

Palliative Surgical Procedures in Patients Suffering from Critical Limb Ischemia

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Abstract: *Profundoplasty has been established as a standard operative method in the 60s of XX century. This article takes under consideration its present significance, the preoperative diagnostic procedures and applying profundoplasty without reconstructive operations of the SFA to improve the blood supply of the limb. Combining the profundoplasty with lumbar sympathectomy strengthens and even improves the outcome. One of the reasons for the better result is the satisfying artery filling from the pelvis arteries as well as the unobstructed blood drainage through the tibial arteries.*

Keywords: Profundoplasty, lower limb, Lumbar sympathectomy

1. Introduction

The use of profundoplasty as an alternative to femoropopliteal bypass for the treatment of rest pain in cases of severe ischemia of the lower limb is well known. The deep femoral artery is considered to be the most important vessel for the blood supply of the lower limb. The collateral blood supply to the recipient vessel – the popliteal artery is sufficient to deliver an adequate blood supply, despite an occluded superficial femoral artery (SFA). Even in the presence of small ostial plaques on the main branch of the deep femoral artery can significantly affect blood supply. In this case performing only arterioplasty of the deep femoral artery (profundoplasty, PP) without reconstructive surgery for the superficial femoral artery (SFA) appears to be sufficient to improve the blood supply to the limb, from a morphological point of view, especially in cases of stenosis of the deep femoral artery (APF). And the combination with lumbar sympathectomy (LS) improves these results. A prerequisite for a successful PP is the good filling of the pelvic arteries, as well as the good retrograde blood flow (runoff) of the lower leg.

Experimental evidence show that LS can increase the healing of traumatized blood vessels and the passability of small arterial anastomosis. [1,2] Some authors register better postoperative results when combining LS with distal arterial reconstructions [3,4].

2. Literature Survey

The value of the deep femoral artery (DFA) has been established in 1961. Since then the DFA is viewed as the most important blood vessel of the lower limb, because of the collateral vessels linking it to the proximal segment of the popliteal artery (PA).

The first lumbar sympathectomy for treatment of arterial occlusive disease was performed in Buenos Aires by Julio

Diaz in 1924. The placement of LS in the treatment of vascular has been reassessed several times due to different clinical outcomes. Although it was presented many decades ago as a method of treating ischemic and pain disorders of the lower limbs, there is still a dispute over long-term outcomes, clinical evidence and the psychological effects of lumbar sympathectomy.

3. Problem Definition

This article aims to show the benefits of profundoplasty in combination with lumbar sympathectomy in patients suffering from severe limb ischemia, were the deep femoral artery appears to be the "final vessel" in the overall obstruction of peripheral blood vessels.

4. Anatomy and Access

Contains standard from 4 to 5 ganglia (L1 – L5). L1 is situated in front of the body of the first lumbar vertebra, above the second, or anterior to the intervertebral disc. L2 is located in front of the body of the second lumbar vertebra. The next two, L3 and L4, are located the same way inferiorly to the first. The last, L5, is most often located behind the iliac vessels. The right sympathetic trunk lies behind vena cava inferior, and the left near the abdominal aorta.

Complete sympatic denervation is important for achieving an adequate sympathectomy for a particular segment of the limb. With the removal of the chain from L2 to L4, sometimes including L1, we can achieve satisfying results. Removing less of the sympathetic chain may prove insufficient. From the source of sympathetic fibers - lumbar ganglia, depends the length of the sympathectomy. L1 innervates the front of the hip and part of the lower leg. L2 and L3 innervate the back of the thigh and lower leg and L4 the feet.

Single or bilateral LS is performed by retroperitoneal access. Two are the most appropriate accesses - anterior-transversal and anterior-lateral, the first is more commonly used. The last one is used for accessing the iliac vessels. General anesthesia is recommended for performing LS.

The number and position of the ganglia differs. From a practical point of view, the chain should be removed between the site of her appearance, in proximity to the diaphragm legs and the site of her disappearance and under the common iliac vessels. This segment mainly includes the ganglia from L1 to L4.

In some patients the sympathetic trunk is not visualized and has to be located by palpation on the vertebrae.

