Abnormalities of Vascular System

Chapter 4

Popliteal Artery Aneurysm

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Abstract

From the peripheral aneurysms, those of the popliteal artery are the most common ones, corresponding to 70-80% of the cases. They frequently occur on male patients older than 60 years, asymptomatic, and about 50% are bilateral. The presence of a popliteal artery aneurysm can be suspected by the physical exam when there is an increased pulsatility on the popliteal fossa. However, when this palpable mass is not pulsatile, it is necessary to exclude important diferential diagnoses, such as benign

tumors (lipomas and fibromas), synovial hernias (Baker's cyst) and acute abcess, besides deep vein thromboses. The vascular ultrasonography is the most useful exam to confirm the diagnosis, since it is capable of evaluating the amount of intraluminal thrombus, diameters of the aneurysm and of the non-affected artery, aneurysm thrombosis and compression of adjacent veins and nerves. Its complications include: rupture, embolization, thrombosis and loss of limb. The convencional surgical treatment is the open surgery of exclusion of the aneurysm and revascularization of the affected limb with bridge graft interposition or parcial or total resection of the aneurysm and arterial reconstruction with graft in continuity. The endovascular treatment appeared as an alternative to the convencional repair; it is less invasive, and has lower morbidity. This treatment option has been of great importance, especially for those patients who have a high surgical risk, unavailability of saphenous vein or graft prosthesis.

Keywords: Aneurysm, Popliteal Artery; Peripheral Arterial Disease; Peripheral Vascular Diseases; Chronic Disease; Hypertension, Vascular Surgical Procedures.

1. Anatomy

The popliteal artery is a direct continuation of the superficial femoral artery after passing through the adductor magnus muscle gap. The popliteal artery and vein are usually located between the medial and lateral heads of the gastrocnemius muscle (**Figure** 1), posterior to the popliteal muscle. Considering that the normal diameter of the popliteal artery is less than 1 cm [1], a popliteal artery with a diameter greater than 1.5 cm, that is, a focal dilation greater than 50% of the maximum expected diameter for the segment, is considered aneurysmal [2-4].

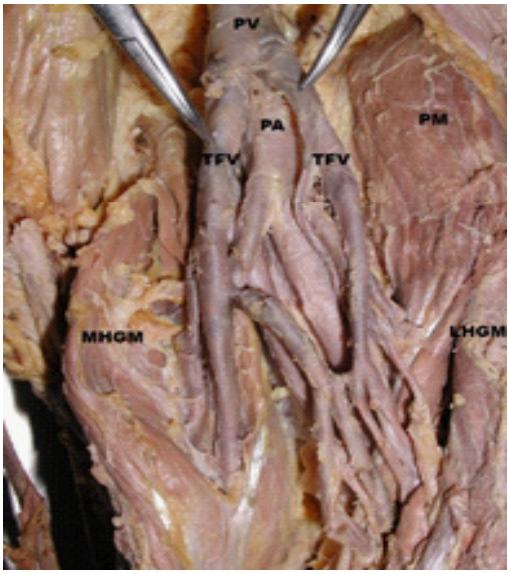

Figure 1: Photograph showing the popliteal vessels.

PV: Popliteal vein; PA: Popliteal artery; TFV: Tibiofibular vein; PM: Plantar muscle; MHGM: Medial head of the gastrocnemius muscle; LHGM: Lateral Head of Gastrocnemius Muscle

2. Epidemiology

The popliteal artery aneurysms are the most frequent peripheral arterial aneurysms, accounting for about 70% to 80% of the total, with an estimated incidence between 0.1% and 2.8% [2,5-13]. They are more common in men over 60 years old, with established cardiovascular disease, and their frequency in relation to females is 20:1 [10], being bilateral in 50% of patients, and may also coexist with femoral and abdominal aortic aneurysm in 50% of cases [3,8,14-20].

3. Etiology

Regarding its etiology, the vast majority of popliteal artery aneurysms were considered to be atherosclerotic [21], but today they are considered non-specific etiology, that is, reflect a multifactorial etiology [6,22-24], such as trauma, congenital popliteal aneurysm, mycotic aneurysm, inflammatory arteritis, or entrapment of the popliteal artery [25-27]. In addition, we often find that popliteal artery aneurysm is associated with other diseases, such as coronary artery disease, systemic arterial hypertension, cerebrovascular disease, diabetes mellitus, and peripheral arterial obstruction.

