THE PROFUNDA FEMORIS ARTERY - A PERTINENT ALTERNATIVE FOR REVASCULARISATION OF THE PATIENTS WITH ATHEROSCLEROTIC OCCLUSIVE DISEASE OF THE LOWER EXTREMIT Y WITH MULTILEVEL LESIONS

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ABSTRACT

Introduction: The profunda femoral artery (PFA) represents one of the most frequently used run-off alternatives for the revascularization of the patients with multilevel lesions, localized both in the aortoiliac and infrainguinal segment (Leriche syndrome type III). Toward of the sequential revascularization, limited in the first step to the profunda femoral artery, it raises the option of complete revascularization. Favorable to the profunda femoral revascularization we bring more reasons and cons, but the main problem remains the mid- and long-term patency of the reconstruction. At this time the specialty literature doesn’t clearly specify the criteria for surgical indication between the patients with revascularization limited on the PFA and the patients with complete revascularization. Material and methods: The study is analyzing the results obtained in 20 cases of revascularization using PFA. Among these 20 cases, 17 were programmed revascularizations and 3 were emergency cases. The postoperative follow-up was between 3 and 15 months, with a mean follow-up of 12 months. Results: The primary patency after 30 days was 96% and 92% at 12 month. The secondary patency was 96 % after one month respectively 12 month. Two amputations were effectuated, one for the thrombosis of the reconstruction and one for severe calf sepsis following fasciotomy, with an overall limb salvage rate of 92%. Conclusion: The results advocate the sequential approach of multilevel atherosclerotic peripheral disease, but only with a good quality PFA as a run-off vessel. There are still necessary supplementary data for statistically validation of these results. Key Words: peripheral arterial disease, multilevel lesions, profonda femoral artery.

INTRODUCTION

The profunda femoral artery (PFA) has an important compensatory role for the collateral blood flow in the aortoiliac atherosclerotic occlusive disease through collateral pathways in the lower pelvis, starting from the internal iliac arteries (or the mesenteric arteries if the internal iliac arteries are affected also). This collateral pathway is more important if the aortoiliac lesions are associated with femoropopliteal lesions (Leriche syndrome type III, the most frequent
type met in the aortoiliac occlusive disease). In this case the PFA represents a “bridge” between the lower pelvis circulation and the infrapopliteal circulation, through the collateral pathways such as the genicular arteries. (Fig. 1)

Figure 1. A PFA with large collaterals in a case of Leriche syndrome type III.

In such circumstances, for the revascularizations performed for multilevel lesions, the question is if the reestablishment of an adequately blood flow exclusive through the PFA is enough for the improvement of the symptoms and assures a good patency of the reconstruction or a concomitant revascularization of the infrainguinal lesions is necessary. The literature presents arguments for each of the above situations.1-4 At this time two major attitudes are established for the revascularization of multilevel occlusive disease:
- Initial reestablishment of the blood flow exclusive through the PFA;
- Complete revascularization of all lesions.

In favor of the first attitude are more arguments such as:
- The solution of the aortoiliac lesions transforms the patient in a patient with lesions localized only on the superficial femoral artery, lesions relatively well tolerated;
- The intervention time decreases considerably, which is an important element for the patients with plurivascular lesions (coronary lesions and/or carotid disease);
- For the patients with tissue necrosis, the revascularization of PFA is considered to be enough for their healing or for minor amputations (solving the tissue necrosis in the same surgical time with the distal revascularization is considered to have an increased septic risk);
- In the case of unsatisfactory amelioration of the symptoms or if complications appear it is possible to perform a reintervention for distal revascularization.

For the second attitude (per primam complete revascularization) there are a few arguments:
- The operative time can be decreased using two surgical teams;
- It avoids the reintervention in the Scarpa’s triangle, relatively difficult through the existing adherences.

A peculiar case represents the emergency surgical intervention for acute ischemia of the lower limbs in patients with preexisting infrainguinal lesions (occlusive disease of the superficial femoral artery) and with arterial disease of aortoiliac arteries. These patients develop an acute ischemia by thrombosis of an atheromatous plaque of the iliofemoral vessels or by an embolus in this segment with subsequent flow cessation through PFA.

In this situation the reestablishment of the blood flow through the PFA may not be enough for the decrease of acute symptoms and an infrainguinal revascularization might become necessary. Supporting the reestablishment of the blood flow only on the PFA are the following arguments:
- The revascularization on PFA brings back the patient in the situation before presenting the acute lower limb ischemia;
- Decrease considerably the operative time (a very important element for an emergency procedure);
- Can be performed in local anesthesia, minimum aggressive for the patient;
- Lowering the importance of the distal reperfusion it decreases the incidence of some complications such as the reperfusion syndrome (compartment syndrome or acute renal failure);
- The relief of acute symptoms provides the necessary time for angiographic evaluation of the patient with the establishment of further optimum revascularization (it can be considered risky a distal emergency revascularization without preliminary imaging techniques).

