



Long-term Results of Elective Open Repair of Abdominal Aortic Aneurysms: 10 Years of Experience at the Tri-Service General Hospital in Taiwan

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Background: Because endoluminal stenting may reduce early mortality and morbidity rates relating to treatment of abdominal aortic aneurysms (AAAs), it is becoming increasingly important to know the long-term survival and quality of life of patients after open repair for an AAA. This report describes our long-term results of conventional elective open surgical repair of AAAs and discusses various aspects of the surgical strategy to improve long-term survival after the operation. **Methods:** We retrospectively reviewed the charts of 53 patients (46 men and seven women) with an AAA who underwent open surgical repair at the Tri-Service General Hospital, Taiwan, from 1996 through 2005. The demographic characteristics, operative data, postoperative results, and long-term outcomes of patients were recorded and analyzed. **Results:** The mean age was 66.5 years (range, 21–88 years). Associated morbidities were hypertension (66.0%), coronary artery disease (51%), peripheral arterial occlusive disease (24.5%), diabetes mellitus (18.9%), stroke (17.0%), and respiratory disease (17.0%). The operative mortality rate was 6.8%. The cumulative survival rates at one year, three years, and five years were 90.6%, 67.5%, and 55.4%, respectively. The long-term death rate involved death from coronary artery disease in eight patients, septic shock in four patients, cancer in four patients, cerebrovascular disease in three patients, and ascending aortic dissection in one patient. No anastomotic pseudoaneurysm or aortoenteric fistula was found in the surviving patients. **Conclusions:** Although conventional open surgery for graft implantation has been challenged recently by endoluminal stenting via the transfemoral approach, open repair of an AAA can be done in elective cases with acceptable morbidity and mortality rates. To improve long-term survival after the aneurysm operation, preoperative coronary artery screening, careful follow-up, and repeated evaluation should be considered to prevent late cardiovascular complications.

Key words: abdominal aortic aneurysm; surgical treatment; long-term follow up

INTRODUCTION

Abdominal aortic aneurysms (AAAs) occur frequently in the elderly population; the prevalence is 5–7% in men aged 65–74 years and increases to >10% in men older than 74 years¹. The overall mortality rate from a ruptured AAA

remains high, up to 75%, and preventive elective repair of a large AAA appears to be the best option². Repair of an AAA using conventional surgical replacement with a vascular graft has been the standard treatment since the mid-1960s³. During the past three decades, there have been major advances in the treatment of AAAs based on changes in preoperative diagnosis and assessment, intraoperative surgical and anesthetic techniques, and postoperative care⁴. However, with improvements in endovascular techniques, the role of open repair has been challenged in recent years. The aim of our study was to determine the perioperative and long-term outcomes of patients who underwent elective open repair for an AAA at a single center in the past 10 years.

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METHODS

Patients

Consecutive patients undergoing an open repair of an infrarenal AAA at Tri-Service General Hospital from 1996 through 2005 were enrolled in this study. Patients with a ruptured, suprarenal, thoracoabdominal, or mycotic aneurysm repair were excluded. Hospital and operation records were reviewed to obtain data on preoperative clinical characteristics, presentation, diagnosis, treatment, complications, and survival. Diagnosis of AAA was confirmed using the results of abdominal angiography, magnetic resonance angiography, or computed tomography angiography.

Indications for Open Repair

The indications for elective open repair included a symptomatic aneurysm, an asymptomatic aneurysm more than 5.0 cm in diameter, or rapid expansion of an aneurysm (>1 cm per year).

Operative Technique

With the patient under general anesthesia, the open AAA repair was performed using the midline transperitoneal approach. The operation involved resection of the aneurysm and implantation of a straight tube or bifurcated prosthetic graft. The inferior mesenteric artery was anastomosed to the side wall of the graft when normal back flow of the vessel was noted.

Statistical Analysis

Descriptive statistics are presented as mean $\pm$ standard deviation (SD). Survival rates were evaluated using the Kaplan-Meier method. SPSS (version 11) was used for data analysis.

RESULTS

During the 10-year period from January 1996 through December 2005, 53 patients underwent open surgical repair for an AAA at the Tri-Service General Hospital. There were 46 men and seven women, with a mean age of 66.5 years. The aneurysm sizes varied from 5.3 cm to 9.0 cm, with a mean size of 6.25 ± 1.42 cm. Most patients were asymptomatic and the AAAs were found incidentally during abdominal sonography or physical examination. The preoperative clinical characteristics are shown in Table 1.

