GÜSBD 2024; 13(4): 1797 - 1806 **Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi** **Araştırma Makalesi**
GUJHS 2024; 13(4): 1797 - 1806 Gümüşhane University Journal of Health Sciences Original Article

Determination of the Incidence of Inadvertent Perioperative Hypothermia, Thermal Comfort, and Factors Affecting Thermal Comfort in Patients Undergoing Elective Surgery: A Cross-Sectional Study

Elektif Cerrahi Geçiren Hastalarda İstenmeyen Perioperatif Hipotermi Sıklığı, Termal Konfor ve Termal Konforu Etkileyen Faktörlerin Belirlenmesi: Kesitsel Bir Çalışma

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ABSTRACT

The aim of this study was to determine the incidence of hypothermia, thermal comfort, and factors affecting thermal comfort in patients undergoing elective surgery during the perioperative period. The study was conducted using a cross-sectional design between 1 October 2020 and 1 March 2021 after obtaining ethical approval. This study included 306 volunteer patients who underwent elective surgery. Data were collected by nurses during nine perioperative periods (T0-T8) in the surgical wards and operating rooms using a form based on relevant literature. Statistical analysis was performed using SPSS 22.0 software, with a significance level of $p<0.05$. The mean age of the patients was 41.81±16.00 years, and 74.8% were female. During the intraoperative period (T3, T4, T5), the average body temperatures were 35.87±0.52°C, 35.31±0.58°C, and 35.64±0.51°C, respectively, while in the recovery room (T6) it was 35.56±0.51°C. There was a statistically significant difference between the body temperatures at T3, T4, T5, and T6 compared to the preoperative period (T0) ($p<0.05$). Patients' thermal comfort in the recovery room was reduced owing to inadequate clothing, insufficient covers, lack of socks, and frequent uncovering. In conclusion, this study shows that patients undergoing elective surgery experienced hypothermia both during surgery and in the recovery room, largely due to poor thermal comfort in the latter.

Keywords: Inadvertent Perioperative Hypothermia, Surgical Nursing, Body Temperature, Thermal Comfort, Shivering

ÖZ

Bu çalışmanın amacı, elektif cerrahi geçiren hastalarda perioperatif dönemde hipotermi insidansını, termal konforu ve termal konforu etkileyen faktörleri belirlemektir. Çalışma, 1 Ekim 2020 ile 1 Mart 2021 tarihleri arasında kesitsel bir tasarımla yürütülmüş ve etik kurul onayı alınarak gerçekleştirilmiştir. Araştırmaya, elektif cerrahi geçiren 306 gönüllü hasta katılmıştır. Veriler, dokuz perioperatif dönemde (T0-T8) cerrahi servislerde ve ameliyathanelerde hemşireler tarafından toplanmış ve literatüre dayalı bir form kullanılarak elde edilmiştir. İstatistiksel analiz SPSS 22.0 yazılımı ile yapılmış ve $p<0,05$ anlamlılık düzeyi uygulanmıştır. Hastaların yaş ortalaması 41,81±16,00 olup, %74,8'i kadındır. İntraoperatif dönemde (T3, T4, T5) ortalama vücut sıcaklıkları sırasıyla 35,87±0,52°C, 35,31±0,58°C ve 35,64±0,51°C iken, iyileşme odasında (T6) 35,56±0,51°C olarak ölçülmüştür. T3, T4, T5 ve T6 dönemlerindeki vücut sıcaklıkları ile preoperatif dönem (T0) arasında istatistiksel olarak anlamlı bir fark bulunmuştur ($p<0,05$). Hastaların iyileşme odasında yetersiz giysi, eksik örtü, çorap eksikliği ve sık sık açılma gibi nedenlerden dolayı termal konforları azalmıştır. Sonuç olarak, çalışma, elektif cerrahi geçiren hastaların hem ameliyat sırasında hem de iyileşme odasında hipotermi yaşadığını ve bunun büyük ölçüde düşük termal konfordan kaynaklandığını göstermektedir.

