Evaluation of the incidence and management of perioperative hypothermia

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Medical College of Ohio

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FINAL APPROVAL OF SCHOLARLY PROJECT
Master of Science in Nursing

Evaluation of the Incidence and Management of Perioperative Hypothermia

Submitted by

Pamela Snyder

In partial fulfillment of the requirements for the degree of
Master of Science in Nursing

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Pamela Diane Snyder

Medical College of Ohio

2005
DEDICATION

I would like to dedicate this scholarly project to my husband Joshua and my son Jeffrey. Joshua, you have been by my side throughout this entire process. Although you haven’t always understood exactly what I was doing or why I was taking so long, you never questioned my ability to complete what I set out to do. I love you for that. You are my rock, and I wouldn’t be where I am today without you by my side.

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CHAPTER I

Introduction

Unplanned hypothermia is a common experience in the perioperative setting, occurring when body heat loss exceeds heat production (Burns, 2001; McNeil, 1998). Hypothermia remains an ongoing problem throughout the perioperative period despite technological advances available to prevent hypothermia including the use of warming blankets, warmed irrigation and intravenous fluids, heat lamps, and humidified and warm anesthetic gases (Arndt, 1999; Atkin, 1998; McNeil, 1998).

The American Society of PeriAnesthesia Nurses (ASPAN) recognized the need to address the current practice regarding temperature management. ASPAN developed a standard of care for the prevention and management of unplanned hypothermia. The Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia (referred to as the Hypothermia Guideline) was developed and published in 2001. Aside from providing the practice of nursing with an established definition of normothermia and hypothermia, the Hypothermia Guideline alerts perioperative health care providers to the importance of maintaining perioperative normothermia. The Hypothermia Guideline was developed as a bedside tool for clinicians to use for the prevention and management of unplanned perioperative hypothermia.

The remainder of this chapter will briefly describe the evaluation and treatment of unplanned perioperative hypothermia in current nursing practice. The chapter will also present research questions, definitions of research variables, introduce how Kolcaba’s Theory of Comfort supports this inquiry, and the significance of this study to nursing.
**Background and Problem Statement**

The hypothalamus is responsible for core temperature regulation in the body, despite external environment changes. The hypothalamus maintains normothermia with a fine balance between heat loss and heat production throughout the body by the physiological processes of conduction, convection, radiation, and evaporation (Arndt, 1999; McNeil, 1998). During normal temperature regulation, the hypothalamus raises and lowers body temperature depending on the body’s requirements. Shivering and vasoconstriction are common responses in the body when the hypothalamus realizes the core temperature is being compromised, usually within a 1°C decrease in temperature (Arndt, 1999).

Research has shown that the greatest decrease in temperature occurs in the first hour after anesthesia is induced because the normal homeostatic mechanisms to produce and conserve heat such as shivering, vasoconstriction, and piloerection are eliminated; leaving the patient susceptible to increasing hypothermia (Burns, 2001; McNeil, 1998). Contributing factors that may increase a patient’s risk for unplanned perioperative hypothermia include extremes of age, female sex, cold ambient room temperature, length and type of surgical procedure, metabolic status, pre-existing health conditions, use of cold prepping and irrigating solutions, skin exposure, and use and type of anesthesia (Arndt, 1999; ASPAN, 2002; Atkin, 1998; Burns, 2001; Connor & Wren, 2000; Ensminger & Moss, 1999; Sessler, 2001). Major bowel, vascular, and orthopedic surgeries have been noted to be at greater risk for hypothermia due to the length of procedure, amount of skin exposure, and use of prepping and irrigating solutions (Atkin, 1998; Sessler, 1998).
As a result of perioperative hypothermia, various physiological effects may occur including patient discomfort from shivering, diminished level of consciousness, altered cardiac function, impaired platelet and coagulopathy function, and altered drug metabolism (Arndt, 1999; Atkin, 1998; Burns, 2001; Connor & Wren, 2000; Sessler, 2001). Other negative consequences that the patients may experience from perioperative hypothermia may include impaired wound healing, increased prevalence of infection, delayed emergence from anesthesia with prolonged stays in the post anesthesia unit, lengthened hospital stays, and increased rate of mortality (Arndt, 1999; Atkin, 1998; Beilin et al., 1998; Bock et al., 1998; Burns, 2001; Connor & Wren, 2000; Flores-Maldonado, Medina-Escobedo, Rios-Rodriguez, & Fernandez-Dominguez, 2001; Kurz et al., 1995; Lenhardt et al., 1997; Sessler, 2001). Because of these potentially serious complications, maintaining perioperative normothermia has become a priority for perianesthesia nurses.

Statement of the Purpose

The purpose of this non-experimental, retrospective study was to determine the incidence of perioperative hypothermia in patients having selected surgeries including, total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy. Additionally, documented interventions used to treat perioperative hypothermia were evaluated and compared to the current Hypothermia Guideline set forth by The American Society of PeriAnesthesia Nurses.
Research Questions

The following research questions were evaluated in the study.

1. What is the incidence of preoperative hypothermia in patients undergoing total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy?

2. What is the incidence of hypothermia in the immediate postoperative period in patients who have had total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy?

3. What is the incidence of hypothermia in patients who have had total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy on admission to the medical-surgical floor or intensive care unit from the postanesthesia care unit?

4. Are the warming interventions currently used in either the operating room or the postanesthesia care unit effective in the prevention and management of hypothermia prior to discharge from the postanesthesia care unit?

5. Do age, gender, and type of surgery affect the incidence of perioperative hypothermia?

Definition of Terms

Hypothermia

Conceptual definition: A potential or actual comfort need occurring in the physical context of experience.
Operational definition: An axillary, oral, or tympanic temperature of less than 36° C (96.8° Fahrenheit (F)) (ASPAN, 2002).

**Perioperative:** The time commencing with the decision for surgical intervention and ending with a follow-up evaluation. This period includes the preoperative, intraoperative, and postoperative phases (AORN, 2003).

**Preoperative:** The time begins when the decision for surgical intervention is made and ends with the transference of the patient to the operating bed (AORN, 2003).

**Postoperative:** The time begins with admission to the postanesthesia care area and ends with a resolution of the surgical sequelae (AORN, 2003).

**Warming Device/Intervention:** A comfort measure designed to prevent or manage hypothermia in the perioperative setting that is implemented for the patient to achieve enhanced comfort. A device or intervention, such as warmed blankets, head wraps, forced air warming, and warmed intravenous fluids or irrigation fluids designed for this purpose is used in the perioperative setting to assist with the control of body temperature. Generally the device is used to prevent hypothermia (AORN, 2003).

**Theoretical Framework**

Kolcaba’s Theory of Comfort (1994) was utilized as a framework for this study. Kolcaba’s Theory of Comfort is relevant to the specialty of perianesthesia nursing because perianesthesia nurses are patient advocates who are committed to the safety and comfort of surgical patients in every age group. Comfort is a shared value for many nurses in the perianesthesia specialty. According to the standards of perianesthesia nursing practice, comfort is an important criterion for the initial, ongoing, and discharge assessment and management of the perianesthesia patient (ASPAN, 2002). The outcome
of comfort however, such as the maintenance of normothermia, is not defined in the standards. Placing normothermia within Kolcaba’s theory provides perianesthesia nurses with a rationale for enhancing patient comfort and evaluating the effectiveness of nursing interventions.

As defined by Kolcaba’s Theory, comfort is “the immediate state of being strengthened by having needs for relief, ease, and transcendence met in four contexts of experience (physical, psychospiritual, sociocultural, and environmental)” (Kolcaba, 1991, pg. 238). In this study, thermoregulation and more specifically the prevention and management of hypothermia can be placed in both the physical and environmental contexts of experience. Careful attention to thermoregulation, in the form of a comfort measure, can potentially enhance total comfort more than could be expected from the specific nursing action. Therefore, comfort measures, designed to prevent or manage unplanned perioperative hypothermia, can be implemented in order for the patient to achieve enhanced comfort. Enhanced comfort strengthens patients “to engage in getting well, following a health care regime, achieving pre-surgical function, and feeling confident about the future” (Kolcaba & Wilson, 2002, pg. 104).

Significance

In nursing literature, the reported incidence of hypothermia in surgical patients throughout the perioperative experience ranges from 60 to 90% (Atkin, 1998; Connor & Wren, 2000; Ensminger & Moss, 1999). This high incidence of hypothermia may produce detrimental consequences for the patient. A study of the incidence of unplanned perioperative hypothermia is significant in order to determine the quality of nursing care that perioperative patients are receiving, and to determine if that care meets the standards
for prevention and maintenance of unplanned hypothermia as presented by ASPAN. A study by Hudson, Beaver, Scott, & Heichemer (1999) found that by standardizing perioperative care in regards to maintaining patient temperature, there was a significant decrease in patient hypothermia. This decrease in patient hypothermia resulted in improved clinical outcomes for patients and satisfactory levels of comfort (Hudson et al., 1999).

Unplanned hypothermia can result in negative consequences including patient discomfort from shivering, untoward cardiac events, adrenergic stimulation with a resultant increase in serum catecholamine levels, altered drug metabolism, and impaired wound healing with increased susceptibility to infections (Sessler, 2001). These negative consequences lead to increased morbidity, mortality, and financial costs related to unplanned perioperative hypothermia. Mahoney and Odom (1999) performed a meta-analysis with a sample of 1575 patients to study the outcomes and costs associated with intraoperative hypothermia. From this study it was determined that the cost of perioperative hypothermia can range from the cost of an extra cotton blanket to the costs associated with increased patient morbidity and mortality. The adverse outcomes of hypothermia “negatively affected the quality and even the length of patient’s lives” (Mahoney & Odom, 1999, pg. 163). Mahoney & Odom (1999) estimated an additional $2,500 to $7,000 per surgical patient was added to the hospitalization costs across a variety of surgical procedures for an average temperature of 1.5°C below normal. The researchers concluded that patients whose temperatures have been maintained at normothermic levels during the perioperative period resulted in both clinical and
financial benefits. Those patients developed fewer adverse outcomes, and their overall hospital costs were lower (Mahoney & Odom, 1999).

Summary

As presented by ASPAN (2002), clearly there is a need to monitor for and prevent unplanned perioperative hypothermia from occurring in the surgical patient. This non-experimental study determined the incidence of unplanned perioperative hypothermia and evaluated current practice and treatment of perioperative hypothermia according to the Hypothermia Guideline. By applying Kolcaba’s Theory of Comfort (1994) to the perioperative process, perianesthesia nurses have a framework to guide patient care and evaluate the effectiveness of comfort measures, specifically the prevention and treatment of unplanned hypothermia. Due to the demand for quality, cost-effective care, it is necessary for nurses to play a vital role in all phases of the perioperative experience.
CHAPTER II

Literature

The purpose of the study was to determine the incidence of perioperative hypothermia in patients having total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy. Additionally, interventions used to treat perioperative hypothermia were evaluated and compared to the current Hypothermia Guideline set forth by The American Society of PeriAnesthesia Nurses (ASPAN). This chapter will discuss Kolcaba’s Theory of Comfort and how it relates to the prevention and management of unplanned perioperative hypothermia. In addition, a review of relevant published literature about the definition and incidence of hypothermia, predisposing factors contributing to hypothermia, complications of hypothermia, and warming interventions used to prevent and treat perioperative hypothermia will be presented. The chapter will conclude with a summary.