Operative Data

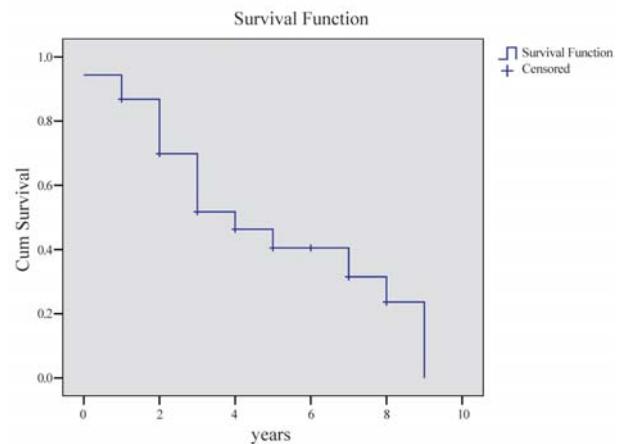


Figure 1. Kaplan-Meier survival curve

The success rate of the surgical techniques was 100%. AAA repairs were accomplished with implantation of a tubular graft in 33 patients and extension of a bifurcated graft to the iliac artery in 11 patients and to the femoral artery in nine patients. The mean operation time was 4.1 ± 1.5 hours. A cell saver system was used for all patients. Blood loss averaged 630 ± 275 ml, and the volume of blood transfused averaged 315 ± 223 ml.

Early Deaths in the Postoperative Course

Three of the 53 patients died, including two who died of perioperative myocardial infarction and one who died of septic shock. The two patients with perioperative myocardial infarction were known to have coronary artery disease before the aneurysm operation. One patient had received coronary stent implantation in the left anterior descending coronary artery and right coronary artery. The other patient had undergone coronary artery bypass grafting two years before the AAA repair. The patient who died of septic shock developed pneumonia after the AAA repair; he was a heavy smoker and had chronic obstructive pulmonary disease.

Complications in the Perioperative Period and Hospital Stay

The major perioperative complication rate within 30 days was 17.0% (9/53); this included respiratory failure in four patients, upper gastrointestinal bleeding in three patients, and renal insufficiency requiring hemodialysis in two patients. The mean intensive care unit stay was 2.97 ± 1.67 days (range, 1-8 days), and the mean hospital stay was 12.7 ± 6.37 days (range, 8-42 days).

Follow-up

Fifty-five patients were followed up for 1-11 years with a mean follow-up period of 69.6 ± 26.9 months (range, 15-138 months). No recurrence of the aneurysm occurred after the operation and no graft-related complications were detected during follow up. Kaplan-Meier estimates for the one-, three-, and five-year survival rates were 90.6%, 67.5%, and 55.4%, respectively. During follow-up, 20 patients died. The causes of death were coronary artery disease in eight patients (40%), septic shock from pneumonia and urinary tract infection in four patients (20%), malignancy in four patients (20%), cardiovascular accident in three patients (15%), and ascending aorta dissection in one patient (5%). No deaths or complications were associated with the grafts in the patients who died more than 30 days after the operation.

DISCUSSION

AAA is a condition affecting mainly older men. In men aged 65-80 years, the prevalence of aneurysms larger than 3 cm in diameter is around 5%^{5,6}.

Most AAAs remain asymptomatic until complications develop, the most serious of which is rupture⁴. An untreated rupture of an AAA leads to death in almost every case. The risk of rupture is related to the size of the aneurysm, and aneurysms greater than 5.5 cm are at significant risk of rupture⁷. Emergency surgical repair of a ruptured aortic aneurysm carries a mortality rate of about 50% in patients who reach hospital alive and has an overall mortality rate of 90%⁸⁻¹⁰. In some patients, warning symptoms such as abdominal pain, back pain, or aneurysmal tenderness indicate that the aneurysm is expanding rapidly, and urgent repair should be performed before rupture occurs. However, even in this situation, urgent repair of these acute, symptomatic aneurysms still carries a mortality of at least 10%¹¹. Elective surgical repair, which carries a low mortality of around 4-8%, appears to offer the greatest chance of reducing the number of deaths associated with this condition¹⁰⁻¹³. The operative results improve consistently in recent years. In three large series of elective surgical repair published in the English literature over the past 10 years, the 30-day mortality rate was 3.6-5.8%¹⁴⁻¹⁶.

