Endoscopic Treatment of Chronic Exertional Compartment Syndrome

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Disclosure

• I have no actual or potential conflict of interest in relation to this presentation.

Overview

• History
• Epidemiology
• Anatomy
• Pathophysiology
• Presentation / Diagnosis
• Diagnostic testing
• Treatment
• Summary / Questions

Image: https://www.idahoankleandfoot.com/chronic-exertional-compartment-syndrome
Overview

- Objectives
  - Add CECS to your differential
  - Develop an algorithm for diagnosis
  - Outline treatment approaches
  - Outline rehabilitation from surgical treatment of CECS

History

- 1881 – Volkmann
  - Describes ischemic contracture
- 1906 – Hildebrand
  - Related Volkmann’s ischemic contracture with elevated tissue pressure
- 1910-1912 – Wilson
  - Probably first description of CECS on Scott’s Antarctic Expedition
- 1914 – Murphy
  - Fasciotomy to relieve elevated compartment pressure
- 1945 – Horn
  - “March-gangrene” – first publication
- 1956 – Mavor
  - The anterior tibial syndrome
- 1967 – Seddon, Kelly, Whitesides
  - 4 compartments in lower leg
  - Necessary to address all compartments

Epidemiology

- Incidence
  - No statistics in general population
  - 0.49 cases per 1,000 person-years in a physically active military population
    - Waterman (AJSM 2013)
- Occurs in a variety of activities
  - Detmer (AJSM 1985)
    - Involved in sports (87%)
    - Running (69%)
Anatomy

• Multiple areas of occurrence
  – Lower leg, thigh, foot, forearm…
• Most common in lower leg: 95%
  – Barnes (BJSM 1997)
• Bilateral lower leg involvement in 82%
  – Detmer (AJSM 1985)

Rajasekaran (PM&R 2012)
  – CECS involves:
    • Anterior 40%-60%
    • Lateral 12%-35%
    • Superficial posterior 2%-20%
    • Deep posterior 32%-60%

Pathophysiology

• Etiology
  – Multiple theories - Lecoq (Ann Re Med Phys 2004)
    • Muscle hypertrophy
    • Noncompliant fascia
    • Decreased venous return
    • Muscular microtrauma
    • Myopathy
  – Increased intramuscular pressure causes transient neuromuscular ischemia during exercise
    • Styf (Compartment Syndromes 2004)
Pathophysiology

Etiology
- Predisposing factors - Anuar (Phys Sing 2006)
  - Leg length discrepancy
  - Varus or valgus malalignment
  - Poor muscle control
  - Inappropriate training (frequency/intensity)
  - Diminished strength & endurance

Presentation / Diagnosis

Pain
- Dull, aching, cramping, sense of pressure
- Reproducible
  - Usually at a certain, predictable time or distance
  - Usually cannot run through pain
- Crescendo - decrescendo
  - Pain resolves after activity cessation
    - 10-60 minutes (Anaur)

When severe, pain may occur at rest
- Pedowitz (AJSM 1990)

Neurologic symptoms
- Paresthesia / numbness
- Transient foot drop – “slapfoot”
Presentation / Diagnosis

• Differential - Vajapey (Phys SM 2017)
  – CECS
  – Medial tibial stress syndrome / stress fracture
  – Tendinitis / myositis
  – Radiculopathy / peripheral nerve entrapment
  – Venous thromboembolism
  – Popliteal artery entrapment syndrome
  – Arterial vascular disease / claudication
  – Sickle cell disease
  – Tumor

Diagnostic Testing

• X-rays

• Nuclear medicine bone scan
Diagnostic Testing

• MRI

Diagnostic Testing

• Electromyogram / Nerve Conduction Study
  – For those with persistent neurologic symptoms

Diagnostic Testing

• Near-infrared spectroscopy
Diagnostic Testing

• Post-exercise needle manometry
  – When other causes ruled out

<table>
<thead>
<tr>
<th>Time</th>
<th>Pressure Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before exercise</td>
<td>&gt;15 mm Hg</td>
</tr>
<tr>
<td>1 min after exercise</td>
<td>&gt;30 mm Hg</td>
</tr>
<tr>
<td>5 min after exercise</td>
<td>&gt;20 mm Hg</td>
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Treatment

• Non-operative management
  – Cessation of activities
  – Physical therapy - gait training
    • Transition to forefoot running
      – Significant decrease in post-run compartment pressures
      – Significant increase in running distance
  – Massage
  – Orthotics
  – Botulinum toxin A (Isner-Horobeti – AJSM 2013)
Treatment

