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ORIGINAL RESEARCH / *ÖZGÜN ARAŞTIRMA*

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Investigation of the Effect of Heating Blanket Use on Bleeding and Long of Intensive Care Unit Stay after Major Open Urology Surgeries

Isıtıcı Battaniye Kullanımının Açık Ürolojik Majör Cerrahilerde Kanama Miktarı ve Yoğun Bakımda Kalış Sürelerine Etkisinin İncelenmesi

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ABSTRACT *Objective:* Intraoperative hypothermia causes increased bleeding, increased transfusion risks, long of intensive care unit stay and subsequently higher medical costs. This study aimed to determine the effects of hypothermia on perioperative bleeding and intensive care unit stay duration in patients undergoing major oncological urology surgery.

Materials and Methods: Following approval of this study by the ethics committee, demographic characteristics, surgery type, operation time, lowest perioperative body temperature, hemodynamic parameters, the use of heating blanket during surgery, the amount of bleeding and transfusıon, postoperative long of intensive care unit stay in patients who underwent open major urological surgery during 2015–2018 were retrospectively evaluated. Esophageal probe was used for temperature monitoring following anesthesia induction and a body temperature of <36°C was considered to indicate hypothermia.

Results: A total of 68 patients without a heating blanket (n: 57) and using a heating blanket (n: 11) were included in the study. The intraoperative lowest recorded body temperature was 32.1°C, and hypothermia (<36°C) developed in 63.6% of patients for whom heating blankets were used and in 94% of patients for whom heating blankets were not used. The amount of intraoperative bleeding was significantly low in patients for whom heating blanket was used (p = 0.03).

Conclusıon: Perioperative hypothermia is a very frequent and preventable clinical condition that increases long of intensive care unit stay, mortality, and morbidity in geriatric patients and in patients undergoing major surgery. Based on our results, less bleeding and decreased need for intensive care unit stay were noted owing to the prevention of intraoperative hypothermia.

Keywords: Hypothermia, Heating blanket, Long of intensive care unit stay duration, Intraoperative bleeding

ÖZ *Amaç:* İntraoperatif hipotermi, kan kaybında ve beraberinde transfüzyon risklerinde artış ve yoğun bakımda kalış sürelerinde uzamaya ve bunun sonucunda da maliyet artışına neden olmaktadır. Bu çalışmada majör onkolojik ürolojik cerrahi geçiren hastalarda hipoterminin perioperatif dönemde kanama, yoğun bakımda kalış süreleri üzerine etkisini görmeyi amaçladık.

Gereç ve Yöntem : Çalışmamızda etik kurul onayını takiben 2015 ile 2018 arası dönemde açık majör ürolojik cerrahi geçiren hastaların demografik özellikleri, geçirecekleri cerrahi türü ve operasyon süresi, peroperatif en düşük vücut sıcaklıkları, hemodinamik parametreleri, cerrahi sırasında ısıtıcı battaniye kullanılıp kullanılmadığı, kanama miktarları, transfüzyon miktarı ve postoperatif yoğun bakım ihtiyacı retrospektif olarak incelendi. Anestezi indüksiyonu sonrası ısı takibi için özefagus probu yerleştirilen hastalarda <36 °C hipotermi olarak kabul edildi.

Bulgular: Çalışmaya ısıtıcı battaniye kullanılmayan (n: 57) ve ısıtıcı battaniye kullanılan (n: 11) toplam 68 hasta kabul edildi. İntraoperatif en düşük vücut sıcaklığı 32.1 olup, ısıtıcı battaniye kullanılan hastaların % 63.6, ısıtıcı battaniye kullanılmayan hastaların %94'ünde hipotermi (<36 °C) görüldüğü tespit edildi. İntraoperatif kanama miktarı ısıtıcı battaniye kullanılan hastalarda anlamlı düzeyde az bulundu(p: 0,03).

Sonuç: Perioperatif hipotermi oldukça sık karşılaştığımız yaşlı hasta popülasyonunun ve majör cerrahi geçiren hastalarının yoğun bakımda kalış süresini mortalite ve morbiditesini artıran önlenebilir bir klinik tablodur. Bu çalışmada elde edilen sonuçlara göre intraoperatif hipoterminin önlenmesi ile daha az kanama izlenirken yoğun bakım ihtiyacıda azalmıştır.

