

Popliteal Artery Pathology: An Uncommon Yet Critical Clinical Challenge

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PART A

Popliteal Artery Pathology:

An Uncommon Yet Critical Clinical Challenge

A 46-year-old woman presented at the hospital with a 20-day history of intermittent claudication of the right calf, which had been gradually worsening. The patient had a history of mild tobacco use and oral contraceptive use. There was no history of rheumatologic or other systemic disease.

Clinical examination revealed a right lower limb slightly colder than the left. Initial laboratory tests were unremarkable. An arterial duplex ultrasound of the right lower extremity demonstrated mural thick-

ening of the popliteal artery (Fig.1) and occlusion of the proximal portion of the tibial-fibular trunk.

The distal arteries were patent with no evidence of thrombosis. Further evaluation with echocardiogram and transesophageal echocardiography showed no abnormalities.

Computed tomography arteriography (CTA) and digital subtraction angiography (DSA) (Fig. 2) were conducted, confirming the previous findings and revealed the presence of collateral arterial network at the right lower limb. Magnetic resonance imaging (MRI) of the knee was performed as depicted below (Fig. 3,4).



KEY WORDS

Knee MRI, Popliteal Artery Entrapment Syndrome (PAES),
Artery Occlusive Diseases, Popliteal fossa



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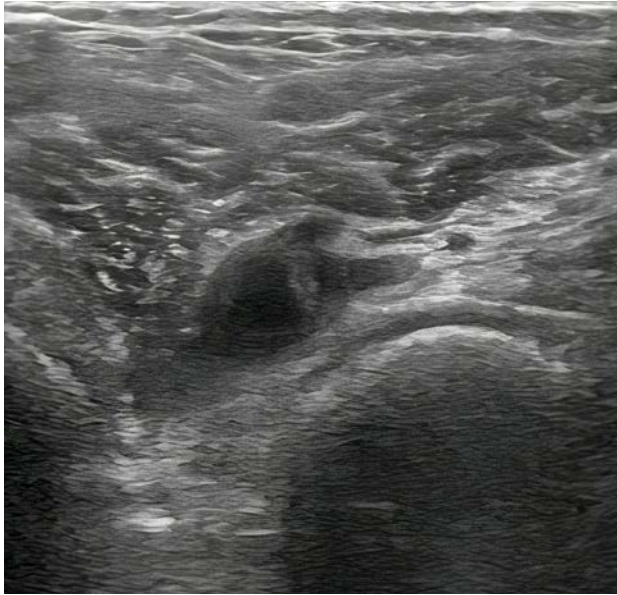


Figure 1. US of the popliteal artery, axial view.



Figure 2. DSA of the popliteal fossa.



Figure 3. Axial view, proton-density fat-suppression weighted imaging of the right knee.



Figure 4. Sagittal view, T1 weighted imaging of the right knee.

PART B

Diagnosis

Popliteal Artery Entrapment Syndrome (PAES)

Based on the MRI findings and the negative results from other tests, a diagnosis of Popliteal Artery Entrapment Syndrome (PAES) was made.

The MRI revealed abnormal thickening of the popliteal artery wall at a length of 2.3 cm. In the same region, a supernumerary ectopic slip of the medial gastrocnemius muscle head was identified compressing the popliteal artery both medially and laterally. These imaging findings are consistent with PAES.

Popliteal artery entrapment syndrome (PAES) is a potential cause of intermittent lower extremity pain in individuals without atherosclerotic risk factors, particularly affecting young active males. Although it might be asymptomatic for some time, it might cause lower limb claudication, sensation of coldness and numbness during physical activity.

Unlike peripheral arterial disease, in which case pain typically subsides with rest, the discomfort may persist even after activity has ceased. Current understanding of PAES pathogenesis suggests that repeated compression of the popliteal artery results in physical damage to the vessel wall, leading to luminal narrowing, aneurysm formation, thrombosis, or distal embolization.

PAES is classified into two forms: anatomical PAES, as in our case, and functional PAES [1, 2]. Anatomic PAES is a rare congenital anomaly. Normally, the popliteal artery and vein run in between the medial and lateral head of gastrocnemius muscle. However, there may be an anatomy variation of the popliteal artery and the gastrocnemius muscle, or there may be an anomalous fibrous band or the popliteus muscle, which can cause compression and damage of the vessel.