Between these two options (PFA revascularization versus complete revascularization), the specialty literature doesn’t infirm either of them, and good results have been obtained with both methods.5,8 The recent guidelines for critical ischemia in patients with multilevel lesions, recommend as a first step, the revascularization of the aorto-iliac lesions, followed (if the symptoms persist or if the ankle-arm pressure index is below 0.8) by a distal revascularization.9,10
Decisive for the surgical decision is the angiographic aspect of the PFA (caliber, collaterals, the presence of stenosis). The final decision is offered by the intraoperative reevaluation of the PFA (caliber, the length of the pervious segment and the presence of the atherosclerotic lesions at this level- even it says that the atherosclerosis avoid the profunda femoris artery sometimes important lesions can be found, especially in the proximal segment). Some authors consider that the PFA with the caliber higher than 4 mm, which allows the passage of a 4 F diameter Fogarty catheter for a length of 20-25 cm is sufficient for a good quality outflow. A good retrograde flow, although a subjective criteria, offers additionally guarantee.

An important technical element is represented by the fashion of the distal anastomosis. This can be made in three different techniques:

- Anastomosis on the bifurcation of the common femoral artery;
- Anastomosis started on the common femoral artery and continued on the first segment of the PFA - the profundoplasty; (Fig. 2)

![Figure 2. Distal anastomosis with profundoplasty of the right prosthetic arm in an aorto-bifemoral by-pass.](image)

- Anastomosis entirely on the PFA (in case of severe proximal lesions).

The choice of either of them is made according to local existing conditions, with respect for a good outflow through the PFA.

**AIM OF THE STUDY**

By the reasons prior exposed the revascularization on the PFA determined a peculiar concern, including the Cardiovascular Surgery Clinic of Institute of Cardiovascular Medicine (ICM) Timisoara, the place where the author was formed, and where there is a special preoccupation for this aspect.

Starting from a rich experience accumulated in ICM Timisoara, the present paper analyses the results obtained through the revascularization on the PFA, using a lot of 20 consecutive cases, which reflects the recent experience of the author (cases operated in the First General Surgery Department of Clinic Emergency Municipal Hospital Timisoara and in the Vascular Surgery Department of the Clinical Emergency County Hospital Timisoara). The results obtained were appreciated comparatively with the similar data offered by the specialty literature.

**MATERIAL AND METHOD**

Our group includes 20 consecutive cases of revascularization using PFA as a run-off, reflecting the personal experience of the author between 01.07.2005 – 31.12.2006. The inclusion criteria were the presence of significant multisegmental disease (aorto-iliac and infrainguinal lesions) in patients with planned and also emergency procedures using only PFA as the first choice for revascularization.

For the planned operations the diagnosis was established using imaging methods (basically standard angiography with a single exception – a patient which had a MRA). The contraindications for using PFA as a unique run-off were represented by a poor aspect on the angiography (small vessel without significant collaterals, poor visualization) corroborated with the intraoperative aspect (diameter < 3 mm, high bifurcation with small collaterals).

In emergency cases the diagnosis was clinically anticipated (history of claudication on the affected limb, presence of the risk factors) and established during the procedure (usually occlusion of the femoral superficial artery).

The analyzed parameters were:

- General data: age, sex, associated atherosclerotic lesions (coronary vessels and/or carotid arteries), risk factors, and clinical stage of disease;
- Specific data: type of revascularization, type of distal anastomosis, primary and secondary patency at 30 days, 6 and 12 months, the degree of residual ischemia after discharge of the patient, the necessity of a infrainguinal revascularization, other complications, including death, during first 30 days after surgery.

The follow-up included postoperative controls at 30 days, 3, 6, 12 and 15 months; the average follow-up period was 12 months. In three cases the patency of reconstructions was proved by a control angiography.
RESULTS

1. General characters: distribution regarding age, gender, sex, comorbidities, risk factors, clinical stage of the disease.

Age: the range was between 46-77 years, with a maximum of cases in two decades of life: 50-59 respectively 60-69 years. (Table 1)

Table 1. Patients’ age distribution.

<table>
<thead>
<tr>
<th>Decade of life</th>
<th>40-49 years</th>
<th>50-59 years</th>
<th>60-69 years</th>
<th>70-79 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n = 20)</td>
<td>2 (10%)</td>
<td>7 (35%)</td>
<td>8 (40%)</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

Gender: the group included 17 men (85%) and 3 women (15%).