Anahtar Kelimeler: Hipotermi, ısıtıcı battaniye, yoğun bakımda kalış süresi, intraoperatif kanama

Introduction

General and neuraxial anesthesia methods applied during surgeries disrupt thermoregulatory responses in patients who are not provided with external heat source (1). Normothermia is necessary for optimum metabolism and for maintaining physiological processes (2).Therefore, maintaining normothermia during anesthesia application requires attention to reduce comorbidities and postoperative complications (3). Perioperative hypothermia is defined as a body temperature of <36°C 1 h preoperatively and within 24 h postoperatively and is a preventable adverse effect (4,5). The predictive factors include age, body mass index (BMI), American Society of Anesthesiologists Physical Status (ASA) score, sex, laparoscopic surgery, anesthesia method and heating techniques (4).

Intraoperative hypothermia causes increased blood loss and subsequent transfusion risks, increased surgical site infection, cardiovascular complications, organ failure, decreased clearance for various drugs, extended hospital and long of intensive care unit stay, consequently higher medical costs (6). Bleeding problems are common in patients who undergo major surgeries. Hemostatic mechanism is a result of the interaction between endothelial, thrombocyte, and plasma coagulation factors. Reduced thrombocyte functions and defects in coagulation cascade enzymes increase the amount of bleeding (1).

Perioperative hypothermia leads to decreased tissue perfusion and decreased motility of immune cells as well as scar formation, and these cause increased infection risk (1,7). The duration of action of some drugs used during anesthesia, especially muscle relaxants, is prolonged. The minimum alveolar concentration of volatile anesthetics required for unresponsiveness against surgical stimulants decreases with hypothermia. Metabolic rate decreases by 7%–8% for each 1°C decrease in body temperature (8). As a result, deeper anesthesia is induced and anesthesia recovery period is extended (7). Hypothermia stimulates the sympathetic nervous system, which increases tachycardia, hypertension, systemic vasoconstriction, and myocardial oxygen consumption. As a result, myocardial ischemia and arrhythmias occur (1,3).

Thus, the present study aimed to examine the effects of heating blanket use for intraoperative hypothermia on bleeding and long of intensive care unit stay. Through the retrospective review of patient medical records, we share our regular experiences regarding patients undergoing major urological surgeries and contribute to the prevention of potential complications by raising awareness in anesthesia and surgical teams for hypothermia.

Materials and Methods

This retrospective study was approved by the Eskisehir Osmangazi University Medical Faculty Ethical Committee (decision no 2019-60) and was conducted by examining the medical records of patients who had undergone major oncological surgeries between January 2015 and December 2018 at the urology clinic. The medical records of patients who aged >18 years, American Society of Anesthesiologists Physical Status Classification I-III (ASA) and had undergone major oncological surgery (nephrectomy, cystectomy, and prostatectomy) that lasted for >120 min were included in the study. As heating blanket use for active heating recently began in our clinic, passive heating method had been used for patients prior to this. Patients were covered with sterile sheets during surgeries until the introduction of active heating. In active heating, patients were covered with heating blankets (Medwarm 190 x 50 cm warming bed + W-500D control unit) that were set at 39°C before patients were taken to the operation table; this was maintained until patients left the operation table. The ambient temperature of the operation room was regulated by the central system and maintained at a routine temperature of 23°C–24°C at 40% humidity. Non-invasive monitoring (electrocardiogram, non-invasive blood pressure, and pulse oxymeter) was conducted before anesthesia induction for patients who had received premedication as per routine practices of our clinic. For general anesthesia induction, thiopental (5–7 mg/kg), rocuronium (0.6 mg/kg), and remifentanil (0.1–0.3 μg/kg were administered and endotracheal intubation was performed after an appropriate time for neuromascular blockade. For anesthesia maintenance, sevoflurane (2%–3%), 50% air + 50% oxygen (4 L/min), and remifentanil infusion (0.1–0.3 μg/kg) were administered. Invasive monitoring was performed by using radial artery and peripheral central venous pressure catheterizations. During the surgery, invasive liquids (crystalloid and colloids) at room temperature were used. After intubation, esophageal temperature probes were placed, and patient body temperatures were recorded every 30 min. All surgeries were performed using the open laparotomy technique. The transfusion of blood products was decided based on blood gas results, the calculated amount of bleeding, comorbidities, and clinician's judgment. The amount of bleeding was calculated by evaluating the aspirator, sponge used and the surgical field.

