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Case report

Popliteal artery entrapment syndrome

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ABSTRACT

Popliteal artery entrapment syndrome is a rare abnormality of the anatomical relationship between the popliteal artery and adjacent muscles or fibrous bands in the popliteal fossa. The following is a case report of a 19 year old female, in whom popliteal artery entrapment syndrome was diagnosed, and successfully treated surgically. A review of literature is also presented and provides details on how PAES is classified, diagnosed both clinically and radiologically, and treated surgically.

The patient, a 19 year old female and non smoker, suffered four episodes of acute onset lower limb ischaemia over a one and a half year period.

The first episode began, when the patient got up from a chair and experienced pain in her left lower limb. When examined initially, the left leg was cool from mid tibia distally. There was altered pin prick sensation in the foot and delayed capillary refill (>2 s). Both dorsalis pedis and posterior tibial pulses were weak. It was also noted that the patient was obese. She was commenced on intravenous heparin and symptoms resolved within the following 24 h. A full embolic screen was negative including a normal duplex scan and a normal angiogram. The patient was discharged on warfarin for followup in outpatients.

A month later, the patient was re-admitted with similar symptoms and signs as her previous admission. INR on admission was 2.3. A full antibody screen was negative. Magnetic resonance angiography was normal. The patient was continued on warfarin with a target INR of 3–4 and discharged for followup in outpatients.

The patient presented to the Emergency Department acutely on two more occasions. By the fourth episode the pulses described as weak on previous admissions, were now absent. The pain started this time when the patient got out of the shower. A positional angiogram was carried out. Patent distal superficial femoral artery, popliteal and infra-geniculate arteries were observed in both lower limbs in the 'Neutral' position. When the left foot was actively plantar flexed, there was an occlusion of the left popliteal artery. A diagnosis of left popliteal artery entrapment syndrome was thus made (Figs. 1 and 2).

Due to recurrent symptoms, surgical intervention was indicated. The patient was placed in the prone position for the procedure. A 'Lazy S' incision was made and the medial head of the gastrocnemius muscle was dissected. The popliteal vessels were mobilized over a 15 cm span. A hypertrophic plantaris muscle and a fascia band were found to be the main cause of arterial occlusion. Division of the fascia band was subsequently carried out. The operation successfully relieved the occlusion. On followup at one year, the patient was completely asymptomatic.

1. Discussion

Popliteal artery entrapment syndrome (PAES) was first described by a Scottish medical student, T.P. Anderson Stuart in 1879. He noticed that the popliteal artery was passing medial to the medial head of the gastrocnemius muscle while examining an amputated gangrenous leg, but it was not until 1965 that 'Love and Whelan' coined the term 'popliteal artery entrapment syndrome'. PAES typically affects both active and sedentary people, without any risk factors for atherosclerotic disease. The precise incidence is unknown but military and civilian studies report the figure between 0.165% and 3.5%. It is found most commonly in males (M:F 9:1) and 34% of cases are bilateral.[1,2]

PAES is due to either an acquired or a congenital abnormality. The acquired form of PAES is caused by hypertrophy of the musculature surrounding the popliteal artery and this is found typically in athletes and military personnel. The congenital form occurs due to anatomical developmental abnormalities during the embryological development of the lower limb. The popliteal artery normally passes between the two heads of the gastrocnemius muscle in the lower leg. Therefore an anatomical developmental abnormality or hypertrophy of muscular tissue following development will result in a band of tissue crossing over the artery and this leads to the intermittent claudication of the artery. This band may be fascia-like or tendinous in nature.

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Fig. 1. Angiography with active plantar flexion shows patent right popliteal artery with distal runoff.

Fig. 2. Occluded left popliteal artery with active plantar flexion.

The classification system used for PAES was introduced by Delaney and Gonzales in 1971 and types V and VI were added on at a later stage.[3] Type I, is the classical presentation with the popliteal artery passing medial to the medial head of gastrocnemius. This results in marked medial deviation of the popliteal artery both anatomically and on angiogram. Occlusion of the artery by plantar flexion is an important sign in type I. Type II, the artery is medial to the medial head of gastrocnemius which is abnormally displaced. Type III entrapment, is caused by the presence of an additional slip of gastrocnemius muscle originating from the lateral or medial femoral condyles. Compression of the popliteal artery occurs if the artery passes anterior to the additional head of gastrocnemius. Type IV entrapment is caused by the development of the popliteus muscle over the popliteal artery. Type V results from external compression of both the popliteal vein and artery. Type VI is a functional/acquired type which results from muscle hypertrophy found most commonly in athletes and military personnel. The classification has a greater role in the understanding of the condition than in the management.

