

## The Effects of Active versus Passive Prewarming of Pediatric Surgical Patients during the Pre-operative Period

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### Objectives

To establish a prevalence of greatest to least in terms of loss of temperature, gain of temperature or no change in temperature as related to warming measures. To identify predisposing factors of perioperative hypothermia and determine the most effective preventive interventions.

**Keywords:** Preventable; Hypothermia; Anesthesia; Skin

### Problem Identification

Unintended or inadvertent hypothermia, defined as any core temperature of less than 36°C (96.8°F), has been called a frequent and preventable complication of surgery. Maintaining normothermia is an important factor in the operating room for both patient comfort and the prevention of complications that occur from hypothermia [1]. Core hypothermia that develops immediately following induction of anesthesia essentially results "from an internal core-to-peripheral redistribution of body heat" [2].

Anesthesia can potentially disrupt normal autonomic responses to decreases in core body temperature, such as shivering and vasoconstriction. Redistribution hypothermia is difficult to treat both because the internal flow of heat is large and heat applied to the skin surface will take a considerable amount of time to reach the core thermal compartment. This compartment is defined as a well-perfused area, consisting of the major organs of the trunk and head [1].

The innovative intervention proposed will be prewarming of surgical patients, either actively or passively, for a minimum of 30 minutes prior to surgery to reduce the risk of lowered body temperature intra-operatively and post-operatively. Prewarming may be defined as the application of heat prior to surgery for the purpose of increasing the mean body temperature; specifically, the average of the core and periphery combined [1].

### Significance of the problem

Review of literature for this proposal was consistent in that pediatric patients were excluded entirely from the studies. Infants and children cool more quickly because of high ratio of surface area to weight [3] and with lack of tissue mass; they are more likely to become hypothermic. Mahoney et al. [4] maintain that studies have shown that normothermia in the operating room is more effectively maintained with the use of forced-air warming. Throughout the perioperative journey, the nurse is the primary advocate for the patient and responsible for the safe and appropriate implementation of prewarming and warming measures. This is especially true for the pediatric patient population.

The immobile, vasodilated patient in a cold operating room will lose body heat, potentially resulting in unfavorable outcomes unless active warming measures are taken. Research demonstrates that in the first hour of anesthesia, an unwarmed surgical patient can lose up to 1.6°C on average, as anesthesia-induced vasodilatation allows warmer blood from the core to flow freely and mix with the cooler blood in the periphery [1]. Intra-operative hypothermia has adverse consequences reaching far beyond patient discomfort and the factors can be easily managed.

A growing body of knowledge supports the clinical benefits of maintaining normothermia throughout the patient's surgical experience, beginning with prewarming in the pre-operative phase of care. The role of unintended hypothermia as a contributing factor to the development of surgical site infections (SSIs) has received increased acknowledgement.

### Innovation description

Literature suggests that warming peripheral tissues or the skin surface for a minimum of 30 minutes before induction of anesthesia may reduce the risk of lowered body temperature [1]. The innovation of passive prewarming will be the application of warmed blankets, socks, surgical drapes and head coverings when applicable (e.g. soft knit caps for infants). The active warming method will be employed by using the Bair Hugger® system, a device consisting of a warming unit and telescoping hose attached to a reinforced paper blanket with cells that provide venting of the warm air.

Forced-air convection warming devices are purposefully built to prevent hypothermia in patients undergoing surgery [1], but must have a power supply to operate. These devices are utilized in most operating rooms because they are effective, safe and inexpensive. The American Society of Perianesthesia Nurses (ASPAN) has indicated the benefits of pre-operative warming or use of forced-air warming devices in the Clinical Practice Guideline for the Promotion of Perioperative Normothermia [1]. In the studies that were examined, warming was achieved primarily by forced-air devices or with warmed blankets, but patients under the age of 18 years of age were excluded from the research examined for this paper.

The practice guideline issued by ASPAN recognizes that forced-air warming represents the first line of intervention to normalize temperature and measures to prevent hypothermia should begin in the pre-operative phase of care [5]. Basic nursing approaches to reduce anxiety and promote comfort can be combined with active thermal protection measures that continue through the perioperative period.

## Research Support

### Hypothesis

Patients whose temperatures have been maintained at normal levels during the intra-operative period experience fewer adverse outcomes [4]. Does utilization of forced-air warming devices pre-operatively have an effect on core body temperature post-operatively? Other research questions for consideration:

Is the difference in adverse outcomes between normothermic and hypothermic patient groups significant across studies?

Do passive or environmental warming measures provide the same clinical benefits as forced-air warming? In other words, is there a significant difference that exists in effectiveness of modality for maintaining intra-operative normothermia? [4].

#### Are results consistent across completed studies?

Studies on perioperative temperature regulation were retrieved electronically by searching CINAHL and MEDLINE databases, limiting consideration to full-text articles in journals published between 1995 and 2011.

