Own the Zone:
The Importance of Proactive Temperature Management as a New Standard of Patient Care

Introduction

Maintaining a normothermic core body temperature before, during and after surgery is an important step to improving patient outcomes. The benefits of normothermia are well established, and temperature management is included in clinical practice guidelines worldwide. However, perioperative hypothermia remains a common, yet preventable, surgical complication. While there are multiple reasons that rates of intraoperative hypothermia remain elevated, two contributing factors include an underappreciation for the dominance of redistribution and a failure to monitor core temperature, especially during shorter surgical procedures.

To achieve the desired outcome of normothermic patients, the surgical care teams need to Own the Zone—keeping a patient's core body temperature within the normothermic temperature zone of 36.0° to 37.5°C[1]—by proactively monitoring and maintaining a patient's core body temperature from the time a patient enters pre-op until the moment that patient is discharged.

The importance of maintaining normothermia

The difference between a positive patient outcome and a complicated recovery can be a matter of degrees. The potentially adverse effects of even mild perioperative hypothermia, defined as a core body temperature of less than 36.0°C (96.8°F)[2], are numerous and well-documented.

Risk of SSI
Studies of the impact of hypothermia on the incidence of wound infection have shown that the hypothermic patient is at an increased risk for wound infection than a normothermic patient.[3-5]

Increased blood loss
Even mild hypothermia significantly increases blood loss by 16 percent and the risk for transfusion by approximately 22 percent.[6] A 1.6°C reduction in core body temperature can increase blood loss by 30 percent and significantly augment allogenic transfusion requirement.[7]

Morbid cardiac events
Hypothermia can increase the incidence of cardiac events.[3,8,9] A study by Scott et al. found that maintaining normothermia was associated with a reduction in ischemic cardiovascular events and mortality.[3]

Extended recovery time
Unintended hypothermia alters the effects of many classes of drugs, including muscle relaxants and intravenous anesthetic agents.[10-12] By decreasing drug metabolism, even mild hypothermia can lead to delayed awakening and require a longer PACU stay.[13,14]

Patient discomfort
Patients often report shivering as the worst part of their hospitalization, sometimes rating it worse than surgical pain.[15]

Knowing these potentially harmful outcomes, and understanding that unintended hypothermia is a very common but also highly preventable phenomenon, it stands to reason that healthcare professionals should introduce the evidence-based preventive measures to proactively manage and maintain a patient's core temperature before, during, and after surgery. In fact, healthcare organizations around the world have published recommendations or guidelines emphasizing the importance of maintaining normothermia. (Fig. 1)

Before discussing the importance of proactive temperature management, it is important to understand how a patient becomes hypothermic and how to prevent this from happening.