On the right side the vena cava inferior covers the sympathetic trunk and must be withdrawn. On the left side the sympathetic chain is better available when the lymphatic mass is moved towards the aorta.

The transversal fascia and peritoneum are often grown together anteriorly and separated laterally from retroperitoneal adipose tissue. If during the separation the peritoneum is ruptured or cut, it must be closed. The peritoneum must be moved medial before the front surface of the psoas major muscle is reached.

The genital vessel and the ureter is covered by the parietal sheet of the peritoneum. These structures are easily visible and should not be mistaken with the lumbar sympathetic chain.

5. Complications

Damage to small structures, such as lumbar vessels located near the sympathetic chain, can cause bleeding. This requires temporary compression and haemostasis. Heavier complications include lumbar artery rupture, vena cava inferior rupture, abdominal aorta or iliac vessels rupture, which requires clamping of the respective vessel due to the potential loss of large amounts of blood.

Another complication is ureter damage. A suture is required to repair such a defect.

The removal of the genitofemoral or iliolumbar nerve instead of the sympathetic stem is also an operational error. Impossibility of ejaculation may follow the LS if the first lumbar ganglia is removed. This happens more frequently in bilateral procedures.

The emergence of collateral innervation is the most common cause of a sympathetic denervation failure [8]. The period in which this takes place is different according to the different authors, but in most cases it is from 3 to 5 years.

Diagnosics

In addition to the clinical evaluation and the doppler sonography is the duplex color scanning of the blood vessels of the inguinal area. Performing an angiography of all the blood vessels of the entire lower limb appears to be a completely necessary diagnostic method considering the

clinical stage and the indications for a surgical intervention. The angiographic imaging includes the visualization of the vessels in the aorto-iliac segment for conformation of a good outflow of blood.

Indications

In 1975 Burger concludes that in cases of complete obturation of the superficial femoral artery, there can be a 50% functional stenosis of the deep femoral artery. This can be due to the fact that a small decrease in the arterial diameter can be linked to a bigger decrease in its cross-section and thus retaining its inflow. Because of this profundoplasia (PP) can be an applied alternative for improving the condition of patients with LEAD. In cases where the distal part of the deep femoral artery is clear, it can be used as a main collateral inflow to the distal part of the lower limb that has an occluded superficial femoral artery. LS indications are limited primarily to patients who are unsuitable for vascular reconstruction with resting pain and / or wounds or vasospastic diseases of the limb.

Taking in to account the effects of LV on the circulation of the lower limbs, especially on the feet and fingers, it is essential to determine the operative indications. The following indicators should mainly be evaluated correctly:

- 1) Collateral circulation and its potential capabilities. According to some authors, this is objectively determined by the ankle-brachial index, which must be over 0.3. [7]
- 2) Vasomotor activity of the limbs
- 3) Causalgia

Many authors find that as a result of the effects of well-performed LS, the number of amputations has decreased significantly, even in patients with advanced ischemic changes [5, 6]. Of our studies in isolated PP as the only possible type of vascular reconstruction combined with LS there was registered a cumulative effect in all patient within their hospital stay.

Contraindications

Rapidly progressing ischemic lesions and poor overall condition of the patient.

6. Materials and Methods

In our department over the past 10 years many isolated procedures of arteryoplasty of the deep femoral artery have been performed and also many combined procedures of lumbar sympathectomy and reconstructive vascular operations, such as PP and aorto-profunda bypass in patients with severe limb ischemia.

Before the procedures all patients undergo an CT - angiography. The ankle-brachial index was measured both pre- and postoperative and at the 24th hour. The average difference between the preoperative and postoperative value of the measurements is acquired. At the same time, skin temperature readings with an electronic thermometer were taken on both sides of the foot – dorsal and plantar. For a constant the temperature is measured in the axillar fossa using the same thermometer, the deviation in this value was

deducted by the difference from the pre- and postoperative value of the measurement.

Patients can be divided into three groups: diabetics, non-diabetics and those with thrombongitis obliterans. Best results for all types of combined procedures can be seen in non-diabetic patients. [9, 11].

