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Help! This Postanesthesia Care Unit Patient Is Hypothermic

LUCITA MAMON VILLAMIEL, RN, MS

Hypothermia is a common intraoperative and immediate postoperative complication. Hypothermia causes morbidity from shivering, hypotension, cyanosis, and respiratory diseases. In severe cases, bradycardia, premature ventricular contractions, and even ventricular fibrillation may occur. The various causes of excessive heat loss, both intraoperatively and during the postanesthesia period, the methods of prevention, and the rewarming measures are important factors in administering patient care. Predisposing factors are large exposed body surface areas, open body cavities, prolonged exposure to low operating room temperature, rapid infusion of cold blood and intravenous (IV) fluids, cold irrigating solutions, ventilation with cold gases in long surgical procedures, age over 60 years, premedication that relaxes muscle tone, and the subcutaneous vasodilatation that occurs during anesthesia. Attempted prevention measures include active warming blankets, increased ambient temperatures, warmed IV and irrigating solutions, and metallized plastic sheeting. Restoration of normal body temperature is achieved by radiant heaters, heated mattresses, and heated humidifiers. Astute assessment, quick response, and correct interventions by the nurse can often minimize risk of postanesthesia hypothermia. These principles are illustrated in a case study of a PACU patient in a large teaching trauma hospital.

HYPOTHERMIA is a frequent and sometimes overlooked cause of distress in postanesthesia patients. Astute assessment, quick response, and correct interventions on the part of the nurse can often minimize the patient's risk of postanesthetic hypothermia. The following case study was compiled from several incidents that occurred during this author's experience as a PACU nurse in a large teaching trauma hospital.

CASE STUDY

Mr B, a 64-year-old man, was admitted to the PACU. He had been a victim of a motor vehicle accident and had been flown in by a helicopter ambulance from the scene of the accident earlier that day. He had blunt trauma to the abdomen and an exploratory laparatomy, splenectomy for ruptured spleen, repair of lacerated liver, and evacuation of abdominal hematoma were performed under general anesthesia. He also had an open reduction internal fixation of a fractured right tibia and fibula. His facial lacerations were also repaired. His estimated blood loss in surgery was 1,500 mL, and his total urine output was 860 mL. He received 2 U of packed cells and a total of

Lucita Mamon Villamiel, RN, MS, is a Clinical Nurse at Hermann Hospital, Houston, TX.

Address correspondence to Lucita Mamon Villamiel, RN, MS, Rt 1, Box 1506, Pearland, TX 77584.

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3,800 mL of crystalloids. He was in surgery for 5 hours; anesthetic agents included a combination of isoflurane, succinylcholine, pancuronium, fentanyl, and etomidate.

Mr B's initial vital signs upon arrival in the PACU were as follows: blood pressure, 140/80; heart rate, 124 and irregular; respiratory rate, 28 beats/min and shallow; and rectal temperature of 94°F. The nurse immediately placed a face mask on with oxygen at 10 L/m and connected him to the electrocardiogram, blood pressure, and O_2 saturation monitors.

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Mr B was shivering, had cold and cyanotic extremities, and began moving restlessly in the PACU bed. When stimulated to wake up and asked how he felt, the patient complained of feeling "very cold." The nurse recognized that Mr B was exhibiting classic symptoms of hypothermia.

The nurse immediately placed freshly warmed blankets under and over the metallized plastic sheeting that was already draped over the patient. She then placed an overhead radiant heater over Mr B, changed the dry oxygen face mask to a heated humidifier oxygen mist, and changed the hanging intravenous (IV) fluids to warmed ones. She also planned to monitor the patient's temperature closely and to change the warmed blankets (every 15 minutes).

MECHANICS OF HYPOTHERMIA

Hypothermia, defined as a core body temperature below 95°F (35°C), is a common intraoperative and immediate postoperative complication. Despite the controlled setting of anesthesia and surgery, ill effects from hypothermia can be detrimental. Intraoperative and immediate postoperative hypothermia causes morbidity from shivering, hypotension, cyanosis, and respiratory distress.[1] Effects of anesthetic drugs are enhanced. Blood volume is decreased in hypothermic patients because of the intense peripheral vasoconstriction and fluid shifts from intravascular to extravascular spaces. As a result, the patient's heart rate and cardiac output ultimately fall. Hypertension initially is followed by hypotension with rewarming as vessels relax, demanding greater intravascular volume. Additionally, mortality is increased among postsurgical patients who have a prolonged postoperative hypothermia associated with intraoperative hypotension.[2]

Shivering, the body's normal compensatory response to cold, is a strong, involuntary muscle activity that increases tissue oxygen demand by as much as 400% to 500%.[3] When a person shivers, heat formation is increased by increased muscle activity. Anesthetized patients cannot warm themselves because muscle responses are chemically diminished. The hypothermic patient in the PACU often shivers violently, looks pale and has cyanotic extremities, and complains of being cold and extremely uncomfortable. Shivering could result in arterial hypoxemia in a patient who is already depressed by anesthetic agents.[4] Cardiac arrhythmias, such as bradycardia, atrial fibrillation, premature ventricular contractions, and even ventricular fibrillation, may occur in severely hypothermic patients.[5]

There are several ways to decrease heat loss and prevent hypothermia from occurring during anesthesia, surgery, and the immediate postanesthesia period. Reduction of heat loss has traditionally included use of active warming blankets, increased ambient temperature, warmed IV and irrigating fluids. More recently, metallized plastic sheeting, radiant heaters, heated mattresses, and heated humidifiers have been found to be effective in restoring normal body temperature.