Theoretical Framework

The basic assumptions of Kolcaba’s Theory of Comfort are that “(a) human beings have holistic responses to complex stimuli; (b) comfort is a desirable holistic outcome that is germaine to the discipline of nursing; and (c) human beings strive to meet, or to have met, their basic comfort needs” (Kolcaba, 1994, pg. 1178). Kolcaba’s theory of comfort care for nursing is derived from the construct of comfort. Kolcaba (1991) has defined comfort as “the immediate state of being strengthened through having the human needs for relief, ease, and transcendence met in four contexts of experience (physical, psychospiritual, sociocultural, and environmental)” (pg. 238). Relief, ease, and
transcendence are three types of comfort levels. Relief is the state of having a specific comfort need met (Kolcaba, 1991). At this level a severe discomfort is mitigated or alleviated. Ease is the state of calm or contentment, the absence of specific discomforts (Kolcaba, 1991). In this comfort level, a patient does not have to have a previous discomfort to experience ease, although the nurse may be aware of predispositions to specific discomforts (Kolcaba & Wilson, 2002). And transcendence, the final comfort level, is the state in which one can “rise above” problems or pain (Kolcaba, 1991). This level occurs when the discomfort cannot be eradicated or avoided, and encompasses the need for inspiration, strengthening, and motivation. Theoretically, the three comfort states imply a strengthening component, providing the central rationale for promoting the patient’s comfort (Kolcaba, 1994). According to the theory, differentiating between relief, ease, and transcendence is unnecessary as nurses move back and forth between these three types of comfort (Kolcaba & Wilson, 2002). The three comfort states are often continuous and interdependent (Kolcaba, 1994). Essential to comfort is the maintenance of homeostatic mechanisms such as oxygenation, normothermia, fluid and electrolyte balances, digestion, and elimination (Kolcaba, 2003).

In Kolcaba’s theory of comfort, nurses attend to these three levels of comfort within four contexts of human experience. The first context is physical or pertaining to the bodily sensations (Kolcaba, 1991). The second context is psychospiritual or pertaining to the internal awareness of self, including esteem, sexuality, meaning in one’s life, and relationship to a higher order or being (Kolcaba, 1991). The third context is sociocultural or pertaining to interpersonal, family, and cultural relationships, and the financial and informational aspects of social life (Kolcaba, 1991). The fourth context is
environmental or pertaining to the external background of human experience (light, noise, ambience, colour, temperature, and natural versus synthetic elements) (Kolcaba, 1991). When comfort needs are met in one context of experience, total comfort is enhanced in all the remaining contexts (Kolcaba & Wilson, 2002).

According to Kolcaba’s theory of comfort, in any stressful healthcare situation nurses must first identify the total comfort needs of their patients. The comfort needs for relief, ease, and transcendence are assessed within the four contexts of the patients’ experience, the physical, psychospiritual, sociocultural, and environmental. A key point to remember is that all comfort needs interact and produce more discomfort together than can be accounted for by considering each comfort need separately (Wilson & Kolcaba, 2004, pg 166). An actual or potential deficit in any of the four contexts triggers a need for a comfort measure.

Comfort measures, or nursing interventions are then designed to meet those needs not currently being met (Kolcaba, 2003). There are three general types of comfort measures. The comfort measures include (1) standard comfort measures designed to maintain homeostasis, (2) coaching to relieve anxiety, provide reassurance and information, and help plan for recovery, and (3) comfort food for the soul or special tasks nurses do to make patients feel cared for and strengthened (Kolcaba & Wilson, 2002).

Intervening variables outside nursings’ influence that affect the outcome of comfort measures must be considered. Intervening variables may have a considerable impact on the success of comfort interventions. These may be conditions such as the patient’s financial status, cognitive status, concomitant illnesses, the extent of social support, and the prognosis of the patient (Kolcaba, 2003). Patients will then perceive
their state of comfort after comfort measures are implemented by nursing. Nursing must assess whether or not the patient’s comfort has been enhanced by the comfort measure both objectively and subjectively; and then decide whether to continue the nursing interventions, try something new, or to reassess the patient’s comfort needs.

If enhanced comfort is achieved, patients are strengthened to consciously or subconsciously engage in behaviors that move them toward a state of well being (Kolcaba, 2003). These behaviors, called health-seeking behaviors occur internally at the cellular or organ level, such as healing or immune function or externally related to the outer world, such as the functional state of health (Kolcaba, 2003). Nurses and patients are more satisfied with health care when patients engage in health-seeking behaviors as a result of being strengthened by comforting measures (Wilson, & Kolcaba, 2004).

The prevention and management of hypothermia can be examined within both the physical and environmental contexts. When a potential or actual comfort need is determined, comfort measures designed to prevent or manage unplanned perioperative hypothermia, can be implemented in order for the patient to achieve enhanced comfort. A diagram of the concepts and their relationships is depicted in figure 1.
**Figure 1**

*Prevention and Management of Hypothermia adapted from Kolcaba’s Theory of Comfort*

**Assessment of Potential or Actual Comfort Needs:**
- Temperature < 96.8°F, Postoperative shivering,
- Patient’s verbalization of feeling cold,
- Piloerection

**Comfort Measures:**
- Warmed, layering of blankets,
- Forced Air Warming

**Comfort = Normothermia**

**Internal Health Seeking Behaviors:**
- Comfortable environment,
- Stable cardio-respiratory system, Improved healing & immune system

**External Health Seeking Behaviors:**
- Improved functional state of health, Decreased PACU & hospital stays, Lower hospital costs
As a patient arrives in the post anesthesia care unit, the post anesthesia care nurse should assess the patient for the presence of postoperative shivering or piloerection and the patient’s temperature should be taken. It can then be determined if there is a potential or actual comfort need in the form of thermoregulation, and the appropriate comfort measure can be implemented. Comfort measures may include the application of a warmed cotton blanket or a forced warm air device. Subjective and objective reassessment and the perception of the patient would influence further decisions regarding the patient’s temperature as the nurse strives to achieve enhanced comfort through the maintenance of normothermia for the patient. This is an example of how comfort measures can be applied in one stage and potentially prevent complications in subsequent stages of the surgical experience.

By applying Kolcaba’s theory of comfort (1994) to the perioperative process, perianesthesia nurses have a framework to guide patient care and evaluate the effectiveness of comfort measures. Simply stated, a series of interventions that target holistic comfort can be implemented during one nurse-patient interaction after a brief assessment of the three comfort states in each human context.

Review of Literature

Definition of Hypothermia

Definitions for normothermia and hypothermia were not well documented in nursing literature until The American Society of PeriAnesthesia Nurses (ASPN) presented definitions in the Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia (referred to as the Hypothermia Guideline). In the Hypothermia Guideline, normothermia is defined as a core temperature range from 36° to
38°C (96.8° – 100.4°F) (ASPAN, 2002). Hypothermia is defined as a core temperature of less than 36°C (96.8°F) (ASPAN, 2002). The Hypothermia Guideline further states that hypothermia may also be present regardless of the patient’s temperature if the patient reports feeling cold or presents with physical signs or symptoms of hypothermia. Common signs of hypothermia include shivering, peripheral vasoconstriction, and piloerection (ASPAN, 2002).

The American College of Surgeons has a documented system of defining hypothermia. The American College of Surgeons has divided hypothermia into categories, including mild, moderate, and severe (McNeil, 1998). Mild hypothermia occurs at a core temperature of 32° to 35°C (89.6° to 95°F). In this stage the body attempts to correct the temperature deficit and maintain homeostasis. Moderate hypothermia occurs at a temperature of 30° to 32°C or 86° to 89.6° F (McNeil, 1998). In this stage if the body fails to return to normothermia the body conserves energy through various metabolic and systemic mechanisms. And severe hypothermia occurs at a core temperature below 30°C (86°F) (McNeil, 1998). If hypothermia progresses to this point, all bodily functions become depressed and the body prepares to shut down (McNeil, 1998).

According to the Hypothermia Guideline, it is at the discretion of the practitioner to decide the most appropriate method for monitoring patient temperature (ASPAN, 2002). The temperature measurement device must be used accurately, consistently, and correctly, with consideration for the accessibility of the site, patient comfort, and the safety of the patient (ASPAN, 2002). The core temperature of the body can be measured in the pulmonary artery, the distal esophagus, and the tympanic membrane; whereas the
Incidence of Hypothermia

Nursing literature cites the incidence rate for hypothermia in surgical patients to be between 60 to 90% (Atkin, 1998; Connor & Wren, 2000; Ensminger & Moss, 1999). However, various research studies contradicted these references. Specifically, two quality improvement studies contradict these findings and report the incidence of hypothermia to be much lower (Ensminger & Moss, 1999; Hudson et al., 1999). Two additional studies were found that provided varying rates of hypothermia related to the type and length of surgery (Atkin, 1998; Stoneham et al., 2000).

Ensminger and Moss (1999), surgery quality assurance team members, began data collection based on staff members concerns that patients admitted to the postanesthesia care unit (PACU) were hypothermic. Based on retrospective data collection during a two-month time period in 1994, it was found that of a population of 260 mixed type patients, only 21 patients or 8% had arrivals temperatures of less than 35°C (95°F).

Information on the type and length of surgeries were not presented. Based on the results of the data collection, the director of the anesthesia department conducted inservice programs related to the causes and prevention of hypothermia. The studies were again repeated with similar patient populations in 1995 and 1996. In 1995, it was found that only nine patients (3%) out of a group of 259 patients had arrival temperatures of less than 35°C (95°F). And again, in 1996 the results were similar with only 4% of the patients having temperatures below 35°C (95°F). Despite the results, both patient and staff members believed that hypothermia continued to be a problem (Ensminger & Moss,
In the study, Ensminger & Moss (1999) defined hypothermia as less than 35°C (95°F), which is a degree lower than the current definition of 36°C (96.8°F) as recommended by ASPAN. This may account for the smaller incidence of hypothermia.

In a similar quality improvement program, Hudson et al. (1999), found that standardizing care related to the maintenance of normothermia in surgical patients resulted in a significant decrease in hypothermia rates. Hudson et al. (1999) collected data on surgical patients following concerns voiced by the anesthesia care provider. The anesthesia care provider observed cardiovascular changes in patients who were hypothermic on arrival to the PACU. Due to the lack of a standard definition for hypothermia, Hudson et al. defined hypothermia as 35.5°C (95.9°F) or below. Data was collected on all surgical patients; again specific data as to the types and lengths of surgeries were not presented. The overall hypothermic rate was 23%. The authors noted that the observed hypothermic rate was much lower than reported in the literature, but decided that it was still too high and that the patients “deserved better care” (Hudson et al., 1999, pg. 247). Standardized thermoregulation care protocols using warm blankets and warm intravenous fluids were instituted perioperatively, and the rate of hypothermia dramatically decreased to 3.7% (Hudson et al., 1999).

