Blankets Warmed to 200^{0}F. Do No Harm

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Overview

A warmed blanket is no longer considered just a comfort item for the surgical patient; it is also an important modality in maintaining a surgical patient in a normothermic state. Incidence of inadvertent hypothermia is estimated to occur in 50-90% of all surgical cases. Besides patient discomfort, consequences of even mild hypothermia can produce a host of adverse physiological and psychological responses. Evidence-based practices show that maintaining normothermia in a surgical patient from the time of admission into the preoperative holding area, through surgery, to discharge from the post anesthesia care unit (PACU) results in faster recovery and discharge, lower infection rates, reduced hospital costs, better thermal comfort, and increased patient satisfaction.[1]

The Surgical Care Improvement Project (SCIP), a national collaboration of healthcare organizations working to reduce surgical complications, states that maintaining a normothermic state in a surgical patient within the first 15 minutes after the patient leaves the operating room is a key measure to preventing infections. Initially, SCIP only monitored colorectal surgery patient populations, but now recognizes the value of hypothermia prevention for patients who receive general or neuraxial anesthesia lasting 60 minutes or more.[2]

Normothermia is defined as a core temperature from 36^{0}C to 38^{0}C. Hypothermia, defined as a core body temperature less than 36^{0}C, is classified as mild, moderate or severe:

Table 1	
Definition	**Core Body Temperature**
Mild Hypothermia	35.5^{0}C to 35.9^{0}C
Moderate hypothermia	35^{0}C and 35.5^{0}C
Severe hypothermia	less than 35^{0}C

The effect of hypothermia in the surgical patient is multisystem. Consequences of hypothermia may include:

- Increased energy expenditure as a result of increased oxygen consumption
- Hypothermic shivering which greatly increases oxygen consumption
- Increased risk for cardiac events such as bradycardia, premature ventricular contraction, atrial fibrillation, ventricular fibrillation
- Reduced medication metabolism with an increased duration of action
- Delayed recovery from anesthesia
- Impaired wound healing leading to increased risk of surgical site infection
- Increased respiratory distress[3]

Maintenance of the surgical patient in a normothermic state commences at time of admission to the preoperative unit. As part of the presurgical preparation and assessment, the nurse routinely asks the patient about feeling cold as well as monitoring temperature measurement. Intuitively, the nurse knows that by providing a warmed blanket the patient will not only feel warmer but also have a sense of comfort and well being. That intuitive knowledge has been validated through patient satisfaction measurement and improvement surveys conducted by independent healthcare research companies, such as Press Ganey.[4] The data allow hospitals to compare their satisfaction scores to peer groups, e.g., hospitals with the same bed volume, to benchmark their scores. One of the key drivers of patient satisfaction is that patients want to feel like their caregiver cares about their comfort. When patients talk about their comfort, they are not necessarily exclusively talking about narcotics or pain, but also the little things such as an extra pillow, pulling the curtain for privacy, and providing a warmed blanket. Delivering to the patient a warmed blanket that is almost at room temperature does not affect the patient's core temperature, foster the image of a caring environment, nor is it satisfying to the patient.

Technology

In the use of warmed blankets the question arises how hot can a blanket be before causing injury to the patient? In May 2005, the Emergency Care Research Institute (ECRI) issued a warning that fluid and blanket warmers be limited to a temperature no higher than 43°C (110°F) to decrease the risk of thermal injuries to patients.[5] ECRI further clarified their position in 2006, stating that while some warming cabinets may be designed with a wide range of temperature settings allowing a variety of temperature settings, patient safety and the prevention of thermal burns should be a primary concern. ECRI asserted that temperatures above 110^{0}F unnecessarily increased the risk of burns while

providing no added clinical benefit.[6] In July 2009, ECRI published a hazard report update changing the recommended safe temperature setting for blanket warmers to 130^0F with the provision that solutions would not be warmed in the same cabinet.[7] The Association of preoperative Registered Nurses (AORN) amended their *Recommended Practices for a Safe Environment of Care (2010)* to reflect ECRI's updated guidelines.[8] While the Joint Commission currently does not have any required range settings for the temperature of blanket warming cabinets, their environment of care standards (EC 6.10 and 6.20) require that institutions provide written plans concerning the effective, safe, and reliable operation of medical equipment.

There are currently no published reports or supporting evidence of patient injury or burns caused by overheated blankets. A review of the U.S. Food and Drug Administration (FDA) Manufacturer and User Facility Device Experience Database contains 192 problem entries from 1992 through 2009 in the category of patient thermal regulating devices.[9] All but four of the reports relate to active warming devices such as those that circulate hot water or air, or contain electric heating elements in contact with the patient. The four reports that involve warming cabinets describe control or safety circuits altered by users in three cases and one case of the warmer not heating adequately.

