Extra-anatomical bypass operation in patients with unilateral graft limb occlusion after endovascular aneurysm repair for abdominal aortic aneurysm

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INTRODUCTION

Femorofemoral crossover bypass is performed in high-risk patients who are not candidates for invasive open surgery due to comorbidities that exclude them from the procedure and in patients with critical limb ischemia or intermittent claudication where anatomic constraints exclude them from endovascular procedures to re-establish in-line flow [1].

An abdominal aortic aneurysm (AAA) is an abnormal dilatation of the abdominal aortic diameter by more than 50%, which is irreversible and permanent [2, 3]. Following endovascular aneurysm repair (EVAR) for AAA, graft limb occlusion is a serious and severe complication [4].

The management options for symptomatic patients with graft limb occlusion are endovascular or surgical. The endovascular options include thrombolytic therapy, angioplasty with or without stenting, and rheolytic therapy, whereas surgical treatment includes thrombectomy or extra-anatomical bypass in the form of femorofemoral crossover bypass. Each treatment option has its drawbacks and should be tailored to each patient.

Thrombolysis therapy can be complicated by hemorrhages, a new endoleak due to thrombus lysis in the aneurysm sack, and leg embolism. It is also time-consuming. On the other hand, surgical thrombectomy has disadvantages such as thrombus migration in the contralateral limb and hypogastric artery, component separation in modular devices, and stent-graft dislodgement [5].

The main objective of our study was to determine the durability of an extra-anatomical femorofemoral crossover bypass procedure in patients with unilateral graft limb occlusion after EVAR for AAA over a 20-year period.

METHODS

From January 2001 to March 2021, 1611 AAA patients were treated with EVAR using a bifurcated stent graft at the Department of General, Endocrine and Vascular Surgery at the Independent Public Central Clinical Hospital in Warsaw, Poland. A total of 33 high-risk patients (American Society of Anesthesiologists [ASA] class III and IV) required an extra-anatomical procedure in the form of femorofemoral crossover bypass due to occlusion of one of the limb branches of the bifurcated stent graft. Patients were included in the study continously and all primary procedures carried out were elective. Patients were re-examined at one month, 6 months, and one year, and then every year afterward, with clinical examination and a computed tomography scan. Four patients died during the follow-up period; all deaths were cardiac-related.

Commercially available devices that were used included Zenith (Cook Medical, Bloomington, Ind), Endurant (Medtronic, Minneapolis, MN, US), and Excluder (W. L. Gore & Associates, Newark, DE, US). Of the 33 patients that had a graft limb occlusion; one patient had an Endurant stent graft and the remaining patients had Zenith stent grafts. The choice of stent graft type was based on institutional practice and vascular surgeons' preference and depended on the technical aspects of the procedure.

The AAA diameter range was from 48 mm to 75 mm. The aortic bifurcation diameter range was from 21 mm to 40 mm. The right

and left iliac diameter range was from 10 mm to 46 mm and from 10 mm to 87 mm, respectively. Six mm, 7 mm, and 8 mm prostheses were used.

Computed tomography angiography was used to determine the occurrence of an occlusion. Patient operative details, immediate and long-term clinical outcomes, aneurysm characteristics, perioperative arteriograms, and computed tomography scans were stored prospectively in a dedicated database and analyzed retrospectively. An extra-anatomical procedure was performed when the patient was symptomatic. Patients were found to have an occluded graft limb when they presented with claudication or acute limb ischemia to the accident and emergency department or during their follow-up appointment.

Ethics

The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Bioethics Committee at the Medical University of Warsaw (AKBE/108/2022) in Warsaw, Poland. The need for informed consent was waived owing to the retrospective study design.

Statistical analysis

Statistical analysis was performed using STATISTICA for Windows software (StatSoft, Inc.). Patients were considered the unit of analysis for clinical data analysis. The Kaplan-Meier method was used to show the percentage of patients free from secondary intervention and the percentage of patients with patent grafts including secondary interventions.

RESULTS AND DISCUSSION

A total of 1611 AAA patients were treated with EVAR using a bifurcated stent graft. This study included 33 high-risk patients (2.05%), ASA class III and IV (30 men; mean [SD] age 70 [7.7] years, range 48–90) who required an extra-anatomical procedure in the form of a femorofemoral crossover bypass due to unilateral graft limb occlusion of the bifurcated stent- graft.

In seven patients, femorofemoral crossover bypass failed due to occlusion during the follow-up period. Five patients had thrombectomy, one patient required an above-the-knee amputation of the right leg due to critical limb ischemia after a failed femorofemoral crossover bypass due to unsuccessful attempts at restoring patency, and one patient was treated conservatively. However, four patients experienced femorofemoral crossover bypass re-occlusion. Two patients required another re-intervention, and the remaining two patients were treated conservatively. One patient had a re-intervention which consisted of an axillo-bifemoral bypass, and the other patient had a successful thrombectomy. In total, three patients were asymptomatic after the occluded femorofemoral crossover bypass was incidentally found on follow-up computed tomography angiography and were treated conservatively.

