Acta Medica Alanya

RESEARCH ARTICLE

ARAŞTIRMA

Acta Medica Alanya

2022;6(2): 173-178

DOI: 10.30565/medalanya.1122479

Prevalence of perioperative hypothermia and predisposing factors in a children's hospital

Bir Çocuk Hastanesinde Perioperatif Hipotermi Prevalansı ve Predispozan Faktörler

Kubra Evren Sahin[1]*, Murat Celal Sozbilen[2]

1.Department of Anaesthesiology and Reanimation, Dr. Behcet Uz Child Diseases and Surgery Training Hospital, Konak, Izmir, Turkey
2 .Department of Orthopaedic Surgery, School of Medicine Hospital, Ege University, Bornova, Izmir, Turkey

ABSTRACT

Aim: Perioperative hypothermia is more common in pediatric patients than in adult patients due to increased body surface area/weight ratio and limited subcutaneous fat deposits. Therefore, active and passive warming techniques are used more frequently in the surgeries applied to pediatric patients. This study presents the prevalence of perioperative hypothermia and the predisposing conditions for perioperative hypothermia in pediatric orthopedic surgeries in which active and passive warming techniques are applied.

Methods: This cross-sectional, descriptive, and observational study included 102 children admitted to the pediatric orthopedic clinic of a children's hospital. Temperature measurements were made with a calibrated infrared tympanic thermometer in all cases while they were waiting in the service room, when they entered the operation theater, when they left the operation theater and when they left the postoperative care unit. Their demographic data, hemogram and thyroid hormone parameters, preoperative fasting times related to the procedure and temperature were recorded. Also, the humidity and temperature values of the operating theater, the operation type performed, the duration of the operation, the time spent in the operating theater and the recovery time from anesthesia, were all recorded in their follow-up forms. Data analysis was done using the SPSS V21.0 and was conducted at a 95% confidence interval.

Results: Hypothermia was observed in 20.58% of 102 patients included in the study. Predisposing factors for perioperative hypothermia included the fact that the patient had a diagnosis of concomitant cerebral palsy, the patient's body temperature was low in the service area, low temperature and humidity values in the operating theatre and staying in the operating theatre for a prolonged period of time.

Conclusion: Although active and passive warming techniques are applied during the operation, perioperative hypothermia was observed in 20.58% of pediatric patients who underwent the orthopedic operation. Consideration of predisposing factors together with active and passive warming techniques may reduce the incidence of perioperative hypothermia.

Keywords: Hypothermia, orthopedic surgery, risk factors

ÖZ

Amaç: Perioperatif hipotermi, artmış vücut yüzey alanı/ağırlık oranı ve sınırlı cilt altı yağ depoları nedeniyle pediatrik hastalarda yetişkin hastalara göre daha sık görülür. Bu nedenle pediatrik hastalara uygulanan cerrahilerde aktif ve pasif ısıtma teknikleri daha sık kullanılır. Bu çalışmada aktif ve pasif ısıtma tekniklerinin uygulandığı pediatrik ortopedik cerrahilerde perioperatif hipotermi sıklığının ve perioperatif hipotermi için predispozan durumların belirlenmesi amaçlanmıştır.

Yöntemler: Bu kesitsel, tanımlayıcı ve gözlemsel çalışmaya bir çocuk hastanesinin pediatrik ortopedi kliniğine başvuran 102 çocuk dahil edildi. Tüm olguların servis odasında beklerken, operasyon odasına girerken, operasyon odasından çıkarken, postoperatif bakım ünitesinden ayrılırken kalibrasyonu yapılmış infrared timpanik termometre ile ateş ölçümleri yapıldı. Hastaların demografik verileri, hemogram ve tiroid hormon parametreleri, prosedürle ilgili olarak operasyon öncesi açlık süreleri ve ateşleri kaydedildi. Ayıca operasyon odasının ısı ve nem değerleri, yapılan operasyon, operasyon süresi, operasyon odasında geçirdiği süre, anesteziden derlenme süresi gibi veriler olgu takip formlarına kaydedildi. Verilerin analizi SPSS 21.0 ile yapıldı ve %95 güven aralığında çalışıldı.

