A systematic review of biocompatible cardiopulmonary bypass circuits and clinical outcome
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CRD summary
This review reported that there were no effects of biocompatible circuits on mortality after cardiac operations and a limited effect on lower transfusion needs and atrial fibrillation rate. Biocompatible circuits were associated with a shorter intensive care unit and hospital stay. The review was generally well conducted and the authors’ conclusions are likely to be reliable.

Authors' objectives
To assess the efficacy of biocompatible circuits for cardiopulmonary bypass in patients undergoing cardiac surgery.

Searching
BioMed Central, Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, Scopus, and The Cochrane Library were searched. The Cochrane Library search was up to May 2008; search dates for other databases were not reported. Search terms were reported. American Thoracic Society, Society of Thoracic Surgeons, Society of Cardiovascular Anaesthesiologist, European Association of Cardiothoracic Anaesthesiologists and American College of Chest Physicians conference proceedings and abstracts were searched from 2002. Reference lists of retrieved articles and relevant reviews were screened. International experts were contacted for relevant studies.

Study selection
Prospective randomised controlled trials (RCTs) that compared any type of biocompatible circuit with untreated circuit and oxygenator of the same type in patients at least 12 years old who underwent cardiac surgery were eligible for inclusion. Studies that reported outcome data with intractable units of measure or that had three or more study arms were excluded.

The control arm of all included studies was a placebo. Included studies were published between 1992 and 2006. Most included studies evaluated heparin-bonded biocompatible circuits. No further data on included patients were reported. Outcomes reported in the review were packed red cells transfusions, surgical revision, perioperative myocardial infarction, low cardiac output syndrome, atrial fibrillation, use of intra-aortic balloon pump after the operation, stroke, lung dysfunction, gastroenteric complications, sepsis, mechanical ventilation time, intensive care unit stay, postoperative hospital stay and hospital mortality.

Two reviewers independently assessed studies for inclusion. Any disagreements were resolved by consensus.

Assessment of study quality
Study quality was assessed using the Jadad scale, a five-point scale for evaluation of randomisation, blinding, withdrawal and allocation concealment.

Three reviewers independently performed the validity assessment.

Data extraction
For dichotomous outcomes, number of events for the intervention and control group were extracted and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. For continuous outcomes, mean and standard deviation (SD) in each group were extracted and the mean differences with 95% CIs were calculated.

Two reviewers independently performed data extraction. Any disagreements were resolved by consensus.

Methods of synthesis
The studies were combined in meta-analyses. Standardised mean difference (SMDs) for continuous outcomes were
calculated, with 95% CIs. Pooled odds ratios for dichotomous outcomes, with 95% CIs, were estimated using the Mantel-Haenszel model. Subgroup analyses of high-quality studies with a Jadad score of at least 3 were performed. Statistical heterogeneity was investigated using Cochrane Q test and $I^2$ statistics. The authors used a random-effects model for the meta-analysis where there was significant heterogeneity and a fixed-effects model was employed in the absence of significant heterogeneity. Publication bias was visualised using funnel plots and assessed using the Egger test.

**Results of the review**

Thirty-six RCTs (n=4,360) were included in the meta-analysis. Fourteen RCTs were judged as high quality (Jadad score of at least 3).

Compared with controls, biocompatible circuits were significantly associated with a reduction in packed red cells transfusions (OR 0.8, 95% CI 0.69 to 0.93; 20 RCTs), atrial fibrillation (OR 0.76, 95% CI 0.61 to 0.93; eight RCTs), intensive care unit stay (SMD -0.25 days, 95% CI -0.37 to -0.14; 13 RCTs) and hospital stay (SMD -0.55 days, 95% CI -0.68 to -0.42; nine RCTs). No significant differences between the two groups were observed for resternotomy, perioperative myocardial infarction, pulmonary complications, stroke and hospital mortality.

Subgroup analyses of high-quality studies showed that results of a reduction in atrial fibrillation and intensive care unit stay remained significant; biocompatible circuits were no longer significantly associated with a reduction in packed red cells transfusions compared with controls.

Statistically significant heterogeneity ($p<0.1$) was observed only for the outcomes of mechanical ventilation time ($I^2=91\%$), intensive care unit stay ($I^2=89\%$) and hospital stay ($I^2=90\%$). The authors reported that publication bias was found only for the outcome of mechanical ventilation time. Funnel plots and results of Egger tests were not presented.

Other outcomes that were not included in meta-analyses were reported descriptively.

**Authors’ conclusions**

There were no effects of biocompatible circuits on mortality after cardiac operations and a limited effect on lower transfusion needs and atrial fibrillation rate. Biocompatible circuits were associated with a shorter intensive care unit and hospital stay.

**CRD commentary**

This review’s inclusion criteria were clear. Several relevant databases were searched. Efforts were made to find published and unpublished studies to minimise potential for publication bias. The authors did not state whether language restrictions were applied in the search, which made it difficult to assess risk of language bias. Sufficient attempts were made to minimise biases and errors in the review process. Relevant criteria were used to examine study quality. Statistical heterogeneity was assessed and appropriate statistical methods were used to pool results. This review was generally well conducted and the authors’ conclusions are likely to be reliable.

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

**Practice:** The authors stated that use of biocompatible surfaces without other measures to contain blood activation resulted in limited clinical benefit.

**Research:** The authors stated that further RCTs were required to examine the effects of new generation biocompatible treatment on postoperative outcomes.

**Funding**

Not stated.

**Bibliographic details**

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.