

Polytetrafluoroethylene use for above-knee femoropopliteal bypass in critical limb ischemia

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ABSTRACT

Objective: The question of the best material for above-knee femoropopliteal bypass (polytetrafluoroethylene [PTFE] versus vein) continues to be controversial. The aim of this study was to evaluate our results of using PTFE in above knee femoropopliteal bypass and to determine the predictors which affect graft patency.

Methods: A retrospective analysis of all above knee femoropopliteal graft surgery (PTFE) carried out for limb salvage between September 1997 and October 2001 at the King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. All records were reviewed for risk factors, presentations, management and complications.

Results: In a 4 year period, 52 above-knee femoropopliteal bypass grafts were performed in 49 patients. Polytetrafluoroethylene 8 mm grafts were used in all bypasses. Preoperative risk factors were diabetes 41 (80%); ischemic

heart disease 17 (33%); and smoking 23 (44%). There was no operative mortality. Primary cumulative graft patency was 94% at first year, 62% at second year, 42% at third year, and 35% at fifth year. Twenty-two grafts have been occluded with re-emergence of critical ischemia in 18 patients, treated by amputation (5) and secondary reconstruction (13), of which 2 limbs required amputation later. Limb salvage was 87%. Female gender and non patent tibial vessels were the only predictors which affected graft patency.

Conclusion: Our results were not comparable in terms of long primary patency as those reported with autogenous vein, but comparable regarding limb salvage, early patency and ease of use. Preservation of the saphenous vein for use later encouraged us towards primary use of PTFE for above-knee femoropopliteal bypass.

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Femoropopliteal bypass grafting has shown to be an effective form of treatment for infra-inguinal artery occlusive disease presenting with critical ischemia.¹ In 1948, Kunlin² pioneered the use of the saphenous vein for above-knee femoropopliteal bypass. Campbell et al³ reported in 1976, the first North American experience with polytetrafluoroethylene (PTFE) bypass grafts. Since that time, it is generally agreed that autologous saphenous vein (ASV) is the best material to use for femoropopliteal bypass especially when the distal anastomosis is below knee joint.^{4,5} Many experiences showed the preferential use of PTFE for above-knee

bypass as the patency results rival that of saphenous vein.^{6,9} Furthermore in critical ischemia, if a PTFE is used first, the saphenous vein is then spared for later use in more distal procedures needed in a second procedure.^{1,10} This study evaluate the results of using PTFE in above-knee femoropopliteal bypass and determine the predictors of graft failure.

Methods. A retrospective analysis of all above-knee femoropopliteal bypass grafting using PTFE, carried out between September 1997 and October

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2001 at the King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. Disabling claudication or critical ischemia were the indications for intervention while patients with moderate claudication, aneurysmal disease, traumatic or acute embolic ischemia were excluded from this study. All records were reviewed for age, sex and presence of risk factors as ischemic heart disease (IHD), diabetes mellitus (DM), smoking, hyperlipidemia and distal run off. All patients were tested before operation with non-invasive vascular studies as ankle brachial index (ABI) and segmental pressures determined by doppler. Patients in which doppler pressures were falsely high due to calcified vessels, had toe pressure determined to document the severity of the ischemic process. Preoperative angiogram was carried out routinely and PTFE grafts size 8 mm was used to all procedures. Postoperative antithrombotic regimens included short-term heparin and aspirin were given to most cases and in selected patients usually with poor distal run off or after failure of initial bypass operation, postoperative oral anticoagulants were continued. Ankle brachial indices were obtained within the first 48 hours postoperatively in all patients. An increase from preoperative value 0.12 and presence of palpable pulses, when they were absent before operation, were considered indicators of graft patency. Ankle brachial indices or duplex were obtained routinely in all patients during follow up. Primary graft patency was defined as continued patency. Graft thrombectomy at any time was considered as graft failure. Amputation in the presence of a patent graft was considered failure in foot salvage, but considered as a patent graft for life-table analysis. Amputations limited to the toes or trans-metatarsal level were not considered failure for foot salvage determination. Primary cumulative patency rates were calculated using the life-table analysis. A cox regression analysis was used to determine the predictors of graft failure.

