Clinical Medicine Research
2016; 5(2-1): 1-5
Published online January 20, 2016 (http://www.sciencepublishinggroup.com/j/cmr)
doi: 10.11648/j.cmr.s.2016050201.11
ISSN: 2326-9049 (Print); ISSN: 2326-9057 (Online)

Core Body Temperature Changes During Surgery and Nursing Management

Rahşan Çam, Havva Yönem, Hatice Özsoy

Surgical Nursing Department, Aydın School of Health, Adnan Menderes University, Aydın, Turkey

Email address:
rahsany@mynet.com (R. Çam)

To cite this article:
Rahşan Çam, Havva Yönem, Hatice Özsoy. Core Body Temperature Changes During Surgery and Nursing Management. *Clinical Medicine Research*. Special Issue: Fever: Incidence, Clinical Assessment, Management Choices & Outcomes. Vol. 5, No. 2-1, 2016, pp. 1-5.
doi: 10.11648/j.cmr.s.2016050201.11

Abstract: The fact that surgical procedures and anaesthesia implementation affect thermoregulation, decrease heat production and increase heat loss cause hypothermia in the individual. This situation may create serious physiological problems both during and after the operation especially in risky patients. Surgical operation is a process threatening that body temperature of individual are maintained within required ranges due to the environment it is performed and requiring anesthesia application. Both general and local anesthesia's suppress afferent and efferent control of thermoregulation. Additionally, surgery environment and exposure to surgical operation generally cause heat loss. Heat loss is a common during surgery. This is because the surgical environment transfers heat from the patient. Anesthesia decreases both heat production and thermoregulation capabilities of patients. Anesthesia also hardens the monitorization of body temperature. Hypothermia may cause complications such as fever, trembling, coldness and paleness in the skin, absent-mindedness, slowing in the metabolic speed, slowing in mental functions, bradycardia and rhythm disturbances, respiration slowing, coma and death. It is important for nurses to appreciate the physiological effects of hypothermia, which can cause complications in surgical patients in these settings. Furthermore accurate and careful monitoring of haemodynamic parameters. In this process the nurse may help maintain the individual's body temperature by taking protective precautions through various methods before, during and after the operation and especially may protect the patient from various complications that may occur as a result of hypothermia.

Keywords: Surgery, Hypothermia, Anesthesia, Nursing Management

1. Introduction

Humans are warm-blooded beings that can keep inside body temperature consistent independent of outer environment temperature [1]. The temperature of deep tissues within the body (core temperature) is almost steady within ± 0.6°C unless the person has an inflammatory disease. Skin temperature, unlike core temperature, increases and decreases depending on the environment temperature [2]. Most of the heat produced within the body is formed in deep organs, particularly liver, brain, heart and skeletal muscle during exercise. Subsequently this heat is transmitted from the deep organs and the tissues to the skin and to air and environment afterwards. Body cells, tissues, organs and functions keep core temperature in a narrow range [1]. Surgical operation is a process threatening that body temperature of individual are maintained within required ranges due to the environment it is performed and requiring anesthesia application. Both general and local anesthesia's suppress afferent and efferent control of thermoregulation [4].

1.1. Regulation of Body Temperature

Body temperature is regulated with neural feedback mechanism. This mechanism is adjusted from heat adjustment centers in hypothalamus. For this feedback mechanism to function, detectors should exist to indicate that body temperature is too high or too low. There are both cold and warm receptors on the skin. However cold receptors are more than warm receptors. When the skin feels cold a variety of reflexes are initiated to increase the temperature: Shivering starts with a strong stimulus and heat formation rate in the body increases, perspiration is inhibited if exists, and transfer of the heat to the skin is decreases with vasoconstriction on the skin [2].