Bulgular: Çalışmaya dahil edilen 102 hastanın %20,58'inde hipotermi gözlendi. Perioperatif hipotermi için predispozan faktörler; hastanın eşlik eden serebral palsi tanısının olması, hastanın serviste vücut ısısının düşük olması, operasyon salonunun ısı ve nem değerlerinin düşük olması, operasyon salonunda uzun süre kalınması olarak belirlendi.

Sonuç: Operasyon sırasında aktif ve pasif ısıtma teknikleri uygulanmasına rağmen ortopedik cerrahi uygulanan pediatrik hastaların %20,58'inde perioperatif hipotermi izlendi. Aktif ve pasif ısıtma teknikleri ile birlikte predispozan faktörlerin dikkate alınması perioperatif hipotermi sıklığını azaltabilir.

Anahtar kelimeler: Hipotermi, Ortopedik cerrahi, Risk faktörleri

Received: 28.05.2022 Accepted: 02.07.2022 Published (Online): 20.08.2022

*Corresponding Author: Kubra Evren Sahin, Department of Anesthesiology and Reanimation, Dr. Behcet Uz Child Diseases and Surgery Training Hospital, Konak, Izmir, Turkey, +90232411600, kubraevren@gmail.com

ORCID ID: 0000-0003-0284-0241

To cited: Evren Sahin K, Sozbilen MC. Prevalence of Perioperative Hypothermia and Predisposing Factors in a Children's Hospital. Acta Med. Alanya 2022;6(2): 173-178 doi: 10.30565/medalanya.1122479

Introduction

Since humans are homeothermic creatures, they need to keep their internal body temperatures constant within certain ranges. Keeping the internal body temperature constant within the 0.2°C variation range (threshold range) is achieved by using various positive and negative feedback mechanisms [1]. In addition to the fact that behavioral regulation, which is the first thermoregulatory response, cannot be performed when patients are unconscious and/or paralyzed during general anesthesia applications, body temperature is also lost because of several other factors. These include redistribution of the body's core temperature, decreases in metabolic rates and heat losses from the body surface through radiation, convection, conduction and evaporation [2]. Aside from these, volatile and non-volatile anesthetics, neuraxial anesthesia and analgesia, and opioids also cause deterioration in the response of the hypothalamus that is necessary for thermoregulation and therefore leads to temperature losses below 36°C in anesthetized patients [2].

A decline in body temperature that goes below 36°C under anesthesia and/or during surgery is called perioperative hypothermia [3], which is common namely in pediatric patients [4]. The reported common effects of perioperative hypothermia include postoperative tremor, coagulopathy, bleeding, cardiac dysfunction, delayed anesthesia recovery and wound infection, resulting in a prolonged hospital stays [5]. ERAS (Enhanced Recovery After Surgery) protocols also recommend avoiding hypothermia during the intraoperative period [6]. Therefore, to prevent perioperative hypothermia, active (infrared lamps, electric blankets, warm air blowing systems, heating of intravenous fluids, humidification, and heating of anesthetic gases) and passive (isolation of exposed areas by wrapping cotton, use of closed or semi-closed anesthesia breathing systems), and low flow anesthesia application warming techniques are recommended [7].

This study presents the prevalence of perioperative hypothermia and the predisposing conditions for perioperative hypothermia in pediatric orthopedic surgeries, in which active and passive warming techniques were applied.

