REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 1990	3. REPORT TYPE AND DATES COVERED Thesis/XXXXXXXXXXXXXXX

4. TITLE AND SUBTITLE	5. FUNDING NUMBERS
PERIOPERATIVE HEAT CONSERVATION: USE OF THE REFLECTIVE BLANKET, LEGGINGS, AND HEAD COVER ON THE SURGICAL PATIENT	

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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFIT/CI Wright-Ptatterson AFB OH 45433	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release IAW AFR 190-1 Distribution Unlimited ERNEST A. HAYGOOD, 1st Lt, USAF Executive Officer, Civilian Institution Programs	12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

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14. SUBJECT TERMS			15. NUMBER OF PAGES 50
			16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std 739-18
298-102

AD-A224 578

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LEGGINGS, AND HEAD COVER ON THE SURGICAL PATIENT

Michael E. Russell

B.S.N., University of Texas at Austin, 1985

A Thesis

Submitted in Partial Fulfillment of

the Requirements for the Degree of

Master of Science

at

The University of Connecticut

1990

APPROVAL PAGE

Master of Science Thesis

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LEGGINGS, AND HEAD COVER ON THE SURGICAL PATIENT

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1990

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CHAPTER 1

INTRODUCTION

Man is a homeotherm which means that he must maintain a core body temperature within narrow limits despite wide variations in ambient temperature. During surgery, patients are subjected to conditions that place them at risk for lowered body temperature (hypothermia). The anesthetic agents block the sympathetic nervous system, not only blocking pain, but virtually eliminating the primary contributor of heat production, muscle movement.

Heat loss occurs in four ways: radiation (from the body surface to the air), conduction (from direct contact with cooler substances), convection (from the movement of air), and evaporation (from the lungs and skin). Each manner in which heat is lost appears accelerated in the surgical patient. Examples are lack of covering, fluids administered at room temperature, high rates of room air flow, and scrubbing of the surgical site with volatile solutions.

Since heat production is compromised in the surgical patient, and its loss accelerated, conservation of heat takes on increased significance. The aluminized blanket, leggings, and head covering were designed to conserve heat by reflecting radiated heat back to the patient.

The purpose of this study was to determine if the reflective blanket, leggings, and head covering reduce the incidence of surgical hypothermia in patients who received regional block anesthesia (spinal/epidural).

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Statement of the Problem

In a zone of thermal neutrality, the environmental temperature is such that the heat produced is equal to the heat lost. For most adults, this neutral zone is considered to be 26-28 degrees Centigrade (°C) or 79-82 degrees Fahrenheit (°F). However, in practice it depends on the mean air temperature, relative air speed, vapor pressure, level of activity of the individual, and thermal resistance of clothing (Holdcroft, 1980).

Morris (1971) found a 100% incidence of hypothermia in patients whose surgical procedures were performed in rooms below 21 °C (70 °F). Vaughan, Vaughan, and Cork (1981) found the incidence of hypothermia to be at 60% in their study of 198 adult surgical patients, though ambient air temperature was not recorded. Stewart (1987), in a study of 110 surgical patients, noted an 85% incidence of hypothermia upon admission of surgical patients to the recovery room. These studies indicate that the surgical patient's ability to adapt to thermal changes was compromised.

Purpose of the Study

The purpose of this study was to determine if the use of the reflective blanket, leggings, and head covering had an impact on the mean temperature of the patient who received surgery under regional block anesthesia (subarachnoid/epidural). Furthermore, this study was to determine if these nursing interventions impacted upon the length of patient's stay in the postanesthesia care unit.

Research Questions

Two research questions were asked. The first question was: do patients who have reflective blanket, leggings, and head covering during surgery and the postanesthesia care phase have significantly higher mean body temperatures through the postanesthesia recovery period than patients who do not have the reflective coverings? The second question was: do patients who have reflective blanket, leggings, and head covering during surgery and the postanesthesia care phase have significantly different length of stays in the recovery unit than patients who do not have the reflective coverings?

Significance to Nursing

Criteria for discharge from the postanesthesia care unit is, in most cases, written by the department of anesthesia. Nurses are, at best, collaborative agents in establishing such criteria. However, the observation for signs of hypothermia, and the interventions appropriate for its treatment, that is, use of the reflective blanket, leggings, and head covering, fall entirely within the realm of nursing. In like manner, few physicians' orders pertain to patients' temperature making it even more apparent that nurses are responsible for the recognition and treatment of hypothermia and, when possible, its prevention. In light of the present nursing shortage, a study which would also observe the impact of these interventions on length of stay of the patient in the recovery room assumed an even greater importance.

Newman (1971) noted cardiac arrest, ventricular fibrillation, and prolonged recovery as sequelae associated with hypothermia. Failure to recognize the presence of hypothermia may delay appropriate nursing interventions such as infusion of warmed fluids, use of heating blanket, and/or surrounding the body with containers of heated fluids.

Regional block anesthesia is of particular concern in that it may mask the presence of hypothermia. Shortly after injection of the anesthetic, the patient notes a sensation of warmth in the lower extremities. This sensation is due in part to a peripheral vasodilation and temporary loss of sensory pathways. The peripheral vasodilation acts to reduce body heat, and the numerous cold receptors, located in cutaneous tissue, are unable to transmit impulses via the spinal cord. Feedback to the hypothalamic thermostat ceases. Deep body temperature receptors, located in the spinal cord, abdominal viscera, and around the great veins, are either delayed in responding, or are completely blocked due to the effects of the anesthetic agent (Guyton, 1936). Furthermore, the skeletal muscles in the lower extremities are temporarily paralyzed, virtually eliminating them as a source for heat production.

The elderly are at an even greater risk for hypothermia. Most have an inability to increase the respiratory quotient and produce heat. Inadequate vasoconstrictor response of the elderly patient leads to the escape of body heat through cutaneous blood vessels. Often, the aged patient has reduced muscle mass, further decreasing the capability of producing body heat.

Harvey (1987) predicted that the vast majority of future surgical procedures will be performed for diseases related to the aging processes. Also, because of the aging process, the elderly are often prime candidates for regional block anesthesia. Unfortunately, the combination of aging and regional block anesthesia may exacerbate an already high incidence of hypothermia and its associated problems.

