Popliteal entrapment syndrome. A systematic review of the literature and case presentation

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Summary

Popliteal artery entrapment syndrome (PAES) is rare in young adults. Claudication of the young patient, which is often overlooked, is a very rare symptom for orthopedic surgeons. In elder patients, the physician might expect atherosclerotic claudication, however in young patients, popliteal artery entrapment syndrome (PAES) should be considered as a possibility in the cases of claudication. Here, an unusual presentation of an uncommon disease that is not widely known by orthopedic surgeons is reported.

KEY WORDS: tendons, circulation, lower limb surgery, muscles, contact sports, popliteal artery.

Introduction

Popliteal entrapment’s anatomical basis was first described by Anderson Stuart in 18791. In 1965, the term “PAES” was coined by Love and Whelan2. Popliteal artery entrapment means popliteal artery compression caused by an abnormal anatomical relationship between the vessel and nearby musculotendinous structures or surrounding muscle hypertrophy. This can cause functional impairment2 or arterial compression which might lead to chronic vascular microtraumas of arterial wall with possible intramural hematoma or thrombus, distal embolization, aneurysm, dissections and thrombosis with acute distal ischemia in later term3. PAES can be explained as the entrapment syndrome of popliteal artery, which is characterized by artery compression secondary to an abnormal relationship of popliteal artery to adjacent muscle and tendons. This is thought to be caused by abnormal embryologic development. Embryological development of popliteal fossa suggests there is a “competition for more space” between primitive neurovascular bundles and migrating muscle groups5-8. Most common anomalies include incomplete or delayed migration of the medial head of gastrocnemius muscle (MHGM). The abnormal lateral position of MHGM might cause popliteal artery displacement2,4,9-11. Contraction of a big and powerful muscle in such a limited space, which is bordered by strong fascias and solid bone, results in forced compression of adjacent neurovascular bundle. Compression and entrapment process may result in repetitive trauma and early atherosclerosis, leading to a decrease in flow of popliteal artery or even occlusion8,12-15. The differential diagnosis for patients with exercise induced lower leg pain includes chronic exertional compartment syndrome16. Unresolved muscle strain (This classically occurs at the musculotendinous junction of the medial head of gastrocnemius. It is common in middle-aged athletes in racquet sports and is often called ‘tennis leg’. On examination, local tenderness over the medial head of gastrocnemius –or which ever muscle is involved– is characteristic)17. Medial tibia stress syndrome, fibular and tibial stress fractures, fascial defects, nerve entrapment syndrome, vascular claudication (atherosclerotic or popliteal artery entrapment syndrome) and lumbar disc herniation17 (Tab. 1).

With this case presentation, we wanted to emphasize a possibility of popliteal entrapment syndrome in a young man during differential diagnosis of chronic lower extremity pain in young individuals or young athletes. The aim of this study is to remind the orthopedic surgeons about the rare and unusual properties popliteal entrapment syndrome.
Case report

A 22-year-old (R.K) professional wrestler came to our clinic with progressive pain, cramps and paresthesia in his right calf after walking 200 m. The pain had been ongoing for 6 months. The patient was diagnosed with peripheral arterial occlusion, not specified as a popliteal entrapment syndrome, and was followed up with medical treatment for 6 months (oral silostazol, Tab. 2 times in a day), mainly because the first colleague did not suspect popliteal artery entrapment syndrome.

Physical examination revealed pain, palor, tingling and marked tenderness with prominent feeling of fullness in his right calf. All the lower extremity muscles, especially crural muscles were hypertrophic when compared to normal. The peripheral pulses of dorsalis pedis and posterior tibial artery were not palpable even during rest and after the exercises and palor of the cruris was evident after exercises. The perimeter of the right calf is 1.5 cm less than his left side.

Table 1.
The Table shows differential diagnosis for patients with exercise induced lower leg pain.

**MUSCLE-FASCIA ORIGIN**
- Chronic exertional compartment syndrome
- Fascial defects
- Unresolved Muscle Strain

**BONE-PERIOSTEUM ORIGIN**
- Medial tibia stress syndrome
- Fibular and tibial stress fractures

**NERVE ORIGIN**
- Lumbar disc herniation
  (Referred pain arises from the low back)
- Nerve entrapment syndrome
  (e.g. of the superficial peroneal nerve as it winds around the head of the fibula)

**VASCULAR ORIGIN**
- Vascular claudication
  (Atherosclerotic or popliteal artery entrapment syndrome)

Table 2.
The Table shows the list of selected articles about popliteal entrapment syndrome in the recent literature.