With contrasting results, Atkin (1998) studied the medical records of patients who underwent vascular, orthopedic, and general surgery from February to April of 1997. The following information was collected on each patient: age of the patient, surgery performed, thermal interventions used, length of surgery, type of anesthetic, and room and patient temperatures recorded on four occasions. The results of the medical record
audit indicated that of the 52 medical records, only 24 (48%) of the patients maintained a core body temperature above 36° C (96.8° F).

Atkin (1998) also reported that patients who had total knee and total hip replacements had significant hypothermia, 88% and 69%, respectively. Time spent in the operating room for the orthopedic cases averaged one hour and forty minutes to two hours. Patients who had surgery for bowel cases with an average operating room time of two hours also experienced a significant hypothermia rate of 30%. According to Atkin (1998), the ambient operating room temperatures were consistently below the stated theatre guidelines of 21° C (69.8° F). Results of this study demonstrated several inconsistencies in patient care when compared to the Hypothermia Guideline (2002) related to the use of warmed and humidified gases and the maintenance of ambient operating room temperatures.

More recently, Stoneham, Howell, and Neill (2000) studied core temperature changes that occurred during the induction of general anesthesia in 18 patients undergoing elective aortic aneurysm repair. Due to the prolonged surgery time (greater than two hours), all patients received prophylactic warming measures in the operating room, including a forced-air warmer, a warming mattress, and warmed intravenous fluids (37° C or 98.6° F), when possible. The insertion of intravascular lines, epidural, and urinary catheters was performed before the introduction of warming methods. It was during this time period that core temperatures decreased by 1.5° C (p<.00). Stoneham et al. (2000) reported that despite the aggressive warming measures intraoperatively, the incidence of hypothermia (core temperature less than 36° C or 96.8° F) at the end of surgery occurred in 33% of the patients. Stoneham et al. (2000) concluded that the
overall temperature decrease correlated significantly with the duration of time between
induction of general anesthesia and surgical incision when patients were not actively
being warmed.

_Predisposing Factors Contributing to Hypothermia_

There are certain groups of individuals including older adults and pediatric
patients who are at greater risk for perioperative hypothermia. The risk for hypothermia
is also greatly increased due to medical conditions, debilitated states, or underdeveloped
thermoregulatory systems (Arndt, 1999; Connor & Wren, 2000). Although these risks
groups are physiologically explained and documented in nursing literature (Arndt, 1999;
Connor & Wren, 2000), no nursing research studies indicating their relative risks were
found.

Older adult patients tend to have a reduced amount of muscle mass and adipose
tissue, which causes temperature regulation and the maintenance of body heat to be
compromised (Arndt, 1999). Declining metabolic activity leads to a delayed
physiological response during hypothermia. Elderly patients tend to lose heat rapidly and
re-warm more slowly. Often, the elderly patient’s temperature is lower than usual before
shivering, vasoconstriction, and other heat loss mechanisms occur (Arndt, 1999).

Pediatric patients are also at increased risk for hypothermia due to their relatively
large surface area compared to body mass. Infants and neonates are unable to shiver, and
as a result are dependent on brown fat metabolism for heat. Brown fat metabolism, or
non-shivering thermogenesis, increases the pediatric patients demand for oxygen (Connor
& Wren, 2000).
Other health conditions that place a patient at increased risk for hypothermia include thyroid disorders, cardiac disorders, circulatory failure, conditions in which circulation is compromised, burn victims, paralysis, muscle atrophy, small body mass index, or impaired metabolic rates (Arndt, 1999; Connor & Wren, 2000).

Conditions present throughout the perioperative period may predispose the patient to hypothermia. These include low ambient room temperatures, increased skin exposure, wet prepping solutions, cool irrigating and intravenous fluids, and dry cool anesthetic gases (Arndt, 1999; ASPAN, 2002; Connor & Wren, 2000). Research studies of these predisposing factors could not be found in the nursing literature.

**Complications of Hypothermia**

The potential effects and complications resulting from unplanned perioperative hypothermia are well documented in the literature. Aside from the discomforts of “feeling cold” and shivering, there are several physiological alterations that can occur in every body system as a result of hypothermia.

Complications resulting from hypothermia include altered drug metabolism, decreased synthesis of collagen, reduced platelet function, and increased intraoperative blood loss (ASPN, 2002; Mahoney & Odom, 1999). Bock et al. (1997), in a study of 40 patients undergoing major abdominal surgery, found that maintenance of normothermia reduced the total costs associated with anesthesia by 24%. The decrease in cost was attributed to shortened stay in the postanesthesia care unit, lower incidence of mechanical ventilation, and reduced perioperative blood loss (Bock et al., 1997).

Mild perioperative hypothermia has also been associated with increased infection of the surgical wound and altered cellular immune responses. Beilin et al. (1998) found
that the perioperative period is characterized by alterations in the immune defense system. Type and length of surgery, type of anesthesia, blood transfusions, and neuroendocrine changes were contributing factors to the observed immune alterations. When exposed to the cold, various components and changes of the immune system occurred such as decreased cell-mediated immunity and NK cell activity; reduced number of thymocytes, splenocytes, and CD4+ cells; suppression of B lymphocytes; and defective function of T lymphocytes. Beilin et al. (1998) concluded that intraoperative hypothermia induces suppression of the immune function, and may thus exacerbate the complications of surgery. Furthermore, maintaining perioperative normothermia leads to a reduction in immune alterations and may improve patients’ outcomes (Beilin et al., 1998).

Hypothermia induced immune system depression can further lead to impaired wound healing and increased wound infections. In a study conducted by Flores-Maldonado et al. (2001), it was found that mild perioperative hypothermia (central temperature less than 36°C or 96.8°F) causes vasoconstriction within the body that reduces nutrient and oxygen supply to wounds, increasing the frequency of infections. A nonrandomized sample of 290 cholecystectomy patients was selected for the study. Of the 290 surgical participants, 261 (90%) completed the follow-up visit with the physician who was blinded to patient hypothermia. Surgical wound infections were diagnosed and confirmed with a positive culture. Overall, twenty subjects (7.6%) developed infection of the surgical wound. Eighteen (11.5%) of the hypothermia patients and only two (2%) of the normothermic patients developed infections. Flores-Maldonado et al. concluded that
mild perioperative hypothermia was a significant independent risk factor associated with surgical wound infection with a relative risk of 6.3 \( (p=.01) \).

The results concluded by Flores-Maldonado et al. (2001) were in agreement with a study by Kurz, Sessler, and Lenhardt (1996) that demonstrated the maintenance of core body temperature diminishes the number of surgical wound infections in colo-rectal surgical patients. Additionally, it was determined that infections are more frequent in subjects with hypothermia than those maintained at normothermia. Kurz et al. (1996) defined hypothermia as a central temperature of 34.7\(^\circ\) C +/- .6. Despite the differences in study conditions including design, definitions, and confounding variables; the conclusions between the two studies remain consistent.

Lenhardt et al., (1997) found that mild intraoperative hypothermia prolongs postanesthesia recovery. A prospective randomized study design was chosen to overcome the limitations of retrospective studies, according to the authors. Patients, age 18-80 who were undergoing elective major abdominal surgery, were chosen to participate in the study. It was determined that a sample size of 150 patients would provide an 80% chance of identifying a 10-minute difference between discharge times from the postanesthesia care unit. Two temperature management groups were utilized including a normal thermal management (n=74) and an extra warming (n=76) patient group (Lenhardt et al., 1997). Patient characteristics, types and duration of surgery, and anesthetic management were similar within the two patient groups. As expected, the final intraoperative core temperatures differed significantly between groups. The normal thermal management group was recorded at 34.8\(^\circ\) C +/- .6, whereas, the extra warming group was 36.7\(^\circ\) C +/- .6 \( (p<.00) \).
Lenhardt el al. (1997) concluded that even when the core temperature is not a criterion for discharge from the postanesthesia care unit, recovery was prolonged approximately 40 minutes. Core temperatures in the hypothermic patients required about two hours, or about .5°C per hour, to reach 36°C (96.8°F). When normothermia (core temperature greater than 36°C or 96.8°F) was included in the criteria for discharge, recovery time was delayed approximately 90 minutes in the unwarmed patients. According to Lenhardt et al. maintaining core normothermia during the intraoperative period is likely to decrease recovery time and thus may reduce costs associated with postanesthesia care, as recovery time is potentially expensive with costs similar to those incurred in an intensive care unit.

In a similar study by Kurz et al. (1995), 74 patients undergoing elective colon surgery were evaluated to determine postoperative hemodynamic and thermoregulatory consequences of intraoperative core hypothermia. In this prospective randomized clinical trial, patients were assigned to either normothermic or 2.5°C hypothermic groups during surgery. An observer blinded to the patient’s group assignment and core temperatures evaluated shivering, thermal comfort, surgical pain, heart rate, and blood pressures during the first six hours after surgery.

The study results indicated that there were no statistically significant differences in patient characteristics or anesthetic management in either patient group. Kurz et al. (1995) found that the hypothermic patients felt “uncomfortably” cold during recovery, and postoperative “core temperatures remained significantly less than” the normothermic group for more than four hours (p. 359). Although shivering was common in the
A hypothermic patient, shivering was rare in the normothermic patients. Heart rates and blood pressures were similar between groups.

In agreement with Lenhardt et al. (1997), Kurz et al. (1995) concluded that intraoperative hypothermia causes postoperative thermal discomfort, and requires additional recovery time if hypothermic. Delayed return to core normothermia results largely from postoperative thermoregulatory impairment (Kurz et al., 1995).

**Warming Interventions**

According to the Hypothermia Guideline set forth by ASPAN (2000), there are two types of warming interventions used in the prevention and management of unplanned perioperative hypothermia. These include preventive and active warming measures. After assessment of the patient, preventive warming measures are instituted for patients who are normothermic. A variety of measures for passive insulation are used unless contraindicated by the patient’s condition. Preventive warming measures may include interventions such as warmed cotton blankets, socks, head covering, limited skin exposure, circulating water mattresses and an increase in ambient room temperature (minimum 20° to 24° C or 68° to 75.2° F) (ASPAN, 2002). The second set of interventions or active warming measures is instituted for patients who are hypothermic upon assessment. Active warming measures include the following: the application of a forced air convection warming system, an increase in the ambient room temperature, and the consideration of warmed intravenous fluids (ASPAN, 2002).

The efficacy of warming measures, including both preventive and active warming measures, are presented in the nursing literature with inconsistent results. Several studies
will be introduced indicating the effectiveness of warming interventions during the perioperative period.

Giuffre, Rinnie, Lynam, and Smith (1991) conducted a study to determine if forced air systems re-warmed patients quicker than radiant heat lamps or warmed cotton blankets. A study population of 90 patients with admission temperatures of 35°C (95°F) or less was randomly assigned to a group with radiant heat lamps, warmed cotton blankets, or forced warmed air. Temperatures were monitored every 15 minutes via either the oral or axillary route until the patients reached a discharge temperature of 36°C (96.8°F). Internal validity of the study was maintained through the random selection of the sample and the maintenance and standardization of the thermometers. The study documented that patients receiving forced warm air systems during the recovery room stay had decreased lengths of stay, higher maintenance of normothermia, quicker return to normal temperature for hypothermic patients, and decreased amount of shivering (Giuffre et al., 1991).

