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Popliteal Artery Entrapment Syndrome: About A Series of Four Cases

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Abstract:-
Introduction: Popliteal artery entrapment syndrome (PAES) is the most frequent cause of non-atheromatous arteriopathy of the popliteal artery responsible for intermittent claudication in young subjects.

Presentation of cases: We report a series of four cases treated for this entrapment syndrome at our vascular surgery department.

Discussion: Through the description and analysis of this series of cases having been treated at our hospital center, we will try to define this (PAES) as well to describe its clinical, morphological, paraclinical, therapeutic and evolutionary aspects.

Conclusion: (PAES) is a rare under diagnosed syndrome due to its asymptomatic character. Magnetic resonance angiography (MRA) is the gold standard for diagnosis and treatment is essentially surgical with promising results.

Keywords:- *Popliteal artery, entrapment syndrome, muscle hypertrophy, adults sportive, bypass.*

I. INTRODUCTION

The vascular trap is defined by an extrinsic or intrinsic compression of an artery and/or a vein by neighboring anatomical elements (bones, muscles, ligaments, nerve and other vessel) [1]. The popliteal trap can be vascular (popliteal artery, popliteal vein) or neurological (tibial nerve). [2]

Popliteal artery entrapment syndrome (PAES) is a non-atheromatous arterial pathology that most often manifests as claudication of the lower limbs, preferentially affecting young and athletic subjects. [3]

Intermittent claudicationis rare in young and athletic patients. PAES is an abnormal relationship between the popliteal artery and the musculotendinous structures that surround it. The symptomatology is essentially revealed during effort, that is to say, during contraction and muscle hypertrophy.

PAES can be either congenital (from birth) or acquired (develops later in life). [4]

This syndrome is often associatedwith a delay in diagnosis due to:

- The rarity of this syndrome.
- Its ignorance by the uninitiated (the disciplines related to sport or with arterial pathologies in general being more likely to know this pathology: Sports doctors, vascular surgeons, orthopedists, radiologists, physiotherapists working with athletes).
- Patients even affected by this syndrome: Young patient, athletic, without cardiovascular risk factor in general. They are not, in fact, the first people to whom we think of an ischemic problem.
- Also the need to carry out radiological examinations (Doppler ultrasound, computed tomography angiogram, magnetic resonance angiography essentially currently) sensitized by dynamic maneuvers to make a diagnosis of certainty; So you have to look for it precisely to find it.

This delay in diagnosis can lead to arterial complications (thrombosis, post-stenotic aneurysm, distal emboli) and thus leads to a significant risk of acute ischemia of the lower limb, all of which makes surgical management more complicated.

II. PRESENTATION OF CASES

These are four male patients, with an age range of 22 to 78 years and an average age of 47 years. The regular practice of sport was found in two patients. The pathology was manifested in three patients by intermittent claudication and by subacute ischemia on femoro-popliteal bypass thrombosis in the fourth patient. Only one of our patients had bilateral PAES.The paraclinical examinations used in the diagnosis approach are based on at least two examinations: Doppler ultrasound, CT Angiogram and MRA revealing a PAES type III in three patients and a PAES type II in one patient. For the second patient, PAES type II was revealed fortuitously during the surgical exploration.The four patients underwent surgical treatment by musculotendinous resection with vascular reconstruction using reversed venous graft bypass except for the second case who benefited from an extension of his bypass with a piece of prosthesis.The postoperative course was simple in three patients except the second one who developed after two months a thrombosis of his femoro-popliteal bypass for the second time which involved the realization of a surgical thrombectomy and endoluminal angioplasty of the popliteal artery.

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We detail the four cases illustrating this syndrome.

A. Case °1

A 38 year old man, with no cardiovascular risk factors, a bodybuilder with a history of right leg fracture at the age of 14 treated by osteosynthesis with good postoperative evolution, was admitted for consultation for a tight intermittent claudication of the right lower limb with a walking distance of 100 meters evolving for 10 months previously. The vascular examination of the concerned limb objectified an abolition of the popliteal, posterior tibial and pedal pulses with an ABI of 0,4.With the pocket doppler, we were able to perceive a right distal flow which disappears with dynamic maneuvers, namely active plantar flexion of passive dorsal flexion. Radiological investigations (Doppler ultrasound, CTA and MRA) objectified the compression of the right popliteal artery by an accessory head of the medial gastrocnemius muscle in favor of a type III PAES. (Wheelan Classification)

