DIAGNOSIS AND TREATMENT OF LOWER LIMB ARTERIES TRUE ANEURYSMS
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ABSTRACT
Lower extremities artery true aneurysm is a rare but significant vascular problem. It is usually found in the popliteal artery, seldom femoral artery. Most important symptoms related with this vascular condition are mainly due to peripheral embolization and untreated may lead to a severe limb ischemia. Usually it is very easy to diagnose such an aneurysm, as we can simply palpate a pulsing knob. Aneurysms can be treated conservatively or surgically. Generally surgical procedure is regarded as a safe and effective method of treatment. Despite rapid development of endovascular techniques open surgery still remains a gold standard of treatment. However, there is still lack of data to confirm the advantages of open or endovascular approach.
BACKGROUND

Aneurysms are segmental, pathological (congenital or acquired), relief (normally baggy) or fusiform dilatation of arterial wall. This definition refers to heart and capillary vessels. We can distinguish two main types – true and false aneurysms.

In case of true aneurysms the wall of aneurysm is a wall of artery as well, despite of the fact that her structural components are progressively disappearing, being substituted by a fibrous connective tissue. False aneurysms are caused by injuries, when blood is pouring out of the artery. This results in connected with lumen of artery hematoma, which is progressively encysting itself. The wall of a false aneurysm consists only of connective tissue, which creates a fibrous bag simulating enlarged wall of the artery. The following work concerns true aneurysms of arteries of lower limbs. Usually they coexist with aneurysms located in other arteries, most often in the aorta. [1,2] They are rarely encountered, because only 1% of vascular patients suffer from this pathology. However 75% of aneurysms of lower limbs are located in popliteal artery and this is the reason why we have decided to focus on them in our elaboration [3]. It is important to emphasize that aneurysms located in lower limbs seldom rapture [4]. Symptoms we encounter are rather associated with embolization and limb ischemia.

HISTORY

First documented and effective trial of surgical treatment of popliteal artery aneurysm was performed by Scottish anatomist and surgeon John Hunter in 1785 [5]. He had noticed the presence of collateral circulation, which motivated him to ligate superficial femoral artery in the middle of its length. The occlusion of blood inflow into the aneurysm inhibited the process of embolization of peripheral vessels. Four out of five patients survived this operation. What is interesting, one of them lived for 50 years after this treatment. In this point it is worth mentioning, that the first endovascular intervention with the use of stent graft was performed by doctor Michael L. Marin in 1994.

ETIOLOGY

Despite many years of research into the causes of aneurysms, their etiology and pathophysiology has not been fully understood yet. We already know, that among multiple risk factors we can distinguish most common ones such as: nicotinism, male sex, age and family history of aneurysms in general. In light of the present studies, the opinion that aneurysms are caused by arteriosclerotic lesions is not valid any longer. Undoubtedly, aneurysms develop as a result of a loss of mechanical integrity of a vessel wall. It is a common belief that etiology of those disorders is comprehensive and has many components. The most crucial ones are:

- inflammation – it has similar course in case of popliteal artery and aortic aneurysm. Genesis of this process is idiopathic, but it is known that reactive forms of oxygen and matrix metalloproteinases cause the destruction of elastin and collagen fibres in a vessel wall
- autoimmunological reaction – although it has been identified in pathogenesis of abdominal aorta aneurysm, it cannot be excluded when it comes to lower limb aneurysms
- mechanical factors – hypertension and turbulent blood flow (for example caused by atherosclerosis) can result in degeneration of a vessel wall

It is important to emphasize, that stenosis can lead to aneurysms. As far as the lower limbs are concerned, the stenosis-like forms can be created by an adductor gap and popliteal arcuate ligament. These structures can constrict arteries and develop narrowings. Just below those narrowings, the dilatations of arteries are formed, which can evolve into aneurysms.

Most of the aneurysms are diagnosed in 5th and 6th decades of life. It affects men more frequently than women, with the ratio 20:1. In 50–90% aneurysms of the arteries of lower limbs coexist with aneurysms of the abdominal aorta. Taking into consideration the localization of aneurysms of the femoral artery we can divide them into those which encompass an outlet of deep femoral artery and those placed peripherally from the outlet. Sixty to eighty percent of the identified aneurysms of the popliteal artery are symptomatic aneurysms [6].

POPLITEAL ARTERY ANEURYSM

Symptoms

The most common popliteal artery aneurysm symptoms are connected with peripheral embolization which causes limb ischemia manifesting itself by intermittent claudication, rest pain and peripheral cyanosis. The presence of popliteal aneurysm can cause acute or critical lower limb ischemia. It may result in necrosis and may lead to amputation. Apart from that peripheral oedema may sometimes appear. This is a result of the compression of the aneurysm sac on popliteal vein. Occasionally an aneurysm presses on the tibial nerve, which causes severe pain.

