

Long-Term Outcome of Aortofemoral Bypass for Aortoiliac Occlusive Disease

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Abstract

Introduction: Revascularisation of aortoiliac occlusive disease has been evolving in the past 2 decades. The present study was undertaken to evaluate the long-term outcomes of aortofemoral bypass for aortoiliac occlusive disease at a tertiary vascular disease centre in Hong Kong. **Materials and Methods:** A retrospective analysis of 94 patients (176 limbs) who survived aortofemoral bypass was performed to evaluate the graft patency, long-term complications, limb loss and patient survival rates. Thirty-six patients were operated for incapacitating claudication (Group I) and 58 for limb salvage (Group II). **Results:** The overall primary patency rates of aortofemoral bypass were 97%, 90%, 89% and 84% at 1, 3, 5 and 10 years, respectively. Poor distal run-off and neointimal hyperplasia were the leading causes of late graft failure. Other late complications included femoral pseudoaneurysm (n = 1), infection (n = 1) and femoral graft aneurysms (n = 2). The limb loss rate was 5.1% at 4 years. The overall survival rates were 95%, 86%, 81% and 75% at 1, 3, 5 and 10 years, respectively. Ischaemic heart disease and malignancy were the 2 major causes of late death. The 5-year survival rate of group I patients (96%) was significantly superior to that of group II patients (70%). **Conclusions:** Aortofemoral bypass achieved a primary patency rate of 89% at 5 years and a satisfactory limb salvage rate. It remains the preferred treatment option for good risk patients with complete occlusion or extensive stenosis of the aortoiliac arteries.

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Key words: Aortofemoral bypass, Claudication, Peripheral vascular disease, Vascular

Introduction

The management of aortoiliac occlusive disease has been evolving in the past few decades.¹ Surgical options include aortofemoral bypass, endarterectomy, extra-anatomical bypass and endovascular intervention.^{2,3} Aortofemoral bypass has been recognised as an effective and durable procedure for relief of ischaemic symptoms in patients with aortoiliac occlusive disease of the lower limbs.⁴⁻⁶ Few Asian series of aortofemoral bypass are available in the literature. The present study was undertaken to evaluate the long-term outcomes of aortofemoral bypass performed in Chinese patients at a tertiary vascular disease centre in Hong Kong.

Materials and Methods

From January 1977 to December 1998, aortofemoral bypass for aortoiliac occlusive disease was performed in 103 consecutive patients at the University of Hong Kong Medical Centre. Nine patients, who died before discharge, were excluded from the present study because of the absence of follow-up data. A retrospective analysis of the

records of 94 patients (176 limbs) was performed to evaluate the patency rate, long-term complications, limb loss and patient survival rates. There were 83 men and 11 women with a mean age of 64 years.

The patients were divided into 2 groups according to the indications of operation. Group I patients (n = 36, 68 limbs) underwent surgery for incapacitating claudication while group II patients (n = 58, 108 limbs) were operated upon for limb salvage. The limbs of group II patients were threatened by the presence of ischaemic pain at rest (n = 21), and tissue loss in the form of ischaemic ulcer (n = 14) or toe gangrene (n = 23). The demographic features of the two groups of patients are shown in Table I. A total of 8 patients had prior vascular interventions, including cross femoral bypass (n = 3), iliac artery angioplasty (n = 2), axillobifemoral bypass (n = 1), iliofemoropopliteal bypass (n = 1) and iliac artery angioplasty with a sequential femoropopliteal bypass (n = 1).

Surgical Technique

A standard transperitoneal approach to the infrarenal

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TABLE I: COMPARISON OF DEMOGRAPHIC FEATURES OF GROUPS I AND II PATIENTS

	Group I (n = 36)	Group II (n = 58)	P
Age (mean $\pm$ S.D.) (years)	63 $\pm$ 7.5	64 $\pm$ 8.6	ns [#]
Sex ratio (male:female)	17:1	49:9	ns [†]
Coronary artery disease	12	16	ns [†]
Diabetes mellitus	8	12	ns [†]
Hypertension	17	33	ns [†]
Hyperlipidaemia	3	8	ns [†]
Smoking	34	51	ns [†]
Stroke	4	13	ns [†]
Chronic obstructive airway disease	1	4	ns [†]
Preoperative ABI (mean $\pm$ S.D.)	0.44 $\pm$ 0.16	0.32 $\pm$ 0.22	ns [#]

ABI: ankle-brachial index; ns: no significance

[†] Chi-square test; [#] Student's *t*-test,

aorta was adopted in most patients.⁷ Dacron grafts, woven in 33 patients and knitted in 61 patients, were employed. Bifurcated grafts were placed in 82 patients and aortounifemoral grafts in 12 patients. The proximal anastomosis was primarily an end-to-side anastomosis to the infrarenal aorta (n = 73), using a single layer of continuous 3/O or 4/O Prolene suture. The distal anastomosis was performed mainly on the common femoral artery (n = 162) with a single layer of continuous 5/O or 6/O Prolene suture. Profundaplasty (n = 15) was performed in the presence of stenotic orifice of the profunda femoris artery and occlusion of superficial femoral artery. Other concomitant vascular procedures included aortic endarterectomy (n = 8), femoral endarterectomy (n = 8), lumbar sympathectomy (n = 2), renal artery endarterectomy (n = 1) and femoropopliteal bypass (n = 1).

