Perioperative fluid management strategies in major surgery: a stratified meta-analysis
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CRD summary
This review concluded that perioperative outcomes favoured goal-directed therapy over liberal fluid therapy without haemodynamic goals in major surgery and that it was uncertain whether goal-directed therapy was superior to a restrictive fluid strategy. Limitations in the reporting of study details and statistical methods make it difficult to determine the reliability of this conclusion.

Authors' objectives
To determine whether liberal use of perioperative fluid therapy without haemodynamic goals had different effects to goal-directed fluid therapy on the outcomes of patients who underwent major surgery.

Searching
MEDLINE, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL) were searched up to July 2009 with update searches in April 2011. Search terms were reported. Reference lists of retrieved articles and abstracts from relevant conferences were searched to identify relevant studies.

Study selection
Randomised controlled trials (RCTs) were eligible for inclusion if they evaluated different fluid amounts administered during and after surgery or compared fluid administration strategies guided by conventional haemodynamic variables with goal-directed fluid therapy. Studies were required to measure mortality, length of stay or organ-specific complications in patients who underwent elective or emergency surgery where substantial systemic inflammatory response was not expected.

Most procedures in the included studies were elective abdominal or colorectal surgery in patients classified as high risk by the American Society of Anaesthesiology physical status classification system.

Two researchers independently selected studies for inclusion.

Assessment of study quality
Allocation concealment, randomisation, blinding and inclusion/exclusion criteria were rated as being adequate, inadequate or unclear.

It appeared that the quality of the studies was assessed independently by two researchers.

Data extraction
Two researchers independently extracted data from the included studies on basic trial characteristics. Authors were contacted for any information that was missing or unclear.

Methods of synthesis
Differences in continuous outcomes were calculated as mean differences (MD) with related 95% confidence intervals (CIs) and pooled using a random-effects inverse variance approach. Where continuous data were reported as medians and outcomes these were first converted to means and standard deviations. Differences in categorical outcomes were calculated as risk ratios (RRs) and pooled using the Mantel-Haenszel random-effects method. Heterogeneity among the included studies was assessed using $\chi^2$ and $I^2$ statistics. The relative risk ratio (RRR) of differences between goal-directed and liberal fluid strategies were calculated by indirect comparisons. Publication bias was assessed using a funnel plot and adjusted for using trim and fill methods. Sensitivity analyses were conducted for higher quality trials and trials that examined only patients who underwent abdominal surgery.

Results of the review
Twenty-three RCTs (3,861 patients) that evaluated goal-directed therapy were included in the review. Seven of these were double-blind and had adequate allocation concealment.
Compared with non goal-directed groups, goal-directed patients had a significantly shorter hospital stay (MD 1.95 days, 95% CI 0.97 to 2.93; I²=95%), less frequent pneumonia (RR 0.74, 95% CI 0.57 to 0.96; I²=0%) and renal complications (RR 0.67, 95% CI 0.46 to 0.98; I²=16%). Mortality (RR 0.88, 95% CI 0.70 to 1.12; I²=0%) and incidence of other complications were not significantly different between the groups.

Twelve RCTs (1,160 patients) that evaluated liberal fluid therapy were included in the review. Six of these were double-blind and had adequate allocation concealment. Compared with restrictive fluid, patients in liberal fluid groups had longer hospital stay (MD 1.96 days, 95% CI 0.49 to 3.43; I²=94%) and more frequently reported pneumonia (RR 2.16, 95% CI 1.04 to 4.47; I²=0%) and pulmonary oedema (RR 3.84, 95% CI 1.13 to 13.07; I²=0%). Mortality (RR 1.68, 95% CI 0.50 to 5.62; I²=0%) and incidence of other complications were not significantly different between the groups.

Indirect comparisons suggested that liberal use of perioperative fluid without any haemodynamic goal was associated with increased hospital stay (MD 4 days, 95% CI 3.4 to 4.4), time to first bowel movement (MD 2 days, 95% CI 1.3 to 2.3) and risk of pneumonia (RR 3, 95% CI 1.8 to 4.8) compared with goal-directed therapy. Mortality, wound infections and renal failure were not significantly different between these approaches.

Difference in hospital stay became statistically non-significant after excluding lower quality studies. Other sensitivity analyses did not substantially change these findings.

**Authors’ conclusions**
Perioperative outcomes favoured goal-directed therapy over liberal fluid therapy without haemodynamic goals. It was uncertain whether goal-directed therapy was superior to a restrictive fluid strategy.

**CRD commentary**
Attempts were made to identify relevant research for this review from several different sources. The research question appeared to be supported by appropriate inclusion criteria. Attempts were made to minimise the potential for errors and bias in the selection, extraction and quality assessment of studies.

The methods used to combine the subsets of studies appeared largely appropriate but insufficient details were reported for the indirect comparison of liberal and goal-directed strategies. Insufficient details of the included studies were available to judge whether these comparisons were appropriate but the high levels of statistical heterogeneity on outcomes such as hospital stay suggested the possibility of important clinical differences between the included studies.

The authors’ suggestion that a factorial trial was required appears appropriate but limitations in the reporting of study details and statistical methods make it difficult to establish the reliability of their conclusions about the relative effects of goal-directed therapy and liberal fluid therapy.

**Implications of the review for practice and research**
The authors did not state any implications for practice.

**Research**
The authors stated a need for an adequately powered factorial RCT of goal-directed versus non goal-directed and liberal versus restrictive fluid strategies controlled for specific subgroups of surgery.

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