Anahtar Kelimeler: İstemsiz Perioperatif Hipotermi, Cerrahi Hemşireliği, Vücut Sıcaklığı, Termal Konfor, Titreme

Ethical Approval No obtained before the start of the study (Approval No: 2020\070).

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Geliş Tarihi / Received: 31.12.2023
Kabul Tarihi/Accepted: 11.05.2024

INTRODUCTION

Inadvertent Perioperative Hypothermia (IPH) is defined as a drop in body temperature below 36 °C from the preoperative period (one hour before anaesthesia) to the postoperative period (the first 24 hours after anaesthesia). [1,2] It has been reported that 50-90% of patients undergoing surgery experience IPH. [3-5] The thermoregulation system becomes ineffective during surgical interventions, disrupting the balance between heat production and loss. As a result of the inability to compensate for heat losses in the perioperative setting, body temperature drops. [6] A drop in body temperature causes peripheral vasoconstriction, chills, shivering, and deterioration in thermal comfort. [1-4,7-9] It has been reported that the thermal comfort of patients who develop IPH also deteriorates [10,11] due to shivering, oxygen consumption, heart work, and blood pressure increase. A study reported hypoxaemia in 73.3% of patients who developed IPH, shivering in 66.6%, and arterial hypertension in 6.6%. [12]

The literature reports that more complications develop in patients with IPH than in normothermic patients. [2,13] IPH affects many systems, including the respiratory, cardiovascular, adrenergic, and immune systems. [4,8,9] Hypothermia and increased release of catecholamines in patients increase the incidence of arrhythmia and cardiac arrest. [7,9] Another study reported that IPH increased mortality. [14] IPH impairs immune system cell chemotaxis and phagocytosis functions and decreases antibody production. Consequently, delays in wound healing and surgical site infections have been observed. [4,9] Moreover, the functions of enzymes that metabolise drugs are disrupted, thereby prolonging their effects. [1,7,9,15] Although inadvertent perioperative hypothermia is a significant problem for surgical patients, heat loss can be prevented in the perioperative setting, and its undesirable effects on patients can be reduced. [1,13]

In the perioperative setting, patients' thermal comfort should be monitored along with their body temperature. However, there are limited studies in which patients' thermal comfort was monitored in the perioperative setting. [13] For this, the risks that may cause IPH should be defined, and preventive measures should be taken, considering the environment and surgical conditions of the patients during the perioperative setting. Monitoring patients' thermal comfort in the perioperative setting can provide measures to be taken before developing hypothermia. This study was conducted to determine the incidence of hypothermia, thermal comfort, and factors affecting thermal comfort in patients undergoing elective surgery during the perioperative period

MATERIAL AND METHODS

Type of Research

This single-centre, prospective, descriptive, and cross-sectional study was conducted in the surgical services, surgical intensive care units, and operating rooms of a private hospital in southeastern Turkey from 1 October 2020 to 1 March 2021.

The Ethical Aspect of The Study

Ethical Approval No obtained before the start of the study (Approval No: 2020\070). After informing the patients about the study, written and verbal consent was obtained from those who volunteered to participate. [16] Every stage of the research was conducted according to the ethical principles stated in the Helsinki Declaration of the World Medical Association. [17]

The Population and Sample of The Study

The study population consisted of patients who were hospitalised and underwent surgery in the surgical clinics of a private hospital located in southeastern Turkey between 1 October 2020 and 1 March 2021.

The study sample comprised 306 patients who voluntarily participated in the study. G*Power 3.1.9.7 software was used to

calculate the sample size. The sample calculation was performed using Cohen's (d) effect size based on the chi-square goodness-of-fit test. Considering an effect size of 0.25, an α error of 0.05, a β error of 0.10, and a power of 90%, it was determined that the minimum number of participants required for sampling was (n = 264). Considering possible data loss, it was decided to include 10% more participants in the sample.

