ORIGINAL ARTICLE

AMPUTATION PREVENTION: EXPERIENCE IN BYPASS SURGERY

ABSTRACT

Introduction: The development of chronic peripheral arteriopathy in the infrapatellar axis is closely related to diabetes. The disease's most advanced stages are a frequent reason for consultation and hospitalization, generally due to unhealed lesions of long evolution. In many cases, the need to revascularize the axis is crucial to prevent its progression and improve its evolution. Failure to act in the resolution may lead to the compromise of the limb up to its loss.

Objective: To disseminate a surgical team's experience using infrapatellar bypass as a valuable resource in preventing amputations due to ischemia.

Material and methods: A retrospective study of 87 infrapatellar revascularizations by the same surgical team from April 2023 to June 2024, with venous bypass as the revascularization method.

Results: The most frequent complication after the procedure was wound dehiscence (28%); major amputation was observed in approximately 6%. Of the sample, 89 % (78 patients) maintained the bypass permeable at 3 months. Of the remaining patients, 5 underwent amputation, and 4 had thrombosis within the first 10 days.

Conclusion: Infrapatellar bypass has proven to be an effective revascularization option. It can improve the quality of life and survival rate by avoiding serious complications associated with ischemia.

Keywords: *infrapatellar bypass, revascularization, diabetes.*

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INTRODUCTION

The current prevalence of chronic peripheral atheropathy worldwide is unknown, although it is estimated to affect more than 200 million people[1]. In the more advanced stages of the disease, there may be severe involvement of the lower limbs, which may lead to amputation[2]. Limb revascularization attempts to limit the progression of the disease and prevent its loss.

The number of people with diabetes in the world increased from 108 million in 1980 to 830 million in 2022. The progression of this disease has increased most rapidly in low- and middle-income countries[3]. The prevalence of diabetes mellitus in Argentina is 8% in the adult population, and almost 50% are undiagnosed. Diabetes is a significant cause of blindness, renal failure, myocardial infarction, and stroke[4]. In vascular disease, as it progresses, the marked relationship between diabetes and the alteration in the infrapatellar axis, which is usually observed in arteriography, is frequent (*Figures 1A and 1B*). Moreover, it is the most significant risk factor for non-traumatic lower limb amputation. Approximately 60-70% of patients with lower limb amputation have diabetes. The 5-year mortality rate after lower limb amputation is high and can exceed 50% in patients with comorbidities such as diabetes and peripheral arterial disease[5-7].

The primary goal of bypass is to restore adequate blood flow to the lower extremities compromised by arterial blockages. Improving blood flow results in symptom relief, improves ulcer healing, and reduces the need for amputation in patients with severe ischemia. Venous bypass as a revascularization strategy increases the likelihood of prolonged improvement of the ischemic foot[8,9].

