Atherosclerotic Peripheral Vascular Disease Symposium II

Controversies in Abdominal Aortic Aneurysm Repair

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Abdominal aortic aneurysms (AAAs) are the result of a progressive degenerative process characterized by elastin depletion and inflammatory changes of the aortic wall. The process leads to gradual enlargement and a localized weakening of the aorta, with eventual rupture. Risk factors include age, sex, family history, and smoking.[1] The normal aortic diameter varies with age, sex, and body size. An infrarenal abdominal aorta with a diameter >3 cm is considered aneurysmal. The risk of rupture increases directly with aneurysm size, and the death rate associated with rupture is very high (90%). Surgical repair has been the standard therapy for patients with AAAs but is associated with a risk of death and a high rate of complication. Thus, in considering open repair, the risk of the procedure is weighed against the risk of rupture.[2] Patients with AAA, especially those with larger aneurysms at high risk of rupture, are usually elderly, and most have multiple comorbidities that increase the risk of surgical treatment. The treating physician, therefore, must balance the natural history of AAA, the operative risk of treatment, and the life expectancy of the patient.

Two prospective, randomized trials of good-risk patients with small AAAs (4.0 to 5.5 cm) found no difference in all-cause death rate between patients who were monitored with ultrasound surveillance and those who underwent early surgical repair[3,4]; however, despite close surveillance with ultrasound, ruptures occurred in 1% of the monitored aneurysm patients each year. Risk of rupture is higher in women, patients who smoke, and those with a family history of aortic aneurysm. Furthermore, most patients with small AAAs undergoing surveillance in these studies ultimately required surgical repair because of AAA enlargement, development of symptoms, or rupture. Therefore, intervention for AAAs <5.5 cm in diameter may be justified in selected patients, and the treatment of small aneurysms is under continued investigation.

Open surgical repair has been performed for more than 50 years and is considered to be the standard of care for patients with AAA. Over the past decade, endovascular aneurysm repair (EVAR) has been introduced as a less invasive treatment alternative for patients with AAA. Several endovascular devices have been approved by the US Food and Drug Administration (FDA) and are available to suitable patients with infrarenal AAA. These devices can be inserted safely and are associated with low death rates,[5,6] but questions remain about the long-term durability, reintervention rate, and cost of these procedures. The task of this writing group is to review the evidence that compares open surgical repair and EVAR of AAA and address areas of controversy that need further investigation. This discussion is relevant specifically to infrarenal AAAs that meet appropriate anatomic criteria to allow the option of EVAR.

Surgical Repair of AAA

The first successful surgical repair of an AAA was described by DuBost et al[7] in 1951. Since then, there have been significant advances in surgical technique, anesthesia, and prosthetic graft design. Death rates for open surgical repair have decreased from 25% to <10% because of improvements in surgical and anesthetic techniques.[8–11] Hertzer and colleagues[8] reported an operative death rate of 1.2% in a series of 939 patients undergoing elective AAA surgery at a single center. Operative death rates from multi-institutional prospective studies of elective infrarenal AAA repair in good-risk patients range from 1.8% to 6.2%.[3,9,10] Using statistics derived from the Medicare administrative database, Lawrence and coworkers[11] reported an operative death rate for elective

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AAA repair of 8.4%. These results may differ from other reports, in part because the study consists of a broader group of patients with AAA and not just those with infrarenal AAA.

The morbidity rate after open aneurysm repair varies between 13% and 23%.[8,12] Cardiopulmonary complications are the most common, followed by wound complications (incisional hernias and groin lymphoceles). Late graft complications after open surgery include graft limb occlusion, pseudoaneurysm formation, and aortoduodenal fistulas and occur in 0.04% to 9.6% of patients within 5 years.[13] The death rate for patients who require secondary operations to treat late graft-related complications may be as high as 28%.[13] Life expectancy for aneurysm patients is reduced compared with age- and sex-matched control subjects, with 5-year survival rates after open surgery ranging from 65% to 78%.[14] Survival is influenced by age and history of congestive heart failure, chronic obstructive pulmonary disease, and renal failure.

