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Editorial Comment

Inadverdent Perioperative Hypothermia

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Inadverdent perioperative hypothermia is the decrease in body temperature to below 36°C from the preoperative period (1 h before anaesthesia) to the postoperative period (first 24 h after anaesthesia) (1). The frequency of inadverdent perioperative hypothermia has been reported to be between 50% and 90%, and it has been estimated to affect 70% of surgical patients. Moreover, undesired clinical results occur with prolonged hospitalisation and increased cost (2, 3).

In a survey study conducted by Köksal et al. (4), the necessity of national guidelines for the prevention of perioperative hypothermia was emphasised and it was specified that the awareness of physicians and assistive health care personnel on this issue needs to be increased. In a study by Aksu et al. (5) on practices in a single clinic in 2014 after the national guidelines were published, the importance of monitoring temperature during anaesthesia administration was highlighted and the need for active heating was emphasised.

In this questionnaire study evaluating the attitudes of anaesthesiology and reanimation specialists towards monitoring perioperative temperature and their reflections to practice, it was found that 26% of physicians monitored temperature, although most of them were aware of the risk of hypothermia and its complications (6). This editorial was prepared for drawing attention to the issue because it was noticed that applications of monitoring temperature varied depending on institutions and that core temperatures are defined differently among physicians.

In this editorial, the regulation of body temperature, effect of anaesthesia and perioperative care on the regulation of temperature, complications of perioperative hypothermia and methods for the prevention of complications are reviewed.

Regulation of body temperature

Body temperature is generally kept between 36.5°C and 37.5°C with heat loss and heat gain. While temperature increases mainly as a result of metabolism and also through the contribution of muscle activity, it decreases due to convection, conduction, radiation and evaporation due to perspiration through the skin.

In order to maintain this balance, information from deep tissues and the skin is processed by the brain. While heat loss is accelerated with perspiration or increased blood flow in the skin, the loss can be reduced by decreasing skin blood flow. Moreover, heat production is increased by increasing the main muscle activity (shivering).

In terms of body temperature regulation, it is useful to know that temperatures of the central compartments are strictly controlled and that temperatures of the peripheral compartments display a wide variation. Typically, the peripheral compartments are 2–4°C colder than the central compartments.

Effect of anaesthesia and perioperative care on the regulation of body temperature

Though opening the skin and abdomen in the perioperative period increases heat loss, the additional use of IV fluids, irrigation fluids and inhaled gases can cool patients directly.

Heat loss can be decreased with the vasoconstriction of normal superficial veins in the cold, but sedative and anaesthetic agents block this normal response. Therefore, vasoconstriction cannot be provided, and heat loss increases due to blood flow

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reduction to the peripheral compartments is prevented. These effects in the early period of anaesthesia administration cause a rapid decrease in the core temperature and re-distribution of temperature in the peripheral and central compartments.

During epidural and spinal analgesia, heat loss occurs because peripheral vasoconstriction is blocked under the block level. They prevent shievering because of paralysis under the blok level.

The frequency of the risk of unintended perioperative hypothermia has been reported to be very wide (1.5%–20%). Very elderly patients, cachectic patients (those with increased metabolism and with cancer) and those having a high anaesthesia risk (ASA 3-4), burn injuries, hypothyroidism and corticoadrenal insufficiency have a high risk of hypothermia development.

Complications of Perioperative hypothermia

Hypothermia can increase morbidity rates by impairing various systems and functions. Shivering comprises involuntary muscular movements that occur when increasing body temperature against the cold (7). However, shivering in the recovery and reanimation periods is the most uncomfortable experience for patients in the postoperative period.

The primary cause of postoperative morbidity is cardiac complications. Prolonged ischemia (decreased blood flow) generally causes cellular injury. Therefore, the treatment of factors such as body temperature is important. Sessler reported that hypothermia causes noradrenalin release and peripheral vasoconstriction and thus hypertension (7, 8). Although it has been suggested that all of them increase the risk for the development of myocardial ischemia, there are a few clinical findings that directly prove the presence of a relationship between hypothermia and perioperative cardiovascular events. In a study (9), only three cases of myocardial infarction were reported.

