Ultrafiltration reduces blood transfusions following cardiac surgery: a meta-analysis
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CRD summary
The review evaluated ultrafiltration of blood following cardiac surgery in adults. The authors concluded that ultrafiltration is associated with a reduction in post-operative blood transfusions and post-operative bleeding. The low quality of the included studies and the use of an unspecified control intervention mean that the results may not be reliable.

Authors' objectives
To investigate the effect of ultrafiltration (UF) on post-operative blood product use and peri-operative bleeding in adult cardiac surgery patients.

Searching
MEDLINE, EMBASE, CINAHL, BIOSIS Previews, HealthSTAR and the Cochrane CENTRAL Register were searched from inception to December 2003. In addition, the bibliographies of selected manuscripts were handsearched. There was no mention of whether any language restrictions were applied to the search.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion.

Specific interventions included in the review
Studies in which either conventional or modified UF was used for haemoconcentration during cardiac surgery were eligible for inclusion. In the included studies, both conventional and modified UF were used, either singly or in combination, as well as UF of pump blood. Details of the control intervention were not reported.

Participants included in the review
Adult participants undergoing cardiac surgery were eligible for inclusion. The included participants were primarily undergoing coronary artery bypass grafting, but there were also participants undergoing valve and other cardiac surgery.

Outcomes assessed in the review
Studies that reported blood product use and/or post-operative bleeding were eligible for inclusion.

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 studies were assessed using the Jadad scale, with the reviewers blinded to the author, institution and journal. Two reviewers independently assessed validity.

Data extraction
Two authors independently extracted the data, with any discrepancies resolved by consensus. Data on blood transfusion were converted to number of units per patient. Weighted mean differences (WMDs) were calculated as the effect estimate. Studies with more than one UF group were treated as two separate trials.

Methods of synthesis
How were the studies combined?
DerSimonian and Laird random-effects models were used to calculate the WMD and 95% confidence interval (CI).
Publication bias was assessed using Begg’s funnel plots.

How were differences between studies investigated?
Statistical heterogeneity was apparently assessed but the methods used were not reported. Heterogeneity between the studies was investigated using stratified analyses, sensitivity analyses and meta-regression.

**Results of the review**

Ten RCTs (1,004 participants) were included in the review. Three studies (106 participants) used conventional UF, three (687 participants) used modified UF, three (131 participants) used conventional and/or modified UF, and one (80 participants) used UF of pump blood.

The quality of the included studies was poor, with only 3 studies having a Jadad score higher than 1. Two of the included studies were blinded. There was no evidence of significant publication bias (p=0.94).

UF was associated with a significant reduction in post-operative blood transfusions compared with control (WMD -0.73 units, 95% CI: -1.16, -0.31, p=0.001). There was significant heterogeneity between the studies (p=0.042). The effect of UF was greater in studies evaluating modified versus other types of UF: the WMD was -0.71 units (95% CI: -1.08, -0.35, p<0.001) for modified UF and -0.61 units (95% CI: -1.65, 0.43, p=0.25) for other UF.

UF was associated with reduced post-operative bleeding compared with control (WMD -70 mL, 95% CI: -118, -21, p=0.005). This effect was driven primarily by trials evaluating modified rather than conventional or other UF: the WMD was -104 mL (95% CI: -161, -46, p<0.001) for modified UF and -10 mL (95% CI: -68, 47, p=0.73) for other UF. Sensitivity analyses showed that the statistically significant beneficial effect of UF on blood transfusions remained when the largest study and the study with the largest effect were removed from the analysis.

Meta-regression analyses found that higher quality studies showed significantly lower treatment effects (p=0.001).

**Authors' conclusions**

UF is associated with a significant reduction in post-operative blood transfusions and reduced bleeding in adults undergoing cardiac surgery.

**CRD commentary**

The objective of the review was clear, as were the inclusion criteria for the participants, intervention, study design and outcomes. The search strategy for published trials was comprehensive, but the authors do not appear to have sought unpublished studies. However, the possibility of publication bias was investigated and there was no evidence of this. The validity assessment showed that the quality of the included studies was low, bringing into question the reliability of the results, as confirmed by the meta-regression results. 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.

Statistical heterogeneity was assessed and various potential sources of heterogeneity were examined. The insufficient description of the participants in the included studies makes the external generalisability of the review results difficult to assess. In addition, no details of the control groups were reported, which meant it was not clear what UF was being compared with. Where multiple comparison groups shared a control group, no adjustment was made for statistical dependency. Given the concerns about the methodology of the review and the quality of the included studies, the results may not be reliable.

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

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

Research: The authors stated that the efficacy and cost-effectiveness of UF should be evaluated in a large, randomised, double-blinded study.

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