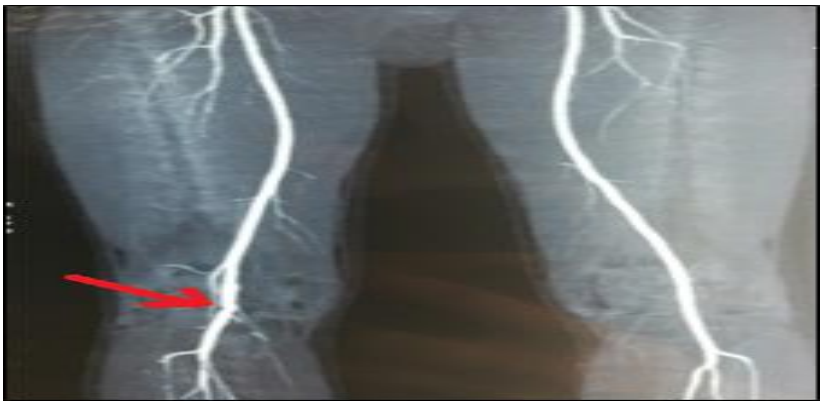

Fig. 1: CT angiography in arterial phase (reconstruction slice): A stenosis of the retro-articular right popliteal artery.

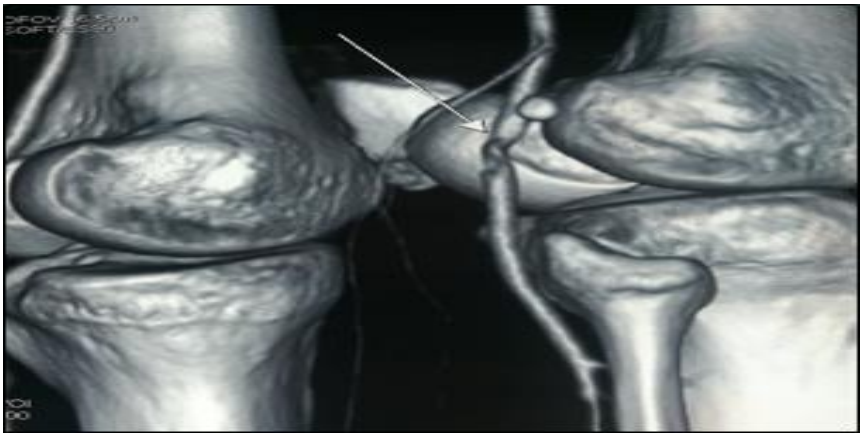

Fig. 2: 3D reconstruction image of an MRA of the right knee showing a tight stenosis of the retro-articular popliteal artery

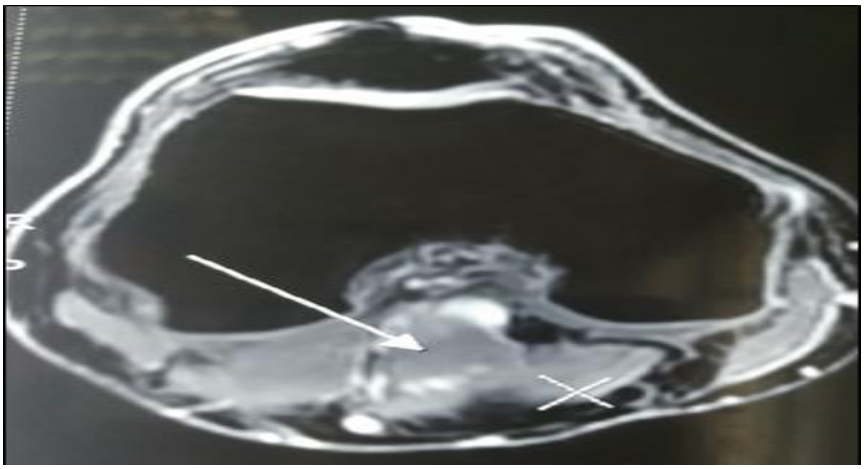

Fig. 3: Axial slice of an MRA of the right knee showing compression of the right popliteal artery by the accessory head

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A surgical intervention was carried out and which consisted, via a posterior bayonet approach, in the resection of the accessory head of the gastrocnemius muscle. The popliteal arteriotomy revealed a circumferential thrombus stenosing this artery due to repeated minimal trauma with post-stenotic aneurysmal dilatation, which required the performance of a poplito-popliteal inverted short saphenous vein bypass.