Endovascular Aneurysm Repair

EVAR was first described by Juan Parodi in 1991.[15] This procedure involves transfemoral insertion of an endovascular stent graft into the aneurysm to exclude aortic blood flow from the aneurysm sac. Over the past decade, a number of prospective clinical trials have been conducted comparing specific endovascular devices with standard open surgical repair. On the basis of these trials, 5 aortic stent grafts have been approved by the FDA, and 4 are currently available for clinical use in the United States. Available FDA-approved devices are the Medtronic AneuRx, Gore Excluder, Cook Zenith, and Endologix Powerlink. The Guidant Ancure endograft was approved by the FDA but was withdrawn from the market in 2002.

EVAR does not require open abdominal exposure of the aneurysm and aortic cross-clamping, thus it is less stressful to the patient. The immediate postoperative benefits of the less invasive procedure are well documented in prospective clinical trials, registry reports, and individual experience reports.[5,6] These benefits include reduced morbidity, less blood loss, less blood transfusion, decreased utilization of intensive care, shorter hospital stays, more rapid recovery, and earlier return to function. Still, late adverse events, including endoleaks, stent migration, and rupture, have raised questions about long-term durability and need for long-term surveillance. Many of these reports involve early experiences with devices that are not currently available. Also, some of these events relate in part to the early learning curve of endovascular repair.[16] Recent experiences with FDA-approved devices may be a better reflection of current outcomes.

Lifeline Registry: Long-Term Outcome of EVAR With FDA-Approved Devices

The FDA required mandatory 5-year follow-up of all patients treated with endografts in the prospective clinical trials that led to FDA approval. This provided a unique opportunity to acquire comprehensive follow-up information on the outcome of EVAR. To this end, the Lifeline Registry of Endovascular Aneurysm Repair was established by the Society of Vascular Surgery in 1998 to determine the long-term outcomes of EVAR.[17] A total of 2664 patients were treated with endografts in 4 controlled clinical trials. These trials also included 334 control patients treated with standard open surgery. Despite the fact that EVAR patients were 3 years older than surgical control patients and had significantly more coronary artery disease and congestive heart failure, there was no significant difference in 30-day operative death rates between patients undergoing EVAR (1.7%) and those having open surgical repair of AAA (1.4%). EVAR was effective in preventing aneurysm rupture, with freedom from rupture in 99% of patients at 1 year and a continuing freedom from rupture of 99% at 5 and 6 years. The safety of EVAR was demonstrated by a low operative death rate and a low rate of aneurysm-related death, which was 2% at 1 year and remained unchanged at 2% at years 5 and 6. Although secondary interventions were required in 18% of patients over a 5-year period, only 4% of patients required conversion to open surgical repair. There was no difference in late survival rate between EVAR (74%) and open surgery (71%) at 4 years. The rate of survival at 6 years in patients treated with EVAR was 52%. These results suggest that EVAR is a safe, effective, and durable procedure for selected patients with AAA.

EVAR-1 and DREAM Randomized, Controlled Trials

Recently, 2 prospective, randomized, controlled trials were reported that compared immediate and late outcomes of EVAR with those of open surgical repair in good- to average-risk patients who had suitable anatomy for endovascular repair.[18–20] The British EVAR-1 trial included patients ≥60 years of age with large aneurysms (>5.5 cm) and randomly assigned 543 patients to EVAR and 539 patients to open surgery. The primary end point was all-cause death.[18,19] Mean follow-up time was 2.9 years (24% completed 4 years). The rate of operative death was significantly lower with EVAR, with a two-thirds reduction in 30-day death rate (1.7% with EVAR versus 4.7% with open repair) and a significant reduction of in-hospital death rate (2.1% with EVAR versus 6.2% with open repair). At 4 years, there was a significantly lower aneurysm-related death rate in EVAR patients (4% with EVAR versus 7% with open repair) but no difference in all-cause death rate between EVAR (26%) and open repair (29%). Secondary reinterventions were more common with EVAR (20%) than with open surgical repair of AAA (5%).

The Dutch Randomized Endovascular Aneurysm Management (DREAM) Trial, which included good-risk patients with aneurysms >5.0 cm, compared 174 patients treated with EVAR to 171 patients who underwent open repair.[20] EVAR patients had a two-thirds reduction in 30-day operative death rate (1.2%) compared with open surgery patients (4.6%) and a significant reduction in severe complications (18% with EVAR versus 24% with open repair). At 2 years, the rate of aneurysm-related death for EVAR remained significantly lower than for open surgery (2.1% versus 5.7%); however, there was no difference in all-cause death rate (90% with EVAR versus 90% with open repair).