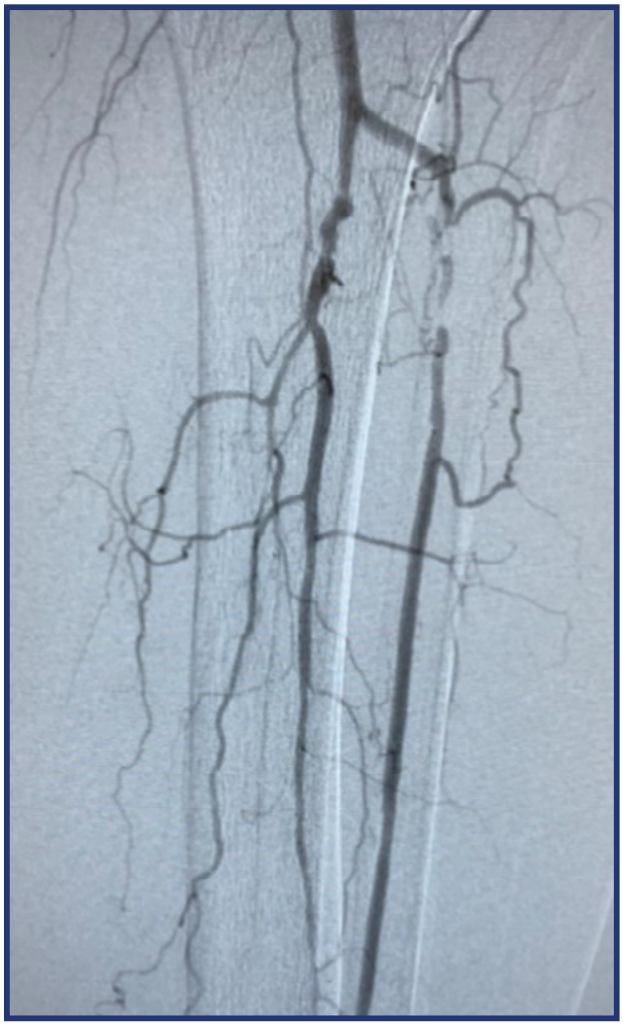

FIGURE 1A. Critical anterior tibial artery lesion with occlusive lesion of the posterior tibial artery.

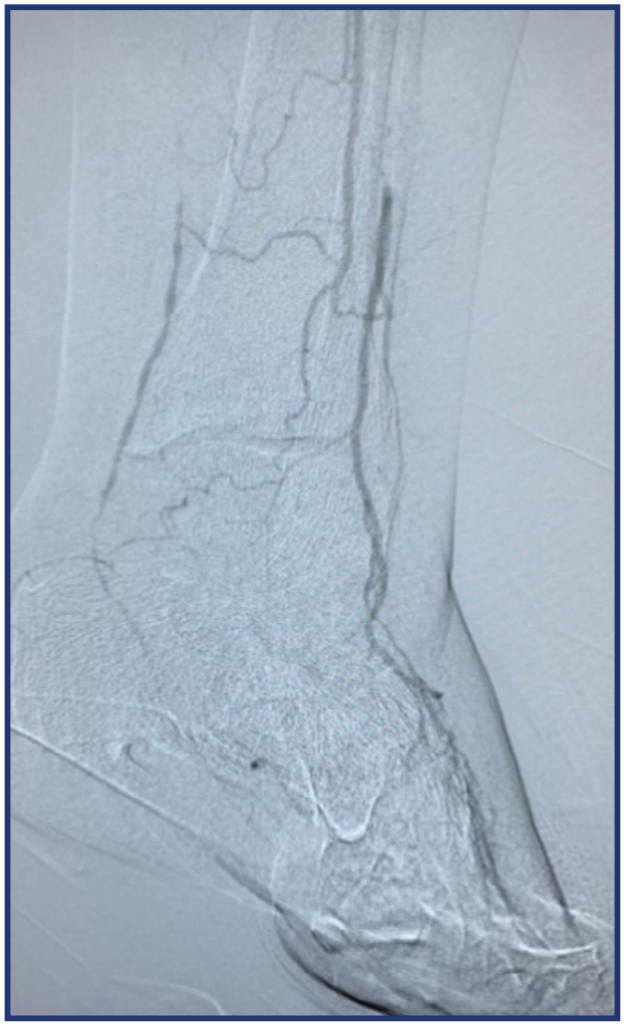

FIGURE 1B. Recanalization of the anterior tibial and posterior tibial arteries by the peroneal artery.

METHODS

Retrospective study of 87 infrapatellar revascularizations by the same surgical team, including 51 popliteal-pedial (*Figures 1C and 1D*) and 36 posterior popliteal-tibial bypasses between April 2023 and June 2024. Internal saphenous vein grafting was used in all. In addition, the study included patients with previous revascularization of the same or contralateral limb or even myocardial revascularization (*Table 1*). More than 88% of the revascularizations were performed in a condition of threatening limb ischemia with the presence of associated trophic and necrotic lesions. The pharmacological strategy in 14 patients requiring endarterectomy included acetylsalicylic acid at 100 mg every 24 h plus enoxaparin at an anticoagulant dose until discharge. After discharge, they continued with oral anticoagulation for 3 months and only with antiplatelet agents.

FIGURE 1C. Distal anastomosis over the pedicle artery.