These are the factors determining the production of heat in the body:

- basal metabolic rates of all cells within the body,
- increase of metabolic rate with muscle activity,
- increase of metabolism in cells with the effect of other hormones such as thyroxin and to a lesser extent growth hormone,
- increase of metabolic rates in cells with the effect of epinephrine, norepinephrine and sympathetic stimulation,
- increase of metabolic rates in cells depending on the increase of chemical activity when particularly cell temperature increases [2].

Heat loss depends on the transmission of the heat from the place where it is produced to the skin and transmission of the heat to the environment. When rate of temperature produced in the body is more than heat loss, the heat accumulated within the body and body temperature increases. When the heat loss is more, both body heat and body temperature decrease [2].

Measurement of the body temperature of the patient in normal ranges is indicated with the term afebrile. Orally measured normal body temperature is generally ranges between 36.5-37.5°C. Generally, rectal temperature is measured 0.5°C higher and axillary temperature is measured 0.5°C lower with respect to the oral temperature. Measurement realized over temporal artery is close to oral measurements. Tympanic temperature measurement corresponds to mean of normal oral and rectal measurements. Body temperature can fluctuate with exercise, hormone level, change in metabolic rate and outer temperature being too high [1].

When temperature exceeds 37.5°C, pyrexia or fever emerges. The case in which body temperature is under normal values is called hypothermia. Hypothermia is divided into three subcategories as mild, medium and severe. In mild hypothermia internal temperature is between 35-32°C and thus skin temperature is low. Indications such as chill, shivering, coldness and paleness on skin and absent-mindedness are seen in the subject. Metabolism has slowed down. In medium hypothermia, internal temperature is below 32-26°C. Shivering in the subject has stopped, the subject is lethargic, slowing down of physical and mental functions is seen. In severe hypothermia, internal temperature is below 26°C, pulse is bradycardic and there are rhythm disturbances. The breathing has slowed down and the subject is in coma. If body temperature is below 25°C, heart cannot function and death follows [3].

1.2. Effect of Surgery on Body Temperature

Surgical operation is a threatening process that effect body temperature. Both general and local anesthesia suppresses afferent and efferent control of thermoregulation. Additionally surgery environment and exposure to surgical operation generally cause heat loss. Heat loss is a common during surgery. This is because the surgical environment transfers heat from the patient. Anesthesia decreases both heat production and thermoregulation capabilities of patients. Anesthesia also hardens the monitorization of body temperature [4].

During the surgery, heat losses can be via radiation, conduction, convection and evaporation [4]. The most common cause of hypothermia is generally radiation. The second most important factor during anesthesia and surgery is conduction. Heat loss with evaporation from surgical incision is significant. Central hypothermia seen after large-scale surgical interventions are deeper than smaller surgical interventions [5, 14].

Hypothermia and shivering can occur in patients after epidural block because of local anesthetics influence on the thermoregulatory center, peripheral defects due to inhibition inhibition of spinal cord afferent thermoreceptors fibers, use of cold local anesthetics [21].

General anesthesia causes thermoregulatory disfunctioning characterized by increase in the threshold of warmth, and decrease in the threshold of coldness [6]. Despite being in different degrees all general anesthesia weakens the thermoregulatory response. During general anesthesia hypothermia development follows a special course [5]. Hypothermia development takes place in these phases.

Phase 1: Central body temperature is lost for 0, 5-1, 5°C with “thermal redistribution” in the first 60 minutes.

Phase 2: After internal redistribution, heat loss from periphery to the environment continues. This period corresponds to 2-4th hour of anesthesia. Body temperature is below 35°C.

Phase 3: It is 3-4th hours of anesthesia. In this period, peripheral vasoconstriction takes place. Central temperature is stable in 33-35°C [6].

1.3. Intraoperative Hypothermia

Unintentional hypothermia can result from low temperature within the operating room, infusion of cold fluid, inhalation of cold gases, open body wounds or body cavities, lessening in muscle activity or pharmaceutical agents used [7].

