Complications and reintervention following elective open abdominal aortic aneurysm repair: a 10-year retrospective analysis

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ABSTRACT

INTRODUCTION Recent data have shown higher rates of graft related complication or reintervention in patients undergoing endovascular aneurysm repair compared with open aneurysm surgery (OAS). However, there are fewer data available regarding procedure related reinterventions following OAS. The aim of this study was to investigate the incidence of procedure related complications and reintervention following elective open abdominal aortic aneurysm repair.

METHODS This was a retrospective analysis of prospectively collected data from the dedicated Portsmouth POSSUM database. Data from 361 patients (median age: 72 years, 91.4% male) who underwent elective OAS between 1993 and 2004 were analysed. The incidences of early and late complications and subsequent reintervention were investigated.

RESULTS The median follow-up duration was 10 years 4 months (range: 5 years – 16 years 4 months). There were 52 reinterventions in the follow-up period. Of these, 34.6% were for incisional hernias or small bowel obstruction with the majority of the remaining laparotomies performed for bleeding or distal ischaemic complications. Almost two-thirds (63.5%) of reinterventions occurred in the first 30 days. There were 30 emergency readmissions to the acute surgical wards that did not require reintervention.

CONCLUSIONS OAS carries a significant reintervention rate. In this study, 54% of reinterventions were directly related to laparotomy.

KEYWORDS

Vascular diseases – Aortic aneurysm, abdominal – Vascular surgical procedures – Endovascular procedures

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Data published in 2010 from the UK multicentre endovascular aneurysm repair (EVAR) study have indicated that there is no significant difference in aneurysm related mortality between endovascular and open infrarenal aneurysm repair (OAS) at eight years, the gap being closed by mortality following late rupture in patients treated by EVAR.¹ Such data challenge current concepts of indications and suitability for EVAR, particularly at a time of renewed scrutiny of cost effectiveness.

While the data from the EVAR trial showed a lower 30-day mortality rate for EVAR and a rough equivalence of cost compared with open surgery, there has been continuing debate about the overall cost effectiveness of endovascular repair.^{1,4,5} The need for continued surveillance of endografts, graft failure rates and the need for reintervention have been the focus of this debate.^{6–8}

The EVAR trial has shown a 3–4 times higher rate of graft related complications or reintervention in the EVAR group compared with the OAS group.¹ (Graft related complications were defined as: endoleak; graft rupture, ie aortic rupture

despite the presence of an aneurysm repair graft; anastomotic aneurysm; graft migration at proximal or distal ends of device; graft kinking; graft thrombosis; graft stenosis; distal embolisation from graft; graft infection; dilatation of the aortic neck, sac or iliac landing zones following graft placement; aortic perforation/dissection; or renal infarction.) However, reinterventions relating to OAS such as for hernias or small bowel obstruction were not included in the analysis. It is vital that accurate data are obtained regarding reintervention and complication rates in both open and endovascular repair to allow a fair debate about the effectiveness of these procedures.

There is little in the literature regarding *procedure related* reintervention following OAS although the update to the Dutch Randomised Endovascular Aneurysm Management (DREAM) trial published at the beginning of 2010 commented that cumulative rates of freedom from secondary interventions were 81.9% for open repair and 70.4% for endovascular repair.⁵ Nevertheless, a study of Medicare beneficiaries in 2008 concluded that late aneurysm related

reinterventions were more common after EVAR but were balanced by an increase in laparotomy related reinterventions and hospitalisations following open surgery.² This study investigated complication and reintervention rates following open abdominal aortic aneurysm (AAA) repair in a cohort of patients who underwent elective repair of infrarenal AAA between August 1993 and November 2004 in a single institution.

Methods

A consecutive series of elective open infrarenal AAA repairs performed at one institution between August 1993 and November 2004 under the care of six vascular surgeons was studied. Data were obtained by interrogating the Portsmouth Physiological and Operative Severity Score for enUmeration of Mortality and morbidity (POSSUM) database as well as the hospital patient letters database. The Portsmouth POSSUM database contains data on all patients admitted under general or vascular surgery. Data have been entered by dedicated staff since 1993 and include patient demographics, procedures performed, operator, diagnosis, interventions and complications prior to discharge. This information is taken directly from patient records following discharge. The patient letters database holds the majority of all patient letters and, in some cases, operation notes. It is linked to the patient administration system.

