PREVALENCE OF HYPOTHERMIA IN ELDERLY PATIENTS UNDERGOING HIP ARTHROPLASTY

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ABSTRACT

Objectives: To determine prevalence of hypothermia in elderly patients undergoing hip arthroplasty

Methods: A prospective, cross-sectional descriptive study was conducted. Tympanic thermometers were used to measure body temperature in patients aged 60 years and older who underwent hip arthroplasty under general endotracheal anesthesia at the Department of Anesthesiology, Cho Ray Hospital, from December 2022 to December 2023. Body temperature was measured at the following time points: pre-anesthesia, induction, and 10, 30, 60, and 90 minutes after induction, as well as at the end of surgery.

Results: The incidence of hypothermia in hip arthroplasty surgery in elderly patients was 38.67%. Mild hypothermia was the most common (25.3%), followed by moderate hypothermia (13.3%), with no cases of severe hypothermia reported.

Conclusion: Hypothermia in hip arthroplasty among elderly patients has a relatively high incidence, accounting for more than a quarter of cases. Strict temperature monitoring and appropriate preventive measures are crucial to reducing perioperative risks.

Keywords: Hypothermia, Surgery, Hip Arthroplasty

INTRODUCTION

Intraoperative hypothermia is a common issue across various surgical specialties. Despite the availability and effectiveness of warming methods, the incidence of hypothermia remains high among surgical patients, ranging from 4% to over 70% [1,2]. One possible reason for this variability is the ineffective use or lack of emphasis on warming measures. A survey on intraoperative hypothermia across 17 European countries revealed that active warming systems were employed in only 38.5% of cases, and surgical temperature monitoring was conducted in merely 19.4% of patients [3]. Furthermore, other studies have reported a high incidence of hypothermia (T < 36℃) upon patient transfer to the postoperative care unit, even when warming systems were utilized [4,5].

Intraoperative hypothermia leads to severe complications both during and after surgery. It has been associated with numerous adverse outcomes, including postoperative cardiovascular events, intraoperative bleeding, altered drug metabolism, and postoperative infections [6,7,8]. Additionally, hypothermia may prolong ICU stays, reduce thermal comfort and patient satisfaction, and increase treatment costs [9,10].

Elderly patients are more susceptible to hypothermia than younger individuals in both cold environments and the operating room. This increased risk may be attributed to factors such as inadequate nutritional intake, lower physical activity levels, or a reduced vasoconstriction threshold compared to younger patients [11]. In orthopedic surgery, particularly hip arthroplasty, preventing hypothermia requires greater attention, as these patients are often elderly and at high risk for complications and infections. Periprosthetic joint infection following hip arthroplasty can lead to significant medical consequences, with a reported mortality rate of up to 2.5% [12].

This study aims to investigate the incidence of hypothermia in hip arthroplasty among elderly patients to assess the prevalence and clinical significance of this issue. The findings will assist physicians and nurses in developing effective monitoring, care, and intervention strategies to prevent complications and enhance patient safety during and after surgery. Therefore, we conducted a study with the aim of determining the incidence of hypothermia in elderly patients undergoing hip replacement surgery under general anesthesia.

II. SUBJECTS AND METHODS

2.1. Subjects

This study was conducted on 75 patients aged 60 years and older who underwent hip arthroplasty

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Received date: 15/2/2025
Revised date: 20/3/2025
Accepted date: 29/3/2025

under general endotracheal anesthesia at the Department of Anesthesiology, Cho Ray Hospital, from December 2022 to December 2023.

Inclusion criteria: Patients aged 60 years and older who were scheduled for elective hip arthroplasty under general endotracheal anesthesia and provided informed consent to participate in the study.

Exclusion criteria: Patients with a preoperative body temperature< 36˚C or those requiring ICU admission postoperatively.

2.2. Research method

Study design: Prospective cross-sectional descriptive study

Sample size: Calculated using the formula for estimating the proportion of a population.

$$n = Z^2_{(1-\alpha/2)} \frac{p(1-p)}{d^2}$$

n: Sample size.

Z: Standard normal distribution value.

α: The Type I error probability is 0.05, resulting in Z(1-α/2) = 1.96

d : Margin of error (confidence interval) with d = 0.10 (10%)

p: The estimated proportion, based on the 2013 study by Borg Leijtens et al. on 'The Incidence of Hypothermia in Knee and Hip Arthroplasty,is p = 0.263 [13]. From this calculation, the sample size was determined to be 74.4 patients

Therefore, the minimum required sample size for the study is 75 cases.

Study Implementation

Patient Preparation: Re-anesthetic evaluation, measurement of weight and height. Body temperature assessment using a tympanic thermometer. Providing an information sheet to the patient and explaining the temperature monitoring method used in the study. Obtaining informed consent for study participation.

Implementation Steps: Body temperature was monitored using a tympanic thermometer, with all measurements recorded in degrees Celsius. Temperature measurements were taken at the following time points: in the pre-anesthesia room (after 5 minutes of rest), at induction, and at 10, 30, 60, and 90 minutes after induction, as well as at the end of surgery. To ensure consistency, the same type of thermometer was used for all patients.

