Outcomes Following Endovascular vs Open Repair of Abdominal Aortic Aneurysm
A Randomized Trial

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Each year in the United States, 45,000 patients with unruptured abdominal aortic aneurysm (AAA) undergo elective repair, resulting in more than 1400 perioperative deaths.1 Endovascular repair was developed to provide a less invasive method than the standard open procedure and has been reported to reduce perioperative mortality, hospital stay, and intensive care unit (ICU) stay. However, more frequent reinterventions have also been reported and the early survival advantage was lost within 2 years in previous randomized trials conducted in Europe,2-4 leaving the preferred approach for AAA repair in doubt. Furthermore, the relative effects of the 2 procedures on quality of life and erectile function remain unclear.

Devices and techniques continue to improve and operative mortalities and morbidities were relatively high in the European trials, raising the question of how relevant their results are to current US practice. We report short-term perioperative outcomes after elective endovascular and open repair of AAA from a US multicenter randomized trial.

Methods

Study Oversight

The study was approved by a central human rights committee and the institutional review boards at each participating center. An independent data monitoring committee reviewed the data at regular intervals.

Patients

Eligible patients had AAA for which repair was planned and had (1) a max-

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Figure 1. Flow Diagram of Study Patients

5161 Patients assessed for eligibility

444 Randomized to receive endovascular repair
427 Received endovascular repair as randomized
9 Had endovascular repair >6 wk after randomization
17 Did not receive endovascular repair
 2 Refused repair
 2 Died before repair
 1 Had repair aborted and never completed
12 Had open repair
 7 After endovascular repair aborted
 3 Due to patient request
 1 Due to urgent symptoms
 1 Not a candidate for endovascular repair

444 Included in primary analysis

4280 Excluded
834 Had AAA <5.0 cm
2702 Were not candidates for both procedures
and/or failed to complete evaluation
294 Were unlikely or unable to comply
450 Refused randomization

881 Randomized

437 Randomized to receive open repair
416 Received open repair as randomized
15 Had open repair >6 wk after randomization
21 Did not receive open repair
 4 Refused repair
 1 Died before repair
 3 Had repair aborted and never completed
13 Had endovascular repair
 3 After open repair aborted
 4 Due to patient request
 6 Due to medical problems

421 Were enrolled for >1 y
348 Were enrolled for >2 y
31 Died
2 Lost to follow-up

437 Included in primary analysis

AAA indicates abdominal aortic aneurysm.

Endovascular and Open Repair of Abdominal Aortic Aneurysm

mum external diameter of at least 5.0 cm, (2) an associated iliac aneurysm with a maximum diameter of at least 3.0 cm, or (3) a maximum diameter of at least 4.5 cm plus either rapid enlargement (at least 0.7 cm in 6 months or 1.0 cm in 12 months) or saccular morphology. To be randomized, a patient had to have completed all preoperative evaluation, be considered a candidate for both procedures by the participating vascular surgeon, and meet the manufacturer’s indications for the endovascular system that would be used if so assigned. Patients were excluded if they had previous abdominal aortic surgery, needed urgent repair, or were unable or unwilling to give informed consent or follow the protocol.

Procedures

Entry evaluation included demographics (race was recorded by study nurses using predefined categories of white, not of Hispanic origin; black, not of Hispanic origin; Hispanic; Asian/Oriental or Pacific Islander; American Indian or Alaskan Native; or other); comorbidities; medications; surgical risk using criteria developed by the RAND Corporation (eAppendix; available online at http://www.jama.com); measurement of height, weight, brachial, and ankle blood pressure; measurement of serum creatinine; and various parameters from preoperative aortic imaging.

Patients provided informed consent for preoperative evaluation and randomization. Randomization assigned equal probability to open or endovascular repair and was stratified by medical center using a permuted block design. Allocation was made by telephone to the coordinating center after baseline information was received and eligibility verified. Although patient assignment was of necessity unblinded, outcome data by treatment group were available during enrollment only to the biostatistician and data monitoring committee.