A total of 498 patients who met the inclusion criteria were invited to participate. The data of 86 patients with missing information in the data collection form, 43 patients who needed intensive care due to critical conditions during the perioperative period, 37 patients who wanted to withdraw from the study after volunteering to participate, 13 patients whose surgery was postponed, 9 patients whose surgery was cancelled, and 4 patients who died during the perioperative period were excluded from the study. The research was completed by 306 participants (n = 306). [1]

The inclusion criteria for the study were as follows: (1) patients aged ≥18 years, (2) patients undergoing planned surgery for the first time, (3) patients admitted to the surgical clinic at least 24 hours before the surgery, (4) patients without any impediment for tympanic temperature measurement, (5) patients who did not receive therapeutic hypothermia at any stage of treatment, and (6) patients who voluntarily agreed to participate in the study. The following data were not included in the research: (1) data from patients who lost consciousness at any stage of the research and were unable to respond to the researcher's questions, and (2) data from patients who decided to withdraw from the study at any stage after volunteering to participate.

Data Collection Forms

The research data were collected using an introductory information form and a thermal perception assessment form for patients. The data collection forms were developed based on the literature review [1,2,6,13,15,18] in line with the research objectives. To determine the content validity of the data collection forms, the opinions of 5 experts, including 3 general surgery specialist physicians and 2 faculty member nurses, were obtained. According to the opinions of the experts, the Content Validity Index (CVI) was calculated as 1, indicating that the data collection forms were suitable for this research. [19] Since the CVI was greater than 0.80, the data collection forms were considered suitable for this research.

Nine different times in the perioperative setting were determined to collect the research data.

Preoperative Period
T0: Patient assessment with clothes on.
T1: Patient assessment in the operating gown.
T2: Patient assessment in the operating hall.
Intraoperative Period
T3: Assessment before anesthesia was started.
T4: Post-incision assessment.
T5: Post-closure assessment.
Postoperative Period
T6: Patient assessment in the recovery room.
T7: Patient assessment in bed with clothes on.
T8:24-hour postoperative assessment.

Collecting Research Data

The data were collected by nurses working in the preoperative and postoperative units of general surgery, obstetrics and gynaecology, neurosurgery, orthopaedics, plastic surgery, and otolaryngology services, as well as in the operating and recovery rooms. T0 and T1 assessments were conducted by nurses in the preoperative unit; T2, T3, T4, and T5 assessments were conducted by operating room nurses; T6 assessment was conducted by recovery unit nurses; and T7 and T8 assessments were conducted by postoperative unit nurses. The body temperatures of the patients were evaluated at nine different time points: three times during the preoperative process, three times during the intraoperative process, and three times during the postoperative process. The thermal perceptions of patients were evaluated six times in total: three times during the preoperative process and three times during the postoperative process.

Statistical Analysis

Statistical analysis of the data was performed using the SPSS 22.0 Windows

software package. Descriptive statistics are presented as number (n) and percentage (%) for categorical variables and as mean ± standard deviation for numerical variables. The normal distribution of continuous variables was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests, and it was determined that the data were normally distributed ($p<0.05$). A paired samples t-test was used to compare the means of body temperatures. A significance level of $p<0.05$ was accepted for statistical significance.

RESULTS AND DISCUSSION

The average age of the patients participating in the study was 41.81, with 57.2% falling within the age range of 18-39. Furthermore, 74.8% of the patients were female. The average Body Mass Index (BMI) of the patients was 28.72, with 47% of them falling within the BMI range of 25-29.9. Regarding the American Society of Anesthesiologists (ASA) score, 55.2% of the patients had a score of I, and 83.4% did not have any chronic diseases. General surgery was performed in 55.6% of the patients, while open surgery was performed in 91% of them. The average surgical duration for the patients was 99.41 minutes, with 53% of them having a surgical duration of ≤60 minutes. Among the patients, 61.8% underwent general surgery, and the average anaesthesia duration was 63.03 minutes, with 76.2% of them having an anaesthesia duration of ≤60 minutes (Table 1).

