

Open Conversion After Endovascular Abdominal Aneurysm Repair: An 8 year Single Centre Experience

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WHAT THIS PAPER ADDS

Open conversion after failed endovascular aneurysm repair appears to be a safe and effective procedure when performed electively. It should be considered as a valuable option, especially in cases of repeated failed endovascular interventions. Elective open conversion should be performed before the occurrence of serious adverse events leading to an emergency open conversion, which in the authors' experience, is significantly associated with increased in hospital mortality and morbidity.

Objective: To report experience with open conversion (OC) after previous failed EVAR and to compare outcomes of patients undergoing elective OC with those operated on in an urgent setting.

Methods: Patients undergoing OC after EVAR between August 2008 and September 2016 were included in this retrospective and observational single institution study. Indications, demographic, anatomical, intra-operative and post-operative data were collected prospectively. Primary endpoints were 30 day and in hospital mortality. Secondary endpoints included moderate to severe complications, secondary interventions, length of intensive care unit, and hospital stay.

Results: OC was performed in 31 patients over the study period: 19 elective and 12 emergency OC, including six ruptures. Median time from index EVAR to delayed OC was 35 months (0–228 months). The most common indications for OC were endoleaks ($n = 24$, 77%), followed by stent graft infection ($n = 3$, 10%), thrombosis ($n = 3$, 10%) and kinking ($n = 1$, 3%). Eight of the removed stent grafts were Endurant, two were Talent, five Excluder, six Nellix, two AFX, five Zenith, one Vanguard, one Anaconda, and one Seta. Overall in hospital mortality was 10%, with significantly increased in hospital mortality in the emergency group compared with the elective group (25% vs. 0%, $p = .049$). Renal and pulmonary complications were significantly higher in the emergency group (42% vs. 5%, $p = .02$ and 42% vs. 0%, $p = .005$, respectively). No late complication or death was recorded after a mean follow-up of 18 ± 13 months.

Conclusions: Emergency OC is associated with significantly increased in hospital mortality and morbidity compared with elective OC. Elective OC appears to be safer and effective, and should be considered as the best option in cases of EVAR failure to avoid further emergency OC procedures.

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INTRODUCTION

Despite improvements in endograft technologies, operator skills, and patient selection, endovascular aneurysm repair (EVAR) continues to be associated with device related complications, sometimes leading to its explantation. Over the past decade, as it has become the treatment of choice over open repair in the USA and many other countries,¹ the

growing number of EVAR procedures means that vascular surgeons are increasingly dealing with conversion to open repair of abdominal aortic aneurysms (AAA) after previous EVAR.^{2,3} This procedure can be technically challenging and involves specific operative management. Indeed, open conversion (OC) after failed EVAR has recently been reported to be associated with increased peri-operative morbidity and mortality compared with standard open repair in a large study using the National Surgical Quality Improvement Program (NSQIP).⁴ Acute OC can sometimes be required as a result of intra-operative issues during EVAR; however, in most cases, patients undergo delayed OC many months, or years, after initial EVAR. This highlights the weak points of EVAR in the long term, such as endoleaks, and the need for lifelong surveillance.⁵ OC can either be

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performed electively, as a last-resort treatment after previous secondary endovascular interventions, or as an emergency in patients presenting with painful, ruptured, or infected AAA.

The aim of the present study was to report growing experience at the study institution with OC after previous failed EVAR and to compare outcomes of patients undergoing elective OC with those operated on in an urgent setting.

METHODS

Patients undergoing OC after EVAR between August 2008 and September 2016 were included in this retrospective single institution study. Demographic, anatomical, intra-operative, and post-operative data were collected by means of a prospectively maintained database. The ethical committee at the study institution dismissed the need for specific consent for this retrospective study on standard health care. OC included all procedures requiring open access for aortic cross-clamping, with partial, complete, or no removal of the stent graft. Attention was given to the time from initial EVAR to OC, device type, and indication for OC. Intra-operative data included aortic clamp site, the extent of stent graft removal, and type of reconstruction. All stent grafts had been implanted according to their instructions for use (IFU), except for the Nellix device which had been used for short, conic, or angulated proximal neck.