Bock et al. (1998) obtained similar results while investigating the effects of preinduction and intraoperative warming during major laparotomy. Forty patients undergoing major abdominal surgery were investigated regarding the influence of active warming preoperatively and intraoperatively on blood loss, transfusion requirements, duration of stay in the post anesthesia care unit, and perioperative costs. Patients were randomly assigned to either an active or passive warming group. Passive protection included the use of circulating water mattresses, blankets, and fluid warming devices. The actively warmed patients were also provided with forced warmed air for 30 minutes before the induction of general anesthesia and during anesthesia.
At the conclusion of surgery, it was determined that changes in the core temperatures of the actively warmed group were significantly less than the passive warming group ($p<.01$). The results of the study were also statistically significant for the group who was pre-warmed and actively warmed with regards to decreased blood loss, decreased recovery room length of stay, and decreased hypothermia during the perioperative stay (Bock et al., 1998). The actively warmed patients had a shorter duration of stay in the postanesthesia care unit (94 minutes, SD 42) versus 217 minutes (SD 169) in the passive warming group ($p<.00$). The actively warmed patient group also had an overall 24% reduction in total anesthetic costs (Bock et al., 1998).

Fossum, Hays, and Henson (2001) conducted an experimental study using a forced warm air device. The purpose of the study was to determine if there was a difference in PACU arrival temperatures in surgical patients who had been preoperatively warmed with a forced warm air blanket and those patients warmed with one warm cotton blanket. One hundred outpatients undergoing general anesthesia for gynecological, orthopedic, or urological procedures were randomly assigned to one of two groups. Core temperatures were measured every 15 minutes throughout the preoperative and postoperative period. There were no significant differences between age, gender, type of surgery, ASA classification, and initial temperature (Fossum et al., 2001).

According to Fossum et al. (2001), several significant findings were revealed. Patients in the treatment group who received forced air warming had a statistically significant increase in temperature during the preoperative period as compared to patients in the control group ($0.45^\circ C +/- 0.38$ vs. $0.17^\circ C +/- 0.51$, respectively) ($p=0.00$). Additionally, patients in the treatment group had significantly higher mean temperatures ($35.97^\circ C$
+/- .52) when they arrived in the PACU as compared to the control group (35.54°C +/- .50) \((p=.00)\). Fifty-six percent (56%) of patients in the treatment group arrived in the PACU with a temperature above 36°C (96.8°F). Whereas 10% \((n=5)\) of the control group arrived in the PACU with a temperature less than 35°C (95°F), and 72% arrived with a temperature of less than 36°C (96.8°F).

Patients in the treatment group were also more likely to self-report thermal comfort when they were able to respond to verbal stimuli \((p=.00)\). Fourteen percent \((n=14)\) of the entire sample arrived to the PACU shivering. Of those patients, 79% complained of feeling cold. Results showed that as patient complaints of shivering increased, comfort level decreased. Temperature appeared to be a key indicator of the patient perception of comfort throughout the perioperative period. A significant correlation was found between age and complaints of shivering that was consistent with the inverse correlation found between age and initial postoperative temperature \((p=.01\) and \(p=.00\) respectively) (Fossum et al., 2001).

Fossum et al. (2001) concluded that the findings from this study support the use of a forced warmed air device to warm surgical patients preoperatively. Because of the limitation in patient population, length of anesthesia time, and types of surgeries performed, Fossum et al., stated the results of this study cannot be generalized to all populations.

Similar results were obtained in a study conducted by Linwall, Svensson, Soderstrom, and Blomqvist (1998). The objective of the prospective study was to compare a forced air warming system with passive measures to avoid perioperative hypothermia. Temperatures were measured before, repeatedly during the operation for
up to three hours, and then up to eight hours postoperatively on 28 patients scheduled for extensive thoracic abdominal surgeries. Of the 12 patients who had forced air warming, temperature was maintained with a range of 36.8°C (98.2°F) at the start of the operation to 35.1°C (95.2°F) after three hours of anesthesia and surgery. Linwall et al. (1998) concluded that forced air warming intraoperatively significantly preserves normothermia during extensive thoracic abdominal operations.

In contrast to the previous studies, Simmons, Phillips, Doctor, and Liehr (1992) conducted a study to compare the efficacy of Thermodrape, a heat-retaining surgical covering, with cotton blankets in maintaining core body temperature. The study sought to evaluate a preventative approach to postoperative hypothermia. A convenience sample of 117 patients having hand, wrist, or elbow surgery under regional or general anesthesia participated in this experimental study. Patients were alternately assigned to either cotton blankets with a paper cotton head covering or to the Thermadrape group with a Thermadrape head covering. Temperatures were taken with a tympanic thermometer preoperatively and again on arrival to the PACU.

Simmons et al. (1992) reported no significant temperature difference throughout the perioperative period for patients wearing cotton blankets or Thermadrape covering when having general or regional anesthesia. Regardless of the type of covering, patients receiving general anesthesia arrived in the PACU with an average 0.27°C cooler temperature than those receiving regional anesthesia, independent of the type of covering worn. A possible explanation for this effect is that general anesthesia surgeries lasted approximately twice as long (Simmons et al., 1992). Due to results indicating equally effective results from both cotton blankets and Thermadrape coverings, Simmons et al.
suggests that the difference in the cost of each intervention merits attention for heath care administrators interested in curtailing health care costs.

In addition to studies of the use of warmed cotton blankets and forced warmed air, studies have been performed to determine the efficacy of warmed intravenous fluids. Ellis-Stoll, Anderson, Cantu, Englert, and Carlile (1996) performed a study to determine the effect of continuously warmed intravenous fluids on female patients undergoing laparoscopic cholecystectomy procedures. A convenience sample of 50 patients was selected and randomly placed into the control or treatment group. Patients in the control group received standard pre-warmed intravenous fluids, which were allowed to cool to ambient room temperature during surgery. Patients in the treatment group received continuously warmed intravenous fluids at 37° C (98.6° F) via a fluid warmer. There were no reported differences in demographic factors between the patients in the treatment and control groups, and the patients had comparable surgical times.

Mean temperature results for both the treatment and the control group varied slightly throughout the intraoperative period (Ellis-Stoll et al., 1996). Ellis-Stoll et al. (1996) concluded there was no statistically significant differences in the groups mean intraoperative or postoperative temperatures ($p<.05$), although patients in the treatment group maintained higher body temperatures. The authors determined that intravenous fluid warmers might not be cost-effective in preventing hypothermia in patients undergoing short surgical procedures. Small sample size and lack of control for extraneous variables limit generalization of the study results to other surgical populations.

A similar study using warmed intravenous fluids produced confounding results. Smith et al. (1998) evaluated whether warmed intravenous fluids versus room
temperature intravenous fluids resulted in less hypothermia, as defined by a core temperature of less than 35.5° C (95.9° F). Thirty-eight adult outpatients undergoing gynecological procedures greater than 30 minutes in length participated in the study. Patients were randomized into two groups: fluid warmed at 38° to 39° C (100.4 to 102.2° F) via a fluid warmer or the control group with room temperature fluid at approximately 21° C (69.8° F). Tympanic temperatures were measured at baseline and at 15-minute intervals after induction with general anesthesia. Temperature measurement was standardized through the use of equipment and technique.

Smith et al. (1998) found that core temperatures at the end of surgery were lower in the control group as compared with the warm fluid group (35.6° C +/- .1 vs. 36.2° C +/- .1 respectively). Surprisingly, there were no significant differences between the groups in time to discharge from the PACU or the incidence of shivering. Smith et al. (1998) concluded that warmed intravenous fluids in addition to standard heat conservation methods were effective in maintaining normothermia during outpatient gynecological procedures; however, there was no substantial improvement in patient outcomes such as decreased incidence of shivering and decreased time to discharge from PACU (Smith et al., 1998).

Summary

This chapter discussed Kolcaba’s Theory of Comfort Care and included a review of relevant research regarding the incidence, management, and prevention of unplanned hypothermia in surgical patients. Kolcaba’s Theory of Comfort Care provides theoretical support for this study. The management and prevention of unplanned perioperative
hypothermia leads to a higher level of comfort and more positive outcomes for surgical patients.

Despite the availability of advanced technological devices and practices to prevent hypothermia, it remains an ongoing problem for surgical patients (ASPAN, 2002). To address this concern a clinical guideline was developed and published in 2001 by the American Society of PeriAnesthesia Nurses. The intent of the Hypothermia Guideline was to provide practitioners a standard of practice for the prevention, care, and management of the surgical patient with unplanned perioperative hypothermia. The Hypothermia Guideline has five established goals which include: (1) establishing a definition for normothermia, (2) establishing a definition for hypothermia, (3) alerting perioperative health care providers to the importance of maintaining perioperative normothermia, (4) providing ways to address the management of unplanned perioperative hypothermia, and (5) improving patient outcomes by establishing strategies to maintain perioperative normothermia (ASPAN, 2002). The Hypothermia Guideline has defined hypothermia as a core temperature of less than 36°C (96.8°F) or if the patient reports feeling cold or presents with physical signs of hypothermia (ASPAN, 2002). This hypothermia definition provides nursing with a standard definition of hypothermia and a standard of practice.

Studies found in the review of literature indicate that the rate of hypothermia varies with the type and length of surgery (Atkin, 1998; Stoneham et al., 2000). Ensminger and Moss (1999) and Hudson et al. (1999) performed quality performance improvement programs related to hypothermia in surgical patients, and both studies reported a low incidence of hypothermia. Following the implementation of education
related to the causes and prevention of hypothermia and standardized thermoregulation care protocols, the rate of hypothermia decreased even further. It is imperative to note however that these studies defined hypothermia as temperatures less than 35°C and 35.5°C (95°F and 95.9°F), respectively.

Atkin (1998) reported contrasting results in a study of patients who underwent vascular, orthopedic, and general surgery. The overall hypothermia rate was found to be 52%; patient who had knee replacements and hip replacements had an incidence of significant hypothermia of 88% and 69%, respectively. This study indicates the importance of the type and length of surgical procedure performed in determining the incidence of hypothermia.