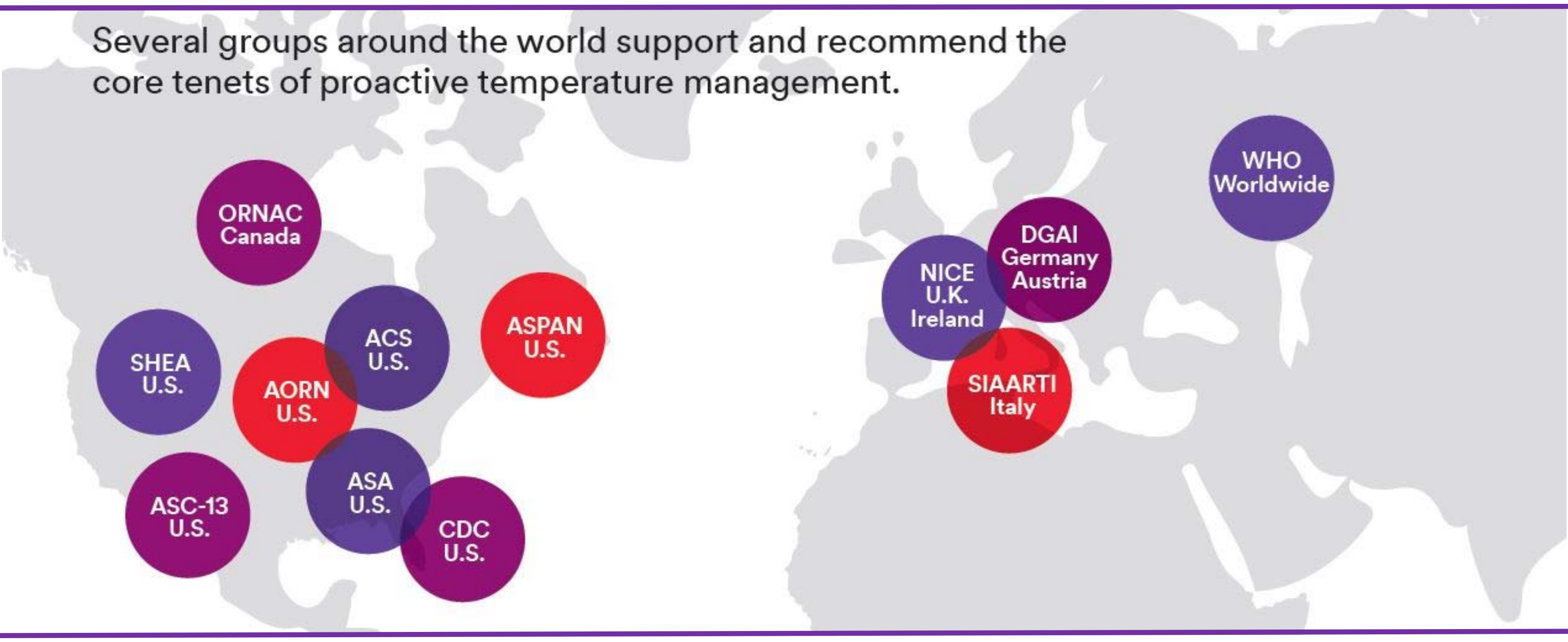

Fig. 1

The thermoregulation system

The body's ideal temperature is approximately 37.0°C (98.6°F) in the patient's core, which encompasses the brain and the body cavity containing the vital organs.[2,16] This thermal state, the state of homeostasis, is aggressively maintained at a set point determined by the central nervous system. The body's autonomic thermoregulation system is so reliable that the core body temperature seldom varies more than ±0.2°C above or below the ideal state.[2,16]

In reality, body heat is distributed unevenly. Under normal conditions, the body's core temperature is 2.0-4.0°C warmer than the temperature of the body's periphery.[2,16] The core temperature remains relatively unaffected by lower temperatures in peripheral areas.[2,16]

The hypothalamus receives and integrates information from thermoreceptors located in the skin, spinal cord, various parts of the brain, and deep central tissues. If external factors push the core temperature outside the ideal range, the hypothalamus triggers the appropriate thermoregulatory response. The responses may include vasoconstriction and shivering when the temperature is too low, or vasodilation and sweating when the temperature is elevated.

Anesthesia's impact on thermoregulation

Although it may seem counterintuitive, the major cause of intraoperative hypothermia is not heat loss from the skin, but redistribution of heat from the core (brain and vital organs) to the peripheral tissue (arms and legs).[2,16] Much of the heat within the body isn't lost after anesthesia induction; it simply moves from one area of the body to another.

Under anesthesia, the ability of the hypothalamus to regulate temperature is degraded as the anesthetic agents reduce metabolism and depress the thermoregulatory response, triggering vasodilation—or an opening of the shunts used to retain warmer blood in the core. Anesthetic-induced vasodilation allows heat in the warm core tissue to mix with cooler peripheral tissue, which warms the periphery at the expense of the core temperature.[2,16]

Redistribution temperature drop

This redistribution of heat, a phenomenon known as redistribution temperature drop, can cause unwarmed surgical patients to experience a decrease in core temperature of approximately 1.6°C during the first hour of surgery.[16] (Fig. 2)

This redistribution is not actual heat loss but rather a shift in thermal energy from the core to the periphery. Subsequently, the warmer periphery caused by general anesthetics also results in a greater risk of the patient losing heat into the OR environment.[16]

The patient will lose heat to the environment even after the initial effect of redistribution as heat loss exceeds metabolic heat production.