Materials and methods

This cross-sectional, descriptive and observational clinical study was evaluated and approved by the clinical research ethics committee (decision number: 2020/16-07; date: 19/11/2020; protocol number:396). All parameters were applied in accordance with the Declaration of Helsinki and EU rules. Our study is a prospective, single-center study designed for cases involving 102 children admitted to the pediatric orthopedic clinic of a children's hospital. Patients and parents were informed of the study and those who gave their consent were included in the study. During the COVID-19 pandemic, all patients hospitalized for orthopedic surgery underwent PCR testing and elective surgery was planned exclusively for patients with negative PCR test results. All necessary precautions were taken to protect the operating theater staff from possible infection of the patients, who were given general anesthesia. The study included patients who were scheduled to have surgeries in the pediatric orthopedic clinic from June 1, 2020 to January 31, 2021, in the operating theater of our hospital. The study evaluated 118 cases in which the patients were admitted between these dates, and 102 cases were ultimately included. These patients met the criteria for inclusion if they did not have any focus of infection, had been scheduled to undergo orthopedic procedures under anesthesia, and had provided their consent to participate in the study.

Inclusion criteria:

a. The patients aged 0 to 18 planned to undergo orthopedic procedures under anesthesia.

b. No symptoms related to COVID-19.

c. No recent family history of COVID-19.

Exclusion or withdrawal criteria:

a. Patients with an abscess-like focus of infection that may cause high fever or disrupt thermoregulation.

b. Cases not willing to have their body temperature measured during the study.

c. Cases whose surgical plan was abandoned for

other reasons.

Temperature measurements of the cases were performed using the calibrated infrared tympanic thermometer. All patients were premedicated with an oral midazolam dose of 0.5 mg/kg (max. 20 mg) 30 minutes before the operation. Such preoperative demographic data as gender, age, body weight, height, Body Mass Index (BMI), any concomitant cerebral palsy, hemogram in addition to thyroid hormone parameters, preoperative fasting times related to the procedure, humidity and temperature values in the operating theater and the operation performed, were all recorded in their follow-up forms. We also added the temperatures taken by a tympanic thermometer in four different periods (in the service room, upon operating theatre entrance, while operating theater exit and upon postoperative care unit exit) to these forms. Standard monitoring was performed in the operating theater. Anesthesia induction was performed on the patients with 8% sevoflurane, 4l/min oxygen/air mixture. Vascular access was established through the peripheral vein. Fentanyl (2 µg/kg), rocuronium (0.6 mg/kg) were administered. The exposed areas were isolated by wrapping them with cotton. The patient was intubated with a suitably sized endotracheal tube. Anesthesia was maintained with remifentanil as 0.2-0.5 µg/kg/min and 2% sevoflurane with a BIS value between 40-60 (Medtronic Covidien 2-Channel Monitor System). Isotonic crystalloid solution warmed to 37 0C (Astoflo Plus; Stihler Electronic, Stuttgart, Germany) and given at 10ml/kg/h. An underbody warming blanket was used actively during the operation. Intravenous paracetamol (10mg/kg) was administered for postoperative analgesia.

Data analysis was done using the SPSS v.21 and was studied at a 95% confidence interval. The kurtosis and skewness coefficients were examined to determine a match between the measurements and the normal distribution. Kurtosis and skewness values were obtained from a scale in the normal distribution range of +3 to -3. When the temperature measurement values were examined, it was seen that the kurtosis and skewness coefficients of each score ranged from -3 to +3, which was analyzed using the repeated ANOVA test. The t-test and ANOVA tests were used to analyze the differences in the measurements according to the categorical variables. While the t-test was used to evaluate demographic variables with two groups, the ANOVA test was used to assess the variables grouped in k (k > 2). While the relationship between quantitative variables with normality was analyzed with the Pearson correlation test, the relationship between those without was analyzed with the Spearman correlation test. The multivariate logistic regression model was used to predict predisposing factors for hypothermia.

Results

Perioperative hypothermia was observed in 21 of 102 patients (20.58% prevalence of hypothermia). The demographic and operative data of patients (female: 39.2%; male: 60.8%) with hypothermia and normothermia are presented in Table 1. Of the 102 patients included in the study, one was a newborn and eight were infants; it was determined that 62 of the patients had cerebral palsy.