Diagnosis

In most cases history and physical examination are enough to recognize an aneurysm. Pulsing knob can be palpable in the patient’s popliteal fossa. The diagnosis can be confirmed by performing ultrasonography or CT angiography.

Indications for surgical treatment

All symptomatic, regardless their size and asymptomatic aneurysms with a diameter above 2 cm should be operated on.

Treatment method

The most common way of treating the aneurysms of popliteal artery is open surgical treatment [7]. During the procedure you dissect the aneurysm, then close the blood inflow and outflow. After this preparation you open the aneurysm sac, remove the thrombus, tie off the collateral arteries and reconstruct the blood flow by making an anastomosis end to end with the use of great saphenous vein or PTFE prosthesis (photograph 1). To
separate the bypass from surrounding tissues you sew up the sac above it [8]. An alternative method is by tying off the aneurysm and making a bypass side to end also with the use of PTFE prosthesis or patient’s vein. The downside of this method is difficulty in tying off the collaterals supplying the aneurysm with blood.

The choice between vein and prosthesis is also not clear. The advantage of artificial prosthesis is easier adaptation to the usually extended artery above and below the aneurysm sac. On the other hand, a venous graft is associated with better post-operative results (data from literature indicates that after five years 90% of venous and 60% of artificial grafts remain patent) [9].

Popliteal artery aneurysm can also be treated with the use of endovascular procedure. However, the popliteal artery constantly changes its shape as the result of limb flexion, which makes it much harder to construct a stent graft that wouldn’t suffer damage [10]. On the polish market the only one available is Viabahn produced by Gore company. When it comes to the choice of the treatment (open vs endovascular), it is very important to well evaluate the patient’s state. Before the procedure you have to measure the artery, assess its anatomy as well as the possibility of stent graft insertion. In literature, it is recommended to leave at least 2 cm of the so called landing/sealing zone (area above the aneurysm which is responsible for stent graft fixation). Recent studies suggest that the results of open and endovascular repair are similar [11]. There is a lack, however, of any long-term observations, which could undoubtedly confirm the advantage of one technique.

Complications

The complications, which may appear after open repair are: wound infection, bleeding, graft’s obstruction, pseudoaneurysm in anastomosis site and stent graft migration (photograph 2).

FEMORAL ARTERY ANEURYSM

Symptoms

In the groin an aching and pulsating mass is palpable. It is often accompanied with limb oedema. Veins are often distended and cyanosed (the result of the aneurysm compression on femoral vein)

Indications for surgical treatment

All asymptomatic, regardless their size and asymptomatic with diameter above 2.5 cm should be operated on. If the patient is not suitable for the surgery, USG has to be performed every 3 months to check if the aneurysm does not enlarge. In case of a raptured aneurysm urgent surgery is necessary.

Diagnosis

There is a painful and pulsing knob in a groin. It is often accompanied with swelling, lividity and distension of veins (resulting from compression of femoral vein).

Treatment method

The surgical treatment is very similar to the one performed in popliteal artery aneurysm (photograph 3). In case of a diffuse aneurysmal disease, when there are multiple aneurysms, you tie off the artery (usually from the proximal side) and then restore the blood flow by sewing in a graft to distal the non-aneurysmal part of the artery [12].

Complications

As in the case of popliteal artery, wound infection, bleeding, graft obstruction and pseudoaneurysm in the place of anastomosis may appear.

SUMMARY

The golden standard in treating lower extremity arterial aneurysms are surgical interventions with the use of open surgical approach. They result is a good and long-lasting effect which carries a low risk of both intra- and postoperative complications. It should be kept in mind that in most cases lower extremity arterial aneurysms are accompanied by aneurysms located in other arteries, most commonly in the aorta. Concomitantly a great progress in endovascular treatment has recently been observed. What is more, research in the application of heparin-bonded covered stents is being conducted (for example the Viabahn stent graft). It is very likely that the development of endovascular techniques will significantly reduce the number of performed open surgeries.

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LIST OF THE PHOTOGRAPHS

Photo. 1. Dissected and opened popliteal aneurysm sac (photo taken by the authors during surgical procedure in Centrum Kardiologii Jozefow in 2016, published by courtesy of Robert Proczka MD, PhD and Stanislaw Mazur MD)

Photo. 2. Viabahn stent graft which migrated - angio CT scan (photo taken by the authors from material belonging to 1st Department of General, Vascular and Oncological Surgery, Medical University of Warsaw, Wojewodzki Szpital Brodnowski, published by courtesy of Bartlomiej Kozdaj MD, PhD)

Photo. 3. Big aneurysm located in femoral artery (photo taken by the authors during surgical procedure in Centrum Kardiologii Jozefow in 2016, published by courtesy of Robert Proczka MD, PhD and Stanislaw Mazur MD)