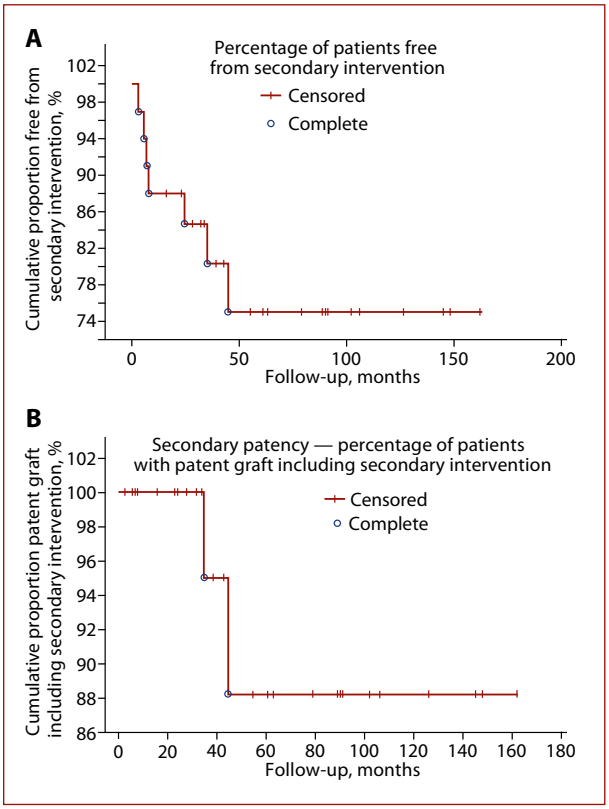

Figure 1. A. Percentage of patients free from secondary intervention. **B.** Percentage of patients with patent graft including secondary interventions

Four patients died during the follow-up period, all due to cardiac-related causes. There were no infections reported during the follow-up period.

Late occlusion (>1 month) occurred in seven patients, whereas early occlusion (<1 month) did not occur in any patient. Primary patency was 78.8% while secondary patency was 90.9%. Kaplan-Meier curves were used to show the percentage of patients free from secondary intervention (Figure 1A) and the percentage of patients with patent grafts including secondary interventions (Figure 1B).

Although EVAR is becoming the preferred treatment for AAA due to its clinical benefits and minimal invasiveness, there is an increase in the number of re-interventions and graft-related complications. Graft limb occlusion presents with severe acute rest pain in the lower extremity which is a significant complication following EVAR [6]. It is one of the top three reasons for readmission to the hospital [7, 8].

Our study shows good primary and secondary patency rates which is consistent with other femorofemoral crossover bypass studies [9, 10]. Our primary and secondary patency rates were 78.8% and 90.9%, respectively. Park et al. [9] showed similar primary and secondary patency rates at 5 years of 70% and 85%, respectively. In a study by Park et al., 32 patients (24%) showed graft occlusion due to thrombosis compared to our study, in which there were as few as 7 such patients (21%). However, our study involved

only 33 patients, whereas Park et al. reported a total of 133 patients, which could account for the difference.

In a study by Ricco et al. [10], primary and secondary patency rates were 71.8% and 89.8%, respectively. Thirty patients (40%) had crossover bypass graft failure; 14 had graft occlusion, 12 had stenosis of the donor iliac artery, and 4 had femoral anastomotic stenosis. However, if we are comparing graft occlusion, Ricco et al. reported 14 graft occlusions (18.9%), which is similar to our study (21%).

In our study, all 33 patients were high-risk patients (ASA class III and IV) with unilateral graft limb occlusion, who presented with either leg claudication or acute limb ischemia. It is our experience, similar to Parent et al. [11], that femorofemoral bypass grafting is frequently required when there is endograft limb occlusion. Femorofemoral crossover bypass is a minor procedure that can be performed under local anesthesia, making it particularly beneficial for patients who are high-risk, are not suitable for major surgery, or have contraindications. In addition, little or no preoperative preparation is required for this procedure to be carried out. All our patients were treated urgently right after unilateral graft limb occlusion, which resulted in continued patency of the limb vessels. However, larger prospective studies are required to validate this hypothesis.

Limitations

This study had several limitations. First, this was a retrospective study, limited by factors inherent in retrospective data analysis and interpretation. Second, the study was based on the experience of one institution with a moderate number of patients.

CONCLUSION

Femorofemoral crossover bypass as an extra-anatomical procedure following unilateral graft limb occlusion should be considered for high-risk patients who are not candidates for major surgery. It is a minor procedure, performed under local anesthesia, with good patency in the long-term and low operative mortality and morbidity.

Article information

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