Some studies have revealed that intraoperative hypothermia coexists with vasoconstriction and that this is an independent factor slowing down wound healing and causing an increase in the number of surgical site infections (10, 11).

Even in moderate hypothermia (35°C), platelet functions are affected; modifications occur in enzymatic functions, and physiological coagulation mechanisms are impaired. Decreased platelet activity increases bleeding and exacerbates the need for transfusion (12). Moderate hypothermia also prolongs the effects of some anaesthetic agents and causes them to be unpredictable by decreasing the metabolic rate. This effect is apparently common among geriatric patients (13-15).

Due to the above-mentioned reasons, it has been stated that undesired non-therapeutic hypothermia should be evaluated as an adverse event during regional and general anaesthesia (8, 16, 17). Monitoring body temperature is very important for the early detection of unintended hypothermia and for providing normothermia during surgery.

Methods for the prevention of hypothermia

For maintaining normal body temperature during anaesthesia and surgery, it is necessary to decrease radiation, reduce heat loss from the skin due to convection and conduction, prevent vaporisation from exposed surgical areas and prevent heat loss due to intravenous fluids and irrigation fluids. The effect of heat loss that can occur due to the use of cold gases for inhalation or for insufflation of body cavities is weak because the heat capacities of gases are low (18).

The interventions to be performed for the maintenance of body temperature are as follows:

1. Interventions that can prevent the re-distribution of heat and following heat loss (for instance, preoperative pharmacological vasodilatation and heating the skin before anaesthesia)

2. Passive heating systems that will prevent heat loss and hypothermia, for example, increasing the temperature of the environment, passive insulation of exposed regions of the body, use of closed or semi-closed anaesthesia circuits and administration of low-flow anaesthesia.

3. Use of active heating systems; the efficiency of these systems depends on some factors such as the design of the device, type of heat transfer, placement of the system on a patient and surface area of the region that will be used for heat transfer. Systems used for this purpose are infrared lamps, electric blankets, blankets or beds with warm water cycles, hot air blowing systems or convective air heating systems, heated intravenous fluids and irrigation fluids, moisturised and heated anaesthetic gases and heated carbon dioxide in laparoscopic surgeries. To increase metabolism and accelerate energy consumption for this, IV nutrition is recommended.

The clinical efficiency of different types of heating systems of patients has been explained by the 'National Institute for Health and Clinical Excellence' in the United Kingdom, and it has been specified that there are adequate clinical data that will make the use of hot-air blowing heating systems routine in the prevention and treatment of perioperative hypothermia and that this is a cost-effective approach (19). Moreover, reviews in Cochrane include some precautions such as heating gases that will be used in minimal invasive abdominal surgeries and heating and moisturising gases inspired in ventilation (18, 20).

Moreover, a review about active heating was published (21). It was demonstrated that the use of air blowing systems in patients who have undergone abdominal surgery and have infection risks in preoperative, intraoperative or both periods decreases the rates of wound site infection and complications compared to those where active heating systems were not used. In addition, it was stated that they decreased the rate of major cardiovascular complications in patients defined as having cardiovascular risk factors and that they increased pa-

tients' comfort by keeping the core temperature within normal intervals. It was mentioned that they reduced blood loss, but their effects on the rate of blood transfusion were not as clear.

Conclusion

It has been specified that there is a need for further qualified and larger studies about the effects of hypothermia on clinical results (21). These studies should compare different active heating systems with each other, instead of comparing active heating systems with a control group, due to practical and ethical reasons. The results of these studies should be evaluated by blinded researchers, their cost-effectiveness should be analysed and their potential risks due to medical devices should be assessed. Moreover, it is recommended to conduct these studies in accordance with the CONSORT standards and TIDieR guidelines on non-pharmacological interventions (22, 23).

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