



How to get away from the cold: body temperature during surgery

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In the movie ‘Titanic’, the hero fell into the cold sea to save the heroine and eventually died of hypothermia. A patient who enters the cold environment of an operating room is also at risk of becoming hypothermic.

The human thermoregulatory system usually maintains the core body temperature near 37°C. Temperature control is accomplished through a feedback mechanism involving the central nervous system. The hypothalamus acts as a thermoregulatory center to increase or decrease total body temperature.

Core temperature is monitored by structures such as the tympanic membrane, pulmonary artery, distal esophagus, and nasopharynx, which can detect hypothermia as well as malignant hyperthermia. Although an increasing core temperature is not the first sign of acute malignant hyperthermia, it can help confirm the diagnosis. However, the most common perioperative thermal disturbance by far is inadvertent hypothermia, which increases the chances of myocardial ischemia [1]. Several studies have shown that hypothermia also slows the healing of surgical wounds and increases the incidence of surgical site infections [2]. Even moderate hypothermia (35°C) can modify the platelet functions and enzymatic reactions that underlie physiological coagulation. Decreased platelet activity can lead to increased bleeding, which may necessitate a transfusion [3]. Hypothermia can also reduce the metabolic rate, leading to a prolonged effect of certain drugs used during anesthesia and some uncertain effects. This is particularly significant in elderly patients [4]. Shivering is a response to cold that is characterized by involuntary

muscular activity, the purpose of which is to increase metabolic heat. However, many patients complain of discomfort caused by shivering in the recovery room [5].

Thermoregulation is impaired during general anesthesia. The suppression of thermoregulatory defense mechanisms during general anesthesia is dose-dependent and mostly results in perioperative hypothermia [6]. In this issue of *Korean Journal of Anesthesiology (KJA)*, Lim et al. [7] report that a combined interscalene block and general anesthesia reduced the concentration of desflurane and prevented intraoperative hypothermia during arthroscopic shoulder surgery. The core temperature of patients who receive only an interscalene block should be monitored to evaluate the effect of the block alone. Although an interscalene block may affect sympathetic nerve activity, the body temperature of the patients decreased less with decreased doses of the volatile anesthetic agent. When inhalational anesthesia was maintained at a constant concentration, the vasoconstriction threshold during combined epidural-general anesthesia was lower and the core temperature was decreased further than for general anesthesia alone [8]. These results indicate that the shielding effect of the decreased temperature, due to the reduced concentration of the inhalation anesthetic, can exceed the decrease in core temperature due to vasodilation caused by the block.

Various methods are used to prevent hypothermia [9]. First, the patient can be warmed before surgery. Warming the surface of the body reduces the temperature gradient between the core and periphery so that the decrease in temperature due to the induction of anesthesia is reduced. Second, the patient can be actively warmed during surgery using several devices. A forced-air warming blanket blows warmed air over the patient’s skin and is very effective. A conductive warming pad can be used for active warming as an alternative to convective methods. Third, passive warming is achieved with surgical draping. Fourth, warmed intravenous infusions and blood products can be used. However, if there is little fluid exchange, this is not sufficient to maintain normothermia. Lastly, irrigation solutions can be prewarmed to

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38–40°C. Combinations of multiple methods are most effective at decreasing the incidence of perioperative hypothermia.

As well as measuring the temperature at the correct location, a suitable method must be used. A nasopharyngeal temperature probe was correctly located in the middle or upper nasopharynx by only 43% and 41% of residents and nurses, respectively [10]. A comparison of the temperatures at different pharyngeal sites is reported in this issue of *KJA* [11]. Because the nasopharynx is located in proximity to the internal carotid artery, the nasopharyngeal temperature probe should be placed in the upper portion of the nasopharynx. In this study, it was recommended that the probe be placed in the nasopharynx (10 cm from the nares) or in the oropharynx (14 cm deep) and attached to the nasopharynx mucosa for accurate measurement. The temperature measured in the nasal cavity was significantly lower than that in the upper nasopharynx, oropharynx, or esophagus, and the temperature difference was constant. Wang et al. [12] also reported that an insertion depth between 10 and 20 cm provides a good indication of core temperature. These studies revealed that the temperature probe should be placed at least 10 cm deep

when measuring the core temperature in the nasopharynx. Additionally, an esophageal temperature probe can measure core temperature effectively due to continuous mucosal contact. Clinicians must select the most appropriate temperature measuring method according to the situation.

Body temperature monitoring is essential for maintaining normothermia during surgery and for the timely detection of unintended temperature changes that can lead to perioperative complications. Therefore, body temperature monitoring is included in the World Health Organization guidelines for safe surgery [13].

In conclusion, anesthesiologists should remember that an abnormal body temperature can cause perioperative complications, and that the core temperature of patients should be continually monitored with a suitable method. The prevention of perioperative hypothermia is particularly important.

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