Open repair involves sutured anastomoses of an anatomically placed vascular graft through an abdominal or retroperitoneal incision and was performed as usual at each participating medical center. Endovascular repair involves the transluminal introduction of an expandable graft system through the femoral or iliac arteries into the aneurysmal region of the aorta and iliac arteries to exclude the aneurysm from arterial pressure. Only endovascular systems approved by the US Food and Drug Administration could be used in the study. To permit subgroup comparisons with randomized controls, the endovascular system intended for a particular patient if so assigned was reported to the coordinating center before randomization.

The protocol specified that repair should occur within 6 weeks of randomization and a study-approved vascular surgeon or interventional radiologist should perform all aneurysm repairs. Criteria for study approval were vascular surgery fellowship, certification or equivalent, or equivalent training for interventional radiologists. Individuals performing study endovascular procedures were required to have completed at least 12 procedures with adequate supervision.

Follow-up visits were scheduled 1 month after aneurysm repair, 6 and 12 months after enrollment, and then yearly. All follow-up visits after endovascular repair included computed tomography and plain radiography of the abdomen, whereas after open repair, only computed tomography at 1 year was specified, a difference intended to reflect usual clinical practice. Patients were called monthly during the first 14 months after repair and then annually midway between study visits to identify outcomes and were asked to log all health care visits. Additional follow-up information was obtained by the coordinating center using national data sets.

Outcome Measures

The primary outcome is long-term (5-9 years) all-cause mortality (October 15, 2002-October 15, 2011). Secondary outcomes included (1) procedure failure, defined as failure to complete the initial repair or any secondary thera-
peutic procedures resulting directly or indirectly from the initial procedure and requiring a separate trip to the procedure suite (each trip to the procedure suite counted as 1 secondary procedure, and these included any unplanned surgical procedures within 30 days of the initial procedure and any additional aorto-iliac procedures at any time); (2) short-term major morbidity, defined as myocardial infarction, stroke, amputation, or renal failure requiring dialysis within 1 year after the initial repair; (3) days in hospital and ICUs associated with the initial repair; (4) other procedure-related morbidities, such as incisional hernia, or new or worsened claudication; (5) health-related quality of life; and (6) erectile dysfunction. These secondary outcomes pertain primarily to the short-term perioperative period and are the main focus of this report.

Outcomes were adjudicated by an outcomes committee blinded (to the extent possible) to the randomized group. Aneurysm-related mortality was not a prespecified outcome because of the potential for ascertainment bias but is presented for comparison with other trials. All deaths within 30 days after repair or during the hospitalization for repair were considered aneurysm-related, as were all late deaths adjudicated as resulting directly or indirectly from the AAA or treatment of the AAA.

Health-related quality of life was assessed by using 2 brief questionnaires, the SF-36 and EQ-5D (EuroQol, Rotterdam, the Netherlands), completed at baseline and follow-up visits. The SF-36 evaluates 8 health dimensions that have been aggregated into 2 summary measures, a mental component summary and a physical component summary. We also computed the physical component transformed with deaths included. The EQ-5D consists of 5 questions used to generate an index score with US population-based preference weights, and a 20-cm visual analog scale. Erectile function was assessed by using the previously validated 5-item International Index of Erectile Func-

