

Frequency of Hypothermia during General Anaesthesia

MUHAMMAD ARSHAD, WAQAR AHMED QURESHI, AHMAD ALI, SYED ZEESHAN HAIDER

ABSTRACT

Introduction: All patients who undergo general anaesthesia (GA) of more than fifteen-minutes must have body temperature monitoring. Changes in body temperature during general anaesthesia depends upon many factors like the kind of anaesthetic technique used, operating room temperature, type of surgery, temperature of intravenous fluids and the duration of anaesthesia/ surgery.

Objective: To determine the frequency of hypothermia during general anaesthesia.

Material and methods: Three hundred patients were included in this study. Study variables were core body temperature, duration of anaesthesia and basic demographic factors like age and gender. Core body temperature was monitored with nasopharynx by thermistor probe attached to "Bedside Monitor" (Nihon Kohden) model BSM – 2301K after every fifteen minutes. Ambient temperature was measured by Mercury in glass thermometer mounted on the wall of operating rooms.

Results: Regarding age distribution, majority of the patients 98(32.6%) were between 31-40 years old. Minimum patients 9(3.3%) were less than 20 years old with mean age of 38.2±11.1 years. Distribution of gender shows 29 males (9.7%) while 271(90.3%) were females. Hypothermia was developed in 75 patients (25.0%).

Key words: Hypothermia, Perioperative period, General anaesthesia

INTRODUCTION

In developed countries, body temperature monitoring is mandatory during anaesthesia, whereas in developing countries like Pakistan it is not done routinely for various reasons. It is perhaps because of lack of temperature monitoring facilities or due to lack of interest on the part of anaesthetists to do body temperature monitoring. This attitude of complacency is contrary to the available literature. All patients who undergo general anaesthesia (GA) of more than fifteen-minute duration must have body temperature monitoring.¹ Changes in body temperature during general anaesthesia depend upon many factors like the kind of anaesthetic technique used, operating room temperature, type of surgery, temperature of intravenous fluids and the duration of anaesthesia/ surgery¹.

The normothermic status of the patients during anaesthesia is disturbed². Hypothermia rather than hyperthermia is a more commonly occurring finding during GA³. Perioperative hypothermia is associated with a large number of serious complications.⁴ such as malignant dysrhythmias, increased incidence of myocardial infarction, decreased tissue oxygenation, platelet and coagulation dysfunction with increased surgical bleeding and poor wound healing, decreased drug metabolism, prolonged recovery, and post

operative shivering¹. Patients often remember postoperative thermal discomfort as the worst aspect of their perioperative experience⁵. Keeping in view these effects of hypothermia it is easily understandable that lack of temperature monitoring and its management in the perioperative period obviously puts the patients at risk. The changes in thermoregulation are detrimental to the patient's normal physiological functions.⁶ and prevention of hypothermia reduces anaesthesia related morbidity⁷.

Hypothermia (core temperature <36°C) often occurs during general anaesthesia because of impaired thermoregulation, redistribution of heat from the core to the periphery, infusion of IV fluids at room temperature, decreased metabolic heat production, and heat loss to a cold operating room environment.¹⁻³. In patients undergoing surgeries requiring postoperative hospitalization, intraoperative hypothermia has been shown to increase blood loss and transfusion requirements, wound infections, adverse cardiac outcomes, and the duration of hospitalization^{4,5,6}. Other complications of hypothermia include, prolonged recovery room stay, enhanced anesthetic drug effect, shivering, and impaired immune function^{7,8}. In an effort to avoid hypothermia, it has become routine anesthetic practice to actively warm the patients undergoing major surgeries with convective warming (forced-air). Convective warming is routinely combined with IV fluid warming if the surgery is accompanied by major fluid shifts.

Department of Anaesthesia Sir Ganga Ram Hospital, Lahore

Correspondence to Dr. Muhammad Arshad, Senior Medical Officer, Department of Anaesthesiology, Sir Ganga Ram Hospital, Lahore.