Table 1. Distribution of Descriptive Characteristics of the Patients (N=306)

Descriptive Characteristics	(n)	(%)
Age(Mean±SD=41.81±16.00;Min-Max=19-87)		
18-39	175	57.2
40-60	81	26.5
≥61	50	16.3
Gender		
Female	229	74.8
Male	77	25.2
ASA Score**		
I	169	55.2
II	117	38.2
III	20	6.5
BMI*(Mean±SD=28.72±5.00;Min-Max =15.94-62.76) kg/m^2		
≤24,9	57	18.6
25-29,9	145	47.4
≥30	104	34.0
Chronic Conditions		
None	255	83.4
Hypertension	16	5.2
Diabetes Mellitus Type 2	35	11.4
Type of Surgery		
Laporoscopic &Endoscopic	26	8.5
Open	280	91.5
Type of Anesthesia		
Local	27	8.8
Spinal /Epidural	90	29.4
General	189	61.8
Surgical Ward		
General Surgery	170	55.6
Obstetrics& Gynecology	105	34.3
Neurosurgery	15	4.9
Orthopedics	7	2.3
Plastic and Reconstructive Surgery	7	2.3
Otorhinolaryngology	2	0.6
Duration of Surgery (Mean±SD=99.41±61.68; Min-max=15-480)		
≤60 min**	162	53.0
61-120 min	84	27.5
≥121min	60	19.5
Duration of Anesthesia (Mean±SD =63.03±50.75; Min-Max=10-420)		
≤60 min**	227	76.2
61-120 min	60	19.6
≥121 min	19	6.2

*Mean=Mean, SD=Standard Deviation *Body Mass Index ** American Association of Anesthesiologists*

During the preoperative process, the average body temperatures of the patients were as follows: T0:36.40±0.26, T1:36.21±0.23, and T2:36.07±0.52. In the intraoperative process, the average body temperatures were T3:35.87±0.49, T4:35.31±0.58, and T5:35.64±0.51, respectively. As for the postoperative process, the average body temperatures were T6:35.56±0.51, T7:36.05±0.34, and T8:36.85±0.24 (Graph 1).

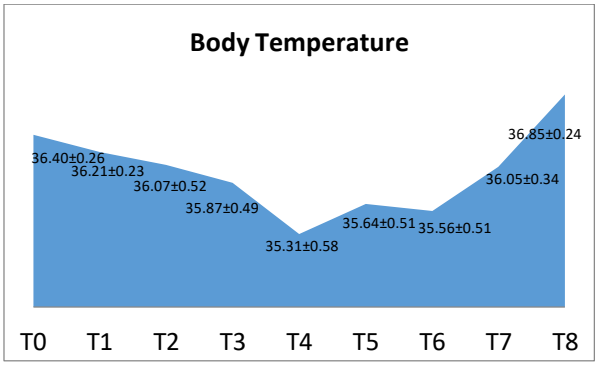

Figure 1. Distributions of Average Body Temperature of Patients during the Perioperative Period (N=306)

T0: Patient assessment with clothes on. T1: Patient assessment in the operating gown. T2: Patient assessment in the operating hall. T3: Assessment before anaesthesia was started. T4: Post-incision assessment. T5: Post-closure assessment. T6: Patient assessment in the recovery room. T7: Patient assessment in bed with clothes on. T8:24-hour postoperative assessment.

T1, T2, and T3 measurements of the average body temperature were not statistically significant compared to the average body temperature measured at T0 (p>0.05). However, T4, T5, and T6 measurements of the average body temperature were found to be statistically significant compared with the average body temperature measured at T0 (p=0.002, p=0.032, and p=0.012, respectively) (p<0.05). However, T7 and T8 measurements of the average body temperature were not statistically significant compared to the average body temperature measured at T0 (p>0.05) (Table 2). During the preoperative process, the percentages of patients reporting feeling cold were as follows: T0:1%, T1:4.2%, and T2:9.8%. The percentages of patients reporting cold hands and feet during the preoperative process were T0:2%, T1:3.6%, and T2:19.4%. Additionally, the percentage of patients reporting feeling chilly during the preoperative process are T0:0.3%, T1:1%, and T2:18.3%. The percentages of patients reporting shivering during the preoperative process were T0:0%, T1:0.3%, and T2:5.2%. Finally, the percentages of patients reporting numbness due to cold during the preoperative process were T0:0%, T1:0%, and T2:3.3% (Table 2).