Table 1: Demographic data and operational characteristics of the patients

Variables	Hypothermia (n=21)	Normothermia (n=81)	p
Age (month)	71.7±53.4	83.2±56.5	0.400
Gender (n) (Female/Male)	7/14	33/48	0.536
ASA classification (I/II/III)	4/0/17	34/2/45	0.034*
Weight (kg)	18 (4-65)	20 (5-69)	0.167
Height (cm)	106±29.9	116±25	0.154
BMI (kg/m-2)	15.9 (11.9-25.6)	16.4 (12.1-22.5)	0.094
Concomitant cerebral palsy (n)	17 (81%)	45 (55.6%)	0.034*
Body temperature in the orthopedics service room (^{0}C)	36.5±0.33	36.7±0.28	0.010*
Operating theater humidity (%)	34.7±8.4	43.1±9.9	0.001*
Fasting time (hour)	9±1.92	8.1±1.59	0.047*
The duration of the operation (min)	53 (18-198)	33 (17-125)	0.003*
The time spent in the operating theater (min)	62 (26-208)	42 (22-132)	0.003*
Recovery time from anesthesia (min)	4.0±1.34	4.06±1.56	0.869

ASA, American Society of Anesthesiologists; BMI, body mass index. Results were presented as mean ± SD, n, %, median (min-max). * p<0.05

Of the operations performed on the patients under general anesthesia, 62 were release operations

for patients with cerebral palsy, 13 were burned contractures, 10 were incisions operations for polydactyly and syndactyly, six triggered finger release, five were foreign body excision, three were achiloplasty, two were ganglion cyst excision and one was a Baker cyst excision. The operations performed are presented in Table 2.

Table 2. Types of operations performed under general anesthesia

Type of operations, n (%)	
Release operations for patients with cerebral palsy	62 (60.8)
Burned Contracture Opening	13 (12.7)
Incision for Polydactyly and Syndactyly	10 (9.8)
Release for Trigger Finger	6 (5.9)
Foreign Body Excision	5 (4.9)
Achiloplasty	3 (2.9)
Ganglion Cyst Excision	2 (1.9)
Baker's Cyst Excision	1 (1.0)

Temperature data measured from patients in four different periods were examined. The number of patients with hypothermia was observed as i) service room 1 (0.98%), ii) operating theatre entrance 3 (2.94%), iii) operating theatre exit 21 (20.58%) and postoperative care unit exit 6 (5.88%).

While the mean body temperature measurement in the orthopedic service room was the highest (mean: 36.66°C), it significantly decreased as they were taken to the operating theater (mean: 36.55°C), continued to decrease in the operating theater, and their body temperature measurement upon leaving the operating theater was the lowest (mean: 36.22°C). It was observed that there was a significant increase in the measurements of the patients taken to the postoperative care unit after awakening (mean: 36.41°C). The most significant decrease in body temperature occurred in the operating theater. The change in temperature measurements of the patients whose measurements were made at four different times was statistically significant, as shown with the repeated ANOVA test ($p<0.05$). Figure 1 presents the patient's temperature changes at four different times.

Predisposing conditions for hypothermia

When the predisposing conditions related to this decrease in body temperature were examined, we found no statistically significant relationship among variables such as gender, age, body weight, height, BMI, hemogram, thyroid hormone parameters, operating theater temperature and postoperative body temperature.

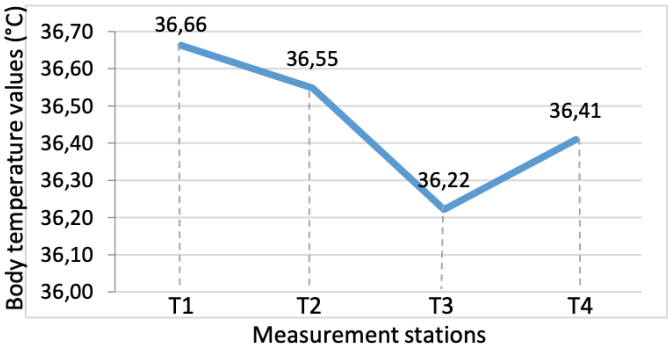

Figure 1: Average body temperature values of measurement stations. Note that; T1, T2, T3, and T4 stand for the service room, operating theatre entrance, operating theatre exit and postoperative care unit exit, respectively.