OCs were performed either in the elective or in emergency setting. Emergency OCs were performed for painful and ruptured aneurysms, stent graft infections, and stent graft thrombosis with lower limb ischaemia. All patients underwent a computed tomography angiography (CT) scan pre-operatively. An additional arteriogram was performed for cases of aneurysm sac enlargement with no evidence of endoleak on CT scan. Although a patient might have more than one type of endoleak, only the most clinically relevant was considered as the indication for OC. As recommended by the French sanitary regulation (HAS), follow-up after EVAR includes a clinical evaluation with CT scan at 1 month, 6 months, 1 year, and yearly thereafter. Compliance with follow-up was defined as the ratio between the number of completed post-operative visits and the theoretical number of post-operative visits that patients were supposed to have had between index EVAR and OC. Intra-operative and post-operative complications were recorded. Post-operative analysed data included 30 day mortality and in hospital mortality, major peri-operative (<30 days) complications, length of intensive care unit stay, and length of hospital stay. Post-operative moderate to severe complications are reported according to the Society for Vascular Surgery/American Association for Vascular Surgery standards.⁶

Cases of intra-operative open conversion during elective EVAR were not included in this series.

Data analysis

Statistical analysis was performed using the Mann–Whitney *U* test, Pearson's chi-square test, Student *t* test, and, if possible, Fisher's exact test. Variables are presented as

mean \pm standard deviation (SD) for continuous data, mean plus range in cases of skewed distribution, and as frequency and percentage for categorical data. Significance was considered to be a *p* value < .05.

RESULTS

Overall results

Study population. During the study period, a total of 338 EVAR and 315 open repairs were performed electively for AAA at the study institution, with a global 30 day mortality of 1.56% (elective EVAR 1.55%, elective OR 1.59%). During the same period, 31 patients required OC after EVAR. Twenty-six patients were male (84%) and the study cohort mean age was 73 ± 11 years. OC was performed electively in 19 cases (61%) and as an emergency in 12 (39%). The emergency group included six patients presenting with rupture out of 83 ruptured AAA managed in the institution over the study period. Patient characteristics and pre-operative conditions are presented in Table 1. Patients in the emergency group had a higher incidence of pre-operative chronic renal disease than those in the elective group (42% vs. 5%, *p* = .02). Initial EVAR had been performed at the study institution in 28 out of 31 cases (90%), resulting in an open conversion rate of 8% (28/338) over the study period. Three patients (10%) had been operated on elsewhere. Median time from index EVAR to OC was 35 months (range 0–228 months). Mean aneurysm original diameter prior to EVAR was 58 ± 10 mm. Mean aneurysm sac enlargement between device implantation and OC was 13 ± 11 mm.

Indications. Indications for both elective and emergency OC are shown in Table 2. Most common indications for OC were endoleaks (*n* = 24, 77%), followed by stent graft infection (*n* = 3, 10%), thrombosis (*n* = 3, 10%), and stent graft kinking with stenosis (*n* = 1, 3%).

In the emergency group, among eight patients with endoleaks, six presented with rupture. Two patients presented with painful AAA (78 and 81 mm aneurysm diameter respectively) associated with a persistent proximal type I endoleak despite addition of a proximal cuff after index EVAR.

Surgical details. All patients were operated on using a transperitoneal approach via a midline laparotomy. The removed stent grafts are listed in Table 3. Fixation was suprarenal for 18 endografts (58%) and infrarenal in 13 (42%). The operative strategy, including proximal clamp site and the extent of stent graft removal, was dependent on several factors: indication for OC, delay between EVAR and OC, and type of stent graft removed.

Proximal aortic cross-clamping was infrarenal in 20 cases (65%), interrenal in three cases (10%), suprarenal in seven cases (23%), and supraceliac in one case (3%). Iliac limbs were clamped using balloon occlusion with Foley catheters.

The stent graft was completely removed in 14 cases (45%), including all three cases of stent graft infection and all six Nellix.

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