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# Femoro-Distal Bypass with Varicose Veins Covered by Prosthetic Mesh

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***Background.*** **The great saphenous vein (GSV) is the material of choice in distal bypass for critical limb ischemia (CLI). Varicosities have been reported as the cause of inadequacy of vein in up to 20% of patients. The hypothesis of this study is to consider the external mesh as a technique to use like conduit, in patients with varicose veins and in young patients with ecstatic veins, with results that at least overlap the traditional technique. We report our experience with bypass surgery using autologous varicose vein covered with prosthetic mesh.**

***Materials and Methods.*** **From May 2005 to July 2008, 249 infrapopliteal bypasses were performed to treat CLI. Twenty-one patients were selected from this group to receive bypass covered by polyester external mesh (ProVena; BBraun, Aesculap, Tuttlingen, Germany). Seventeen patients had varicose veins, four young patients had venous ectasia or previous bypass failure for dilatation. Graft patency was evaluated at 1, 3, 6, and 12 mo, and every 6 mo thereafter. All patients underwent epidural anesthesia with ropivacain 0.75%.**

***Results.*** **The mean follow-up time was 32 mo. No dilatation or infection was found in this period. Two early bypass thromboses were recorded and treated immediately. Two lesions were treated at 3 and 8 mo with surgical substitution of the distal portion and PTA of focal intermediate stenosis, respectively. Primary patency at 24 mo was 57.1% (SE ± 3.9), assisted 81% (SE ± 3.2), and had an amputation-free survival rate of 85.7% (SE ± 2.8). In other bypass without mesh, primary patency was 63.8%, secondary 80.5%, and amputation-free survival rate 89.3% at 24 mo.**

***Conclusion.*** **Polyester external mesh is a valid method to perform bypass with autologous material, as ectatic or varicose veins. Moreover, in young patients with long-term bypass patency expectancy, it prevents vein dilatation during arterialization process.** 

***Key Words:*** **femoro-distal bypass; vein graft; external polyester mesh support.**

## INTRODUCTION

The surgical treatment of critical ischemia with bypass can be performed using different graft materials. Nevertheless, autologous saphenous vein is still the treatment of choice due to its long-term patency and resistance to infections [1–5]. Furthermore, Recommendation 40 of the TASC II states that the great saphenous vein (GSV) is a better conduit in which to perform femoro-distal bypass. In its absence, other good quality veins, such as the lesser saphenous vein (LSV), arm vein, or other GVS, should be used [6]. The incidence of the absence of an adequate ipsilateral GSV has been reported to be as high as 40% to 45% [2, 6]. The absence or the nonoptimal quality of this conduit is due to previous treatment of varicose veins, its use in a previous bypass (e.g., coronary bypass), an insufficient diameter, or the presence of varicose dilatation.

Varicose dilation may involve an isolated segment or the entire vein. In addition, the basilic vein, taken from the upper limb, is usually thinly walled and has a large diameter; therefore, it is susceptible for long-term dilatation [7, 8]. These situations are usually a contraindication to autologous vein grafting due to the increased formation of intimal hyperplasia and dilatation, which could lead to aneurism formation and thrombus apposition [9–13]. Attention to this problem is crucial in younger patients undergoing vein bypass graft. Young people have a long life expectancy, and their arterialized veins frequently undergo progressive dilatation [7].

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**TABLE 1**

**Demographic Data and Risk Factors in the Patients of the Whole Series**

| Age, median (range) | 62 (34–84) | | CLI group without mesh | *P* value |
|---|---|---|---|---|
| | *n* | % | | |
| Male | 15 | 71% | | |
| <40 y | 4 | 19% | | |
| Smoking | 10 | 47% | 73% | <0.005 |
| Hypertension | 16 | 76% | 62% | <0.05 |
| Diabetes | 8 | 38% | 61% | <0.005 |
| Hyperlipidemia | 9 | 42% | 46% | >0.5 |
| Coronary artery disease | 10 | 47% | 46% | >0.5 |
| Chronic pulmonary disease | 9 | 42% | 59% | <0.005 |
| Renal insufficiency | 3 | 14% | 20% | >0.25 |
| ESRD | 2 | 9% | 14% | >0.25 |
| Mean ABI | 0.39 | ±0.007 | 0.37 ± 0.005 | >0.5 |

Several researchers who have conducted animal studies have described a beneficial effect of an external polyester support on reducing neointimal hyperplasia [9, 10]. This effect is mediated by the promotion of angiogenesis and the formation of a neo-vasa vasorum. The promotion of angiogenesis is further mediated by the accumulation of a pro-angiogenic exudate in the space between the graft and the sheath. The external sheath must be loose-fitting to allow for the normal expansion of the vein, in response to arterial pressure, in order to elicit the inhibitory effects on graft thickening, in contrast to restrictive stents, which can augment graft hyperplasia [10, 14].