Every patient undergoing a surgical procedure is at risk for developing unplanned perioperative hypothermia (ASPAN, 2002). According to nursing literature, surgical patients are prone to a number of conditions that occur throughout the perioperative period that predispose them to hypothermia. Contributing factors that are associated with an increased risk for unplanned perioperative hypothermia include extremes of ages including pediatric patients and elderly individuals, female sex, cold ambient room temperature, length and type of surgical procedure, metabolic status, pre-existing health conditions, use of cold prepping and irrigating solutions, skin exposure, and use and type of anesthesia (Arndt, 1999; ASPAN, 2002, Atkin, 1998; Burns, 2001; Connor & Wren, 2000; Ensminger & Moss, 1999; Sessler, 2001). Although these variables are widely published in nursing literature, research to support this claim was not found in the literature review. Major bowel, vascular, and orthopedic surgeries have been noted to be at an increased risk for perioperative hypothermia due to the length of procedure, amount

As a result of perioperative hypothermia, various physiological effects may occur including patient discomfort from shivering, diminished level of consciousness, altered cardiac function, impaired platelet and coagulopathy function, and altered drug metabolism (Arndt, 1999; Atkin, 1998; Burns, 2001; Connor & Wren, 2000; Sessler, 2001). Other negative consequences that the patients may experience from perioperative hypothermia may include impaired wound healing, increased prevalence of infection, delayed emergence from anesthesia with prolonged stays in the postanesthesia unit, lengthened hospital stays, and increased rate of mortality (Arndt, 1999; Atkin, 1998; Beilin et al., 1998; Bock et al., 1998; Burns, 2001; Connor & Wren, 2000; Flores-Maldonado, Medina-Escobedo, Rios-Rodriguez, & Fernandez-Dominguez, 2001; Kurz et al., 1995; Lenhardt et al., 1997; Sessler, 2001). Because of these potentially serious complications, maintaining perioperative normothermia has become a priority for perianesthesia nurses.

The use of both passive and active warming devices are actively researched in nursing literature, however inconsistent results have been obtained, leading to the concern that there may be inconsistent use of warming interventions for patients at risk for and experiencing unplanned perioperative hypothermia. This also indicates a need to continue to evaluate interventions for effectiveness. In a study by Fossum et al. (2001), results indicate that as the patients’ complaints of shivering increased, their level of comfort decreased. Fossum et al. (2001) concluded that temperature regulation appears
to be a key indicator of the patients’ perception of comfort throughout the perioperative period.

In conclusion, the literature review has produced several contradictory reports of the knowledge of unplanned perioperative hypothermia occurring in surgical patients, including varying incidence rates and inconsistent use of active and passive warming devices for the prevention and management of perioperative hypothermia. It was the goal of this study to determine the incidence of perioperative hypothermia in patients having selected surgeries, surgeries that have been reported in nursing literature to have higher than normal rates of hypothermia. The warming interventions currently used in care of the surgical patients were also evaluated and compared to the Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia developed by The American Society of PeriAnesthesia Nurses.
Chapter III

Method

The purpose of this chapter is to describe the methods used to address the research purpose and answer the research questions about the incidence of hypothermia in perioperative patients and factors that may affect hypothermia. This chapter begins with a description of the study design followed by a description of the patients in the sample. Next, a review of the materials required for the study, and the data collection procedure is provided. The chapter concludes with a description of the data analysis, including statistical tests to be performed followed by a chapter summary.

Design

A non-experimental design utilizing retrospective chart review was used to conduct this study.

Sample

The retrospective medical records review consisted of a convenience sample of 66 patients who had surgery at a small, rural hospital in a midwestern state. Inclusion criteria included adult surgical patients aged 18 years or older who underwent one of the following surgeries: total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, or open cholecystectomy. Patients less than 18 years of age, pregnant patients, and patients with a documented thermoregulatory disease including hypothyroidism, hypopituitarism, and neurosarcoidosis were excluded from the study.
Materials

A copy of the data collection tool that was used to collect information from the medical records is included in Appendix A. The following data was recorded from the chart onto the data collection tool: type of procedure, age, height, weight, gender, length of surgery, intra-operative fluid intake, temperature measurements with time taken (including preoperative, on admission to the PACU, on discharge from PACU, and on admission to the floor), amount of time in minutes from admission to PACU to the time the patient’s temperature reaches 96.8°F, and the use of warming interventions: preoperative, intra-operative, and postoperative (including warm blankets, layering of blankets, head wraps, forced air warming, warmed intravenous or blood products, and warmed irrigating solutions).

Data Collection

After obtaining Institutional Review Board (IRB) approval of the proposed study (See Appendix B), the investigator obtained a list of medical record numbers of persons who had a total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, or open cholecystectomy during a period of twenty four months prior to the start of the study at one small Midwestern hospital from the director of medical records. The investigator randomly selected every third patient from the obtained list. Each of the selected patient’s medical records was scanned for exclusion criteria: age of patient, pregnancy, and the presence of thermoregulatory disorders. Charts were reviewed until the desired sample size was obtained. A power analysis indicated that a sample size of 34 patients with complete data would achieve sufficient power. However, based on other studies, the researcher
anticipated reviewing a larger number of charts. No patient identifiers were recorded. The patient list was destroyed at the end of data collection. Data was then entered into an electronic database and analyzed using SPSS.

Assumptions

An assumption of this retrospective study was that nurses were documenting care provided, including the assessment of the patient’s temperature and the implementation of warming interventions. The calibrations of the institution’s thermometers were considered accurate.

Limitations

The medical record review was limited to patients who live in a limited geographic area, and was subject to selection bias as a result of convenience sampling of charts for review. Unforeseen inconsistencies in documentation may have limited the study.

Data Analysis

Each primary study variable was analyzed using descriptive statistics and graphical representation where appropriate. The first three research questions related to the incidence of hypothermia were addressed using descriptive statistics. For the research questions examining the effect of demographic variables and warming interventions on perioperative temperatures, a repeated measured analysis was used with temperature measurement as the within subjects factor and demographic and intervention variables as the between subject factors.
Summary

This chapter described the methods used to address the research purpose and answer the research questions about the incidence of hypothermia in perioperative patients and factors that may affect hypothermia. After IRB approval the data for this study was gathered retrospectively from the medical records of patients who met the inclusion/exclusion criteria of the study. Following data collection, the data was analyzed using descriptive statistics and repeated measured analysis.
CHAPTER IV

Results

The purpose of this study was to determine the incidence of perioperative hypothermia in patients having selected surgeries including total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, or open cholecystectomy. This chapter contains a description of the sample that was used for this retrospective chart review. The statistical analysis of the data is presented as it relates to the research questions. The chapter concludes with a summary.

Sample

The retrospective medical records review consisted of a convenience sample of 66 patients who had surgery at a small, rural hospital in a midwestern state. The ages of the patients ranged from 28 to 93 with a mean of 57.9 years (SD= 17.15). There were 20 males (30.0%) and 46 females (69.7%). The average height of the patients was 65.7 inches (SD= 4.08), with an average weight of 182.3 pounds (SD= 46.51). The length of surgery ranged from 62 to 365 minutes with a mean of 122.7 minutes (SD= 60.35). The average intra-operative fluid intake was 1367.4 cc (SD= 770.5). A frequency table describing the surgical procedures experienced by the patients is presented in Table 1.
Table 1

*Frequency of Surgical Procedures*

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>N (66)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopedic Procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>53.0</td>
</tr>
<tr>
<td>Total Knee Arthroplasty</td>
<td>19</td>
<td>28.8</td>
</tr>
<tr>
<td>Total Hip Arthroplasty</td>
<td>10</td>
<td>15.2</td>
</tr>
<tr>
<td>Partial Hip Arthroplasty</td>
<td>6</td>
<td>9.1</td>
</tr>
<tr>
<td>Abdominal Procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>47.0</td>
</tr>
<tr>
<td>Exploratory Laparotomy</td>
<td>2</td>
<td>3.0</td>
</tr>
<tr>
<td>Abdominal Hysterectomy</td>
<td>19</td>
<td>28.8</td>
</tr>
<tr>
<td>Open Cholecystectomy</td>
<td>10</td>
<td>15.2</td>
</tr>
</tbody>
</table>

Due to the unequal distribution of numbers for each specific surgical procedure, data analysis was done using orthopedic procedures (N= 35) versus abdominal procedures (N= 31). Descriptive data about preoperative, PACU admission, PACU discharge, and floor admission temperatures for the total sample, orthopedic, and abdominal procedures is presented in Table 2.
Table 2

Temperatures for Orthopedic and Abdominal Procedures

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Total Sample</th>
<th>Orthopedic</th>
<th>Abdominal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Preoperative</td>
<td>97.9</td>
<td>.78</td>
<td>97.6</td>
</tr>
<tr>
<td>PACU Admission</td>
<td>95.5</td>
<td>1.39</td>
<td>95.3</td>
</tr>
<tr>
<td>PACU Discharge</td>
<td>95.8</td>
<td>.76</td>
<td>95.8</td>
</tr>
<tr>
<td>Floor Admission</td>
<td>96.1</td>
<td>1.28</td>
<td>96.0</td>
</tr>
</tbody>
</table>

The preoperative temperatures of the patients ranged from 96° to 100.9° F with a mean of 97.9° F (SD= .78). The PACU admission temperatures of the patients ranged from 92.8° to 99.7° F with a mean of 95.5° F (SD= 1.39). The PACU discharge temperatures of the patients (N= 35) ranged from 94.3° to 98° F with a mean of 95.8° F (SD= .76). The temperature of the patients on admission to the floor ranged from 93° to 99° F with a mean of 96.1° F (SD= 1.28). The amount of time from PACU admission to the patient’s temperature reached 96.8° F ranged from 0 minutes to 570 minutes with a mean of 167.9 minutes (SD= 141.55).

The use of warming interventions preoperative, intra-operative, and postoperative included warmed blankets, layering of blankets; head wraps, forced air warming, warmed intravenous or blood products, and warmed irrigating solutions. The only interventions used preoperatively were warmed blankets and layering of blankets, which was used for 48 patients (72.7%). Warming interventions used in the intra-operative phase included
warmed blankets, layering of blankets, forced air warming, warmed intravenous or blood products, and warmed irrigating solutions. The intervention used most frequently was warmed irrigating solutions. Warmed irrigating solutions were used for 64 patients (96.9%). The intervention used the least was forced air warming and warmed intravenous or blood products, which were used for 20 (30.3%) and 47 (71.2%) patients, respectively. Warmed blankets and layering of blankets were both used for 60 (90.9%) patients. Warming interventions used in the postoperative phase included warmed blankets, layering of blankets, head wraps, forced air warming, and warmed intravenous and blood products. The intervention used most frequently was warmed blankets and layering of blankets, which were used for 57 (89.1%) and 56 (87.5%) patients, respectively. The intervention used the least was head wraps. Head wraps were only used for 3 (4.7%) patients. Forced air warming was used for 24 (37.5%) cases, and warmed intravenous or blood products were used for 48 (75%) patients.

