Influence of dialysis membranes on outcomes in acute renal failure: a meta-analysis

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Authors' objectives
To ascertain the effects of dialysis membrane composition on survival and recovery of renal function in patients with acute renal failure.

Searching
MEDLINE was searched from January 1966 to December 2000 for both English and non-English references. The search terms were not reported. The reviewers also attempted to find unpublished material by reviewing their files of personal correspondence, obtaining proceedings from meetings and by perusing bibliographies of review articles.

Study selection
Study designs of evaluations included in the review
The studies needed to be prospective in design. Both randomised and non-randomised trials were included.

Specific interventions included in the review
The studies needed to have compared cellulose-based membranes with synthetic membranes. Both unsubstituted (cuprophane) and substituted (cellulose acetate and cellulose diacetate) membranes were compared to synthetic membranes (polyacrylonitrile, polymethyl methacrylate and polysulfone).

Participants included in the review
No inclusion criteria for the participants were given. All those included had acute renal failure, but no further data on the patients were provided.

Outcomes assessed in the review
The studies had to have included an assessment of survival and/or recovery of renal function. The survival rates were based on all-cause mortality at the end of the follow-up period. Recovery of renal function was defined as the discontinuation of dialysis because it was no longer required.

How were decisions on the relevance of primary studies made?
Each author independently reviewed each article.

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

Data extraction
The data were abstracted in a non-blinded fashion. The cumulative odds ratios (ORs) for survival and for renal recovery were calculated.

Methods of synthesis
How were the studies combined?
The studies were combined using meta-analysis techniques. The data were analysed using a Mantel-Haenszel test, based on a fixed-effect model.

How were differences between studies investigated?
Heterogeneity between the studies was estimated using the Mantel-Haenszel test.
The trials were stratified by the type of membrane used (those using cellulose acetate and those using cuprophane were analysed independently) and by study design (including studies that used only well-defined randomisation methods). Sensitivity analyses were performed for these two variables.

Results of the review
Ten studies were included in the review. Eight studies providing survival data (867 patients) and six providing data on recovery of renal function (641 patients) were included in the meta-analyses.

The studies were found to be statistically homogeneous (data not provided).

Four trials suggested a survival benefit for synthetic membranes and four did not. The cumulative OR for survival was 1.37 (95% confidence interval, CI: 1.02, 1.83, P=0.03) in favour of synthetic membranes. The OR for renal recovery was 1.23 (95% CI: 0.90, 1.68, P=0.18).

The survival advantage for synthetic membranes was mainly found in comparison with the unsubstituted cellulose group (cuprophane) than the substituted group (cellulose acetate): OR 1.64 (95% CI: 1.10, 2.45) versus OR 1.20 (95% CI: 0.73, 1.97). Sensitivity analyses did not reveal any benefits of synthetic membranes for renal recovery.

An analysis of more rigorously designed trials demonstrated no benefit of synthetic membranes in terms of survival or renal recovery.

Cost information
The reviewers commented on the greater cost differences between synthetic and cuprophane membranes.

Authors' conclusions
Synthetic membranes appeared to confer a significant survival advantage over cellulose-based membranes. The survival disadvantage of cellulose-based membranes may be limited to unsubstituted cellulose (cuprophane) membranes. A benefit of synthetic membranes over cellulose-based membranes was not demonstrated for recovery of renal function, but the sample size was limited.

CRD commentary
The reviewers addressed a clear research question with defined criteria for the study design, interventions and outcomes. Searching was restricted to one database, but the reviewers supplemented this with handsearches. They also attempted to find unpublished material but, apart from abstracts, only published material was eligible for inclusion in the review. The reviewers did not assess study validity, which is particularly important when including study designs other than randomised controlled trials. The reviewers tested for statistical heterogeneity and found studies to be homogeneous, but they admitted that there may have been clinical and methodological variations between the studies. The study details in the report were limited, so it is not possible to ascertain how differences in the study sample or dialysis dose, for example, might have influenced the results. It is questionable as to whether the studies should have been combined using a meta-analysis given such variation. However, the reviewers performed sensitivity analyses to test the impact of study design and membrane type, and explained that other analyses were not possible due to a lack of data. The reviewers' conclusions were based on their results, but it is possible that the effects may be modified by factors other than those analysed in the report.

Implications of the review for practice and research
Practice: The authors stated that they advocate the use of synthetic dialysis membranes in the treatment of acute renal failure.

Research: The authors stated that there is a need to show, in adequately-powered trials, whether substituted cellulose membranes are equivalent to synthetic membranes.
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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.