Age, sex, BMI, ASA score, surgery type, initial body temperature, lowest body temperature, systolic blood pressure, diastolic blood pressure, and mean arterial pressure values at the lowest body temperature, the amount of bleeding and transfusıon, surgical duration, postoperative intensive care unit stay duration of the patients were retrospectively evaluated.

Statistical Analysis

Continuous data have been presented as means ± standard deviations. Categorical data have been indicated as percentage (%). The Shapiro–Wilk's test was used for the normal distribution analysis of data. The Mann-Whitney U test was used for the cases with two groups in comparison of the non-normally distributed groups. Pearson exact chi-square, and Fisher's exact chi-square tests were used for analyzing the cross tables generated. The data were statistically analyzed using the SAS version 9.2 software (SAS Institute, Cary, North Carolina). P values of <0.05 were considered statistically significant.

Results

The medical records of 68 patients who had undergone major urological surgeries (prostatectomy, nephrectomy, or cystectomy) were included. The mean age of the patients was 70.2 ± 7.59 in patients using a heating blanket, 61.5 ± 8.15 in patients not using a heating blanket and BMI was 26.4 ± 2.47 in patients using warming blanket, 26.0 ± 4.69 in patients not using warming blanket (Table 1). Of all patients, underwent nephrectomy 32%, cystectomy 29% and prostatectomy 38%.

Operation room temperature was similar for both the groups. The lowest body temperature measured using the esophageal probe inserted after anesthesia induction was 35.1°C. The initial body temperature measurement in 32% of the patients was <36°C.

The lowest intraoperative body temperature was 32.1°C. Intraoperative hypothermia threshold was accepted as a body temperature of 36°C. The comparison of the two groups demonstrated that 63.6% of patients for whom heating blankets were used and 94% of patients for whom heating blankets were not used had hypothermia.

Intraoperative blood loss was significantly lower in patients for whom active heating used mean 586ml±386.7 ml than in those for whom passive heating mean 1161ml±919.5 ml was used (p:0.03). The amount of transfusion was mean 0.18 ± 0.60 (IU) in the group with active heating and mean 0.93 ± 1.26 (IU) in the group without active heating (p= 0.04). The lactate level between the groups was statistically significant (p: 0.02). (Table 2)

The average lowest body temperature of patients for whom passive heating was used was 34.3°C and that of patients for whom active heating was used was 35.4°C; a statistically significant difference was noted between the groups (p: <0.001*).

At the end of the surgery, no postoperative intensive care was required for patients for whom heating blankets were used; however, 9 of the 57 patients for whom heating blanket was not used required intensive care after surgery. There was no difference between the groups in terms of ASA (p: 0.057) and surgical operation type (p: 0.417). The mean age was statistically significant between the groups (mean age was 70.2 ± 7.59 in the group with active heating, 61.5 ± 8.25

Table 1. Demographic data of patients included in the study

	Mean	Standard deviation	Minimum	Maximum	n
Age (years)	62.926	8.646	38.000	83.000	68
Initial body temperature (°C)	36.073	0.503	35.100	37.200	68
Lowest body temperature (°C)	34.545	1.009	32.100	36.100	68
BMI	26.110	4.401	17.000	44.400	68
Amount of bleeding (mL)	1068.38	880.124	50.000	4700.00	68
Surgical duration (h)	4.073	1.567	2.000	8.000	68
Systolic blood pressure (mm/Hg)	104.529	16.788	73.000	151.000	68
Diastolic blood pressure (mm/Hg)	58.617	9.519	43.000	88.000	68
Mean arterial pressure (mm/Hg)	75.323	11.807	57.000	114.000	68

BMI: Body mass index

Table 2. Clinical data			
Parameters	**Heating blanket (+) (n=11)**	**Heating blanket (-) (n=57)**	**p**
Initial body temperature (°C)	36.0±0.58	36.0±0.49	0.953
Initial lactate	0.94±0.50	1.04±052	0.319
Lowest body temperature (°C)	35.4±0.70	34.3±0.96	<0.001*
Lactate	1.20±0.73	1.64±0.84	0.02*
Amount of bleeding (mL)	586.3±386.7	1161.4±919.5	0.03*
Transfusion amount (IU)	0.18±0.60	0.93±1.26	0.04*
SAP (mm/Hg)	104.3±19.4	104.5±16.4	0.86
DAP (mm/Hg)	58.6±12.3	58.6±9.0	0.75
MAP (mm/Hg)	74.9±16.0	75.4±10.9	0.51
Need of intensive care	0 (%0)	9 (%15)	0.35

*p<0.05 indicates statistically significant values, SAP: Systolic arterial pressure, DAP: Diastolic arterial pressure, MAP: Mean arterial pressure

in the group without active heating, p: 0.004). The type of operation performed (p: 0.417) and the mean operation time were similar between the groups; in the group with active heating was mean 3.72 ± 1.27 hour, in the group without active heating was mean 4.14 ± 1.62 hour, p: 0.55).

