Asian Journal of Surgery (2019) 42, 235–239

Available online at www.sciencedirect.com

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journal homepage: www.e-asianjournalsurgery.com

ORIGINAL ARTICLE

Risk factors associated with postoperative prosthetic graft patency in Leriche syndrome

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Received 15 May 2018; received in revised form 13 August 2018; accepted 22 August 2018
Available online 12 November 2018

KEYWORDS
Arterial occlusive disease;
Graft occlusion;
Vascular;
Leriche syndrome;
Vascular patency

Abstract *Background:* In Leriche syndrome, postoperative graft thrombosis remains one of the most significant clinical challenges.
Methods: We reviewed 51 patients who underwent surgery for aortoiliac occlusive disease at our hospital from January 2007 to December 2014. The factors associated with graft patency were determined using the Cox proportional hazard model.
Results: The 2-year prosthetic graft patency rate was 72.5%. Younger age ($p = 0.017$, Odd ratio (OR) = 1.112), postoperative uncontrolled hypertension ($p = 0.044$, OR = 3.797), and associated Trans Atlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease II (TASC II) D femoropopliteal lesion ($p = 0.008$, OR = 11.139) were significantly related factors for prosthetic graft patency after surgical repair. The existing comorbidities of the patients that indicated the need for axillo-bifemoral bypass seemed to be related to lower graft patency or other complications.
Conclusions: For better graft patency after an open surgical repair of Leriche syndrome, strict postoperative hypertension control and distal run-off resolution are necessary.

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https://doi.org/10.1016/j.asjsur.2018.08.009

1. Introduction

Leriche syndrome is a condition caused by occlusion of the terminal aorta, and iliac arteries as in aortoiliac obstruction. Leriche syndrome usually occurs in males and is characterized by impotence, absence of a pulse in the femoral arteries, and weakness and numbness in the lower back, buttocks, hips, and lower limbs.

Patients who have Leriche syndrome with collateral blood flow in the lumbar spine and pelvis are sometimes asymptomatic. However, in the case of a patient who does not have collateral blood flow, the patient may experience convulsion or numbness of calf muscles while walking or may show stiffness of hip and thigh muscles. Moreover, circulation impairment, caused by bilateral femoral artery pulse weakness or loss, can lead to atrophy or necrosis of the leg or foot. Impotence could also occur in males.[1,2]

After correction of this occlusive disease, postoperative graft patency remains as a significant clinical problem. In this study, we reviewed the baseline characteristics of patients with Leriche syndrome who underwent surgical corrections. We also analyzed risk factors which are related to postoperative graft patency.

2. Methods

This is a retrospective, single center study. Fifty-three patients, who underwent open surgical treatment for Leriche syndrome for 8 years from January 2007 to December 2014, were reviewed. Among them, two patients were excluded due to loss at follow up. Consequently, 51 patients of those initial patients were included in this study. Data collection included age, sex, comorbidities, and complications. All patients took daily acetylsalicylic acid (100 mg) and atorvastatin (10 mg) after surgery. Postoperative surveillances were performed regularly; patency of vascular graft was confirmed by follow-up duplex ultrasound and CT angiography.

Graft thrombosis is defined as the presence of a thrombus within the graft. This includes total thrombosis which causes occlusion, or partial thrombosis which causes stenosis. In addition to the periodic routine surveillance, the diagnosis of thrombosis was made by rechecking CT angiography when patients complained of recurrence of symptoms, such as claudication during outpatient visit, abnormal findings in the physical examination, and Doppler signal monitoring.

The basic situations for which extra-anatomic bypass procedures as axillo-bifemoral bypasses were developed include patients at unusually high risk for direct aortoiliac replacement (coronary artery atherosclerosis or other severe medical comorbidities), "hostile" abdomen (previous surgery or infection with adhesions, intestinal stomas, active intra-abdominal infection, or otherwise contaminated fields), infected prosthetic intra-abdominal vascular grafts, aortoenteric fistulae, and infected inguinal and infrainguinal arterial bypass grafts or other groin sepsis.[3]

The location of the distal anastomosis was determined according to the degree of iliac arterial lesion.

Retroperitoneal approaches were used when aorto-bifemoral bypass or aorto-biiliac bypass using aorta was used for inflow.

