Complex Nerve and Vascular Conditions of the Upper Extremity

Disclosures

❖ None

Learning Objectives

1. Identify the typical signs and symptoms of nerve and vascular disorders in the upper extremity
2. Determine early management strategies for these conditions
3. Understand when to refer for specialized care
Outline

❖ Thoracic Outlet Syndrome
❖ Exertional Compartment Syndrome
❖ Cubital Tunnel Syndrome
❖ Complex Regional Pain Syndrome
❖ Raynaud's Disease and Phenomenon

Thoracic Outlet Syndrome

 Thoracic Outlet Syndrome

Thoracic Outlet Syndrome compression of neurovascular bundle
❖ Brachial plexus and Subclavian Artery and Vein
❖ Neurogenic vs vascular
❖ Symptoms >90% neurogenic
❖ No reproducible diagnostic study
Thoracic Outlet Syndrome

Etiology - Thoracic Outlet Syndrome

- Anatomic predisposition with addition of neck trauma from acute or chronic injury
- Young, thin females with a long neck and drooping shoulders
- Soft-tissue (70%)
  - Accessory scalene muscle, trauma and scarring
- Bony (30%)
  - Cervical ribs, prominent C7 transverse process

Presentation - Thoracic Outlet Syndrome

- Variable!
  - Symptoms with activity (especially overhead) and with sleep
  - Neurogenic: Weakness, numbness, paresthesia, pain in a non-dermatomal distribution
  - Must differentiate from other nerve compression
    - Cubital Tunnel, Carpal Tunnel, Cervical Radiculopathy

<table>
<thead>
<tr>
<th>Symptom</th>
<th>All patients (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck pain</td>
<td>94</td>
</tr>
<tr>
<td>Paresthesia pain</td>
<td>92</td>
</tr>
<tr>
<td>Cervical pain</td>
<td>79</td>
</tr>
<tr>
<td>Hands pain</td>
<td>69</td>
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<tr>
<td>Difficulty holding</td>
<td>59</td>
</tr>
<tr>
<td>arrest</td>
<td>58</td>
</tr>
<tr>
<td>All 5 fingers</td>
<td>58</td>
</tr>
<tr>
<td>4th and 5th fingers</td>
<td>26</td>
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<tr>
<td>3rd and 4th fingers</td>
<td>24</td>
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<tr>
<td>2nd and 3rd fingers</td>
<td>22</td>
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<tr>
<td>No Paresthesia</td>
<td>2</td>
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</tbody>
</table>
Presentation - Thoracic Outlet Syndrome

- Vascular - Rare
  - Swelling of upper extremity, pain in arm/chest/shoulder, cyanosis
  - Symptoms worse after activity

Exam - Thoracic Outlet Syndrome

- Differentiate from other disorders
- Inspect appearance of arms
  - Gilliat-Sumner hand: atrophy of thenar AND hypothenar muscles
  - Color, temperature, atrophy, nail changes, edema, prominent veins
- Vascular
  - 20 mmHg difference between the extremities (rare)
Exam- Thoracic Outlet Syndrome

Edson

Roos

Exam- Thoracic Outlet Syndrome

Upper Limb Tension Test

Position 1

Position 2

Position 3
Imaging - Thoracic Outlet Syndrome

- X-rays, CT/MRI
- Nerve Conduction Studies
- Anterior scalene blocks - prognosis for surgery

Diagnosis - Thoracic Outlet Syndrome

- Almost all neurogenic TOS
- Novak et al: 42 patients
- Education and activity modification with therapy
  - Relaxation techniques, posture modification, weight control
  - Limit repetitive overhead stress
  - Stretching, core strengthening, aerobic conditioning, ROM, nerve and tendon gliding exercises
  - Ultrasound guided Botox injections
  - NSAID's, TENS

Treatment - Thoracic Outlet Syndrome: Non-Operative

- Outcome following conservative management of thoracic outlet syndrome

CT scan showing possible compression at the thoracic outlet.
Treatment- Thoracic Outlet Syndrome: Operative

- For those who fail non-operative treatment for 6 months, or vascular TOS
- Multiple methods and approaches, depending on pathology
  - Can include cervical or first rib resection, or release of tight fibrous bands
  - High risk of complications

Thoracic Outlet Syndrome

Take Home Points
- The majority of thoracic outlet syndrome presents with pain and neurogenic symptoms in a non-dermatomal distribution
- Exam maneuvers can give false positive results
- All patients should have at least 6 months of physiotherapy prior to considering any surgical intervention

Exertional Compartment Syndrome


CCSU Sports Medicine Symposium 2018
Tuesday March 6, 2018
**Exertional Compartment Syndrome**