In the logistic regression analysis, concomitant cerebral palsy, body temperature in the orthopedics service room, operating theater temperature, operating theater humidity and the time spent in the operating theater, were found statistically significant as an independent risk factor for perioperative hypothermia (Table 3).

Table 3. Risk Factors for Perioperative Hypothermia (Binary Logistic Regression Analysis)

	B	SE	Wald	P	OR	95% CI
Concomitant cerebral palsy	2.264	0.872	6.738	0.009*	9.622	1.741-53.178
Operating theater temperature (°C)	-0.691	0.374	3.422	0.064	0.501	0.241-1.042
Operating theater humidity (%)	-0.178	0.051	12.179	0.000*	0.837	0.757-0.925
Body temperature in the orthopedics service room (°C)	-5.651	1.675	11.381	0.001*	0.004	0.000-0.094
The time spent in the operating theater (min)	0.048	0.017	7.948	0.005*	1.049	1.015-1.084
Constant	222.494	63.508	12.274	0.000*		

B, coefficient value; SE, standard error of coefficient; OR, odds ratio. *: $p<0.05$.

Discussion

Perioperative hypothermia is a common and preventable side effect. Therefore, the Surgical Care Improvement Project (SCIP) also recommends active warming, regardless of the patient's body temperature [8]. However, active warming is not widely used in most operating theater and only a small number of patients are actively warmed. As only pediatric patients are operated on in our operating theater, we apply active warming with underbody warming blankets and heating of intravenous fluids, passive warming with wrapping cotton dressing, and low-flow anesthesia applications on all operating tables.

While the incidence of perioperative hypothermia for our patient group was 20.58%, in the study of Yi et al., which is a 28-centered national study, the incidence of hypothermia in patients only 14.2% of whom applied active warming, was 17.8% in the 1 hour following the induction of anesthesia, 36.2% in the 2nd hour, 42.5% in the 3rd hour, and 44.1% in the 4th hour [9]. We think that the ≤90-minute surgical procedure time of our patients helped them maintain their normothermia, thus resulting in a lower incidence of hypothermia.

We measured the body temperature of the patients in the orthopedic service room, operating theater entrance, operating theatre exit and postoperative care unit exit. We found that there were significant changes in these four different periods ($p<0.05$). While the mean temperature of the patients in the service room was the highest (mean: 36.66°C), the postoperative temperature (mean: 36.22°C) was the lowest. There was a significant increase in the body temperature of the patients in the postoperative care unit (mean: 36.41°C). Some factors also add up to the heat loss, such as taking off the patient's clothes for surgery, transferring to the operating theater and waiting in the theater corridors, which cause a significant amount of heat loss. During this period, thermoregulatory vasoconstriction is triggered, peripheral temperature decreases and the temperature gradient increases. When the patient is brought to the operating theater, heat loss continues. There is a linear relationship between operating theater temperature and cutaneous heat loss. Because a temperature increase of approximately 1°C reduces cutaneous heat loss by 10%, the American Society of Perianesthesia Nurses (ASPAN) guidelines recommend that the operating theater temperature should be in the range of 20 to 25°C [10]. However, the recommended operating theater relative humidity values are different. While American Society of Heating and Refrigeration (ASHRAE) standards recommend that the relative humidity be between 20% and 60%, UNE 100713 recommends that the relative humidity should be between 45% and 55% [11]. The fact that the relative humidity values in the operating theater are not at normal values facilitates the proliferation of bacteria [12]. During the study, the temperature values of the operating theater ranged from 19.20°C to 23.80°C, while the relative humidity values of the operating theater ranged between 20.00% and 60.00%.