Thus, for good-risk patients who are fit for surgery and have suitable anatomy for endovascular repair, there is a

significant reduction in perioperative mortality and morbidity with EVAR compared with open surgery. There is a reduction in aneurysm-related death rate for up to 4 years but no difference in total death rate.

EVAR-2 Trial: High-Risk Patients

The role of EVAR in high-risk patients with large AAAs who are poor candidates for surgery was the subject of a recent prospective, randomized clinical trial from the United Kingdom.[21] Patients with large aneurysms (>5.5 cm) who were deemed "unfit for surgery" by the local treating physicians were enrolled and randomly assigned to EVAR (n=166) or no treatment (n=172). In this trial, there was a 9% operative death rate for EVAR. There were no differences in aneurysm-related death rate at 4 years (12% with EVAR versus 12.9% with open repair) or in all-cause death rate (survival at 4 years: 44.5% after EVAR and 39.5% after open surgery). On the basis of these results, the authors concluded that "unfit patients should not be treated with EVAR." Although the EVAR-2 trial is a prospective randomized trial, the results are the subject of significant dispute. Criticisms of this study include lack of a clear definition of "unfit for surgery," prolonged delays for patients randomized to EVAR, and significant patient crossover with an intention-to-treat analysis. Among patients randomized to EVAR, 9 ruptures occurred while patients waited for the procedure (median wait time 57 days; 3 patients waited for >1 year). These account for half of the deaths in the EVAR group. Among patients randomized to "no treatment," more than one fourth (27%) chose to undergo elective endovascular repair, with only 1 patient death (2%), which suggests that many patients may not have been truly "unfit for surgery."

Lifeline Registry: High-Risk Patients

A recent report from the Lifeline Registry compared 565 high-risk patients treated with EVAR in 5 prospective US trials who were age- and risk-matched with patients in the British trial.[22] The operative death rate of high-risk patients in the US clinical trials was 3%, compared with the 9% reported in EVAR-2. At 4 years, aneurysm-related death was 4% in the Lifeline high-risk registry, compared with 14% for EVAR-2, and total survival rates were 56% in the Lifeline registry and 34% for EVAR-2. These data suggest that properly selected high-risk patients with large aneurysms can be treated safely with EVAR with low operative death rates and low long-term aneurysm-related death rates similar to those for low-risk patients. Clinical judgment and risk analysis are required in selecting high-risk patients for endovascular repair, and further studies are needed on this subject.

Recommendations

The introduction of EVAR has revolutionized the care of patients with infrarenal AAA. Patients with AAA face the risk of rupture and until recently had only 2 options: watchful waiting or open surgical repair. The decision to recommend open surgical repair was based on the size of the aneurysm and the estimated risk of rupture, balanced against the patient's medical risk, comorbidities, and risk of operative death. Patients with AAA now have a less invasive therapeutic option to avoid aneurysm rupture: endovascular repair. Still, endovascular repair requires that the patient's aneurysm meets well-defined anatomic selection criteria. For average-risk patients who meet anatomic selection criteria for endovascular repair, evidence indicates that risk of operative death is reduced with EVAR and that the AAA-related death rate benefit is maintained for at least 4 years. In addition, postoperative morbidity is significantly reduced and recovery more rapid with EVAR. On the basis of this evidence, we believe that EVAR is the preferred method of treatment for average-risk patients with AAA and suitable anatomy; however, EVAR requires long-term surveillance with imaging studies to determine endograft position, aneurysm size, and the presence or absence of endoleak. High-risk patients with large AAAs (>5.5 cm) who have anatomy suitable for endovascular repair can be treated successfully with EVAR. Patients with unsuitable anatomy for EVAR who are at high risk for surgery should undergo careful risk-benefit assessment of risk of rupture versus risk of open repair versus life expectancy and should be monitored closely. If the risk of rupture becomes greater than the risk of surgery (the aneurysm enlarges, becomes painful or tender, or shows signs of rupture), open repair is recommended.

Disclosures

Potential conflicts of interest for members of the writing groups for all sections of these conference proceedings are provided in a disclosure table included with the Executive Summary, which is available online at http://circ.ahajournals.org/cgi/reprint/118/25/2811.

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