### Table 1. Patient Characteristics at the Time of Randomization

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Endovascular Repair (n = 444)</th>
<th>Open Repair (n = 437)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>69.6 (7.8)</td>
<td>70.5 (7.8)</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>441 (99.3)</td>
<td>435 (99.5)</td>
</tr>
<tr>
<td>White race, No. (%)</td>
<td>387 (87.2)</td>
<td>379 (86.7)</td>
</tr>
<tr>
<td>Weight, mean (SD), kg</td>
<td>89.9 (16.8)</td>
<td>89.7 (17.8)</td>
</tr>
<tr>
<td>BMI, mean (SD)</td>
<td>28.6 (5.2)</td>
<td>28.7 (5.6)</td>
</tr>
<tr>
<td>Current</td>
<td>47 (10.6)</td>
<td>44 (10.1)</td>
</tr>
<tr>
<td>Smoking history, No. (%)</td>
<td>Ever</td>
<td>428 (96.4)</td>
</tr>
<tr>
<td>Current</td>
<td>170 (38.3)</td>
<td>193 (44.2)</td>
</tr>
<tr>
<td>Blood pressure, mean (SD), mm Hg</td>
<td>Systolic</td>
<td>133.5 (18.6)</td>
</tr>
<tr>
<td>Diastolic</td>
<td>75.8 (10.9)</td>
<td>74.3 (10.6)</td>
</tr>
<tr>
<td>Current history, No. (%)</td>
<td>Coronary artery disease</td>
<td>174 (39.2)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>105 (23.6)</td>
<td>110 (25.2)</td>
</tr>
<tr>
<td>Coronary revascularization</td>
<td>159 (35.8)</td>
<td>153 (35.0)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>67 (15.1)</td>
<td>70 (16.0)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>347 (78.2)</td>
<td>330 (75.5)</td>
</tr>
<tr>
<td>Claudication</td>
<td>66 (14.9)</td>
<td>81 (18.5)</td>
</tr>
<tr>
<td>Cancer (other than skin)</td>
<td>83 (18.7)</td>
<td>70 (16.0)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>100 (22.5)</td>
<td>100 (22.9)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>126 (28.4)</td>
<td>133 (30.4)</td>
</tr>
</tbody>
</table>

**Notes:**

- **Medications, No. (%)**
  - β-Blocker: 292 (63.5) vs. 282 (64.5)
  - Aspirin: 244 (55.0) vs. 277 (63.4)
  - ACE inhibitor: 192 (43.2) vs. 180 (41.2)
  - Anticoagulants: 44 (9.9) vs. 34 (7.8)
- **Ankle-brachial index on at least 1 side, No. (%)**
  - ≤0.9: 159 (35.8) vs. 155 (35.5)
  - ≤0.4: 48 (10.8) vs. 45 (10.3)
- **Maximum activity level, No. (%)**
  - Sedentary or mild: 182 (41.0) vs. 185 (42.4)
  - Moderate or vigorous: 262 (59.0) vs. 252 (57.6)
- **Serum creatinine, mean (SD), mg/dL**
  - 1.2 (0.5) vs. 1.1 (0.4)
- **GFR <60 mL/min per 1.73 m², No. (%)**
  - 140 (31.5) vs. 136 (31.1)
- **Surgical risk (RAND score), No. (%)**
  - Low: 240 (54.1) vs. 227 (51.9)
  - Intermediate: 169 (38.1) vs. 176 (40.3)
  - High: 31 (7.0) vs. 29 (6.6)
- **Family history of AAA, No. (%)**
  - 70 (15.8) vs. 51 (11.7)
- **AAA diameter, No. (%), cm**
  - Mean (SD): 5.7 (0.8) vs. 5.7 (1.0)
  - <5.0: 23 (5.2) vs. 18 (4.1)
  - <5.5: 192 (43.2) vs. 190 (43.5)
  - 5.5-5.9: 133 (30.0) vs. 123 (28.1)
  - 6.0-6.9: 86 (19.4) vs. 83 (19.0)
  - ≥7.0: 33 (7.4) vs. 41 (9.4)
- **Intended device, No. (%)**
  - Cook Zenith: 166 (37.4) vs. 175 (40.0)
  - Gore Excluder: 177 (39.6) vs. 150 (34.3)
  - Medtronic AneuRx: 88 (19.8) vs. 98 (22.4)
  - Other: 13 (2.9) vs. 14 (3.2)

Abbreviations: AAA, abdominal aortic aneurysm; ACE, angiotensin-converting enzyme; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); GFR, glomerular filtration rate.