Porosity is crucial for the beneficial effect of the external sheath. The external sheath acts to contain the graft, prevents turbulent blood flow, and significantly improves long-term patency rates compared with unsupported grafts [9, 10, 13]. An external polyester mesh tube provides external support for autologous vein grafts and limits postoperative dilatation [13]. An external support has been proposed to increase the use of large diameter veins that are otherwise considered unacceptable for arterial replacement. Clinical studies have shown acceptable results utilizing varicose vein grafts with prosthetic reinforcement [15].

The hypothesis of this study is to consider the external mesh as a technique to use like conduit, in patients with varicose veins and in young patients with ecstatic veins, with results that at least overlap the traditional technique.

We evaluate the early and late results in terms of patency rate and vein graft dilatation in infrainguinal bypasses covered by prosthetic mesh in patients with varicose veins and in young patients with regular or large veins. The secondary endpoints were the evaluation of possible infection of bypass, tendency of dilatation, and practical problems related to the use of external scaffolding.

**TABLE 2 (A)**

**Indication to Treatment in Patient with External Mesh**

| | |
|---|---|
| Critical limb ischemia | 14 |
| Redo procedure | 3 |
| Acute ischemia | 2 (traumatic injury and thrombosis of popliteal aneurysm) |
| Popliteal aneurysm | 2 |

## MATERIALS AND METHODS

From May 2005 to July 2008, 249 infrapopliteal bypasses were performed to treat critical limb ischemia (CLI). Patient demographics and indications for treatment are reported in Table 1, Table 2A and B. Patients with extensive wet gangrene were excluded, as in these cases we preferred the use of autologous material for the bypass. Preoperative evaluations were conducted *via* clinical examination and ultrasound arterial mapping (USAM). The angiography was also used in select cases (i.e., young patients and redo procedures). We performed angiography in three patients who had previously failed revascularization performed in other institutions with occlusion of previous bypass, and in young patients. The previous revascularizations entailed a popliteal-tibial bypass in the greater saphenous vein, and two femoro-popliteal in PTFE (one above-knee and one below-knee), in these patients we performed a new bypass.

With echo-scan, veins were assessed throughout the limb by measuring the diameters in orthostatic position for GSVs and LSVs. The veins of the arms were assessed using proximal compression.

Inclusion criteria for the use of the mesh were (1) the presence of suboptimal venous material due to varicosities or ectatic dilatation and (2) patients under the age of 40. A multifilament polyester mesh was utilized for the study (polyethylene terephtalato: ProVena; BBraun Aesculap, Tuttlingen, Germany). It was an open, porous prosthesis with a honeycomb-like structure to allow for the intraoperative external scaffolding of autologous veins (see Fig. 1). The choice of external mesh was based on the mean diameter evaluated at echo-scan. All patients were informed of the type of revascularization and the possible complications resulting from the use of prosthetic coating prior to enrollment in the study.

In 21 patients, autologous veins covered by polyester external mesh were used. Alterations were found in four patients in the initial portion of the GSV with a normal distal segment. In 13 patients, all of the veins were covered with a minimum diameter of 6 mm and a maximum diameter of 12 mm ($m = 7$ mm). In six cases, bypass was performed by spliced vein with total (one case GSV + arm vein) or partial (three GSV, two arm vein) external mesh (see Table 3). The remaining four cases involved young patients with

**TABLE 2 (B)**

**Indication to Treatment in Patient Without External Mesh**

| Clinical presentations | No. of the patients (%) |
|---|---|
| Foot finger gangrene | 56 (24) |
| Ante foot gangrene | 41 (18) |
| Hind foot gangrene | 34 (15) |
| Ulcers | 69 (30) |
| Rest pain | 28 (12) |