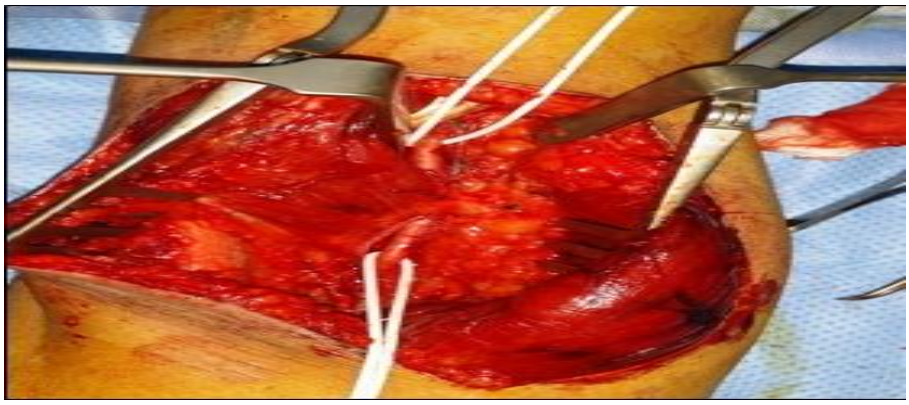

Fig. 4: Intraoperative image showing the accessory head of the medial gastrocnemius muscle compressing the right popliteal artery

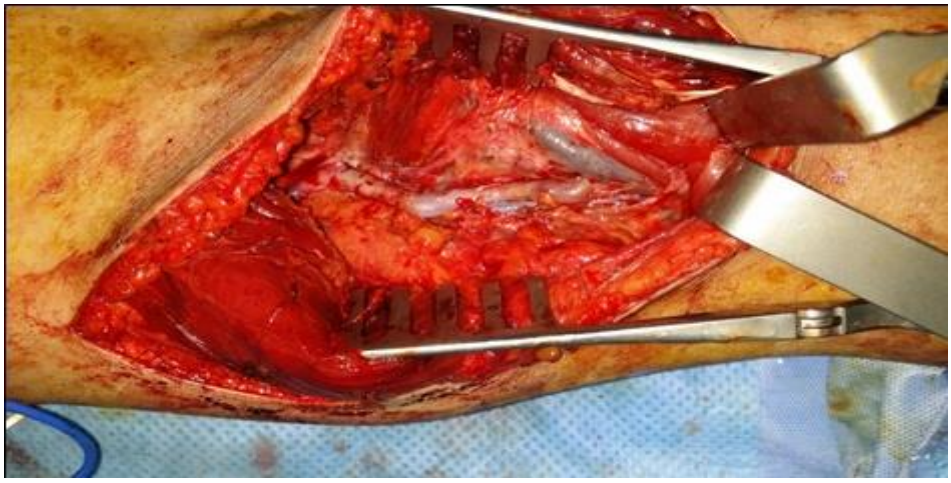

Fig. 5: Intraoperative image after performing a short poplito-popliteal saphenous vein bypass

The postoperative course was good, in particular no ischemic complications or hematoma with the recovery of a popliteal and posterior tibial pulse of the right lower limb and a normal ABI.

B. Case °2:

A 78-year-old man, poorly balanced type II diabetes on oral antidiabetic drugs for ten years, having benefited from a supra-articular prosthetic left femoro-popliteal bypass one year ago, admitted for the management of severe pain in the left lower limb. On clinical examination: The left lower limb slightly pale at the level of the foot, slightly cold compared to the contralateral side, a femoral pulse that is present with abolition of the popliteal, posterior tibial and pedal pulses while they are present on the right. The ABI of the symptomatic limb at 0,55 and 1,1 on the right lower limb.Radiological investigations (Doppler ultrasound, CTA) showed a thrombosis of the femoro-popliteal bypass at the level of the upper 1/3 of the left thigh. The diagnosis of acute ischemia due to thrombosis of the femoro-popliteal bypass was retained.

