

Exertional Leg Pain

5 Diagnosis to Consider in Unusual Case Management



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Objectives

Mostly...there are zebras.

- Recognize key historical features of exertional lower extremity complaints
- Recognize "compartment syndrome" as both a diagnosis and symptom
- List at least 3 "uncommon" causes of exertional leg pain and claudication
- Describe diagnostic approaches using provocative measures



Case 1

21 year old with "shin splints" for 3 years.
Pain achy/crampy on the anterior shins R>L
Onset with running ~ 1-1.5 miles.
No change with cessation, orthotics
Symptoms resolve with rest ~ 5 min.



Causes of Exertional Leg Pain

- Pain**
- Medial Tibial Stress Syndrome
 - Stress Fractures
- Claudication**
- CECS
 - PAES
 - Nerve entrapments



Pathophysiology

Underlying symptoms of CECS

- **Exercising Muscle**
 - Increasing blood flow
 - Muscle fibers can swell 20 X
 - Weight & volume up 20%
 - Mismatched supply vs demand eventually stops perfusion
 - Ischemia painful & leads to muscle damage



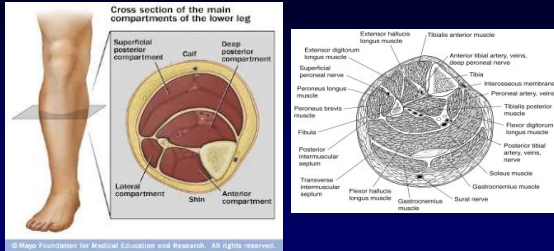
Image for educational purposes only, downloaded from: http://www.danerika.com/wp-content/uploads/2010/10/227_600_get_problem_shinsplints.jpg

Progressive Damage

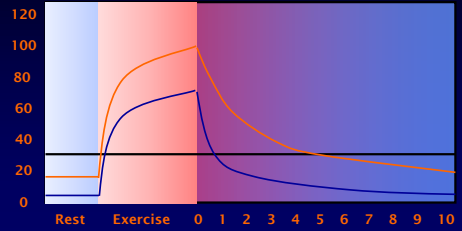
- **↑ pressure in confined space ↓ blood flow & leads to ischemia**
 - 50 mm Hg pressure ↓ flow to 70%.
 - 80 mm Hg pressure ↓ flow to 5%.
- **Prolonged ischemia damages nerves & muscles** (acute)
 - 50 mm Hg pressure for 4-8 hrs leads to muscle necrosis
 - 40 mm Hg left for 6 hours lead to sensorimotor & neuromuscular deficits



Anatomy of the Lower Leg



Leg Compartment Pressures as a Function of Exercise



Diagnostics

Followed based on the most common diagnosis

- Radiography
- EMG
- Bone Scan
- Near-IR Spectroscopy*
 - Sensitivity 78 (68-86)%
 - Specificity 67 (22-96)%
- Direct Pressure Testing*
 - Sensitivity 77 (67-86)%
 - Specificity 83 (36-100)%
- MRI



*van den Brand et al (2005) AJSM 33:699

Diagnosis

- Direct measurement of compartment pressures
 - Slit catheter in compartment
 - Resting P > 15 mmHg
 - Exertional P (1 min after exercise) > 30 mmHg
 - 5 min after exercise > 20 mmHg
 - BP dependent



Compartment	Rest	1 min after exercise	5 min after exercise
R ant	29	70	--
R lat	24	27	--
L ant	9	17	--
L lat	7	16	--

Treatment

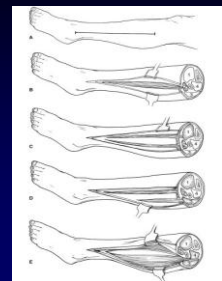
Conservative Measures Usually Fail – Why?

- Non Operative
- Operative



Operative Treatment

- A: Single or two incision technique
- B: IM septum & release of lateral compartment
- C: Fasciotomy anterior to intermuscular septum
- D & E: Superficial posterior compartment release if needed



Adapted from Rorabeck CH: A practical approach to compartment syndromes: III. Management. Instr Course Lect 1983;32:102-113.

