

POPLITEAL ARTERY ENTRAPMENT SYNDROME

Background

1. Definition: Rare cause of exertional leg pain
 - Due to an abnormal relationship between popliteal artery and surrounding myofascial structures in popliteal fossa.

Pathophysiology

1. Pathology of Disease
 - Structural-multiple variations. May be most important to describe the arterial path.
 - Classification¹
 - Type I
 - Popliteal artery loops medially then deep to normal positioned medial gastrocnemius.
 - Type II
 - Artery lies in normal position but is compressed by laterally displaced edge of gastrocnemius.
 - Type III
 - Medial gastrocnemius has additional musculotendinous slip on lateral side, compressing artery as it runs into muscle bulk.
 - Type IV
 - Artery loops medially and then deep to medial gastrocnemius
 - Is compressed by fibrous bands tethered to artery.
 - Type V
 - Artery and vein loop medially then deep to normal positioned medial gastrocnemius.
 - Type VI
 - Normal anatomy with compression of vasculature during exercise by muscle and tendon structures
 - Functional²
 - Anatomically normal
 - Muscle hypertrophy constricts artery with contraction.
 - Theoretical compression between medial gastrocnemius and lateral condyle of femur.
2. Incidence, Prevalence
 - Absolute rates of occurrence cannot fully be described due to previously under recognized pathology.
 - Reports of 0.165%-3.5% of general population^{3,4}
 - Bilateral entrapment common: 27-67% of presenting patients.^{5,6}
 3. Risk Factors
 - Young Athletes
 - Male > Female-may be over-representation due to historic predominance of male athletes and military based studies⁷

4. Morbidity / Mortality

- Progressive condition
- Symptoms correlate with degree of entrapment.
 - Repetitive trauma to arterial intima leads to intrinsic atherosclerosis and/or thrombus.
 - Intraluminal stenosis can lead to poststenotic dilation and aneurysm formation.
 - Distal embolic disease can lead to ischemia.

Diagnostics

1. History

- Population:
 - Young, active, fit individuals often involved in military or athletics.
 - Higher muscle development may unmask occult pathology.
- Presentation:
 - 90% with claudication⁸ - lower extremity pain at a reproducible duration and intensity of exercise, which resolves with rest.
 - 10% with acute or chronic ischemia signs and/or symptoms⁹
 - Often free of atherosclerotic risk factors due to younger age at onset.

2. Physical Examination

- Normal at rest
- Pulses:
 - Decreased dorsalis pedis and posterior tibial pulse in plantar flexion compared to dorsiflexion considered highly sensitive.
- If aneurismal formation: pulsatile mass in popliteal fossa¹
- Venous involvement may occur and lead to exertional leg swelling.

3. Diagnostic Testing

- Ankle/Brachial Index: ratio of blood pressure in ankle to arm¹⁰.
 - Calculated by dividing systolic blood pressure at ankle by systolic blood pressure in arm
 - Rest: Normal ABI > 1
 - Stressed (either plantar flexion or treadmill stress test):
 - ABI < 1 suggestive of exercise induced arterial insufficiency
 - Indicates need for further diagnostic testing.
- Diagnostic imaging
 - All modalities:
 - Test or image bilateral popliteal artery due to common bilateral disease.
 - Bilateral exam of lower extremity in neutral, active plantar flexion, and passive dorsiflexion.
 - Digital Subtraction Angiography (DSA):¹¹
 - Historically considered as reference standard.
 - Advantages:
 - Clearly shows anatomic features of arterial lesions
 - Typical popliteal artery findings:
 - Medial deviation of proximal portion

- Segmental occlusion in mid-portion
 - Post-stenotic dilation in distal portion
 - Suggestive finding: artery patent in neutral but absent in active plantarflexion or passive dorsiflexion.
- Limitations:
 - Invasive
 - Unable to show soft-tissue structures leading to entrapment
 - Unable to differentiate entrapment vs. arteriosclerosis or degenerative causes.
- Doppler Sonography:^{11,12}
- Advantages:
 - Quick, inexpensive, non-invasive
- Limitations:
 - False-positive possible
 - Common in athletes with developed musculature¹³
 - Poor identification of soft-tissue structures
- CT Angiogram (CTA)^{6,11}
 - Advantages:
 - Rapid high spatial-resolution images
 - Delineates muscle, vessel, fat tissue, and bone
 - Positional relationship of muscle to artery
 - Provides axial images.
 - Allows grading of stenosis/occlusion
 - 3-D reconstruction aid surgical planning.
 - Better than DSA at evaluating etiology of occlusion from atherosclerosis and/or thrombus.
 - Limitations:
 - Radiation exposure
 - Contrast dye
 - Less specificity in soft tissues than MRI
- Magnetic Resonance Imaging (MRI) & Magnetic Resonance Angiography (MRA)¹¹
 - Advantages:
 - Noninvasive, no radiation.
 - Best soft-tissue resolution, superior to CTA.
 - Provides surgically relevant anatomy
 - Able to investigate adventitia of artery.
 - Limitations:
 - Expensive
 - Motion artifact common, especially with provocative, active plantarflexion.

Differential Diagnosis

1. Key Differential Diagnoses
 - Medial Tibial Stress Syndrome

- Stress Fracture of tibia or fibula
- Muscle Strain
- Tendinopathy
- Peripheral nerve entrapment, superficial peroneal or saphenous nerve
- Chronic exertional compartment syndrome
- Endofibrosis (external iliac artery)

Therapeutics

1. Acute Treatment
 - Avoid exacerbating activity
2. Definitive Treatment
 - Refer to Vascular surgery for surgical treatment.
 - Structural Entrapment:¹⁴
 - Bypass graft or Vascular repair
 - Repair of musculotendinous anomaly
 - Functional Entrapment:¹⁴
 - Musculotendinous resection
 - Prognosis:¹⁴
 - Good to excellent surgical response.
 - Progressive disease without surgical correction.

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