Are active warming measures required during paediatric cleft surgeries?

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ABSTRACT

Background: During paediatric cleft surgeries intraoperative heat loss is minimal and hence undertaking all possible precautions available to prevent hypothermia and use of active warming measures may result in development of hyperthermia. This study aims to determine whether there will be hyperthermia on active warming and hypothermia if no active warming measures are undertaken. The rate of intraoperative temperature changes with and without active warming was also noted. Methods: This study was conducted on 120 paediatric patients undergoing cleft lip and palate surgeries. In Group A, forced air warming at 38°C was started after induction. In Group B, no active warming was done. Body temperature was recorded every 30 min starting after induction until 180 min or end of surgery. Intragroup comparison of variables was done using Paired sample test and intergroup comparison using independent sample t-test. Results: In Group A, all intraoperative temperature readings were significantly higher than baseline. In Group B, there was a significant reduction in temperature at 30 and 60 min. Temperature at 90 min did not show any significant difference, but further readings were significantly higher. Maximum rise in temperature occurred in Group A between 120 and 150 min and maximum fall in temperature in Group B was seen during first 30 min. Conclusion: In pediatric cleft surgeries, we recommend active warming during the first 30 minutes if the surgery is expected to last for <2h, and no such measures are required if the expected duration is >2h.

Key words: Active warming, hyperthermia, hypothermia, paediatric cleft surgeries

INTRODUCTION

We as Anaesthesiologists are always worried about hypothermia in paediatric patients. We believe that during anaesthesia, there can be marked fall in body temperature, which can be dangerous if not prevented or treated properly. Since intraoperative heat loss will be minimal during paediatric cleft surgeries, using active warming measures in the absence of temperature monitoring might actually result in development of hyperthermia rather than prevention of hypothermia in these patients.

The aims of our study were to determine if there was the development of hypothermia during cleft lip and palate surgeries if no active warming measures were undertaken and to find out whether there was an increase in body temperature with active warming. We also wanted to determine the rate of intraoperative body temperature changes with and without active warming measures in these patients.

METHODS

A randomised observational study was conducted during the period January 2008 to June 2012, on 120 patients coming for cleft lip and palate surgeries in the age group 1 month to 3 years, belonging to American Society of Anesthesiologist grade (ASA) I and II, after taking consent from parents.
10 cases from each group as a pilot study, from the existing data sample, we got the standard deviation of 0.75, and with an expected change in temperature difference of 0.50°C, \( \alpha = 5\% \) and power \((1-\beta) = 90\%\) applied in to the equation \( n = \frac{2[(Z_\alpha + Z_\beta)\sigma/\delta]^2}{\sigma} \), we got a sample size of 47 for each group.

Randomisation was done by a closed envelope technique allotting patients to either of the two Groups A or B, with 60 patients in each group. Patients older than 3 years, belonging to ASA III or above, febrile and children whose parents were not willing were excluded from the study.

A detailed pre-anaesthesia check-up was done and patients were kept fasting for 4 h for milk and 2 h for clear fluids. All patients underwent a standardised anaesthetic protocol. Intravenous (IV) cannula was secured once the patient was induced with 8% sevoflurane using Jackson-Ree’s circuit. Meanwhile pulse oxymeter, non-invasive blood pressure, electrocardiogram and EtCO\(_2\) were connected and a paediatric temperature probe was placed in the axillary region with the arm adducted so that the tip of the probe was in close contact with the body. The probe was fixed to the anterior aspect of shoulder using plasters. Temperature probe was part of multichannel monitor.

After induction, glycopyrrolate 0.004 mg/kg body weight and fentanyl 3 mcg/kg body weight were given IV followed by suxamethonium 2 mg/kg body weight. Intubation was performed using a straight laryngoscope blade with an appropriate sized oral RAE tube, which was fixed to the lower lip. Maintenance of anaesthesia was with \( O_2 + N_2O + iso\)flurane (40:60:1%) and mechanical ventilation to maintain EtCO\(_2\) between 30 and 35 mm of Hg. Closed circuit with a total fresh gas flow of 2 L/min was used. Intraoperatively muscle relaxation was provided with vecuronium 0.1 mg/kg body weight IV after intubation, followed by 0.02 mg/kg body weight every 30 min. Ringer lactate solution was administered intraoperatively to maintain fluid balance according to Holiday-Segar formula. Fentanyl 0.5 mcg/kg body weight was repeated after 60-90 min if heart rate was more than 140/min or systolic blood pressure was 30% more than the baseline value.

In Group A, forced air warming was started soon after induction of anaesthesia using a Bair Hugger set at 38°C, with the warming blanket above the body, whereas in Group B no active warming measures were adopted. Temperature of 38°C was chosen as warming blanket was covering only the anterior aspect of the body and that too below upper half of the chest. The IV fluid administered was not warmed. Operating room temperature was kept at 18-19°C and not increased by switching off the air conditioner. Body temperature readings were made half hourly, starting immediately after induction, which was taken as the baseline value, until 180 min or end of the surgery whichever was earlier. Ambient temperatures of the operating room at the beginning and end of surgery were also documented.

If there was a fall in body temperature by more than 2°C, forced air warming was initiated in Group B. If the body temperature rose to more than 36.5°C in Group A, the forced air warming system was discontinued. If temperature further increased to more than 38°C, active cooling measures like placing ice packs over groin and wetting drapes with tepid water were undertaken. In unresponsive cases the body was exposed, tepid sponging was done and paracetamol suppository 20 mg/kg body weight was administered per rectally.