Case 1: Resolution

- Compartment release
- 4 week post-op & progressive rehab
- Custom orthotics
- Full RTP without complications



Case 2: Claudication

- 20 yo LAX w/ bilateral exertional shin pain for 9 months
- Pain @ medial tibial borders, throbbing
- Onset 10-30 min into workouts.
- Pain resolved 30-60 min post exercise



Pertinent Physical Exam

- 64", 131# (BMI 22.4)
- Gait: ↑ pronation right foot
- Pain distal medial aspects of tibiae bilaterally; mildly tight anterior compartment
- (+) Tinel's over bilateral common peroneal & sural nerves
- Pain along medial tibial borders w/resisted ankle motions
- Normal pulses – Popliteal harder to palpate on left



Case 2: Diagnostic Testing

(4 month work-up reveals no diagnosis)

- **Radiographs:**
 - Bilateral tib/fib, knees/ankles
- **Bone Scan:**
 - Bilateral ↑ uptake mid tibiae, c/w shin splints
- **MRI**
 - Bilateral tib/fib (-)
- **ECS testing (-)**
- **Coagulopathy work-up (-)**

Case 2: Further Diagnostic Testing

Be persistent; insist on provocative maneuvers

- **ABI/ Plethysmography**
 - Negative
- **CT angiogram**
 - Negative
- **Repeat CT angiogram**
 - After exercise and with active dorsiflexion bilateral ankles
 - Bilateral popliteal artery entrapment, left greater than right



Atypical Claudication

Similar symptoms between CECS & Popliteal Entrapment

- **854 patients with claudication**
 - 557 women; 297 men
- **Symptoms**
 - Cramping swelling parasthesia
 - Persistent symptoms 18 months (6-24)
- **Radiographic work up**
- **ABI, Plethysmography & CS testing** (if indicated)



Turnipseed J Vasc Surg 2009 49:1189-95.

Results

240/854 patients for surgical treatment

- 233 Patients
 - 30 FPAES
 - 203 CRECS
 - » 72% ant/ lateral
 - » 16% deep post
 - » 12% sup post
- 7 Patients
 - Abnormal non-invasive vascular testing
 - » 2 venous
 - » 5 arterial = anatomic PES

Anatomic Entrapment is relatively rare; Functional entrapment may exist in up to 15% of CECS patients – Surgical implications

Turnipseed J Vasc Surg 2009 49:1189-95.

Anatomic PAES

Anomalous relationship of muscle & artery in popliteal fossa

- **Type I:** Aberrant course
- **Type II:** Atypical muscular insertion
 - » Soleus, lat head gastroc, plantaris, popliteus
- **Type III:** Both present
- **Type IV:** Artery deep to popliteus muscle

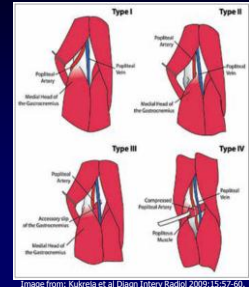


Image from: Kukurja et al Diagn Interv Radiol 2009;15:57-60.

Anatomic vs Functional

Anatomic entrapment patients usually have **focal extrinsic** compressive bands of tendon or fascia that are associated with the development of **intrinsic** arterial disease and subsequent ischemic symptoms

Functional entrapment have **more diffuse** lateral compression of **disease-free** vessels and/or symptoms that result from peripheral nerve compression

Anatomic Entrapment

Characteristics and clues to diagnosis

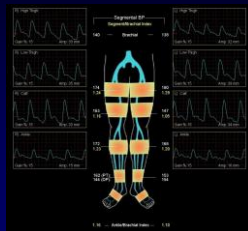
- Male (72%)
- Older (mean age, 43 years)
- Sedentary (14% athletically active)
- Restrictive claudication symptoms (exercise distance < 2 blocks 70%)
- Noninvasive test + of peripheral occlusive disease (30%)



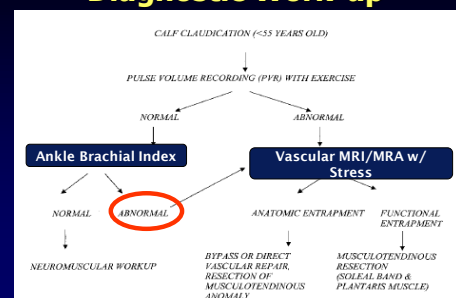
Functional Entrapment

This is an "overuse" injury

- Younger (mean age, 24 years)
- Female (66%)
- Well-conditioned, highly trained athletes or have active lifestyles (90%)
- Normal resting & post-exercise noninvasive tests



Diagnostic Work-up



Turnipseed, WD. Popliteal entrapment syndrome. J Vasc Surg. 2002;35:910-5.