Discussion

Intraoperative hypothermia is a preventable clinical condition. The incidence of intraoperative hypothermia in patients who are not warmed is higher in major, longer, and complicated surgeries compared with that in shorter and minor operations. Especially geriatric patients; cachectic (with increased metabolism, such as in cancer) patients, who are at risk associated with anesthesia use (ASA III-IV); and burn patients are in the high-risk group for unwanted hypothermia . It has been reported that the incidence of unwanted hypothermia is between 50-90%. (5). With the increase in the elderly population, the incidence of many chronic diseases, malignancies and oncological surgeries has increased. Similarly, a majority of patients undergoing major urological surgery have systemic diseases related to the geriatric respiratory and circulatory systems.

Perioperative hypothermia results in extended hospital stay duration, increased costs, and mortality. Achieving normothermia requires multimodal and multidisciplinary (physician, nurse, medical staff, and intensive care team) approaches and awareness (6). In the perioperative period, warming the patient and monitoring body temperature are crucial for the early detection of hypothermia and achieving normothermia (5). Patients are exposed to unwanted hypothermia during the perioperative period owing to many reasons such as low room temperature, the administration of cold intravenous liquids, and blood transfusion (9).

Advanced age is an independent risk factor of hypothermia; therefore, routine body temperature measurement and perioperative heating must be performed. Shivering encountered in the postoperative period is a common condition that increases oxygen consumption and potential complications in high-risk patients (10). In this study, the mean age of the patients was 62.9 ± 8.46, and the average age was 70.2 ± 7.59 and higher, especially in the group using heating blankets.

In a study that retrospectively analyzed the data of 2,574 adult patients who underwent planned abdominal surgery and for whom heating blankets were used, the determinant factors of intraoperative body temperature were examined. Body temperature decreased 1 h after surgical incision and then increased again. However, body temperature increase may not occur in surgeries longer than 3 h owing to thermoregulation mechanisms such as perspiration. Body temperature increase 1 h after surgical incision was associated with young age, increased BMI, male sex, laparoscopic surgery, and heating blanket use. Male sex and heating blanket use were strong predictive factors of preventing hypothermia 3 h after surgical incisions. Although the mechanism that prevents hypothermia in males is unclear, decreased conduction owing to higher subcutaneous adipose tissue in females may prevent hypothermia. In addition, compared with females, males have higher musculoskeletal mass, which participates in thermogenesis (4). The cause of continued decrease in body temperature after the first hour depends on ambient temperature, the extent of the surgical procedure, patient-specific factors, insulation, and active heating (1). In our study, only 10.2% patients were female as only urological oncology cases were included. ASA, BMI, gender, type of operation and operation times ratios were similar in both groups. However, although there was no need for intensive care in the group in which a heating blanket was used, there was no significant difference between the groups (p: 0353).

Sosyal G.E et al. investigated the effects of active and passive heating on perioperative hypothermia. For at least 20 min, active heating was applied for the first group (using carbon fiber resistive system - W500D + 190 ×50 cm) and passive heating (using blankets or socks) for the second group in the preoperative period. The third group was monitored as a control group. Body temperature of the active heating group until 3 h was significantly higher than that of the other two groups ($p < 0.001$). Mean body temperatures were 36.2°C ± 0.26°C, 35.4°C ± 0.49°C, and 35.2°C ± 0.47°C, respectively. Body temperature in the perioperative period was not significantly different between the passive heating group and control group. A significant difference was noted between the active heating and control groups regard to body temperature. Thus, active heating applied using the carbon fiber resistance system was an effective method (9). In our study, the average lowest body temperature of patients for whom active heating was not used was 34.3°C and of those for whom active heating was used was 35.4°C with a statistically significant difference ($p<0.001$*); these results were similar to those reported in the literature