Intraoperative hypothermia during ambulatory surgery can be minimized by pre-warming the patient in the holding area prior to induction of anaesthesia and by infusing warm IV fluids.^{9,10} The effectiveness of pre-warming is due to the reduction or elimination of the normal core to peripheral temperature gradients that exist in the awake state, which in turn minimizes heat loss from the core to the periphery.¹¹ The effectiveness of warming IV fluids is due to the high specific heat of water. The negative thermal balance of infusing 1-1.5 liter of 21°C crystalloid into a normothermic patient is -16 to -24 kcal and is sufficient to decrease body temperature in a 70 kg patient by about 0.25- 0.38°C¹².

The effects of hypothermia are proportional to the change in temperature. Metabolic rate is reduced by up to 10% for every 1°C fall in body temperature. There is a reduction in cardiac output and an increase in haemoglobin oxygen affinity. This leads to a decrease in tissue oxygen delivery. Significant hypothermia is associated with metabolic acidosis, oliguria, altered platelet and clotting function and reduced hepatic blood flow with slower drug metabolism. The MAC of inhalational agents is reduced and muscle relaxants have a prolonged effect. Postoperative shivering increases oxygen consumption and myocardial work. There may also be an increased incidence of wound breakdown and infection¹³.

MATERIAL AND METHODS

Three hundred patients were included in this study from the department of Anaesthesiology, Sir Ganga Ram Hospital, Lahore during six months. Patients between 15–60 years of age who had GA of more than one hour duration both male and female were included. Patients having preoperative hypo or hyperthermia and patients on antipyretic drugs were excluded. Informed consent from patients was taken regarding general anaesthesia, surgical procedure and temperature monitoring in the perioperative period. Study variables were core body temperature, duration of anaesthesia and basic demographic factors like age and gender. Core body temperature was monitored from nasopharynx by thermistor probe attached to “Bedside Monitor” (Nihon Kohden) model BSM – 2301K after every fifteen minutes. Duration of anaesthesia was measured by personal wrist watch. Ambient temperature was measured by Mercury in glass thermometer mounted on the wall of operating rooms. On arrival of patient on the operating table all mandatory monitoring including non invasive blood pressure, electrocardiogram, pulse oximeter and end tidal carbon dioxide was applied. Intravenous fluids were given at room temperature. Body irrigation fluids

were given at 37°C. Third space fluid loss was replaced at room temperature. Data were collected personally. Data were collected through a comprehensive proforma. For ethical reasons, core body temperature was not allowed to fall below 34°C. If core body temperature fell below 34°C, necessary measures were taken to correct hypothermia.

RESULTS

Regarding age distribution, majority of the patients 98 (32.6%) was between 31-40 years old. Minimum patients 9 (3.3%) were less than 20 years old with mean age of 38.2±11.1 years. Distribution of gender shows 29 males (9.7%) while 271(90.3%) were females. Hypothermia was developed in 75 patients (25.0%).

Table-1: Age distribution

Age (Year)	Number	Percentage
< 20	09	03.3
20-30	76	25.3
31-40	98	32.6
41-50	80	26.6
51-60	37	12.2
Total	300	100.0
Mean ± SD	38.2±11.1	

Table-2: Gender distribution

Gender	Number	Percentage
Male	29	09.7
Female	271	90.3
Total	300	100.0

Table-3: Hypothermia

Hypothermia	Number	Percentage
Yes	75	25.0
No	225	75.0
Total	300	100.0

DISCUSSION

Systematic review shows that for non-invasive temperature monitoring the oral route is the most reliable; infrared ear temperature measurement is inaccurate. Intraoperatively, acceptable semi-invasive temperature monitoring sites are the nasopharynx, oesophagus and urinary bladder.