Results. Forty-nine patients underwent 52 above-knee femoropopliteal bypasses using 8 mm PTFE grafts. Ages ranged from 53-79 years with a mean age of 69 years. Follow up period was 6-48 months. Of the 49 patients, 38 were men. Risk factors distribution were: DM 41 (80%), IHD 27 (33%), smoking 23 (44%), and hypercholesterolemia 9 (17%). Angiographic distal run off was: one assigned for an entirely normal 3 tibials, 14 assigned for an isolated popliteal segment with all 3 tibial arteries occluded and 18 for one patent tibial vessels and 19 for 2 patent tibial vessels. Indication for procedures was severe disabling claudication 4 (8%), rest pain 14 (27%), and gangrene 34 (65%). Previous operations to femoropopliteal bypass were: aortobifemoral bypass (7), axillobifemoral bypass (1), ipsilateral iliac angioplasty (5), femoropopliteal crossover (3) and ilio-femoral bypass (1). There was no operative mortality (one to 30 days). Eleven patients (21%) had significant postoperative morbidity which was hematoma (2), lymphuria (3), congestive heart

failure (2), deep venous thrombosis (1), pathological fracture of calcaneus due to osteomyelitis (1) and pneumonia (2). All of them responded well to symptomatic treatment. During the study period, 22 grafts were occluded and 18 of them re-emerged critical ischemia. Five were unsuitable for further reconstruction and required amputations. The remaining critical limbs (13) had secondary operations, which were thrombectomy (11), distal jump graft (9), thrombolysis (1) and redo bypass (1). Of a total 22 occluded grafts, 7 limbs were lost (30%). The 4 year limb salvage was 87% and cumulative primary graft patency at one year was 94%, 2 years was 62%, 3 years was 42%, and 4 years was 35% (**Table 1**). The influence of various risk factors on patency was subjected to cox regression study. Female patients were at a higher risk of experiencing bypass failure as compared to male patients. The estimated bypass failure was 6.1 times higher ($P=0.018$). Non-patent tibial vessels (isolated popliteal artery segment) estimated significant higher risk of graft failure than one or more patent tibial vessels ($P=0.0432$).

DISCUSSION. Since the first studies in 1976, PTFE has been used extensively for infrainguinal vascular reconstruction.³ Based on early results, PTFE seemed at least a satisfactory alternative and perhaps an equivalent substitute for ASV in the above-knee bypass surgery.^{9,11} Recent reports^{1,12} have found no statistically significant difference in cumulative patency rates between the venous and PTFE above-knee bypass grafts up to 3 years the primary patency rates being 61.8% and 57%.

Table 1 - Life-table for cumulative primary graft patency with polytetrafluoroethylene grafts above knee.

Months	Entering interval	Withdrawn	N of graft occlusion	Cumulative patency	SE
0-1	52	1	1	1.00	0.0000
1-6	50	2	2	0.98	0.0192
6-12	46	3	9	0.94	0.0333
12-18	34	12	5	0.75	0.0626
18-24	17	4	1	0.62	0.0748
24-30	12	2	3	0.58	0.0803
30-36	7	2	1	0.41	0.0968
36-42	4	1	0	0.35	0.1028
42-48	3	3	0	0.35	0.1028
Total		30	22		

Quinones-Baldrich et al⁹ and Rosen et al,¹³ also reported good performance of PTFE in the above-knee, 65% and 50% at 4 years. Prandiville et al¹⁴ reported good results in patients with favourable angiographic run off. In the current study, one year patency were 94% and 2 years patency were 62% but dropped to 35% at 4 years. Although long-term was poor, early patency was favourable. Veith et al⁴ and O'Riordain et al⁶ have reported results similar to ours 85% and 80% at one year patency for above-knee PTFE bypass, falling to 38%, 39% at 4 years. Limb salvage is of paramount importance and is not determined entirely by primary patency. Perhaps of most importance in limb salvage is the combined interval patency of the initial bypass and any secondary reconstructions required to treat graft failure. Quinones-Baldrich et al,⁹ O'Riordain et al⁶ and Rosen et al¹³ reported that only 29%, 27.5% and 29% of their patients with occluded above-knee prosthetic grafts, lost their limbs. In this study, of 22 occluded PTFE grafts, 7 limbs (30%) have been lost. The 4 year limb salvage rate of 87% is very encouraging and demonstrate the value of an intact ASV at the time of failure of the primary reconstructive procedures. Such facts have led some authors to suggest that primary use of PTFE for femoropopliteal bypass, preserving ASV for later, more distal use, may improve limb salvage.^{8,9,14,15} As for risk factors, only female gender (p=0.018) and non-patent tibial vessels (p=0.043) were significantly at the highest risk of experiencing bypass failure. Evans et al¹⁶ and Prandiville et al¹⁴ found that diabetes has a negative influence on the patency of bypass grafts, others have found no such effect. In this study, there was no difference in patency due to the influence of diabetes or smoking. Due to our grafts were all 8 mm, we were unable to analyze the influence of different graft diameter on patency. Some authors believe larger diameter grafts should be selected for above-knee femoropopliteal bypass.^{1,17}

In conclusion, our favourable results, in terms of early patency and limb salvage, have further defined for us the role of PTFE in above-knee bypass surgery and favor its use for the elderly in whom operative morbidity can be reduced to a minimum.

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