Postoperative Management

All patients received 150 mg aspirin daily after operation. Regular follow-up of clinical symptoms and signs was arranged at our Vascular Clinic every 2 to 4 months. Follow-up was calculated from the date of operation and ranged from 2 months to 18 years with a mean follow-up of 5 years. Thirty-nine patients (41%) were followed for more than 5 years. Any relapse of clinical symptoms or signs was recorded. The ankle-brachial index was measured during each follow-up visit. Since 1996, all patients had 6-monthly duplex scans for surveillance of the bypass graft patency. Graft failure was determined by clinical examination, duplex scan or arteriography if further intervention was contemplated. Primary patency was terminated in the event of graft thrombosis or any reasons that require operative revision.

Statistical Analysis

Graft limb patency and patient survival rates were

evaluated by the Kaplan-Meier method, according to the Reporting Standards of the Society for Vascular Surgery/International Society for Cardiovascular Surgery (SVS/ISCVS).⁸ Log-rank test was used to compare the primary patency and survival rates between the 2 groups of patients. Demographic features and limb loss rates between the 2 groups of patients were compared by chi-square test. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS Inc, Chicago, Illinois, USA). A *P* value of less than 0.05 was regarded as statistically significant.

Results

Primary Graft Limb Patency

The overall primary patency rates of aortofemoral bypass (176 limbs) were 97% $\pm$ 1.4%, 90% $\pm$ 2.6%, 89% $\pm$ 2.8% and 84% $\pm$ 4.1% at 1, 3, 5 and 10 years, respectively (Fig. 1). The primary patency rates of aortofemoral bypass in group I patients (68 limbs) were 100% $\pm$ 0%, 94% $\pm$ 3.1%, 92% $\pm$ 3.8% and 87% $\pm$ 5.7% at 1, 3, 5 and 10 years, respectively (Fig. 2). Whereas the primary patency rates of aortofemoral bypass in group II patients (108 limbs) were 94% $\pm$ 2.3%, 87% $\pm$ 3.7%, 87% $\pm$ 3.7% and 83% $\pm$ 5.7% at

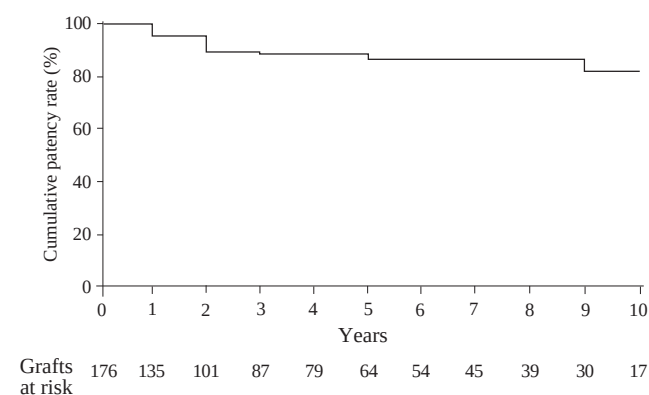
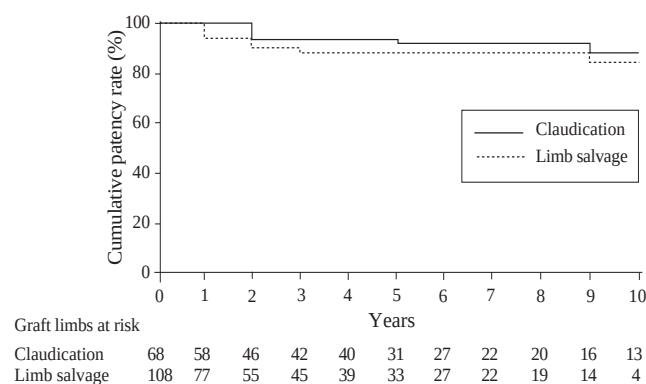


Fig. 1. Overall cumulative primary patency rate of aortofemoral bypass.

Fig. 2. The primary patency rates of aortofemoral bypass in groups I and II patients. *P* = ns. Log-rank test.