HEMAGARD knitted (Maquet, Rastatt, Germany) 14−7 mm grafts were used in most cases; however, the grafts used by these patients differed slightly depending on the size of their aortas. For axillo-femoral bypasses, an Advanta™ VS PTFE vascular grafts (standard wall-ringed 8 mm, Atrium Medical Corp, Hudson, NH) were used.

The factors associated with graft patency were analyzed using the Cox proportional hazard model. Comparisons of outcomes depending on the surgical method were analyzed by one-way ANOVA. Results were expressed as means with 95% confidence intervals (CIs) where appropriate, and $p < 0.05$ was considered to be statistically significant. Statistical analysis was performed using SPSS statistics version 20 (IBM, Armonk, NY, USA).

3. Results

All patients were male. The mean patient age was 62.53 years, and the mean follow-up duration was 29.53 ± 19.82 (1.97−72.23) months. The patency of the 2-year prosthetic graft was 72.5%. Every patient had a smoking history, and 41 patients continued smoking at the time of surgery. The mean smoking pack-years was 45.29.

There were 27 patients with preoperative hypertension with or without anti-hypertensive medications. There were 20 hypercholesterolemic patients with or without a lipid lowering agent.

Other comorbidities are described in Table 1.

The clinical manifestations seen at diagnosis are presented in Table 2. Most of the patients had severe disabling claudication (Rutherford classification grade 3). There were 5 patients with resting pain and 5 patients with minor tissue losses. Furthermore, there were 3 patients with acute limb ischemia. Other symptoms were impotence (6) and sciatic pains (6).

Associated femoropopliteal lesions are described in Table 3. There were 2 patients with TASC II D femoropopliteal lesions.[4] These 2 patients suffered postoperative graft thrombosis and additional surgeries were done, such as a femoro-popliteal bypass with thrombectomy.

Table 1 Baseline characteristics (n = 51).

Variables	n (%)
Age, years (mean ± SD[a])	62.53 ± 7.466
Sex	
Male	51
Hypertension	27 (52.9)
Diabetes mellitus	20 (39.2)
Hypercholesterolemia	20 (39.2)
Congestive heart failure	2 (3.9)
Chronic renal failure	2 (3.9)
Ischemic heart disease	8 (15.7)
Carotid artery stenosis	7 (13.7)
Chronic obstructive pulmonary disease	4 (7.8)
Deep vein thrombosis	2 (3.9)
Current smoker	41 (80.4)
Ex-smoker	10 (19.6)
Smoking pack years (mean ± SD)	45.29 ± 14.581

[a] SD = Standard Deviation.

Table 2 Clinical manifestations (n = 51).

Rutherford classification (Category[a])	n (%)
0	0 (0)
1	0 (0)
2	2 (3.9)
3	39 (76.5)
4	5 (9.8)
5	5 (9.8)
6	0 (0)

[a] Category 0: asymptomatic, Category 1: mild claudication, Category 2: moderate claudication, Category 3: severe claudication, Category 4: ischemic rest pain, Category 5: minor tissue loss, Category 6: major tissue loss.

Table 3 Associated femoro-popliteal lesion.

TASC II classification	n (%)
None	40 (78.4)
A	5 (9.8)
B	2 (3.9)
C	2 (3.9)
D	2 (3.9)

Table 4 Postoperative complications.

Complications related with surgery	n
Early complications (within 30 days of surgery)	
Leg edema	13
Scrotal edema	6
Distal arterial stenosis	4
Pneumonia	6
Acute renal failure	4
Toe amputation	2
Bowel ischemia	2
Pseudoaneurysm	2
Wound infection	2
Postoperative bleeding	2
Distal artery embolism	1
Acute myocardial infarction	1
Late complications (after 30 days of surgery)	
Artificial graft thrombosis	14
Bilateral	6
Unilateral	8
Distal arterial stenosis	4
Death[a]	3

[a] Causes of deaths: pneumonia (2) and bowel ischemia with acute renal failure (1).

Aorto-biiliac, aorto-bifemoral, and axillo-bifemoral bypasses were performed in 8, 31, and 12 patients, respectively.