Table 2. Comparison of preoperative body temperatures with intraoperative and postoperative body temperatures (N=306).

		Test*	p
T0:36.40±0.26	**T1:**36.21±0.23	t=1.717	p=0.228
T0:36.40±0.26	**T2:**36.07±0.52	t=1.723	p=0.227
T0:36.40±0.26	**T3:**35.87±0.49	t=1.953	p=0.190
T0:36.40±0.26	**T4:**35.31±0.58	**t=20.977**	**p=0.002**
T0:36.40±0.26	**T5:**35.64±0.51	**t=5.485**	**p=0.032**
T0:36.40±0.26	**T6:**35.56±0.51	**t=9.093**	**p=0.012**
T0:36.40±0.26	**T7:**36.05±0.34	t=1.740	p=0.224
T0:36.40±0.26	**T8:**36.85±0.24	t=-1.726	p=0.227

T0: Patient assessment with clothes on. T1: Patient assessment in the operating gown. T2: Patient assessment in the operating hall. T3: Assessment before anaesthesia was started. T4: Post-incision assessment. T5: Post-closure assessment. T6: Patient assessment in the recovery room. T7: Patient assessment in bed with clothes on. T8:24-hour postoperative assessment.

Table 3. Patients' Views on Thermal Comfort during the Preoperative and Postoperative Periods (N=306)

Preoperative Setting	**T0 n(%)**	**T1 n(%)**	**T2 n(%)**
My body is cold			
I disagree	283(92.5)	263(86.0)	206(67.3)
I neither agree nor disagree	20(6.5)	30(9.8)	70(22.9)
I agree	3(1)	13(4.2)	30(9.8)
My hands and feet are cold			
I disagree	276(90.2)	264(86.2)	197(64.4)
I neither agree nor disagree	24(7.8)	31(10.1)	49(16.0)
I agree	6(2.0)	11(3.6)	60(19.4)
I have chills			
I disagree	289(94.4)	289(94.4)	211(68.9)
I neither agree nor disagree	16(5.2)	14(4.6)	39(12.7)
I agree	1(0.3)	3(1.0)	56(18.3)
I am shivering			
I disagree	295(96.5)	294(96.1)	211(68.9)
I neither agree nor disagree	11(3.6)	11(3.6)	79(25.9)
I agree	-	1(0.3)	16(5.2)
My body is numb from the cold			
I disagree	306(100)	302(98.7)	270(88.2)
I neither agree nor disagree	-	4(1.3)	26(8.5)
I agree	-	-	10(3.3)
Preoperative Setting	**T6 n(%)**	**T7 n(%)**	**T8 n(%)**
My body is cold			
I disagree	54(17.6)	196(64.0)	285(92.9)
I neither agree nor disagree	8(2.6)	20(6.5)	12(3.9)
I agree	**244(79.8)**	90(29.4)	9(2.9)
My hands and feet are cold			
I disagree	51(16.7)	180(58.8)	286(93.4)
I neither agree nor disagree	11(3.6)	22(7.2)	12(3.9)
I agree	**244(79.8)**	103(34.0)	8(2.6)
I have chills			
I disagree	69(22.5)	161(52.8)	294(97)
I neither agree nor disagree	9(2.9)	21(6.9)	7(2.3)
I agree	**228(74.5)**	123(40.4)	2(0.2)
I am shivering			
I disagree	273(89.2)	286(93.4)	306(100)
I neither agree nor disagree	9(2.9)	10(3.3)	-
I agree	**28(9.1)**	10(3.3)	-
My body is numb from the cold			
I disagree	271(88.5)	286(93.4)	306(100)
I neither agree nor disagree	9(2.9)	10(3.3)	-
I agree	**26(8.5)**	10(3.3)	-

T0: Patient assessment with clothes on. T1: Patient assessment in the operating gown. T2: Patient assessment in the operating hall. T3: Assessment before anaesthesia was started. T4: Post-incision assessment. T5: Post-closure assessment. T6: Patient assessment in the recovery room. T7: Patient assessment in bed with clothes on. T8:24-hour postoperative assessment.