Via an antero-internal approach to the upper left popliteal bone with downward extension, thrombectomy of the left femoro-popliteal bypass was performed using a 5F Fogarty probe. During the intraoperative exploration, the fortuitous discovery of the presence of an accessory head of the gastrocnemius head compressing the popliteal artery corresponding to a type III PAES.The vascular trap (accessory head) was resected with extension of the bypass on the retro-articular popliteal artery via a piece of PTFE graft.

The postoperative course was good with improvement in clinical symptoms and recovery of the popliteal and posterior tibial pulses. The postoperative ABI of the limb was at 0,9.

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Fig. 6: CT angiogram of the aorta and lower limb (reconstruction section) showing thrombosis of the left femoro-popliteal bypass in the upper 1/3 of the left thigh

Fig. 7: Intraoperative image showing dilatation of the popliteal artery post-lesion

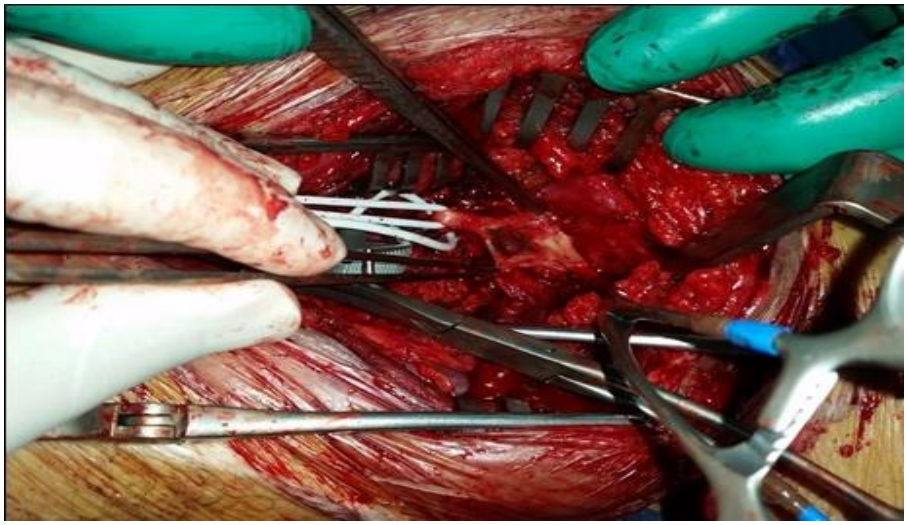

Fig. 8: Intraoperative image illustrating the intra-arterial thrombus

This patient was admitted three months later for pain in the left lower limb with gangrene of the big pulp. CT angiography showed thrombosis of the left femoro-popliteal bypass with uptake of the contrast product at the level of the distal popliteal artery which is continued by the tibioperioneal trunk and the posterior tibial artery. A thrombectomy of the bypass was performed then completed by angioplasty of the distal popliteal artery with regularization of the big toe. The postoperative course was favorable with the disappearance of the clinical symptoms and recovery of the popliteal and posterior tibial pulses.

C. Case °3

A 53-year-old man, chronic smoker for fifteen years, with no other cardiovascular risk factors, who consulted for bilateral intermittent claudication of both lower limbs, especially on the right, made up of cramps and pain in the calves evolving for one year with walking distance 200

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meters away. On vascular examination, the two lower limbs are warm, without trophic disorders, femoral pulses are present in both sides with absence of popliteal, posterior tibial and pedal pulses bilaterally. The measurement of the ABI of the right lower limb was at 0,5.Radiological investigations (CTA and MRA) led to the diagnosis of PAES type II (Wheelan Classification): Short occlusion of the two popliteal arteries bilaterally at the level of their articular segments with a high and lateral insertion of the medial gastrocnemius muscle between the popliteal artery and vein.