Postoperative complications are shown in Table 4. Early complications, except for graft thrombosis and distal arterial stenosis, occurred within 30 days after surgery. Artificial graft thrombosis occurred in 14 patients during follow-up. Endovascular thrombolysis was performed in 8 patients, and one of them underwent endovascular thrombolysis three times. Reoperations were performed in 4 patients. There were 3 (5.88%) deaths and 2 (3.92%) minor amputations after surgery.

Death Case 1 was a 71-year-old man who underwent aorto-bifemoral bypass surgery with bilateral claudication. Forty months after the operation, he visited the emergency room with acute limb ischemia of the right leg. On CT, total occlusion from the origin of the right femoral limb was observed, and emergency thrombectomy was performed, but flow did not recover. Therefore, femoro-femoral bypass was performed. Eventually, the patient died of reperfusion injury, and acute kidney injury due to rhabdomylosis, and multi-organ failure.

Death case 2 was a 79-year-old man with severe claudication of the lower extremity, resting pain, and ischemic ulcer at right 1st toe. The patient has a history of multiple stents inserted into the coronary arteries due to coronary arterial occlusive disease (3 vessele disease). The patients were also undergoing hemodialysis. Because of the comorbidities of the patient, axillo-bifemoral bypass was performed. The patient recovered smoothly. Suddenly cerebral infarction occurred and accompanied by aspiration pneumonia. Eventually he died on the 59th day after surgery.

Death case 3 was a 63-year-old man. Thirty years ago, he was undergone abdominal surgery, and left nephrectomy due to trauma. Right axillo-bifemoral bypass was performed. One year after surgery, right axillary artery anastomosis ruptured, and pseudoaneurysm occurred. Endovascular stent graft insertion was performed on the right axillary artery. An axillary-bifemoral bypass was performed using the opposite axillary artery for the blood flow of the legs. One year and two months after this, Lt. Femoral anastomosis was ruptured and he was referred to the emergency room with hypovolemic shock. He died of pneumonia during treatment in the intensive care unit.

The sites where graft thrombosis occurred were 4 distal anastomotic lesions and 4 graft bifurcations in the patients who underwent aorto-bifemoral bypass. In patients who underwent an axillo-bifemoral bypass, the graft thrombosis sites were 2 proximal anastomotic lesions and 4 femoro-femoral bypass grafts. Patients who underwent an aorto-biiliac bypass had no graft thrombosis.

The factors associated with graft patency were analyzed. The factors that were analyzed are the risk factors for peripheral arterial disease, which was suggested in TASC II.[3] The younger age ($p = 0.017$, OR = 1.112), postoperative uncontrolled hypertension despite medications ($p = 0.044$, OR = 3.797), and associated TASC II D femoropopliteal lesion ($p = 0.008$, OR = 11.139) were significantly related to graft patency after surgical repair (Table 5).

Because graft thrombosis occurred in 50% (6/12) of patients with an axillo-bifemoral bypass, the method of operation was considered as a risk factor for consequent graft thrombosis.

4. Discussion

Aortoiliac occlusive disease typically begins at the aortic terminus and common iliac artery origins and slowly

Table 5 Factors related to graft patency by Cox-regression survival analysis.

Variables	*p* value	Odd ratio	CI
Younger age	0.017	1.112	1.059–1.340
Postoperative hypertension	0.044	3.797	1.149–24.139
Diabetes mellitus	0.367	0.483	0.304–15.336
Hypercholesterolemia	0.828	1.139	0.083–3.509
Total cholesterol level	0.753	1.003	0.981–1.037
Current smoker	0.868	1.145	0.965–1.073
Smoking pack years	0.769	0.994	0.347–25.775
Preoperative CRP[a]	1.022	1.013	0.948–1.095
Femoro-popliteal lesion (TASC D)	0.008	11.139	1.220–38.839
Rutherford classification	0.906		0.463–1.762
Method of operation	0.298		0.753–2.718

[a] CRP: C-reactive protein.

progresses proximally and distally over time.[5,6] Although an atherosclerotic disease limited to the aortoiliac region commonly gives rise to claudication of varying degrees, it is rarely associated with critical limb ischemia.[6]

Among many complications, postoperative graft thrombosis remains as a significant clinical challenge, and accounts for significant morbidity, limb loss, and mortality. The accumulated experience to date has shown that 5- and 10-year primary patency rates between 85% and 90% and between 75% and 85%, respectively, can be expected with aortobifemoral grafting.[6] In addition, unilateral limb thrombosis is more common, which most often reflects progressive intimal hyperplasia at the distal anastomosis or progression of outflow disease.[6] Although axillo-bifemoral bypasses have a higher incidence of graft thrombosis, their primary patency has been reported to be about 53%–79% at 3 years.[7–9]