Thirty-nine patients (59.1%) received the standard care of layering of warmed blankets, but did not receive forced warm air intra- or postoperatively. In this study those patients who did not receive forced air warming are referred to as the unwarmed group. The remaining 27 patients (40.9%) were warmed via forced warm air intra- or postoperatively, and are referred to as the warmed group in this study. The temperatures of the patients with forced air warming verses those without are presented in Table 3.
Preoperatively, the average temperatures of the patients who received forced air-warming intra- or postoperatively were 97.5°F (SD=.60). The patients who received the standard care of warmed blankets and layering of blankets, but no forced air warming, had an average pre-operative temperature of 98.1°F (SD=.81). On admission to PACU, patients who received the standard care had an average temperature of 96.1°F (SD=1.37), and patients who received forced air warming had an average temperature of 94.8°F (SD=1.04). On discharge from PACU, patients who received the standard care had an average temperature of 96°F (SD=.72), and similarly patients who received forced air warming had an average temperature of 95.8°F (SD=.78). On admission to the patient’s room, the average temperatures of the two groups were again similar. Patients who received the standard care had an average temperature of 96.2°F (SD=1.13), whereas patients who received forced air warming had an average temperature of 96°F (SD=1.49).
Descriptive data about the temperatures of orthopedic and abdominal surgery patients in the warmed versus unwarmed group are presented in Table 4.

Table 4

*Temperatures of Orthopedic and Abdominal Patients by Intervention Group*

<table>
<thead>
<tr>
<th></th>
<th>Unwarmed Group</th>
<th>Warmed Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abdominal</td>
<td>Orthopedic</td>
</tr>
<tr>
<td>Temperatures (°F)</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Preoperative</td>
<td>98.3</td>
<td>.90</td>
</tr>
<tr>
<td>PACU Admission</td>
<td>96.1</td>
<td>1.43</td>
</tr>
<tr>
<td>PACU Discharge</td>
<td>96.2</td>
<td>.74</td>
</tr>
<tr>
<td>Floor Admission</td>
<td>96.3</td>
<td>1.20</td>
</tr>
</tbody>
</table>

For those patients who received the standard care only, there was a consistent trend. The abdominal surgery patients had consistently higher average temperatures in the preoperative, PACU admission, PACU discharge, and floor admission phases. For the patients who received the forced air warming, the average preoperative temperature of the abdominal surgery patients (97.6° F, SD=.46) was slightly higher than the orthopedic patients (97.5° F, SD=.63). However, both averages of the temperatures during PACU admission and PACU discharge were lower in the abdominal surgery patients than in the orthopedic surgery patients. On admission to the floor, both the abdominal surgery patients and the orthopedic surgery patients who received the forced air warming had average temperatures of 96° F.
Findings

The first three research questions addressed the incidence of hypothermia in the preoperative period, the immediate postoperative period, and on admission to the floor from the postanesthesia care unit in patients undergoing total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy. The number of patients experiencing hypothermia during each of the three surgical phases is listed in Table 5.

Table 5

*Incidence of Hypothermia*

<table>
<thead>
<tr>
<th>Surgical Phase</th>
<th>N (66)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>5</td>
<td>7.6</td>
</tr>
<tr>
<td>Immediate Postoperative</td>
<td>56</td>
<td>84.8</td>
</tr>
<tr>
<td>Admission to Floor</td>
<td>50</td>
<td>75.8</td>
</tr>
</tbody>
</table>

There were a small percentage of patients who presented in the preoperative period with hypothermia. Five patients (7.6%) had temperatures below 96.8°F prior to surgery. The highest incidence of hypothermia occurred in the immediate postoperative period with 84.8% of patients experiencing hypothermia upon admission to PACU. There were still a significant number of patients, 75.8% or 50 patients experiencing hypothermia, upon admission to the floor.

Not all patients’ temperatures were checked at discharge from PACU. Thirty-one patients either did not receive a PACU discharge temperature or the temperature was not...
charted. Of the 35 patients who had PACU discharge temperatures recorded, 33 patients or 94.3% had temperatures below 96.8°F.

The fourth research question was, “Are the warming interventions currently used in either the operating room or the postanesthesia care unit effective in the prevention and management of hypothermia prior to discharge from the postanesthesia care unit?” Initially, a repeated measure analysis was done with temperature as the within subject factor with four levels (preoperative, PACU admission, PACU discharge, floor admission) and two between subject factors: procedure group with two levels (orthopedic and abdominal) and intervention group with two levels (warmed and unwarmed). The warmed group consisted of those patients who received the forced air warming at some point during the perioperative phase; whereas the unwarmed group received only warmed, layering of blankets and no forced air warming. The distribution of patients across groups was unequal and there were a significant number of patients where the PACU discharge temperature was missing. After examining the mean temperatures for each procedure group, no significant differences were found in this analysis. The mean temperatures by procedure group are presented in Figure 2.
The pattern of mean temperatures by procedure groups was nearly identical. Considering these issues, the analysis was modified. A repeated measures analysis was done with temperatures as the within subject factor with three levels (preoperative, PACU admission, floor admission) and one between subject factor, the intervention group with two levels (warmed and unwarmed). The temperature x intervention group interaction effect was tested using the multivariate criterion of Wilks’ lambda ($\Lambda$). The interaction effect was significant [$\Lambda=.87$, $f(2, 63) = 4.71, p=.01$]. A graph of the mean temperatures for the warmed and unwarmed groups is presented in Figure 3.
Therefore, a repeated measures analysis was conducted separately for the warmed and unwarmed groups to follow up the significant interaction. For the unwarmed group, there was a significant difference among the temperatures \( \Lambda = .16, f(2, 37) = 95.31, p = .00 \). Paired t-tests were done for the temperatures in the unwarmed group. The mean difference in the preoperative temperature and the PACU admission temperature was statistically significant \( t(38) = 9.286, p = .00 \). The mean difference in the preoperative temperature and the floor admission temperature was statistically significant \( t(38) = 13.025, p = .00 \). The mean difference in the PACU admission temperature and the floor admission temperature was not statistically significant \( t(38) = -.550, p = .59 \).
For the warmed group, there was a significant difference among the temperatures $[\Lambda = .19, f(2, 25) = 52.04, p=.00]$. Paired t-tests were done for the temperatures in the warmed group. The mean difference in the preoperative temperature and the PACU admission temperature was statistically significant $[t (26) = 10.36, p=.00]$. The mean difference in the preoperative admission temperature and the floor admission temperature was statistically significant $[t (26) = 5.14, p=.00]$. The mean difference in the PACU admission temperature and the floor admission temperature was statistically significant $[t (26) = -4.12, p=.00]$.

In summary, the mean temperatures of patients who received forced air warming were consistently lower than patients who did not receive forced air warming. The mean temperatures for patients in both the warmed and unwarmed group were hypothermic by definition upon admission to the floor. The primary difference between the groups was that in the warmed group there was a statistically significant difference in the temperatures between PACU admission and floor admission that was not present in the unwarmed group.

The fifth research question was, “Do age, gender, and type of surgery affect the incidence of perioperative hypothermia?” The ages of the patients ranged from 28 to 93 with a mean of 57.9 years (SD= 17.15). After reviewing a frequency distribution of the ages, the patients were divided into the following groups: 18-49 years, 50-60 years, and 70 years and older. The incidence of hypothermia by age group and perioperative phase are presented in Table 6.
Table 6

*Incidence of Hypothermia by Age Group and Perioperative Phase*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Preoperative</th>
<th>PACU Admission</th>
<th>PACU Discharge</th>
<th>Floor Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 49 years</td>
<td>3 (13%)</td>
<td>20 (87%)</td>
<td>13 (92.9%)</td>
<td>17 (73.9%)</td>
</tr>
<tr>
<td>50 – 69 years</td>
<td>1 (4.5%)</td>
<td>19 (86.4%)</td>
<td>8 (100%)</td>
<td>17 (77.3%)</td>
</tr>
<tr>
<td>70+ years</td>
<td>1 (4.8%)</td>
<td>17 (81%)</td>
<td>12 (92.3%)</td>
<td>16 (75.8%)</td>
</tr>
</tbody>
</table>

Overall, the highest incidence of hypothermia occurred in the 18-49 year age group during PACU admission, with 20 patients or 87% experiencing hypothermia. The lowest incidence of hypothermia overall, occurred preoperatively with one patient (4.5%) in the 50-69 year age group and one (4.8%) in the 70+ year age group experiencing hypothermia. Chi-square tests were done to examine temperatures measured during the preoperative, PACU admission, PACU discharge, and floor admission by age group. There were no significant differences in the distributions of any of the temperatures by age group.

There were 20 male (30.0%) and 46 female (69.7%) patients’ records reviewed in this study. The incidence of hypothermia by gender and perioperative phase is presented in Table 7.
### Table 7

*Incidence of Hypothermia by Gender and Perioperative Phase*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Preoperative</th>
<th>PACU Admission</th>
<th>PACU Discharge</th>
<th>Floor Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>1 (5%)</td>
<td>17 (85.0%)</td>
<td>9 (90.0%)</td>
<td>11 (55.0%)</td>
</tr>
<tr>
<td>Females</td>
<td>4 (8.7%)</td>
<td>39 (84.8%)</td>
<td>24 (96.0%)</td>
<td>39 (84.8%)</td>
</tr>
</tbody>
</table>

During the preoperative period, one male (5.0%) and 4 females (8.7%) experienced hypothermia. At PACU admission there were 17 males (85.0%) and 39 females (84.8%) who experienced hypothermia. Nine males (90.0%) and 24 females (96.0%) experienced hypothermia at PACU discharge. Gender during the preoperative, PACU admission, and PACU discharge phases did not significantly affect the incidence of hypothermia. However upon admission to the floor, 39 females (84.8%) and only 11 males (55.0%) were hypothermic with temperatures below 96.8°F. There was a significant difference in the incidence of hypothermia upon admission to the floor between males and females [Pearson $\chi^2 (1, N = 66) = 6.73, p = .01$]. Females were more likely to be hypothermic on admission to the floor postoperatively.

As previously noted, data analysis was done using orthopedic procedures (N= 35) versus abdominal procedures (N= 31) due to the unequal distribution of numbers for each specific surgical procedure. The incidence of hypothermia for orthopedic and abdominal procedures throughout the perioperative phase is listed in Table 8.
Table 8

*Incidence of Hypothermia by Procedure Group and Perioperative Phase*

<table>
<thead>
<tr>
<th>Procedure Group</th>
<th>Preoperative</th>
<th>PACU Admission</th>
<th>PACU Discharge</th>
<th>Floor Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopedic</td>
<td>3 (8.6%)</td>
<td>31 (88.6%)</td>
<td>21 (95.5%)</td>
<td>26 (74.3%)</td>
</tr>
<tr>
<td>Abdominal</td>
<td>2 (6.5%)</td>
<td>25 (80.6%)</td>
<td>12 (92.3%)</td>
<td>24 (77.4%)</td>
</tr>
</tbody>
</table>

The highest incidence of hypothermia for the orthopedic and abdominal procedure groups was on admission to PACU, with 31 (88.6%) and 25 (80.6%) patients experiencing hypothermia, respectively. The lowest incidence of hypothermia for the orthopedic and abdominal procedure groups was preoperatively, with 3 (8.6%) and 2 (6.5%) patients experiencing hypothermia, respectively. Following chi-square analysis, it was determined that the procedure group did not significantly affect the incidence of perioperative hypothermia.