Nursing interventions based on research and aimed at the prevention of postsurgical hypothermia would advance the science of nursing. The interventions of covering the head and the body with reflective sheeting should be based upon nursing's body of knowledge.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

The literature review focused on the major variables relevant to this study. Six studies addressed the use of covers in maintaining body heat, four used reflective material, one used warmed flannel blankets, and one used a plastic bag. Three studies observed for the effects of the amount of exposed body surface area on temperature. Two studies observed the relationship between room temperature and body temperature. Five studies focused on the effects age had on body temperature. Most of the literature noted specific times in which heat loss occurred, and three studies cited other variables associated with hypothermia.

Studies Using the Reflective Material

Radford and Thurlow (1979) used reflective blankets on 42 neurosurgical patients. They found no significant difference in temperatures of treated versus control groups during the surgical procedure.

Bourke, Wurm, Rosenberg, and Russell (1984) monitored esophageal temperatures on 60 carotid endarterectomy and 30 neurosurgery patients who were covered with the reflective blanket during surgery. Carotid endarterectomy patients in the experimental group never exhibited a drop in temperature and actually had a temperature rise within the first 30 minutes after application of the reflective blanket. Temperatures in the

control group continued to drop up to 60 minutes after surgical drapes were applied. Analysis of variance revealed a significant difference between groups at 60, 90, and 120 minutes after covers were applied. Neurosurgery patients experienced a drop in temperature regardless of treatment group.

Crayne and Miner's (1988) study attempted to treat hypothermia in the postanesthesia care unit. In their study of 18 patients, both control and experimental groups received warm blankets and head turbans on admission to the unit. The experimental group also received the reflective blanket. They observed a faster rewarming in the experimental group, though the difference in time was not significant.

Erickson and Yount (1989) studied tympanic temperatures in 60 patients undergoing abdominal surgery. These two researchers observed groups with head covering only; blanket and leggings only; head covering, blanket and leggings together; and a control group. The group that received reflective covers over the arms, trunk, and legs entered the recovery unit with a mean temperature 0.9 ºF (0.5 ºC) higher than the control group. Analysis of variance at $p < .05$ indicated the difference was not statistically significant.

Body Coverings of Other than Reflective Material

Body covering is not limited to reflective blankets. Biddle and Biddle (1985) studied the use of a plastic covering on 127 elderly patients. To prevent hypothermia, they placed a plastic bag completely over the head of the patient receiving general endotracheal anesthesia. They measured

nasopharyngeal temperatures at the start of the surgical procedure and again 60 to 70 minutes later. Data analyzed with an analysis of variance at $p < .005$ found heat loss significantly reduced in the experimental group. They stated that heat was preserved through the following measures: (a) providing conductive insulation by immobilizing the air, (b) reducing the intensity of radiation heat loss, and (c) preventing evaporative heat loss. This intervention, though effective for the general anesthesia patient, is inappropriate for the conscious patient under regional block.

White, Thurston, Blackmore, Green, and Hannah (1987) studied 37 elderly patients. They used extra heated flannelette blankets to cover exposed, unaffected areas of patients undergoing hip surgery. The blankets were warm when initially placed on the patient, but were not continuously heated. These researchers found significant differences in body temperatures between the group receiving the intervention and the control group.

Effects of Exposed Body Surface Area

Borchardt and Fraulini (1982) performed a retrospective study on the incidence of hypothermia. They observed that exposed large surface areas, as in major vascular surgery, were related to lower temperatures.

Similarly, Bourke et al. (1984) monitored surface area covered while they studied effects of reflective blankets on the neurosurgery and carotid endarterectomy patients. Even though they found limited success in the use of the reflective blanket, they concluded that at least 60% of the body surface area should be covered to provide effective heat conservation.

Finally, Erickson and Yount's (1989) study recommended use of the reflective blanket and leggings together, but noted that head covering alone had no beneficial effect on conserving body heat.

Effects of Operating Room Temperature

Morris (1971) and Rozien, Sohn, L'Hommedieu, Wylie, and Ota (1980) focused their research on the effects of operating room air temperature. Both studies found that a significant relationship exists between low room temperature and low body temperature. In Morris' study of 45 patients, he found that, in rooms below 21 °C (70 °F), there was a 100% incidence of hypothermia. In rooms maintained at greater than 24 °C (75 °F), there was no occurrence of hypothermia, however, staff discomfort was noted to be a problem. Morris (1971) further recommended that surgical procedures be performed in rooms maintained between 21-24 °C, a range in which hypothermia occurred only 30% of the time.

Rozien et al. (1980) focused on operating room temperatures prior to the draping of the patient. Subjects were exposed to "cold" (18.9 °C [66 °F] and below), versus "warm" (22.2 °C [72 °F] and above), operating rooms prior to draping. After surgical drapes were placed, room temperatures were set at the lowest values. These investigators found a difference in mean temperature loss prior to draping, with loss greater in the patients who underwent procedures in the "cold" rooms. However, they found no significant difference in mean temperature between groups on admission to the postanesthesisa care unit.

Age as a Variable

Goldberg and Roe (1966) observed temperatures in 101 adult surgical patients. Five patients showed temperature elevations, 18 patients presented no temperature change, and 78 patients exhibited a fall in temperature. These authors recognized that heat loss occurs in all age groups. Thermostatic regulators reappear during the recovery room phase, with shivering often seen as a prime example. Shivering is associated with a marked increase in oxygen consumption. They concluded that the elderly patient may have preexisting cardiovascular or pulmonary conditions, therefore, the increase in oxygen demand could be hazardous.

Vaughan et al. (1981) studied 198 adult surgical patients and found those over 60 years of age had significantly lower temperatures upon admission to and discharge from recovery.

Stewart (1987) concurs with Goldberg and Roe's (1966) findings, noting a higher incidence of hypothermia in patients over the age of 40. Her study of 198 surgical patients under general anesthesia also noted the incidence of hypothermia was 85% in the over 40 age group. In contrast, Morris (1971) and Crayne and Miner (1988) found no significant difference in hypothermia in young versus older age groups.

Time at Which Heat Loss Occurs

The last major variable studied in relation to hypothermia in the surgical patients was the time of its occurrence. Nearly every study conducted on the surgical patient found that the greatest drop in body

temperature occured either at the end of surgery or on admission to the recovery room (Borchardt & Fraulini, 1982; Goldberg & Roe, 1966; Stewart, 1987; Vaughan et al., 1981; White et al., 1987). Three studies (Goldberg & Roe, 1966; Morris, 1971; Rozien et al., 1980) also found that the period prior to the start of surgery was critical for heat loss.

