Elective endovascular versus open surgical repair of abdominal aortic aneurysms: systematic review of short-term results
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Authors' objectives
To compare elective endovascular repair with elective open surgical repair in patients with abdominal aortic aneurysms (AAAs).

Searching
MEDLINE was searched from 1991 onwards for studies published in the English language. In addition, the reference lists in identified papers were checked. Only English language publications were included.

Study selection
Study designs of evaluations included in the review
Prospective and retrospective studies were eligible for inclusion if there were at least 10 patients in each treatment group and the characteristics of the patients were reported. Case reports and reviews were excluded. All of the included studies were observational studies. Some studies used different methods (prospective or retrospective) to obtain data for the two treatment groups, while some studies did not report which method was used.

The methods used to recruit patients varied between the studies: in some studies the patients were matched according to characteristics; some studies used the most recently performed open repairs as the control group; some studies performed endovascular surgery in high-risk patients considered unfit for open repair and performed open repair on patients anatomically unsuitable for endovascular repair; some studies did the endovascular repair in patients who fulfilled the anatomical criteria, with patients aged less than 65 years undergoing open repair; and in one study endovascular repairs were only allowed after the institution had enrolled five open repairs into the study.

Specific interventions included in the review
Studies that compared elective endovascular repair with elective open surgical repair were eligible for inclusion. Some studies included the results for the first endovascular repairs carried out in institutions, whereas other studies reported the results for surgery some years after the first procedure or did not provide this information. Included studies providing relevant information used general anaesthesia and epidural anaesthesia. A variety of endografts were used in the included studies: AneuRx, Bard, Baxter, EVT, Gore, Stentor, Stentway, Talent, Vanguard, Zenith, and grafts that were custom made or designed in-house. The most commonly used type of endograft was of bifurcated design (76%); other grafts were aortouniliac (15%) and tubular (9%). Open surgical repairs were preformed using tubular (51%) or bifurcated (49%) grafts.

Participants included in the review
Studies of patients with AAAs were eligible for inclusion. The percentage of male patients ranged from 71 to 97%, while the percentage of smokers ranged from 11 to 85%. The mean age ranged from 66 to 76 years. The mean aneurysmal diameter ranged from 5.0 to 6.2 cm.

Outcomes assessed in the review
Studies that reported complications and mortality for each treatment group were eligible for inclusion. The review assessed the following short-term outcomes (within 30 days of surgery): mortality; the duration of surgery; the length of stay in intensive care and the total hospital stay; and the complication rate, including total, local and/or vascular and systematic and/or remote complications. In the review, graft-related failures (endoleak, graft thrombosis, graft occlusion, increase in aneurysm size, aneurysm rupture and conversion to open repair) were considered as outcomes rather than complications.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.
Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Two reviewers independently extracted the data and resolved any disagreements through consensus.

Methods of synthesis
How were the studies combined?
Weighted means and 95% confidence intervals (CIs) for patient age and abdominal aortic diameter were estimated using a random-effects model, with weighting by sample size. The weighted mean difference and 95% CI between endovascular and open surgery were estimated for the duration of surgery, length of stay in intensive care and the total hospital stay. A random-effects model was used to estimate a pooled odds ratio (OR) and 95% CI for 30-day mortality, total complication rate, local and/or vascular complication rate, and systematic and/or remote complication rate. The possibility of publication bias was explored using a funnel plot for 30-day mortality.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the chi-squared statistic or the Cochran-Mantel-Haenszel test.

Results of the review
Nine observational studies (1,318 surgical procedures) were included.

The funnel plot was not symmetrical. It suggested the relative absence of small studies with low mortality for endovascular surgery compared with open repair.

Patients undergoing endovascular repair had higher rates of cardiac morbidity, nonsmokers and male gender than patients undergoing open repair.

Endovascular repairs were converted to open repairs in 0 to 10% of the patients. Early leaks after endovascular repair occurred in 7 to 29% of patients across studies.

Blood loss: endovascular repair significantly reduced blood loss during surgery compared with open repair. Blood loss was 456 mL with endovascular surgery versus 1,202 mL with open repair (P=0.003).

Hospital stay: endovascular repair significantly reduced the length of stay in intensive care and the overall hospital stay. The number of days spent in intensive care was 0.5 with endovascular repair versus 2.2 days with open repair (P=0.04). Total hospital stay was 3.9 and 10.3 days, respectively (P=0.02)

Mortality: elective endovascular repair of an AAA significantly reduced the risk of death within 30 days. Thirty-day mortality was 3% (endovascular repair) versus 4% (open repair); the OR was 0.55 (95% CI: 0.18, 0.71, P=0.03).

Complications.
Endovascular repair significantly reduced the total complication rate compared with open repair. The complication rates were 30% and 53% for endovascular repair and open repair, respectively; the OR was 0.26 (95% CI: 0.09, 0.78). Significant heterogeneity was found. There was no significant difference between the two techniques in the rate of local and/or vascular complications: 16% versus 12%; the OR was 0.97 (95% CI: 0.62, 1.54). The systemic and/or remote complication rate for endovascular repair (17%) was significantly lower than that for open repair (44%); the OR was 0.22 (95% CI: 0.11, 0.45). Significant heterogeneity was found. Open repair was associated with an increase in bleeding (2% versus 1%, P=0.04) and other complications: cardiac (11% versus 3%, P<0.001), pulmonary (13% versus 4%, P<0.001), renal (8% versus 5%, P=0.02), and gastrointestinal (2% versus 0%, P=0.002). Endovascular repair was associated with an increase in arterial injury (2% versus 0%, P<0.001).
Authors' conclusions
Compared with open surgical repair, elective endovascular repair of AAAs decreased blood loss, length of stay in the intensive care unit and in hospital, 30-day mortality, and systemic and/or remote complications. However, the long-term effectiveness of endovascular versus open repair is unknown.

CRD commentary
The review question was clear in terms of the intervention and participants. The inclusion criteria were broadly defined in terms of the study design but were not explicitly defined in terms of the outcomes, although the outcomes assessed in the review were clearly stated. Some relevant studies may have been omitted by limiting the included studies to those in English listed in one database. No attempt was made to locate unpublished studies, thus raising the possibility of publication bias. The methods used to select the studies were not described; hence, the adequacy of the methods used cannot be judged. Validity was not formally assessed, but some aspects of validity were mentioned in the discussion section. Two reviewers independently extracted the data, which reduces the potential for bias and errors.

The studies were combined in a meta-analysis and statistical heterogeneity was assessed. Having found significant heterogeneity, the authors did not explore potential reasons for it. They did, however, suggest that the variation in risk factors among patients at baseline may account for the differences. The influence of study quality, particularly the validity of the data collection methods (which differed among studies), on the results was not examined. This means that the quality of the evidence on which the conclusions were based is uncertain, so the conclusions are not definitive.

Implications of the review for practice and research
The authors did not state any implications for practice or further research.

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