Skin disinfection solutions used before the patient's surgical incision are also effective in perioperative hypothermia. When a surgical incision is made on the patient, there is heat loss caused by evaporation resulting from the incisions, which is related to factors such as the size of the surgical field, the airflow in the operating theater, the humidity level and the temperature of the operating theater. Cold intravenous and irrigation fluids used for the patient are also among the causes of heat loss, depending on the amount [13]. In our study, to prevent this heat loss, we give all infusions by warming them with a blood-serum warming device.

Kang et al. [14], observed that when active heating and applications to prevent heat loss recommended by ASPAN were applied together in patients undergoing upper extremity surgery, body temperature was maintained, and there was no decrease in body temperature measured in the waiting room before the operation.

While hypothermia was observed in 45 of the cerebral palsy patients (62 patients), hypothermia was not observed in 17 ($p=0.034$). The fact that children with cerebral palsy have less muscle and fat tissue due to malnutrition and dysfunction of the hypothalamus, which provides thermoregulation, makes these children more prone to hypothermia development [15].

There is a negative relationship between

hypothermia and body temperature measurement of the patients in the service room (B=-5.651). The lower the patient's body temperature measurement in the service room, the higher the risk that the body temperature change in the operating theater will be ≥ 0,3°C. Studies have shown that low baseline temperature is a predisposing factor for perioperative hypothermia and that elevated body temperature before anesthesia can prevent intraoperative hypothermia [16,17].

Since the training and research hospital where we conducted the study is located at sea level, it is highly affected by humidity in the external environment. During the study, the humidity values of the operating theater ranged between 20% and 60%. In this study, it was observed that there was a negative relationship between operating theater humidity and perioperative hypothermia. We think that the decrease in heat loss from the patient's skin through evaporation from the operating area with the increase in the humidity level in the operating theater is due to the laws of physics.

We observed that the development of perioperative hypothermia of the patients included in the study increased proportionally with the duration of stay in the operating room. Sahutoglu et al. [4], reported that an increase in the duration of surgery in minor operations, such as circumcision, increases the risk of hypothermia.

Limitations: The limitation of this study is that it included a small patient population and different surgeries were applied to the patients.

Conclusion: The prevalence of perioperative hypothermia is high in pediatric patients undergoing orthopedic surgery. There are some predisposing conditions for perioperative hypothermia, which can be listed as the presence of concomitant cerebral palsy, low operating theater temperature, low operating theater humidity, low body temperature in the service room, as well as prolonged time spent in the operating theater. Paying attention to these predisposing conditions would reduce the incidence of perioperative hypothermia.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The authors declare that this study has received no financial support

Ethics Committee Approval: Health Sciences University Dr Behcet Uz Child Diseases and Surgery Training Hospital, Clinical Studies Ethics Committee (Dated November 19th, 2020; decision no: 2020/16-07, protocol no:396).

Peer-review: Externally peer-reviewed.

ORCID and Author contribution: K**ES (0000-0003-0284-0241):** Study design, Data collection, Manuscript preparation, Critical review. **MCS (0000-0001-7128-6227):** Study design, Data collection, Manuscript preparation, Critical review.

