Endovascular stent-graft placement in aortic dissection: a meta-analysis

CRD summary
The review assessed the effectiveness of endovascular stent-graft placement for descending aortic dissection. The authors concluded that the intervention is technically feasible in type B aortic dissection, with favourable neurological complication rates and acute and mid-term survival in comparison with surgical treatment. The small observational series identified provide limited evidence and the authors correctly state that further research is required to confirm these findings.

Authors' objectives
To assess the effectiveness of endovascular stent-graft placement in patients with descending aortic dissection (AD) with respect to clinical success, complications and other outcomes.

Searching
MEDLINE was searched from January 1999 to May 2004 for publications in the English language; the search terms were reported. The reference lists of retrieved articles were checked for additional studies.

Study selection
Study designs of evaluations included in the review
Any study, with the exception of case reports and studies with fewer than three participants, was eligible for inclusion. Studies that did not report sufficient data (less than 25% of predefined variables) were excluded from the analysis.

Specific interventions included in the review
Studies of retrograde endovascular stent-graft placements into the descending thoracic aorta were eligible for inclusion. Studies of antegrade, surgical ('open') stent-graft placement via the aortic arch were excluded.

Participants included in the review
Studies of patients with descending AD defined according to the Stanford classification were eligible for inclusion. Data concerning patients with other thoracic aortic pathologies (i.e. thoracic aortic aneurysms) were not included in the review. Most of the studies included patients with a mixture of acute AD (within 14 days of the onset of symptoms) and chronic (occurred after 14 days). The studies included in the review had participants with mainly type B AD (AD confined to the descending aorta, 96%). The majority (75.8%) of participants were men.

Outcomes assessed in the review
Studies reporting clinical success, complication rates and other outcomes relating to stent-graft placement were eligible for inclusion. The outcomes reported in the studies included: procedural success; emergency conversion; overall complications; major complications; minor complications; overall neurologic complications; paraplegia; 30-day mortality; late surgical conversion; aortic rupture during follow-up; re-intervention rate; in-hospital mortality; and late mortality during follow-up.

Procedural success was defined as the technically successful deployment of the endoprosthesis at the intended target location. Complications were classified as major if they were life-threatening or prompted major therapeutic consequences (e.g. access complications requiring surgical revision), whilst those that did not require further treatment (e.g. transient renal failure not requiring dialysis) were classified as minor. Patient deaths which occurred suddenly and could not be related to other causes were classified as being due to aortic rupture. Re-intervention was defined as the need for any surgical conversion or additional endovascular stent-graft procedures.

How were decisions on the relevance of primary studies made?
Initially, the abstracts of retrieved articles were screened for relevance. Full paper copies of potentially relevant articles
were then obtained and reviewed for inclusion. The authors did not state how many reviewers were involved in this process.

**Assessment of study quality**
The authors did not state that they assessed validity.

**Data extraction**
One author extracted the data according to 53 predefined reported criteria relating to clinical characteristics, procedural data, in-hospital course and long-term outcomes. Two other authors independently checked the data and any discrepancies were resolved by mutual consensus. Unspecified information was classified as not available. For each study, the number of patients with the events of interest was extracted. Rates of events were calculated as the number of events divided by the number of treated patients with available data.

**Methods of synthesis**
**How were the studies combined?**
The studies were grouped under the following sections: procedural and in-hospital course, and follow-up data. Mean rates of events of interest were calculated as the number of events divided by the number of treated patients with available data, and were presented with standard deviations. Estimates of survival (30 days, 6 months, 1 year and 2 years) were calculated using the Kaplan-Meier non-parametric method; only those studies reporting the exact time of fatal events were included.

Survival estimates were compared using the log rank test. Comparisons between acute and chronic patients were made using a two-sided chi-squared test for categorical variables and a two-sided Student's t-test for continuous variables. P-values of less than 0.05 were considered statistically significant. The mortality (30 day) of stent-graft patients was compared with that of medically and surgically treated patients using data taken from the Registry on Aortic Dissection.

A ‘worst case’ model was also calculated for clinically important variables such as complications and mortality. This model assumed that all reported but unspecified events occurred in dissection patients.

**How were differences between studies investigated?**
The studies were analysed in relation to the study publication date (1999 to 2002 compared with 2002 to 2004), the type of dissection (acute versus chronic) and the influence of operator experience (more experienced versus less experienced). Centres with a published total number of patients treated by endovascular stent-graft placement (including dissections and other diseases of the thoracic aorta such as thoracic aortic aneurysms) that were above the median (i.e. greater than 20 patients) were considered to be more experienced than those with numbers below the median.