HOW HEAT IS LOST

Body temperature is determined by the balance of heat production and heat loss.[6] If an individual is to remain in thermal equilibrium, the body must gain as much heat as it loses. On the skin surface, loss of heat occurs by conduction, radiation, evaporation, and convection.[7] Heat is produced by basal metabolism and by activity that includes muscle tone, movement, and shivering. During anesthesia and surgery, heat production is impaired because of decreased muscle tone and limited movement. During recovery from general anesthesia, compensatory thermostatic reflexes reappear. Shivering increases muscle activity to produce heat

and vasoconstriction to limit further loss occurring when the body temperature is low. Large, exposed surface areas, open body cavities, prolonged exposure to low operating room temperature, rapid infusion of cold blood and IV fluids, cold irrigating solutions, and ventilation with cold gases in long surgical procedures contribute to hypothermia. Age, premedication (which relaxes muscle tone), and subcutaneous vasodilatation that occurs during anesthesia also predispose a patient to development of hypothermia.

Age is one factor that contributed to Mr B's intraoperative hypothermia. Roe et al[1] found that body temperature decreased faster during surgery in elderly patients who were 60 years or older. Slotman et al[2] also found that elderly patients are more likely to become hypothermic after surgery. Elderly patients studied by Vaughan et al[3] also demonstrated a similar response with more pronounced and prolonged hypothermia compared with younger patients. Vaughan et al found that elderly patients had significantly lower temperatures upon arrival at the PACU, and their temperatures remained lower during the first 1.5 hours of their stay. In addition, older patients stayed hypothermic longer, and their discharge temperatures from the PACU were lower compared with younger patients. Vaughan et al[3] concluded that elderly patients have a decreased ability to regain normal, thermoregulatory control, which causes hypothermia in the operating room to extend into the immediate postoperative period.

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Mr B's prolonged surgical procedure is another factor contributing to his hypothermia. Mr B lost heat in the operating room through convection and radiation from prolonged body surface exposure during anesthesia and surgery. Despite drapings, patients experience heat loss in the operating room from exposure to low environmental temperature and humidity because operating room temperature is commonly set below 21°C.[8] The temperature is kept low to afford comfort for the operating room staff, who are well insulated in gowns, caps, masks, and gloves and who work in close proximity to heat-producing lamps. In a study performed by Morris and Wilkey,[9] the operating room temperature was maintained at 21°C or higher to keep the patient's temperature at the normal range of 36° to 37.5°C. Roizin et al[10] indicated that intraoperative use of warm fluids and warming blankets and placement of the patient in a warm room before surgical draping ultimately did not influence the patient's temperature on arrival at the PACU. Roizin et al found that the room temperature before draping did not affect early intraoperative heat loss.

Mr B was also rapidly infused with cold packed cells and cold IV fluids to replace massive blood loss and to prevent hypovolemia. Holdcroft and Hall[6] demonstrated that heat loss occurred during anesthesia and surgery because of infusion of cold IV fluids, especially in cases where large amounts were given, and from ventilation with cold gases in long surgical procedures.

The amount of radiation produced by the body is affected by subcutaneous vasodilation from the effects of anesthetic agents and from the absence of muscle movement. This process begins with premedication of the patient, which relaxes muscle tone, limiting voluntary movement and reducing heat production.

Recall that Mr B had general anesthesia. Some anesthetic agents, muscle relaxants, and regional techniques relax smooth muscle, causing vasodilation. Blood circulating at the skin surface promotes heat loss through the skin. Holdcroft and Hall[6] also found that a large amount of heat was lost, especially toward the end of anesthesia and during transfer of the patient to the PACU, despite the maintenance of the operating room temperature at 24°C.

Opening of the abdomen and chest cavity, as was done with Mr B, is also an important factor in increasing heat loss by evaporation of water from warm, moist, serosal surfaces.[7,11,12]

PREVENTIVE AND REWARMING MEASURES

Prevention of hypothermia preoperatively and intraoperatively can reduce some of the postoperative complications related to hypothermia. Nurses play a significant preoperative and intraoperative role in instituting preventive measures. Nursing interventions begin with use of a thermal or bath blanket during transport from the unit to the preoperative area. Placing another warm blanket over the patient in the cold operating room can also help

the patient feel more comfortable until surgery starts. Wehmer and Baldwin[13] found that covering the patient with warm blankets upon arrival in the operating room and immediately after sterile drapes were removed after surgery decreased the development of hypothermia.

