Meta-analysis of endovascular vs open repair for traumatic descending thoracic aortic rupture

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CRD summary
The review compared the safety and effectiveness of endovascular versus open repair of traumatic thoracic aortic lesions and found that 30-day mortality, procedure-related mortality and risk of postoperative paraplegia/paraparesis were significantly lower with endovascular repair. The review had some flaws and the authors' conclusions should be interpreted with caution.

Authors' objectives
To evaluate the mortality and ischaemic spinal cord complication rates of endovascular versus open repair treatment of traumatic thoracic aortic lesions.

Searching
MEDLINE, CINAHL, Cochrane Central Register of Controlled Trials (CENTRAL), DARE, Proquest, UpToDate, ClinicalTrials.gov and MD Consult were searched for published and unpublished studies in any language between 1966 and 2007. Bibliographies of each retrieved article, relevant journals and a textbook of vascular surgery were handsearched. Authors' files were reviewed and the authors corresponded with study authors. Search terms were reported.

Study selection
Studies that compared outcomes of endoluminal treatment of traumatic thoracic aortic injury versus open repair and reported at least one relevant outcome were eligible for inclusion. Studies of other types of rupture were eligible only if data for the traumatic injury group could be obtained. It appeared that studies of delayed repair were excluded (unless immediate repair data was also reported).

The techniques used for open repair in the included studies were bypass and clamp and sew. Where reported, mean age of patients was 38.8 years (range 14 to 82 years) and mean proportion of males was 74% (range 67% to 84%). The mean injury severity score for the included patients was 40.4 (range nine to 66). Eligible outcomes included: procedure-related mortality (death within 30 or fewer days of the procedure related to aortic graft placement); overall 30-day mortality (death within 30 or fewer days of the procedure from all causes); and paraplegia/paraparesis rate. Studies that reported results for all three outcomes were identified. Not all studies reported length of follow-up and for most studies it differed for the two intervention groups: mean length of follow-up for open repair group was 51 months (range three to 187 months); mean length of follow-up for TEVAR (Thoracic Endovascular Aneurysm Repair) group was 28 months (range two to 90 months).

One reviewer screened all article titles, abstracts and subject headings for potential relevance. Two reviewers independently assessed the initial citations identified for a full text examination.

Assessment of study quality
Thirteen criteria were used to assess study quality: mechanism of injury; objective assessment of aortic injury with computed tomography or angiogram; type of endograft used; location of injury; mortality rate; paraplegia/paraparesis rate; conversion rate from endovascular to open repair; interval time between injury and repair; injury severity score (ISS) or other assessment of the extent of injury; report of coverage of the left subclavian artery; reintervention rate; endoleak rate; and length of follow-up.

The authors did not report the number of reviewers who assessed study quality.

Data extraction
Two reviewers independently extracted data using a standard form. Disagreements were resolved by consensus. Authors were contacted for additional information or clarification of data, where necessary. The number of events for each outcome was extracted in order to calculate odds ratio (OR) and 95% confidence intervals (CI).

Methods of synthesis
Odds ratios and 95% confidence intervals were pooled using both fixed-effect and random-effects models. The Cochran Q test for between-study heterogeneity was performed. Heterogeneity was assumed to be present if \( p<0.05 \). Publication bias was evaluated using funnel plots. A sensitivity analysis was performed by removal of each study in turn and evaluating the resulting effect. Studies with no occurrence of an outcome in either the TEVAR or the open repair group were excluded from the statistical calculation for that outcome.

Results of the review
Seventeen relevant retrospective cohort studies \((n=589, \text{range 10 to 74 patients})\) were identified. The reported mean quality score out of 13 was 10.6 (range four to 13).

Procedure-related mortality was significantly lower with TEVAR than with open repair \((\text{OR} 0.31, 95\% \text{ CI} 0.15 \text{ to } 0.66, p=0.002; \text{15 studies})\). Overall 30-day mortality was significantly lower with TEVAR than with open repair \((\text{OR} 0.44, 95\% \text{ CI} 0.25 \text{ to } 0.78, p=0.005; \text{16 studies})\). Postoperative paraplegia/paraparesis rate was significantly lower with TEVAR than with open repair \((\text{OR} 0.32, 95\% \text{ CI} 0.10 \text{ to } 0.93, p=0.04; \text{nine studies})\).

Three studies had significantly lower quality scores, but sensitivity tests found pooled odds ratios did not vary significantly with and without these studies included. A funnel plot for 30-day mortality showed little publication bias and the Q-test did not show significant heterogeneity for mortality \((p=0.09)\), procedure-related mortality \((p=0.09)\) and for paraplegia/paraparesis \((p=0.08)\). Random-effects and fixed-effect models gave similar results.

Details were given of the types of endograft used and the techniques used for open repair in the individual studies.

Authors’ conclusions
Endovascular treatment of descending thoracic aortic trauma was an alternative to open repair and associated with lower postoperative mortality and ischaemic spinal cord complication rates.

CRD commentary
The review addressed a well-defined question in terms of participants, interventions, study design and relevant outcomes. Relevant databases were searched in any language and unpublished studies were considered. Efforts were made to reduce error and bias for data extraction, but not for quality assessment and only partially for screening. The Cochran Q test for between-study heterogeneity was performed and heterogeneity was assumed to be present if \( p<0.05 \) when typically a value of \( p<0.10 \) is used, so the level of heterogeneity was probably higher than the authors assumed. Publication bias was assessed and shown to be limited. Study quality was assessed and quality scores were assigned for each study, but neither confounding nor how patients were selected for inclusion were assessed. Some baseline differences between groups were identified. Relevant study details were reported, but there were some minor errors. The statistical method used for the meta-analysis seemed appropriate. Sensitivity analyses were carried out. The lack of assessment (and handling) of confounders and of how patients were selected, coupled with uncertainty surrounding the issue of heterogeneity, means the authors’ conclusions should be interpreted with caution.

Implications of the review for practice and research
Practice: The authors stated that endoluminal stent graft insertion for the treatment of traumatic aortic tear seemed to avoid many of the complications associated with open thoracic aortic repair. Other advantages of TEVAR included avoidance of thoracotomy, single-lung ventilation, aortic cross-clamping and left heart or cardiopulmonary bypass. TEVAR also required less time. There was a technical limitation of TEVAR in younger patients, who tend to have a smaller aorta).

Research: The authors identified a need for further studies on the long-term side effects and durability of the repair in TEVAR patients. Another factor that required further study was the significance of the interval from injury to repair. They considered that it was unlikely that open repair and TEVAR would be compared in prospective randomised trials...
due to ethical issues and the relatively small number of patients with thoracic aortic rupture. Therefore, evidence would be derived only from prospective population-based studies.

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