• Open fasciotomy
• Percutaneous fasciotomy
• Endoscopic-assisted fasciotomy
• Other techniques
  – Ultrasound-guided
  – Thermal

Fasciotomy is gold standard
• Campano (Arthroscopy 2016) – systematic review
  – 68% overall success
  – Satisfaction rate 84%
  – Return to previous or full activity 75%
  – Symptom recurrence 0% to 44.7%
  – Reoperation 0% to 19%
  – Overall complication rate 13%
• Packer (AJSM 2013)
  – Compared non-operative to operative management
  – Satisfactory outcomes in 41% vs. 81%

Treatment - Open

• Open fasciotomy
  – Anterior & lateral compartments
  • Identify / protect superficial peroneal nerve

Images: Vajapey – Phys SM 2017
Treatment - Open

• Open fasciotomy
  – Posterior release
  • Split fascia of superficial and deep compartments
  • Avoid saphenous NV bundle

Image: Vajapey – Phys SM 2017

Treatment - Open

• Open fasciotomy
  – Failure of open surgical treatment
  • Schepsis (AJSM 2005)
    – 18 patients with failure after open fasciotomy
      » 60% localized fibrosis / constriction
      » 40% recurrence of entire compartment

Image: DeLee & Drez

Treatment – Minimally Invasive

• Minimally invasive / percutaneous
  – Small incision, done essentially blind
  – Most common complication: superficial peroneal nerve injury
    • Finestone (FAI 2014)
      – 3/36 patients with nerve injury
      – One reoperation
    • Drexler (AOTS 2017)
      – 4/54 patients with nerve injury
      – 8 with recurrence of symptoms

Image: Finestone & Drex
Treatment

- Hutchenson (AJSM 2003)
  - Cadaveric study of endoscopic vs. mini-open
  - Endoscopic had lower rate of SPN injury
  - Both had high rates of saphenous vein injury

Treatment - Endoscopic

- Lohrer (Arch Orthop Trauma Surg 2007)
  - 19 deep posterior, 16 anterior, 3 lateral in 17 athletes
  - No complications in anterior & lateral
  - Deep posterior
    - Hemorrhage in 2 patients
    - Required conversion to open
    - Recommend against endoscopic deep compartment release
  - 10/17 returned to previous level of activity

Treatment - Endoscopic

- Lui (Arthrosc Tech 2017)
  - Posterior compartments
  - Incision away from saphenous n./v.
  - No outcomes published
Treatment - Endoscopic

- Wittstein (AJSM 2010)
  - 8/9 returned to previous level of activity
  - 2 hematomas – resolved without intervention
- Lohrer (Sports Med Arthrosc 2016)
  - Systematic review of endoscopic vs. mini-open
  - No statistically significant difference

Treatment - Endoscopic

- Standard 30 degree scope
- 12” curved Metzenbaum scissors
- “Finger” retractors

Treatment - Endoscopic

- Incisions over raphe
  - At junction of prox/mid & mid/distal 1/3
Treatment - Endoscopic

• Superficial peroneal nerve
  – Identified in distal incision

Treatment - Endoscopic

• Small transverse incision in fascia
  – Work distal to level of superior retinaculum
  – Work as proximal as able to visualize
  – Move scope and instruments to proximal incision
  – Connect to distal fasciotomy
  – Work proximal
Treatment - Pearls

- Protect SPN – it’s in the fat
- Avoid perforating veins
- Ensure complete release

Treatment

- Closure
  - I do not use a drain
  - Monocryl & Dermabond
  - Toe-to groin ACE wrap

Rehabilitation

- Phase 1
  - Protect weightbearing with crutches
    - NWB for 3 days
    - WBAT to follow
  - Rest / Ice / Compression / Elevation
  - Stretching (AROM / AAROM)
Rehabilitation

• Phase 2 (2-3 weeks post-op)
  – Wound check in office, begin formal PT
  – Continue ROM of ankle & knee
  – Low-impact
    • Stationary bike, elliptical, Alter-G, hydrotherapy

• Phase 3 (4-6 weeks post-op)
  – Progress strength
  – Progress running
  – Increase duration of activity

• Phase 4 (by 8 weeks post-op)
  – Impact / plyometrics
  – Speed / agility drills
  – Sport-specific activities

• Phase 5 (~12 weeks post-op)
  – Return to all activities without restriction

Summary

• Objectives
  – Add CECS to your differential
  – Develop an algorithm for diagnosis
  – Outline treatment approaches
  – Outline rehabilitation from surgical treatment of CECS
Summary

- CECS exists!
- You can diagnose CECS
- You have the tools & skills to treat surgically if necessary

Sources