Other Variables

In addition to the previous variables, Goldberg and Roe (1966) noted a higher incidence of hypothermia in patients receiving abdominal surgery. White et al. (1987) also found anxiolytics related to hypothermia in the aged and, finally, Vaughan et al. (1981) observed regional anesthetics to be associated with low body temperature.

Conceptual Framework

Healthy human beings maintain a core temperature of 36-38 ℃ (97-100 ℉), a range in which most bodily processes perform at optimum. Stability of the core temperature is continually challenged by forces both within and external to the body. Internal forces on temperature are usually associated with inflammatory reactions. External forces concern the climate to which humans are subjected.

To maintain an optimum core temperature, voluntary and involuntary adaptations to the environment must take place and be controlled by the processes of heat production and heat loss (see Figure 1). Variations of core body temperature of 2 ℃ (4 ℉) do not appear to severely affect the

functioning of bodily processes; while changes of 4 ºC (7 ºF) or greater have a profound effect. Life is considered incompatibile with a core body temperature outside the 28-45 ºC (82-113 ºF) range (Erickson, 1982).

Heat Production
  Voluntary (Skeletal Muscle Activity,
    Warm Food/Drink, Clothing)
  Involuntary (Shivering, Metabolism,
    Hormonal Response)

38 ºC
36 ºC

Heat Loss
  Radiation (Head/Skin)
  Conduction (Intravenous/
    Irrigation Fluids)
  Convection (Room Air Flow)
  Evaporation (Skin/Lungs)   **Healthy Temperature Range**
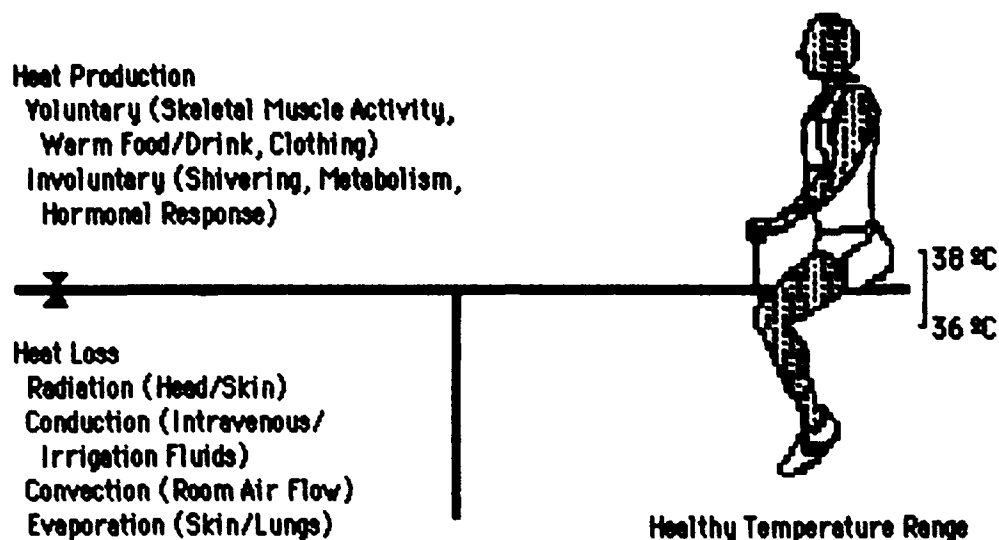
Figure 1. Factors that influence body temperature.

Factors Contributing to Heat Production

Voluntary temperature regulation. Adaptation to changes ir. temperature incorporates both voluntary and involuntary mechanisms. Voluntary regulation of temperature involves responses of skeletal muscle to sensations of heat or cold, thus modifying the rate of heat production or heat loss. The primary manner in which heat is produced is through

increased skeletal muscle activity. Skeletal muscle at rest contributes approximately 20% of the heat whereas, during activity, heat production may increase 10 times. Although heat production may be increased as much as 10 times, the net effect is less because of the increase in heat loss due to convection.

Involuntary temperature regulation Involuntary regulation encompasses mechanisms which detect changes in the body's temperature and a control system which counteracts those changes (Holdcroft, 1980). The hypothalamus is the primary involuntary temperature regulator of the central nervous system. The anterior hypothalamus is responsible for temperature sensing and the posterior hypothalamus for eliciting responses. Peripheral neurotransmitters relay cold sensations to the hypothalamus via the afferent pathways in the spinal cord and spinothalamic tract (Smith & Aitkenhead, 1985).

Involuntary means of producing heat include shivering and increasing the metabolic rate. Shivering may increase the metabolic rate by as much as five times.

In addition to these mechanisms, hormonal activity plays a part in heat production. The hypothalamus, thyroid, pituitary, and adrenal glands all affect heat production by altering the metabolic rate. Such hormonal response is slow and not considered significant in the treatment of hypothermia in the postoperative patient.

Factors Contributing to Heat Loss

Heat is lost through four mechanisms, radiation, conduction, convection, and evaporation. Radiation is chief among the body's heat loss mechanisms, with 85% of the surface of the human body being an effective radiating area. The amount of heat lost through radiation is affected by cutaneous vasodilation. Control of the cutaneous flow of blood regulates the amount of heat that is transferred from the core to the surface. Under normal conditions, the cutaneous blood flow can be reduced to the point that the outer inch of the body conducts very little heat (Holdcroft, 1980).

During regional block anesthesia, not only is vasoconstriction interrupted, but cold receptors are unable to transmit impulses to the hypothalamus which monitors and corrects changes in surface temperature. During this time of peripheral vasodilation, the heart continues to circulate to the brain warmed, oxygen-rich blood. It was observed that the unprotected head may lose half of the body's total heat produced in a cold environment (Rueler, 1978).

Conduction transfers heat by direct contact. This is especially significant since cold water conducts heat 32 times faster than air (Rueler, 1978). Large volumes of irrigation or intravenous fluids could adversely affect the body's ability to maintain heat

Convection involves the loss of body heat by particles of moving air. The body heats up a layer of air between itself and the environment, and the movement of air transfers this heat to the environment (Rueler, 1978). The surgical patient experiences heat loss when the drapes which contain

that layer of heat are removed. With shivering, the increase in temperature is not maintained due to the increased convection from body movement (Holdcroft, 1980).

Finally, evaporation from the skin and lungs acts as a means of reducing body heat. Less heat is lost via this mechanism than through any other but, when the patient's skin is prepared with volatile antiseptics, evaporation must be considered a contributing factor.

