Surgical Care Improvement

Taking steps to keep OR patients warm

Part of a series on the Surgical Care Improvement Project.

Even a small drop in patients’ core temperatures triples the risk of surgical site infections after colon surgery and increases the hospital stay by 20%. Since these landmark findings were reported in 1996, clinicians have taken steps to make sure patients stay warm before, during, and after surgery.

In 2005, the Surgical Care Improvement Project (SCIP) chose immediate postoperative normothermia for colorectal surgery patients as 1 of 7 infection control measures. These patients were targeted because many of the studies on normothermia focus on this population.

OR Manager interviewed Daniel Sessler, MD, senior author of the landmark study and a leading researcher on normothermia, about his research and advice for maintaining normothermia.

Warm patients before surgery

Dr Sessler advises active warming of every patient preoperatively, saying that is key for preventing intraoperative hypothermia.

“Patients need active warming for at least 30 minutes to be effective,” he adds. An hour or more of prewarming prevents core hypothermia for 2 to 3 hours of open abdominal surgery without any intraoperative warming, his research shows.

“It is remarkably effective, and patients love it because they feel warm and toasty preoperatively,” he says.

Warming patients in the preoperative holding area prevents “redistribution hypothermia,” the most important cause of hypothermia in most patients (sidebar).

About 80% of hypothermia in the first hour of surgery results from a redistribution of heat from the internal core to peripheral tissues. This large internal flow of heat is induced by anesthesia and occurs independently from the environment, heat loss from the skin, or a net decrease in body heat content (sidebar).

Preoperative warming does not change patients’ core temperatures because they are unanesthetized and thus able to regulate their core temperatures. But it does transfer body heat into the peripheral tissues, which reduces the core-to-periphery temperature gradient. If a patient is prewarmed sufficiently, there is essentially no temperature gradient between the core and the periphery, he says. Then when anesthesia is induced and causes vasodilation, heat cannot flow from the core to the periphery because of the Second Law of Thermodynamics, which holds that heat can only flow down a temperature gradient.

Warming every patient

Warming every patient is a reasonable strategy given the low cost, high efficacy, and safety of forced-air warming, Dr Sessler says. He would accept not warming patients having short operations, but says patients should be warmed when a procedure lasts for close to 1 hour. His personal cutoff time for not warming is about 30 minutes.
Paradoxically, “it is actually harder to keep patients normothermic in short operations than in long ones,” he says. The reason is that a short procedure is finished before the redistribution hypothermia can be treated by active warming.

**Which warming method?**

SCIP does not recommend how to measure patients’ temperatures or keep them warm. Each organization needs to determine what methods are most efficient and give the most reliable results.

Dr Sessler does not have a preference for a patient warming device. He says ORs tend to use forced-air warming covers because they are effective, safe, and inexpensive—note that the blowers are often free, and the blankets cost about $8.

His research has found the newer circulating water devices, such as circulating water garments and energy transfer pads, warm about 50% better than forced air because they also warm the posterior skin. They are also more expensive.

Manufacturers of the circulating-water devices say their products are cost-effective because they result in improved patient outcomes compared with traditional warming methods. They also say their devices can be placed on all body surfaces, not just on the anterior surface as with forced-air covers. They say this is important for patients having surgery that requires large areas of their anterior skin to be exposed.

As long as the patient’s temperature is approximately normal at the end of surgery, it doesn’t matter whether the method used is circulating water, forced air, an increase in the ambient room temperature, or prewarming patients in the holding area, says Dr Sessler, who is chair of the Outcomes Research Department at the Cleveland Clinic and professor of anesthesiology and director of the Outcomes Research Institute at the University of Louisville in Kentucky.

About warming of IV fluids, he says, “There is no scientific basis for this approach in 90% of patients. Fluid warming costs as much as forced air but transfers a tiny amount of heat compared to forced air.”

**What’s best for measuring temperature?**

Measuring core body temperature is important because of the redistribution effect caused by anesthesia.

For intubated patients, the best route is the distal esophagus, Dr Sessler says, noting that flexible esophageal probes “are inexpensive, easy to insert, and resistant to artifact.”

For nonintubated patients, he recommends oral, axillary, or forehead skin temperature measurement. Bladder temperature is a good alternative for patients who require catheters for other reasons, he says.

“The data show the forehead strips work remarkably well,” says Dr Sessler. In a 1997 study that tested use of the liquid-crystal forehead temperature indicator strips in 3 different ways, the strips didn’t fail, though he says he thought they would.

He doesn’t recommend using aural canal (tympanic membrane) or temporal artery infrared thermometers to monitor core temperature during surgery, having found these to be “insufficiently accurate to be used in the perioperative period.” Both appear to be “little better than random number generators,” he says.

In a 1998 study, Dr Sessler and researchers from Japan studied the accuracy of 4 infrared aural canal thermometers during cardiac surgery and concluded none was sufficiently accurate and precise for perioperative care. In a 2002 study of temporal-artery thermometers in adult and pediatric patients, his team found their accuracy was poor in adults and suboptimal in infants and children. Other researchers have come to similar conclusions for use in intensive care unit (ICU) patients.

In the postanesthesia care unit (PACU), his first choice is oral temperatures.

For axillary temperature, he says, “any electronic thermometer will work. The only important thing is to locate the sensor over the artery and keep the patient’s arm at the side to keep the axillary space closed.”