1, 3, 5 and 10 years, respectively. Comparison of the primary patency rates between the 2 groups of patients by log-rank test showed no significant difference ($P = 0.27$).

Late Graft Thrombosis (>30 days)

A total of 12 unilateral graft limb thrombosis were documented during follow up. The initial indications for these 12 operations were incapacitating claudication ($n = 4$) and limb salvage ($n = 8$) ($P = 0.77$). Causes of late graft thrombosis included poor distal run-off ($n = 4$), neointimal hyperplasia ($n = 4$), femoral graft aneurysm ($n = 1$) and unspecified reasons ($n = 3$).

Secondary procedures were performed in 9 patients. Thrombectomy was successful in restoring the patency of 5 limbs. All 5 patients received additional concomitant vascular procedures, including femoropopliteal bypass ($n = 2$), patch angioplasty ($n = 2$) and dilatation of the profunda femoris artery ($n = 1$). Of the 4 patients with unsuccessful thrombectomies, 1 had a cross femoral bypass alone and 1 had a cross femoral bypass with a sequential femoropopliteal bypass. The other 2 patients underwent multiple bypass revisions and both ended up with above-knee amputations.

Expectant treatment was adopted in 3 patients with late graft thrombosis. One patient had mild claudication that did not warrant further intervention. Another was medically unfit for operation because of myocardial infarction, which led to the late graft thrombosis. The third patient refused surgical intervention but subsequently required a major amputation.

Late Complications (>30 days)

Other late complications included bilateral femoral graft aneurysms ($n = 1$), graft infection ($n = 1$) and femoral pseudoaneurysm ($n = 1$).

One patient sustained prosthetic graft infection by methicillin-sensitive *Staphylococcus aureus* which presented with groin pain and leukocytosis 2 years following aortofemoral bypass. The sepsis was successfully controlled by removal of the aortic graft followed by bilateral axillopopliteal bypass. The patient recovered uneventfully.

A femoral pseudoaneurysm developed in a patient who discovered an enlarging groin mass 4 years after surgery. Repair was performed by Goretex patch angioplasty.

An enlarging right groin mass 13 years postoperation was found to be due to femoral graft aneurysm in one patient. Aneurysmectomy with an interposition graft was performed. A year later, thrombosis of left femoral graft aneurysm led to sudden development of ischaemic rest pain of his left foot. Aneurysmectomy, retrograde thrombectomy and a sequential femoropopliteal bypass were performed. The patient made a full recovery.

Secondary Graft Limb Patency

A total of 8 graft limbs were salvaged by secondary procedures. The overall secondary patency rates were $97.7\% \pm 1.1\%$, $92.6\% \pm 2.3\%$, $91.4\% \pm 2.6\%$ and $89.0\% \pm 3.4\%$ at 1, 3, 5 and 10 years, respectively. The 5-year secondary patency rates of groups I and II were $92.1 \pm 3.8\%$ and $91.6 \pm 3.2\%$, respectively ($P = 0.53$).

Limb Loss Rate

Of the group I patients, only 1 required a major amputation 3 years after aortofemoral bypass. The patient suffered from a unilateral limb graft thrombosis secondary to progression of distal atherosclerosis. Of the group II patients, early limb salvage was achieved in 103 limbs after aortofemoral bypass. Within the first 4 years after operation, major amputations were required in another 3 patients in group II. The limb loss rate at 4 years was thus 1.5% and 7.4% in groups I and II, respectively ($P = 0.16$). The overall limb loss rate was 5.1% at 4 years.

Long-term Survival

The overall survival rates of the study population ($n = 94$) were $95 \pm 2.2\%$, $86 \pm 4.1\%$, $81 \pm 5.0\%$ and $75 \pm 6.3\%$ at 1, 3, 5 and 10 years, respectively (Fig. 3). The 5-year survival rate of group I patients ($96\% \pm 4.3\%$) was significantly superior to that of group II patients ($70\% \pm 7.5\%$) ($P < 0.001$) (Fig. 4). A total of 16 patients were documented dead during follow-up. The causes of late death included ischaemic heart disease ($n = 5$), malignancy ($n = 3$), bronchopneumonia ($n = 1$), stroke ($n = 1$) and unspecified causes ($n = 6$).

Discussion

In the present study, aortofemoral bypass achieved a primary 5-year patency rate of almost 90%. This is comparable to the results of overseas centres.^{4-6,9-11} Consistent with the Western experience, all our late graft failures happened in only 1 limb of the bifurcated grafts.