A Method to Conserve Heat

In order to limit the loss of body heat, the aluminized blanket was designed to reflect up to 80% of the radiant heat back to the body. According to Bourke et al. (1984) the reflective blanket could reduce patient heat loss in a 21 °C (70 °F) room from approximately 100 kilocalories per hour down to 40 kilocalories per hour. A head covering would be particularly beneficial, since the head can radiate as much as 50% of the total body heat which is lost (Rueler, 1978).

The Effects of Time

Time is needed for the body to return to a normothermic state postoperatively. Slotman, Jed, and Burchard (1985) state "the mortality of patients who remained hypothermic at two hours was significantly increased compared with that of normothermic patients" (p. 496). They also discovered fluid requirements were significantly greater for patients who remained hypothermic.

When the patient is admitted to the recovery room, the effects of the anesthetic are diminishing. Circulatory activity increases, and areas of the body that were anesthetized for surgery begin to regain function. This brings about a rapid rise in metabolism, thereby increasing body temperature (Borchardt & Fraulini, 1982; Stewart, 1987; Vaughan et al., 1981). Hypothermic humans, already in need of greater fluid requirements, have difficulty adapting to the added demand on the myocardium. They require a longer period in which to rewarm. Nursing interventions which reduce the incidence of hypothermia would, therefore, reduce the complications associated with hypothermia.

CHAPTER 3

METHODOLOGY

Design

A convenience sample was used in this quasi-experimental design. This was a pre-post two group design with subjects randomly assigned to treatment groups The independent variable had two levels, one with the reflective blanket, leggings, and head covering (experimental group), and one without (control group). The dependent variables were (a) mean core body temperature during the stay in the postanesthesia care unit, and (b) length of stay in the postanesthesia care unit.

Operational Definitions

The following operational definitions applied to this study:

Reflective blanket, leggings, and head covering. These consisted of a disposable aluminized sheeting (Thermadrape™; O.R. Concepts, Roanoke, TX). Leggings resembled large stockings which fully covered the leg from toes to groin. Head covering was bouffant style with an elastic band to ensure placement. The blanket, leggings, and head cover were placed on the subjects in the preoperative waiting area.

Mean body temperature. This was the mean temperature calculated on core temperatures taken on admission and every hour during subjects stay in the recovery unit. It was recorded with the infrared tympanic thermometer (ITT; FirstTemp™, Intelligent Medical Systems, Inc., Carlsbad, CA).

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Sample Population

The target population for this study was all adult elective surgical patients in the United States whose procedures are performed under regional block anesthesia (subarachnoid/epidural). Subjects were 18 years of age or older who received surgical intervention while under subarachnoid/epidural block anesthesia. Accessible population was all patients having surgery in a 300 bed community hospital in New England.

Criteria for patient selection were as follows: (a) 18 years of age or older; (b) received subarachnoid or epidural block as the primary anesthetic; (c) presented no preoperative temperature elevation; and (d) did not have, nor were scheduled to have, an amputation of an extremity. The following were rationale for the criteria: (a) individuals had to be 18 years of age or older in order to give legal consent for surgical intervention; (b) any agent, used as a primary anesthetic, other than subarachnoid/epidural block may influence the properties being examined; (c) the interventions of this study for prevention of hypothermia were inappropriate for preoperative temperature elevations; and (d) individuals with an amputated extremity would have less surface area and muscle mass involved for the loss of and generation of heat.

Loss of Subjects

Subjects could be lost from the study for the following reasons: (a) extreme temperature variations (hyperthermia or hypothermia) which would necessitate extensive thermal resuscitative measures, (b) subjects

with loss of covering for greater than ten minutes, (c) subjects requiring cardio-pulmonary resuscitation, (d) subjects noted to be febrile prior to surgery, and (e) subjects exposed to room temperatures of less than 19 ℃ (66 ℉) or greater than 24 ℃ (75 ℉).

Data was collected for reasons of loss.

Research Procedures

All patients who met the criteria were asked to participate in this study. They were given an informed consent (Appendix A) to read and sign. Random assignment to either the experimental or control group was made using the table of random numbers and the subject's study number.

Data was gathered preoperatively and during surgery on the Demographic and Intraoperative Data Sheet (Appendix B). Information included: (a) patient number, (b) age at last birthday, (c) sex, (d) height, (e) weight, (f) American Society of Anesthesiologists (ASA) classification, (g) surgical procedure to be performed, (h) data collection date, (i) temperature upon admission to the hospital, (j) temperature within six hours of the start of surgery, (k) temperature upon entry into the operating room, (l) temperature after site preparation, (m) temperature of the operating room at the start of surgery, (n) hourly temperatures during surgery, (o) anesthetic agent used, (p) level of anesthesia, and (q) percent of body surface area covered for the experimental group.

Item (f) of the demographic data refers to the patient's physical status as determined by the ASA classification. Categories are as follows: (a) Class 1, normal, healthy person; (b) Class 2, mild systemic disease;

(c) Class 3, severe systemic disease that limits activity but is not incapacitating; (d) Class 4, incapacitating systemic disease that is a constant threat to life; and (e) Class 5, moribund patient, not expected to survive 24 hours (Snow, 1982).

Both groups received routine intraoperative nursing interventions with the experimental group receiving the reflective blanket, leggings, and head covering prior to surgery. The researcher personally applied the blanket, leggings, and head covering to subjects in the experimental group and determined total body surface covered as per the Lund and Browder (1944) estimation of areas of burns chart (Appendix C). Caution was taken to keep the blanket and leggings dry during the prepping and surgical procedure and cover the subjects as much as possible. Body surface area covered by the reflective covering ranged from 54 to 91%, with a mean of 77.3%.

The subject was monitored during transfer to the postanesthesia care unit, and the continuity of the covers on those subjects in the experimental group was maintained. At the time of transfer, the covers were adjusted for maximum coverage resulting in 97% coverage for all subjects in the experimental group throughout the postanesthesia recovery phase.

Postanesthesia data consisted of time of admission and subject's temperature upon admission to the postanesthesia unit. Temperatures were recorded hourly. Upon subject's discharge from the recovery room, time of discharge and subject's temperature were recorded. The reflective covers were removed from experimental group subjects. Postanesthesia data was transcribed on to the Postanesthesia Data Sheet (Appendix D).

Instruments

Core temperatures of subjects were measured with the FirstTemp™ tympanic thermometer. Operating room temperatures were measured with a bulb thermometer. Time was measured with a unit wall clock.