**Turning up the thermostat**

There are patients who will not be normothermic despite the best of efforts, he adds. Procedures such as a colectomy in lithotomy position entail so much skin
exposure that there is not enough surface area to warm. In these cases, some clinicians turn up the temperature in the operating room. This can help, says Dr Sessler, though raising the OR temperature enough to help “makes everyone in the operating room miserable.”

A more sophisticated approach, he says, would be to keep the ambient temperature comfortable for people working in the operating room and keep the patient warm with an active warming device.

**Postop warming nice but not necessary**

If patients are normothermic at the end of surgery, they won’t necessarily need or want warming postoperatively.

“Patients won’t get colder in recovery because they are not anesthetized, and they are thermoregulating very well on their own,” Dr Sessler says.

“There is nothing wrong with leaving active warming devices on patients in the PACU if they feel more comfortable, and they like it.” SCIP calls for patients to be normothermic immediately postoperatively, he points out. This means patients have to be normothermic during surgery—not be allowed to become hypothermic and rewarmed at the end of surgery.

“It is okay to keep the warming blanket on patients postoperatively, but warming in recovery is no excuse for inadequate intraoperative thermal management. Intraoperatively is when hypothermia occurs, and most complications develop,” he says.

—Judith M. Mathias, RN, MA

**References**


---

**Temperature measurement methods**

Methods for monitoring core temperature in perioperative patients.

**Effective methods**

*Intubated patients*

- Distal esophageal probe

*Nonintubated patients*

- Oral thermometer
- Axillary thermometer
- Liquid crystal forehead strip
- Bladder catheter thermometer

**Ineffective methods**

- Aural canal (ear) infrared thermometer
- Temporal artery infrared thermometer

Source: Daniel Sessler, MD.
Normothermia definitions

Normothermia: Core temperature range of 36°C to 38°C (96.8°F to 100.4°F)
Hypothermia: Core temperature less than 36°C (96.8°F)

Core temperature: Core temperature is the single best indicator of a patient’s thermal status. Roughly speaking, the core thermal compartment consists of the head and trunk and is nearly half the body mass. About 80% of thermal input to the regulatory system is derived from the core, and most complications associated with hypothermia are related to core temperature.

Sources: American Society of PeriAnesthesia Nurses Hypothermia Guideline.
www.aspan.org/hypothermia.htm

How hypothermia develops

Hypothermia develops during general anesthesia in 3 phases:
1. An initial rapid reduction in core temperature occurs after anesthesia induction and results from an internal redistribution of body heat. Redistribution occurs because anesthetics inhibit the tonic vasoconstriction that normally maintains a large core-to-peripheral temperature gradient.
2. Core temperature subsequently decreases at a rate determined by the difference between heat loss and production.
3. When surgical patients become sufficiently hypothermic, they trigger thermoregulatory vasoconstriction, which restricts the core-to-peripheral flow of heat. Constraint of metabolic heat, in turn, maintains a core temperature plateau—despite continued systemic heat loss—and eventually reestablishes the normal core-to-peripheral temperature gradient.

The patient’s postoperative return to normothermia occurs when the anesthetic agents decrease sufficiently to trigger the body’s normal thermoregulatory defenses.


SCIP targets normothermia

This article is the fifth in a series focusing on the Surgical Care Improvement Project (SCIP). SCIP targets 4 broad areas:

• surgical site infections
• adverse cardiac events in patients having noncardiac surgery
• venous thromboembolism
• postoperative ventilator-associated pneumonia.

SCIP process measure for normothermia

Maintaining normothermia is one of the measures for preventing surgical infections. The measure is:

• Colorectal surgery patients with immediate postoperative normothermia.

Previous articles discussed antibiotic prophylaxis (April 2006), venous thromboem-
bolism prevention (May 2006), using computerized data to guide OR QI (June 2006), and glucose control (September 2006).

More information on SCIP is at www.medqic.org/scip.

---

**Key research on normothermia**

**Colorectal surgery patients**

The study involved 200 patients divided into 2 groups:

- Control patients: routine intraoperative thermal care (mean temperature 34.7°C)
- Treatment patients: active warming (mean temperature on arrival to PACU 36.6°C).

**Results**

- Control patients: 19% surgical site infection (SSI) (18/96)
- Treatment patients: 6% SSI (6/104), P=0.009

—Kurz A, Sessler D I, Lenhardt R.  

**Clean surgery**

In the study, 421 patients having clean surgery (breast, varicose vein, or hernia procedures) were divided into 3 groups:

- Unwarmed group (standard)
- 2 warmed groups (local and systemic): warming applied for at least 30 minutes before surgery.

**Results**

- Unwarmed group: 14% SSI (19/139)
- Warmed groups: 5% SSI (13/277), P=0.001


**Preoperative warming**

Patients were divided into 2 groups:

- Control patients: covered only with a wool blanket during a 1-hour preinduction period
- Treatment patients: received forced-air warming for 1 hour before induction.

**Results**

- Control patients: following induction of anesthesia, core temperature decreased at a rate of 1.1 +/- 0.1°C/ hour. After 1 hour of anesthesia, only 1 of 8 patients had core temperatures of at least 36.5°C
- Treatment patients: following induction, core temperature decreased at a rate of only 0.6 +/- 0.1°C/hour. After 1 hour of anesthesia, 6 of 8 prewarmed patients had core temperatures of at least 36.5°C