

Effects of preinduction and intraoperative warming during major laparotomy

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An investigation into the influence of active warming before and during operation on blood loss, transfusion requirements, duration of stay in the post-anaesthesia care unit (PACU) and perioperative costs in patients undergoing major abdominal surgery.

This study looked at whether warming for 30 minutes before induction of anaesthesia combined with intraoperative warming with forced air prevents hypothermia during major abdominal surgery.

The main finding was that maintenance of normothermia reduced the total costs for anaesthetic treatment overall by 24% during major abdominal surgery. This was because of a shortened stay in the PACU, lower incidence of postoperative mechanical ventilation and reduced perioperative blood loss, resulting in fewer transfusions in normothermic patients.

The costs of perioperative management were lower in patients who remained normothermic although they had to be supervised during the preinduction warming period.

Heat loss

Central body temperature decreases after induction of general anaesthesia as a result of reduced metabolic heat production and redistribution of heat from to peripheral areas. During laparotomy, heat loss may also be increased because the large surface of the intestine is exposed to the relatively cold environment of the operating room.

Intraoperative hypothermia is associated with an increased rate of postoperative myocardial ischaemia, increased plasma concentrations of catecholamines and an increased rate of postoperative wound infection.

In this study 40 patients undergoing major abdominal surgery were allocated randomly to two groups. Study group patients were actively warmed using forced air for 30 minutes before induction of general anaesthesia and during anaesthesia. Passive protection against heat loss consisted of circulating water mattresses, blankets and fluid warming devices, and was used both in the active warming group and in the control group.

At the end of surgery the change in core temperature was significantly less in the group of actively warmed patients. Blood loss and transfusion requirements were less in the actively warmed patients, who had a shorter duration of stay in the PACU (94 min vs 217 min) and a 24% reduction in total anaesthetic costs.

In patients undergoing total hip replacement, blood loss and transfusion requirements were reduced when central body temperature was kept normal.

Active and passive warming

Passive prevention of hypothermia included covering the patient's body and extremities with two layers of blankets and the use of circulating water mattresses (temperature set at 39°C) and fluid warming devices for infusions. Active warming was provided by the Warm Touch System set at the highest flow rate and in the temperature range 40–42 °C. Ambient room temperature was maintained at approximately 22°C. The patient's abdomen and legs were covered with two layers of blankets. The arms and chest of those patients receiving preoperative active warming were warmed using forced air, whereas in the control group the arms and chest were covered with blankets. Thirty minutes later, general anaesthesia was induced.

During operation arterial pressure, heart rate, peripheral oxygen saturation, end-tidal carbon dioxide and isoflurane concentrations, and temperatures were recorded at 15-minute intervals. After operation, temperatures were recorded at 30-minute intervals until normothermia was achieved.

On arrival in the PACU, blood samples were obtained for coagulation tests and blood cell counts. Laboratory analyses were repeated on the first postoperative day and blood loss was estimated by an independent anaesthetist who was not involved in the study.

The presence or absence of shivering was determined by the anaesthetist in charge on the PACU. The time the patient was ready to be discharged from the PACU was set retrospectively by a blinded observer using a scoring system. A core temperature of more than 36.0 C and a score of 14 points was regarded as a criterion for discharge.

Key findings

- During the preinduction period, central body temperature did not differ significantly between the two groups.
- From 15 minutes after intubation until the end of surgery, central body temperature was higher in the pre-warmed group and remained higher in this group for 180 minutes after arrival in the PACU.
- At the end of surgery and during the first hour in the PACU, 12 of 20 patients in the control group showed significant vasoconstriction, whereas it was detectable in only four of 20 patients in the pre-warmed group.
- On arrival in the PACU, seven patients in the control group showed signs of shivering, and six additional patients underwent mechanical ventilation because of hypothermia.
- Intraoperative blood loss was less in the normothermic group (635 ml vs 1070 ml).

- After 94 min, pre-warmed patients were ready to be discharged from the PACU compared with 217 min in the control group.
- The costs of treatment from the beginning of preinduction warming until discharge from the PACU were £408 for an aggressively warmed patient and £534 for a control patient.

The costs of perioperative management were calculated with respect to the salaries and costs for the University of Heidelberg in August 1996. For preinduction warming, it assumed a nurse-to-patient ratio of 1:4; the costs of treating patients in the control group before induction of anaesthesia were calculated as zero.

A smaller number of nurses have to work during the night shift in PACU if patients are ready to be discharged earlier in the evening after maintenance of perioperative normothermia.

The estimated salary of a nurse taking care of four patients in a holding area and the cost of the upper body layer of the Warm Touch System contributed to 4.6% of the costs of total perioperative anaesthetic management during the day of surgery. Considering all aspects, however, the costs of perioperative management for each patient were significantly lower in the actively prewarmed group.

The 24% reduction in costs for each actively warmed patient represents a large economic impact. The reduction in total costs of perioperative treatment of a single patient produces an economic benefit for the anaesthetic department as a whole.

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