Altering Environment

A warmer operating room and less exposure of the patient during induction of anesthesia and throughout surgery will reduce the tendency toward hypothermia. Morris and Kumar[8] found that warming blankets alone were not sufficient to keep the lightly anesthetized patient's temperature above 36°C, unless the operating room temperature was above 21°C.

A heated mattress insulates the patient from heat loss. The mattress should be covered with a warmed bath blanket before the patient is placed on it. Thermal mattresses prevent heat loss by increasing conduction of heat from the surroundings to the patient. Newman[14] found that patients placed on an insulated electric blanket during surgery had less significant temperature reduction compared with those who were not placed on thermal mattresses during surgery. In another study, however, a limited benefit of using a heated mattress in preventing hypothermia in surgery was found.[8]

Evaporation heat loss can occur from wet towels and drapes in direct contact with the patient's body during surgery. This situation can be remedied by using plastic adhesive drapes applied directly to the patient.

Mechanical Interventions

Prewarmed IV fluids and transfusing blood through a blood warmer can help maintain the patient's temperature in the normothermic range.[14] In a study of patients undergoing peripheral vascular surgery, Newman[14] found that a combination of an electric blanket placed under the patient and infusion of warmed IV fluids resulted in a temperature fall of only 0.5°C or less. Solutions used to irrigate operative wounds can also be prewarmed.

Inhalation of heated humidified oxygen is another technique to prevent heat loss. Tausk et al[15] found that humidifying the patient's gases during prolonged anesthesia decreases lung damage and prevents the development of hypothermia.

A reflective blanket is especially effective to reduce intraoperative hypothermia when the surgical procedure does not involve opening the body cavities. Bourke et al[16] demonstrated that using a reflective blanket (the aluminized Tyvek 1443), which reflects 80% of radiated heat in a 21°C operating room, can reduce radiant heat loss when more than 60% of the body surface area can be covered. Dyde and Lunn[11] found that wrapping the lower half of the body of a patient about to undergo a thoracotomy with metalized plastic sheeting reduced heat debt and almost eliminated the fall in body temperature during surgery. Recently, Crayne and Miner[17] showed the reflective blanket to be effective as a rewarming device in the PACU.

Bernard et al[18] demonstrated that the use of a heating humidifier of anesthetic gases combined with a reflective blanket were effective in slowing the development of hypothermia. Pflug et al[19] found that using warm, humidified, anesthetic gases during surgery provides heat transfer by the lungs, which thus also prevents hypothermia.

PACU Considerations

Before transfer to the PACU, care must be taken to not expose the patient. The patient should be covered with warm thermal blankets immediately after removal of surgical drapes. Holdcroft and Hall[6] found that despite the maintenance of environmental temperature during the surgical procedure, there was a significant decrease in skin temperature during transfer of the patient from the operating room to the PACU.

In the PACU, active external measures should be continued to gradually rewarm the patient

In the PACU, active external measures should be continued to gradually rewarm the patient. The reflective blanket should be left on the patient and a newly warmed bath blanket should be added and changed at intervals. The use of prewarmed IV fluids and warmed blood should also be continued if initiated in the operating room. The radiant heat shield can also be used to rewarm the patient. This

heat source should be placed primarily on the trunk of the body and should extend outward to the extremities.

Various researchers[6,7,12,18] have found that a combination of several known preventive and rewarming measures are more effective in conserving heat loss and expediting return of the patient's temperature to a normothermic level than one measure used alone.

After 2 hours in the PACU unit, Mr B was transferred out of the PACU to the surgical intermediate care unit with stable vital signs (blood pressure, 124/80; heart rate, 76; respiratory rate 16; and oral temperature of 98.4°F); he was awake, alert, and comfortable. The immediate action of Mr B's PACU nurse in recognizing the signs and symptoms of intraoperative postanesthetic hypothermia and acting appropriately helped to prevent a further decrease in Mr B's temperature and to return him to his preoperative normothermic level.

SUMMARY

The various causes of excessive heat loss, both intraoperative and during the postanesthesia period, methods of prevention, and rewarming measures are important factors in administering patient care. Nurses play a significant role in these preventive and rewarming processes. Astute assessment, quick response, and correct intervention by nurses lessen the frequency of hypothermia.

Effects of hypothermia during surgery may not be seen until the patient is recovering in the PACU, when the need to replace the heat loss causes complications. The patient's temperature must be monitored closely and a combination of rewarming measures must be initiated immediately if not begun previously in the operating room. Preventive and rewarming measures initiated in the operating room should be continued during the immediate postanesthesia period to prevent complications resulting from further heat loss.

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