Using the principle of specific heat capacity, Jon K. Moon, PhD (physicist, MEI Research, Inc.) asserted that a blanket warmed to a temperature of 93^0C (200^0F) is incapable of causing thermal injury because the blanket does not transfer significant specific heat to the patient. Specific heat capacity, often termed specific heat, is the measure of heat energy required to increase the temperature of a unit quantity of a substance by a unit of temperature. For example, when boiling water (100^0C) is exposed to skin, the skin and water will equilibrate to a new, intermediate temperature. Because the skin and water have similar, specific heat and density (skin, like the rest of the body has high water content) the equilibrium temperature will be between the two starting temperatures. Boiling water at 100^0C will raise skin temperature at 31^0C to more than 55^0C (not halfway between because 31^0C and 100^0C because large amount of heat is dissipated into the atmosphere). At a temperature of 55^0C, tissue damage occurs very rapidly. However, if a cotton blanket heated to 90^0C is in contact with skin the patient does not experience the same tissue injuries, because the blanket has less than one third the specific heat of skin. In addition, the blanket has less than 1/1000 the density of skin (the density of a blanket is about $1Kg/m^3$ because it is roughly half cotton and half air.) The blanket can give up all of its heat to the skin yet raise the temperature no more than $1/80^{th}$ of the 70^0C temperature difference, or about 1^0C. Since there is little heat energy transferred to the patient, injury to the patient does not occur.

Clinical Studies

Many studies and papers have addressed the need to prevent hypothermia in the surgical setting, yet few studies have addressed the efficacy and safety of a warmed blanket. In an unpublished study, Texoma Ambulatory Surgery Center conducted a 100 patient (93 adults and 7 children) survey to determine patient satisfaction with blankets warmed in two separate warmers one at 110^0F and the other at 200^0F.[10] Blankets removed from the respective warmer were unfolded and placed on the patient. Surgical patients were asked to rate the blanket provided as warm or cool, indicate if they wanted the blanket to be warmer or cooler, and their level of satisfaction on a scale of 1-10 with 10 being the most satisfied. The nursing staff rated the patients' awareness level (scale of 1-5 with 5 being the most aware), recorded temporal temperatures at pre-placement of blanket, and post placement of blanket at the one minute and three minute interval; and observed the skin for evidence of damage or burns. Findings showed that, on an average, patients receiving a blanket warmed to 200^0F had a temperature increase ranging from 0.5-1.50^0C. When the patient received a blanket warmed to 110^0F, their temperatures did not change or increased by 0.2^0C. All of the patients were rated as five on the awareness scale. The staff did not report any perceived overheating or skin burns on any of the 100 participants using blankets warmed to 200^0F. Patient feedback indicated a preference for the warmer blanket over the cooler blanket and level of satisfaction was consistently rated as extremely satisfied. In addition, it was noted that the cost associated with providing warmed blankets rose when blankets were only warmed to a temperature of 110^0F. More blankets were used thereby increasing laundry costs and increasing staff time as they made more trips per patient to the warming cabinet to retrieve blankets.

A 270-bed hospital in Columbus, Ohio often used warmed blankets to increase the warmth and comfort of patients in the preoperative area. Patient complaints about the blankets not keeping them warm enough increased when the facility policy changed to comply with ECRI recommendations to

limit warming cabinet temperatures to no higher than 110^0F (43^0C). A comparison study was conducted by Paul Bujdoso, RN to determine if cotton-polyester blend blankets warmed in blanket warming cabinets at various temperatures were safe for patient care.[11] Three staff volunteers were asked to rate perceived warmth and comfort of three test blankets: unheated blankets, blankets warmed to 110^0F and blankets warmed to 150^0F, after one, three, and five minutes of blanket exposure. Using a scale of 1 to 10, the volunteers rated perceived feelings of warmth and comfort. Greatest satisfaction (9.3) was reported at one minute with the blanket warmed to 150^0F. Skin temperatures of the abdomen and lower legs were measured before placement of the blankets and at three minutes after placement of the blankets. Temperature findings can be found in Table 2.

No skin temperature increases greater than 10^0F were measured on any of the volunteers. While the volunteers reported an increase in perceived warmth and comfort, they did not experience overheating or burning with any of the three blanket temperature ranges.

A blanket removed from a warming cabinet and carried to the bedside loses heat when exposed to the environment. Dr. Moon wrote that a blanket warmed to 200^0F cools as much as 50 to 75^0F before it is placed over the patient, but the patient still perceives added warmth and comfort. However, a blanket removed from a warmer set at 110^0F will almost be at the same temperature as an unheated blanket by the time it is placed on the patient. The desired psychological effect of added warmth and comfort is lost with blankets only warmed to a temperature of 110^0F.

Conclusion

Unintentional hypothermia is said to be among the most common complications of surgery, even though it is easily preventable through proper patient warming. Maintaining patient normothermia is a standard of care that can positively affect surgical outcomes and prevent postoperative complications that can drive up healthcare costs. Mahoney estimated costs of treating hypothermia ranged from a low of $2,495.00 to a high of $7,037.00.[12] According to the American Society of PeriAnesthesia Nurses Clinical Guidelines for the Prevention of Unplanned Perioperative Hypothermia "The cost of perioperative hypothermia varies and can range from the cost of an extra warm blanket to increased patient morbidity and mortality."[13] Treatment of hypothermia begins with prevention. Selection of a warming modality is dependent on the perioperative situation; however, there is always a role for a warm blanket. Limiting the temperature settings on a warming cabinet so the blankets are barely above room temperature limits the therapeutic benefits of warmed blankets. The direct benefit of a warmed blanket may last only for a few minutes but the perception of comfort and psychological well-being last much longer and is the beginning of healing.

References

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Table 2

Average Warming	Unheated Blankets	Blankets Warmed to 110^0F	Blankets Warmed to 150^0F
Abdomen	0.3^0F	2.0^0F	4.3^0F
Lower Legs	0.6^0F	1.6^0F	2.0^0F

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