4. Clinical evolution

Diagnosing popliteal artery aneurysm has often not been a simple task for physicians as they are asymptomatic for a variable time [28]. Symptomatic patients have complaints arising from complications such as acute ischemia, caused by aneurysm thrombosis, or chronic ischemia by distal embolization, and both are related to the significant risk of loss of the affected limb [29-31]. Although there is a risk of rupture, this occurrence is uncommon [32]. In very large or ruptured aneurysms, it is possible to have compression of the popliteal vein, which can lead to edema, or branches of the sciatic nerve, producing sensory or even motor phenomena, which can often lead to loss of movement of the foot [31,33,34].

5. Diagnosis

The diagnosis is usually made by physical examination, by palpating a large arterial pulse or a pulsatile tumor in the popliteal cavity region and, eventually, by imaging with another purpose. On the other hand, a very detailed and meticulous anamnesis can reveal a history of episodes of minor peripheral embolization, that appeared as cyanosis of one or a few toes (blue finger syndrome), and/or with pain and coldness in cases of acute arterial occlusion (**Figure**. 2). When this occurs, with no history of previous claudication and no known emboligenic sources, as well as the disappearance of the popliteal and distal pulses, it is mandatory to think of thrombosed popliteal aneurysm. However, when this palpable mass is not pulsatile, important differential diagnoses should be ruled out, such as benign tumors (lipomas or fibromas) [35,36],

synovial cysts (Baker's cyst) [37,38], acute abscess [22], in addition to deep vein thrombosis [39-43].

Figure 2: Photograph showing ischemia of the distal phalanges of the left foot.

Whenever the suspicion or diagnosis of a popliteal artery aneurysm occurs, the detailing of the diagnosis or its definitive confirmation should be done by a color Doppler (**Figure 3**), that provides information on speed, direction and volume of the blood flow. Consideration should be given to the presence of mural thrombi in the aneurysmal sac (**Figure 4**), which constitute a potential risk of thrombosis or distal embolism. The color Doppler is the best follow-up method for non-operated cases, as it has no known side effects, is easily accessible and inexpensive. Angiotomography, magnetic resonance and arteriography can be performed for surgical planning in order to evaluate the proximal and distal arteries [44]. Some authors point out angiotomography (**Figure 5**) as the best exam for this purpose [45].

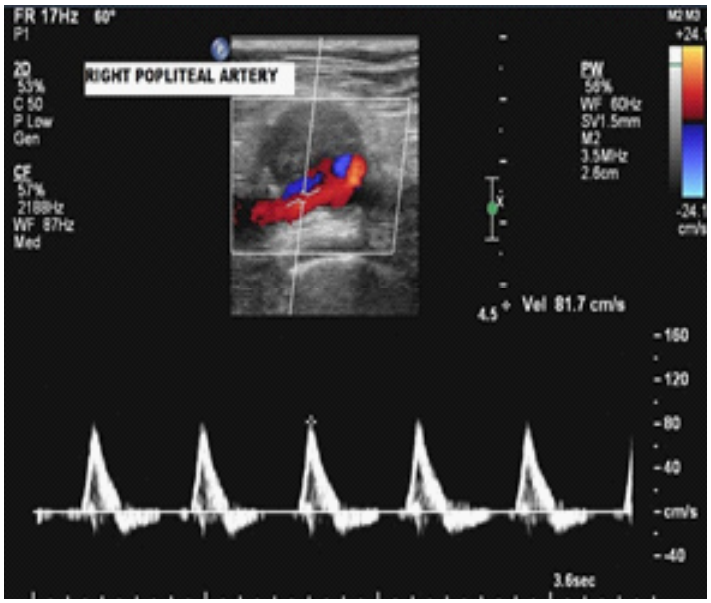

Figure 3: Saccular aneurysm with parietal thrombus and no change in the flow pattern.

