Below-knee Popliteal and Distal Bypass with PTFE and Vein Cuff

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Objectives: To determine the value of PTFE grafts with a distal vein cuff as a conduit for below-knee (BK) popliteal and distal bypass in the absence of autologous vein.

Design: Retrospective study.

Materials and methods: Forty below BK popliteal and distal bypass procedures in 39 patients with PTFE and distal vein cuff (Miller cuff n = 31, Wolfe cuff and adjuvant arteriovenous fistula n = 9). Nineteen primary and 21 secondary reconstruction procedures.

Results: The primary patency rate was 62.5% at 1 year falling to 50% at 2 years. The secondary patency rates were very similar owing to poor outcome of thrombectomy. Ten cases (25%) resulted in major amputation postoperatively. There was a tendency towards better outcome for primary procedures compared to secondary/reo procedures.

Conclusions: BK popliteal and distal bypass with PTFE and distal vein cuff is a worthwhile procedure in the absence of autologous vein. The value of thrombectomy following thrombosis of a secondary bypass procedure with PTFE and distal vein cuff is questionable.

Key Words: BK popliteal and distal bypass; PTFE; Miller cuff; Patency; Thrombectomy.

Introduction

Autologous vein remains the best available conduit for femorodistal bypass procedures. When autologous vein is either not available or unsuitable, a prosthetic graft must be used for the bypass procedure. Expanded polytetrafluoroethylene (PTFE) was introduced in the 1970s for clinical use as small-calibre arterial substitute. Although grafting with PTFE produces acceptable results for above-knee femoropopliteal reconstructions, its use remains controversial for femorodistal bypass procedures. Due to unsatisfactory patency rates achieved with PTFE for femorodistal grafting, some surgeons have suggested that primary amputation should be considered if autologous vein is unavailable. However, if acceptable limb salvage rates are achieved, femorodistal grafting is economically viable. Some modifications have been suggested to optimise patency, and interposition of a vein cuff at the distal anastomosis was first described by Siegmann in 1979. The technique was further developed by Miller, who reported promising early clinical results in 1984 and later by Tyrrell and Wolfe. The cuff was originally employed to facilitate the technically demanding distal anastomosis, but preliminary results from a randomised trial comparing PTFE grafts with and without Miller cuff show a clear advantage for the Miller cuff A modification of the venous cuff technique, with construction of an adjuvant arteriovenous fistula at or close to the distal anastomosis has been proposed to enhance patency, theoretically by augmentation of blood flow through the prosthetic graft.

In the absence of a suitable vein we have used a PTFE graft with vein cuff for below-knee (BK) popliteal and distal reconstruction for more than 5 years. The purpose of the present paper was to describe our results with this technique.

Material and Methods

We performed 40 BK popliteal and distal bypass procedures with thin-wall, ring-supported PTFE and distal vein cuff in 39 patients from October 1990 to January 1996. There were 17 men and 22 women with a mean age of 74.5 years (range 55–88 years). The indication for surgery was critical ischaemia in all cases. Three patients had diabetes mellitus. We performed 19 primary procedures in which the saphenous
vene was absent or unsuitable due to previous surgery or thrombosis, and 21 secondary grafting procedures, in which the saphenous vein had been used for in situ bypass to the same segment. Interposition of a Miller cuff was used in 31 procedures, the remainder had a Wolfe cuff with adjuvant arteriovenous fistula performed. The selection of distal cuff-type was arbitrary. For anticoagulation all patients received dextran peroperatively. Postoperatively we used low molecular weight heparin (LMWH) in two cases (5%), Dextran in 15 cases (37.5%) and vitamin K antagonist in the last 23 cases (57.5%). LMWH and Dextran was only used during hospitalisation, while vitamin K-antagonist treatment was continued after the discharge from hospital. The level of distal anastomosis was to the distal popliteal in eight cases (20%), of which two cases had run-off via three patient crural vessels, four cases had two patent and the last two cases only one patent crural vessel. The tibioperoneal trunk (TP) was used in two cases (5%) with a two and one crural vessel run-off, respectively. The anterior tibial artery was utilised in three cases (7.5%), posterior tibial artery in 12 (29%) and the peroneal artery in the remaining 15 cases (37.5%).

All patients were followed by regular clinical examination and recording of ankle:brachial index. In case of graft occlusion, thrombectomy was performed. Further arteriography was not performed if reocclusion occurred following thrombectomy, since the patient then was considered inoperable. All results were subjected to life-table analysis, and statistical analysis was performed by the log-rank test.