FirstTemp™ infrared tympanic thermometer. For the purposes of data collection, the FirstTemp™ infrared tympanic thermometer was used. The FirstTemp™ thermometer consists of an otoscope-like probe, covered by a disposable speculum.

The FirstTemp™ thermometer automatically recalibrates itself each time the probe is returned to its cradle. Any further calibration of the instrument must be accomplished using the FirstTemp™ Model 2000A-CL Calibrator. This service was accomplished prior to the start of the study. Validity was checked twice during the study; once after gathering of data from fourteen subjects and, finally, at the end of the study. Validity performed in vitro, compared the thermometer provided to the researcher with a FirstTemp™ thermometer routinely used at a nearby hospital. At no time was there a difference of more than 0.2 °F (0.1 °C), thus falling within manufacturer's (0.2 °F) specifications (Intelligent Medical Systems, 1988).

Shinozaki, Deane, and Perkins (1988) compared the infrared tympanic thermometer with core temperatures measured by the thermistor tip of the pulmonary artery catheter and found a correlation coefficient of 0.98. During in vitro testing, Shinozaki et al., found the infrared tympanic thermometer to remain within 0.13 °C (0.23 °F) over a range of 34-39 °C.

Bulb thermometer. The researcher was unable to control operating room temperatures, however, room temperature was measured with a bulb thermometer. The same thermometer was used throughout the study, always placed at table height, approximately six feet away from the operating table, and away from any source of heat. Validity of the thermometer was checked with four other bulb thermometers, and at no time was there any difference noted between any of the bulb thermometers.

Unit clock. Time in the postanesthesia care unit was measured using the unit clock. Length of time was measured in minutes from time of admission to the postanesthesia care unit until discharge from that unit.

Hypothesis

There were two research hypotheses:

1. Subjects who have the reflective blanket, leggings, and head covering applied prior to surgery, and maintain these coverings until discharge from the recovery unit, will have statistically higher mean body temperatures through the postanesthesia recovery period.

2. Subjects who have the reflective blanket, leggings, and head covering applied prior to surgery, and maintain these coverings until discharge from the recovery unit, will have a shorter length of stay in the recovery room than the patients who did not receive these interventions.

Analysis

Statistical analysis consisted of a t test between the means of the temperatures between the groups and the means of the time of stay in the postanesthesia care unit. A chi square analysis was performed to evaluate the effectiveness of the reflective covers on preventing temperature loss of greater than 1.0 °F. A Pearson product-moment correlation coefficient was computed to examine the relationship between the amount of body surface area covered and body temperature. Statistical significance was established at $p < 0.05$.

CHAPTER 4

ANALYSIS OF DATA

Core temperatures were measured in 25 subjects who received subarachnoid/epidural anesthesia for surgical intervention. The experimental group subjects received reflective blankets, leggings, and head covers (n = 14). The control group (n = 11) did not receive reflective covers. Means of the means of groups' core temperatures measured in the postanesthesia care unit were compared. Also, means of the length of stay of the two groups in the postanesthesia unit were compared.

This chapter will present information on the study sample with findings of the statistical analysis testing the two hypotheses of this study.

Subject Sample Characteristics

Thirty-seven subjects were contacted and asked to participate, 33 (89%) agreed. Eight subjects (24%) were lost to the study after being brought into the operating room. Five subjects were placed on a circulating water blanket as routine for their surgical procedure. Though they were not being treated for hypothermia, they received measures appropriate for hypothermia, which was an exclusion criteria, and were, therefore, excluded from the study. Three subjects were placed under general inhalation anesthesia via endotracheal tube. They, then, did not meet study criteria. Complete data sets were gathered on 25 subjects: 14 (56%) in the experimental group and 11 (44%) in the control group.

Subjects ranged in age from 27 to 91 years with a mean age of 51.9 years for the total sample. Control group age ranged from 27 to 90, with a mean age of 49.4 years; while the experimental group ranged from 27 to 91, with a mean age of 53.9 years. The majority of subjects were at each end of the distribution, rendering an unusual U-shaped curve, and unusual standard deviation (±24.6 control, ± 22.6 experimental).

Gender was similar between the groups (control, 5 males, 6 females; experimental, 6 males, 8 females).

Homogeneity of variance was calculated on the remaining demographic, procedural, and environmental factors. As shown in Table 1, F ratio values indicate groups were not significantly different with regard to: a) age, b) height, c) weight, d) American Society of Anesthesiologists (ASA) classification, e) level of anesthesia, and f) operating room temperature.

Range for ASA was 1-3 for each group. Range for level of anesthesia was 1-9 for the control group, and 1-10 for the experimental group.

Anesthetic Agents

The type of anesthetic used was not significantly different between the control and experimental group. Twenty-one (84%) of the subjects received lidocaine (9 control, 12 experimental) for their regional block anesthesia. Of the four remaining subjects, three (12%) received tetracaine, (2 control, 1 experimental), and one (4%) experimental subject received bupivacaine.

Table 1

Comparison of Group Means of Demographic, Procedural, and Environmental
Factors (N = 25)

Factor	Control n = 11	Experimental n = 14	Level of Significance
Demographic Factors:			
Age (yrs)	49.4±24.6	53.9±22.6	p>.05
Low-High	27-90	27-91	
Height (in)	66.6±3.9	65.6±5.9	p>.05
Low-High	61-74	58-76	
Weight (lbs)	178.2±32.9	168.3±44.2	p>.05
Low-High	133-228	111-246	
ASA	1.6±0.5	2.1±0.8	p>.05
Procedural Factor:			
Anesthesia level	5.1±3.1	4.2±3.2	p>.05
Environmental Factor:			
Room temp (ºF)	71.5±2.0	70.9±2.1	p>.05
Low-High	69-75	67-75	

Note Values are means and ±SD.

Preoperative Temperature Screening

Data on preoperative temperatures was obtained from the subject's hospital record. This data was used to screen subjects for preoperative temperature elevation and not for data analysis or comparison of subjects. Preoperative temperature means were 98.1 ºF for the control group and, 98.2 ºF for the experimental group.

