Early thrombosis in bovine mesenteric vein grafts after infrainguinal reconstruction

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INTRODUCTION: Autologous vein grafts are still the gold standard in infrainguinal arterial bypass grafting procedures. However, due to the unavailability of suitable autologous vein grafts, heterogeneous grafts are usually preferred. In the present study, surgical outcomes with bovine mesenteric vein grafts (ProCol, Hancock Jaffe Laboratories, USA) in the infrainguinal location in patients with ischemic leg infection or necrosis are presented.

METHODS: Seven patients who underwent infrainguinal arterial reconstructions with ProCol grafts were evaluated retrospectively.

RESULTS: Graft thrombosis was seen in two patients on postoperative day 1 (28.5%). The shortest and the longest patency durations were six and 18 months, respectively. Aneurysmal dilation developed postoperatively in two grafts (28.5%) after 12 and 18 months, respectively.

CONCLUSION: In cases where infection accompanies ischemia, and autologous veins are not available as graft materials, ProCol grafts can be used as temporary grafts in infrainguinal arterial reconstructions. The use of the graft is believed to be unacceptable for any indication other than infection due to its low short- and long-term patency rates and high risk of aneurysm formation in this location.

Key Words: *Bovine mesenteric vein graft; Early graft thrombosis; Infrainguinal reconstruction*

In infrainguinal bypass surgery, the availability of suitable autologous graft materials decrease as the age of the patients increase. The use of biological graft material is preferable because heterogeneous grafts are more resistant to infection than prosthetic grafts.

Heterogeneous grafts have been used since 1963, although with disappointing outcomes reported in the early attempts (1-3). However, graft harvesting and preservation methods have improved during the past decade. One of the new grafts manufactured with this new technology is the bovine mesenteric vein graft (ProCol, Hancock Jaffe Laboratories, USA). The advantages of the ProCol graft include a highly preserved media layer and a large extracellular matrix. In the current study, we present our surgical outcomes using this graft in the infrainguinal location in patients with ischemic leg infection or necrosis.

METHODS

Seven patients who underwent infrainguinal arterial reconstructions with ProCol grafts between April 2004 and August 2004 were evaluated retrospectively. Patient data are tabulated in Tables 1 and 2. Preoperative digital subtraction angiography (DSA) revealed satisfactory distal run-off in all patients. No suitable autologous vein graft was found in any patient in the preoperative duplex Doppler vein mapping.

Surgical technique

ProCol grafts were prepared according to the instructions of the manufacturer. All patients were administered intravenous 5000 IU heparin before clamping of the native vessels. Proximal and distal anastomoses were performed in an end-to-side fashion with 6/0 prolene sutures. Five grafts (71%) were anastomosed to the supragenicular femoropopliteal arteries, and two grafts (29%) were anastomosed to the infragenicular femoropopliteal arteries. Following each anastomosis, flow

through the graft was measured with Doppler ultrasound intraoperatively, to exclude any technical error in each patient. Postoperative continuous intravenous heparin infusion (1000 IU/h) was administered on the first postoperative day. All patients were anticoagulated with warfarin sodium postoperatively. Follow-up examinations with Doppler ultrasound (US) and DSA were used to evaluate graft patency rates.

RESULTS

Graft thrombosis was seen in two patients on postoperative day 1 (28.5%). These patients underwent a second operation and thrombectomy was performed in both. Primary patency rates were 71.4%, 57.1% and 42.8% at one, six and 12 months, respectively. Secondary patency rates were 100%, 50% and 50% at one, six and 12 months, respectively. The shortest and longest patency durations were six and 18 months, respectively.

Aneurysmal dilation developed postoperatively in two grafts (28.5%) at 12 and 18 months, respectively. These grafts were replaced with polytetrafluoroethylene grafts. Histological examinations of these aneurysmal grafts revealed giant cell infiltrations without any sign of infection.

In two patients, hematoma in the femoral incision area and superficial wound infection, confined to the dermal and subdermal layers, were seen in the early postoperative period. No graft infection was detected in any patient. Below-knee amputation had to be performed in one patient on postoperative day 16 in an attempt to salvage most of the limb. There were no mortalities during the follow-up period.