From these data sources, post-operative complications and subsequent operative reinterventions were recorded using a bespoke spreadsheet database maintained by the vascular surgery department. Complications were divided into those requiring operative reintervention and those that did not. They were also categorised into immediate complications (days 0–1 after surgery), early complications (days 2–30 after surgery) and late complications (days 31+ after surgery). Complications not requiring surgical reintervention were subdivided into cardiac, respiratory (including infections), renal (including acute kidney injury and urinary tract infections), gastrointestinal, wound and other complications. Data were also recorded if the patient required readmission as an emergency referral from primary care. A death certificate search was attempted but not deemed possible by the local coroner's office.

Results

Data on 361 patients (91.4% male; median age: 72 years [range: 55–86 years]) were analysed (Table 1). All patients were from the NHS South Central Strategic Health Authority (or its predecessor). The median follow-up period was 10 years 4 months (range: 5 years – 16 years 4 months).

In 289 cases (80.1%) the procedure was performed by a consultant, the remainder being performed by a supervised trainee. The median length of hospital stay was 11 days (range: 0–56 days). The observed 30-day all-cause mortality rate for all patients undergoing open AAA repair was 6.4%. There was no difference in mortality for cases with a registrar as primary surgeon (mortality 8.3%) and a consultant as primary surgeon (mortality 5.9%). A total of nine patients

Table 1 Patient demographics

	Patients	Median age (range)
Male	330 (91.4%)	72 (55–86)
Female	31 (8.6%)	74 (61–84)
Total	361 (100%)	72 (55–86)

Table 2 Emergency additional procedures performed at open aneurysm surgery

Procedure	Emergency / elective	Patients
Splenectomy	Emergency	4
Peri-operative graft failure	Emergency	1
Duodenal injury – oversewn	Emergency	1
Left nephrectomy	Emergency	1
Jump graft to common iliac artery for intra-operative occlusion	Emergency	1
Small bowel injury – resection	Emergency	1

(2.5%) had unplanned additional procedures at the time of the original surgery and six (1.7%) had planned, additional surgery (Table 2).

A total of 52 reinterventions were necessary following 361 elective open AAA repairs. Over half (53.8%) of these were directly related to laparotomy, ie surgery was performed for small bowel obstruction, post-operative bleeding and incisional hernia.

Complications requiring reintervention

Overall, 38 patients (10.5%) had reinterventions. Patient episodes requiring surgical reintervention are summarised in Table 3. There were 12 immediate (days 0–1 after surgery) operative reinterventions. Ten were laparotomies for bleeding (anastomosis, lumbar arteries or other intra-abdominal sources) and two were a bilateral femoropopliteal bypass for lower limb ischaemia.

In the early post-operative period (days 2–30 after surgery), 21 reinterventions were performed. Six were laparotomies for bleeding (anastomosis, lumbar arteries or other sources), six reinterventions were performed for distal ischaemia, three laparotomies were performed for small bowel obstruction (defined as failure of small bowel drainage with radiographic features of dilated small bowel), two were incisional hernia repairs, two were wound closures and two were laparotomies for other indications (first episode: perforated large bowel resection, second episode: further washout).

A total of nineteen late (days 31+ after surgery) reinterventions were performed: seven incisional hernia repairs, six laparotomies for small bowel obstruction, three procedures for distal ischaemia, two aneurysm repair revisions

Table 3 Patient episodes requiring surgical reintervention by time and type

	Immediate reinterventions (days 0–1)	Early reinterventions (days 2–30)	Late reinterventions (days 31+)
Laparotomy for bleeding (anastomosis / lumbar arteries / other)	10	6	1
Laparotomy for small bowel obstruction	0	3	6
Laparotomy for other	0	2	0
Surgery for distal ischaemia	2	6	3
Incisional hernia repair	0	2	7
Wound closure	0	2	0
Revision surgery for graft infection	0	0	2
Total	12	21	19

Table 4 Patient episodes not requiring surgical reintervention by time and type

	Immediate complications (days 0–1)	Early complications (days 2–30)	Late complications (days 31+)
Respiratory	0	49	0
Cardiac	0	42	0
Renal	0	20	0
Small bowel obstruction / abdominal pain	0	10	16
Incisional hernia	0	8	10
Wound	0	7	1
Hallux embolus / femoral nerve palsy	0	2	0
Graft infection	0	0	2
Aortoduodenal fistula	0	0	1
Total	0	138	30

due to infection and one laparotomy for bleeding (anastomosis, lumbar arteries or other sources).