**Results of the review**
Thirty-nine studies (609 patients with AD) were included in the review; the studies appeared to be observational case series.

Procedural data and in-hospital course.

Procedural success (n=551) occurred in 98.2 +/- 0.5% of patients. Emergency surgical conversion (n=609) was required in 1.1 +/- 0.4% and elective surgical conversion was performed in a further 1.2 +/- 0.4%. In-hospital complications (n=449) were reported in 13.6 +/- 1.5% of patients (worse-case estimate 17.6 +/- 1.4%). Most were of major clinical significance (n=449) (11.1 +/- 1.4%; worse-case estimate 10.2 +/- 1.2%), including those related to retrograde extension of the dissection into the descending aorta (n=429; 1.9 +/- 0.6%) and neurologic complications (n=518; 2.9 +/- 0.7%; worse-case estimate 3.4 +/- 0.7%); stroke (n=518) occurred in 1.9 +/- 0.6% (worse-case estimate 2.6 +/- 0.6%) and paraplegia (n=609) in 0.8% +/- 0.4%. Minor complications (n=449) were less frequent (2.5 +/- 0.7%; worse-case estimate 7.4 +/- 0.9%).
Overall in-hospital mortality (n=524) was 5.2 +/- 0.9% (worse-case estimate 6.2 +/- 0.9%) and 30-day mortality (n=524) was 5.3 +/- 0.9% (worse-case estimate 4.1 +/- 0.9%).

Follow-up data.

The total re-intervention rate was 11.9 +/- 0.2% over a period of 19.5 +/- 7.1 months, including the index hospitalisation. All-cause mortality (n=609) was 2.8 +/- 0.7% (worse-case estimate 4.1 +/- 0.9%). Survival rates were 93.3 +/- 1.4% at 30 days, 90.6 +/- 1.6% at 6 months, 89.9 +/- 1.7% at 1 year, and 88.8 +/- 1.9% at 2 years.

Influence of publication date.

Technical success rates were lower in earlier studies (i.e. those published from 1999 to 2001) in comparison with later studies (i.e. those published from 2002 to 2004). However, overall complications and neurological complication rates were higher in the more recently published studies. No differences were observed in operative or 1-year mortality rates.

Influence of operator experience.

More experienced centres (i.e. with a total number of patients above the median) performed better than less experienced centres (i.e. with a total number of patients below the median).

Acute versus chronic AD.

Acute AD patients were significantly younger. In-hospital complications were significantly more common in acute AD than in chronic AD patients (21.7% versus 9.1, P=0.005). Major complications (14.5% versus 7.9%, P=0.124) and 30-day mortality (9.8% versus 3.2%, P=0.015) were also greater in acute AD than in chronic AD, but not significantly. Survival rates failed to differ between the two groups after 1 year (P=0.088).

Authors' conclusions

The data suggest that endovascular stent-graft replacement in type B AD is technically feasible and minimally invasive, with success rates of over 95% in selected cohorts, major complications in 14 to 18% of patients, and a low incidence of paraplegia. Further research is required, but this review suggests that neurological complications and acute and mid-term survival rates are favourable in comparison with those previously reported for the surgical treatment of AD.

CRD commentary

This review was based on a well-defined question, although the inclusion criteria for study design were necessarily broad. Some relevant data might, however, have been missed as the review searched only one electronic database and included only English language publications. Given the types of eligible study designs and the failure to search grey and unpublished literature sources, publication bias cannot be ruled out. The authors took appropriate steps to reduce errors when extracting data from the included studies, but it was unclear whether similar care was taken to reduce bias in the selection of studies as the authors failed to report their methods. There also appears to have been no assessment of study quality.

Given the inclusion of what appear to have been mainly small retrospective observational studies, the authors' methods of analysis appear reasonable. However, they themselves acknowledged that their methods and data are limited and their findings are likely to be subject to confounding and bias, including selection bias. They did make some attempt to investigate the influence of certain potential confounders such as operator bias, publication date and type of dissection. However, in view of these factors, their findings should be interpreted with caution. The authors are correct to recommend that further research be conducted.

Implications of the review for practice and research

Practice: The authors did not state any implications for practice.

Research: The authors stated that further research is required to confirm their findings. A direct randomised
prospective comparison of stent-graft placement and conventional medical and surgical treatment is lacking. Future studies should assess the long-term outcomes of stent-graft placement and focus on morphological follow-up, rather than just clinical end points, in order to assess any causal relationship between morphology (successful stent-graft-induced aortic reconstruction) and outcomes.

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