Those variations can result in six forms of arterial compression. Type I through V are anatomical in nature. Type I involves the artery taking a medial route around the gastrocnemius muscle, while in Type II, the medial head of the gastrocnemius attaches laterally.

Type III is characterized by an accessory slip of the gastrocnemius muscle and Type IV occurs when the artery passes beneath the popliteus muscle or a fibrous band associated with it.

Type V involves a combination of any of the previous anatomical variations (Types I to IV) along with concur-

rent compression of the popliteal vein. Our patient is characterized as category III (there is a supernumerary ectopic bundle of the medial head of the gastrocnemius). Functional PAES (Type VI form), could also lead to arterial occlusion, although there is no visible anatomical abnormality in the popliteal fossa and it is due to anomalous hypertrophy of the gastrocnemius muscle. Most studies indicate a higher prevalence of PAES in male athletes, with a mean age between 30 and 35 years, and it is often bilateral [3, 4].

Long term arterial compression causes chronic vascular wall microtrauma which may become irreversible over time, resulting in localized premature arteriosclerosis, thrombus formation, with distal ischemia, as well as poststenotic ectasia or aneurysm formation.

Early diagnosis is crucial, as PAES is a progressing disorder, and timely treatment can help prevent significant complications [5].

If PAES must be ruled out, a positional stress test should be conducted. This involves performing altering maneuvers of dorsiflexion or plantar flexion of the forefoot while monitoring the pedal pulse. In case of PAES, pedal pulse often disappears [4]. Additionally, signs of reduced perfusion may be present, including pallor, coldness of the peripheral lower limb, and cyanosis in acute cases, though sometimes there may be no observable findings.

Imaging diagnostic methods include angiography, computed tomography angiography (CTA), Doppler ultrasound and magnetic resonance imaging (MRI). While digital subtraction angiography (DSA) is highly accurate, MRI is generally preferred for evaluating the popliteal fossa due to its non-invasive nature, lack of radiation exposure, and superior soft-tissue differentiation over CT [5, 6].

Literature reports the use of repeated dorsiflexion and plantar flexion of the foot, followed by maintaining plantar flexion throughout the MRI to provoke symptoms in case of no anatomic variation detection.

However, maintaining this position is often challenging for patients, leading to motion and thus artifacts which lowers the diagnostic value of the examination [7].

MRI, DSA and CTA are also useful in identifying bilateral disease, as approximately two-thirds of patients with symptoms have contralateral involvement. However, there is still no definitive consensus on which diagnostic method is the most effective [8].

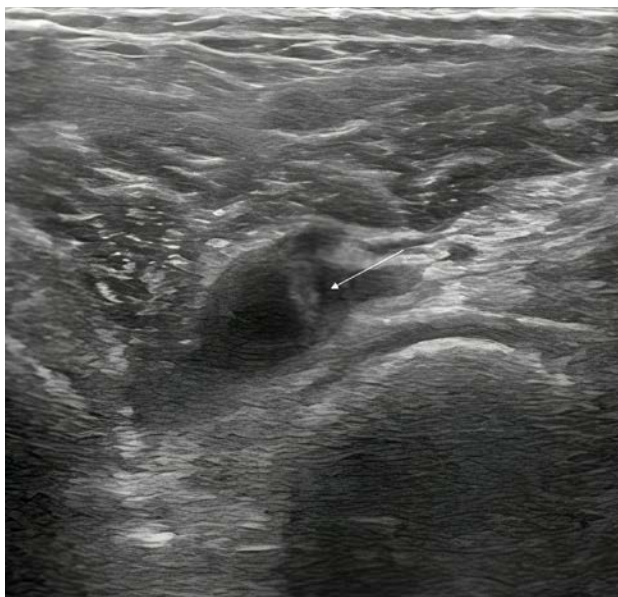


Figure 1. US, axial view. There are focal thickening and an anomaly at the popliteal artery wall (arrow).