Complications not requiring reintervention

Patient episodes not requiring surgical reintervention are summarised in Table 4. There were no immediate (days 0–1 after surgery) complications.

There were 138 episodes of early (days 2–30 after surgery) complications that did not require reintervention. These included: 49 respiratory complications (eg pneumonia, pulmonary embolism), 42 episodes of cardiac complications (eg cardiac failure, arrhythmias, myocardial infarction), 20 renal complications (eg acute renal failure, urinary tract infections), 10 episodes of small bowel obstruction not requiring surgery or of abdominal pain, 8 gastrointestinal complications, 7 cases of delayed wound healing or dehiscence, 1 femoral nerve palsy and 1 hallux embolus leading to peripheral tissue necrosis.

There were 30 episodes of late (days 31+ after surgery) complications not requiring reintervention or where the patient was unfit for reintervention: 10 incisional hernias managed conservatively, 10 episodes of small bowel obstruction

(1 patient was admitted 5 times), 6 readmissions within 1 year of OAS for abdominal pain that was clinically attributed to OAS by the admitting consultant surgeon, 2 graft infections (both patients were unfit for reintervention), 1 wound infection and 1 aortoduodenal fistula.

Discussion

Over the past decade there has been a dramatic change in practice in the treatment of AAA disease with EVAR increasingly prevailing as the treatment of choice in anatomically suitable cases. Supported in the UK by both the Vascular Society and health commissioners, this change has come about because of the good evidence showing it carries a significant procedure related mortality advantage over OAS that endures after the procedure for at least the first few years.

Nevertheless, important recent longer term follow-up data from the UK EVAR study have shown convergence of survival of patients treated by EVAR and OAS.⁸ This is apparently attributable to mortality following late rupture in patients treated by EVAR and it has brought back into focus

the question of relative indications for EVAR and OAS. Some of the debate concerns the use of EVAR in cases of borderline suitability, particularly in terms of neck anatomy where the use of standard infrarenal devices may predispose the development of late endoleaks. Meanwhile, the longer term durability of EVAR devices itself remains uncertain and requires ongoing data collection and reporting.

One area of early unease regarding the use of EVAR with both clinical as well as cost implications concerned the requirement of sustained surveillance of EVAR devices after implantation and the associated possibility of further intervention to correct for or prevent late complications. This was taken to be in great contrast to the case of OAS where patients could, it was said, be discharged safely following successful surgery without further follow-up because of the negligible incidence of late complications, it being an operation 'for life'. In fact, while there are plenty of data surrounding long-term survival following aneurysm surgery in historical series, the available literature on reintervention following OAS surgery is surprisingly small.

While investigating mortality as the primary endpoint, the important EVAR⁴ and DREAM⁵ studies both reported comparative data with regards to complication/reintervention rates following EVAR or OAS. Such data were incomplete in the case of the EVAR study as it only addressed device specific complications and did not include OAS procedure related complications arising from laparotomy (eg incisional hernia and small bowel obstruction). The 2010 update of the DREAM trial included laparotomy related complications/reinterventions in the analysis and found freedom from intervention to be higher for the OAS group than in the EVAR group.¹² However, for the majority of the follow-up period complication/reintervention rates were similar for both techniques, diverging only in the last three years. The number of patients in each group at that point had dropped significantly, making the data difficult to interpret.

In this study, a total of 52 reinterventions were necessary following 361 elective open AAA repairs. Over half (53.8%) of these were directly related to laparotomy, ie surgery was performed for bleeding, small bowel obstruction and incisional hernia. This finding that laparotomy significantly contributes to the need for reintervention was also reported in the DREAM trial, in which half of primary interventions in the OAS group were performed for incisional hernias.⁵

Data on complications not requiring reintervention, in particular those directly relating to laparotomy, were not part of the analysis in some of the major trials.^{4,5} The fact that in 361 patients there were 162 major complications that were not followed by surgical reintervention is a reminder of the morbidity associated with OAS.

