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## Popliteal Artery Entrapment Syndrome with Peripheral Thromboembolism: Report of a Case

The popliteal artery entrapment syndrome (PAES) is an uncommon developmental abnormality, which comprises various anatomic variants causing compression of the popliteal artery. Strenuous athletic activity can cause repetitive compression or microtrauma to the popliteal artery and may result in foot or calf claudication. Popliteal artery aneurysm, thrombosis, or thromboembolism may rarely occur which may mask the underlying pathology.

The first diagnostic technique of choice in patients with possible PAES should be duplex color Doppler ultrasonography with high-frequency transducers. Use of stress views—active plantar flexion and passive dorsiflexion of the ankle—increases the diagnostic accuracy. Classically, arteriography with the foot in the neutral position demonstrates abrupt medial deviation of the popliteal artery. In this article, we describe imaging findings in a young wrestler with complicated PAES.

As far as we know, this is the first reported case from Iran with PAES.

**Keywords:** popliteal artery, aneurysm, ultrasonography, Doppler, angiography, digital subtraction

### Introduction

Popliteal artery entrapment syndrome (PAES) is an uncommon developmental abnormality which results from an anomalous anatomic relationship between the popliteal artery and the gastrocnemius muscle or, infrequently, from an anomalous fibrous band of the popliteus muscle.<sup>1</sup> It is an important cause of claudication in otherwise healthy young patients.<sup>2</sup>

Strenuous athletic activity can cause repetitive compression or microtrauma to the popliteal artery and may result in foot or calf claudication. Symptoms usually develop over time, but acute onset after strenuous exercise has also been described. Ultimately, popliteal artery aneurysm, pseudoaneurysm, atherosclerosis, thrombosis, or thromboembolism may occur.<sup>3</sup> Peripheral thromboembolism is a less common complication which occurs particularly after aneurysm formation.<sup>2</sup> Development of popliteal artery aneurysm distal to the stenosis and arterial occlusion due to thromboemboli, may mask the underlying pathology.<sup>4</sup>

We described the color Doppler and arteriographic findings in a 19-year-old athletic boy with rare complications of PAES. As far as we know, this is the first reported case from Iran with PAES.

### Case Presentation

A 19-year-old boy was transferred to our center for evaluation of right calf pain and intermittent coldness of his right foot. A detailed history revealed progressive right-sided claudication-type pain in the calf and plantar areas. The patient was a professional wrestler with intensive regular training. He had stopped training from one month before due to claudication. There was no family history of

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peripheral vascular or embolic diseases; the patient had never smoked. Except for the absence of the right posterior tibialis, peroneal and dorsalis pedis arterial pulses, physical examination was completely normal.

Doppler ultrasonography (Siemens Antares, Germany) showed a small aneurysm of popliteal artery with some mural thrombosis (Fig. 1). Foot dorsiflexion showed severe reduction in popliteal artery flow (Fig. 2). For medial deviation of the artery, finding the popliteal artery in its normal position in the middle of the popliteal fossa was difficult. Color Doppler sonography of the left leg was completely normal.

Digital subtraction angiography (G.E. Advantex, USA) showed medial deviation of popliteal artery with post-stenotic dilatation and mural thrombosis (Fig. 3), cut-off noted in the distal third of all leg arteries with multiple collateral vessels (Fig. 4).

## Discussion

PAES comprises various anatomic variants causing compression of the popliteal artery. Although, PAES was first described in 1879, its clinical significance and treatment was not recognized before 1965.<sup>2</sup> It typically affects young male athletes who have no identified cardiovascular risk factors.<sup>5</sup> Our patient was a 19-year-old professional wrestler without any identified cardiovascular risk factors.

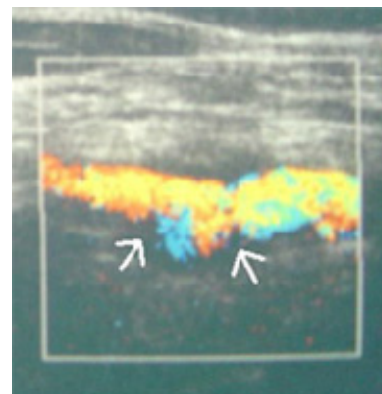
Symptoms usually include transient tingling or coldness in the foot which progress to intermittent claudication and, rarely, ischemia due to thrombosis. On physical examination, these patients may have normal pulses which disappeared or decreased on plantar flexion or dorsiflexion of the foot.<sup>6</sup> Our patient had right calf pain and intermittent coldness of his right foot and apart from the absence of right lower extremity pulses, physical examination was completely normal.

There are essentially four anatomic variants of PAES: Type I is when the popliteal artery is markedly deviated medially around the proximal insertion of the gastrocnemius muscle and passes inside and below the normal insertion.<sup>7</sup>

A functional entrapment without any anatomic abnormalities, mostly encountered in highly trained athletes, has also been described.<sup>2,3</sup>

Classically, arteriography with the foot in the neu-

**Fig. 1.** Color Doppler ultrasonography of the right popliteal artery of the patient, showing small aneurysm with mural thrombosis (white arrows). The popliteal artery is medially deviated from its normal position in the middle of the popliteal fossa.