Skin surface warming for 20 min immediately before anaesthesia (pre-warming) minimizes initial redistribution hypothermia. Intraoperatively, active warming should be applied when anaesthesia time is > 60 min. Effective methods of active warming are forced-air warming or conductive warming, provided that enough skin surface is available. Infusion fluid warming, increasing the operating room temperature,

and warming of irrigation fluids are adjunctive therapies. The patient's body temperature should be above 36°C before induction of anaesthesia, and should be measured continuously throughout surgery. Active warming should be applied intraoperatively. Postoperative patient temperature and outcomes should be evaluated¹⁴.

Perioperative hypothermia is a common and serious complication of anaesthesia and surgery and is associated with many adverse perioperative outcomes. It prolongs the duration of action of inhaled and intravenous anaesthetics as well as the duration of action of neuromuscular drugs. Mild core hypothermia increases thermal discomfort, and is associated with delayed post anaesthetic recovery. Mild hypothermia significantly increases perioperative blood loss and augments allogeneic transfusion requirement. Only 1.9 degrees C core hypothermia triples the incidence of surgical wound infection following colon resection and increases the duration of hospitalization by 20%. Hypothermia adversely affects antibody and cell-mediated immune defences, as well as the oxygen availability in the peripheral wound tissues. Furthermore mild hypothermia triples the incidence of postoperative adverse myocardial events. Thus, even mild hypothermia contributes significantly to patient care costs and needs to be avoided¹⁵.

Perioperative hypothermia occurs in many patients because warming techniques are insufficient to counteract thermal redistribution resulting from the ablation of thermoregulatory vasoconstriction associated with anaesthesia¹⁶.

Thirty-one patients were prewarmed and 37 patients were in the control group. There was a 0.3 degrees C smaller decrease in mean core temperature in the prewarmed group at 40, 60, and 80 min post-induction ($P < 0.05$). Temperature was maintained above the hypothermic threshold of 36 degrees C in 21 (68%) patients in the prewarmed group, compared with 16 (43%) patients in the control group ($P < 0.05$). Preoperative warming using the Bair Paws system results in smaller decreases in core temperature intraoperatively and less IPH in patients undergoing spinal surgery under general anaesthesia¹⁶.

In present study, hypothermia was observed in 25% of patients. Zhao et al demonstrated the core temperature at the end of the surgery in the warming group was significantly different from that in the control group (36.4 +/- 0.4 degrees C vs. 35.3 +/- 0.5 degrees C, $P < 0.001$). Application of intraoperative warming significantly shortened the time between the end of the surgery and extubation ($P < 0.01$). Postoperative shivering occurred in 30% of the patients in the control group compared to no patient

in the warming group ($P < 0.01$). Active warming with air-forced blanket and fluid warming system provides sufficient heat to prevent hypothermia during abdominal surgery¹⁷.

Perioperative hypothermia triples the incidence of adverse myocardial outcomes in high-risk patients. Mild hypothermia significantly increases blood loss and augments allogeneic transfusion requirement, but the molecular pathophysiology of this effect remains to be elucidated. Only 1.9 degrees C core hypothermia triples the incidence of surgical wound infection following colon resection and increases the duration of hospitalization by 20%. Hypothermia adversely affects antibody and cell-mediated immune defences, as well as the oxygen availability in the peripheral wound tissues. Mild perioperative hypothermia changes the kinetics and action of various anaesthetic and paralysing agents, increases thermal discomfort, and is associated with delayed post-anaesthetic recovery. Finally, mild core hypothermia influences pulse oximetry monitoring and various electrophysiological indices of the nervous system, with questionable clinical significance, as yet¹⁸.

Both regional and general anaesthesia markedly impair the normal precise regulation of core body temperature. Consequently, inadvertent perioperative hypothermia is common. Hypothermia develops because the typical operating room environment is cold; however it is anesthetic-induced impairment of thermoregulatory responses that contributes most. Internal redistribution of body heat is a surprisingly important factor, contributing more to core hypothermia than net heat loss in most patients. There is now convincing evidence that a typical degree of intraoperative hypothermia, say 2 degrees C, predisposes to numerous complications such as shivering, prolonged duration of action of several drugs, myocardial ischemia, coagulopathy and increased incidence of surgical wound infections, which alter patient outcome. Fortunately, effective methods such as convective warming are available for preventing hypothermia¹⁹.