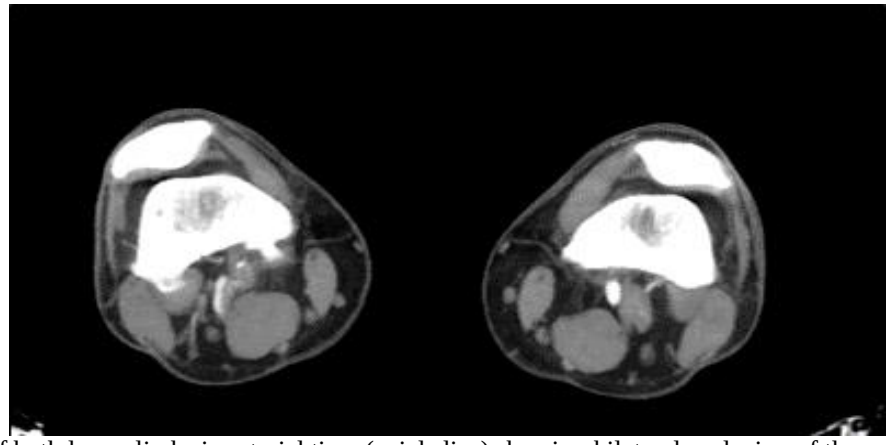

Fig. 9: CTA of both lower limbs in arterial time (axial slice) showing bilateral occlusion of the popliteal arteries

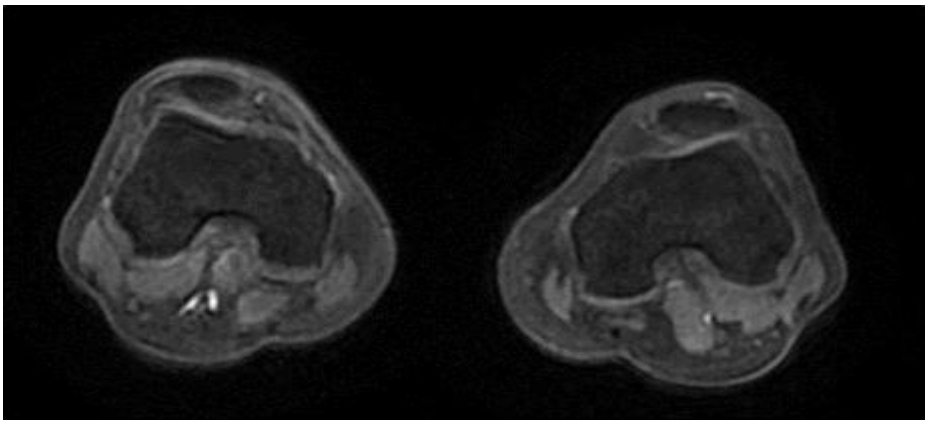

Fig. 10: Axial Fat-Sat T1 MRA with injection of gadolinium chelate at arterial time illustrating bilateral occlusion of the popliteal artery

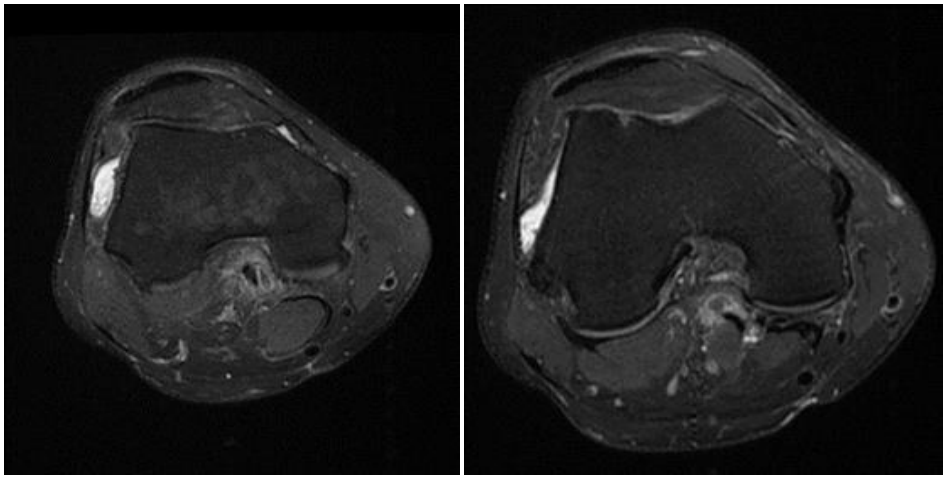

Fig. 11: MRA of both knees (axial slice) of the upper lateral insertion of the medial gastrocnemius muscle on both sides

Surgery was indicated and we started with the right lower limb. The patient was placed in the prone position, then via the posterior popliteal bayonet approach, during the surgical exploration, the type II PAES was confirmed with a more external insertion of the medial gastrocnemius muscle between the popliteal artery and vein. The surgical gesture consisted in the release of the right popliteal artery with vascular reconstruction by a poplito-popliteal bypass using reversed great saphenous vein.