Hypothermia is also intentionally triggered to lower the metabolic rate of the patient. Hypothermia is caused artificially in brain or heart surgeries [3, 7]. Despite the complications, postoperative hypothermia during cardiac surgery is still a valid method in terms of its benefits [19]. It is considered that therapeutic hypothermia suppress chemical reactions resulting from a perfusion injury in cases like post cardiac arrest syndrome [20]. Some examples relating to use of hypothermia for such purposes are after cardiac arrest, surgical repairing of aortic aneurysm, brain trauma and Intracranial aneurism surgery [8]. Against ischemia and hypoxia in the brain, protection can be provided with hypothermia of 1-3°C. In some cases, despite having some benefits, pre anesthesia hypothermia can cause serious complications [5]. These complications can be ranked as:

- Action times of hypnotic drugs and neuromuscular blockers are prolonged,
- There is increase in coagulopathy,

- Blood transfusion requirement increases due to intraoperative blood loss,
- Heart problems such as myocardial ischemia can develop which can increase the mortality,
- Recovery period is prolonged after anesthesia,
- Oxygen consumption increases with shivering development and thermal comfort of the patient is disturbed,
- Wound healing is delayed and infection development in surgical wound area is facilitated,
- Hospital stay and cost increases,
- Mortality rate increases [6, 15].

Risk factors for Intraoperative hypothermia are large-scale surgeries such as abdominal, thoracic and backbone surgeries, blood transfusion, history of diabetic neuropathy, immediate surgery, surgery time lasting longer than 2-3 hours, operating room temperature lower than 21.3°C and general anesthesia. Intraoperative hypothermia is affected by physical features such as age, gender, catecholamine level, body temperature before surgery, fat tissue, body surface and body weight, surgery's being urgent, anesthesia technique, time of mechanic ventilation administration, amount of IV liquid replacement and temperature of irrigation liquids [9, 10].

Patient with high risk of developing hypothermia under anesthesia is as follows:

- ASA II-IV (patient with mild systemic disease, patient having severe systemic disease whose daily activities are affected and are not),
- Female patients,
- Patient having preoperative body temperature below 36°C,
- Patient administered sedation and premedication,
- Patients to undergo large-scale or medium-scale surgical intervention,
- Patient having concomitant cardiovascular disease,
- Patient administered combined regional and general anesthesia,
- Patients above the age of 70,
- Newborns and children under five kilograms,
- Those having systolic blood pressure over 140 mmHg [5, 12, 16].

Coagulation may be disturbed due to the reduction in the activity of coagulation factors in hypothermia. Due to the affected thrombocyte function, high tendency of bleeding exists, however real thrombocyte number does not fall down until a serious hypothermia (hypothermic thrombocytopenia). In mild hypothermia coagulation factors are not affected while deep cooling may be prolonged [5, 11].

Obvious effects of hypothermia on drugs are available. For example inhalation anesthetics are more soluble in low internal temperature, thus it takes more time for patients to wake up in hypothermia. Muscle relaxants may also serve a two-fold longer effect due to the decrease in internal temperature [11].

A most scared and unwanted complication of surgery, wound infection, is also affected negatively from hypothermia. Hypothermia causes enhancement of wound infections by causing decrease in O_2 use by degrading direct immunity functions and thermoregulatory vasoconstriction. As an indicator of bad wound healing in patients with hypothermia nitrogen excretion in the urine is high for some postoperative days [5].

Hypothermia that occurs during surgery affects the formation of pressure ulcers in these patients [21].

Due to postoperative hypothermia patient comfort is disturbed remarkably. When the patients are asked about their surgical experiences, they express that chill and shivering feeling after surgery are two of the worst experiences during hospital stay period [11].

2. Other Effects of Hypothermia

2.1. Circulation

Coldness has a negative effect on heart, it causes obvious decrease in heart rate, pulse volume and cardiac contractility. Moreover, irritability of myocardium enhances. In case of the absence of protective measurements, heart tends to develop morbid cardiac events. Between 27°C and 25°C there is the risk of ventricular fibrillation and stasis [11].