CONCLUSION

Alteration in body temperature is common during anaesthesia. Anaesthetics create a state of poikilothermia in which body temperature tends to equilibrate with ambient temperature. Clinically relevant hypothermia starts at 36 degrees C with regard to major adverse outcomes (increased infectious complications, morbid cardiac events, coagulation disorders, prolonged length of hospital stay, and increased costs). Body temperature should be managed in a similar fashion as the other vital

signs, and efforts should be made to maintain normothermia for the better management and safety of the patients.

REFERENCES

1. Holdcroft A, Hall GM, Cooper GM. Redistribution of body heat during anaesthesia. A comparison of halothane, fentanyl and epidural anaesthesia. *Anaesthesia* 1979; 34:758-64.
2. Sessler DI. Mild perioperative hypothermia. *N Engl J Med* 1997; 336:1730-7.
3. Morrison RC. Hypothermia in the elderly. *Int Anesthesiol Clinics*. 1988; 26:124-33.
4. Schmied H, Kurz A, Sessler DI, Kozek S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty. *Lancet* 1996; 347:289-92.
5. Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. *N Engl J Med* 1996; 334:1209-15.
6. Frank SM, Fleisher LA, Breslow MJ. Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events: a randomized clinical trial. *JAMA* 1997; 227:1127-34.
7. Lenhardt R, Marker E, Goll V, Tschernich H. Mild intraoperative hypothermia prolongs postoperative recovery. *Anesthesiology* 1997; 87:1318-23.
8. Sessler DI. Consequences and treatment of perioperative hypothermia. *Anesthesiol Clinics North America*. 1994;12:425-56.
9. Smith CE, Gerdes E, Sweda S, Myles C, Punjabi A, Pinchak AC et al. Warming intravenous fluids reduces perioperative hypothermia in women undergoing ambulatory gynecological surgery. *Anesth Analg* 1998; 87:37-41.
10. Just B, Trevien V, Delva E, Lienhart A. Prevention of intraoperative hypothermia by preoperative skin-surface warming. *Anesthesiology* 1993; 79:214-8.
11. Sessler DI, Schroeder M, Merrifield B, Matsukawa T, Cheng C. Optimal duration and temperature of prewarming. *Anesthesiology* 1995; 82:674-81.
12. Gentilello LM, Cortes V, Moujaes S, Viamonte M, Malinin TL, Ho CH et al. Continuous arteriovenous rewarming: experimental results and thermodynamic model simulation of treatment for hypothermia. *J Trauma*.1990; 30:1436-49.
13. Barash PG, editor. *ASA Refresher Courses in Anesthesiology*. 1993.
14. Torossian A. Thermal management during anaesthesia and thermoregulation standards for the prevention of inadvertent perioperative hypothermia. *Best Pract Res Clin Anaesthesiol* 2008; 22:659-68.
15. Reynolds L, Beckmann J, Kurz A. Perioperative complications of hypothermia. *Best Pract Res Clin Anaesthesiol* 2008;22:645-57.
16. Andrzejowski J, Hoyle J, Eapen G, Turnbull D. Effect of prewarming on post-induction core temperature and the incidence of inadvertent perioperative hypothermia in patients undergoing general anaesthesia. *Br J Anaesth* 2008;101:627-31.
17. Zhao J, Luo AL, Xu L, Huang YG. Forced-air warming and fluid warming minimize core hypothermia during abdominal surgery. *Chin Med Sci J* 2005;20:261-4.
18. Doufas AG. Consequences of inadvertent perioperative hypothermia. *Best Pract Res Clin Anaesthesiol* 2003;17:535-49.
19. Kurz A. Intraoperative hypothermia: pathophysiology and clinical sequelae. *Wien Klin Wochenschr* 1997; 109:261.