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Fig. 12: Intraoperative image illustrating the popliteal artery after resection of the medial gastrocnemius muscle

Fig. 13: Intraoperative image showing vascular reconstruction by poplito-popliteal bypass using the reversed great saphenous vein

The postoperative evolution was favorable with recovery of the popliteal and distal pulses and a normal ABI. Currently, two months postoperatively, the intermittent claudication of the right lower limb has disappeared. He is scheduled for the PAES surgery on the left lower limb.

D. Case °4:

A 22-year-old man, having a history of fracture of the right leg at the age of 14 treated by osteosynthesis with a good evolution, without any cardiovascular risk factor, an adept of sport and bodybuilding, who consults for an intermittent claudication of the left lower limb evolving for two months with a walking distance of 500 meters. The vascular examination of the concerned limb finds a warm limb with a present femoral pulse and an abolition of the popliteal, posterior tibial and pedal pulses. The pocket doppler perceived a left distal flow which disappears during dynamic maneuvers, namely active plantar flexion or passive dorsal flexion. The ABI of the symptomatic limb was at 0,4.

The radiological investigations (CTA and MRA) showed a tight stenosis of the left popliteal artery due to the compression of this artery by a muscular accessory head with a small post stenotic aneurysmal dilation and a good downstream bed allowing to retain the diagnosis of a type III PAES (Wheelan Classification).

In the operating room, the patient was placed in prone position; a left posterior popliteal bayonet approach was used. On surgical exploration, the imaging data was confirmed with the presence of a muscular accessory head compressing the popliteal artery. Resection of this accessory head was performed with an arteriotomy revealing a circumferential thrombus of the popliteal artery at the level of the lesion due to repeated minimal trauma with post-stenotic aneurysmal dilation requiring poplito-popliteal bypass using an inverted great saphenous vein.

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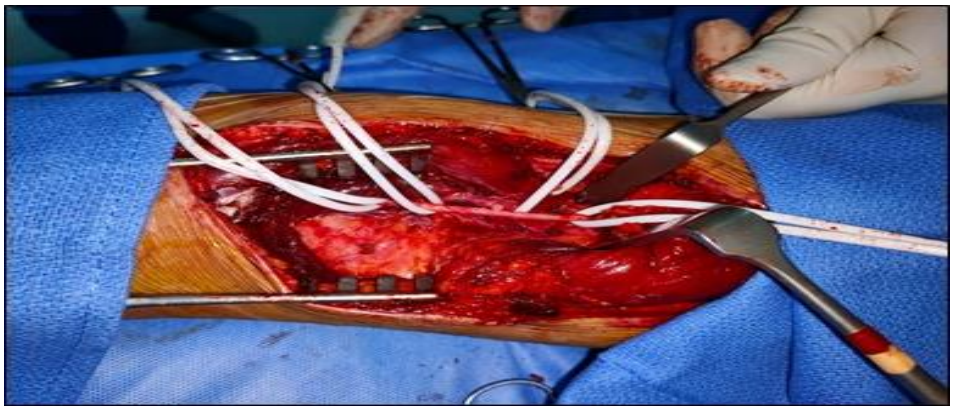

Fig. 14: Intraoperative image of the muscular accessory head which compresses the left popliteal artery after resection

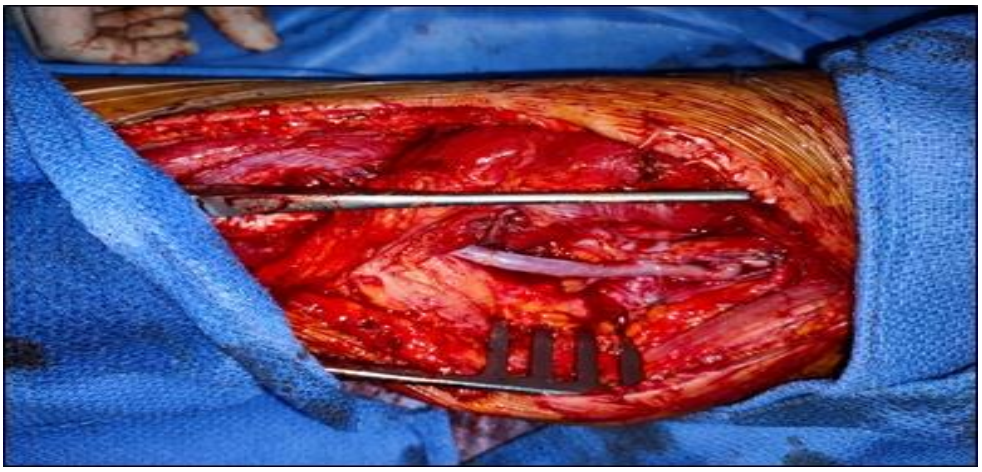

Fig. 15: Intraoperative image after reconstruction of the popliteal artery by reverted short saphenous vein bypass.

