Abstract

Hypothermia is one of the common complications in the perioperative period. Currently, normothermia is maintained with forced air warming (FAW) or passive heat retention methods. We compared the efficacy of the Mediwrap® blanket with FAW in maintaining normothermia during intra-operative period in thoracic surgery in a prospective randomised controlled trial on 30 patients. Core temperature was measured at 30-min intervals in the perioperative period and the time taken to attain baseline in the postoperative periods in the two groups was compared. There was no difference in core temperatures between the groups during pre- and intra-operative period, with mean ± S.D. final core temperatures of 36.2 ± 0.6 °C with Mediwrap® and 36 ± 0.9 °C with the FAW blanket. However, the postoperative core temperatures were significantly higher in the Mediwrap® group. The time required to reach baseline temperature was lower in the Mediwrap® group with a mean ± S.D. of 66 ± 66 min as compared to 161 ± 108 min in the FAW group. The Mediwrap® blanket is as effective as the FAW blanket in maintaining core body temperature during thoracotomy when applied thirty minutes before the surgery.

Keywords: Hypothermia; Thoracic surgery; Warming devices; Forced air warming; Mediwrap®

1. Introduction

Hypothermia (defined as core body temperature < 35 °C) is one of the common complications of surgery. It causes several adverse events including shivering, delayed recovery from anaesthesia, myocardial ischaemia, wound infection and coagulopathy resulting in increased transfusion requirements [1–4]. Hence, it is a standard practice to monitor temperature and adopt strategies to prevent heat loss, in the perioperative period.

Forced air warming (FAW) is considered the gold standard practice to maintain normothermia, especially during long procedures [4–7]. However, there are several disadvantages with FAW such as active pre-warming required to prevent the heat loss due to re-distribution following induction of general anaesthesia [8], recommencing of FAW in the recovery period and potential source of nosocomial infections [9–11]. We have observed in our practice that in the majority of thoracic surgical patients the core temperature falls after discontinuation of FAW and did not return to baseline temperature up to 4 h. Mediwrap® heat retention blanket (Mediwrap™ Ltd, Essex, UK) is a simple single use disposable passive insulation system. It is produced from high bulk, air laid material laminated to a heat reflective material which is designed to prevent heat loss and associated hypothermia. Mediwrap® blankets do not require electricity and there are no re-usable parts, thus avoiding the risk of nosocomial infections. They can be continued into the postoperative period without incurring additional costs or resources. To date there are no randomised controlled trials evaluating the efficacy of Mediwrap® blankets with FAW system.

We compared the effectiveness of passive heat retention with Mediwrap® blanket and FAW in the maintenance of core body temperature in patients undergoing thoracotomy.

2. Methods

2.1. Study design

A randomised controlled trial was performed in accordance with CONSORT guidelines and a protocol approved by the Local Ethics Committee.

2.2. Patient selection

Thirty patients undergoing major thoracic surgical procedures between November 2005 and September 2006 were recruited after obtaining written informed consent. Inclu-
sion criteria were patients aged >18 years and undergoing elective major thoracic surgical procedures and the exclusion criteria included patients aged <18 years, refusal of consent, emergency procedures, evidence of preoperative infection, and preoperative temperature >37.5 °C.

2.3. Randomisation

Patients were allocated randomly to receive either Mediwrap® blanket or FAW (Warm Touch-Mallinckrodt Medical) by a computer generated randomisation by a research nurse who was not involved in the study.

2.4. Intervention

In the Mediwrap® group (Study group), Mediwrap blankets were applied 30 min prior to transfer to the operating room. This was continued during positioning of patients for epidural (allowing exposure of thoracic spine), induction of anaesthesia, and positioning for surgery. A flap of the blanket was cut open to allow access for surgery. At the end of the procedure this flap was placed back and fastened with tapes to be continued into the postoperative period (Fig. 1).

FAW group (Control group) patients were covered with standard cotton blankets during transfer and FAW was applied after positioning of the patient on the operating table. It covered the lower half of the body from iliac crest with extensions to cover the chest and abdomen outside the area of sterile preparation. The medium temperature setting i.e. 38 °C was used in all patients. FAW blankets were replaced by cotton blankets at the end of the procedure as per unit practice (Fig. 2).

