A systematic review of intraoperative warming to prevent postoperative complications

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CRD summary
The authors concluded that preventing intra-operative hypothermia should be routine practice in all peri-operative departments, especially for patients undergoing major surgery. Overall, the authors' conclusions are likely to be reliable.

Authors' objectives
To evaluate the effect of interventions to prevent hypothermia during surgery on post-operative complications.

Searching
The Cochrane Wounds Group Specialised Register and the Cochrane CENTRAL Register were searched, without language restrictions, for studies published between 1948 and May 2003; the search terms were reported.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion. Where reported, the duration of follow-up in the included studies varied from 90 minutes to the total hospital stay.

Specific interventions included in the review
Studies that evaluated interventions to prevent hypothermia during surgery were eligible for inclusion. Studies in which hypothermia was induced were excluded, as were studies of the efficacy of the intervention. All of the included studies compared standard care with one or more methods of preventing hypothermia. More than half of the included studies evaluated forced air or intravenous fluid warming; other studies used electric blankets, irrigation fluid warming, warming of insufflation gas, circulating water mattresses, reflective (space) blankets and warming of anaesthetic gas; some studies evaluated combinations of methods. All interventions were used intra-operatively; some studies also used interventions pre-operatively or post-operatively.

Participants included in the review
Studies of patients of any age who were undergoing noncardiac surgery under regional or general anaesthesia were eligible for inclusion. Most of the participants were undergoing major surgery (major elective colorectal, vascular and orthopaedic surgery; major gynaecological, orthopaedic and general surgery; transurethral resection of the prostate; and intracranial surgery) and were classified as 1 to 3 on the American Society of Anesthesiologists (ASA) Physical Status Classification System. Other participants were undergoing minor or intermediate procedures requiring a short hospital stay (endoscopic procedures, minor orthopaedic and plastic surgery, day gynaecological surgery) and had ASA scores of 1 or 2. The majority of participants were aged over 50 years (range: 18 to 85). General anaesthesia (GA) was used in most studies; other studies used spinal anaesthesia or a combination of general and epidural anaesthesia.

Outcomes assessed in the review
The studies had to assess outcomes beyond the intra-operative phase to the post-anaesthesia care unit (PACU) and/or the total hospital stay; other than that, no inclusion criteria were specified. The review assessed post-operative complications such as shivering, cardiac events, need for blood transfusion, wound infections and pressure sores, pain and thermal comfort. 'Post-operative' was defined as the period from the end of surgery to hospital discharge.

How were decisions on the relevance of primary studies made?
Two reviewers independently selected the studies and resolved any disagreements through discussion.

Assessment of study quality
Two reviewers independently assessed the validity of the studies and resolved any disagreements through discussion.
Validity was assessed by considering the randomisation method, adequacy of allocation concealment, level of blinding, and baseline comparability of the treatment groups (or analysis adjusted for baseline differences).

Data extraction
Two reviewers independently extracted the data and resolved any disagreements through discussion. Degrees of shivering and data on blood transfusions were translated into dichotomous outcomes.

Methods of synthesis
How were the studies combined?
The studies were pooled using a fixed-effect model in the absence of heterogeneity (I-squared <40%) and a random-effects model otherwise. Pooled relative risk reductions with 95% confidence intervals (CIs) and the absolute risk reduction (ARR) were calculated for dichotomous data, while standardised mean differences with 95% CIs were calculated for continuous data. Studies that were not suitable for pooling were combined in a narrative.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the I-squared statistic. Sensitivity analyses were conducted by examining the influence of allocation concealment, blinding and study size for the most frequently reported post-operative complication. Data on primary complications (blood transfusion, cardiac event, wound infection and pressure sores) in studies involving major surgery and general anaesthesia were pooled separately. Potential causes of differences between the studies were also discussed.

Results of the review
Twenty-six RCTs (n=2,070) were included. The sample size ranged from 16 to 324.

Seven studies reported a priori power calculations. Seventeen studies did not describe the process of randomisation in full. Eight studies reported blinding of the patients and outcome assessors, eight did not describe methods of blinding, and three reported that blinding was not possible.

Shivering in the PACU (14 studies) was significantly less common in the intervention group than in the control group (RR 0.26, 95% CI: 0.20, 0.35); heterogeneity was low (I-squared 11.4%); the ARR was 30%.

Morbid cardiac events (2 studies) were significantly less common in the intervention group than in the control group (RR 0.34, 95% CI: 0.20, 0.57). Blood transfusions (4 studies) were significantly less common in the intervention group than in the control group (RR 0.39, 95% CI: 0.22, 0.68; I-squared 20.1%); the ARR was 18%. Wound infections (2 studies) were significantly less common in the intervention group than in the control group (RR 0.26, 95% CI: 0.12, 0.58); the ARR was 13%. There was no significant difference in pressure sores (1 study) between the intervention and control groups (RR 0.54, 95% CI: 0.25, 1.17); the ARR was 4%. Complications in major surgery under general anaesthesia (7 studies) were significantly less common in the intervention group than in the control groups (RR 0.37, 95% CI: 0.27, 0.51); heterogeneity was low; the ARR was 13%.

Two small studies (n=27 and 30) in patients undergoing colorectal procedures reported no significantly different pain scores between the intervention and control groups; the results were unclear in a third study (n=20). Two small studies (n=30 and 20) that evaluated warming gases in laparoscopic cholecystectomy reported no difference in pain levels or post-operative analgesic consumption.

In terms of thermal comfort (1 study, n=29), one small study reported that patients in the intervention group described themselves as warmer compared with the control group patients.

Cost information
One cost-effectiveness study reported no difference in the length of stay in the PACU, and time to extubation was reduced by a mean of 4 minutes. The review authors referred to a meta-analysis that evaluated the cost-benefits of preventing hypothermia (see Other Publications of Related Interest).
Authors' conclusions
Preventing intra-operative hypothermia should be routine practice in all peri-operative departments, especially for patients undergoing major surgery.

CRD commentary
The review addressed a clear question that was defined in terms of the participants, intervention and study design. The search was based on existing Cochrane registers rather than standard databases, and sources such as conference proceedings were not searched for recent and unpublished data; the review may thus be subject to publication bias. However, attempts were made to minimise language bias. Methods were used to minimise reviewer errors and bias in the study selection, validity, assessment and data extraction processes. Validity was assessed using specified criteria and the results of the assessment were discussed. Only clinically heterogeneous studies were pooled but heterogeneity was not consistently reported. Overall, the authors' conclusions are likely to be reliable.

Implications of the review for practice and research
Practice: The authors stated the need to draw attention to the results of hypothermia in all surgical specialities, to monitor patients' temperatures, and to make normothermia one of the criteria for discharge from the PACU.

Research: The authors stated the need for further studies to evaluate the safety, efficacy and cost-effectiveness of warming devices. Such studies should include a systematic review of highly specialised temperature management (including induced hypothermia) in cardiac surgery.

Funding
Actamed Ltd; Pegasus Ltd.

Bibliographic details
Scott E M, Buckland R. A systematic review of intraoperative warming to prevent postoperative complications. AORN Journal 2006; 83(5): 1090-1104, 1107-1113

PubMedID
16722286

Original Paper URL
http://www.aornjournal.org/article/S0001-2092(06)60120-8/fulltext

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Hot Temperature /therapeutic use; Humans; Hypothermia /prevention & control; Intraoperative Care; Postoperative Complications /prevention & control; Randomized Controlled Trials as Topic; Treatment Outcome

AccessionNumber
12006003729

Date bibliographic record published
30/09/2007

**Date abstract record published**
30/09/2007

**Record Status**
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.