The postoperative evolution was favorable. The ABI measurement was normal with the reappearance of the popliteal and distal pulses.

III. DISCUSSION

The first data on the pathology of the popliteal artery entrapment syndrome (PAES) was published by Anderson Stuart on an anatomical structure abnormality in 1879. [5]In 1969, M.Wheelan and al. named this pathology caused by a structural abnormality as PAES. [6]PAES is one of the rare causes of intermittent lower extremity claudication that has been underestimated or underdiagnosed. The incidence of this syndrome is not known, but it is likely to be more common than currently thought.

The prevalence is between 0,165% and 3,5% while the prevalence of bilateral involvement is 27-67%. [6,7]This syndrome has been described mainly in young adult athletes without cardiovascular risk factors [8,9], the condition is more common in men perhaps because on average men tend to be more active than women and would therefore be more likely to suffer from the symptoms. In a large series byZund and al. [8] 17 of 20 (85%) patients were male with onset of first symptoms at a mean age of 33,5 years.A recent study published in 2018 concerning 31 patients, 26 of them were male, with an average age of 32 +/- 7,9 years. [10]According to the literature, this syndrome can rarely affect children with an age below 15 years. [11]

Bilateral involvement in PAES is possible and has been described in the literature in various studies, notably in 1989 by Collins and al. [12] as well as a retrospective study published in 2013 in the HAS [13].

This PAES often occurs in subjects without cardiovascular risk factors, most studies and published articles confirm this point. The profile of patients affected by this syndrome is readily a young athletic man in most studies. [13,14,15]However, it remains difficult to establish a causal link with the pathology, because all the studies find patients practicing quite numerous and different sports: Walking, bodybuilding, cycling, football… This also depends on the frequency as well on the intensity of the sport activity.

Concerning our series, the four cases were all males with an age range between 22 and 76, with an average age of 44 years, and a bilateral involvement of 25%. Two cases had cardiovascular risk factors, one was diabetic and the other was a chronic smoker. We also note that two patients in this series were sports and bodybuilding enthusiasts.

Regarding the clinical presentation, most subjects (90%) present with intermittent claudication. [16]In this syndrome, this claudication occasionally occurs when walking and not when running [17,18], due to the fact that more prolonged contraction of the gastrocnemius muscle occurs with walking.About 10% of patients with PAES have signs and symptoms of acute or chronic limb ischemia.

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These include paresthesia, discoloration of the foot and toes, temperature change, pain at rest and tissue necrosis. [19]

A study published in 2018 on 31 patients with PAES: 26 patients (83%) have intermittent claudication as a clinical manifestation. [10]

Other functional signs have been described, such as: Compartment syndrome described by some authors and which can be associated with PAES or sometimes reveal it outright. In a French series, 21% of patients simultaneously or previously had a compartment syndrome. [13]

Some patients may remain clinically asymptomatic.According to an English series: In 12 out of 30 studies, 17,5% of limbs diagnosed with PAES were asymptomatic. [20]

Concerning our series, ¾ of the cases showed only intermittent claudication, while one case showed signs of subacute ischemia.

Clinical examination of subjects suspected of having PAES is often normal at rest. The popliteal, posterior tibial and pedal pulses should be carefully palpated to determine a decreased pulse or an asymmetry between the limbs.Pulses should be palpated in passive dorsiflexion of the ankle and in active plantar flexion with the knee in extension. The deficit in these provocative positions (dynamic maneuvers) has been considered pathognomonic of PAES. [21]

The paraclinical assessment usually includes the combination of two imaging examinations: Doppler ultrasound with magnetic resonance imaging (MRI) or computed tomography (CT). These examinations must be carried out bilaterally, and must specify not only the functional and anatomical state of the popliteal artery but also the structural details of the popliteal fossa. [4]In the English publication covering 30 studies on PAES between 1947 and 2010, the main paraclinical examinations requested were: Arteriography, Doppler ultrasound, CTA and MRA, with a median of three paraclinical examinations carried out for the diagnosis.A recent study on the modality of exploring this syndrome, Williams and al. reported that a combination of MRA and doppler ultrasound is far superior in the diagnosis of PAES. [22]A Turkish article published in 2008 compared the results of MRA and arteriography in the diagnosis of PAES and concluded that MRA is preferable for diagnosing PAES and can avoid the need for arteriography. [23]

In our study, the diagnosis of the PAES was based on the realization of at least two radiological investigations and which are the CTA and MRA.