In their study, Aksu et al. (10) examined 564 patients of the Kocaeli University; they defined hypothermia as a body temperature of <35°C. They determined that the incidence of perioperative hypothermia was higher in the thorax and open abdominal surgery cases with general anesthesia. The incidence of perioperative hypothermia was 2.4% and that of postoperative hypothermia was 45.7%. Time required for normothermic and hypothermic patients to reach a satisfactory Aldrete score was 15 and 24.5 min, respectively. In the aforementioned study, age, surgery type and duration, and the amount of liquid administered were found to be the significant risk factors of hypothermia (10). In the present study, the lowest initial body temperature was 35.1°C; of all patients, 32.3% had a body temperature of <36°C and 64.8% developed hypothermia (<35°C) when the lowest body temperatures were evaluated. These results may be explained by the fact that in our study, the mean age of patients was higher, surgical duration was longer, and all surgeries were open abdominal surgeries.

In a study that retrospectively investigated the time at which hypothermia develops in colectomies, a perioperative body temperature of >36.5°C was directly proportional to a postoperative body temperature of >36°C. It was highlighted that this relation was not affected by laparoscopic or open surgeries and that procedures designed for normothermia should be utilized before anesthesia induction and in the intraoperative period. Although some researchers have recommended the heating of intravenous fluids before administration, its efficacy is yet to be proven. Temperature measurements were performed using different methods via the oral route in pre- and postoperative periods and using esophageal heat probe during the intraoperative period (11). In our study, temperatures recorded using the esophageal heat probe inserted after intubation were considered as initial body temperatures. The lowest measured initial body temperature was 35.1°C, which was considered to be affected by factors such as anesthesia induction and ambient temperature. While the entrance body temperature was similar between the groups, there was a significant difference between the lowest intraoperative body temperature.

A study conducted by Hassani et al. (12) found no difference between the effect of heating blankets set at 38°C and those set at 40°C on patients undergoing spinal fusion surgery under total intravenous anesthesia for preventing hypothermia-related complications during the induction, surgical, and recovery periods. However, hypothermia prevalence was lower in patients for whom heating blankets were set at 40°C than in those for whom heating blankets were set at 38°C (12).

Analysis based on current literature showed that each 1°C decrease in body temperature with mild hypothermia increases blood loss by 16% and transfusion risk by 22% (1,13). A study assessing surgeries with high hypothermia risk such as hip and thorax surgeries demonstrated that the active heating group had less bleeding and hemoglobin decrease than the passive heating group; however, both the groups had similar transfusion requirements (6). In our study, intraoperative blood loss was also statistically significantly lower in the patients for whom active heating was used (mean 586ml±386.7) than in those for whom passive heating was used (mean 1161ml±919.5) ($p = 0.03$*). The amount of transfusion was: 0.18 ± 0.60 in the group with active heating, the mean amount of transfusion ((IU) in the group without active heating (IU): 0.93 ± 1.26, and it was statistically significant (p: 0.04). Lactate level also supports this (p: 0.02).

Study Limitations

The study had its own limitations. First, the data were single-centered, retrospectively collected, and the distribution between groups was uneven. The lack of perioperative temperature measurements of the patients and the inability to access records of complications other than bleeding and the need for intensive care, which are thought to be related to this, limits the study. Although statistically significant results support other studies, it was not evaluated before the sample size because it was retrospective.

Conclusion

Perioperative hypothermia is a clinically significant and preventable condition that can cause long-term complications. Our results suggest that perioperative hypothermia is a frequent and serious problem that is encountered in clinical practice. Therefore, we concluded that temperature monitoring and the application of necessary active heating methods during the perioperative period can prevent hypothermia and deep anesthesia and mitigate serious complications such as bleeding.

Ethics

Ethics Committee Approval: This retrospective study was approved by the Eskisehir Osmangazi University Medical Faculty Ethical Committee (decision no 2019-60) and was conducted by examining the medical records of patients who had undergone major oncological surgeries between January 2015 and December 2018 at the urology clinic.

Informed Consent: Age, sex, BMI, ASA score, surgery type, initial body temperature, lowest body temperature, systolic blood pressure, diastolic blood pressure, and mean arterial pressure values at the lowest body temperature, the amount of bleeding and transfusıon, surgical duration, postoperative intensive care unit stay duration of the patients were retrospectively evaluated.

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