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Review Article

REVIEW ARTICLES

The Effect of patient warming during Caesarean delivery on maternal and neonatal outcomes: a meta-analysis

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Abstract

Background: Perioperative warming is recommended for surgery under anaesthesia, however its role during Caesarean delivery remains unclear. This meta-analysis aimed to determine the efficacy of active warming on outcomes after elective Caesarean delivery.

Methods: We searched databases for randomized controlled trials utilizing forced air warming or warmed fluid within 30 min of neuraxial anaesthesia placement. Primary outcome was maximum temperature change. Secondary outcomes included maternal (end of surgery temperature, shivering, thermal comfort, hypothermia) and neonatal (temperature, umbilical cord pH and Apgar scores) outcomes. Standardized mean difference/mean difference/risk ratio (SMD/MD/RR) and 95% confidence interval (CI) were calculated using random effects modelling (CMA, version 2, 2005).

Results: 13 studies met our criteria and 789 patients (416 warmed and 373 controls) were analysed for the primary outcome. Warming reduced temperature change (SMD −1.27°C [−1.86, −0.69]; P=0.00002); resulted in higher end of surgery temperatures (MD 0.43 °C [0.27, 0.59]; P<0.00001); was associated with less shivering (RR 0.58 [0.43, 0.79]; P=0.0004); improved thermal comfort (SMD 0.90 [0.36, 1.45]; P=0.001), and decreased hypothermia (RR 0.66 [0.50, 0.87]; P=0.003). Umbilical artery pH was higher in the warmed group (MD 0.02 [0, 0.05]; P=0.04). Egger's test (P=0.001) and contour-enhanced funnel plot suggest a risk of publication bias for the primary outcome of temperature change.

Conclusions: Active warming for elective Caesarean delivery decreases perioperative temperature reduction and the incidence of hypothermia and shivering. These findings suggest that forced air warming or warmed fluid should be used for elective Caesarean delivery.

Key words: anaesthesia; body temperature, hypothermia; caesarean section; obstetric; temperature

The benefits of maintaining normothermia in the perioperative period include reductions in: postoperative wound infection,[1 2] myocardial ischaemia,[3] the risk of perioperative coagulopathy, blood loss and transfusion requirement.[4] Although maintenance of normothermia before, during and after surgery in order to help prevent surgical site infection has been recommended for adults undergoing surgery under general or regional anaesthesia,[1 5 6] the benefits of preventing hypothermia in women undergoing Caesarean delivery remain unclear. There are currently no European or American national recommendations regarding the use of perioperative warming for elective Caesarean delivery. Consequently routine warming of patients during Caesarean delivery is not widely practiced, despite almost all obstetric operating rooms having the capability to do so.[7]

Despite several studies investigating active warming during Caesarean delivery, there is still no consensus regarding whether

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Editor's key points

- Perioperative warming is recommended practice but rarely used for Caesarean section.
- This meta-analysis evaluated 13 randomized control trials of warming in 789 patients undergoing elective Caesarean section with neuraxial anaesthesia.
- Warming reduced temperature change, improved thermal comfort and other measures.
- Active warming for Caesarean delivery is suggested.

it improves maternal or neonatal outcomes. Studies have used different warming or anaesthetic techniques, variable ambient room temperatures, different durations of patient warming, diverse temperature measurement devices and various temperature measurement intervals, making interpretation of the effects of active warming difficult. This meta-analysis aimed to determine the effects of active warming (either fluid warming or forced air warming) on maternal temperature change and other maternal (temperature at the end of surgery, shivering, thermal comfort, hypothermia, vomiting, vasopressor use) and neonatal (temperature, umbilical cord pH and Apgar scores at 1 and 5 min) outcomes during and immediately after elective Caesarean delivery.

Methods

For this meta-analysis, we analysed randomized controlled trials comparing active warming techniques (specifically forced air warming or warmed fluid) to no warming before and during elective Caesarean delivery, and followed PRISMA guidelines.[8] We conducted a literature search with no language restriction on January 16, 2014 and repeated the search on August 27 and December 3, 2014. Searches were performed in PubMed (1950 to August 2014), Ovid EMBASE (1970 to December 2014), Ovid MEDLINE (1950 to December 2014), Scopus (1960 to December 2014), EBM Reviews Cochrane Central Register of Controlled Trials 2nd Quarter 2014, clinicaltrials.gov, and CINAHL (December 2014). We consulted the clinical trials registry (www.clinicaltrials.gov) on August 27, 2014 to identify any unpublished studies. The search strategy consisted of a combination of subject headings (obstetric, Caesarean) and keywords/ key phrases (temperature, warming, Caesarean) for each of MEDLINE, EMBASE, and CINAHL searched in specified fields (such as ti=title/ab=abstract). In the event that a database did not index articles, we conducted keyword searching in the entire record (see Appendix 1 for detailed PubMed search criteria). Reference lists of all identified studies were also checked.