In the postoperative process, the percentage of patients reporting feeling cold was as follows: T6: 79.8%, T7: 29.4%, and T8: 2.9%. The percentages of patients reporting cold hands and feet during the postoperative process were as follows: T6: 79.8%, T7: 34.0%, and T8:

2.6%. Moreover, the percentages of patients reporting feeling chilly during the postoperative process were: T6: 74.5%, T7: 40.4%, and T8: 0.2%. The percentages of patients reporting shivering during the postoperative process were as follows: T6: 9.1%, T7: 3.3%, and T8: 0. Finally, the percentages of patients reporting numbness due to cold during the postoperative process were: T6: 8.5%, T7: 3.3%, and T8: 0 (Table 3)

Table 4 provides patients' perspectives on the factors affecting their thermal comfort. The reasons that mostly contribute to feeling cold are "Not having clothes on me" and "Frequent removal of clothes for care procedures" (76.5% and 55.3% respectively). The reasons that primarily affected feeling cold in the hands and feet were "Not having socks on my feet" and "Not having clothes on me" (90.5% and 76.8%, respectively). The reasons that had the most significant impact on feeling chilly were "Not having clothes on me" and "Not being covered" (73.9% and 43.8%, respectively). The reasons that primarily contributed to shivering were "Not having clothes on me" and "Not being covered" (40% and 18.3%, respectively). Lastly, the reasons that mainly affect feeling numbness due to cold are "Not being covered" and "Not having clothes on me" (8.8% each) (Table 4).

Numerous risk factors related to individuals, surgery, environment, and attitudes of healthcare professionals play a role in the aetiology of hypothermia development during the perioperative process. [20,21] The Association of Perioperative Registered Nurses (AORN) recommends understanding the factors and underlying causes of hypothermia development for effective management of inadvertent perioperative hypothermia (IPH). [20]

Table 4. Patients' Views on Factors Affecting Their Thermal Comfort in the Recovery Room (N=306)

	No Affected n(%)	Neither Affected nor Unaffected n(%)	Affected n(%)
Causes Affecting the Body Being Cold			
I do not have my clothes on	70(22.8)	2(0.7)	**234 (76.5)**
Not being covered	101(33.0)	57(18.6)	148(48.4)
I do not have socks on my feet	128 (41.8)	51(16.7)	127(41.5)
Frequent opening of the cover for maintenance applications	133(43.4)	73(23.9)	73(23.8)
Having wet covers on me	-	-	**27(8.8)**
Causes Affecting Cold Hands and Feet			
I do not have socks on my feet	7(2.3)	22(7.2)	**277(90.5)**
I do not have my clothes on	62(20.2)	9(2.9)	235(76.8)
Not being covered	105(34.3)	57(18.6)	144(47.1)
Frequent opening of the cover for maintenance applications	136(44.5)	83(27.1)	63(20.5)
Having wet covers on me	-	-	**24 (7.8)**
Causes Affecting Chills			
I do not have my clothes on	53(17.3)	27(8.8)	**226(73.9)**
Not being covered	101(33)	71(23.2)	134(43.8)
I do not have socks on my feet	148(48.4)	52(17.0)	106(34.6)
Frequent opening of the cover for maintenance applications	151(49.4)	75(24.5)	53(17.3)
Having the covers on me wet	-	-	**27 (8.8)**
Causes Affecting Tremors			
I do not have my clothes on	126(41.2)	56(18.3)	**124(40.5)**
Not being covered	174(56.9)	76(24.8)	56(18.3)
I do not have socks on my feet	189(61.8)	69(22.5)	48(15.7)
Having wet covers on me	-	-	**27(8.8)**
Frequent opening of the cover for maintenance applications	199(65.0)	65(21.2)	15(4.90)
Causes Affecting My Body to Go Numb from the Cold	-	-	
Not being covered	201(65.7)	61(19.9)	**27(8.8)**
I do not have my clothes on	213(69.6)	53(17.3)	27(8.8)
I do not have socks on my feet	224(73.2)	56(18.3)	27(8.8)
Frequent opening of the cover for maintenance applications	228(74.6)	51(16.7)	27(8.8)
Having wet covers on me	-	-	**27(8.8)**