SI conversion factor: To convert serum creatinine to µmol/L, multiply by 88.4.

** ever smoking history is smoking more than 100 cigarettes over lifetime. The GFR was estimated using the 4-variable Modification of Diet in Renal Disease Study equation. For surgical risk (RAND score), see online eAppendix at http://www.jama.com.1 Current smoking was defined as smoking more than 10 cigarettes per day on an average day. Cigarettes smoked were counted as 1 unit.

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All-cause mortality 31 (7.0) 43 (9.8) .13

Time in intensive care unit, d 1.0 (1.0-2.0) 4.0 (3.0-6.0)

Duration of hospital stay for initial repair, d 3.0 (2.0-5.0) 7.0 (6.0-10.0)

Banked red cell transfusion within 24 h, unit 0 1.0 (0-3.0)

Estimated blood loss, mL 200 (150-400) 1000 (650-2000)

Volume of contrast used, mL 132.5 (96.5-176.0) 0

Duration of mechanical ventilation, h 3.6 (3.0-4.5) 5.0 (4.0-9.1)

Duration of procedure, h 2.9 (2.3-3.7) 3.7 (2.9-4.7)

Time from randomization to repair, d 18.0 (10.0-28.0) 17.0 (9.0-26.0)

Patients with aorta as distal attachment site

Patients with new or worsened claudication 37 (8.3) 20 (4.6) .02

Patients with procedure failure 58 (13.1) 51 (11.7) .53

Patients with no repair attempted 4 (0.9) 5 (1.1) .75

Patients with aborted initial procedure 8 (1.8) 6 (1.4) .61

Patients having secondary therapeutic procedures 46 (10.4) 40 (9.2) .73

All secondary therapeutic procedures, No. of events 61 55

Patients with any 1-year major morbidity 18 (4.1) 20 (4.6) .70

Myocardial infarction 6 (1.4) 12 (2.7) .14

Stroke 7 (1.6) 4 (0.9) .38

Amputation 1 (0.2) 3 (0.7) .37

Renal failure requiring dialysis 5 (1.1) 3 (0.7) .73

Patients with new or worsened claudication 37 (8.3) 20 (4.6) .02

All postrepair aneurysm-related hospitalizations, No. of events 106 86

Abbreviation: AAA, abdominal aortic aneurysm.

aIncludes all deaths within 30 days after repair or during hospitalization.

bIncludes cerebrovascular disease, injury, pneumonia, other infections, and unexplained sudden deaths not considered AAA-related.

during the second year of follow-up in previous published trials,2,4 this plan was amended by the investigators with the approval of the data and safety monitoring board without knowledge of the results in February 2007 to include all follow-up data to 2 years after randomization as of the same date of October 15, 2008.

RESULTS

We randomized 881 patients (aged ≥49 years) at 42 medical centers (FIGURE 1).
The 2 groups were similar at baseline (TABLE 1), with no significant differences except for a greater proportion using aspirin in the open repair group. Of the 41 patients randomized with AAA of less than 5.0 cm, reasons for eligibility were iliac aneurysm in 34 patients, rapid enlargement in 4 patients, and saccular morphology in 3 patients. Fifteen patients (8 endovascular repair and 7 open repair) had abdominal or back pain noted before repair, but no aneurysm ruptures were identified at any time during the study period. More than 95% of randomized patients had the assigned repair (n=843) and in another 2% (n=14), the assigned repair was attempted but aborted (Figure 1).

All 109 lead proceduralists for aneurysm repair were vascular surgeons. An endovascular system other than the one prespecified as intended was used in 43 patients in the endovascular group. Endovascular repair resulted in significantly reduced procedure time, duration of mechanical ventilation, hospital and ICU stays, blood loss, and transfusion requirement, but required substantial exposure to fluoroscopy and contrast (TABLE 2).