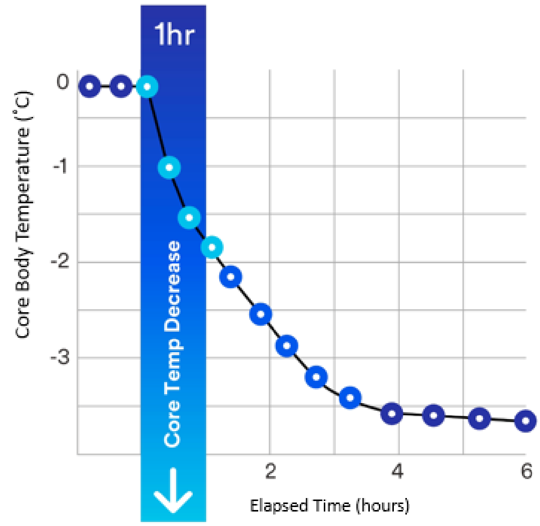

Fig. 2

Graph Adapted from: Sessler DI, Anesth. 2000; 92(2): 578-96.

Hypothermia caused by redistribution is almost impossible to reverse quickly because heat applied to the skin surface requires considerable time to reach the core thermal compartment.[17]

Regional anesthesia

The processes that lead to hypothermia are similar for patients undergoing regional anesthesia. Although there are different physiologic mechanisms for thermoregulatory inhibition during general and regional anesthesia (central vs. peripheral nervous system effects, respectively), patients are at significant risk for hypothermia during spinal anesthesia, especially if the level of spinal block is high.

During regional anesthesia, core hypothermia is accompanied by a real increase in skin temperature. The paradoxical result is often a perception of continued or increased warmth. Eventually, a patient who is sufficiently hypothermic will shiver unless inhibited by the administration of sedatives.

Some patients undergoing regional anesthesia may perceive thermal comfort despite having substantial hypothermia.[18,19] It's important to remember that even though the patient is awake and can communicate their perception of comfort, they are still under the effects of anesthesia and a patient's self-described thermal comfort level is not a reliable indicator of normothermia during neuraxial anesthesia or regional blocks. The only reliable way to know what a patient's temperature is for sure is to use a core temperature monitoring device, even with shorter procedures or those utilizing regional anesthesia.

Own the zone with proactive temperature management

Unfortunately, unplanned hypothermia is still a patient safety issue because the use of simple, cost-effective prevention measures is not the standard of care for all patients undergoing surgery.

Given the availability of temperature monitoring and active warming modalities, the ease of use and cost-effectiveness of these interventions, and the wealth of scientific evidence supporting the practice, proactive temperature management throughout the patient's surgical experience needs to become the new gold standard in patient care.

Clinicians can easily Own the Zone by taking a proactive approach. Unintended hypothermia can be prevented when core temperature is continuously monitored and active warming is instituted throughout the perioperative process, starting before the induction of anesthesia. (Fig. 3)

