Perioperative thermoregulation in ambulatory anaesthesia and surgery

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Abstract

Thermoregulation is essential during ambulatory surgery because hypothermia increases the incidence of complications and delays recovery. The role of preoperative factors in the development of hypothermia has not been studied in ambulatory surgery. This retrospective study evaluated the impact of preoperative temperature on perioperative hypothermia and the effect of hypothermia on haemodynamics, oxygenation and recovery. The results showed a 32% rate of preoperative hypothermia, with no effect on the development of perioperative hypothermia. Obesity and warm air blanket were associated with less hypothermia. The effects of mild hypothermia were modest in ambulatory surgical patients because they are relatively healthy.

Keywords: Ambulatory surgery, Complications, Hypothermia, Temperature.

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Introduction

Perioperative thermoregulation is an important aspect of the anaesthetic management of ambulatory surgery patients. Perioperative hypothermia increases the incidence of cardiac morbidity, sympathetic over-activity, wound infection, increased surgical bleeding, prolonged hospitalization, intensive care unit admission, impaired immunity, abnormal drug metabolism, impaired wound healing, thermal discomfort and shivering [1, 2, 3]. Hypothermia may delay recovery from anaesthesia, with prolonged stay in the postanaesthesia care unit or the ambulatory surgery unit [4]. It may also delay the discharge of ambulatory surgery patients with cost implications on hospital beds, surgical operating schedule and other resources. Risk factors that may contribute to perioperative hypothermia include old age, general anaesthesia, central neuraxial anaesthesia, endocrine or metabolic disease, American Society of Anesthesiologists (ASA) physical class 3 or above, prolonged duration of surgery, open thoracic surgery, open abdominal surgery, burns, cold infusions or transfusions, massive haemorrhage and low operating room temperature [1, 4, 5].

The role of preoperative factors, such as the patient's initial temperature or preoperative hypothermia, in the development of perioperative hypothermia has not been fully elucidated in ambulatory surgical patients. The aim of this study was to evaluate the prevalence of preoperative hypothermia in patients presenting for ambulatory anaesthesia and surgery, predisposing factors for preoperative hypothermia and the role of preoperative temperature in the development of perioperative hypothermia. A secondary aim was to examine the effect of perioperative hypothermia on oxygenation, haemodynamics, postoperative discharge, and early postoperative complications.

Methods

This was a retrospective review of the perioperative record of patients who underwent outpatient or ambulatory surgery and anaesthesia at the main adult hospital of the University of Michigan Health System. We analyzed perioperative data from our electronic patient records, including the Centricity anaesthesia information system (Centricity, GE Technologies, Waukesha, WI). The data covered a period of two years, from July 2003 to July 2005. The patients underwent minor to moderate ambulatory surgery under general or regional anaesthesia. None of the patients underwent open abdominal surgery, open thoracotomy or major surgery. Preoperative and postoperative core temperature values were recorded from the tympanic membrane. Intraoperative core temperature values were recorded via oesophageal, nasopharyngeal or bladder catheter thermistors. Hypothermia was generally defined as core temperature ≤ 360C and mild hypothermia was specifically defined as core temperature of 34-360C [6].

The data collected included patient demographics, body mass index (BMI), ASA physical status class, type of surgery and surgical specialty. The preoperative physiological variables analyzed included temperature, respiratory rate, heart rate, non-invasive blood pressure and oxygen saturation. The intraoperative data collected included oxygen saturation, maximum temperature, duration of surgery, use of warm air blanket and the use of intravenous fluid warmer. Postoperative physiological variables analyzed included temperature, respiratory rate, heart rate, non-invasive blood pressure, and oxygen saturation. Postoperative complications recorded in the post-anesthesia care unit were also analyzed. These included shivering, nausea, vomiting, uncontrolled pain, urinary retention and prolonged stay. Data analysis was performed using the SPSS program version 13 (SPSS Inc, Chicago, IL). Bivariate analysis was performed using the Student's t-test and the Levene's test. Differences between groups were compared using the Pearson's Chi-square test and the Fisher's Exact test. A P value <0.05 was considered statistically significant.

Results

A total of sixteen thousand and seventy-two ambulatory surgical patient perioperative records were obtained from our anaesthesia information system for the two year period. After excluding 4,972 case records because of incomplete data, the remaining 11,100 cases were examined and analyzed. The age range of patients was 13 to 92 years; comprising adolescents (4%), adults (76%) and elderly (20%).

The patients were ASA physical status class I to III and underwent minor or moderate ambulatory surgery.

Thirty-two percent of the ambulatory surgical patients presented to the operating department with mild hypothermia, but there was no significant correlation with body mass index or age. Preoperative hypothermia did not have a significant effect on preoperative haemodynamics or oxygen saturation (Table 1). In addition, preoperative temperature did not have a significant effect on intraoperative and postoperative temperature (Table 2). Intraoperative temperature was not significantly affected by the ASA physical status class, type of ambulatory surgery or duration of surgery. The duration of surgery ranged from 20 to 290 minutes. The intraoperative use of a warm air blanket was associated with a significantly lower prevalence of intraoperative and postoperative hypothermia (Table 2).

Table 1 Preoperative hypothermia and patient variables.

	Temp≤36	Temp>36	% of total	p-value
BMI ≤ 30	n=2721	n=5603	75%	0.92
BMI > 30	n=918	n=1858	25%	
SpO2≥94%	n=2344	n=4982	66%	0.93
SpO2<94%	n=1256	n=251	8 34%	
SBP≤150	n=2620	n=3929	59%	0.96
SBP>150	n=1774	n=2777	41%	

Temp=Temperature BMI=Body Mass Index SpO2=Oxygen saturation
SBP=Systolic Blood Pressure in mmHg

Table 2 Factors affecting intraoperative hypothermia.