Co-morbidities: we looked for other localization of the atherosclerotic disease (coronary disease, carotidian lesions) and for the presence of atrial fibrillation. From this point of view, 6 patients (30%) presented coronary disease and 3 patients (15%) showed carotidian disease. Atrial fibrillation was present in 2 cases (10%).

Risk factors: the disease most frequently associated as a risk factor was arterial hypertension, which was noted in 18 patients (90%). The second disease was diabetes mellitus, present in 4 patients (20%). Regarding smoking, all men and one woman were smokers.

Clinical stage of disease: we used Leriche-Fontaine classification completed with critical limb ischemia (severe pain lasting for two weeks with no response to antalgic medication with or without tissue loss) and acute lower limb ischemia. (Table 2)

Table 2. Clinical stage of disease at the time of presentation.

<table>
<thead>
<tr>
<th>Clinical stage of disease</th>
<th>II B</th>
<th>III</th>
<th>IV</th>
<th>Critical limb ischemia</th>
<th>Acute limb ischemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n = 20)</td>
<td>3 (15%)</td>
<td>1 (5%)</td>
<td>10 (50%)</td>
<td>3 (15%)</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

2. Particular characters: included technical aspects and follow-up data.

Type of revascularization: we performed 6 bilateral revascularizations (aorto-bifemoral by-passes), 11 unilateral (aorto and ilio-femoral by-passes) and 3 emergency procedures (three thrombembolectomies with Fogarty catheter, one of them involving also a profundoplasty) (Table 3)

Distal anastomosis: in the 17 cases, which required a by-pass, we have performed 23 distal anastomosis (6 revascularizations were bilateral) in three different techniques:
- Anastomosis on the common femoral artery at the bifurcation – 3 (13%);
- Profundoplasty – 9 (39%);
- Anastomosis performed entirely on the PFA – 11 (48%).

Table 3. Type of revascularizations performed in the studied group.

<table>
<thead>
<tr>
<th>Type of revascularization</th>
<th>Aorto-bifemoral by-pass</th>
<th>Aorto-femoral by-pass</th>
<th>Ilio-femoral by-pass</th>
<th>Fogarty thromboembolectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n=20)</td>
<td>6 (30%)</td>
<td>5 (25%)</td>
<td>6 (30%)</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

Thrombosis of the arterial reconstruction was noted as follow:
- Under 30 days (early thrombosis) – 1 case (5%);
- Between 1-3 months – 1 patient (5%);  
- Over 3 months – none.

Primary patency at 30 days after procedure was 96% and 92% at 12 month.

Secondary patency at 30 days was 96% and also 96% at 12 month.

Infrainguinal extension (femoro-popliteal by-pass): was necessary for thrombosis of reconstruction (in adjunction with Fogarty dezobstruction) and for residual ischemia. In our study residual ischemia is defined by the persistent claudication following revascularization, as a consequence of the remaining infrainguinal lesions. The significance of the residual ischemia was appreciated starting one month after surgery (under 30 days the pain is usually intricated with the pain generated by the surgical wounds). According to the Leriche-Fontaine classification the residual ischemia was appreciated as stage II A (claudication after walking more than 100 meters), stage II B (claudication after walking less than 100 meters) and stage III (rest pain – it was not the case in our study). The distribution of cases which required infrainguinal extension is depicted in Table 4.

Table 4. Cases that required infrainguinal extensions.

<table>
<thead>
<tr>
<th>Infrainguinal extensions</th>
<th>0-30 days</th>
<th>1-3 month</th>
<th>3-6 month</th>
<th>&gt; 6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n = 20)</td>
<td>1 (5%)</td>
<td>1 (5%)</td>
<td>2 (10%)</td>
<td>0</td>
</tr>
</tbody>
</table>
number of revascularized lower limbs (which is 26) the rate of limb salvation is 92%.

The degree of residual ischemia: it was not more severe than stage II B (please note that in the first 30 days the group lost one patient, so the lot consists now in 19 patients). Table 5 A suggestive aspect regarding the severity of ischemic pain at the admittance and after 30 days following surgery can be seen in Table 6.

Table 5. The degree of residual ischemia after surgery.

<table>
<thead>
<tr>
<th>Residual ischemia</th>
<th>Number of patients (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No residual ischemia</td>
<td>9 (47%)</td>
</tr>
<tr>
<td>Stage II A</td>
<td>6 (32%)</td>
</tr>
<tr>
<td>Stage II B</td>
<td>4 (21%)</td>
</tr>
</tbody>
</table>

Mortality: during the first 30 days after surgery one death was recorded, which means a mortality rate of 5%. The cause of death was sepsis, with septic shock (this case was also complicated with evisceration and early thrombosis of an prosthetic arm which required a thigh amputation).