Additional data collected included the patient’s time to warming to 96.8° F. An independent *t*-test was performed to determine if there was a difference in the mean time to warming for the warmed group and unwarmed group. The mean time to warming for the patients in the unwarmed group (those that received only warmed, layering of blankets) was 157.3 minutes (SD= 140.5). Those patients in the warmed group that received forced air warming at some point in the perioperative phase had a mean time to warming of 182.9 minutes (SD= 144.3). There was no significant difference in the time to warming for the warmed and unwarmed groups 

\[ t(64) = -.72, p = .78 \]. The
intervention of forced air warming would have been discontinued upon discharge from the PACU. The time from floor admission to warming was not examined in this study.

Summary

The results of this study indicated that the incidence of hypothermia upon admission to PACU was 85%, and the incidence of hypothermia upon admission to the floor was 76%. Although not all patient’s temperatures were checked upon discharge from PACU, the incidence of hypothermia for those patients’ whose temperature was checked was 94%. It was determined that age and procedure group did not statistically affect the incidence of hypothermia. A statistically significant difference was found in the incidence of hypothermia upon admission to the floor between males and females, with females more likely to be hypothermic.

Overall, the mean temperatures of patients who received forced air warming were consistently lower than patients who did not receive forced air warming. The mean temperatures for patients in both the warmed and unwarmed group were hypothermic by definition upon admission to the floor. The primary difference between the warmed and unwarmed groups was that in the warmed group there was a statistically significant difference in the mean temperatures between PACU admission and floor admission. There was no significant difference found in the mean temperatures of the unwarmed group between PACU admission and floor admission. A discussion of the findings will occur in Chapter Five.
Chapter V
Discussion

This chapter discusses the findings of this research study as they relate to previous literature and the nursing theoretical framework. Conclusions will be drawn and limitations of this study will be addressed. The chapter will also include a discussion of the implications for nursing practice, education, and theory as well as recommendations for further research. Previous nursing literature findings about perioperative hypothermia focus on the incidence of hypothermia, predisposing factors contributing to hypothermia, warming interventions used in the perioperative period, and complications of hypothermia.

Incidence of Hypothermia

Throughout nursing literature the incidence of unplanned perioperative hypothermia is reported to be between 60 to 90% (Atkin, 1998; Connor & Wren, 2000; Ensminger & Moss, 1999). However, in the literature review varying rates of postoperative hypothermia were found. The first three research questions of this study addressed the incidence of hypothermia in patients having select surgeries, including total knee arthroplasty, total hip arthroplasty, partial hip arthroplasty, exploratory laparotomy, abdominal hysterectomy, and open cholecystectomy. The average incidence of postoperative hypothermia for both abdominal and orthopedic procedures combined was found to be 85%.

Two quality improvement studies reported the incidence of hypothermia to be as low as 3 to 23% (Ensminger & Moss, 1999; Hudson et al., 1999). In both of these studies however, the types and lengths of surgeries studied were not provided. In addition,
Ensminger & Moss (1999) and Hudson et al. (1999) defined hypothermia as temperatures less than 35°C (95.8°F) and 35.5°C (96°F), respectively, which was lower than the defined hypothermia limit for this study.

Two additional studies were found that provided varying rates of hypothermia related to the type and length of surgery (Atkin, 1998; Stoneham et al., 2000). Atkin (1998) found an overall rate of hypothermia to be 52%. However, the study also reported that patients who had total joint replacements of the knee and hip had significant hypothermia rates of 88% and 69%, respectively (Atkin, 1998). Although this is similar to the results of the current study, the patients who underwent bowel procedures had hypothermic rates of only 30% (Atkin, 1998). In contrast to these results, the current study determined that the procedure group (abdominal verses orthopedic group) did not significantly affect the incidence of hypothermia.

A study by Stoneham et al. (2000), reported a postoperative hypothermia rate of 33% in 18 patients undergoing elective aortic aneurysm repair, and statistically correlated the overall decrease in temperatures with the duration of time between induction of general anesthesia and surgical incision when patients were not actively being warmed. Although hypothermia was defined as core temperatures less than 36°C (96.8°F) in this study, all patients received prophylactic warming measures in the operating room, including a forced air warmer, a warming mattress, and warmed intravenous fluids (37°C or 98.6°F), when possible.

The review of literature indicated that certain groups of individuals including older adults and pediatric patients were at greater risk for perioperative hypothermia (Arndt, 1999; Connor & Wren, 2000). However, despite the physiological explanations...
as to why they may be at increased risk, no nursing research studies were found indicating their relative risks. Although this study was limited to patients aged 18 years and older, it was found that age group did not significantly affect the incidence of hypothermia.

This study did find a statistically significant difference in the incidence of hypothermia upon admission to the floor between males and females, with female more likely to be hypothermic. At the time of the literature review, no nursing research studies were found regarding gender differences related to postoperative hypothermia.

**Effectiveness of Warming Interventions**

The efficacy of warming measures, including both preventive and active warming measures, are presented in the nursing literature with inconsistent results. The studies found in the nursing literature review regarding the efficacy of warming measures were prospective studies. Therefore, the findings of this retrospective study add to the current body of literature.

In this retrospective study it was determined that the mean temperatures of patients who received forced air warming were consistently lower at all phases of the perioperative period than patients who did not receive forced air warming. Patients received forced air warming during either the intraoperative or postoperative period or both; with no patients receiving forced air warming preoperatively, even those presenting to the operating room hypothermic. The decision for the placement of forced air warming was nurse dependent. Patients who received the forced air warming were more severely hypothermic upon admission to PACU with an average temperature of 94.8°F.
Patients who only received the warmed, layering of blankets had an average temperature of 96.1° F upon admission to PACU.

Two nursing research studies found in the literature review evaluated the effectiveness of preoperative warming with forced air warming devices. Bock et al. (1998) found that an actively warmed group of patients using forced air warming devices for 30 minutes before the induction of anesthesia and during anesthesia had significantly less changes in core temperatures and decreased hypothermia during the perioperative stay. This resulted in decreased recovery room length of stay and an overall 24% reduction in total anesthetic costs (Bock et al., 1998). Additionally, Fossum et al. (2001) found that patients in a treatment group who received forced air warming preoperatively had statistically significant higher mean temperatures on arrival to PACU as compared to a control group.

When examining the use of forced air warming intraoperatively, two contrasting results were found in the literature review. Linwall et al. (1998) found that forced air warming intraoperative significantly preserves normothermia during extensive thoracic abdominal procedures. However, Simmons et al. (1992) reported no significant temperature differences throughout the perioperative period for patients wearing cotton blankets or a Thermadrape covering when having regional or general anesthesia. Regardless of the type of covering, the patients receiving general anesthesia arrived in PACU with an average temperature cooler than those receiving regional anesthesia. A possible explanation for this effect is that the general anesthesia cases lasted approximately twice as long (Simmons et al., 1992).
In the current study, the primary difference between the warmed group who received forced air warming at some point during the perioperative period and the unwarmed group was that in the warmed group there was a statistically significant difference in the mean temperatures between PACU admission and floor admission. Therefore, in the warmed group, the forced air warming was effective in that it raised the more severely hypothermic group up to a temperature level comparable to the unwarmed group. The mean temperature upon admission to the floor for patients in the warmed group was 96.0°F. For the patients in the unwarmed group, the warmed, layering of blankets did not significantly raise or lower their temperatures, but maintained their temperature at a consistent level. Their mean temperature upon admission to the floor was 96.2°F. Therefore, the mean temperatures for patients in both the warmed and unwarmed groups were still hypothermic by definition upon admission to the floor. The outcomes or complications of this significant rate of hypothermia were not addressed in this study.

These findings are in contrast to a study by Giuffre et al. (1991). Giuffre et al. (1991) found that patients receiving forced warm air systems during the recovery room stay had decreased lengths of stay, higher maintenance of normothermia, quicker return to normal temperature for hypothermic patients, and decreased amounts of shivering. No significant difference in the time to warming for the warmed and unwarmed groups was found in the current study.

Conclusions

Overall, the incidence of perioperative hypothermia found in this retrospective study was somewhat disappointing with 75.8% of the patients hypothermic upon
admission to the floor, and an average postoperative hypothermic rate of 85%. The Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia, as presented by the American Society of PeriAnesthesia Nurses (ASPAN) in 2001, defined hypothermia as a core temperature of less than 96.8°F. The Guideline also stated that hypothermia may also be present regardless of the patient’s temperature if the patient reports feeling cold or presents with physical signs or symptoms of hypothermia, which include shivering, peripheral vasoconstriction, and piloerection (ASPAN, 2002). According to the Hypothermia Guideline, following assessment of the patient, preventative and active warming measures are to be instituted depending on if the patient is determined to be normothermic or hypothermic, respectively. Preventative warming measures include the initiation of passive insulation, where as active warming measures is the application of a forced air convective warming device (ASPAN, 2002). In general, the care documented by the perianesthesia nurses in this study did not meet the criteria established in the Hypothermia Guidelines.

In this study, not all patients who had temperatures of less than 96.8°F received the forced air warming. The application of the forced air warming device was nurse dependent, and applied only for those patients who were more severely hypothermic. The forced air warming was effective for raising patient’s temperatures, however, the patient was often discharged to the floor prior to reaching a normothermic temperature. In following the Hypothermia Guidelines, the expected outcomes for the patient prior to discharge from PACU include (1) a minimum core temperature of 36°C (96.8°F), (2) resolution of signs and symptoms of hypothermia, and (3) patient’s verbalization of an acceptable level of warmth (ASPAN, 2002).
Limitations

A convenience sample was used limiting the generalizability of the results. Unforeseen inconsistencies in the documentation, including the lack of a PACU discharge temperature also limited the study.

Implications for Nursing Theory

Kolcaba’s Theory of Comfort (1994) was used as a framework for this study. Perianesthesia nurses must be advocates for patient’s safety and comfort throughout the surgical process. According to the standards of perianesthesia nursing practice, comfort is an important criterion for the initial, ongoing, and discharge assessment and management of the surgical patient. And furthermore, the prevention and management of unplanned perioperative hypothermia is a standard of care for perianesthesia nurses (ASPAN, 2002). By placing thermoregulation within Kolcaba’s framework, perianesthesia nurses are provided with a rationale for maintaining normothermia, enhancing patient comfort, and evaluating the effectiveness of comfort measures.

Generally, the care that was documented and collected in this study was not consistent with Kolcaba’s Theory of Comfort. Nurses were neither adequately evaluating nor managing patient’s temperatures according to the Hypothermia Guideline, and therefore were not enhancing the patients’ comfort within the physical and environmental contexts of experience. Without providing care that is consistent with the standards for perianesthesia practice, enhanced comfort in the form of thermoregulation cannot be achieved.
Implications for Nursing Practice and Education

The role of the Advanced Practice Nurse (APN) is in a state of constant change. In the current managed care environment, the pressure to be cost-effective and to make an impact on clinical outcomes is one of the greatest challenges for the APN. APN’s must be involved in and have direct input into decisions regarding the development and implementation of patient care standards. It is the responsibility of the APN, who is providing care to a specific population, that they are familiar with the standard treatment recommendations for that patient population. This assures that safe and appropriate care is being provided. APN’s must continually be aware of the most current research findings in order to educate themselves and others within their professional practice of nursing.