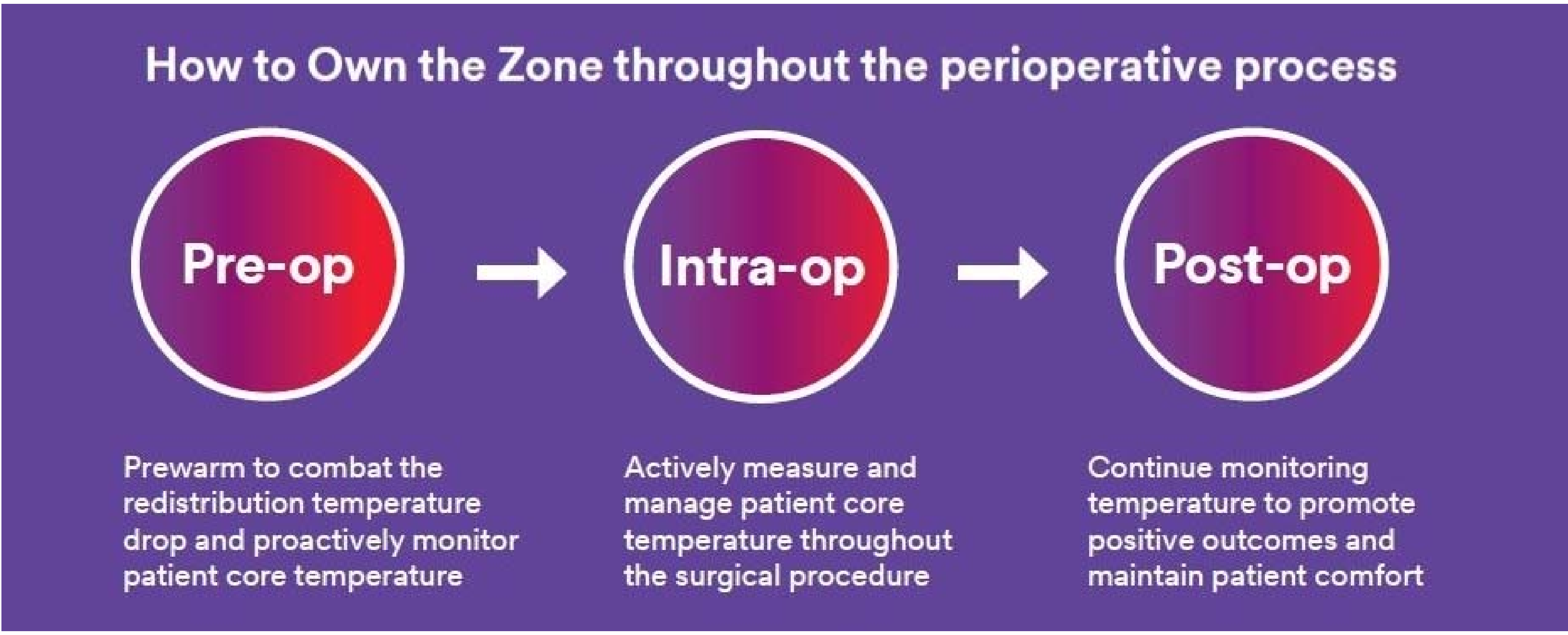

Fig. 3

Preoperative care

Patient temperature monitoring and management should begin during the preoperative period because temperature is impossible to manage when it isn't accurately measured. Monitoring at this stage will determine if the patient's thermoregulatory system is normal and the patient is ready for surgery. Temperatures outside the normothermic zone could be a sign that a patient is sick, has an infection or has developed another condition that might make them ineligible for surgery, so knowing actual core temperature beforehand is critically important.

As outlined earlier, redistribution, not heat loss to the environment, is the dominant cause of intraoperative hypothermia. Hypothermia prevention, then, becomes about minimizing or eliminating the decline in core temperature before the induction of anesthesia.

Actively warming surgical patients before the induction of anesthesia – known as prewarming – is an effective way to help prevent intraoperative hypothermia. Prewarming with forced-air warming blankets or gowns can help to prevent unintended hypothermia in patients, reducing the rate of complications.[20,21] Increasingly, the practice of prewarming is being recommended in clinical practice guidelines and quality improvement initiatives across the globe.[22-26]

Prewarming works by increasing the temperature of the peripheral tissue, reducing or eliminating the temperature gradient with the body's core.[17] When vasodilation occurs following anesthesia induction, blood temperature in the core and periphery are similar, thereby minimizing redistribution temperature drop.[27]

Prewarming patients with forced-air warming before induction of general anesthesia decreases inadvertent hypothermia caused by post-epidural block temperature redistribution (the most important cause of hypothermia after epidural anesthesia).[21,28,29]

For patients undergoing short procedures or those undergoing procedures where warming may be difficult, prewarming can prove to be especially useful.[17,30] Patients having shorter surgeries are more likely to experience postoperative hypothermia because there is simply not enough time to overcome the effect of redistribution with intraoperative warming alone.[17]

Intraoperative Care

When a patient is prewarmed, intraoperative temperature management allows clinicians to continue active warming in the O.R. and focus on maintaining temperature for the duration of surgery rather than potentially playing catch-up.