The main objective of the management of this syndrome is to relieve the symptomatology as well as to ensure the resumption of the patient's professional and sports activities. Another objective is to avoid complications due to the formation of arterial thrombi and their distal embolization and to prevent lesions of the arterial wall caused by repeated micro traumas due to the release of the popliteal artery.Surgical treatment is the reference treatment in the event of an anatomical trap. In the absence of arterial damage, the intervention may only concern the treatment of the musculotendinous part (myotomy and release of the fibrous bands at the origin of the trap). In the case of arterial damage, it will be necessary to carry out vascular reconstruction.The posterior approach (bayonet incision) offers excellent access to the popliteal artery and the popliteal fossa, facilitating confirmation of the diagnosis and musculotendinous section. In addition, the external saphenous vein can be harvested as an interposition graft. However, the medial approach is preferable for longer occlusions that require a long bypass. On the other hand, the disadvantage of this approach remains to expose the popliteal artery completely and to demonstrate its relationship with the surrounding muscles/tendons.In general, the choice of approach depends on the height of the anomaly in the popliteal fossa, the extension of the lesions, the need for revascularization on a leg axis and the graft used in the event of bypass surgery.

Different surgical methods have been described so far: Thrombectomy and/or endarterectomy with patch closure; Autogenous vein bypass; Segmental arterial resection with graft interposition using autogenous or prosthetic grafts. [24]The patency rate of bypasses using vein grafts is 57% to 65% over a period of 8 to 10 years [25,26]. Levien and al. reported a series of cases involving 66 limbs who underwent musculotendinous section (group A) and 16 limbs who underwent segmental replacement of the popliteal artery occluded by a reversed saphenous vein (group B). In all members of group A, the popliteal artery remained patent during the follow-up period (median 3,9 years). Members of group B had no graft occlusion (median 4,2 years). [24]

Di Marzo and al. reported 15 cases who underwent reconstructive surgery of the popliteal artery with a patency rate of 65% (after an average follow-up of 107 +/- 8 months). Revascularization techniques consisted of nine vein graft interposition procedures and six long vein bypasses. [26]Kim and al. also reported that bypass surgery is associated with a lower patency rate than interposition procedures (30% at 5 years versus 85,9%;) By comparing these ratios, it can be assumed that the short vein interposition graft has a better patency rate than the long vein bypass.

About our series, 3 cases benefited from a vascular reconstruction by the short interposition of a venous graft, in addition the fourth case (fortuitous discovery of PAES) benefited from an extension of its bypass by a piece of prosthesis on the retro-articular popliteal artery.

Regarding endovascular treatments, these are not effective and are associated with a high risk of re-occlusion, especially if the underlying cause of the vascular entrapment is not treated. Some authors suggest a combined endovascular treatment, arterial thrombolysis especially downstream bed in case of severe ischemia, followed by surgical decompression. [27]Sometimes, thrombolysis can be useful in cases of acute ischemia of the limb to restore the downstream bed. [28]In an English series: four studies

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described initial thrombolytic treatment in seven patients, thrombolysis was chosen to improve the distal arterial bed in four patients, but it did not avoid the need for surgery in any of them. [20]

IV. CONCLUSION

PAES is a rare pathology but represents the main cause of intermittent claudication in young subjects without cardiovascular risk factors. MRA remains the gold standard in terms of paraclinal tests because it shows the musculotendinous insertions as well as the course of the popliteal artery and the presence of emboli or arterial lesions. Surgical treatment is the reference treatment and consists of releasing the trap by musculotendinous resection alone when a muscular aberration is found or coupled with a revascularization gesture when there is significant arterial damage. The results of surgery are excellent when treatment is provided at an early stage of the pathology, allowing a resumption of activities of daily living one month after surgery with a resumption of sport in general after two months.

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