However, despite recent perioperative advances such as cardioprotective medication and improved anesthesiological and surgical care, perioperative cardiac complications are a major cause of morbidity and death in patients with multiple cardiac risk factors undergoing AAA repair¹⁷⁻¹⁹. Coronary artery disease is a predictor of unfavorable outcomes of AAA repair²⁰; however, the optimal treatment

for these patients is not well defined. Perioperative beta-blockers reduce the incidence of perioperative cardiac complications in patients with limited or no stress-inducible myocardial ischemia during preoperative testing^{18,21}. However, patients with extensive stress-inducible ischemia remain at high cardiac risk despite the use of beta-blockers and have a perioperative event rate of about 30%²¹. It was hypothesized that prophylactic revascularization might provide sufficient protection in this patient group. Unfortunately, a recent study on prophylactic coronary revascularization failed to improve perioperative cardiac outcomes in 510 patients undergoing major vascular surgery²². Our data show that coronary artery disease is one of the most frequently encountered problems before the operation and the number one cause of death. In our clinical practice, we do not perform prophylactic coronary revascularization in patients scheduled for AAA repair, but we watch carefully the patients with history of coronary artery disease. Antiplatelet drugs are usually discontinued before the operation, but are prescribed soon after the operation.

Chronic occlusive pulmonary disease is an independent predictor of operative mortality rate²³. In our study, nine patients were diagnosed with chronic obstructive pulmonary disease. The morbidity rate was high in these nine patients because four needed mechanical ventilation for more than two weeks. To reduce the occurrence of postoperative complications for high-risk patients, preoperative maneuvers such as deep-breathing exercises and goal-based incentive spirometry should be encouraged. In patients with severe lung disease, epidural anesthesia should be considered to lessen the postoperative morbidity and mortality rates.

Endovascular repair, pioneered in the early 1990s by Parodi et al. and Volodos et al., is a less invasive alternative to conventional open repair^{24,25}. With the use of guide wires, catheters, and specially designed introducer systems, a so-called endograft is assembled under fluoroscopic guidance, thus excluding the aneurysm sac without opening the abdomen²⁶. Since the introduction of endovascular aortic aneurysm repair (EVAR), great progress has been made in treatment methods in the past decade. The main impetus behind EVAR has been its potential to significantly reduce the procedural mortality and morbidity rates, but it was also expected to speed recovery and reduce costs through decreased use of hospital resources. At the outset, EVAR was touted as a better alternative to an open repair in patients with a large AAA at high surgical risk and to "watchful waiting" (periodic ultrasound surveillance) in patients with an AAA. This new technology has evoked

mixed responses, with enthusiasts and detractors debating its advantages and disadvantages. Bias and conflict of interest are apparent on both sides²⁷. In patients undergoing the endovascular procedure, no aortic clamping or declamping is performed. The procedure is done under locoregional anesthesia and, by reducing blood loss, a more hemodynamic stable condition is achieved²⁸. Cuypers et al. also confirmed the purported benefits in an observational study²⁹. Hemodynamic instability occurred after aortic clamping and declamping in the conventional surgery group, and this was associated with a higher incidence of myocardial ischemia. Unfortunately, endovascular repair can be performed only in patients with distinct aortic anatomy and iliac arteries suitable for vascular access. Although technological development continues and the first results of branched endografts are promising³⁰, endovascular repair of juxtarenal or suprarenal aortic aneurysms is not common practice so far.

Another important aspect of comparing endovascular and open repair of an AAA is the long-term outcomes after repair and the reintervention rate. Although the DREAM trial and EVAR-1 trial showed perioperative benefits for patients treated endovascularly, both trials failed to show any benefits in overall survival after a median follow-up of 1.8 and 2.9 years, respectively^{31,32}. In both studies, 30-40% of late deaths were attributable to cardiovascular causes. This is not surprising because more than 60% of vascular surgery patients have documented coronary artery diseases, which mainly determine adverse late outcomes³³. Open AAA repair could be considered the ultimate cardiac test. On the other hand, this "selection" of frail patients does not occur in patients who undergo endovascular repair. The overall cardiac prognosis might not be that bad for a patient who survives the operation. The most important point is to justify the candidacy of otherwise asymptomatic patients for either open repair or endovascular stenting. Moreover, AAA affects primarily older patients who have other morbidities that shorten life expectancy and increase perioperative risks. Thus, proper management of each patient with an AAA should be based on balancing the perioperative risk, the risk of rupture, and life expectancy.

In conclusion, although open repair of AAAs has been challenged by endovascular stent graft placement, open repair of an AAA can be done in elective cases with acceptable morbidity and mortality rates. In terms of the long-term outcomes after successful repair of an AAA, coronary artery disease is the most frequent concomitant disease and the major risk factor requiring close observation and aggressive treatment. The data presented on open surgery for graft implantation over the past few years

provide the basis for comparison with future results after transfemoral graft placement and useful information about subsequent follow-up for patients undergoing open repair for an AAA.

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