Recommendations for Further Research

1. Replication of the study over a longer period of time in order to obtain a larger sample.
2. Examination of the time (minutes) from floor admission to the time to warming to 96.8°F.
3. Examination of the outcomes of unplanned perioperative hypothermia.
4. Replication of the study following education on the prevention and management of unplanned perioperative hypothermia.
5. Examination of nurses’ decision making regarding treatment of hypothermia.

Summary

This study found the average rate of hypothermia in postoperative patients to be 85%. Females were statistically more likely to be hypothermic upon admission to the
floor than males. Forced air warming was typically applied to patients who were more severely hypothermic. Forced air warming was found to be effective in raising patient’s temperatures, however even patients who received forced air warming were often discharged to the floor prior to reaching normothermia.

This study revealed a high incidence of unplanned perioperative hypothermia and inconsistent use of warming measures. The care documented by perianesthesia nurses was not in agreement with the standards outlined in the Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia (ASPAN, 2002). As a result of these findings, it is logical that perianesthesia nurses must be educated on the standards of care. In accordance with ASPAN (2002), clearly there is a need to monitor for and prevent unplanned perioperative hypothermia from occurring in the surgical patient. A study by Hudson et al. (1999), found that by standardizing perioperative care in regards to maintaining patient temperature, there was a significant decrease in patient hypothermia, and this decrease resulted in improved clinical outcomes for patients and satisfactory levels of comfort.

Kolcaba’s Theory of Comfort (1994) can serve as a framework to guide patient care and evaluate the effectiveness of comfort measures, specifically comfort measure designed for the prevention and treatment of unplanned hypothermia. According to the standards of perianesthesia nursing practice, comfort is an important criterion for the initial, ongoing, and discharge assessment and management of the perianesthesia patient (ASPAN, 2002). Nurses and patients are more satisfied with health care when patients engage in health-seeking behaviors as a result of being strengthened by comforting measures (Wilson, & Kolcaba, 2004).
The results of this study can serve as an educative tool to perianesthesia nurses, as well as other nursing areas caring for patients with unplanned hypothermia. Nurses must be educated on the current recommendations and practice standards outlined in the Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia. Clarifying current practice standards and incorporating them into nursing practice ensures that adequate attention is placed on the prevention and management of unplanned perioperative hypothermia, and that safe quality care is provided to surgical patients.
References


Appendix A

Hypothermia Data Collection Tool

Age: ______ yrs  Height: ______ inches  Weight: ______ lbs

Gender:  ☐ Male  ☐ Female

Procedure:  ☐ total knee arthroplasty  ☐ total hip arthroplasty
            ☐ partial hip arthroplasty  ☐ exploratory laparotomy
            ☐ abdominal hysterectomy  ☐ open cholecystectomy

Length of Surgery ______ min  Intra-op Fluid Intake ______ cc

<table>
<thead>
<tr>
<th>Temp. (°F)</th>
<th>Pre-op</th>
<th>PACU Admission</th>
<th>PACU Discharge</th>
<th>Temp on Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken</td>
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<td>Method</td>
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</table>

Time from PACU admission to patient temperature reaching 98.6°F: ______ min

<table>
<thead>
<tr>
<th>Use of Warming Interventions</th>
<th>Pre-op</th>
<th>Intra-op</th>
<th>Post-op</th>
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</tr>
</thead>
<tbody>
<tr>
<td>warm blankets</td>
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<td>☐</td>
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<tr>
<td>layering of blankets</td>
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<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>head wraps</td>
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<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>forced air warming</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>warmed IV or blood products</td>
<td>☐</td>
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<tr>
<td>warmed irrigating solutions</td>
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<tr>
<td>Other</td>
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</tr>
</tbody>
</table>

APPROVED BY MCO IR

MCO IRB #104653
Appendix B

Medical College of Ohio
INSTITUTIONAL REVIEW BOARD

MEMORANDUM

TO: Debra Buchman, Ph.D., R.N.
Department of School of Nursing
MCO

FROM: Daniel Cipriani, Ph.D., P.T.
Vice-Chair, Institutional Review Board
Research and Grants Administration

DATE: March 5, 2004

SUBJECT: IRB #104653- Evaluation of the Incidence and Management of Perioperative Hypothermia

The above project was reviewed and approved by the Vice-Chair of the Medical College of Ohio Institutional Review Board as an expedited review (category #7). The requirement to obtain informed consent and/or authorization for use and disclosure of protected health information form has been waived, as this research does not include the collection of identifiable health information as defined by the HIPAA Privacy Rule. It was determined that this waiver for informed consent and authorization for use and disclosure of protected health information form at this site will not adversely affect the rights and welfare of the participants. This approval is in effect until the expiration date listed below, unless the IRB notifies you otherwise. This review and approval includes the data collection tool being used for this research. The full board will review this research at its meeting on 05/20/2004.

APPROVAL DATE: 03/05/2004
EXPIRATION DATE: 03/04/2005

NOTE: ALL of the materials (data, documents, records, or specimens) to be utilized in this project must “have been collected, or will be collected solely for nonresearch purposes* (such as medical treatment or diagnosis)” [Expedited category description as revised, effective November 9, 1998]. (* MCO IRB emphasis)

All information - that which is pertinent to the research project and that which is incidental to the project - must be handled at all times in a manner to protect patient confidentiality and privacy.

It is the Principal Investigator’s (P.I.’s) responsibility to:

1. Abide by all federal, state, and local laws and regulations; the MCO federal assurance and institutional policies for human subject research and protection of individually identifiable health information including those related to record keeping and be sure that all members of your research team have completed the required education in these areas.

2. Promptly notify the MCO IRB at (419) 383-4251 of any untoward incidents or unanticipated adverse events that develop in the course of your research. Please complete and submit RGA Form 317 for ALL SUCH REPORTS for this protocol. The Principal Investigator is also responsible for submitting to the MCO IRB reports of adverse events that occur at other sites conducting this study and for maintaining an up-to-date cumulative table of adverse events (RGA Form 316) and submitting it to the MCO IRB for each research project. The Principal Investigator is responsible for reporting adverse events to the appropriate federal agencies and the sponsor (when one exists).
3. Report **promptly** to the MCO IRB any deviations or violations from the MCO IRB approved protocol in accordance with the procedures outlined in RGA Form 309. In your report include the protocol number and title, the subject's initials/specimen identifier (as appropriate) and study ID number, date of the event, a brief description of the occurrence and a description of any corrective actions taken. The Principal Investigator is responsible for reporting deviations, violations and participant non-compliance to the appropriate federal agencies and the sponsor (when one exists) in accordance with federal regulations, institutional policy and any other legal agreements with these organizations.

4. Obtain **prior MCO IRB review and approval** for changes in study personnel and for any and all changes/new information that may require additional information be provided to participants.

5. Report **promptly** to the MCO IRB, sponsor (if this is research is sponsored) and all other required federal and state agencies all new information affecting the risk/benefit ratio and obtain **prior MCO IRB approval** for any changes in the study documents that may be required by the new information.

6. Obtain **prior MCO IRB review and approval** for all modified and/or added incentives going to the P.I., study coordinator, other study personnel, and/or the institution. These incentives may be in the form of money or other items of value, including, but not limited to, equipment, such as computers, and intangibles, such as frequent flyer miles.

7. **Promptly** notify the MCO IRB; other required MCO committees, departments or individuals; the sponsor (if this is research is sponsored); and all other required federal and state agencies of any potential conflicts of interest before beginning this research and, during the course of this research report to these committees, individuals and agencies any changes that may affect conflict of interest for any of the study personnel. **Prior MCO IRB approval** must be obtained for any changes in the study documents that may be required by information related to conflict of interest or any changes in this information during the course of the research.

8. **Promptly** notify the MCO IRB of any changes in contracts, budgets, grants or other agreements with sponsors, agencies or individuals regarding the conduct of this research before initiating these changes. The IRB reserves the right to review these study related documents and changes to them to verify accuracy and consistency with regard to the research protocol in order to protect the rights and welfare of the study subjects. Changes in these documents that have the potential to affect the rights, welfare or willingness of the study subjects to participate in or continue to participate in this research and changes in subject documents (such as informed consent, assent or authorization for use and disclosure of protected health information forms, etc.) that are a result of these changes **must** be reviewed and approved by the MCO IRB **prior** to being instituted.

### Additional Information:

- **Other Required Review(s) or Approval(s)**
  Review or approval by the MCO Institutional Review Board/Privacy Board does not take the place of any other review or approval required by the Medical College of Ohio, non-MCO performance sites, the government and/or the study sponsor.

- **Required Procedure to Request Review and Approval for Changes/Updates to MCO IRB Approved Research**
  Please complete and submit the Request for Amendment/Changes/Updates (RGA Form 314 found at [http://www.mco.edu/research/rga_firms/rga314.doc](http://www.mco.edu/research/rga_firms/rga314.doc)) with a copy of all materials relevant to the requested change (including consent/assent/authorization for use and disclosure of protected health information forms if applicable) with the changes underlined. If you are requesting review and approval of consent/assent/authorization for use and disclosure of protected health information forms, please attach a clean copy of the revised forms for the MCO IRB to stamp. Please remember that all changes and correspondence submitted to the MCO IRB (regardless if they are generated by a sponsor, the P.I. or requested by the MCO IRB) must be in writing, signed and dated by the Principal Investigator.

- **Federally Mandated Continuing Review**
  MCO IRB protocols must be reviewed and reapproved **not less than once per year**. Research and Grants Administration will try to remind you when reapproval is due. **However, it is the**
responsibility of the Principal Investigator to have his/her own reminder system in place to initiate the re-approval process at least a month prior to the expiration date shown above. Please note that Federal Regulations prohibit the extension of this expiration date. Please see the Application for Continuing Review (RGA Form 319 found at <http://www.mco.edu/research/rga_frms/rga319.doc>) for items required for continuing review.

> **Required Final Report Upon Termination of Research:**
> When you decide to stop this research, you are responsible for completing and submitting a Final Report (RGA Form 320 found at <http://www.mco.edu/research/rga_frms/rga320.doc>) to the MCO IRB for review.

EASjm  

DHHS MPA # M-1358
Evaluation of the Incidence and Management of Perioperative Hypothermia
Pamela Diane Snyder

ABSTRACT

The purpose of this study was to determine the incidence of perioperative hypothermia in patients having selected surgeries. Additionally, documented interventions used to treat perioperative hypothermia were evaluated and compared to the Clinical Guideline for the Prevention of Unplanned Perioperative Hypothermia as developed by The American Society of PeriAnesthesia Nurses. This study utilized a non-experimental retrospective chart review and was guided by Kolcaba’s Theory of Comfort. This study demonstrated an average postoperative hypothermic rate of 85%. The mean temperatures for patients who received forced air warming were consistently lower at all perioperative phases. There was a statistically significant difference in the mean temperature between PACU admission and floor admission for patients in the warmed group. Therefore, forced air warming effectively raised the more severely hypothermic group up to a level comparable to the unwarmed group, however both groups were often discharged prior to reaching normothermia.