Systematic review of the literature for the use of oesophageal Doppler monitor for fluid replacement in major abdominal surgery

Abbas SM, Hill AG

CRD summary
The review concluded that oesophageal Doppler monitoring for fluid replacement in major abdominal surgery improved short-term outcomes, reducing hospital stay, complications and intensive care unit admissions and promoting a more rapid return of gut function. In view of some potential limitations in the review process and low sample sizes of included trials, the reliability of the authors' conclusion is unclear.

Authors' objectives
To evaluate the safety and effectiveness of the use of oesophageal Doppler monitoring for fluid replacement in major abdominal surgery.

Searching
MEDLINE and EMBASE were searched for publications in any language; search terms were reported. Search dates were not explicitly stated (but the included studies were published between 2002 and 2006). Relevant conference proceedings were also searched. Bibliographies of each retrieved article were handsearched.

Study selection
Randomised controlled trials (RCTs) of acceptable quality that compared oesophageal Doppler monitoring with conventional clinical practice for fluid replacement in patients undergoing major elective abdominal surgery were eligible for inclusion. Oesophageal Doppler monitoring for the continuous measurement of cardiac filling was compared with conventional practices for guiding intravenous therapy including measurement of venous pressure, heart rate, arterial blood pressure and urine output. Trials of orthopaedic and cardiac surgery were excluded.

The primary outcomes were hospital stay, overall complications (including cardiovascular, renal, respiratory and gastrointestinal complications), admissions to intensive care units, return of gut function (defined as tolerating a solid diet), requirement for inotropes, and mortality. Secondary outcomes were crystalloid use, colloid use, urine output, cardiac output, mean arterial blood pressure, oxygen delivery, corrected flow time in the descending aorta, and differences in the systemic response to injury.

Included patients underwent elective colorectal resection in most trials, major elective abdominal surgery in one trial, and oesophageal, gastric and pancreatic surgery in another trial. Patients were reported to be comparable for age, type of surgery, preoperative haemoglobin level, and for physiological scores including the ASA (American Society of Anesthesiologists), Goldman Cardiac Risk Index and POSSUM (Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity) scores; and there were no significant differences between the Doppler and control groups.

The authors did not specifically report how many reviewers performed the selection.

Assessment of study quality
Methodological quality was assessed using a critical appraisal of method of randomisation, allocation concealment, blinding, intention-to-treat analysis, the nature of the intervention, co-interventions and follow-up.

Two reviewers performed the quality assessment; trials were not included unless they were of “acceptable” quality.

Data extraction
Dichotomous data was extracted and used to calculate odds ratios (OR) and 95% confidence intervals (CI). For continuous data, mean differences (MD) and 95% confidence intervals were extracted.
The authors did not report how many reviewers performed the data extraction, but reported that extracted data was checked.

**Methods of synthesis**

Data on weighted mean differences (WMD) and odds ratios were pooled using a fixed-effect model or a random-effects model if significant heterogeneity was present ($p<0.1$). Between trial heterogeneity was determined using the $X^2$ and $I^2$ tests and visually using Forest plot.

Sensitivity analyses were performed excluding poorer quality and possible outlier trials.

A narrative synthesis was provided for trials with insufficient data to be included in the pooled analyses.

**Results of the review**

Five RCTs were identified (n=428, range 40 to 128). All five RCTs had adequate randomisation, allocation concealment, intention-to-treat analysis and blinding of assessment; four trials had adequate blinding for the intervention, which was not clear for the fifth trial.

**Main outcomes:** For the Doppler groups versus the control groups, there was a significantly shorter length of hospital stay (WMD -1.60 days, 95% CI -2.58 to -0.62; $I^2=10.4$%; four RCTs), significantly fewer complications (OR 0.28, 95% CI 0.17 to 0.46; $I^2=9.0$%; four RCTs), significantly fewer admissions to intensive care units (OR 0.20, 95% CI 0.07 to 0.57; $I^2=4.0$%; three RCTs), and a significantly more rapid return of gut function (WMD -1.85 days to -1.47; $I^2=26.5$%; four RCTs), using fixed-effect models. There was no significant difference in mortality between the Doppler groups and control groups ($I^2=0$%; five RCTs). Two trials reported the numbers of patients requiring inotropes, but there was significant heterogeneity, so a pooled analysis was not performed.

**Other outcomes:** For the Doppler groups versus control groups, significantly greater volumes of intravenous colloids were given; there was significantly greater cardiac output at the end of surgery (WMD -0.97 litres/minute, 95% CI -1.31 to -0.63; $I^2=0$%; five RCTs); and the corrected flow time in the descending aorta was significantly higher for the Doppler group (three RCTs). One trial reported significantly higher oxygen delivery in the intervention group than the control group. No significant differences were reported between the Doppler and control groups for volume of crystalloid used, mean urine output during surgery (2 RCTs), mean arterial blood pressure after surgery (3 RCTs; $I^2=0$%), or central venous pressure (two RCTs). Results were also reported for differences in systemic response (three RCTs).

**Authors’ conclusions**

Oesophageal Doppler use for monitoring and optimisation of flow-related haemodynamic variables improved short-term outcomes in patients undergoing major abdominal surgery.

**CRD commentary**

The review addressed a well-defined question in terms of participants, interventions, study design and relevant outcomes. Relevant databases were searched in any language, but the authors gave no specific search date details, and the search for unpublished studies did not appear to be extensive, so some relevant studies may have been missed. Publication bias was not assessed. It was not clear what efforts were made to reduce error and bias in the review process, although it appeared that the two reviewers were involved and data was reported to be checked.

Trial quality was assessed using suitable criteria; the included trials appeared to be generally of good quality. The authors reported that only trials of acceptable quality were included, but did not specifically describe how this decision was made. Some relevant trial details were reported, but some specific details were not given (for example no details of loss to follow-up). The statistical methods used for the meta-analysis seemed appropriate and statistical heterogeneity was assessed. The results of sub-analyses were not described.

In view of some potential limitations arising from the review process and the low sample sizes of the included trials, the reliability of the authors’ conclusion is unclear.
Implications of the review for practice and research

Practice: The authors stated that the use of Doppler guided fluid management may help to optimise the intravascular volume to maintain cardiac output and tissue oxygen delivery by detecting changes more rapidly than conventional methods.

Research: The authors identified a need for studies of the benefit of oesophageal Doppler in a peri-operative care programme.

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