcomes associated with obesity, worker’s compensation, and double crush pathology (cubital or carpal tunnel)

• Focus of treatment: SYMPTOM REDUCTION

• NSAIDs – reduce pain and inflammation

• Botox injection – anterior and middle scalenes
PT MANAGEMENT

• Restore normal arthrokinematics of surrounding joints
  • 1st rib mobility
  • SC and AC joints

• Correcting related muscle weaknesses and imbalances
  • Diaphragmatic breathing
  • Scalene muscles
  • Pectoralis major and minor
  • Posture
  • All therapeutic exercises should focus on muscle endurance rather than strength
PT MANAGEMENT

• Improve nerve mobility to decrease tension on brachial plexus
  • Neural mobilizations
  • Emphasize proximally with 1st rib inferior mobilizations
  • All mobilizations should be pain free
  • Start at 20 repetitions and increase up to 100 repetitions as tolerated for 1-2x/day

• Unloading tape

• Sleep adjustments
REHAB EXERCISES

- Multi angle isometrics
- Prone row
- Prone extension
- Rhythmic stabilization
- Weight bearing
- Elevation in scapular plane
- Thoracic extension and rotation
- Neural flossing/mobilizations
- Deep cervical flexion
- Core activation
APPLICATION TO OVERHEAD ATHLETE
“ONE OF THE MOST DIFFICULT UPPER LIMB CONDITIONS TO MANAGE”

WATSON³
CONSIDERATIONS

• TOS: pain, paresthesia, weakness, & discomfort in UE aggravated by elevation of the arms or movement of head/neck

• Repeated overuse in the overhead position

• GH instability

• “Double crush” – proximal compression could cause compression at distal sites along the nerve
ROM PROGRESSION

• Scapular position in lower ranges (<30 deg ABD)
• 45-90 deg ABD
• Flexion control – use of serratus anterior without pec minor recruitment concentrically and eccentrically
• >90 deg ABD
SPECIAL PRECAUTIONS

• Do not OVER retract – may create a relative entrapment of retropectoralis minor space

• Careful with ER since may provoke neurological symptoms
  • Add once patients have sufficient scapular control
  • May be too aggressive for some patients
RETURN TO SPORT\textsuperscript{5}

- High physical performance demands
- Pressure to return to previous level of performance
- Timeframes NTOS
  - 11 months out of sport prior to surgery
  - 4.4 months full return following surgery
- Successful conservative approach
  - shorter duration of symptoms prior to beginning PT (3 months vs. 15 months)
  - Lower quick DASH baseline score
- 81.5% successfully return to full activity
• Different complaints from classic swimmer’s shoulder (MDI/impingment)
• No GH instability
• Pain both anterior and posterior to clavicle
• Radicular symptoms
• Inability to keep fingers together to control hand movement during the pull-through phase
THROWING

• Trouble with grabbing, holding, and throwing ball due to loss of intrinsic muscle strength of hand
• Career-threatening
• Study showed postop pitching performance largely equivalent to before tx
• Gradual recovery is crucial (~1 year postop for MLB pitchers)
REFERENCES