### Implementation plan

The innovation will be employed in the perioperative department of a metropolitan pediatric hospital. Prior to the implementation of the innovation, education will be provided for the anesthesiologists and perioperative staff. Patients aged newborn to 19 years who have been assigned an American Society of Anesthesiologists (ASA) Physical Status score of I-III, and who are having elective procedures, will be eligible. The participants will consist of patients whose surgical procedures are equal to or greater than one hour but no more than four hours, and with extubation in the operating room.

The following characteristics will be recorded by a staff nurse, advanced practice nurse or anesthesiologist: age, sex, body weight and height, ASA physical status, type and magnitude of surgery, anesthesia technique, amount of intravenous fluids administered in the operating room, use of temperature monitoring and warming techniques and duration of anesthesia.

Patients will be randomly allocated to one of the following groups: 1) Passive Insulation – routine thermal measures (warmed cotton blankets, socks, surgical drapes and head coverings); 2) Active External Warming – forced-air warming with Bair Hugger device set on “Medium” (38°C) or “High” (43°C) as indicated that begins at the time anesthesia is induced; and 3) Early Active External Warming – forced-air warming with Bair Hugger device set on “Medium” (38°C) or “High” (43°C) as indicated for 30 minutes prior to induction of anesthesia. Active forced-air warming devices will be used according to manufacturer’s recommendations.

The first temperature measurement will be recorded before the start of the randomized treatment and a second temperature will be recorded in the operating room just before induction of anesthesia. Upon arrival to PACU, the patient temperature will be recorded followed by two subsequent measurements, the first at fifteen minutes after arrival. The study for each participant will conclude with the second subsequent temperature measurement recorded at thirty minutes following arrival in PACU. Infrared tympanic thermometers (Exergen Temporal Scanner, Watertown, MA) will be used, and temperature inaccuracy between instruments should not exceed 0.5°C

[1]. No additional personnel are needed to implement the prewarming innovation.

### Time line

April 2015: Initial idea / research completed

May 2015: Development of strategy / completion of proposal

1 – 2 months: Solicit staff and physician support to ensure adoption

1 – 2 months: Provide education for staff and physicians

1 month: Conduct pilot testing of innovative intervention (if needed)

1 month: Implementation

3 – 6 months: Trial of innovation

1 month: Evaluate effectiveness of innovation

1 month: Disseminate results of innovation

1 – 2 months: Determine feasibility of future study on prewarming

### Evaluation Plan

#### Outcome measure

The risk/ benefit ratio and the amount and quality of evidence supporting the recommended change in practice must be evaluated. The evidence rating scale of the Stetler Evidence Hierarchy has been identified as the preferred instrument for evaluating the strength and quality of evidence for all ASPAN clinical practice guidelines [1]. The strength of the evidence is classified by the tool ranging from Level I, a systematic statistical view of multiple controlled studies (e.g. meta-analysis), to Level VIII, a consensus opinion of respected content experts. The quality of the evidence is rated as A through D, with the highest quality study represented by A, and D being flawed study findings.

The variables to be evaluated will include perioperative hypothermia and tympanic temperature <36°C in PACU on admission and subsequently, and all variables will be subjected to logistic regression analysis. Variables with  $p > 0.05$  will be discarded; all values with  $p \leq 0.05$  will be considered statistically significant. The success for the outcome of the recommendation will be largely determined by criteria of interest that include clinical relevance, type and quality of studies and the consistency of the findings.

### Evaluation Data Collection

Examination of effectiveness will be conducted systematically and empirically through careful data collection and thoughtful analysis. Gathering complete and accurate information to generate findings that are useful is the objective. To compare differences between the characteristics of hypothermic and normothermic patients, t-test will be used for continuous variables (e.g. age, duration of surgery, temperature in the OR), and chi-square test will be used for categorical variables (e.g. gender, ASA status, anesthesia type). Patients will be divided into subgroups according to age (less than twelve years, twelve years and older), type of procedure (laparoscopic or limb surgery versus “open” abdominal) and differences between hypothermic and normothermic patients. The limited area of skin on a pediatric patient that can potentially be covered or warmed may be a limitation;

specifically, when large areas of skin are exposed as donor sites for skin or tissue. Statistical significance will be set at  $p < 0.05$ .

## Decision Making

The literature review strongly maintains that perioperative hypothermia as being linked to poorer post-operative outcomes, with contributing factors being reduced metabolic heat production due to anesthetic, cold operating room environment and impaired thermoregulation [1]. This proposed innovation can help identify predisposing factors, causes and prevention of hypothermia, and potentially influence organizational and regulatory policies to standardize pediatric patient temperature management [5,6]. By using current science, perioperative nurses can prevent the chilling outcomes of inadvertent hypothermia by enacting, supporting and formalizing policy in the perioperative arena. It will be consequential to redesign processes, develop department protocols/algorithms and establish the industry standard for managing normothermia in the pediatric perioperative setting [7,8].

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