According to the Fontaine stage in which the studied patients are also divided into three main groups (II, III, IV stage). As chronic arterial insufficiency progresses, we can see reduced results in the measurements of ABI index and skin temperature. [10, 15]

In stages III and IV of LEAD, where there is an inability to perform infrainguinal bypass surgery, PP is the only possible solution to relieve pain and to help cure gangrene. In this case if PP combined with LS is insufficient to provide peripheral blood supply the level of amputation is reduced from the hip to the lower leg.

Results in stages III and IV are significantly less favorable for the salvage of the limb. [12,13]

Patients that undergo aorto-profunda bypass surgery or extensive profundoplasty combined with a LS also show a cumulative effect with rise in ABI index and skin temperature due to a better inflow in the deep femoral artery. [14]

After performing extensive profundoplasty and immediately after that LS, patients had their ABI index and skin temperature measured. A cumulative effect can be seen in the postoperative measurements. There can be seen a decrease in the improvement of the averaged values of the ABI index by reducing the number of passable arteries of the lower leg. [12, 14] However, there is a negative or no effect of these procedures in patients with thrombosis in three tibial arteries. [14, 15]

In chronic SFA occlusion, where the distal part of the SFA and the popliteal artery (AP) is passable the deep femoral artery (PA) appears to be a "terminal collateral". This can be important for results after extensive profundoplasty. Even an insignificant stenosis of the PA has been found to be sufficient to compromise the inflow of blood to the distal part of the limb after PP.

Operational mortality and morbidity in our study are reduced to zero because PP can be performed quickly and sometimes only under local anesthesia in high risk patients

7. Discussion

Our results largely coincide with those of other authors. As can be seen from our practice, a combined approach of lumbar sympathectomy and reconstructive surgery can lead to improvement in patients with critical limb ischemia. By combining LS with PP when femoropopliteal bypass surgery is not possible, the amputation rate can be reduced in patients with critical limb ischemia. When the distal portion of AFS or AP is not occluded, they can be used as the primary collateral. A successful PP also depends on good

blood flow (inflow). Therefore, it is important to assess and / or improve the proximal blood flow.

Local anesthesia can be preferred in high-risk patients. It is important to note that there are patients with significant peripheral vascular diseases who suffer from pain at rest and initial gangrene have a higher risk of complications if they undergo complete anesthesia.

Approximately 70% of the patients have objective evidence of improvement in circulation post-operatively. [12]

The greatest difference from pre- and post-operative results can be seen in patients with chronic occlusion of SFA, AP and tibioperoneal trunk but with three passable arteries.

The objective improvement in ABI is 0.29. There is no evidence of TAO or diabetes mellitus in these patients. Lumbar sympathectomy performed immediately after that also improved ABI by 0.15.

Patients not different from the pre- and post-operative results, with no signaling of the arteries or venous signal only, have complete thrombosis at a. poplitea and the three tibial arteries even in passable a. femoralis superficialis. Accompanying disease is associated with long-standing diabetes mellitus. Subsequent lumbar sympathectomy is also unsatisfactory.

8. Conclusions

Profundoplasty and LS considered a standard surgical method since 1960, there is no summary of the results in recent literature. PP as a single operation and its more frequent combination with lumbar sympathectomy show good early results patients with severe limb ischemia. It can be expected that the results in stages III and IV are significantly less favorable for the preservation of the limb. The use of new techniques, for example the co-administration of endovascular and open surgery methods, have made profundoplasty attractive again.

PP in combination with LS is a good feasible alternative when there is an inability to perform femoropopliteal bypass. This combination improves the collateral and cutaneous capillary blood supply of the lower limb. Distal perfusion increases and peripheral resistance is reduced.

9. Future Scope

The combination of PP with LS can play a key role in limb salvage in patients with severe limb ischemia. If there is need PP can be combined with other endovascular procedures to improve the inflow or outflow of blood. With the constant innovations in minimally invasive surgery in recent years there are many ways to accomplish a LS, such as chemical, radio-frequency, which can be done with a percutaneous access. These methods in combination with PP can make it possible to improve the microcirculation of the lower limb without the need for a second surgical intervention. This leads to an improvement in the patient's vascular status and reducing the amputation rate in patients suffering from severe limb ischemia.

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