DISCUSSION

Autologous vein grafts are still the gold standard in infrainguinal arterial bypass grafting procedures. However, in patients of advancing age and with the accompanying pathologies that

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TABLE 1
Patient characteristics

Patient	Age/sex	Fontaine stage	Risk factors and accompanying disease	Arterial stenosis	Leg infection and/or necrosis
1	53 years, male	III	Diabetes mellitus, hypertension, coronary artery disease	Proximal popliteal artery (80%)	Yes
2	60 years, male	III	Smoking, coronary artery disease	Superficial femoral artery (80%)	Yes
3	53 years, male	IV	Diabetes mellitus, smoking	Superficial femoral artery (70%)	Yes
4	34 years, male	IV	Smoking	Proximal popliteal artery (90%)	Yes
5	72 years, female	III	Diabetes mellitus, hypertension, coronary artery disease	Superficial femoral artery (70%)	Yes
6	55 years, male	IV	Smoking, coronary artery disease	Superficial femoral artery (90%)	Yes
7	62 years, male	III	Diabetes mellitus, coronary artery disease	Superficial femoral artery (80%)	Yes

TABLE 2
Patient operative and postoperative outcomes

Patient	Type of femoropopliteal bypass	Early thrombosis	Thrombectomy performed	Graft aneurysm	Amputation
1	Infragenicular	No	No	No	No
2	Supragenicular	No	No	No	No
3	Supragenicular	Yes	Yes	Yes	No
4	Infragenicular	No	No	No	No
5	Supragenicular	No	No	No	Yes
6	Supragenicular	Yes	Yes	Yes	No
7	Supragenicular	No	No	No	No

are often seen in these elderly groups, suitable autologous vein grafts are difficult to obtain, especially in patients with limb infection and necrosis. In these patients, heterogeneous graft use may be preferable. For infrainguinal bypass operations in the present group of patients, ProCol grafts were used.

In the literature, the first and the most important complication reported after ProCol graft implantation is graft thrombosis. Postoperative day 1 graft thrombosis was seen in two patients in our study (28.5%). Interestingly, at the time of the reinterventions, both patients had favourable anticoagulation levels, with activated partial thromboplastin time values of 90 s to 120 s. Thrombectomy was performed and the graft patency was maintained in both patients. The main reasons for early graft thrombosis are the lack of suitable distal run-off and technical failure in anastomosis. All our patients were examined preoperatively for arterial lesions and distal arterial bed structures with DSA, and no pathology in distal run-off in any of our patients was detected. During the operation, anastomosis and blood flow through the grafts were checked with a hand-held Doppler US following each procedure. Therefore, the probability of technical failure and inadequate distal arterial bed can be excluded. Similar results were found in a study of infrainguinal bypass operations with ProCol grafts in 32 patients by Schmidli et al (4), who reported graft thrombosis in 19 patients on postoperative day 1 (4). On the other hand, there have been numerous reports of successful results with ProCol grafts used in arteriovenous fistula operations (5). Kalangos et al (6) used ProCol grafts in constructing systemic-to-pulmonary shunts in children (6). Neither of these studies has reported graft thrombosis on the first postoperative day. The seemingly contradictory outcomes in these studies may be related to the disease-free nature of the distal run-off and the low intraluminal pressure of the distal bed in this group of patients.

Schmidli et al (4) reported primary patency rates of 16% one month postoperatively, and secondary patency rates of 26% at 14 months postoperatively. Their results are similar to ours, with very low patency rates compared with the patency rates of other types of grafts used in infrainguinal localization. In our study, primary and secondary graft patency duration was 18 months or less.

Aneurysmal dilation is one of the major problems in heterografts. Two patients developed aneurysmal dilation at eight and 10 months postoperatively, respectively. These patients were the same patients in whom thrombectomies were performed on the first postoperative day. We believe the factor(s) that led to graft thrombosis in the early postoperative period, or the thrombectomy itself, are predisposing factors for aneurysm formation. Schmidli et al (4) also reported two aneurysms in their 32-patient series, whereas Kovalic et al (7) had a higher incidence of aneurysmal dilation; they reported one aneurysm among six patients in whom ProCol grafts has been used for infrainguinal reconstruction.

It is crucial to emphasize that none of the authors reported ProCol graft infection in any of their patients. Although the ProCol graft has a poor long-term patency rate, the graft may serve as a temporary graft in infected limbs with serious vascular compromise and can be used to maintain blood flow. With the cessation of infection, the graft may then be replaced with another type of graft material.

We believe that ProCol grafts can be used as temporary grafts in infrainguinal arterial reconstructions in patients with ischemia accompanied by infection and in whom autologous veins are not available as graft materials. We believe use of the ProCol graft is unacceptable for any other indication other than infection, due to its low short- and long-term patency rates and high risk of aneurysm formation in this location.

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