**N folded because patients could tick more than one option.*

The most important finding of our study, which aimed to determine hypothermia and thermal perceptions in patients undergoing elective surgery, is that the decrease in body

temperature starts during the preoperative process and continues during the intraoperative process. Our study revealed that patients' thermal perception begins to deteriorate during the preoperative process and continues during the postoperative process. The management of patients' thermal status is an important component of their recovery. [1,2,14,20,21] According to the American Society of PeriAnesthesia Nurses (ASPAN), the prevention of hypothermia not only provides physical benefits but also psychological benefits. It has been reported that maintaining body temperature, reducing shivering, and ensuring thermal comfort can increase psychological comfort. [13]

In our study, measurements taken when patients had their clothes on (T0) showed that the majority of patients were normothermic, while measurements taken after patients wore surgical attire (T1) revealed a decrease in body temperature by 0.19 units. We believe that the reason for the decrease in body temperature is the removal of patients' clothes, socks, and underwear before wearing the surgical attire, which may lead to a decrease in body temperature. Additionally, surgical attire is generally in the form of gowns, which are usually short-sleeved and made of thin fabrics, which may further contribute to the decrease in body temperature. When patients are prepared for surgery, the use of a long-sleeved surgical attire made of thicker fabrics is recommended. Furthermore, the use of hospital socks, pajamas, and surgical gowns is recommended in appropriate cases. Previous studies have reported that clothing deficiency is a factor that affects body temperature. [1,20,21]

In our study, measurements taken after patients were taken into the operating room (T2) revealed a decrease in body temperature by 0.33 units compared to the T0 measurement. The reason for the decrease in body temperature at T2 may be that the operating rooms were colder than the patient rooms. To prevent a decrease in body temperature after patients are taken into the operating room, they should be covered with thick blankets. Nurses should be informed of the possibility of decreased body temperature in patients during this process.

Measurements taken after anaesthesia administration (T3) showed a decrease in body temperature by 0.53 units compared to the T0 measurement. We believe that the decrease in body temperature at T3 may be due to the effects of anaesthetic drugs. Anaesthetic drugs, opioids, and sedatives inhibit the hypothalamus. Inhibition of the hypothalamus suppresses autonomic responses and can change the regulatory range from 0.2°C to 4°C. Unless there is an extreme temperature change, the thermoregulation system is not activated to regulate the temperature (1,18). Additionally, when the patient is under anaesthesia, lying motionless in a cold operating room without clothing, and inhaling cold gases, heat loss through open body cavities decreases body temperature. [1]

Measurements taken after incision closure (T4) showed a decrease in body temperature by 1.09 units compared to the T0 measurement. The lowest body temperature during the perioperative process was observed at T4. The decrease in body temperature at T4 may be accelerated by the effects of anaesthesia in addition to the initiation of incision, resulting in blood loss and exposure of internal organs to ambient temperature. Blood loss increases the risk of IPH. In patients with IPH, coagulopathy leads to increased blood loss. [15] Ireland et al. (2006) reported a coagulopathy rate of 27% in patients with IPH. [22] A systematic review has shown an increased need for blood transfusion in patients with IPH. [2] A meta-analysis study found that even mild hypothermia (<1°C) increased blood loss by 16% and transfusion requirements by 22%. [23] Rapid evaluation of blood loss and timely compensation of lost blood and fluids are necessary after surgical incision. Additionally, it is recommended to warm blood and fluids to 38-40°C for transfusion and intravenous fluid administration. [15,21,24] Karalapillai et al. (2009) demonstrated that as the degree of hypothermia increased, the mortality rate also increased. They reported mortality rates of 5.6% in normothermic patients, 8.9% in all

hypothermic patients, and 14.7% in severely hypothermic patients. [14] Measures to prevent hypothermia during the intraoperative process are also important for reducing mortality.

