Arm Vein as an Alternative Autogenous Conduit for Infragenicular Bypass in the Treatment of Critical Limb Ischaemia: A 15 Year Experience

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WHAT THIS PAPER ADDS
This study adds to the data regarding open revascularization surgery for CLI using an alternative vein conduit.

Objectives: The value of alternative autogenous venous conduits for treating critical limb ischaemia (CLI) with infragenicular bypass surgery is well established. In this study, the results of using arm veins as alternative conduits for treating CLI over a 15-year period have been evaluated.
Methods: This was a retrospective study. Between 1991 and 2005. 120 infragenicular bypasses using arm vein conduits (AVCs) were performed in 120 patients. CLI was the main indication (87.5%) for the procedures. The indications for using arm veins were inadequacy or absence of the ipsilateral greater saphenous vein (GSV). Survival, limb salvage, and patency rates were calculated using the Kaplan–Meier method.
Results: There was a predominance of male gender (65%), and the group mean age was 68.1 ± 8.3 years. The mean follow-up period was 29.6 ± 26.3 months. The operative mortality (30 days) rate was 7.5%. The main alternative conduit was non-spliced cephalic vein (37.5%). Composite grafts included GSV + AVC (45.2%), AVC + AVC (43.3%) and small saphenous vein + AVC (11.5%). The 5-year primary and secondary patency (SP) rates were 45.2 ± 5.6% and 56.5 ± 5.0%, respectively. The 5-year SP rate was greatest when using non-spliced cephalic vein (65.8 ± 7.6%), but there was no difference in cumulative patency between spliced and non-spliced veins (49.5 ± 8.0% vs. 61.2 ± 6.4%; $p = 0.501$). The 5-year limb salvage and survival rates were 70.6 ± 5.9% and 59.6 ± 5.8%, respectively.
Conclusions: The favourable long term results of secondary patency and limb salvage rates encourage the use of arm veins as alternative conduits for infragenicular bypass surgery.

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INTRODUCTION

The use of an arm vein as an alternative conduit to the great saphenous vein (GSV) for infrainguinal bypass surgery, especially to infragenicular arteries, was first proposed by Kakkar in 1969,[1] who demonstrated that the wall of the cephalic vein can resist arterial pressure and is long enough to reach the distal popliteal artery. If the GSV of the affected limb is unavailable because it is absent or inadequate for infrainguinal bypass, some surgeons resort to using the contralateral GSV,[2,3] while others spare this vein and use an arm vein conduit (AVC)[4,5] as the all-autologous policy. Despite a lack of consensus regarding the best technical approach, this policy has led to renewed interest in AVC and has led to improved technical skills for arterial reconstruction procedures[6,7] and to better overall outcomes in large surgical series.[5,6,8]

Although prosthetic grafts have been used for below-knee arterial bypass procedures, Veith et al.[9] reported poor patency of prosthetic grafts compared with the GSV in a randomized clinical trial. Recent developments in prosthetic grafts, including the introduction of heparin-coated PTFE, have improved the cumulative patency and limb salvage rates.[10] However, Arvela et al.[11] reported that arm veins, even when spliced, are superior to prosthetic grafts in terms of secondary patency and limb salvage for treating critical limb ischaemia (CLI). Therefore, the aim of the current study was to evaluate the long-term outcome of using an AVC as an alternative conduit in infragenicular bypass procedures over a 15-year period in this department.

MATERIALS AND METHODS

Study design

Between 1991 and 2005, 1,634 infrainguinal bypass procedures were performed in the Vascular Surgery Department of the Hospital do Servidor Público Estadual de São Paulo, Brazil. These procedures included 120 (7.3%) infragenicular bypass procedures using arm veins. During the

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study period, no infragenicular bypasses using prosthetic graft were performed. Patients were prospectively followed up according to a specific protocol advocated by the Society for Vascular Surgery Joint Council.[12] Data were retrospectively collected from the patient's medical records. All patients and relatives were informed of the proposed procedure, including the harvesting of arm veins. The current study was approved by the local ethics committee.

Patient selection

The majority (87.5%) of patients underwent revascularization to treat CLI. Other reasons for treatment were salvage of a failed previously constructed arterial bypass graft (10%) and popliteal artery aneurysm (2.5%).