Case 2: Resolution

- Surgical decompression & exploration of left popliteal artery
- Full return to activity 12 weeks post surgery with slow progression of activity
- Left leg remained asymptomatic
- With increased activity levels, pain in right leg returned
- Decompression of right popliteal artery performed
- Returned 12 weeks after second surgery
 - Currently asymptomatic x 5 years; coaching HS Lac



Unusual Causes – Case 3

- 21 year old pitcher
- 4 week onset of exertional calf pain
- 3 months after hit in thigh with line drive
- Radiology negative
- (+) deep posterior compartment test



Unusual Causes – Case 4

Circuitous diagnostic testing

- 48 year old tri-athlete presents with exertional L calf pain
- Previous lateral meniscus
- MRI of calf, knee
- Angiogram, US



Cystic Adventitial Disease

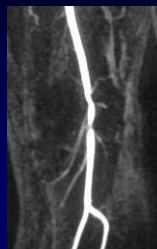
- Claudication
- Men, 4th-5th decade
- Origin
 - Synovium
 - Mucin-secreting cells incorporated into arteries
- Popliteal artery 85%
- Symptoms wax/wane
- Ishikawa's sign
 - Pedal pulse lost with knee flexion.



N Ni Mhuircheartaigh, et al 2005 BJSM

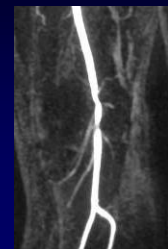
Cystic Adventitial Disease- Diagnosis

- Popliteal US
- MR Angiogram
 - "Scimitar Sign"
- External compression



Cystic Adventitial Disease- Diagnosis

- PTA relatively ineffective for treatment due to external high-pressure cystic structure
- US guided aspiration effective although recurrence reported
- Close US follow up indicated



Fox et al. J Vasc Surg 1985; 2:464

Sieunarine et al J Cardiovasc Surg 1991; 32:702

Endofibrosis

- Cyclists. 50's
- External Iliac Artery fibrosis
- Repetitive trauma
- Claudication
 - Neurologic
 - Swelling
- Iliac fossa bruit with exertion



http://www.wired.com/news/images/full/hourofcall1_f.jpg

Endofibrosis - Diagnosis

- ABI
 - Sensitive, non-localizing
 - Compare rest/ exercise
- Duplex US
 - Combine with exercise ABI, Plethysmography and segmental pressures
- Contrast angiography
 - Gold standard
 - 100% sensitive with thigh in flexion



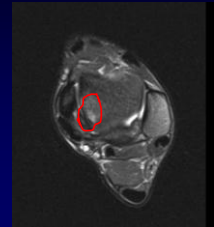
Endofibrosis Treatment

- PTA with/without stent
 - Helpful
 - Risks
- Surgery
 - Endarterectomy with vein patch or bypass
 - Success vs downside
- Seat mechanics



Unusual Case 5

- 29 year old marathon runner with running induced pain
- Onset at 1 mile
- Distal 1/3 medial tibia to medial arch
- Relieved after running cessation



Nerve Entrapments

- Common peroneal
- Sural
- Tarsal tunnel
- Foot & ankle
- Overuse & Microtrauma
- Work-up
 - Detailed NCV
 - US
 - High resolution MRI



Image adapted from Default et al. RadioGraphics 2003; 23:613-623 • Published online 10.1148/rp.233025053

Coleman Block Test

Cavus foot type may be overlooked mechanical contributor

- Forefoot "off-weighted" by placing a block under the heel
 - Rearfoot no longer compensates for forefoot cavus
- If rearfoot normalizes & becomes perpendicular to the ground, the deformity lies in the forefoot
- In rigid cavovarus foot, the deformity does not reduce



Coleman S, Chestnut W A simple test for hindfoot flexibility in the cavovarus foot. Clin Orthop 1977;122:60-62.

Biomechanics

Fibular motion deficit may contribute to exertional symptoms

- **Fibular motion with gait**
 - Motion is anterolateral to postero-medial
- **Talus inversion**
 - ATF pulled tight
 - Pulls distal fibula anterior
 - Proximal fibula moves posterior – becomes locked
- **Irritation common peroneal nerve**
- **Neuromuscular alteration**

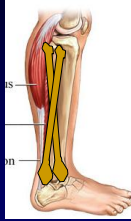


Image from <http://www.physiotherapy.com/legfoot.php>

Persistent Symptoms

What if symptoms recur after compartment release?

Summary

- Exertional symptoms can be challenging to diagnose: Start with a systematic approach based on most common diagnosis
- When suspecting unusual causes, vascular are the next most common causes
- US can be helpful first line, but provocative maneuvers must be utilized
- Don't abandon your patient

Thank You