Results

Ten patients (26%) died during the study period. Four of these died in early postoperative period (<30 days) as a consequence of vascular disease; two as sequelae to contemporaneous aorta surgery. The primary patency (Fig. 1) was 82.5% at 1 month, falling to 62.5% at 1 year and 50% at 2 years. Thrombectomy was performed in 12 cases, four within the early postoperative period and eight in the late postoperative period. Thrombectomy was, however, only successful in one case; the remaining 11 reoccluded. Five of the thrombectomies were performed after a primary reconstruction and seven following a secondary reconstruction. Reocclusion following thrombectomy resulted in five amputations, all of which occurred in the secondary reconstruction group. The secondary patency rate was not very different from the primary patency rate, 82.5% at 1 month falling to 62.5% at 1 year and 52.5% at 2 years. Ten cases (25%) resulted in major amputation postoperatively, and the limb salvage curve is shown in Fig. 2. One year salvage rate was 80% and 75% at 2 years. Except for the primary patency rate at 1 month, where the Vitamin-K antagonist treated group had a superior patency, no differences were found with regard to antithrombotic treatment. When comparing primary reconstructions to secondary/redo reconstructions, primary patency rates (Fig. 3) were higher for the secondary reconstruction group at 1 month, but 1 and 2 years' patency showed a tendency towards better outcome in the primary group (i.e. 74% and 63%, respectively), compared with 1 and 2 years' patency of, respectively, 48% and 38% in the secondary reconstruction group. However, the sample size was small and not significant.

Fig. 1. Primary patency in BK popliteal and distal PTFE bypass with distal vein cuff. The secondary patency rates were almost identical and are not shown. Numbers at risk are shown at each time interval. (●) Patency.

Fig. 2. Limb salvage rate of BK popliteal and distal PTFE bypass with distal vein cuff. Numbers at risk are shown at each time interval. (●) Limb salvage.
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Fig. 3. Primary patency rates for Primary and Secondary procedures in BK popliteal and distal PTFE bypass with vein cuff. Numbers at risk are shown at each time interval. (●) Redo; (■) primary.

(p>0,1). The distal popliteal and tibioperoneal trunk combined achieved the best patency rates at 1 year; 80% compared to 60% for the peroneal artery, 50% for the posterior and 34% for the anterior tibial artery. Two year patency rates were however similar for the distal popliteal and TP group and the peroneal artery (60%). For the anterior and posterior tibial artery 2-year patency rates of only 34% and 33% were achieved. But again, sample size was small and not significant (p>0,2).

Comparing the Miller to the Wolfe cuff with adjuvant arteriovenous fistula, 1-year patency rates were 59% and 67%, and 2-year patency rates 49% and 56%, respectively (p>0,2).

Discussion

We think that the 1-year patency rate of 62.5% achieved in this study for BK popliteal and distal reconstruction is acceptable and compares favourably to the patency rates found by Tyrell and Miller, i.e. 40% and 51%, respectively.17,21 We also think that our limb salvage rate of 80% at 1 year is acceptable and comparable to other studies with limb salvage rates between 65–74%.17,21,22 The mean patient age in this study is very similar to, or even a little higher than in other studies.16,17,20 The perioperative mortality rate of 10% (four patients) in this study was influenced by the fact that two patients underwent aortic surgery at the same time as the distal bypass procedure, which places these patients in a higher risk group. The two other patients did not differ from the remaining patients with regard to age, cardio-vascular disease or severity of disease.

In our study, early thrombosis occurred in 20% of the procedures, a relative high percentage, but comparable to other studies (13–21%).17,20 We have no specific explanation for the high percentage of early graft thrombosis, which is probably due to the severity of arteriosclerotic disease in these patients. Miller claimed that the presence of a venous cuff facilitated later thrombectomy,16 and a 40% success rate for thrombectomy in the early postoperative period has been described.17 However, in our study only one graft out of 12 had a successful thrombectomy, and rethrombosis in the redo-group resulted in an amputation rate of 71%, which raises the question of whether thrombectomy for thrombosis of a secondary reconstruction is a worthwhile procedure. As described in other studies, 10–25% of patients are able to tolerate occlusion of a reconstruction, even if the operation was performed for limb salvage.22,23 This proportion seems to increase with the time interval between the primary operation and failure. Our study seems to confirm this tendency, with a limb salvage rate of 75% at 2 years. Twenty-five per cent of the cases required major amputation, and 80% of these were following a secondary procedure. Neither age nor severity of limb ischaemia helped to identify the patients with poorer outcome.

Interposition of a vein cuff at the distal anastomosis was originally employed to facilitate accurate suturing without distortion or stenosing the recipient artery,16 and in addition, the presence of distal vein cuff reduces the anastomotic myointimal hyperplasia, which is responsible for approximately one-third of all PTFE graft failures.24 Examination of occluded Miller cuffs have shown that the myointimal hyperplasia is restricted to the cuff, and that the recipient artery remains patent and free from myointimal hyperplasia.25 Thus the zone of myointimal hyperplasia is removed from the very small recipient artery to a point in which the cross-sectional area is considerably greater. An explanation may be that interposition of a vein cuff reduces the compliance mismatch between a rigid PTFE graft and an artery, hereby reducing the hyperplasia.26 Another theory is that the special flow-pattern in the cuff causes high shear stresses on the arterial wall, which suppress the formation of myointimal hyperplasia.27 Another theory is that the vein cuff increases total graft flow by acting as an elastic reservoir. However, experimental data comparing PTFE alone to PTFE with vein cuff, has not been able to show any increased graft flow due to the cuff.28

In conclusion, BK popliteal and distal bypass with PTFE and distal vein cuff for critical ischaemia in the absence of autologous vein results in acceptable patency rates. There is a tendency towards secondary
procedures resulting in a poorer outcome than primary procedures, and thrombectomy following occlusion of a secondary bypass procedure is of questionable benefit.

References


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