As simple as it may seem, one of the challenges in the management of patient temperature lies in effective temperature measurement and monitoring. Many surgical patients do not receive any form of core temperature monitoring. When they are monitored, inadequate methods are often used.

Although core temperature is a vital sign, it is frequently thought of as being less important than the other signs clinicians must monitor during anesthesia. It can, and should be, closely tracked and managed to help ensure patients stay within the normothermic temperature zone between 36.0 and 37.5°C.

Many thermometers are available that accurately report the tissue temperature they measure. However, the less invasive the measurement location, the more likely the tissue does not reflect true patient core temperature. Core body, as opposed to surface temperature, is more valuable because it is the most relevant indicator of the body's overall thermal condition.[31] The skin surface has been used to estimate core temperature; however, skin temperature is several °C lower than core temperature, and the relationship between core and skin surface temperature varies among individuals, as well as over time within individuals.[32,33]

Because of the effect anesthesia has on the thermoregulatory system, intraoperative temperature monitoring is essential to help detect significant core temperature changes. In the absence of temperature monitoring during surgery, there is no way to determine the existence or severity of hypothermia or hyperthermia during anesthesia.[34]

Common Patient Warming Misconceptions

MISCONCEPTION

"Cotton gowns and blankets are effective patient warming methods."

REALITY

Heat from a warmed cotton blanket is quickly lost to its surroundings, making cotton blankets an ineffective way to prevent perioperative hypothermia.

MISCONCEPTION

"The temperature monitoring modality I use doesn't really matter."

REALITY

Using multiple modalities throughout the surgical process can result in variable and inaccurate data.

MISCONCEPTION

"My patient isn't cold, so I don't need to prewarm."

REALITY

Prewarming isn't about patient comfort in the pre-op phase; it's to help prevent hypothermia in the intra-op and post-op phases.

Continuous temperature monitoring will help manage heat preservation and warming therapy during the procedure.

Conclusion

To Own the Zone and practice proactive temperature management is neither difficult nor expensive. Keeping patients normothermic isn't simply important to stay compliant with practice guidelines and recommendations, but to lower the patient's risk of negative surgical outcomes associated with unintended hypothermia while increasing overall patient comfort in the perianesthesia setting.[35,36]

Clinicians have the incredibly important task of maintaining patient temperature within the safe and critical normothermic zone. To be successful, facilities should supply clinicians with the temperature management and monitoring systems they need to warm and monitor patients in any type of procedure, under any type of anesthesia, and throughout the perioperative journey.

When selecting a partner to support your patient warming or temperature monitoring efforts, it is important to consider that partner's ability to meet your facility's unique needs. Ultimately, the chosen solution should provide broad clinical flexibility and proven efficacy. Ask about a warming product's history, it's track record of safety and efficacy, and review the available research. Take the input of a product's end user into account—no one knows more about a system's performance than those who use it every day. The importance of clinician confidence in a product cannot be overlooked.

Perioperative temperature management interventions—particularly forced-air warming—can bring new value to facilities today and in the future. When used properly, patient warming and temperature monitoring systems will help facilities take a proactive approach to temperature management and provide optimal clinical care.

3M can help clinicians Own the Zone

Unsure of whether your facility is ready to Own the Zone? 3M can help. We will work together with you to understand your warming needs, identify your clinical challenges and evaluate your practice requirements so that we can recommend proven, cost-effective solutions to advance your patient warming goals.

3M offers a simple, concise Temperature Review Program designed to demonstrate the hypothermia rate within your facility. Through this program you'll learn:

- The percentage of your patients who are normothermic vs. hypothermic
- How 3M's expertise can help establish (or improve) your warming protocol, including prewarming
- An innovative way to continuously monitor core body temperature before, during & after surgery

To learn more about the importance of patient warming, temperature monitoring, and how to Own the Zone, visit BairHugger.com/OwntheZone.

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