

Efficacy of Prewarming With a Self-Warming Blanket for the Prevention of Unintended Perioperative Hypothermia in Patients Undergoing Hip or Knee Arthroplasty

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Purpose: Unintended perioperative hypothermia (UPH) is a common and serious complication for patients undergoing anesthesia. The purpose of this study was to identify the incidence of UPH and evaluate the efficacy of a self-warming blanket on the drop in core temperature and risk of UPH in patients undergoing hip or knee arthroplasty.

Design: A case-control study was used.

Methods: Sixty patients were included. Thirty patients received prewarming with a self-warming blanket and forced-air warming intraoperatively; thirty patients received only forced-air warming intraoperatively.

Finding: The incidence of UPH ($< 36^{\circ}\text{C}$) was identified in 13% of the patients in the prewarmed group and 43% of the patients in the control group. Mean core temperature in the prewarmed group was significantly higher and remained above 36°C in the perioperative period.

Conclusions: The study suggests that preoperative warming with a self-warming blanket reduces the incidence of UPH and decreases the drop in core temperature.

Keywords: prewarming, hypothermia, core temperature, warming devices.

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Conflict of interest: No conflict of interest has been declared by the authors.

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UNINTENDED PERIOPERATIVE HYPOTHERMIA (UPH), defined as a core temperature $< 36^{\circ}\text{C}$, is a common and serious complication for patients undergoing anesthesia and surgery.¹⁻³ The incidence of UPH ranges from 50% to 90% if no preventative methods are conducted.^{4,5} Even mild hypothermia can cause numerous adverse outcomes, such as risk of wound infections, cardiac complications, coagulation disorders, and increased bleeding.⁶⁻⁹ Patients undergoing general anesthesia with neuraxial anesthesia, geriatric patients, patients with low body mass index (BMI) (kg/m^2), and patients undergoing surgery in low ambient operating room temperatures are particularly at risk of developing UPH.¹⁰⁻¹³ Patients undergoing spinal anesthesia are at risk of UPH at the same level as

patients under general anesthesia.^{8,14,15} Furthermore, UPH decreases the metabolism of the anesthetic agents, which can prolong the effects of anesthesia, thereby extending the duration of the patient's stay in the operating room.^{7,8,16} Patients arriving with hypothermia in the postanesthesia care unit (PACU) may have a prolonged stay.¹⁰ These complications can have serious impact on both the patient's medical condition and the health care system. In the United States, it has been estimated that complications due to UPH can result in an additional cost of \$2,500 to \$7,000 per surgical patient.¹⁶

Background

Thermoregulation and Anesthesia

The core temperature is determined by the balance between heat production and environmental heat loss.^{8,17} The body produces heat through muscle activity and by basal metabolic rate, and loses heat due to sweating and vasodilation of peripheral blood vessels.^{15,17} The temperature-regulating center in the hypothalamus is the body's thermostat. It adjusts heat production and heat loss, thus maintaining a balance in the core temperature within a threshold between 36.5°C and 37.5°C.^{8,15}

UPH occurs as a result of anesthetic-induced impairment of thermoregulation and the basal metabolism rate in combination with environmental heat loss.⁸ Anesthetic agents alter thermoregulation, and the threshold for cold is reduced by approximately 3°C. Therefore, the body's response to cold is correspondingly delayed. Consequently, maintaining a normal core temperature is dependent on metabolic heat production, which is reduced by 30% during anesthesia.¹⁸

As a result of anesthesia-induced altered thermoregulation and environmental heat loss, the patient is at risk of developing UPH. Initially, the temperature decreases 1°C to 1.5°C within the first hour after induction of anesthesia due to the redistribution of body heat from the core to the periphery.^{14,15,19}

Prewarming

Skin surface warming (prewarming) before induction of anesthesia increases the heat contents of

the peripheral compartment and thereby decreases the core-to-peripheral redistribution of body heat.^{13,20} Clinical guidelines^{10,21,22} recommend rewarming with forced-air warming (FAW) in preventing UPH. FAW is presumably recommended since it represents the most commonly used active warming method in published literature. To achieve the optimal effect of prewarming, the warming device should be activated 30 minutes before induction of anesthesia.^{23,24} Prewarming does not completely eliminate the initial decrease in the temperature drop, but the reduction of the initial decrease in the core temperature prevents or reduces the incidence of UPH.^{20,25}

In Europe and North America, FAW is often used only during surgery, since prewarming with FAW can be a challenge due to lack of time, equipment, and facility at the operating ward.^{13,20,22} In 2012, a self-warming blanket (BARRIER® EasyWarm® Mölnlycke Health Care) became available on the market as an active warming device in reducing UPH. Using this self-warming blanket made it possible to overcome the aforementioned barriers since no additional equipment is required and the prewarming process can be initiated on the surgical ward. Before considering implementing the self-warming blanket, a literature search was performed in 2012 to identify any studies using the self-warming blanket as a warming device in preventing or reducing UPH. The search did not reveal any published scientific studies. Therefore, it was relevant to explore whether the self-warming blanket could be used in prewarming a group of patients, especially patients at risk of UPH when only given FAW intraoperatively. Patients undergoing hip or knee arthroplasty are at special risk of UPH because they are older adults with a higher incidence of comorbidity and the surgery is performed in a low ambient room temperature with laminar air flow.^{10,12,13} The present study aims to present new knowledge on to which extent the self-warming blanket reduces or prevents UPH in patients at risk of UPH.

Purpose

The purpose of this study was (1) to identify the incidence of UPH using traditional care with FAW intraoperatively among patients undergoing hip or knee arthroplasty, (2) to identify the incidence of UPH using a self-warming blanket preoperatively

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