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What's Wrong With This Picture?

Clearing the confusion over wrong-site, wrong-patient, wrong-procedure cases. **P. 32**

- Wrong-site joint prosthesis
- Four real-life wrong-site cases
- Never skip a timeout again
- Safely mark the surgical site

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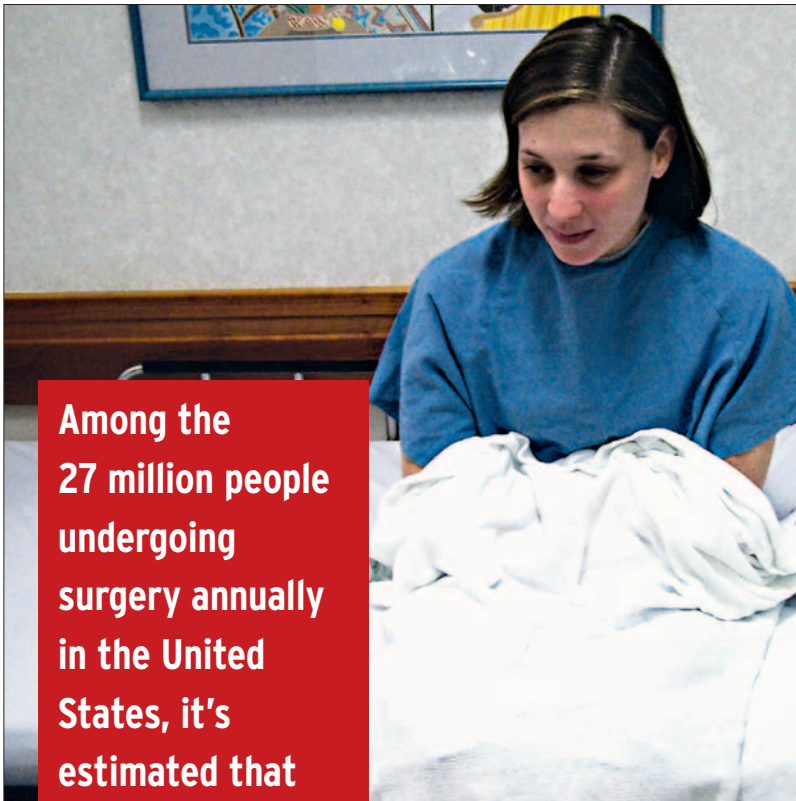
Take Our Patient Warming Quiz

And get all the answers to the most burning questions about unplanned hypothermia.

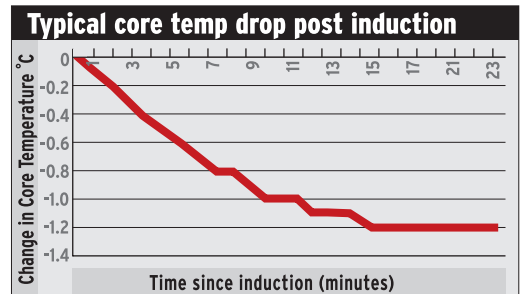
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Heat loss during surgery? Nearly unavoidable. Inadvertent perioperative hypothermia? Largely preventable. Yet hypothermia remains the most frequent complication of surgery. Research shows that hypothermia causes many physiological changes that may predispose patients to surgical site infections. It may also prolong patient recovery and decrease drug metabolism and clearance. Here's a quiz designed to test your

knowledge of the causes, complications and cures of intraoperative hypothermia.



Among the 27 million people undergoing surgery annually in the United States, it's estimated that 14 million suffer from unintended hypothermia.



Sessler Daniel I: *Mild Perioperative Hypothermia: NEJM June 12, 1997*
 Michelson AD et al. *Coagulation disorders Thromb Haemost 1994*
 Kurtz A et al. *Wound infection risk N Engl J Med 1996*
 Frank SM et al. *Myocardial ischaemia JAMA 1997*
 Just B et al. *Increased oxygen demand and pain Anesthesiology 1992*

1 Is hypothermia only a problem associated with major surgical procedures?

No. Temperature declines most dramatically during the first hour of surgery. This makes hypothermia a real possibility, even for short surgical procedures. Normal core temperature varies between 36.5°C and

37.5°C. Core temperature usually decreases 0.5°C to 1.5°C in the first 30 minutes after induction of general anesthesia. Patients undergoing general anesthesia experience a shift in body heat from the core to the periphery, which leads to vasodilation. Hypothermia results from this internal redistribution of the core body heat out to the body's extremities during anesthetic induction.

2 Just what is unplanned perioperative hypothermia?

Normothermia is best defined as a core temperature range from 36°C to 38°C. Hypothermia is defined as a core temperature less than 36°C. Body temperature even one-tenth of a degree less than 36°C constitutes hypothermia. And it can make all the difference in patient outcomes and costs. There are varying degrees of hypothermia. Mild hypothermia is a core body temperature between 35.5°C and 35.9°C. Moderate hypothermia is a core body temperature between 35.0°C and 35.5°C. Severe hypothermia is a core body temperature less than 35.0°C.