Measurements taken after the patients were taken to the recovery room (T5) showed a decrease in body temperature by 0.76 units compared to the T0 measurement. Furthermore, at T5, it was determined that the patients' thermal comfort was also compromised. The decrease in body temperature at T5 may be attributed to the inadequate covering of patients during their transfer from the operating room to the recovery room. Additionally, this situation may have been caused by the patient's underlying and overlying wet cover. Wet covers underneath and on top of patients should be changed as soon as possible. During transfer, patients should be covered with thick blankets. Whenever possible, patients should be dressed in socks and underwear. The head and feet of patients are the main areas of heat loss. Covering the head and using sleeping bags have been found to provide a warmer environment for patients during the perioperative process and increase patient comfort. [13] In patients with a body temperature above 36°C, cotton and wool blankets, socks, and bonnets can be used in the recovery unit. Passive insulation can reduce the heat loss by up to 30%. [1,18] In hypothermia treatment, active warming methods are generally initiated when body temperature falls below 32 °C (89.6 °F). For moderate hypothermia, external warming methods such as warmed air and heated intravenous fluids are used, while severe cases may require internal warming techniques such as peritoneal dialysis or ECMO. Medical supervision is crucial throughout the treatment process.[1,8,13]

The signs and symptoms of perioperative hypothermia include shivering, piloerection, and cold extremities. [1] The decrease in body temperature leads to peripheral vasoconstriction, impaired thermal comfort, and shivering. [1,4,9] Shivering increases oxygen consumption by approximately 40%. [24] Increased oxygen consumption increases the metabolic rate, heart rate, blood pressure, and the risk of cardiac complications [25], arrhythmias, and myocardial infarction. [24] Shivering has been reported to increase the release of catecholamines and the incidence of arrhythmias and cardiac arrest. [9] It is recommended to cover patients with at least one blanket during their transfer to the recovery unit after completion of the surgical procedure and when their body temperature is 36ºC or higher. [1] In the study, measurements taken after patients were taken to their rooms and dressed in their clothes (T7) showed a decrease in body temperature by 0.35 units compared to the T0 measurement. Although the body temperature at T7 did not reach T0, we believe that patients wearing their clothes contributed to an increase in body temperature. Measurements taken 24 hours after surgery (T8) showed an increase in body temperature by 0.45 units compared to the T0 measurement. The increase in body temperature at T8 may be attributed to the postoperative response in the patients.

Perioperative hypothermia leads to serious complications in surgical patients, including wound infections and blood loss. [13] It has been found that patients with IPH have increased hospital stay duration and increased risk of wound infection, as well as decreased collagen levels compared to normothermic patients. [10] Nurses should regularly evaluate patients' body temperatures and closely monitor their thermal perceptions to prevent perioperative hypothermia. Patients with decreasing body temperature should be appropriately warmed according to guideline recommendations during the perioperative process. [13] Active warming methods are highly effective in maintaining optimal body temperatures for patients during the perioperative period, thereby reducing the risk of hypothermia. These methods include heated blankets, warm-air devices, and heated intravenous fluid systems. When applied before, during, and after surgery, these devices are critical for enhancing patient thermal comfort and minimising the risk of complications. Particularly after major surgical interventions, the use of active warming methods is recommended to ensure

patients quickly and safely return to normothermia.[1,8,13]

CONCLUSION AND RECOMMENDATIONS

It was determined that the patients were hypothermic during the intraoperative process and in the recovery room. The decrease in body temperature in these patients begins when they remove their clothes and wear a surgical attire. A decrease in body temperature is accompanied by deterioration in thermal comfort. The period during which patients experience the most compromised thermal comfort is their stay in the recovery room. Patients reported that the most significant factors affecting their thermal comfort during their time in the recovery room were lack of clothing, uncovered bodies, absence of socks on their feet, and frequent removal of covers for treatment and care purposes. Active warming methods, such as heated blankets and warm air devices, play a crucial role in maintaining optimal body temperature and enhancing patient comfort throughout the perioperative period.

Limitations

One limitation of this study is that it was conducted at a single centre with a limited sample size. Therefore, the findings of this study cannot be generalised to the entire population. However, the limited number of studies that have monitored body temperature during different stages of the perioperative process and assessed patients' thermal comfort adds uniqueness and value to the findings of this study.

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