- Temporary increase in the pressure within compartments of the arm during and after exercise activity
- Muscle expansion against tight fascial compartments
- Increased pressure leads to decreased perfusion (ischemia)
- Pain and neurologic symptoms from ischemia

**Exertional Compartment Syndrome: Presentation**

- Pain, swelling, and cramping during and immediately after exercise
- Repetitive and vigorous gripping exercises
  - Rowers, cyclists, gymnasts
- Predictable pattern of onset with delayed improvement after exercise cessation

**Exertional Compartment Syndrome: Exam**

- Physical exam at rest? **Normal**
  - Rule out other entities
- Examination during exercise is crucial
  - Firm, tender compartments
  - Paresthesias/dysesthesia in some cases
Exertional Compartment Syndrome: Diagnosis

- Intra-compartmental pressure measurements
  1. Resting pressure: >15 mm Hg
  2. 1 min post-exercise: >30 mm Hg
  3. 5 min post-exercise: >20 mm Hg

Exertional Compartment Syndrome: Diagnosis

- Dynamic MRI

Exertional Compartment Syndrome: Treatment

- Conservative Treatment
  - Activity modification/cessation
  - Technique modification
  - Stretching
  - Ice/NSAID’s with gradual return to sport

Exertional Compartment Syndrome: Diagnosis

Chronic Exertional Compartment Syndrome in Athletes. Liu B, Barrazueta G, Ruchelsman DE.
Exertional Compartment Syndrome: Treatment

- Surgical Fasciotomy
  - Open, mini-open, endoscopic
  - Can release specific nerve compression sites
  - 86-99% Successful resolution of symptoms
  - 3-21% complications
  - Scar widening, paresthesias, hematoma
  - Return to play 4-6 weeks

Take Home Points

- Predictable pattern of symptom onset followed by relief after exercise cessation
- Pain and neurologic symptoms
- Physical exam needs to be performed immediately after exercise
- Compartment pressure measurements key to diagnosis
- Surgical release has good outcomes with a moderate complication rate

Cubital Tunnel Syndrome
Cubital Tunnel Syndrome

- Second most common compressive neuropathy in the upper extremity
- Rare in pediatric and adolescent patients
- Increased incidence in throwing athletes
- Numerous case studies
- Specific interest in addressing this in ulnar collateral ligament reconstruction


Cubital Tunnel Syndrome

- 35 patients from 7-18 yo with EMG confirmed cubital tunnel syndrome
  - 25% throwing athletes
  - 62% dominant arm
  - 56% post-traumatic
- Presentation: Medial Elbow pain, numbness/tingling ring and small finger, weakness of hand
  - 41% with ulnar nerve instability on exam

Surgical and Nonsurgical Treatment of Cubital Tunnel Syndrome in Pediatric and Adolescent Patients


Surgical and Nonsurgical Treatment of Cubital Tunnel Syndrome in Pediatric and Adolescent Patients

Cubital Tunnel Syndrome

- **Take Home Points**
- When evaluating complaints of numbness and tingling in a throwing athlete, have a higher suspicion for cubital tunnel syndrome.
- Many of these patients have a history of prior elbow trauma.
- Non-operative management has a low success rate in adolescents.
- For surgical cases, transposition is most appropriate.

Complex Regional Pain Syndrome

- Initially known as RSD (Reflex sympathetic dystrophy).
- Causalgia, shoulder-hand syndrome, algodystrophy.
- Disproportionate amount of pain that persists after an injury has healed or in a different location from a defined injury.
- Diagnosis of exclusion.
- **Classification:**
  - Type 1: No identifiable nerve lesion.
  - Type 2: Identifiable nerve injury or compression.
Complex Regional Pain Syndrome

- Rare in children and adolescents
- True incidence and prevalence unknown
  - Estimated to affect between 4-39% of distal radius fractures
- Can have a prolonged time course
- Staging (acute, dystrophic, and atrophic) is variable and questionable prognostic ability

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<thead>
<tr>
<th>Heat</th>
<th>Cold</th>
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<tr>
<td>The two states of microvascular perfusion associated with CRPS</td>
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<td>Signs</td>
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<td>Edema</td>
<td>Atrophic</td>
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<td>Increased swelling</td>
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<td>Signs</td>
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<td>hyperalgesia</td>
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<td>Without hyperalgesia</td>
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Risk factors:
- Prior CRPS
- Wrist fractures immobilized in extreme positions after manipulation

Symptoms:
- Pain out of proportion with hyperalgesia and increased anxiety
- Sensations:
  - Allodynia, hyperalgesia
- Joint swelling
- Swelling, skin color changes, sweating, hair growth, fingernail growth