Data Analysis

Core Temperature Findings

Tympanic temperatures were measured on each subject on entry to the operating room, after surgical site prep, on admission to the postanesthesia care unit, and at discharge from that unit. Table 2 presents the comparison of mean core temperatures for each group at the four times recorded. An F ratio analysis indicated there was no significant difference between the groups

Figure 2 illustrates mean temperatures of the groups as measured on each subject on entry to the operating room, after surgical site prep, on admission to the postanesthesia care unit, and at discharge from that unit. Temperatures dropped slightly, 0.1-0.3 ºF, during surgical site preparation. At entry to the postanesthesia care unit, mean temperatures were the lowest (98.5 ºF, control and 99.1 ºF, experimental). The control group exhibited one degree Fahrenheit lower mean core temperature (98.9º versus 99.9º) than the experimental group at time of discharge from this unit.

Table 2

Mean Temperatures as Measured in ºF with the Fi₁ ₂ᵗTemp™ Thermometer

(N = 25)

Event	Control n = 11	Experimental n = 14	Level of Significance
Entry to O.R.	99.9±0.8	100.0±0.8	p>.05
Low-High	98.3-100.9	98.5-101.6	
After site prep	99.7±0.7	99.9±0.7	p>.05
Low-High	98.5-100.9	98.5-100.9	
Admission to PACU	98.5±0.9	99.1±0.8	p>.05
Low-High	97.5-100.0	98.1-100.5	
Discharge from PACU	98.9±1.3	99.9±1.1	p>.05
Low-High	97.5-100.7	98.0-101.7	

Note   Values are means and ±SD.

O.R. = operating room, PACU = postanesthesia care unit.
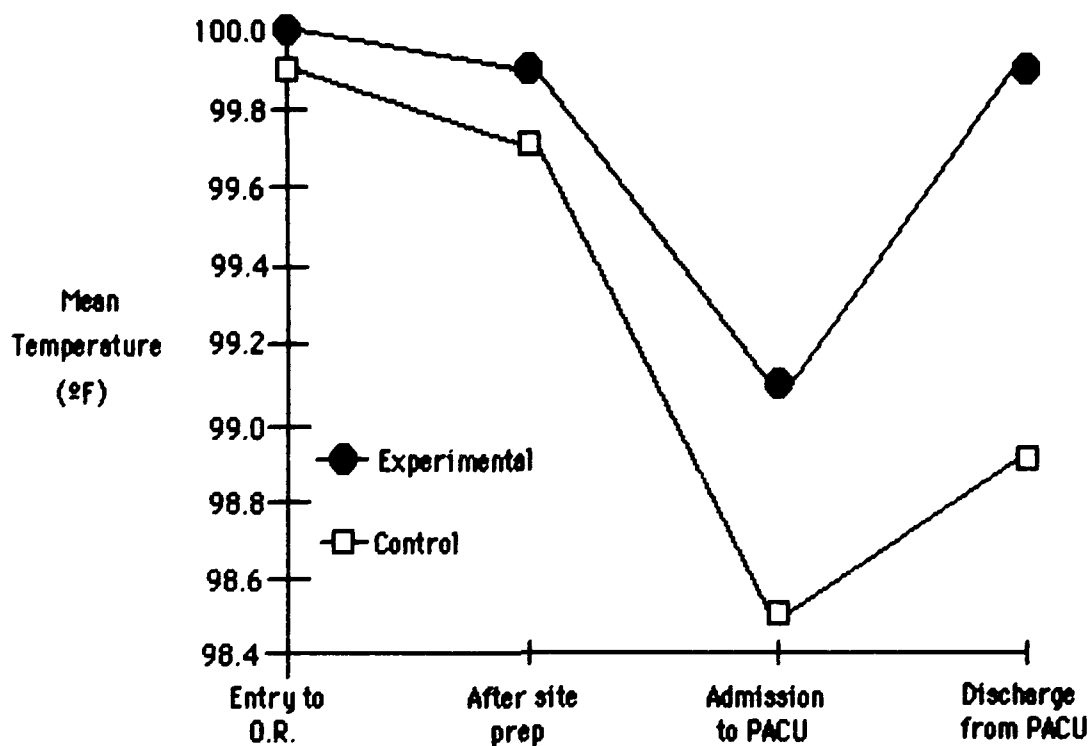
Figure 2. Mean temperatures at four times of measurement.

Hypothesis Testing

The first hypothesis stated that subjects with the reflective blanket, leggings, and head covering will have statistically higher mean body temperatures through the postanesthesia recovery period. A mean of the mean temperatures was calculated for each group. The control group demonstrated a mean core temperature of 98.6 ºF, while the experimental group showed a mean core temperature of 99.5 ºF. A directional t test indicated no significant difference between the groups, $t(23) = 0.81$.

The second hypothesis stated that subjects who have the reflective blanket, leggings, and head covering will have a shorter length of stay in the recovery room than the subjects who did not receive these interventions. The control group experienced a mean stay of 83.4 minutes, whereas, the experimental group remained in the unit for a mean of 89.1 minutes. Analysis of time in the postanesthesia care unit revealed a $t(23) = 0.03$, indicating no significant difference between groups.

Serendipitous Findings

Number of subjects with loss of greater than 1.0 ºF. The subjects were divided into groups according to temperature loss of greater than and less than 1.0 ºF from entry to the operating room to admission to the postanesthesia care unit. A two-by-two chi square (see Table 3) analysis was done. The tested chi square statistic was significant, $X^2(1, N = 25) = 9.000$, $p < .01$. The control group had significantly more subjects with heat loss than the experimental group.

Relationship of percentage of body surface covered to temperature. Pearson product-moment correlation coefficient was calculated on the experimental group to determine if a relationship existed between core body temperature and amount of surface area covered with reflective material. Body surface area covered by the reflective material ranged from 54 to 91%. The computed correlation coefficient indicated no significant relationship, $r(14) = -.253$.

Table 3

Chi Square Analysis: Number of Subjects with Temperature Loss of Greater than and Less than 1.0 ºF by Group Membership (N = 25)

	Control	Experimental	Total
Loss >1 ºF	9	3	12
	82%	21%	
	(6)	(7)	
	(55%)	(50%)	
Loss <1 ºF	2	11	13
	18%	79%	
	(5)	(7)	
	(45%)	(50%)	
Totals	11	14	25

Note. Chi square = 9.00,* df = 1, $p<.01$.
Parenthetical values indicate expected occurrence.

Difference in mean temperature by surgical procedure. Core temperatures were measured at entry to the operating room, on admission to, and at discharge from the postanesthesia care unit. Comparison of mean

group temperatures at those three times was made in different surgical procedures, with the results shown in Table 4.