Mean follow-up was 1.8 years, and 80% of patients (n=710) had either completed 2 years of follow-up or died before 2 years (follow-up was truncated at 2 years for both study groups). Perioperative mortality was significantly higher for open repair at 30 days (0.2% vs 2.3%; P = .006), and at 30 days or during hospitalization (0.5% vs 3.0%; P = .004) (TABLE 3), a difference that did not appear to vary with AAA diameter (P for interaction = .25). Vital status after 2 years or by October 15, 2008, was confirmed for all but 2 patients, and national data sets contained no death reports on these 2 patients. There was no significant difference in all-cause mortality at 2 years (7.0% vs 9.8%; HR, 0.7; 95% CI, 0.4-1.1; P = .13) (FIGURE 2). Mortality after the perioperative period was similar in the 2 groups (6.1% vs 6.6%) (TABLE 3), but 4 of the late deaths in the endovascular group were aneurysm-related compared with none in the open repair group. No significant differences in mortality were observed for any of the prespecified subgroups shown in FIGURE 3, including patients with coronary artery disease (P = .06). No significant interactions were found between treatment effect and any subgroup characteristic.

No differences were observed between the 2 groups in procedure failures, secondary therapeutic procedures, aneurysm-related hospitalizations, or 1-year major morbidity (TABLE 3). The 61 secondary therapeutic procedures in the endovascular repair group included 42 endovascular procedures, 3 explanations of the graft with conversion to open repair, 9 other arterial procedures with an open component, 5 groin wound procedures, and 2 amputations (both legs of 1 patient). The 55 secondary therapeutic procedures in the open-repair group included 24 incisional hernia repairs, 7 aortic graft procedures, 4 procedures for wound complications, 4 amputations (1 toe, 1 leg, and below and above knee on same leg), 4 laparotomies for bowel obstruction, 2 laparotomies for hematoma, 2 procedures to relieve claudication, and 8 miscellaneous minor procedures.

Incisional hernia was reported in 30 patients who had open repair, resulting in secondary therapeutic procedures in 21 patients (4.9%), all of whom had undergone an anterior surgical approach in the original open repair. In the endovascular repair group, there were 134 endoleaks (blood flow between the graft and the aneurysm wall) in 110 patients (25%), resulting in 21 secondary therapeutic procedures in 18 patients (4.1%).

### Table 1

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>No. of Patients</th>
<th>Deaths</th>
<th>Hazard Ratio (95% CI)</th>
<th>Favors Endovascular Repair</th>
<th>Favors Open Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomization period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before April 15, 2005</td>
<td>413</td>
<td>40</td>
<td>0.6 (0.3-1.2)</td>
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<tr>
<td>After April 15, 2005</td>
<td>468</td>
<td>34</td>
<td>0.8 (0.4-1.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;70</td>
<td>406</td>
<td>26</td>
<td>0.6 (0.3-1.3)</td>
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<td></td>
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<tr>
<td>≥70</td>
<td>475</td>
<td>48</td>
<td>0.8 (0.4-1.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA diameter, cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5.5</td>
<td>382</td>
<td>27</td>
<td>0.7 (0.3-1.5)</td>
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</tr>
<tr>
<td>≥5.5</td>
<td>499</td>
<td>47</td>
<td>0.7 (0.4-1.2)</td>
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<td>Surgical risk (RAND score)</td>
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<tr>
<td>Low</td>
<td>467</td>
<td>29</td>
<td>0.7 (0.3-1.4)</td>
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<tr>
<td>Intermediate or high</td>
<td>405</td>
<td>42</td>
<td>0.7 (0.4-1.3)</td>
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<td>Coronary artery disease</td>
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<tr>
<td>No</td>
<td>522</td>
<td>43</td>
<td>0.9 (0.5-1.6)</td>
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<tr>
<td>Yes</td>
<td>359</td>
<td>31</td>
<td>0.5 (0.2-1.0)</td>
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<tr>
<td>Intended endovascular system</td>
<td></td>
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<tr>
<td>Cook-Zehrith</td>
<td>341</td>
<td>26</td>
<td>0.6 (0.3-1.4)</td>
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<tr>
<td>Gore Excluder</td>
<td>327</td>
<td>28</td>
<td>0.6 (0.3-1.2)</td>
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<tr>
<td>Medtronic AneuRx</td>
<td>186</td>
<td>15</td>
<td>1.1 (0.6-2.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>881</td>
<td>74</td>
<td>0.7 (0.4-1.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AAA indicates abdominal aortic aneurysm; CI, confidence interval. Size of the data markers is relative to the number of deaths in that subgroup. All P > .10 for interaction with treatment effect. For surgical risk (RAND score), see online eAppendix at http://www.jama.com.
As shown in Table 4, there were no significant differences between the 2 groups in health-related quality of life or erectile function over the 2 years of follow-up.