REFERENCES

1. Jung KT, Kim SH, Lee HY, Jung JD, Yu BS, Lim KJ, et al. Effect on thermoregulatory responses in patients undergoing a tympanoplasty in accordance to the anesthetic techniques during PEEP: a comparison between inhalation anesthesia with desflurane and TIVA. Korean J Anesthesiol. 2014;67(1):32-7. DOI: 10.4097/kjae.2014.67.1.32.
2. Sessler DI. Perioperative thermoregulation and heat balance. Lancet. 2016;387(10038):2655-64. DOI: 10.1016/S0140-6736(15)00981-2.
3. Freundlich RE, Nelson SE, Qiu Y, Ehrenfeld JM, Sandberg WS, Wanderer JP. A retrospective evaluation of the risk of bias in perioperative temperature metrics. J Clin Monit Comput. 2019;33(5):911-6. DOI: 10.1007/s10877-018-0233-1.
4. Sahutoglu C, Bor C, Dokumcu Z, Balcioglu T. Is temperature monitoring necessary in pediatric circumcision? Eurasian J Med. 2022;54(1):41-4. DOI: 10.5152/eurasianjmed.2022.21071.
5. Lai LL, See MH, Rampal S, Ng KS, Chan L. Significant factors influencing inadvertent hypothermia in pediatric anesthesia. J Clin Monit Comput. 2019;33(6):1105-12. DOI 10.1007/s10877-019-00259-2.
6. Solmaz FA, Kırdemir P. Enhanced recovery after surgery (ERAS) and anesthesia. Acta Medica Alanya 2020;4(1):95-101. DOI 10.30565/medalanya.587027.
7. Bilgin H. Inadverdent perioperative hypothermia. Turk J Anaesthesiol Reanim. 2017;45(3):124-6. DOI 10.5152/TJAR.2017.200501.
8. Scott AV, Stonemetz JL, Wasey JO, Johnson DJ, Rivers RJ, Koch CG, et al. Compliance with surgical care improvement project for body temperature management (SCIP Inf-10) is associated with improved clinical outcomes. Anesthesiology 2015;123(1):116-25. DOI 10.1097/ALN.0000000000000681.
9. Yi J, Lei Y, Xu S, Si Y, Li S, Xia Z, et al. Intraoperative hypothermia and its clinical outcomes in patients undergoing general anesthesia: National study in China. PloS one 2017;12(6):e0177221. DOI 10.1371/journal.pone.0177221.
10. Hooper VD, Chard R, Clifford T, Fetzer S, Fossum S, Godden B, et al. ASPAN's evidence-based clinical practice guideline for the promotion of perioperative normothermia. Journal of perianesthesia nursing 2009;24(5):271-87. DOI 10.1016/j.jopan.2009.09.001.
11. ANSI/ASHRAE/ASHE Standard 170-2017 Ventilation of Health Care Facilities; American Society of Heating, Refrigerating and Air-Conditioning Engineers: New York, NY, USA, 2017.
12. Cubi ME, Salom Tormo J, Garrido Soriano N. Indoor environmental quality and infection control in surgery rooms: Code requirements vs. performance motivation. A critical review. HVAC&R Research. 2014;20(6):643-54. DOI 10.1080/10789669.2014.929423.
13. Pit M, Tegelaar R, Venema P. Isothermic irrigation during transurethral resection of the prostate: effects on perioperative hypothermia, blood loss, resection time and patient satisfaction. Brit J Urol. 1996;78(1):99-103. DOI 10.1046/j.1464-410X.1996.04819.x.
14. Kang S, Park S. Effect of the ASPAN Guideline on Perioperative Hypothermia among Patients with upper Extremity Surgery under General Anesthesia: A Randomized Controlled Trial. J PeriAnesth Nurs. 2020;35(3):298-306. DOI 10.1016/j.jopan.2019.11.004.
15. Darcey M. Hypothermia in cerebral palsy. Anaesthetic management of patients with cerebral palsy. ATOTW 2010;196:1-7.
16. Tander B, Baris S, Karakaya D, Ariturk E, Rızalar R, Bernay F. Risk factors influencing inadvertent hypothermia in infants and neonates during anesthesia. Pediatr Anesth. 2005;15(7):574-9. DOI 10.1111/j.1460-9592.2005.01504.x.
17. Yi J, Xiang Z, Deng X, Fan T, Fu R, Geng W, et al. Incidence of inadvertent intraoperative hypothermia and its risk factors in patients undergoing general anesthesia in Beijing: a prospective regional survey. PloS one 2015;10(9):e0136136. DOI: 10.1371/journal.pone.0136136.