The six subjects undergoing transurethral resection of the prostate exhibited the lowest core temperatures on admission to the postanesthesia care unit of either surgical group, control or experimental. The control group had a mean core temperature of only 0.2 ºF lower than the experimental group on admission to the recovery unit, however, increase while in the unit was only 0.1 ºF compared to 0.7 ºF for the experimental group

The experimental subjects with Cesarean delivery displayed less gain in the postanesthesia phase. However, they displayed only a 0.3 ºF drop overall compared to the 0.9 ºF drop in the control group.

As a final observation, subjects with arthroscopic surgery exhibited the greatest difference in heat exchange. The control group experienced a 1.5 ºF drop in mean temperature from entry to the operating room until admission to the postanesthesia care unit with only a 0.2 ºF rise in temperature while in this unit. By comparison, the experimental group lost only 0.8 ºF and displayed an increase of 1.3 ºF while in the recovery unit.

Table 4

Comparison of the Mean Core Temperature in ºF of Subjects having Three
Different Types of Surgical Procedures (N=17)

Event	Control	Experimental	Difference (ºF)
Transurethral Resection of Prostate			
n=	3	3	
Entry to O.R	99.7	99.9	+0.2
	(-1.8)	(-1.8)	
PACU admit	97.9	98.1	+0.2
	(0.1*)	(0.7*)	
PACU exit	98.0	98.8	+0.8
Cesarean Section Delivery			
n=	3	3	
Entry to O.R.	99.4	99.7	+0.3
	(-0.9)	(-0.3)	
PACU admit	98.5	99.4	+0.9
	(0.8*)	(0.6*)	
PACU exit	99.3	100.0	+0.7
Arthroscopy of Knee			
n=	2	3	
Entry to O.R.	99.7	100.3	+0.6
	(-1.5)	(-1.0)	
PACU admit	98.2	99.3	+1.1
	(0.2*)	(1.2*)	
PACU exit	98.4	100.5	+2.1

Note. (-) denotes temperature loss from entry to O.R. to PACU admit.

(*) denotes temperature gain from PACU admit to PACU exit.

Other subjects surgeries. The following procedures were performed on other subjects in the control group: a) incision and drainage of a perirectal abscess, b) vaginal hysterectomy, and c) open reduction, internal fixation of a fractured ankle.

The experimental group experienced these other procedures: a) lag screw reduction of a fractured hip, b) open reduction, internal fixation of a fractured ankle, c) total knee arthroplasty, d) resection of the sigmoid colon, and e) open reduction, internal fixation of a fractured knee.

Summary of Findings

Both research hypotheses were rejected. Mean core temperatures of subjects while in the postanesthesia care unit was not significantly different between the groups. Difference in length of stay in the postanesthesia care unit was not statistically significant. Significance did exist in the number of subjects in the control group with temperature loss of greater than 1.0 $^\circ$F when compared to the experimental group.

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

This study was designed to test the effectiveness of the reflective blanket, leggings, and head cover in conserving body heat through the postanesthesia recovery phase. Subjects received surgical intervention under regional (subarachnoid/epidural) block anesthesia. A convenience sample of 25 subjects (11 control, 14 experimental) received surgery in one clinical agency in New England. Core temperatures were measured on entry to the operating room, after site preparation, every hour during surgery, on admission to the postanesthesia care unit, every hour during the stay in the postanesthesia unit, and on discharge from that unit. Comparison was also made between groups in regard to length of stay in the postanesthesia care unit.

Results of this study indicate 0.9 ºF was not a significant difference between the two groups in terms of mean temperature during the subjects' stay in the postanesthesia care unit. There was only a 0.6 ºF difference between groups on admission to and a 1.0 ºF difference on discharge from the postanesthesia care unit. No significant difference was found between groups in regard to length of stay in the postanesthesia care unit.

Analysis of the occurrence of loss of greater than 1.0 ºF temperature from entry to the operating room to admission to the postanesthesia care unit was found to be significant, with the loss noted to occur more frequently in the control group (9 of 11) versus experimental (3 of 14).

Discussion

Findings Compared with Other Studies

Mixed results in the literature exist on the effectiveness of reflective coverings. Radford and Thurlow (1979) found there to be only 0.1 °C (0.2 °F) difference between the mean body temperatures of control and experimental groups during surgery even after as long as three hours of surgery. They found reflective covers had no impact on temperature during surgery

Bourke et al. (1984) discovered a significant difference in mean temperatures between groups after 60 minutes of surgery. However, they intervened during surgery with heating blankets in the control group, and then found no difference between group temperatures on admission to the recovery room.

Crayne and Miner (1988) studied reflective blanket effectiveness on hypothermic subjects. They used the reflective cover on the subject's arrival to the postanesthesia care unit. Crayne and Miner found the 0.5 °F difference between group means was not significant with the small sample size of 18 subjects.

Erickson and Yount (1989) measured temperatures in subjects with and without reflective covers who had major abdominal surgery under general anesthesia. They performed an analysis of covariance and discovered 0.9 °F to be a statistically significant difference between group temperatures on entry to the postanesthesia care unit (F = 5.241, p<.01). This was

accomplished after they accounted for five background variables that correlated with temperature on entry to the postanesthesia care unit. Background variables accounted for were pretransport temperature, age, body mass index, length of surgery, and coverage with a warmed cotton blanket on subjects arrival to the operating room. Erickson and Yount recommended the combination of reflective blanket and leggings to cover as much body surface area as possible, 75% or more.

This study found 0.9 ºF was not a significant difference between groups. However, this researcher did not account for background variables.

Effects of Operating Room Temperature

Operating room temperature, often associated with hypothermia, may have had a lesser impact on this study sample than one normally encounters. Only five subjects received surgical intervention in rooms colder than 70 ºF (67 ºF for 1 experimental, 69 ºF for 2 control and 2 experimental). All other surgical procedures were performed in rooms from 70-75 ºF, a range in which Morris (1971) noted only a 30% incidence of hypothermia.

Correlation Between Surface Area Covered and Temperature

The unusual nonsignificant negative correlation between percentage of surface area covered and temperature may be explained. Six experimental subjects, with the highest percentage of body surface area covered with reflective material, received continuous irrigation with large volumes of

room temperature fluids. Water conducts 32 times more body heat than does air, and the reflective covering was not designed to reduce heat lost through conduction. Mean temperature loss for the two groups with irrigation was greater than loss for subjects without irrigation.