When clinically examining the patient, it is important to monitor peripheral pulses (dorsalis pedis and posterior tibial) in response to active plantar flexion and passive dorsi-flexion of the foot. Diminished peripheral pulses in response to this test (Positional Stress Test), is a characteristic sign of PAES but this is not reliable. Other associated signs include pallor, pain, paraesthesia, poikilothermy and paralysis. The pain, similar to intermittent claudication, may be reported after a short, gentle walk but not while running or resting as the soleus muscle is more active than the gastrocnemius muscles while running, but this is an unreliable symptom.

Radiological imaging studies are very useful when combined with positional manoeuvres. Duplex Doppler imaging is the first line study of choice.[4] Angiography is the traditional method of second line investigation, and it was the key investigation in this case study. It is useful in ruling out differential diagnoses such as popliteal aneurysms, adventitial cystic disease and emboli which present with similar clinical findings. The disadvantage of angiography is that it is invasive and furthermore it fails to clearly identify surrounding structures. It was not known prior to the operation carried out in this study what structures were occluding the popliteal artery. Computed tomography, with or without 3-dimensional reconstruction, is also reported as being useful for diagnosing PAES in the literature. It provides detailed information on the wall and diameter of the artery and relation of the artery to adjacent structures but it too uses contrast material and ionizing radiation.[5] MRI and MR angiography have emerged as promising imaging modalities for the diagnosis of PAES, and have the advantage of multiplanar capabilities, nonionizing radiation, high soft-tissue contrast and avoidance of iodinated contrast material. They can be undertaken at rest and during active manoeuvres, and thus show functional entrapment if present. Magnetic resonance imaging is reported as the diagnostic method of choice when there is clinical evidence or duplex Doppler imaging suggestive of PAES.[6]

Recurrent external compression of the popliteal artery leads to mechanical damage to the vessel wall. This damage occurs in three distinct histological stages.[7] In the earliest stage, the areas distal to the occlusion show neovascularization of the adventitia progressing to include the outer half of the media of the artery. There is little fibrosis or destruction of the media. In stage 2, as the disease progresses, there is much more neovascularization which spreads to include the entire media. There is fibrous replacement of the media and focal fragmentation of the internal elastic lamina. Extensive fibrous replacement of the media, marked fragmentation of the internal elastic lamina and extensive fibrointimal proliferation with overlying thrombi characterize stage 3. The development of collat-

eral vessels may occur with these chronic changes. Therefore early diagnosis is essential to avoid these chronic intravascular changes. The early diagnosis in this case study resulted in little mechanical damage to the vessel wall. When the diagnosis is not made until the patient has reached stage 3 in the mechanical damage to the vessel wall, vascular reconstruction is required.

It was not until 1959, that Hamming reported the first successful surgical treatment of PAES.[8] The aim of treatment of PAES is to release the entrapped artery by myectomy and to re-establish transluminal flow by repairing the luminal stenosis. If the transluminal flow is unable to be re-established then a venous graft may be utilized instead. It has been reported that transluminal angioplasty is ineffective, as the extraluminal aetiology will result in restenosis of the artery upon active plantar flexion.[9] The long term prognosis following release of the entrapped artery has not been extensively reported in the literature to date. Marzo et al. looked at the 30 cases of PAES over a 26 year period and found that patients who needed to have popliteal artery release were younger (mean 31 years, ±3 years) than patients who required vascular reconstruction (mean 41 years, ±4 years). These patients were diagnosed at an earlier stage and therefore as a result had a better outcome (94.4% long-term patency rate) as vascular reconstruction was associated with shorter long term patency rates (long-term patency rate was only 58.3%).[4,10]

2. Conclusions

Popliteal artery entrapment syndrome has evolved as a diagnosis since its first description in 1879. We now have six different types described in the literature and theories of how the congenital abnormality occurs. Early cases were diagnosed based on history and examination alone, but at present, a combination of both duplex Doppler ultrasound and magnetic resonance angiography is the optimal way of investigating suspected PAES cases. These advances in radiology should allow easier diagnosis of PAES and will result in patients presenting at an earlier stage with less mechanical damage to the artery wall.

Conflict of interest

There are no conflicts of interest.

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Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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