A systematic review and meta-analysis of treatments for aortic graft infection
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CRD summary
The authors concluded that findings from studies with design limitations suggest that extra-anatomic bypass may not be the most appropriate 'gold' standard treatment for aortic graft infection. The authors' cautious conclusion appears appropriate in view of the limited evidence obtained from potentially biased, retrospective observational studies.

Authors' objectives
To compare extra-anatomic bypass, rifampicin-bonded prostheses, cryopreserved allografts and autogenous veins for the treatment of aortic graft infection.

Searching
MEDLINE was searched from 1985 to August 2005 for studies reported in English; the search terms were reported. The reference lists from identified studies were screened.

Study selection
Study designs of evaluations included in the review
Retrospective chart reviews, single-arm non-randomised clinical trials, clinical registries, prospective multicentre data surveys and prospective randomised controlled trials were eligible for inclusion. Case studies were excluded. All of the included studies were retrospective observational studies. The duration of follow-up, where reported, ranged from 5.3 to 44 months.

Specific interventions included in the review
Studies that evaluated extra-anatomic bypass, rifampicin-bonded prostheses, cryopreserved allografts and autogenous veins were eligible for inclusion in the review.

Participants included in the review
Studies in patients being treated for prosthetic aortic graft infection, mycotic aneurysm, or both, were eligible for inclusion. Studies were excluded if they involved only patients within a narrow age range (less than 15 years' difference), a high or disproportionate proportion of patients with highly virulent microorganisms in the aortic graft infection, or poorly reported patient characteristics. The included studies involved men and women with a mean age of approximately 60 years (range: 25 to 93). Reasons for the initial aortic graft varied among participants, as did co-morbidities and the aetiology of the aortic graft infection.

Outcomes assessed in the review
Studies were excluded if relevant outcome data were poorly reported. Relevant outcomes included amputations, conduit failures (thrombosis, stenosis, or both), reinfections, and early (30 days or less) and late (more than 30 days) post-operative mortality.

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
Two reviewers, blinded to the study authors and results, independently assessed the validity of the included studies using a standardised scoring system. The scoring system considered the source of the study report, study design, study outcomes, study participants, controls, study implementation, treatment protocol, methods and statistics. The maximum possible score was 28 points.
Data extraction
Two reviewers independently extracted event rates for the outcomes of interest from each study. The mean event rates with 95% confidence intervals (CIs) were calculated for each outcome.

Methods of synthesis
How were the studies combined?
Data from studies that scored at least 18 out of 28 points for validity were pooled in meta-analyses. For each treatment, pooled mean event rates with 95% CIs were calculated for all outcomes combined and for each outcome using fixed-effect and random-effect models. The possibility of publication bias was examined using a funnel plot.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the Q statistic. Where heterogeneity was found, analyses were repeated after the exclusion of outliers. The studies were ranked in order of treatment effect for each outcome of interest, before and after tests of heterogeneity using fixed-effect analyses. A sensitivity analysis was used to examine the effect on the results of excluding the following studies: partial excisions formed 29% or fewer of all excisions performed; 41% or less cases were performed emergently; patients with aorto-enteric fistulas made up 44% or less of the study sample; the mean length of follow-up was 16.5 months or less; sepsis was reported in 44% or less of the study sample; and indication for aortic graft was occlusive disease in 70% or less of the study sample.

Results of the review
Thirty-seven retrospective observational studies were included. Some studies appeared to report results for more than one treatment. Twelve studies (n=459) evaluated extra-anatomic bypass, 5 studies (n=96) evaluated rifampicin-bonded prostheses, 16 studies (n=616) evaluated cryopreserved allografts and 9 studies (n=219) evaluated autogenous veins. One additional study (n=27) that evaluated silver coated polyester grafts was included in some tables but was not included in the meta-analyses.

All of the included studies scored 18 or more points for validity.

After tests for heterogeneity, overall event rates using fixed-effect models were highest for extra-anatomic bypass (0.16), followed by autogenous veins (0.10), cryopreserved allografts (0.09) and rifampicin-bonded prostheses (0.07). There was 'reasonable' heterogeneity (p>0.10) for all outcome measures across all treatments.

After tests for heterogeneity, event rates were lowest with rifampicin-bonded prostheses for amputations (0 versus 0.03 for cryopreserved allografts, 0.08 for autogenous veins and 0.08 for extra-anatomic bypass), conduit failures (0.02 versus 0.09 for cryopreserved allografts, 0.17 for autogenous veins and 0.25 for extra-anatomic bypass) and early mortality (0.07 versus 0.14 for cryopreserved allografts, 0.10 for autogenous veins and 0.18 for extra-anatomic bypass). Re-infection rates were greatest for rifampicin-bonded prostheses (0.07) and lowest for autogenous veins (0.01) compared with cryopreserved allografts (0.03) and extra-anatomic bypass (0.06). Late mortality was lowest for autogenous veins and cryopreserved allografts (both 0.14) compared with rifampicin-bonded prostheses (0.16), and highest for extra-anatomic bypass (0.24).

There was little change in the results after sensitivity analyses.

Funnel plots suggested the absence of major publication bias.

Authors' conclusions
Findings from studies with design limitations suggest that extra-anatomic bypass may not be the most appropriate 'gold' standard treatment for aortic graft infection.

CRD commentary
The review addressed a clear question that was defined in terms of the participants, intervention, outcomes and study
design. Limiting the search to studies reported in English in one database might have resulted in the omission of other relevant studies and an increased possibility of both language and publication bias. However, the authors assessed the potential for publication bias and found no evidence of it. Methods were used to minimise reviewer errors and bias in the assessment of validity and extraction of data, but it was unclear whether similar steps were taken at the study selection stage. Validity was assessed using specified criteria but the results were not reported.

The studies were pooled using meta-analysis, statistical heterogeneity was assessed, outliers were identified and sensitivity analyses were conducted. The evidence came from retrospective observational studies and these are subject to various potential biases; the results from these studies and any synthesis may not, therefore, be reliable. In addition, the main review results about the relative effect of different treatments were based on comparisons between subgroups of trials rather than direct comparisons within trials, thus any conclusions drawn about the relative effects should not be relied upon, especially given the level of heterogeneity between the studies. The authors' cautious conclusion appears appropriate in view of the considerable limitations of the evidence.

**Implications of the review for practice and research**

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

**Research:** The authors stated that the need for more high-quality studies to evaluate silver-coated prostheses and to determine the mode of action, especially the time course of these prostheses.

**Bibliographic details**


**PubMedID**

16828424

**DOI**

10.1016/j.jvs.2006.02.053

**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Antibiotics, Antitubercular /administration & dosage; Aortic Diseases /mortality /surgery; Blood Vessel Prosthesis /adverse effects; Blood Vessels /transplantation; Cryopreservation; Humans; Prosthesis-Related Infections /mortality /surgery; Rifampin /administration & dosage; Transplantation, Autologous; Treatment Outcome

**AccessionNumber**

12006003725

**Date bibliographic record published**

30/09/2007

**Date abstract record published**

30/09/2007

**Record Status**

This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.