Complex Regional Pain Syndrome

A. Best treatment? PREVENTION!
   - Avoid tight casts with significant wrist flexion
   - Protect sensory nerves during surgery
   - Vitamin C?
   - Early identification of patients to start treatment
     - Up to 94% good outcomes when treatment started within 4 months of injury
     - Identification of the type 2 patients for potential nerve decompression

B. Prevention
   - Vitamin C
     - Zollinger et al (1999 and 2007)- RCT's showing decreased incidence from 10% to 2% with 500mg/day
     - Ekrol et al (2014)- RCT showing no difference in CRPS incidence
     - Meta-Analysis combining data from these trials: No statistically significant benefit of Vitamin C
   - Take-home? Vitamin C may not decrease CRPS incidence, but has minimal potential for side effects
Type II Complex Regional Pain Syndrome: Treatment

- Patients with a diagnosis of CRPS who were found to have positive exam and EMG findings for carpal or cubital tunnel
- Results (Pre-op, 8d post-op, 1 yr post-op)
  - DASH score: 71>53>30
  - VAS 7.5>3.5>1.8
- Take Home? When there is a defined nerve injury, decompression can significantly improve pain and function for the patient

Complex Regional Pain Syndrome: Treatment

- Potential Treatments
  - Gabapentin
  - Pregabalin
  - Psychological Therapy
  - Anti-depressants
  - Nerve decompression for Type II
  - Anti-Epileptics
  - Bisphosphonates
  - Sympathetic nerve blocks
  - Dimethyl sulfoxide
  - Neurostimulation
  - N-acetylcysteine
  - Amputation
  - Glucocorticoids
  - Calcitonin

Complex Regional Pain Syndrome: Treatment

- Physiotherapy
  - Cochrane review (2016) on 18 RCT’s
  - Graded motor imagery
  - Multimodal physiotherapy
  - Mirror therapy
  - No benefit seen for tactile discrimination training, manual lymphatic drainage, or pulsed electromagnetic field therapy
  - Stress loading (Watson and Carlson, 1987)
  - 85% pain relief and 95% improved ROM
  - Desensitization and edema management
**Complex Regional Pain Syndrome: Treatment**

- **Local Anesthetic Sympathetic Blockade**
  - Temporarily prevents maintenance sympathetic tone
  - Cochrane review (2016)
    - “Limited data available do not suggest that LASB is effective for reducing pain in CRPS”
    - Lack of high-quality evidence on this topic

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**Take Home Points**

- Diagnosis of exclusion
- Important to identify any contributing peripheral nerve compression
- Prevention is best treatment option
- Early institution of treatment with therapy is likely to improve long-term results
- Graded motor imagery
- Limited evidence on any of the other medical or invasive therapies

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**Raynaud’s Disease**

Raynaud’s Disease is a condition characterized by episodes of abnormally altered blood flow to the fingers and toes. It is more common in women and often affects people with other vascular conditions. The primary symptoms are cold sensitivity, blanche (pallor), and cyanosis (blue discoloration) of the fingers or toes in response to cold exposure or emotional stress. Treatment options include lifestyle modifications, medications, and sometimes surgical procedures.
Raynaud’s Disease

- Raynaud’s Disease
- Cold hypersensitivity
- Temporary digital color change
- Cause: exaggerated vasoconstrictive response to cold or emotional stress
- Typically symmetric
- Irreversible Tissue injury does NOT occur

Raynaud’s Phenomenon
- Patients have a diagnosis of collagen vascular disease
- Abnormal vascular flow can be appreciated on Allen’s test and angiography
- Progressive and permanent changes to the digits

Raynaud’s Disease

- Etiology
  - Healthy young women in cold climates
    - 11% of women, 8% of men
- Evaluation
  - Full vascular exam
    - Rule out abnormalities such as injury, aneurysm, or thrombus with asymmetric exam findings
    - Signs of connective tissue diseases

Raynaud’s Disease: Treatment

- Conservative
  - Limitation of cold exposure
  - Glove wear
  - Smoking/tobacco cessation
Raynaud’s Disease: Treatment

❖ Medications
  ❖ Calcium channel blockers
    ❖ Meta-analysis (Thompson et al 2005): 33% reduction in symptom severity and 50% reduction in frequency of episodes
  ❖ Vasodilators
  ❖ Botulinum toxin injections
  ❖ Temperature Biofeedback

Raynaud’s Disease

❖ Take Home Points
  ❖ Raynaud’s disease does not cause irreversible tissue damage
  ❖ Raynaud’s phenomenon requires a diagnosis of a collagen vascular disease
  ❖ Management is conservative, with appreciable benefit in some patients with Ca-channel blockers

References

Questions?