	Temp≤36	Temp>36	p-value
Warm air blanket	38%	62%	0.007
No warming	59%	41%	
Preop temp≤36	33%	67%	0.929
Preop temp>36	32%	68%	

Preop=Preoperative Temp=Temperature

With regard to the postoperative phase, obese patients (BMI > 30) showed a lower prevalence of postoperative hypothermia (Table 3). Postoperative hypothermia had no significant effect on oxygen saturation or haemodynamics (Table 3). The data on postoperative complications in the post-anaesthesia care unit was unreliable and thus was excluded from the final analysis.

Table 3 Postoperative hypothermia and patient variables.

	Temp≤36	Temp>36	% of total	p-value
BMI ≤ 30	n=5160	n=3164	75%	0.001
BMI > 30	n=1148	n=1626	25%	
SpO2≥94%	n=1578	n=7191	79%	0.2
SpO2<94%	n=372	n=1969	21%	
SBP≤150	n=4033	n=1073	46%	0.09
SBP>150	n=4855	n=1139 5	4%	

Temp=Temperature BMI=Body Mass Index SpO2=Oxygen saturation
SBP=Systolic Blood Pressure in mmHg

Discussion

The perioperative implications of hypothermia are far-reaching. It is detrimental to ambulatory surgery patients, causes peri-anaesthesia problems, and delays patient discharge from the post-anaesthesia care unit or ambulatory surgery unit. There are many risk factors for developing perioperative hypothermia, including preoperative patient factors. Our study showed a thirty-two percent prevalence rate of preoperative mild hypothermia in patients presenting for ambulatory anaesthesia and surgery. This prevalence rate seems high and may be due to inadequate warm clothing or exposure to cold during the journey to the hospital. It may also be related to preoperative fasting, the lack of thermogenesis or specific dynamic activity of feeding and reduced energy metabolism. Endocrine diseases such as hypothyroidism may also play a limited role in the development of preoperative mild hypothermia. The data limitations of our retrospective study did not allow the analysis of the possible influence of these factors. Contrary to previous beliefs or reports [1, 5], our study showed no correlation between preoperative hypothermia and body mass index or age. However, low body mass index or old age may predispose to preoperative hypothermia in patients with other negative factors such as trauma, burns, fluid loss or hypovolaemia.

Preoperative hypothermia did not have a significant influence on the development of intraoperative or postoperative hypothermia in our patients, mainly because the hypothermia was mild. Severe preoperative hypothermia in emergency patients or hospital inpatients undergoing major surgery has been shown to be a major risk factor or causative factor for the development of perioperative hypothermia [2, 5]. The nonseverity of the preoperative hypothermia in our patients may also be the reason for the 7 lack of significant effect on preoperative respiratory rate, haemodynamics and oxygen saturation. However, mild hypothermia is known to cause thermal discomfort which is physiologically stressful and leads to adrenergic activation, hypertension and tachycardia [7]. It is important to prevent preoperative hypothermia in ambulatory surgical patients by encouraging warm clothing and preoperative cutaneous warming.

Intraoperative temperature was not significantly affected by the ASA physical status class because the patients were relatively healthy ambulatory surgical patients of mainly ASA I and II class. Similarly, intraoperative temperature was not significantly affected by type or duration of surgery because the ambulatory surgical procedures were not major surgery. The practice of using intraoperative warm air blanket for relatively long cases may be responsible for the lack of association between intraoperative temperature and duration of surgery. Intraoperative warm air blanket significantly reduced the prevalence of perioperative hypothermia in our patients, as previously reported by other authors [8].

The relationship between obesity and perioperative hypothermia is controversial. Our study showed a lower prevalence of postoperative hypothermia in obese ambulatory surgical patients. Obese patients usually experience less perioperative heat loss because of their protective layer of fat. However, they have less muscle mass and higher surfaceto- mass ratios which may also predispose them to significant heat loss after prolonged exposure to a cold environment [4]. This implies that it is important to prevent heat loss and ensure adequate active warming in obese patients who are undergoing relatively prolonged ambulatory surgery.

Hypothermia is a major cause of postoperative morbidity. It markedly increases adrenergic activity, impairs thermal comfort and causes shivering with increased oxygen consumption [1, 3, 4, 9]. However, our study revealed that mild postoperative hypothermia does not have significant effects on oxygen saturation, haemodynamics and respiratory rate in ambulatory surgical patients. This supports the

finding of a previous study which reported that the effects of mild hypothermia on postoperative oxygen saturation, blood pressure, respiratory rate and heart rate are modest in relatively healthy patients [9]. Ambulatory surgical patients are usually relatively healthy and thus can compensate for hypothermia-induced haemodynamic or respiratory derangements. The initial autonomic thermoregulatory response to hypothermia is peripheral vasoconstriction with resultant hypertension and this is usually followed by shivering [9, 10]. Postoperative shivering occurs in half of hypothermic patients [4, 9]. It involves increased tone and involuntary contractions of skeletal muscles, with consequent increased thermogenesis and oxygen consumption. Thus, it is imperative to administer supplemental oxygen to hypothermic ambulatory surgical patients, in order to prevent hypoxia and oxygen debt.

This retrospective study had limitations of data which prevented valid analysis of the effect of hypothermia on postoperative complications and discharge. Every effort was made to limit the impact of data inadequacy and errors. In conclusion, our study revealed a relatively high prevalence of mild preoperative hypothermia in ambulatory surgical patients, with no significant effect on intraoperative or postoperative temperature. The effects of mild hypothermia are modest in ambulatory surgical patients because they are relatively healthy. The logical approach to perioperative hypothermia is prevention.

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