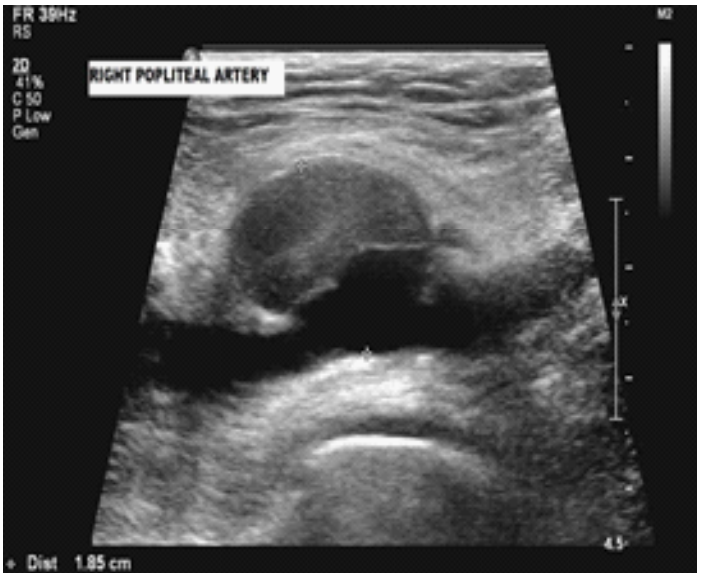

Figure 4: Two-dimensional popliteal artery saccular aneurysm with parietal thrombus.

Figure 5: Angiotomography showing fusiform popliteal artery aneurysm.

6. Treatment

The main purpose of the treatment of the popliteal artery aneurysm is to prevent lower limb loss due to thrombosis or distal embolization of the aneurysm. In principle, any asymptomatic or symptomatic popliteal artery aneurysm would have surgical indication, however the size of the aneurysm has to be taken into account, whose diameter can be larger or smaller than 2 cm, also the comorbidities, and the life expectancy compared to natural evolution of the disease.

Traditionally, symptomatic or asymptomatic popliteal artery aneurysms larger than 2 cm in diameter should be surgically treated. While for aneurysms smaller than 2 cm in diameter and without parietal thrombi, conservative treatment with serial follow-up is recommended.

Surgical access for treatment of the popliteal artery aneurysm, either for aneurysm ligation or to restore arterial continuity, is preferred by most surgeons to be performed medially, which facilitates the removal of the great saphenous vein [23,46-50]. Some surgeons prefer the posterior approach (**Figure 6**), especially for large aneurysms, or those that cause compression

of adjacent structures [9,51-53].

Figure 6: S-shaped posterior access for popliteal artery aneurysm.

Open surgical treatment of the popliteal artery aneurysm (**Figure 7a**), described by Edwards et al. [47] in the late 1960s, is still the most widely used procedure. It consists in the exclusion of the aneurysm (**Figure 7b**) by ligation and revascularization with interposition of an autologous (**Figure 7c**) or synthetic prosthesis, or bypass [54]. This procedure has low rates of perioperative complications, and maintains excellent graft patency rates and absence of long-term amputation, particularly in asymptomatic aneurysms [9,55].