**COMMENT**

In this interim report of 2-year outcomes after elective AAA repair, endovascular repair resulted in lower perioperative mortality than open repair without evidence of excess late mortality. Hospital and ICU stays were shorter with endovascular repair and need for transfusion was decreased. No significant differences were observed in major morbidities, secondary procedures, or aneurysm-related hospitalizations.

Two European trials, the United Kingdom Endovascular Aneurysm Repair Trial 1 (EVAR-1) and the Dutch Randomized Endovascular Aneurysm Management (DREAM) trial, previously reported lower operative mortality with endovascular vs open repairs. Perioperative mortality in our study was lower than in the European trials for both treatments. Mortality within 30 days or during hospitalization for endovascular repair was 2.1% in the EVAR-1 trial, 1.2% in the DREAM trial, and 0.5% in our study, and for open repair, mortality was 6.2% in the EVAR-1 trial, 4.6% in the DREAM trial, and 3.0% in our study. We did not observe the increased mid-term mortality after endovascular repair that resulted in the loss of its early survival advantage in those trials, but all 4 late aneurysm-related deaths in our study occurred in the endovascular group.

The lower perioperative mortality in our study compared with the previous trials could result from several possible factors. First, our procedures were performed more recently, from 2002-2007 compared with 1999-2003 in the EVAR-1 and DREAM trials. Of the 15 deaths within 30 days after repair or during hospitalization in our study, 10 occurred in the first 412 patients, enrolled before April 15, 2005, indicating the 2 deaths in the endovascular group.

Second, our results could have been improved by enrollment of patients with small AAA. Forty-three percent of our patients (n=382) had aneurysms smaller than 5.5 cm in diameter and therefore would not have been eligible for enrollment in the EVAR-1 trial. However, perioperative mortality rates (Table 3) and treatment effects (Figure 3) were similar between patients with AAA of less than 5.5 cm and those with larger AAA, suggesting that AAA diameter was not an important factor.

Third, there could be differences in surgical technique and postoperative care between our trial and the European trials. Procedures in our trial were performed by experienced vascular surgeons. Although the participation of more than 100 surgeons in our trial supports generalizability within this group, and procedures in the European trials were also performed by experienced vascular surgeons, differences between trials in surgical technique and postoperative care cannot be completely excluded. Inpatient mortality following nonruptured open AAA repair in the United States during our enrollment period was 4.5%, roughly half that in the United Kingdom during the EVAR-1 enrollment period, a difference that reflects the differences in operative mortalities between trials. Furthermore, previous studies have reported low perioperative mortality for AAA repair in the Veterans Affairs health system compared with other US health care organizations.

Fourth, there were differences in the endovascular systems used. The EVAR-1 trial used the Medtronic Talent (which was not approved for use in the United States until after our enrollment ended) in a third of the patients and used the Gore Excluder and Medtronic AneuRx much less frequently than in our study. We did not find significant interactions between device selection and treatment effect in our study, although there was a nonsignificantly less favorable outcome after endovascular repair with AneuRx compared with other endovascular systems (Figure 3), and the 2 perioperative deaths and 2 of the 4 late aneurysm-related deaths in our endovascular and open repair of abdominal aortic aneurysm.