<table>
<thead>
<tr>
<th>Patient groups</th>
<th>Articles - Authors</th>
<th>Year</th>
<th>Journal</th>
<th>Article Message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Popliteal artery entrapment syndrome presenting with acute limb ischaemia: a case report Soobrah R et al.</td>
<td>2010</td>
<td>Case Rep Med.</td>
<td>24 year old fit and healthy ex army officer. Limb threatening condition</td>
</tr>
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<td></td>
<td>Bilateral popliteal aneurysm as a result of vascular type IV entrapment in a young patient: a report of an exceptional case. López García D et al.</td>
<td>2007</td>
<td>J Vasc Surg.</td>
<td>Type 4 popliteal entrapment by a fibrous band independent of gastrocnemius muscle was diagnosed during surgery and divided.</td>
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<td></td>
<td>A Popliteal artery entrapment syndrome: diagnosis and management, with report of three cases. Radonić V et al.</td>
<td>2000</td>
<td>Tex Heart Inst J.</td>
<td>31 years old bus driver 33 year old skilled mechanic 21 year old lorry driver</td>
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<tr>
<td>Childrens</td>
<td>Popliteal arterial entrapment syndrome — a rare cause of thromboembolic lower leg ischemia in a 14-year-old. Chang DH et al.</td>
<td>2013</td>
<td>Rofo.</td>
<td>A rare cause of thromboembolic lower leg ischemia in a 14 year old</td>
</tr>
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<td></td>
<td>Popliteal artery entrapment syndrome in a young girl. Haidar S et al.</td>
<td>2005</td>
<td>Pediatr Radiol.</td>
<td>11.5 year old girl with thrombosed aneurysm with right popliteal artery subsequently diagnosed with bilateral type I PAES.</td>
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Continue
Table 2. (continue)

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<tbody>
<tr>
<td></td>
<td>The popliteal artery entrapment syndrome in children. Cummings RJ et al.</td>
<td>1992</td>
<td>J Pediatr Orthop.</td>
<td>This article reviews 41 cases of the popliteal artery entrapment syndrome in individuals less than 20 years of age. Because vascular insufficiency is uncommon in orthopedic patients in this age group and this syndrome has received little attention in the orthopedic literature, orthopedists unfamiliar with this relatively easily diagnosed condition may miss it.</td>
</tr>
<tr>
<td></td>
<td>Bilateral popliteal artery occlusion in a competitive bike rider: case report and clinical review. McAree BJ et al.</td>
<td>2008</td>
<td>Vasc Endovascular Surg.</td>
<td>33-year-old bike rider with PAES</td>
</tr>
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<td></td>
<td>Bilateral functional popliteal artery entrapment in a young athlete. Symeonidis PD et al.</td>
<td>2008</td>
<td>Knee.</td>
<td>19-year-old Australian football player</td>
</tr>
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</table>
Doppler ultrasonography revealed increased popliteal artery flow that was consistent with stenosis and MRI and CT angiography revealed a segmental stenosis, post stenotic aneurysm and thrombus of popliteal artery (Fig. 1a,b) which leads embolism to the small crural arteries (Fig. 2a).

On MRI, an abnormal tendinous insertion originating from medial head of gastrocnemius was detected. After a neglected period of 6 months with conservative treatment at other clinics, the patient finally came to our clinic. Based on these clinical and radiological findings, the source of claudication was thought to be popliteal artery stenosis and with the aid of MRI imagining, abnormal tendinous insertion which originates from gastrocnemius medial head was found (Fig. 3a), confirming the diagnosis of popliteal entrapment syndrome.

Surgical intervention (surgical decompression of the popliteal artery and embolectomy with prophylactic four compartment fasciotomies) is considered. Under general anesthesia, patient was set in prone position. The classical S shaped incision is used to cross the flexion crease. The fascia overlying the popliteal fossa is incised, exposing the neurovascular bundle. The abnormal musculotendinous insertion originating from the gastrocnemius medial head was detected between the artery and vein. Following that, myotomy and decompression were performed by orthopaedic surgeons (Fig. 3b). After this procedure, the cardio-vascular surgeons performed arteriotomy and embolectomy. The arteriotomy closed with separated sutures. Following that the patient was set in supine position and the four compartment fasciotomies were performed.

Figure 1a. Pre operative - MRI angiography: the arrows show stenotic segment clearly. Notice the decreased blood flow at distal crus.
Our patient was a professional young wrestler. Following the surgical intervention, pain resolved and patient returned his professional wrestling after two months. No weakness was detected at plantar flexion and no discomfort about the functions of the gastrosoleus group was reported at follow up.

Figure 1b. Arrow 1: popliteal artery stenotic segment; Arrow 2: post stenotic aneurysm and thrombus.

Figure 2a. Ct angiography: 1,2,3,4 numerics show abundant collateral arteries, right popliteal artery is normal. Ω, α, β represent distal occlusions due to micro embolism. The arrow shows stenotic segment.

Figure 2b. Post operative angiography; Arrow a shows foot print of previous stenotic segment that totally resolved. Arrow c shows one branch of the trifurcatoile still occluded but collateral circulation established (Arrow d); Arrow b shows unaffected side.

Figure 3a. Arrow a shows abnormal musculotendinous insertion of the medial gastrocnemius head. (Type 3), Arrow b shows medial gastrocnemius medial head.