Measures to prevent hypothermia like fluid warmers (set at 38 °C), low flow anaesthesia (fresh gas flow 0.5–1 LPM), heat and moisture exchange filters in the breathing circuits were used in both groups. The operating room temperature was maintained at 22±0.5 °C for all patients.

2.5. Assessments

We measured baseline core (via the tympanic membrane) in the ward and at 30-min intervals up to 6 h after the procedure. They were performed by a research fellow using the same infrared tympanic thermometer (Welch Allyn) in each patient after ensuring no wax or tympanic damage was present. ECG, invasive blood pressure, heart rate, pulse oximetry, end tidal carbon-dioxide, end tidal vapour concentration, inspired oxygen concentration and airway pressures were recorded. Though nasopharyngeal temperature was also monitored, we only used intermittently

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Fig. 1. (a) Mediwrap blanket prior to positioning. (b) Mediwrap blanket in the lateral position. (c) Surgical area exposed by folding the flaps inwards prior to preparation. (d) Cut and folded flaps refastened to provide postoperative heat retention.

Fig. 3. The trends of peri-operative core temperatures °C (Mean±Standard error of the mean).
measured tympanic thermometer recordings for comparison.

2.6. Anaesthesia and analgesia

Analgesia was provided by continuous thoracic epidurals or intra-thecal morphine followed by morphine infusions as per the anaesthetist preference. Single lung ventilation was provided through a double lumen endotracheal tube. Anaesthesia was maintained with isoflurane in oxygen and air mixture.

2.7. Data collection

Demographic details such as age, sex, ASA grade, height and weight were collected. The duration of anaesthesia (the time from the insertion of intravenous cannula in the anaesthetic room to extubation), the duration of surgery (the time from incision to application of dressing), volume of intravenous fluids (including blood and blood products used), estimated blood loss, methods of pain relief and extubation time (time taken to extubate the trachea from the time of application of surgical dressings) were recorded. Incidences of shivering hemodynamic instability and hypothermia (defined as core temperature ≤ 35 °C) were collected. Patients who developed hypothermia were considered as device failure in the study and were commenced on FAW but were included for analysis of results with an intention to treat.

In the thoracic high dependency unit, we continued to record core temperature, blood loss through chest drains, fluid balance and haemodynamic parameters for the first 6 h or until the baseline temperatures were reached or whichever occurred earlier.

2.8. Primary endpoint

The primary outcome of the study was the core body temperature at the end of surgery and 2 h after surgery at the time of discharge from recovery.

2.9. Secondary endpoints

Secondary outcomes were extubation time, incidence of shivering, postoperative blood loss, length of stay in recovery unit, time taken to reach baseline core temperature.

2.10. Sample size and statistical methods

This study was powered to detect a difference in core temperature of 0.5 °C which was considered to be clinically relevant. Sample size was calculated based on our pilot study which revealed a total sample size of 26 patients with 13 patients in each group to detect a difference of 0.5 °C for a power of 0.8 with α-value of <0.05. We recruited 30 patients (16 in Mediwrap® group and 14 in FAW) to allocate for drop-outs. Normally distributed data were compared using two-tailed t-test and non-parametric data were analysed using two-sided Mann–Whitney U-test. Categorical data were analysed with two-sided Fisher’s exact test. We have taken a P-value of <0.05 as significant.

3. Results

We enrolled 30 patients with no statistically significant differences in demographics (Table 1) who underwent similar surgical procedures (Table 2). Six patients were deemed failures in the study in the postoperative period as their core body temperature decreased to <35 °C (FAW: 4; Mediwrap: 2). Another patient from Mediwrap® was withdrawn in the immediate postoperative period as the patient died because of a massive haemorrhage due to a surgical complication. Mode of analgesia, duration of anaesthesia, duration of surgery, time to extubation, estimated blood loss and length of stay in recovery room were comparable between the groups. Volume of fluids infused was significantly higher in Mediwrap® group at 1573 ± 313 ml compared to 1125 ± 386 ml in the control group (mean ± S.D., P = 0.006).