3 Does general anesthesia cause more heat loss and hypothermia than regional anesthesia?

No. Spinal or epidural anesthesia produces a pattern of heat loss and hypothermia similar to that of general anesthesia. Like general anesthesia, regional anesthesia lowers the shivering and vasoconstrictive thresholds (central effect). In addition, shivering and vasoconstriction are prevented in blocked regions (peripheral effect).

During exposure to cold environments, surface temperature sensors provide important information to central thermoregulatory centers in the anterior hypothalamus from the patient's legs. Because cold input to thermoregulatory control centers from blocked regions is interrupted, the brain interprets this as relative warming of the legs and lower body.

This combination of vasodilation and blocked cold information during regional anesthesia results in the paradox of a patient's experiencing significant heat loss, yet not feeling cold. Interestingly, once triggered, shivering and vasoconstriction intensity only approach about half their baseline effectiveness in reducing heat loss and

increasing heat production.

Most patients who receive regional anesthesia will also receive supplemental sedation with a variety of hypnotic or anxiolytic medications that can also impair central regulatory control and inhibit behavior responses to heat loss.

4 What are the major adverse consequences of intraoperative hypothermia?

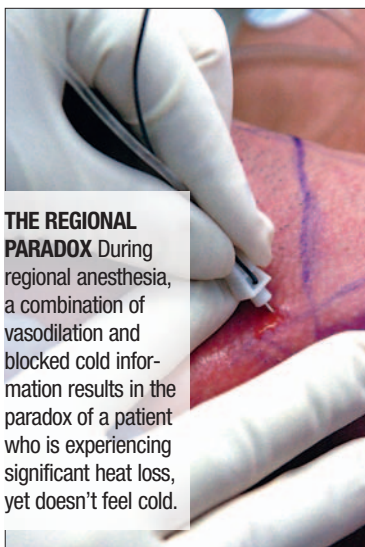
Even mild hypothermia has many adverse consequences besides significant patient discomfort. The physiologic response to hypothermia often leads to increased blood pressure, heart rate and the secretion of plasma catecholamines. As a result, myocardial morbidity is threefold higher in mildly hypothermic patients. Shivering associated with hypothermia can double metabolic oxygen consumption and worsen the patient's subjective cold experience.

Hypothermia also has deleterious effects on coagulation by decreasing platelet function and the activity of coagulation factors and other important enzymes, leading to increased bleeding and blood loss during surgical procedures. Further, hypothermia directly impairs immune system function and is associated with significant increases in the rate of post-operative wound infections. Vasoconstriction and the reduced delivery of oxygen to injured tissues also lead to delayed wound healing. Hospital discharge can be delayed in by as much as 20 percent in hypothermic patients — even in the absence of wound infections.

In addition to delayed metabolism of a variety of anesthetic drugs, particularly muscle relaxants, recovery from anesthesia and discharge from the PACU is significantly delayed in hypothermic patients.

5 What is the cost of hypothermia?

The cost of perioperative hypothermia varies and can range from the cost of an extra cotton blanket to increased patient morbidity and mortality. Research suggests that body temperature averaging only 1.5°C below normal caused cumulative adverse outcomes, which added \$2,500 to \$7,000 per surgical patient to hospitalization costs.



THE REGIONAL PARADOX During regional anesthesia, a combination of vasodilation and blocked cold information results in the paradox of a patient who is experiencing significant heat loss, yet doesn't feel cold.

An Evidence-based Review: Keys to Preventing Hypothermia

6 **Are there any benefits from mild hypothermia?** The simple answer is yes; not all of hypothermia's effects are deleterious. Decreases in body temperature of 1°C to 3°C may provide some protection against ischemia and hypoxia, and may be indicated for some surgical procedures. Additionally, animal studies suggest that malignant hyperpyrexia may be more difficult to trigger in mildly hypothermic swine.

Nonetheless, the predominant deleterious effects of hypothermia warrant extreme caution when choosing to let patients become mildly hypothermic.

7 **Which of the following patients should have intra-operative temperature monitoring?**

- pediatric patients
- patients undergoing procedures longer than 30 minutes
- patients undergoing major surgical procedures
- patients receiving regional anesthesia
- all of the above

You can make a compelling argument for monitoring temperature in all of these patients. Pediatric patients, because of their relative large surface area to body mass ratio, are particularly prone to heat loss, and have the least effective compensatory mechanisms for preserving and generating body heat.

8 **Warmed cotton blankets are effective for maintaining normal body temperature.**

- true.
- false

False. Warmed cotton blankets are a comfort to patients, but the warmth lasts typically only three minutes to five minutes. Regardless of whether you warm blankets, the reduction in heat loss will be small but the improved comfort and psychological perception of using them can last much longer.