In this study, the graft patency was measured as 72.5% after surgery for 2 years. Among them, 43% and 57% were bilateral and unilateral graft thromboses, respectively. All patients with bilateral graft thrombosis were part of the axillo-bifemoral bypass group. The factors related to graft patency were analyzed. Younger age ($p = 0.017$, OR = 1.112), presence of postoperative uncontrolled hypertension ($p = 0.044$, OR = 3.797), and associated TASC II D femoropopliteal lesion ($p = 0.008$, OR = 11.139) were significantly related to graft patency after surgical repair.

Age has proved to be a significant predictor of outcome. In one report, primary patency rates at 5 years were greater than 95% for patients older than 60 years, but only 66% for those younger than 50 years.[10] Younger age ($p = 0.017$, OR = 1.112) was significantly related to poor graft patency. Although it is not clear why younger patients have inferior long-term patency rates, it could be speculated that they have a more aggressive form of atherosclerosis or are at a different point in disease progression compared to their older counterparts.[6]

Our study showed that poorly controlled hypertension after surgery has a negative effect on the patency of an artificial vascular graft. Additional research is needed to determine how graft thrombosis affects uncontrolled postoperative hypertension.

Conflicting results have been documented with regard to the impact of preexisting superficial femoral artery (SFA) occlusion, with some, but not all reports, suggesting improved late patency when a simultaneous outflow procedure is performed at the time of aortobifemoral grafting.[6,11,12] In contrast, the benefits of combining profundaplasty with the inflow procedure have been unambiguously demonstrated.[6,13] In this study, the associated TASC II D femoropopliteal lesion ($p = 0.008$, OR = 11.139) was significantly related to poor graft patency.

Of note, no major differences in aortobifemoral graft durability have been noted between the transperitoneal and retroperitoneal approaches, between end-to-end and end-to-side anastomotic techniques, or between the indications of surgery as claudication or critical limb ischemia.[6]

In our study, the surgical method has not been shown to be a factor affecting the graft patency. However, it is necessary to include such result in the overall interpretation of the results, as the number of patients included in this study was low — moreover, many disturbance factors were not excluded.

Urayama et al. noted a markedly reduced primary patency for extra-anatomic bypass compared with direct aortobifemoral reconstruction, but the former group was older, more likely to have critical limb ischemia, and had markedly lower survival to at least 10 years after the procedure.[14] It seems that certain comorbidities of patients who required axillo-bifemoral bypass might have influenced the incidence rate of postoperative graft thrombosis or other complications. In this research, consistent with previous studies, the axillo-bifemoral group with significantly more elderly patients, had higher occurrences of postoperative acute renal failure, graft thrombosis, and pseudoaneurysm, and needed more interventions due to graft thrombosis.

Looking at the papers from another viewpoint, Garcia-Fernandez et al reported a decreased graft patency in the patients with chronic renal failure.[15] Moreover, Davidovic et al stated that the use of a PTFE graft, rather than Dacron graft, causes more cases of distal anastomotic stenosis due to neointimal hyperplasia, which eventually lowers graft patency, suggesting that performing end-to-end configuration of proximal anastomosis and a simultaneously performed femoropopliteal bypass with the distal anastomosis site of deep femoral artery could promote the graft patency.[16,17]

Postoperative graft thrombosis remains as one of the most significant clinical challenges, accounting for significant morbidity, limb loss, and mortality after revascularization surgery, even though it is associated with many complications. Younger age, presence of postoperative uncontrolled hypertension, and associated TASC II D femoropopliteal lesion were significantly related to poor graft patency after surgical repair in Leriche syndrome. It is necessary to be aware that the younger the age of the patient, the higher the chance of developing graft thrombosis. In addition, strict blood pressure control after surgery will help in maintaining good graft patency. If a coexisting TASC II femoropopliteal lesion is present, simultaneous operation of the lesion will help to improve graft patency.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgments

This work was supported by 2-year research grant form Pusan National University.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.asjsur.2018.08.009.

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