2.2. Respiration

Hypothermia suppresses respiratory center. During mild hypothermia respiration frequency and tidal volume increase, however dead space increases due to the dilatation of airways. The more temperature drops the more volume and respiration frequency per minute decreases and it keeps decreasing until apnea formation. CO_2 production drops while CO_2 solubility in the blood increases. Oxygen solubility in the blood increases as well, causing these tissues to pull less oxygen from the blood [11].

2.3. Endocrine System

In the case where body temperature is 30°C hyperglycemia develops as glucose uptake is delayed by the cells and glucose release is reduced by the kidneys [11]. Hypothermia induces endocrine metabolic response to trauma and increases sympathetic discharge and causes bleeding by disrupting the coagulation balance [17].

2.4. Liver

As the temperature drops, liver loses its detoxification ability rapidly. When the body temperature drops below 30°C, hyperglycemia develops. When the body temperature is 28°C, metabolic capacity decreases for 40% of normal. Furthermore, an increase in lactic acid synthesis and a decrease in catabolism are observed [11].

2.5. Kidneys

Hypothermia causes inhibition of antidiuretic hormone release and low oxidative renal tubular activity, thereby leading diuresis volume decrease. Diuresis develops in cold and this leads Na+, K+, Mg+ and Phosphate secretion [11].

2.6. Electrolytes

Changes in potassium and magnesium levels are critical. A cold heart is sensitive to the changes in these levels, thus rhythm disturbances can easily develop [11].

2.7. Central Nervous System

Cerebral blood flow diminishes 7% for every 1-degree decrease in internal temperature. Hypothermia causes transmission disturbances in nerves. In 33°C, high cerebral functions and retroactive amnesia are seen. Human loses consciousness between 30°C to 28°C [11].

2.8. Gastrointestinal System

In a temperature of 30°C, shivering develops as glucose uptake is delayed by the cells and there is a decrease in insulin release. If it continues for too long shivering can cause shivering as well, glycogen storages can be completely emptied [11].

2.9. Immunosuppression

There is a three-fold risk with respect to normothermic patients [11]. The best way to prevent the problems arising from hypothermia is to prevent hypothermia. This can be achieved by active and passive heating techniques. Hypothermia risk is high before, during and after surgical intervention when the patients are particularly weak. In order to prevent hypothermia caused by redistribution it is not adequate to initiate active heating during surgery. Because it take much longer time for heat to reach core thermal compartment [11].

2.10. Pre-heating

Pre-heating is a way to store energy by providing active heating to patient before surgery. Pre-heating is the most effective way of preventing redistribution hypothermia. Increasing average skin temperature can be achieved by a rapid heat transfer to the patient. Temperature increase in peripheral compartment aids in the minimisation of the difference between normal core and periphery temperature and causes vasodilatation before induction. Thusly, heat transfer to periphery during anesthesia is restricted [11].

2.11. How to Pre-heat

Core heat and peripheral heat should be close for the prevention of heat loss via redistribution. To enable this, especially arms and legs should be covered. Ideal period and temperature of pre-heating varies among patients, however, clinic findings show that heat provided during 30 minutes of blowing air heating performed in 40°C to 43°C is more than heat amount redistributed during the first hour of general anesthesia [11].

Generally, pre-heating should be initiated as soon as patient arrives in preoperative waiting area. It is important to cover the skin as possible. Patient should be covered except for face. Heating should be continued until the patient is taken to the operating room. During transfer patient should be covered with good insulation material to maintain the body heat [11].

It should also be indicated that active heating must not be stopped during surgery. Pre-heating with blowing air heating is the most effective way to obtain a good result [11].

It has been proved that pre-heating has a positive effect on heat distribution causing hypothermia in the beginning. It is easy to heat a patient before surgery as the patient can be completely covered without any intervention to patient's position and surgical area. Vasodilatation caused by pre-heating facilitates the attachment of peripheral venous catheter and has a positive effect on thermal comfort of the patient [11].