Our patient was a professional young wrestler. Following the surgical intervention, pain resolved and patient returned his professional wrestling after two months. No weakness was detected at plantar flexion and no discomfort about the functions of the gastrosoleus group was reported at follow up.
After surgery, vascular claudication resolved rapidly and patient was able to return his professional wrestling career in two months. We were able to obtain post-operative (4 months after surgery) MRI angiography results of the patient, showing the stenotic segment and occlusion of the distal segments were resolved but one branch of trifurcation remained still occluded. However, the occlusion was compensated by peripheral collateral circulation (Fig. 2,b), as a result of decompression, embolectomy and fasciotomy.

**Discussion**

Abnormal embryologic development leads to various anomalous relations in the popliteal fossa that are responsible for entrapment\(^\text{15,18,19}\). The most widely accepted classification system, proposed by Love and Whelan\(^\text{2}\) and modified by Rich et al.\(^\text{12}\) divides popliteal vascular entrapment syndrome into six types. Type 1 is an aberrant medial arterial course around a normal medial head of gastrocnemius muscle. In Type 2, the abnormal medial head of the gastrocnemius inserts laterally on the distal femur and medially displaces the popliteal artery. In Type 3, the popliteal artery is in its normal position, but an aberrant accessory slip from the medial head of the gastrocnemius muscle wraps around the popliteal artery and entraps it. In Type 4, the popliteal artery is entrapped by a fibrous band or the popliteus muscle. Type 5 is any form of the first four types that involves the popliteal vein. Type 6, the functional type, has been described in people with symptoms in whom a normally positioned popliteal artery is entrapped by a normally positioned but hypertrophied gastrocnemius muscle. In our case, the patient was classified as a “Type 3” (Fig. 3b).

The differential diagnosis for patients with exercise induced lower leg pain includes chronic exertional compartment syndrome, medial tibia stress syndrome, fibular and tibial stress fractures, fascial defects, nerve entrapment syndrome, vascular claudication (atherosclerotic or popliteal artery entrapment syndrome) and lumbar disc herniation\(^\text{16,17}\). In our case, physical examination and radiologic imaging studies were all clear, proving popliteal entrapment syndrome. As the surgical intervention certainly showed popliteal artery, we also decided to make a prophylactic fasciotomy in order to prevent the lower limb from compartment syndrome, which can happen following vascular surgery\(^\text{10,20}\).

The presence of vascular injury more often results in the development of extremity compartment syndrome (ECS) and has been shown to be highly predictive of the need to perform fasciotomy to reduce the risk of limb loss or death\(^\text{21,22}\). There is an abundance of evidence that treatment of an existing ECS requires urgent and complete fasciotomy and that a delay in treatment results in significant morbidity\(^\text{22-26}\). The chronic exertional compartment syndrome might be a second possible diagnosis but since we made the decision about the prophylactic four compartment fasciotomy, we did not think this alternative diagnosis might cause us trouble.

In the literature there were a few articles about popliteal artery syndrome that affects young sports participants. We scanned 390 articles in literature (pubmed from 1965 to 2013). In this scan we mostly selected articles about the young individuals (5 articles), extremely interesting and didactic cases (5 articles), pediatric cases (8 articles), Sport professionals (10 articles: female olympic taekwondo player, 34 year old athletic trainer, basketball, Football and Roller Hockey Players, elite rower, competitive bike rider, young athletes), functional entrapment syndromes (2 articles)\(^\text{3,6,9,11,27-55}\). In this point of spectral focus our article might be described as unique about being focused on a professional wrestler.

Also our case will be the first case which popliteal entrapment syndrome in a young wrestler who was treated with both fasciotomy and decompression of popliteal artery with embolectomy. In our case, the poststenotic aneurysm and thrombus which leads to embolism at crural arteries can easily be seen. These late changes can be attributed to the delayed diagnosis.
Wrestling (Turkish: güreş) is considered as an “ancestral sport” in Turkey, represented foremost by the annual Kırkpınar tournament in oil wrestling 56. Our patient was the young participant of the Kırkpınar oil wrestling tournament. Usually an open fasciotomy for an athlete need to be choice very carefully, we have only one case who treated with embolectomy and prophylactic fasciotomy at this manner (prophylactic fasciotomy to prevent the lower limb from compartment syndrome which can occur after vascular surgery in an athlete). So we need more cases to make a scientific evidence. This was the limitation of our paper.

In conclusion, a physician (Emergency medicine doctors, Orthopedic surgeons, Family doctors, General surgeons, Vascular surgeons) should evaluate unilateral lower extremity pain with his/her existent knowledge, but popliteal entrapment syndrome is a very rare condition and is not widely known by orthopedic surgeons. Popliteal entrapment syndrome has the potential to cause significant morbidity. With this case presentation, we wanted to emphasize a possibility of popliteal entrapment syndrome during differential diagnosis in vascular claudication and chronic pain of the lower extremity. The aim of the surgical intervention is to restore the abnormal relationship between the artery and medial head of gastrocnemius and decompress four compartments in leg.

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References