All patients admitted to the department with a diagnosis of chronic CLI are considered candidates for peripheral revascularization of the affected limb. The ipsilateral GSV is the conduit of choice if it is present and adequate. Since 1998, all autogenous conduits have been assessed by duplex ultrasonography with the following criteria assessed: available length, diameter ($\geq$3 mm), absence of a thickened wall (focal or diffuse), and preserved compressibility. The GSV was deemed inadequate for use as the primary conduit if any of these criteria were not fulfilled. In this situation, upper limb veins were assessed as alternative primary conduits using the same criteria as for GSV. After selecting the conduit, the vein was safeguarded by obtaining venous access through one of the internal jugular veins and looking for any signs of previous venous puncture in the chosen limb.

Surgical technique

The non-reversed translocated graft method was used in all patients, with valve lysis achieved using a Mills valvulotome[13] after completing the proximal anastomosis and removing the clamps. Valve lysis is routinely performed, even for the inherently reversed segment of the basilic—cephalic loop, to maintain physiologic flow phasicity. A second surgical team generally harvested the AVC simultaneously with achieving arterial access and creating the tunnel for the graft. General anaesthesia was used for all patients except in high surgical risk patients who received regional blockade with no complications. A single incision was made over the anatomic vein trajectory. AVC compliance is greater than that of GSV, and the tributaries must be ligated $>$1 mm from the main venous trunk to avoid focal stenosis after removing the arterial clamps. Compressive bandages were applied after closing the incision.

Follow-up

All patients were treated with aspirin (100 mg/day) perioperatively and after discharge. Regular follow up included the following bypass graft assessments: signs and symptoms questionnaire, physical examination with pulse palpation and measurement of the ankle—brachial index (ABI), and laboratory tests. If possible, duplex scan surveillance was performed 1 month after surgery, every 6 months for 2 years, and yearly thereafter. A duplex scan was always performed if any change was noted at the clinical examination (e.g., reduction in pulse or ABI). If any haemodynamically significant stenosis[14] was detected at the anastomotic sites or in the graft body, the patient was admitted for digital angiography to plan an assisted primary patency procedure.

Statistical analysis

Patency, limb salvage, and survival rates were analysed using the Kaplan—Meier method and were compared with log-rank tests using the Statistical Package for Social Sciences version 13.0 (SPSS Inc., Cary, NC, USA). A standard error of $\leq$.1 to was considered to be acceptable. A p value $\leq$.05 was considered to indicate statistical significance in comparisons between variables.

RESULTS

The study group consisted of 78 men and 42 women, with a mean $\pm$ standard deviation age of 68.1 $\pm$ 8.3 years. The most prevalent risk factors were systemic hypertension (68.3%), diabetes mellitus (68.3%), smoking (55.8%), and heart disease (10.4%) (Table 1).

Indications for using arm veins included the absence of an ipsilateral GSV in 67 patients, inadequate GSV in 46 patients, and was unknown in seven patients. Single-segment veins were used in 67 patients, including cephalic vein in 45 patients, basilic vein in 17 patients, and a basilic—cephalic loop in five patients. Spliced veins were used in 53 patients with a composition as following: GSV plus arm vein (24—45.2%); cephalic plus basilic vein (23—43.3%), and saphenous vein plus arm vein (6—11.5%). Primary and secondary revascularization with AVC was performed in 65 (54.2%) and 55 (45.8%) patients, respectively. The proximal and distal anastomoses are listed in Table 2.

The operative mortality rate (30 days) was 7.5% and there was no association with any condition, including coronary heart disease and age $>$80 years. The main surgical complications included early graft occlusion (9—7.5%) and one graft infection, which was treated by ligature and major amputation.

The mean follow-up period was 29.6 $\pm$ 26.3 months. During the follow-up period, 54 and 55 bypass grafts were occluded at 3 and 5 years, respectively, yielding primary

Table 1. Clinical and demographic characteristics.

Age	68.1 $\pm$ 8.3
Male gender	78 (65.0%)
Systemic hypertension	82 (68.3%)
Diabetes mellitus	82 (68.3%)
Smoking	67 (56%)
Coronary heart disease	12 (10.0%)
Critical limb ischemia	105 (87.5%)
Tissue loss	84 (70.0%)
Rest pain	21 (17.5%)
Composite substitute	53 (44.2%)
Previous ipsilateral bypass graft	55 (45.8%)