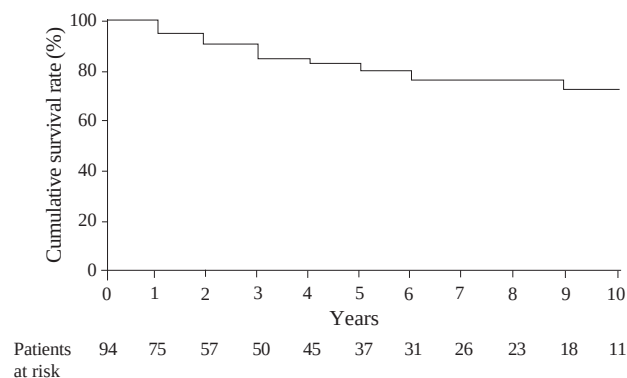


Fig. 3. Overall cumulative survival curve of patients ($n = 94$).

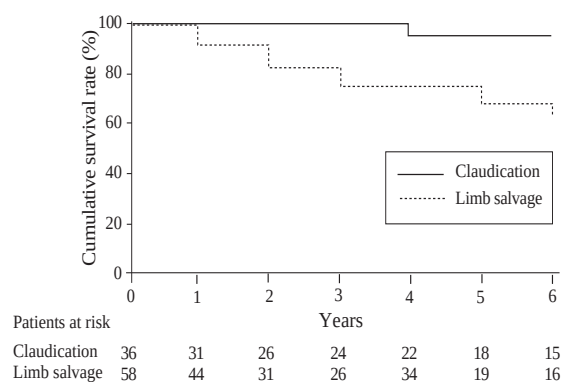


Fig. 4. Cumulative survival curves of groups I and II patients. $P < 0.05$. Log-rank test.

This reflected the significance of local factors in the development of late graft thrombosis. Neointimal hyperplasia and poor distal outflow resulting from progression of atherosclerosis were the main causes of late graft thrombosis.¹¹⁻¹³

In patients who presented with graft thrombosis, a simple retrograde thrombectomy should be attempted to restore the inflow and the graft limb patency whenever feasible. However, thrombectomy alone has been associated with a high incidence of early re-thrombosis.¹⁴⁻¹⁸ To maintain the graft patency, it is therefore essential to rectify the underlying aetiology of graft limb thrombosis at the same setting. Patch angioplasty could be used in patients with neointimal hyperplasia at the femoral anastomosis. Alternatively, the femoral anastomosis can be reconstructed with an interposition graft. For late graft failures resulting from poor distal run-off involving the femoral arteries, a sequential femoropopliteal bypass is necessary.

Retrograde thrombectomy is futile in patients who present late after the graft thrombosis. In such cases, an extra-anatomical bypass or repeat aortic surgery are the remaining options. As direct aortic surgery is not only technically difficult, but also associated with significant morbidity and mortality, cross femoral bypass is often preferred. In case of inadequate inflow in the donor femoral artery, axillo-femoral bypass could then be a last resort.

Aortic graft infection is the most formidable complication in vascular surgery as it carries a high mortality and limb loss rate (50%).¹⁹ As illustrated by our patient, most infected grafts are contaminated by skin flora, *Staphylococcus aureus*, at the time of primary operation. Complete removal of the infected aortic graft with an extra-anatomic bypass remains the gold standard.¹⁹⁻²¹

Following aortobifemoral bypass using a knitted Dacron graft, false aneurysms most commonly develop at the femoral anastomosis.²² Our incidence of femoral pseudoaneurysm was relatively low. Structural weakness

of the artery, particularly after endarterectomy, has been suggested to be an important aetiology for the development of pseudoaneurysm.^{22,23} Other possible causative factors include tension or stress on the suture line, prosthesis defects, local wound complications and hypertension.

Most reported graft aneurysms occur 5 years or more after the bypass procedure.^{24,25} Structural failure of the knitted Dacron graft is the main aetiology. The aneurysmal dilatation of the graft is susceptible to thrombosis or even rupture with massive haemorrhage. Life-long follow up of patients is therefore essential following aortofemoral bypass. Surgical repair can be achieved by aneurysmectomy with an interposition graft.

With regard to the long-term survival, about 20% of our patients were dead within 5 years following the aortofemoral bypass. Ischaemic heart disease followed by malignancy were the leading causes of late death.²⁶⁻²⁸ Our study demonstrated that the long-term survival of patients operated for incapacitating claudication was significantly better than those for limb salvage. It indicated a more severe generalised atherosclerotic disease in patients with critical ischaemia. In a recent review by Dormandy et al,²⁹ most patients with critical leg ischaemia were dead within 10 years. It should be noted that more than half of our patients were operated for limb salvage.³⁰ In contrast, most Western series comprised mostly patients operated for incapacitating claudication.^{4,11}

In conclusion, aortofemoral bypass achieved a 5-year patency rate of more than 80%. It provided a durable relief of ischaemia symptoms in most patients. Aortofemoral bypass remains the preferred procedure for lower limb revascularisation in patients with extensive aortoiliac occlusive disease.

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