9 **Can blankets heated to more than 100°C burn patients?**

No. There are no published reports of patient injury caused by warmed hospital blankets. Heated blankets transfer very little energy to a patient. For

- ▶ Pre-warm patients for one hour before surgery. (Camus, 1995)
- ▶ Warm IV fluids. (Smith et al., 1998)
- ▶ Prevent cutaneous heat loss through insulation (for example, warmed cotton/reflective blankets). (Durel, 2000)
- ▶ Actively warm patients through forced air warming. (more than 20 supporting studies)
- ▶ Maintain ambient room temperature >24°C. (Durel, 2000)
- ▶ Limit patient's skin surface exposure.
- ▶ Maintain patient temperature of 36°C unless hypothermia is indicated. (ASPAN)
- ▶ Monitor patient temperature every 30 minutes. (ASPAN)
- ▶ Humidify and warm and warm inspired gases at 40°C. (Ip Yam and Carli, 1990)

example, a cotton blanket heated to 93°C would raise the temperature of the top-most layer of skin only by about 0.8°C.

10 **Which is most effective at preventing hypothermia in the OR?**

- heat and moisture exchangers
- a single layer of cotton blankets
- a heat-reflective composite blanket
- forced air warming blanket
- fluid and blood warmers

Forced air warming blankets are superior to all other methods for preventing perioperative hypothermia and rapidly increasing mean body temperature during surgery. While heat and moisture exchangers are relatively effective at reducing the loss of body heat and moisture from the respiratory tract, the percent of heat lost to the environment from this route is minor (less than 10 percent).

Forced air warming systems have been shown to preserve body heat and maintain normothermia even during the longest and most invasive surgical procedures. Forced air systems are also superior to water mattress warming systems. Relatively little body heat is lost into the mattress supporting the patient and diminished circulation due to pressure predisposes patients to thermal injury even when circulating water doesn't exceed 40°C.

While you can't warm patients using fluid warmers, it's important to warm fluids administered to surgical patients when fluids or blood products are administered rapidly or in large volumes. One liter of room temperature fluid administered to a patient will reduce mean body temperature about 0.25°C.

11 Is forced air warming effective for most surgeries?

Yes, but complex, long and invasive procedures that require access to a large body surface area — such as cardiac surgery, thoracic surgery, organ transplantation, total hip replacement, even robotic surgery — carry a greater risk of hypothermia. These types of procedures aren't particularly suited for the more traditional forced air warming products.

Water is an inherently more efficient heat conductor than air. Hydrogel pads provide an excellent interface with the patient's skin for maximum heat transfer.

An important component of any perioperative temperature management protocol is fluid warming, and there are several ways to warm both blood and fluids for injection or irrigation. Another method of fluid warming involves the use of warming cabinets designed specifically for injection fluids.

Think of cotton blankets as complementary to other methods of warming.

12 Which site should you use to most accurately assess core body temperature?

- distal esophagus
- skin surface
- oral cavity
- axillary skin fold

Esophageal temperature probes enclosed in esophageal stethoscopes can be positioned at the point of maximum heart sounds and accurately assess core temperature. While skin surface temperatures, oral temperatures and axillary skin fold temperatures tend to be lower than core temperature, they do, when properly calibrated, reflect core temperatures fairly well. While pulmonary artery temperature, distal esophageal and tympanic membrane temperature all accurately reflect core temperature, the key principle to keep in mind is that temperature monitoring should be instituted whenever significant heat loss and hypothermia is planned, expected or suspected.

13 During the perioperative period when core temperature rapidly changes, the relationship temperatures measured at various body sites may differ considerably.

True. It is the responsibility of the practitioner to determine the best method for monitoring patient tem-

perature and to use the temperature monitoring device correctly while considering accessibility of the site, patient comfort and safety. Rectal temperatures are equal to core temperature when the patient is normothermic. Rectal temperatures become unreliable measurement when temperature flux is anticipated.

14 Do you have to keep the OR warm during the entire case?

No. Keep the OR warm during induction of anesthesia, during prepping and draping of the patient, and at the end of the case. After you've draped the patient and applied warming devices, you may decrease the room temperature for the comfort of the surgical team.

15 What is pre-warming?

That's when patients are warmed with forced-air systems *before* induction of anesthesia to minimize the drop in core temperature caused by redistribution. Pre-warming simply, effectively and inexpensively reduces perioperative hypothermia.

16 You should resolve all signs and symptoms of hypothermia before discharging a patient.

True. Patient core temperature will be a minimum of 36°C before discharge from PACU. Patients should describe feeling an acceptable level of warmth. Continue preventive warming measures and observation for hypothermia in phase II PACU or on the medical/surgical unit.

Prevention is the goal

Only about one of every four patients deemed to be at risk of unintended hypothermia is said to receive active patient warming, surprising because preventing hypothermia is preferable to treating it — both in terms of cost and operational efficiency. In some patients, the complications of hypothermia are discomfort and slow recovery. In others, those complications are likely to be dangerous. **OSM**

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