The effects of an increase of central blood volume before spinal anesthesia for Cesarean delivery: a qualitative systematic review

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Authors' objectives
To evaluate the role of central blood volume augmentation in reducing the incidence of hypotension with spinal anaesthesia for Caesarean delivery.

Searching
MEDLINE was searched from 1966 to 2000, and EMBASE from 1988 to 2000, using the following MeSH terms and textwords: 'cesarean section', 'hypotension', 'anaesthesia, spinal', 'leg wrapping' and 'trendelenberg'. The last search was conducted on May 1, 2000. The Cochrane Library (Issue 1, 2000) was also searched. Additional material for the period 1995 to 2000 was identified by examining the bibliographies of retrieved studies and reviews, by handsearching journals not covered by MEDLINE, and by checking the abstracts of major anaesthetic meetings. Abstracts, correspondence and unpublished observations were excluded.

Study selection

Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible. One study that randomised the first 40 patients in blocks of two, and thereafter enrolled patients using a 'play the winner' strategy, was included; a quality score was not assigned to this study.

Specific interventions included in the review
Any method of increasing central blood volume to prevent hypotension was eligible. These included:

- crystalloid preload;
- colloid, i.e. albumin, hetastarch, modified gelatin and dextran; and
- mechanical interventions used singly or in combination, such as wrapping the legs, leg elevation, tilting the bed down, thromboembolic stockings, and inflatable splints or boots.

Balanced salt solutions of crystalloids were used with or without dextrose, in widely varying volumes. The volumes ranged from 0 to 1,787 mL in the control groups, and from 997 to 2,970 mL in the experimental groups. Some protocols included the use of prophylactic or therapeutic ephedrine and/or left uterine displacement.

Participants included in the review
Women undergoing Caesarean delivery were eligible. The participants included women undergoing elective Caesarean delivery or Caesarean section after labour.

Outcomes assessed in the review
The primary outcome was the incidence of hypotension as defined in the primary studies. The secondary outcomes included: ephedrine use, Apgar scores, umbilical cord blood pH, and maternal nausea and vomiting. The various definitions of hypotension used included: any decrease in blood-pressure; a decrease in systolic blood-pressure of more than 10 to 30% of the baseline value; and a systolic blood-pressure of less than 85 to 100 mmHg.

How were decisions on the relevance of primary studies made?
The searches were conducted by the authors independently.

The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.
Assessment of study quality
Validity was assessed and scored using the 5-point, 3-item, validated Oxford scoring system of Jadad et al. (see Other Publications of Related Interest no.1). The items assessed were the adequacy of randomisation, the appropriateness of blinding, and the description of the withdrawals (number of and reasons for) by intervention group. At least two authors assessed and scored the studies according to the validity criteria. Any disagreements were resolved by consensus.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

The following information were tabulated in the review: author and year of publication; the number of participants per intervention arm; details of the interventions; definition of hypotension; use of ephedrine according to intervention group; and outcome.

Methods of synthesis
How were the studies combined?
The studies were grouped by the method of increasing central blood volume and a narrative synthesis was undertaken. L'Abbe scatter plots were calculated for each method of increasing central blood volume (see Other Publications of Related Interest no.2).

How were differences between studies investigated?
Differences between the studies were discussed in the text of the review.

Results of the review
Twenty-three RCTs (1,504 patients) were included.

Larger versus smaller crystalloid preload (9 RCTs, 533 patients).
Only 3 RCTs had a quality score of greater than 2. Crystalloid preload was inconsistent in preventing hypotension; only 3 of the 9 RCTs reported a significant effect of a larger preload on the incidence of hypotension. There was a wide variation in the preload volume in the control and experimental groups. In 5 RCTs, the control group received little or no preload, whilst in 4 RCTs, the control groups received a preload volume between 750 and 1,800 mL. The use of prophylactic and therapeutic ephedrine varied among studies. Umbilical cord pH (5 RCTs): only 1 of the 5 RCTs reported a significant difference between the intervention groups. Apgar score of less than 7 (6 RCTs): only 1 of the 6 RCTs reported a significant difference between the intervention groups.

Maternal nausea and vomiting (2 RCTs): neither RCT reported a significant difference between the intervention groups.

Colloid (7 RCTs, 559 patients).
The quality scores ranged from 2 to 5, with 5 RCTs scoring more than 2. Colloid versus crystalloid (6 RCTs): 5 of the 6 RCTs reported a statistically-significant decrease in the incidence of hypotension for colloid, compared with crystalloid. Some investigators used equal volumes of crystalloid and colloid, whilst others used larger volumes of crystalloid.

Apgar scores or umbilical artery pH (6 RCTs): only 1 of the 6 RCTs showed an improved neonatal outcome in the colloid group.

Maternal nausea and vomiting (2 RCTs): neither RCT reported a significant difference between the intervention groups.
Mechanical interventions (7 RCTs, 447 patients).

Most studies were small with low quality scores; only 1 RCT scored more than 2. All patients received between 500 and 2,000 mL of prophylactic crystalloid.

Leg wrapping (3 RCTs, 203 patients): all 3 RCTs reported significant reductions in hypotension for leg wrapping, compared with control or leg elevation.

Inflatable splints (1 RCT, 46 patients): compared with control, inflatable splints significantly decreased hypotension after a crystalloid preload; hypotension was reduced from 83 to 48%. Inflatable boots (1 RCT, 79 patients): no difference was found in the rates of hypotension between the intervention groups. Tilting the patient's head down was of no significant benefit (1 RCT, 34 patients).

Authors' conclusions
Increasing central blood volume by using colloid and leg wrapping decreases, but does not abolish, the incidence of hypotension before spinal anaesthesia for elective Caesarean section delivery.

CRD commentary
The aims were stated and the inclusion criteria were defined in terms of the study design, intervention and participants. The primary outcome was defined as used in the individual studies. Several relevant sources were searched and the search terms were reported. Some details were given of the methods used to select the primary studies. It was not reported whether any language restrictions were applied and, since unpublished observations were excluded, the possibility of publication bias was raised. Validity was assessed using a validated scale; the scores were reported and the methods used to assess validity were described.

Relevant data were presented in tabular format, but the methods used to extract the data were not described. The reasons for not performing a meta-analysis were stated and, given these problems, a narrative synthesis was appropriate. Where heterogeneity between studies was found, the potential reasons for it were discussed. The review did not consider adverse reactions. The statement that colloid use was associated with increased costs and adverse reactions was not supported by the evidence presented.

The evidence presented supports the authors' conclusion.

Implications of the review for practice and research
Practice: The authors state that the common practice of volume expansion with crystalloid is not uniformly effective in reducing the incidence of maternal hypotension after spinal anaesthesia for Caesarean delivery. Colloid administration is more consistent but is associated with additional risks and costs.

Research: The authors state that future studies should measure maternal side-effects.

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