This study benefits from a large dataset collected over ten years from a dedicated database at Queen Alexandra Hospital. While we believe that these data accurately reflect procedure related complications treated in this hospital, inevitably loss to follow-up will have occurred. In addition, our study would not have picked up patients treated for complications in other hospitals. It is therefore possible that the recorded rate of complications following OAS actually underestimates the true incidence.

No comparison with EVAR performed in the same time period was carried out as only a small number of such procedures were performed at Queen Alexandra Hospital over the study period. However, the long and mid-term results from the EVAR trials⁴ have shown that the reintervention rate within four years of randomisation for EVAR was 41% while that of OAS was 9%. Our data reflect the figures for OAS although they also highlight that the number of patient episodes was much higher, illustrating the fact that often patients will undergo multiple reinterventions with the associated morbidity, mortality and cost implications.

The high rate of reintervention related directly to laparotomy highlights that while reinterventions affect a small proportion of patients, often multiple reinterventions are required per patient.

Conclusions

A number of patients undergoing OAS experience complications. In our study, 52 reinterventions were performed with 38 patients (10.5%) requiring reintervention. Over half of the reinterventions (53.8%) were directly related to laparotomy. All procedure related complications and reinterventions should be included in any cost-benefit analysis comparing OAS and EVAR. A measured and long-term dataset is required before either open AAA repair or EVAR can convincingly be named the gold standard or the most cost-effective method for AAA repair.

References

- Greenhalgh RM, Brown LC, Powell JT *et al.* Endovascular versus open repair of aortic aneurysm. *N Engl J Med* 2010; **362**: 1,863–1,871.
- Schermerhorn ML, O'Malley AJ, Jhaveri A *et al.* Endovascular vs open repair of abdominal aortic aneurysms in the Medicare population. *N Engl J Med* 2008; **358**: 464–474.
- De Bruin JL, Baas AF, Buth J *et al.* Long-term outcome of open or endovascular repair of abdominal aortic aneurysm. *N Engl J Med* 2010; **362**: 1,881–1,889.
- Greenhalgh RM, Brown LC, Kwong GP *et al.* Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day operative mortality results: randomised controlled trial. *Lancet* 2004; **364**: 843–848.
- Prinssen M, Verhoeven EL, Buth J *et al.* A randomized trial comparing conventional and endovascular repair of abdominal aortic aneurysms. *N Engl J Med* 2004; **351**: 1,607–1,618.
- Thomas SM, Gaines PA, Beard JD. Short-term (30-day) outcome of endovascular treatment of abdominal aortic aneurysm: results from the prospective Registry of Endovascular Treatment of Abdominal Aortic Aneurysm (RETA). *Eur J Vasc Endovasc Surg* 2001; **21**: 57–64.
- Galland R. Endovascular repair (EVAR) of abdominal aortic aneurysms: the case for and against. *Ann Roy Coll Surg Engl* 2004; **86**: 377–380.
- Brown LC, Epstein D, Manca A *et al.* The UK Endovascular Aneurysm Repair (EVAR) trials: design, methodology and progress. *Eur J Vasc Endovasc Surg* 2004; **27**: 372–381.
- Torella F. Effect of improved endograft design on outcome of endovascular aneurysm repair. *J Vasc Surg* 2004; **40**: 216–221.
- Dardik A, Lin JW, Gordon TA *et al.* Results of elective abdominal aortic aneurysm repair in the 1990s: a population-based analysis of 2335 cases. *J Vasc Surg* 1999; **30**: 985–995.
- Lawrence PF, Gazak C, Bhirangi L *et al.* The epidemiology of surgically repaired aneurysms in the United States. *J Vasc Surg* 1999; **30**: 632–640.
- De Bruin JL, Baas AF, Buth J *et al.* Long-term outcome of open or endovascular repair of abdominal aortic aneurysm. *N Engl J Med* 2010; **362**: 1,881–1,889.