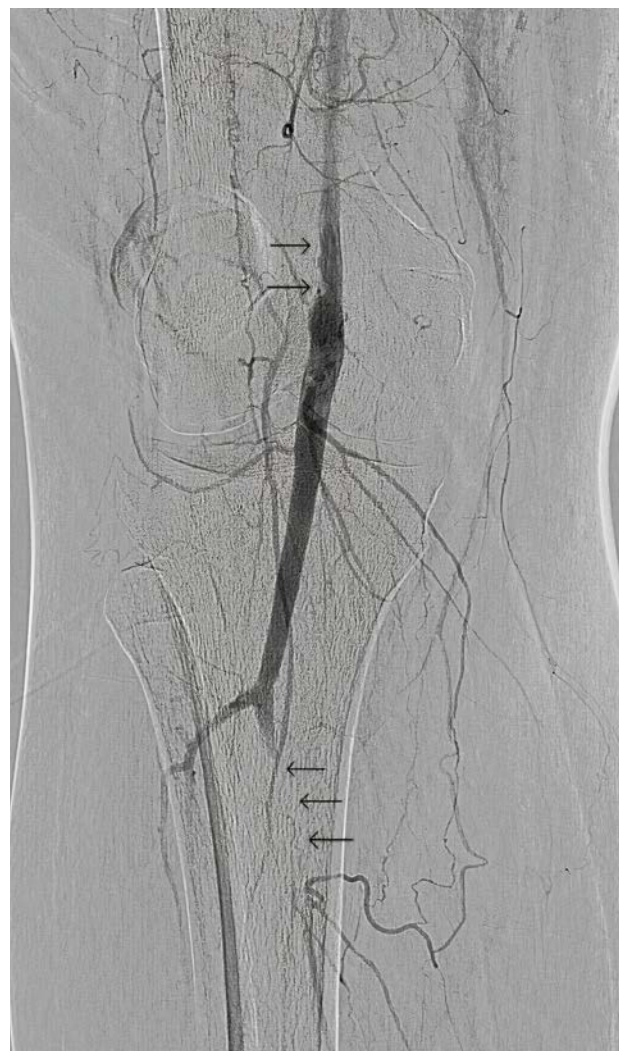


Figure 2. DSA of the popliteal fossa. There is an anomaly and fuzziness of the lateral wall of the popliteal artery (arrow). There is also occlusion of the proximal portion of the tibial-fibular trunk (arrowheads).



Figure 3. Axial view, proton-density fat-suppression weighted imaging. There is a supernumerary ectopic bundle of the medial head of gastrocnemius (arrow) in contact with the lateral wall of the popliteal artery (arrowhead).



Figure 4. Sagittal view, T1 weighted imaging. There is a supernumerary ectopic bundle of the medial head of gastrocnemius (arrow).

PAES should be differentially diagnosed from other entities with similar symptoms. MRI is a valuable imaging tool for distinguishing PAES from other conditions, ruling out other causes of popliteal fossa pain, such as popliteal cyst rupture, synovial cysts, and injuries to bones, muscles, or ligaments.

Moreover, MRI can assess vessel wall, allowing the evaluation of other vascular conditions, including vasculitis, cystic adventitial disease of the popliteal artery, iliac artery endofibrosis, iliac or femoral giant cell arteritis, collagen vascular disease, popliteal artery aneurysm, as well as chronic compartment syndrome and thromboembolism [7].

Surgery for PAES is typically reserved for cases with confirmed symptoms and a structural cause. The procedure involves decompressing the popliteal artery being entrapped by the muscle.

During surgery, revascularization is often achieved through grafts, which generally have a high success rate, with five-year patency rates above 90%. Literature indicates that many patients experience significant symptom relief and can resume normal physical activities within three months following the surgery. If the condition is diagnosed early and the popliteal artery is not severely damaged, a simpler surgical approach such as fascioto-

my, myotomy, or fibrous band sectioning might be sufficient to alleviate the problem [5, 6].

Our patient underwent surgical resection of the supernumerary ectopic bundle of the medial head of the right gastrocnemius muscle, along with bypass of the occluded popliteal artery using a venous graft obtained from the great saphenous vein. The procedure was successful, and the patient remains asymptomatic postoperatively. PAES should always be ruled out especially in patients who lack atherosclerotic risk factors, particularly young adults, presenting with lower extremity pain that persist after rest or with findings of acute limb ischemia.

However, a medical history indicating presence of peripheral vascular disease should not rule out PAES. MRI play a critical role in the evaluation of the disease and are often considered superior to other diagnostic modalities by many experts. Prompt diagnosis is critical as if it is left untreated, it can result in permanent vessel damage [2, 5]. **R**

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