Preoperative active heating is a cost-efficient and simple method to apply which should be applied on sensitive patient against especially hypothermia complications.

Moreover, it should be noted that even short term procedures can cause hypothermia development in patients in a short time [11].

2.12. Hypothermia Management in Intraoperative Period

Intraoperative period starts with anesthesia induction and continues until patients are taken to the recovery room. Body temperature must be monitorized in all surgeries lasting longer than thirty minutes.

Surgical nurses should cooperate with each other in order to prevent the risk of surgical site infection, surgical bleeding, hypothermia and to reduce patient discomfort [1, 18].

Patients should be heat with temperature regulator blankets to prevent hypothermia according to the surgery site [18].

For patients with detected hypothermia before anesthesia induction "critical incident form" should be filled [14].

Central temperature of the body of patient of whose body temperature was measured before anesthesia induction should be monitored from lower end of esophagus after induction, if possible.

If esophagus temperature is not possible "tympanic" temperature should be measured with 15-minute-intervals.

It should be remembered that patients are naked in operating room and ambient temperature should be above 21°C.

After the patients are covered with surgical drape ambient temperature can be lowered to lower degrees appropriate for surgical teem with the provision of initiating active heating.

If patients are to be administered intravenous liquid, blood or blood product over 1000 mL they should be heated up to 37°C via special heaters.

Risky patients should certainly be active-heated even if they have a short intervention of shorter than 30 minutes.

Temperature should be maximum while using hot air blowing systems, body temperature should be maintained 36°C or above. When body temperature is 37°C or above active heating should be terminated.

All washing liquid to be used on the patient should be heated up to 38-40°C [14].

2.13. Management in Postoperative Period

Surgical nurses should cooperate with in order to prevent hypothermia and to reduce patient discomfort at risk of surgical site infection, surgical bleeding in postoperative period [19].

It encompasses the period starting from arrival in recovery unit until postoperative 24 hours.

1. Body temperatures of patients should be measured upon arrival into recovery unit. Measurement should be continuous or repeated with 15-minute intervals until the patient leaves the service.

2. Patients should not be transferred to service until the body temperature is above 36°C.

3. Patients with body temperature of or above 36°C on arrival to recovery should be applied passive insulation

4. Active heating should be applied to patients whose body temperature is below 36°C using air blowing systems and blankets. This process should be continued until body temperature of the patient is 36°C.

5. Patients with body temperature of 36°C or above should be covered with at least one blanket while being transferred to service.

6. Body temperature controls of patients arriving in the service should be made with 4-hour interval. Patients should be given at least 2 blankets [14].

3. Conclusion

Body temperature should be within a range so that vital activities can be performed. Surgical operation is a process threatening that body temperature of individual are maintained within required ranges due to the environment it is performed and requiring anesthesia application. Nurse can help maintain body temperature of the individual by taking protective measures for body temperature in preoperative, intraoperative and postoperative periods during this process and can protect the patient from complications that may occur particularly as a result of hypothermia.

References

[1] Dikmen Y. Hemşirelik Esasları İnsan Sağlığı ve Fonksiyonları: Ağrı Yönetimi, 7. Edition. Palme Yayıncılık, 2015; 1144-1179.

[2] Çavuşoğlu H, Yeğen BÇ (eds) Tıbbi Fizyoloji, Nobel Matbaacılık, 2007.

[3] Akça Ay F. Temel Hemşirelik Kavramlar, İlkeler, Uygulamalar, 2. Edition. İstanbul Medical Yayıncılık, 2008; 270-285.

[4] Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC. (Günaydın B, Demirkıran O(ED)) Klinik Anestezi, 5. Edition, Nobel Tıp Kitabevleri, 2012; 685.

[5] Karaçayır Y. Deksmedetominin genel anestezi ve epidural anestezide vücut sıcaklığı değişikliği ve titreme üzerine etkileri, Uzmanlık Tezi. Trakya University Medical Faculty Department of Anaesthesiology, Edirne, 2006.