Other complications:
- Wound problems – 2 cases;
- Compartment syndrome (required fasciotomies) – 1 case;
- Reintervention for hemostasis (technical error) – 1 case.

DISCUSSION

The first remark to be made is about the clinical stage of disease with a surprising large number of patients presented in an advanced stage of disease (stage IV or critical limb ischemia) – 65%! This is a critical point for the health assistance system in this particular field of peripheral atherosclerotic disease, which involves both general population (with a low level of elementary knowledge about this disease) and also general practitioners.

Another aspect is the severity of the suprainguinal lesions. In all our patients we had significant stenosis (more than 75%) or complete occlusion of the suprainguinal vessels. Of course, if we talk about a mild stenosis (between 50-75%) in the suprainguinal level, it is a high probability that flow restoration using only the PFA would be not enough to alleviate symptoms and/or to heal throphic lesions. In such cases a complete supra and infrainguinal revascularization is mandatory.

We appreciate the results of revascularizations performed on the PFA as good (despite the relatively low number of the patients), with a high rate of primary and secondary patency, comparable with the results reported by another authors. Three patients had control angiography, which proved the patency of reconstructions. (Fig. 3) The mortality rate was quite high but it is due to a single death and the cause of death was not correlated with the type of procedure.

Figure 3. The aspect of a distal anastomosis performed entirely on the PFA in an aorto-femoral graft (6 month control angiography).

Regarding the early thrombosis it was only one case, which was the only one investigated by MRA and probably this conducted to a misjudgment about the quality of the run-off through the PFA. This case also presented severe general complications (sepsis with a poor hemodynamic status) that contraindicated a distal revascularization and an emergency thigh amputation was performed; anyway the evolution of the patient was to exitus.

The infrainguinal extension (femoro-popliteal bypass) was necessary in 4 cases, one case under 30 days after procedure and three cases between 1-6 month
after procedure. These four cases had a few particular aspects:

- One patient with an aorto-bifemoral by-pass presented soon after surgery bilateral distal lower limb ischemia, with a patent reconstruction (good pulse in both groins). It was performed a bilateral infrainguinal extension with good outcome. The mechanism of distal ischemia was unclear, probably done by an atheroembolism (poor quality of the aortic wall). Control angiography proved the patency of all by-passes;

- One case was a patient with a thrombosed ilio-femoral by-pass 2 months after surgery due to inadequate doses of oral anticoagulants; for safety reasons we performed thrombectomy and infrainguinal extension with a good final result.

- In two cases the infrainguinal extension was performed between 3-6 month after surgery because of a short claudication (about 50 meters). The distal revascularization was performed successfully, without complications regarding the approach of the prosthesis in the Scarpa’s triangle.

Regarding the mortality we can say that it reflects the comorbidities and the septic risk. The patient died after a severe infectious complication (evisceration followed in evolution by a septic shock and exitus).

Another aspect of our discussion is the high incidence of the patients with tissue loss at the moment of surgery (about 65%). It should be emphasized that the flow restoration through the PFA allowed the healing of the skin lesions or the limited amputations performed (toes, forefoot) which significantly reduced the septic risk for a delayed infrainguinal revascularization.\(^{13}\)

A final remark is about the revascularization using PFA in emergency cases (acute lower limb ischemia) in patients with chronic occlusion of the superficial femoral artery and stenotic lesions of the iliac arteries. These patients should be considered as an initial experience of using PFA in emergency situations. In all three cases the reestablishment of the flow through the PFA (by performing a thrombembolectomy of the ilio-femoral axis with the Fogarty catheter) was enough for the relief of the acute symptomatology. One case required also a profundoplasty because of a severe stenotic lesion at the origin of the PFA. This approach is quite expeditive and could be done using only local anesthesia, two important aspects in an emergency procedure. Doing this way you get the necessary time to obtain, in the following days, an angiography in order to have a clear idea about the quality of the native vessels. This is an important aspect for the vascular surgeon to take the right decision for a subsequent planned arterial revascularization.

**CONCLUSIONS**

As a conclusion, even the number of cases was not too large, we affirm that the PFA can be used safely as a run-off in multilevel occlusive disease of the lower limb in patients with severe stenosis and/or occlusion of the suprainguinal vessels corroborated with a good quality of the PFA. It is to be studied on a larger number of patients for getting more data to statistically support this statement.

**REFERENCES**