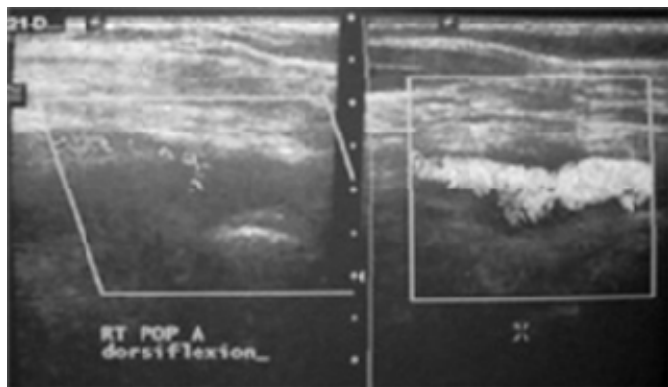
tral position demonstrates abrupt medial deviation of the popliteal artery—a finding consistent with type I anatomy. Other findings may include stenosis, mural irregularity, slow flow, aneurysm, and occlusion. Our patient also showed medial deviation of the popliteal artery with aneurysm formation, mural thrombosis and distal occlusion of calf arteries with multiple collateral vessels, probably due to recurrent distal emboli (Figs. 1 and 3). Arteriography in patients with other anatomic types of PAES may demonstrate mild medial or lateral deviation of the popliteal artery or may be normal. Lateral deviation is uncommon.<sup>3</sup>

Anyhow, the anatomic types of the PAES do affect neither the treatment nor the prognosis.

Bilateral popliteal artery involvement has been reported in 22%–67% of patients.<sup>5</sup> Most patients with bilateral PAES present with unilateral symptoms. An asymptomatic but entrapped popliteal artery must be treated to prevent future disability due to thrombosis, aneurysm, emboli and, in patients with type V entrapment, aneurysmal changes in the entrapped vein. Early treatment results in better long-term outcome.<sup>3</sup> Our patient had unilateral involvement.

Use of stress views—active plantar flexion and passive dorsiflexion of the ankle—increases the diagnostic accuracy. Active plantar flexion may cause compression of the entrapped popliteal artery by the belly of the contracted gastrocnemius muscle. With passive dorsiflexion, the entrapped popliteal artery may be stretched and compressed between gastrocnemius muscle fibers. Our patient showed severe reduction in popliteal flow with passive dorsiflexion of the right foot (Fig. 2). In active plantar flexion, no changes were noted in flow of the popliteal artery.

PAES can be diagnosed with non-invasive imaging modalities (*e.g.*, ultrasound, computed tomography



**Fig. 2.** Severe reduction of flow in the popliteal artery after foot dorsiflexion (left image). Right image shows flow in popliteal artery and aneurysm in neutral position.



**Fig. 3.** Digital subtraction angiography shows medial deviation of the popliteal artery (white arrowhead) with post-stenotic dilatation (white arrow) and mural thrombosis (black arrow).



**Fig. 4.** Multiple collateral vessels are noted in distal third of leg. All normal arteries are occluded probably due to multiple recurrent emboli from the popliteal aneurysm.

and magnetic resonance imaging). These are particularly valuable when the popliteal artery is occluded and therefore cannot be evaluated arteriographically. Cross-sectional imaging methods also demonstrate the relationship between the artery and the entrapping muscle slips and can reveal thrombosis, thrombosed aneurysms, and other arterial wall abnormalities. The imaging protocol however, must be tailored to include detailed sections through the popliteal fossa, and stress maneuvers may be required to demonstrate arterial compression.<sup>3</sup>

It is important to remember that loss of pulses at the ankle on Doppler ultrasonography during active dorsal and plantar flexion is not a specific finding and may be found in up to 53% of normal subjects.<sup>2,3</sup>

Repeated insults to the popliteal artery can cause ar-

terial damage and lead to aneurysm formation, thromboembolism, and arterial thrombosis. This aggressive natural history warrants early diagnosis and treatment.

The first diagnostic technique of choice in patients with possible PAES should be duplex color Doppler sonography with high-frequency transducers. It shows the presence or absence of flow at this level—both at rest and during stress exercise.<sup>6</sup> Doppler color sonography, however, provides little information about anatomic anomalies; other diagnostic techniques like magnetic resonance imaging or magnetic resonance angiography are necessary for this purpose.

Stress angiography (*i.e.*, angiography performed with the foot in either dorsiflexion or plantar flexion) is usually performed to confirm the diagnosis prior to surgical treatment. Abrupt medial deviation of the popliteal artery is a classic angiographic finding in type 1 PAES.<sup>3</sup> However, imaging findings on arteriograms are nonspecific in most cases.<sup>7</sup>

The differential diagnosis of arterial insufficiency in young patients includes cardiogenic or paradoxical thromboembolism, cystic adventitial degeneration and premature arteriosclerosis. In addition, thromboangiitis obliterans (Buerger's disease)—occurring almost exclusively in heavy smokers—and Takayasu's arteritis which predominantly affects young women, should be considered as other causes of peripheral vascular disease in young patients. Vascular occlusions may occur in cryoglobulinemia, excessive polycythemia or thrombocytosis due to myeloproliferative disorders, hypercoagulability states caused by antiphospholipid antibodies and lupus anticoagulants, or in hereditary disorders of the coagulation system. Furthermore, claudication type pains can occur in young athletes with chronic exertional compartment syndrome.<sup>2</sup>

We concluded that in a young athlete who has no recognized cardiovascular risk factors and presents with manifestations of lower limb ischemia, PAES must be considered in differential diagnosis, especially if medial deviation of popliteal artery can be noted in color Doppler or angiography. Stress views should be taken in all these patients.

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