RESULTS

To evaluate the efficiency of the procedure, we considered the presence of a pulse on the bypass, the improvement of the patient's symptoms and the size of the previous lesions, the lack of need for amputations and surgical cleaning beyond the necrotic tissue existing before the time of revascularization, if present, and Doppler ultrasound three months after the procedure with the presence of flow in the bypass. Among the associated complications, the most frequent was wound dehiscence due to reperfusion edema (approximately 28%), followed by infections (9%). Complications extended the hospitalization period, always longer than 7 days, in all patients. The most serious events (major amputations) occurred in almost 6%. Death was not recorded in the 3 months after surgery. The most frequent risk factor in these patients with chronic infrapatellar peripheral arterial disease was diabetes (93.1%). One hundred percent of the patients (78) evaluated at 3 months by the outpatient clinic maintained a patent bypass. This number of patients had to be adjusted from the initial sample since 4 patients presented thrombosis within the first 10 days and were referred to hemodynamics; in another 5 patients, supracondylar amputation was performed on the revascularized limb. Despite the clinical improvement with the procedure, most patients required some minor amputation and surgical cleaning after revascularization.

DISCUSSION

The worldwide prevalence of chronic peripheral artery disease has shown a significant increase in recent decades, affecting more than 200 million people worldwide. It has a remarkable progression in patients with type 2 diabetes mellitus[1]. In this context, diabetes is one of the most prevalent risk factors for the development of this disease, and the relationship with lower limb amputations is increasingly recognized in medical literature[2]. The 5-year mortality rate after lower limb amputation can exceed 50% in patients with comorbidities such as diabetes and peripheral arterial disease, which underlines the importance of therapeutic interventions to prevent[5-7].

In this retrospective study of 87 infrapatellar revascularizations performed by a single surgical team, the results of the use of popliteal-pedial (51 cases) and posterior popliteal-tibial (36 cases) bypass with internal saphenous vein grafting were evaluated in patients who were mostly in life-threatening critical ischemia of the lower limbs.

FIGURE 1D. Popliteal-pedial bypass.

Characteristics	N (87)	Percentage (%)
Sex		
Male	49	56.33
Female	38	43.67
Age (years)		
50-60	13	14.95
61-70	39	44.83
71-80	29	33.33
81-90	6	6.89
Revascularizaed vessel		
Pedial artery	51	58.62
Posterior tibial artery	36	41.38
Associated endarterectomy		
Yes	14	16.09
Comorbilidities		
Diabetes mellitus	81	93.10
Arterial hypertension	75	86.20
Smoking	15	17.24
Ex-smoker	58	66.66
Complications		
Wound dehiscence	24	27.58
Infection	8	9.19
Thrombosis	4	4.59
Major amputation	5	5.74
Restenosis	2	2.29

TABLE 1. Summary of patient demographic and clinical characteristics.

The choice of venous bypass in all cases reflects its efficacy and long-term durability, and it is widely used due to its favorable hemodynamic properties and easy availability. The literature supports this approach, as venous grafting is a safe and effective option for the revascularization of patients.

The finding that more than 88% of revascularized patients had limb-threatening ischemia with associated trophic or necrotic lesions reinforces the severity of the disease in the population studied. This fact highlights the need for early intervention in these patients to avoid progression to amputations and improve functional prognoses and quality of life. In line with this need, bypass revascularization has proven to be an effective strategy to restore blood flow to the lower extremities, alleviate symptoms, improve ulcer healing, reperfuse the affected territory rapidly, and ultimately reduce the need for amputations. In 2024, a study analyzed 665 revascularized patients; 326 received open tibial bypass, and 339 received tibial endovascular intervention. It was concluded that an adequate single segment of the internal saphenous vein in infrapopliteal revascularization for chronic limb-threatening ischemia: open bypass surgery was associated with a lower incidence of death and fewer major amputations compared with endovascular intervention. Amputation-free survival was similar between groups[8].

CONCLUSION

Revascularization can improve quality of life and survival by avoiding serious complications associated with ischemia. Infrapatellar bypass is an effective and fast-access revascularization option in the need to reverse the last stage of chronic peripheral arterial disease, such as limb-threatening critical ischemia. In our setting, other revascularization methods carry a higher risk of amputation depending on the time and the elements necessary to perform them. Diabetes was present in 93% of the cases and is the most influential factor for the development of infrapatellar pathology.

As a limitation of this study, the follow-up of patients at 6 months was less than 60%, with patent bypass in all of them.

Declarations

The authors declare no conflict of interest.

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