**Table 4. Quality of Life and Erectile Dysfunction**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Baseline</th>
<th>1 Year Minus Baseline</th>
<th>2 Years Minus Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 MCS</td>
<td>50.6 (10.9)</td>
<td>51.7 (10.4)</td>
<td>−0.77 (10.2)</td>
</tr>
<tr>
<td>PCS</td>
<td>40.5 (10.4)</td>
<td>40.1 (10.5)</td>
<td>−1.2 (9.8)</td>
</tr>
<tr>
<td>PCTD</td>
<td>62.5 (22.8)</td>
<td>61.6 (22.8)</td>
<td>−3.0 (22.0)</td>
</tr>
<tr>
<td>EQ-5D Index score</td>
<td>0.79 (0.16)</td>
<td>0.79 (0.16)</td>
<td>−0.02 (0.16)</td>
</tr>
<tr>
<td>Visual analog scale</td>
<td>71.5 (19.1)</td>
<td>70.3 (18.6)</td>
<td>−1.3 (18.9)</td>
</tr>
<tr>
<td>IIEF-5</td>
<td>11.4 (8.7)</td>
<td>10.3 (8.8)</td>
<td>−2.5 (8.3)</td>
</tr>
</tbody>
</table>

Abbreviations: EQ-5D, EuroQol; IIEF-5, 5-item International Index of Erectile Function; MCS, mental component summary; PCS, physical component summary; PCTD, physical component transformed with deaths included; SF-36, 36-item Short Form Health Survey.

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vascular group were in the AneuRx subgroup, suggesting that greater use of this device probably did not improve survival in our study relative to the European trials. In 2008, the US Food and Drug Administration issued a public health notification regarding higher than expected late aneurysm–related mortality with AneuRx. Longer follow-up is needed to monitor performance of the various graft systems.

Our findings of no difference in major morbidities or secondary therapeutic procedures contrast with the EVAR-1 findings of highly significant differences favoring open repair in complications and reinterventions. At least some of these differences between the 2 trials may result from how the categories were defined. For example, the EVAR-1 trial appears to have counted as reinterventions only procedures directly related to graft placement, whereas our study included any secondary therapeutic procedures resulting from the original procedure, such as incisional hernia repairs. Incisional hernia repairs were the most common secondary therapeutic procedures in the open-repair group in our study, occurring in 4.9% of patients at 2 years. This is comparable with the 5.8% rate reported in a Medicare population within 4 years after open repair. A recent meta-analysis found that open AAA repair carries a 5-fold greater risk of incisional hernia than does surgery for aortoiliac occlusive disease, possibly reflecting an underlying collagen defect in patients with AAA.

Health-related quality of life decreased in the early postoperative period in the European trials, particularly following open repair, but these changes resolved before 6 months. In the DREAM trial, quality of life at 6 months and 1 year was lower in the endovascular group. Our study focused on later postoperative quality of life and found no differences between the 2 groups at 1 and 2 years.

Open AAA repair results in erectile dysfunction in some patients, although most of the dysfunction observed after repair in a large trial was not new. Erectile dysfunction has been reported to be reduced after endovascular repair compared with open repair, but these data are from nonrandomized retrospective surveys and are subject to recall and response bias. Our finding of no difference between open and endovascular repair in erectile dysfunction at 1 and 2 years is in agreement with randomized prospective data from the DREAM trial, which reported no difference between open and endovascular repair in erectile dysfunction at 3, 6, and 12 months.

CONCLUSION

In this randomized trial, endovascular repair resulted in fewer perioperative deaths than open repair, even though open repair was performed with low mortality. This early advantage was not offset by increased morbidity or mortality in the endovascular group in the first 2 years after repair. Longer-term data are needed to fully assess the relative merits of the 2 procedures.

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ENDOVASCULAR AND OPEN REPAIR OF ABDOMINAL AORTIC ANEURYSM

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