Intragroup comparison of variables was performed using paired sample test and intergroup comparison using independent sample t-test, the level of significance being \( P < 0.05 \).

**RESULTS**

The two groups were comparable in terms of distribution of age, sex, weight, ASA grading, duration of surgery and ambient operating room temperatures (at the beginning and end of surgery) [Table 1].

In Group A, when the mean baseline temperature was compared with subsequent readings at 30, 60, 90, 120, 150 and 180 min it was found that all the readings were significantly higher \((P < 0.05)\). In Group B, there was a statistically significant reduction in temperature at 30 \((34.45 \pm 0.61°C)\) and 60 min \((35.05 \pm 0.35°C)\) from the baseline temperature. However, the temperature at 90 min didn’t show any significant difference from baseline value \((P = 0.146)\). Further readings at 120, 150 and 180 min were significantly higher when compared with baseline value [Table 2].
When the values were compared between groups, it was found that only the baseline values were comparable ($P=0.053$). All other readings in Group A were significantly higher than corresponding values in Group B ($P=0.00$) [Table 3].

The rate of change in body temperature in 30 min was calculated as the difference in temperature at one point of time from the previous reading made 30 min back. The highest rate of the rise in temperature (0.86±0.77°C in 30 min) was seen in Group A between 120 and 150 min and maximum fall (−0.77±0.85°C in 30 min) in Group B was between post induction and at 30 min [Table 4].

### DISCUSSION

Paediatric patients are prone for perioperative hypothermia\(^2\) due to their thin insulating fat, large body surface area in relation to body weight and also because their thermoregulatory function is not well developed as in adults.\(^3,4\)

The main factors, which decrease the core temperature in neonates and infants are the type of surgery, cold IV fluids and the operation room temperature.\(^2\) Thermoregulatory responses are impaired by general anaesthesia (GA)\(^5\) and core temperature usually decreases by 0.5-1.5°C in the first 30 min following induction of GA.\(^6\)

Mild hypothermia (about 2°C below normal) by decreasing metabolism prolongs drug action, triggers post-anaesthetic shivering, prolongs post-anaesthetic recovery, increases perioperative blood loss and prolongs hospital stay.\(^7\) Hence, it is important to maintain body temperature within the normal range.

For intraoperative temperature monitoring, the temperature probes are kept commonly in nasopharynx or axilla. In general, the skin surface temperatures are relatively lower than core temperature. Even then, it reflects core temperature reasonably well. Temperature measured at axilla is usually 0.5-1°C below oral temperature, hence normal axillary temperature ranges between 36.4°C and 36.7°C.\(^8\)

Unlike pulseoxymeters or capnographs, temperature monitors are still not routinely available during the conduct of anaesthesia except in major centres. However as a routine whenever a paediatric patient is being operated, all possible measures to warm the baby are undertaken. It is common practice to increase the operating room temperature to the neutral temperature...
of the patient, the ambient temperature at which there is minimum oxygen consumption. Usually, all the IV fluids are warmed and warming blankets and mattresses are used when a paediatric patient is being operated.

During cleft surgeries heat loss is minimal as compared with surgeries involving major body cavities. The whole body except the lower face is well-covered under thick drapes during cleft corrections. During palatoplasty, only the oral cavity is exposed in addition. The thick drapes reduce heat loss. As the exposed parts are kept warm by the operating lights, the heat loss from these areas is also less. So if more heat is supplied to the baby there is a possibility of development of hyperthermia.

Hyperthermia cannot be considered a lesser evil compared with hypothermia. The systemic effects of hyperthermia include disorientation, seizures and coma in central nervous system, whereas cardiovascular effects are tachycardia, hypotension and high output failure. Acute tubular necrosis, low urine output and renal failure are the renal effects and haematologically, thrombocytopenia and disseminated intravascular coagulation can occur. It can be fatal if not effectively treated in time.

In the present study, Group A showed a steady increase in temperature from the baseline value up to 150 min, reflecting heat gain due to the supplied heat and inability to loose heat due to thick drapes. The drop in temperature at 180 min reflects discontinuation of forced air warming and/or because of active cooling measures undertaken [Figure 1]. Group B showed a drop in temperature from baseline value at 30 min reflecting impaired thermoregulatory response following induction of GA. As there was no continued heat loss, probably because the whole body was well-covered, by 90 min the baseline level was regained. The same reason could have caused the temperature to rise above baseline value until the end of surgery [Figure 1].

Hence in children undergoing cleft surgeries, which are expected to last more than 2 h there is no need for active warming as the body temperature normalises by 2 h and in case of cleft surgeries, which are expected to last less than 2 h use of warming blankets, warm IV fluids, keeping the child covered and keeping air conditioning off until the child is properly covered and drapped can be tried during the first 30 min while monitoring the temperature. Once that period is over, it is better to discontinue the active warming techniques, but continue vigilant temperature monitoring for detection of hyperthermia.

CONCLUSION

In pediatric cleft lip and palate surgeries, we recommend active warming during the first 30 minutes if the surgery is expected to last for <2h, and no such measures are required if the expected duration is >2h.

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**Figure 1:** Mean temperatures in both groups at various time intervals