All randomized controlled trials utilizing forced air warming or warmed fluid were considered. We included studies comparing groups that commenced warming from within 30 min of neuraxial anaesthesia placement up to and including warming in the post anaesthetic care unit. We excluded studies using general anaesthesia and other methods that may minimize perioperative hypothermia including various intrathecal opioid doses, leg wrapping, warmed intrathecal drugs, different anaesthetic techniques, and increased ambient temperature. Studies were also excluded if they did not report maternal or neonatal outcomes. The quality of studies included in the meta-analysis was reviewed using the Cochrane Collaboration's tool for assessing risk of bias.[9] Areas of methodological quality assessed included concealment of allocation, random sequence generation, blinding of the assessors and participants, and accounting for all subjects. Overall quality was graded as low (high risk of bias), high (low risk of bias), or unclear risk of bias for each domain entry using a standardized tool.[9] At least two individuals extracted the study data independently utilizing a standardized review protocol and recorded the information on a data collection sheet. Differences were resolved by re-examination of the original manuscripts and by discussion with a third investigator. The data were then entered into a computer by one of the authors (Y.C.) and checked by a second investigator (P.S.).

The primary outcome was the maximum temperature change in the perioperative period. For the purposes of this study, the perioperative period was defined as the time from 30 min before anaesthesia to 15 min after arrival on the post anaesthetic care unit.[10] Secondary outcomes included (1) temperature at the end of surgery or on admission to the post anaesthetic care unit (2) shivering (3) nausea and vomiting (4) thermal comfort (5) hypothermia (6) hypotension (7) vasopressor use (8) neonatal temperature at delivery (9) umbilical cord blood pH and (10) Apgar scores at 1 and 5 min.

Data were analysed using the Review Manager software (RevmanVersion 5.3.5 Copenhagen: the Nordic Cochrane Centre, The Cochrane Collaboration, 2014), CMA (comprehensive meta-analysis, Version 2, 2005),[11] and R routine metacont (R package Meta). We calculated pooled estimates for all studies combined and also performed a subgroup analysis according to warming modality used (forced air warming or fluid warming). We compared subgroups using the Q test. For dichotomous outcomes, the risk ratio (RR) and 95% confidence interval (CI) were calculated (a RR<1 favoured warming). In addition, the number needed to treat (NNT) was calculated for statistically significant dichotomous outcomes. For continuous data, the standardized mean difference (SMD) or mean difference (MD) and 95% CI were determined. The MD was used for all continuous outcomes except when the data available from the included studies were in different formats. This applied to the outcome of temperature change, where data was available either as a mean (SD) temperature change or as baseline temperature and post intervention temperature, and the outcome of thermal comfort where two different scales were used by the included studies. The percentage of heterogeneity was assessed with the I^2 statistic. Significant heterogeneity was assumed to be present if I^2>50%. For the primary outcome we explored significant heterogeneity, by performing sensitivity analyses, excluding studies with methodological differences according to type of neuraxial technique or site of forced air warming. Publication bias for the primary outcome was assessed using funnel plots and Egger's test. In case of funnel plot asymmetry, a contour-enhanced funnel plot was examined to further assess for publication bias. A P value <0.05 was considered statistically significant. All data were combined and analysed using the DerSimonian-Laird random effects model.

Results

The flow diagram of the study selection is provided in Fig. 1. We retrieved all 34 shortlisted articles that were identified from the literature search. Six additional publications found from reference lists of retrieved articles were added to the literature search results, only one of which was included in the final meta-analysis.[12] No additional unpublished positive or negative trials were identified on clinicaltrials.gov. The retrieved articles were examined by two authors (P.S. and B.C.) to assess eligibility for inclusion in the meta-analysis. Excluded studies are listed in Appendix 2. Thirteen articles met our inclusion criteria. Of the studies that met the inclusion criteria: 2 evaluated forced air warming;[13 14] 8 evaluated fluid warming;[12 15–21] 1 study utilized