Length of Stay in the Postanesthesia Care Unit

Several factors, other than temperature, may have impacted on length of stay in the postanesthesis care unit. This unit often experienced a high patient volume, and staff were often unavailable for transport of subjects. This often delayed discharge of subjects for as long as 20 minutes because of lack of staff to transport. Also, the postoperative surgical unit receiving the subject delayed transport due to lack of staff. This delay accounted for over 60 minutes on two occasions (1 control, 1 experimental). Though subjects met discharge criteria, they remained in the postanesthesia care unit until staff were available to receive the subject for patient care.

Another possible explanation for no significant difference in length of stay could be found in patient controlled analgesia (PCA). Many subjects received PCA. There was often a delay in orders being written for PCA or the medication being received from the pharmacy.

Temperature limits were not an established criteria for discharge from the postanesthesia care unit. Patients were monitored for hypothermia only if they appeared to be cold, or complained of extreme coldness, or physician orders dictated it.

Limitations

Subjects were chosen from a convenience sample, however, true random sampling was not possible in this study. Also, sample size must be considered a limitation of this study. Finally, data were limited to one clinical agency.

Implications for Nursing

The perioperative nurse recognizes hypothermia as a problem, and measures to correct this problem in the operating room environment are being tested. Hypothermia does not cease to exist once the patient leaves the operating room. This study, limited as it is in scope, suggests that reflective coverings impact on the number of subjects who experience heat loss. Findings from this study must be viewed critically and may require revision when tested in a different group or setting.

Recommendations for Future Research

Replication of this study with a larger sample size, performed in other geographic areas, would increase generalizability. Also, replication of this study observing for time from admission to the postanesthesia care unit until discharge criteria had been met could prove useful. The impact of irrigation fluids on the subject in this study suggests that more research in this area is needed.

Mean temperature differences between groups may not accurately provide information on the impact of heat loss. The physiological significance of heat loss could be studied. Such a study into the effects of heat loss on metabolism and oxygen consumption (Vo_2), with a goal to determine critical value(s) of that heat loss is certainly warranted. The critical point(s) could then be determined to be either an absolute value, such as Morris' (1971) study defining hypothermia as 36 °C (97 °F), or a temperature loss from a baseline value. This may not only provide clinically useful information, but could change the manner in which studies involving body temperature are examined and tested for significance.

Conclusions

Reflective covers have been shown to be clinically useful in conserving body heat in surgical patients. This study examined the effectiveness of Thermadrape™ covers on surgical patients receiving spinal or epidural anesthesia. Significantly fewer subjects with reflective blankets, leggings, and head covers lost more than 1.0 °F temperature from entry to the operating room to admission to the postanesthesia care unit than did those subjects who did not receive the reflective covers.

Mean core temperatures of patients measured with the FirstTemp™ thermometer showed a 0.6 °F difference between groups on admission to the postanesthesia care unit. The group receiving Thermadrape covers also exhibited a 1.0 °F higher mean temperature on discharge from that unit, suggesting added benefit in heat conservation with continued use.

APPENDICES

Appendix A

Patient Consent Form

University of Connecticut School of Nursing
Storrs, CT 06268

Dear Patient,

I am a masters degree candidate, requesting your voluntary participation in a nursing research study I am conducting. It has long been established that surgical patients experience low body temperatures during, and immediately after surgery. I am interested in finding out if the use of reflective blankets, leggings, and head coverings have an impact on conserving body heat. This blanket, leggings, and head covering are already in use in many hospitals throughout the United States. However, there is no known research in which they have been used together to effectively prevent heat loss.

There are no known risks in using these procedures, and of course, no costs to you for agreeing to participate. The benefits of this study will be the knowledge of whether the use of the reflective blanket, leggings, and head cover decrease the occurrence of low body temperature in future surgical patients. Whether you volunteer for this study, or not, will not change the care you receive. You are entitled to answers to any questions you may have regarding this study. You have the right to withdraw from this study at any time, and if you choose to do so, it will not influence the care you receive while you are here. Your identity will be safeguarded by identification of material only with a code number.

It is not the policy of the University of Connecticut or this hospital to compensate subjects in the event that a research procedure results in physical injury. The University of Connecticut and this hospital will, however, make its most advantageous recommendations upon request.

I the undersigned, have read this consent form. All my questions have been answered, and I freely and voluntarily choose to participate.
I understand that my rights and privacy will be maintained.

Researcher's Name: Michael E. Russell, BSN, RN   Phone: 646-1635
Advisor's Name : Kathleen A. Bruttomesso, DNSc, RN Phone: 486-4729
Subject's Name: _____ Date: _____
Witness's Name: _____ Study *_____ ___

Appendix B

Demographic and Intraoperative Data Collection Sheet

PATIENT ID #_____ HOSPITAL _____ STUDY #_____

AGE AT LAST BIRTHDAY_____YEARS

HT _____ WT _____
    Inches   Pounds

SEX
   Male   1
   Female 2

ASA CLASSIFICATION

___   ___   ___   ___   ___
 1   2   3   4   5

SURGICAL PROCEDURE TO BE PERFORMED _____

DATA COLLECTION DATE _____
                mo/day/yr

TEMPERATURE UPON ADMISSION TO HOSPITAL _____

TEMPERATURE WITHIN SIX HOURS OF START OF SURGERY _____

ROOM TEMPERATURE OF O. R. _____

TEMPERATURE UPON ENTRY INTO O. R. _____

TEMPERATURE AFTER SITE PREP _____   STUDY#_____

HOURLY TEMPERATURES WHILE IN O. R.

    1st hour _____

    2nd hour _____

ANESTHETIC AGENT USED _____

LEVEL OF ANESTHESIA

__	__	__	__	__	__	__	__	__	__
1	2	3	4	5	6	7	8	9	10
T - 6	7	8	9	10	11	12	L-1	2	3

% BODY SURFACE AREA COVERED _____

Appendix C

Estimation of Areas of Burns Chart

"The estimation of areas of burns" by C. Lund and N. Browder, (1944).
Copyright 1944 by Editors of <u>Surgery, Gynecology, and Obstetrics</u>.

Appendix D

Postanesthesia Data Sheet

TEMPERATURE UPON ADMISSION TO PACU _____   STUDY # ____

TIME OF ADMISSION TO PACU _____

HOURLY TEMPERATURES WHILE IN PACU

    1st hour _____

    2nd hour _____

    3rd hour _____

    4th hour _____

TEMPERATURE UPON DISCHARGE FROM PACU _____

TIME OF DISCHARGE FROM PACU _____

TOTAL TIME PATIENT IN PACU _____

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REFERENCES

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