The core temperatures at baseline and at the end of surgery were comparable between the two groups, however, in the postoperative period, there was a trend favouring the Mediwrap® group reaching statistical significance at 2nd postoperative hour (Fig. 3). Mediwrap® group attained their baseline temperature earlier compared to FAW group; (Mean ± S.D.) 66 ± 66 vs. 161 ± 108 min (P = 0.009) (Table 3). None of the patients in either group had shivering or haemodynamic instability. Blood loss was comparable in both the groups postoperatively.

4. Discussion

The efficacy of FAW for maintaining body temperature intraoperatively is established [4–7]. However, a minimum of 30 min pre-warming is required in order to prevent the
decrease in core body temperature following induction of general anaesthesia [8]. FAW prior to induction of anaesthesia reduces the core-peripheral temperature gradient, increases the total body heat content and produces peripheral vasodilatation. All these mechanisms prevent hypothermia due to re-distribution of heat following induction of anaesthesia. Although pre-warming is effective, it is not feasible in all operating departments and it often produces thermal discomfort and sweating in conscious patients. Hence standard practice is to use active warming devices in the intra-operative period and to continue or recommence in the recovery only if the patient is hypothermic.

In our study, Mediwrap® blanket applied 30 min prior to induction of general anaesthesia was as effective as FAW in the intra-operative period. Although Mediwrap® blankets are passive devices, if applied for sufficient length of time prior to induction of anaesthesia, they can be as effective as active warming devices. Application of these blankets in conscious patients can prevent convective and conductive heat losses thereby reducing the core-peripheral temperature gradient in the same way as active pre-warming with FAW albeit to a lesser degree.

It is important to note that the FAW was started after epidural catheter insertion, induction of general anaesthesia (reflecting a routine clinical practice) which was later than the start of the use Mediwrap® blanket. FAW device was used on the medium temperature setting due to perceived risk of burns from higher setting. In the Mediwrap® group we tried to cover maximum surface area possible and we did not encounter any difficulty with surgical access. Moreover, we continued the use of Mediwrap® blanket into postoperative period, in order to maximise the benefits to the patient without incurring additional costs. In our study, the patients in Mediwrap® group maintained their core temperature better than FAW group in the postoperative period.

It is possible, that if the two systems were compared in similar settings, results would have been different. The warming strategy in FAW group represents the usual clinical practice in our institution. In this respect, the current study did not compare the warming effectiveness of two different devices, but two different strategies of maintaining perioperative normothermia.

Several investigators have compared the effectiveness of passive warming devices with active FAW blankets with conflicting results. Ordinary cotton blankets in patients undergoing laparotomy for bowel surgery [12], passive heat retention blankets with reflective properties in hip and knee arthroplasty [13], metallised plastic sheets in patients undergoing hip surgery were compared to FAW and were found to be inferior [5]. However, there are several methodological differences between these studies when compared to our study. The passive devices studied were not similar to Mediwrap® blanket and studies were limited to intra-operative period only. Unlike active devices, passive devices will not supply any external heat and hence their conclusions are not surprising. Mediwrap® blanket evaluated in our study has heat reflective property and is moisture absorbent. We apply them preoperatively in order to increase the total body heat content as with active pre-warming. Thermadrape, a metallised plastic sheet with an inner cotton layer, maintained core body temperature better than plastic wraps in hepatobiliary surgery [14] and was comparable to FAW in patients undergoing general surgical, orthopaedic and gynaecological surgeries [15]. The methodology and results of these studies were similar to our study. Our study has demonstrated comparable intra-operative and better postoperative temperature with Mediwrap® blankets when compared to FAW devices.

The other area of concern about using active FAW devices is the infection risk. Although the blanket is disposable, the electrically powered heater-blower is not, thereby adding to the risk of infection. Pathogenic organisms in the air stream samples [10], growth of bacteria in swabs obtained from the warming unit and from the distal end of the hose [12] have confirmed these fears. The Mediwrap® blanket has no non-disposable parts, thus completely eliminating all potential sources of bacterial contamination.

Our study has demonstrated that a passive warming device such as Mediwrap®, if used appropriately, is as effective as FAW in maintaining normothermia during intraoperative period. By virtue of its ability to prevent heat loss and conserve internal heat, Mediwrap® results in overall better maintenance of core body temperature as compared to FAW in the perioperative period of thoracic surgical procedures.

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References