[6] Guide, Prevention of Unwanted Perioperative Hypothermia "Türk Anesteziyoloji ve Reanimasyon Derneği." 2013; 41: 188-9.

[7] Aksoy G, Kanan N, Akyolcu N. Cerrahi Hemşireliği I. Nobel Kitabevi, 2012; 328-329.

[8] Hard SR, Bordes B, Hart J, Corsino D, Harmon D. Uninted perioperative hypothermia. The Ochsner Journal 2011; 11: 259-270.

[9] Kongsayreepong S, Chaibundit C, Chadpaibool J, Komoltri C, Suraseranivongse S, Suwannanonda P, Raksamanee EO, et al. Predictor of core hypothermia and the surgical intensive care unit. Anesthesia & Analgesia 2003; 96(3): 826-833.

[10] Kim EJ, Yoon H. Preoperative factors affecting the intraoperative core body temperature in abdominal surgery under general anesthesia. Clinical Nurse Specialist 2014; 268-276.

[11] Successful heat management. Practical guide for preventing hypothermia. 2013. http://www.the37company.com/dbdownload/154/Succesful-Temperature-Management-booklet-Second-Edition-Turkish.pdf

[12] Sessler DI. Central termoregulatory inhibition by general anesthesia. Anesthesiology 1991; 75: 557-559.

[13] Sessler DI. Temperature monitoring and perioperative thermoregulation. Anesthesiology 2008; 109(2): 318-338.

[14] Buggy DJ, AW Crossley. Thermoregulation, mild perioperative hypothermia and post-anaesthetic shivering. British Journal of Anaesthesia 2000; 84(5): 615-628.

[15] The management of inadvertent perioperative hypothermia in adults. Clinical practice guideline. 2015. http://www.ncbi.nlm.nih.gov/books/NBK53797/pdf/TOC.pdf

[16] Ünver, S., Yıldırım, M., Üniversitesi, T., Fakültesi, S. B., & Üniversitesi, H. (2013). Cerrahi Girişim Sürecinde Çocuk Hastaya Yaklaşım. Journal of Current Pediatrics/Guncel Pediatri, 11(2): 128-133.

[17] Demirhan, İ., & Pınar, G. (2014). Postoperatif İyileşmenin Hızlandırılması Ve Hemşirelik Yaklaşımları. Yıldırım Beyazıt Üniversitesi Hemşirelik E-Dergisi, 1(2): 43-53.

[18] Özşeker, E., Dinç, G., & Soğukpınar, N. (2015). Gebelikle İlgili Olmayan Cerrahi; Gebe Hastanın Bakımı. Dokuz Eylül Üniversitesi Hemşirelik Fakültesi Elektronik Dergisi, 8(2): 101-107.

[19] İnan, M. B., AÇIKGÖZ, B., Eyileten, Z. B., YAZICIOĞLU, L., Atilla, A. R. A. L., Uysalel, A., ... & Özyurda, Ü. (2011). Kalp Cerrahisi ve Lokal Hipotermi: 731 Hastanın Retrospektif Değerlendirilmesi. Ankara Üniversitesi Tıp Fakültesi Mecmuası, 64(01), 026-029.

[20] Kardiyopulmoner Resüsitasyon Sonrası Hasta; USLU, Yasemin; KORKMAZ, Fatma Demir. DERLEME REVIEW. Türk Kardiyol Dern Kardiyovasküler Hemşirelik Dergisi - Turk Soc Cardiol Turkish Journal of Cardiovascular Nursing 2015; 6(10): 99-111.

[21] Nihal Yüzbaşıoğlu, Lomber Disk Cerrahisinde Az Kullanılan Bir Teknik Olan Epidural Anestezi İle Genel Anestezinin Hemodinami, Hasta Konforu Ve Maliyet Hesabı Yönünden Karşılaştırılması, 2006.