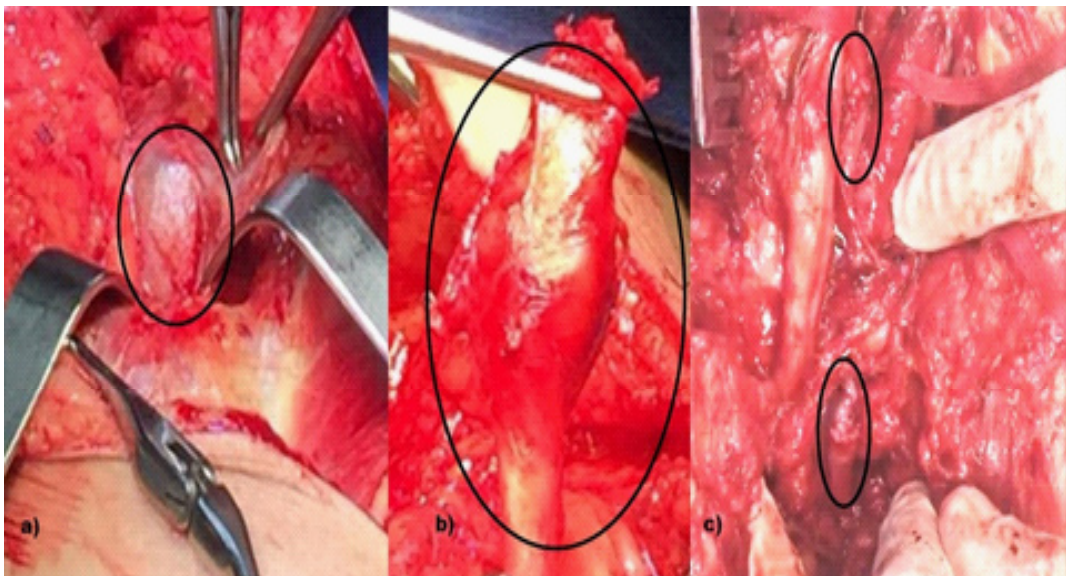

Figure 7: Open surgical treatment of popliteal artery aneurysm (a), with exclusion (b) and interposition of inverted great saphenous vein (c).

Endovascular treatment of the popliteal artery aneurysm is indicated in patients with favorable anatomy, 1.5 cm proximal and distal neck and at least one patent distal vessel. Over the past decades, the results of endovascular treatment of the popliteal aneurysm (**Figure 8a**, **b**, **c**) have been, in the medium term, comparable to open surgery, and appear to be a safe alternative to conventional open surgical repair. This treatment option has been of great importance, especially for those patients who have a high surgical risk, unavailability of saphenous vein or graft prosthesis [56,57]. However, electively, there is no clear evidence suggesting better

outcomes between open and endovascular surgical treatment, as demonstrated by the Cochrane systematic review, that has a moderate level of evidence [4,58].

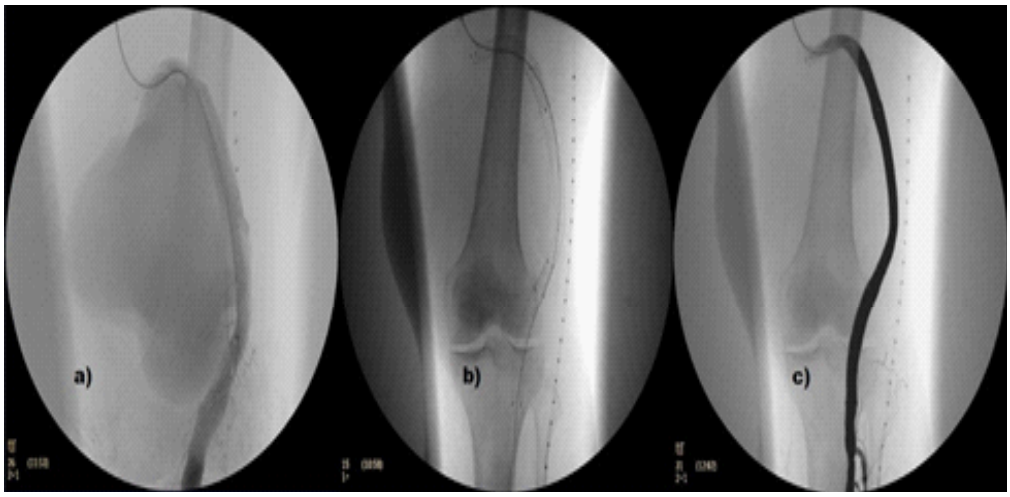

Figure 8: Endovascular treatment of popliteal artery aneurysm (a), stent placement in the artery (b) and aneurysm exclusion (c).

7. Conclusion

The topographic position of the popliteal artery favors the silent evolution of its parietal lesions, which makes the initial diagnosis a challenge for the physician. The popliteal artery aneurysm is potentially thrombogenic and emboligenic, which may lead to obliteration of the arterial trunks of the leg and plantar arch, significant ischemia, and high incidence of amputation, indicating the performance of elective surgery in a timely manner. Even if no other aneurysms in other parts of the body were identified at the time of diagnosis, long-term follow-up is necessary, as over time other aneurysms may develop.

8. References

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