Hypothermia was defined as a core temperature below 36°C. According to the American Society of Anesthesiologists and other authors [14,15], hypothermia was classified into three levels:

Mild: 36°C – 35°C

Moderate: 35°C – 34°C

Severe: < 34°C

Statistical Methods

Data were entered using Epidata Entry Client and analyzed with STATA 17.0. Categorical variables were presented as percentages, while continuous variables were expressed as mean ± standard deviation. A p-value < 0.05 was considered statistically significant.

2.3. Ethical Considerations: The study was approved by the Biomedical Research Ethics Committee of Cho Ray Hospital, approval number 14B1/GCN-HĐĐD, dated December 15, 2022.

III. RESULTS

Table 1. Patient Characteristics of the Study (n = 75)

Variable Names	Quantity (Ratio %)
Old (year):	70.92 ± 8,01 *
60 - ≤ 70	33 (44.0)
> 70	42 (56.0)
Gender:	
Male	34 (45.3)
Female	41 (54.7)
Classification of BMI (kg/m^2):	
Underweight	21.71 ± 3.07 *
Normal weight	14 (18.67)
Overweight	33 (44.0)
Obesity	20 (26.67)

* mean ± SD

"The study on 75 patients undergoing hip arthroplasty recorded a mean age of 70.92 ± 8.01 years, with 56.0% of patients aged over 70. Females accounted for more than half of the study sample. The mean BMI was 21.71 ± 3.07. Underweight patients comprised 18.67% of the sample, while overweight and obese patients accounted for a total of 37.33%

Table 2. Method of operation (n=75)

Method of operation	Frequency	Ratio (%)
Left hip arthroplasty	33	44.0
Right hip arthroplasty	38	50.7
Total hip arthroplasty	4	5.3
Total	75	100

The proportion of left hip arthroplasty was 44.0%, which was lower than the 50.7% observed for right hip arthroplasty.

Table 3. Incidence of Intraoperative Hypothermia (n = 75)

Variable Names	Quantity (Ratio %)
Hypothermia	29 (38.67)
Mild	19 (25.3)
Moderate	10 (13.3)
Severe	0 (0)

The incidence of hypothermia was 38.67%, with mild hypothermia being the most common (25.3%), followed by moderate hypothermia (13.3%). No cases of severe hypothermia were recorded.

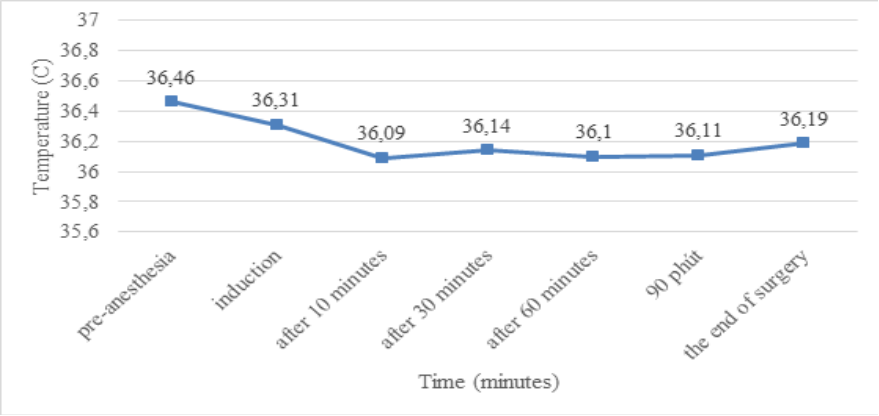

Figure 1. Mean body temperature at each time point during anesthesia (n=75)

During the first 10 minutes following anesthesia induction, body temperature exhibited a rapid decline of 0.37°C. This was followed by a slight increase to 36.14°C before experiencing a subsequent decrease of 0.04°C, with minimal fluctuations of approximately 0.01°C between 60 and 90 minutes. From the conclusion of surgery onward, body temperature demonstrated a modest upward trend, rising by 0.09°C.

Table 4. Variations in body temperature during anesthesia

Time	Median(Interquartile Range)	Min - Max
Pre-aesthesia	36.4 (36.1 – 36.7)	34.6 – 37.8
Induction	36.4 (36.2 – 36.6)	34.9 – 36.9
10 minutes	36.3 (36.0 – 36.4)	34.3 – 36.8
30 minutes	36.3 (36.0 – 36.5)	34.7 – 36.6
60 minutes	36.3 (35.9 – 36.4)	34.2 – 36.6
90 minutes	36.1 (35.9 – 36.5)	34.7 – 36.7
End of surgery	36.3 (36.0 – 36.5)	34.7 – 37.0

Body temperature exhibited a rapid decline within the first hour following anesthesia induction, reaching 36.3°C. Thereafter, a gradual increase was observed, with the final intraoperative temperature recorded at 36.19 ± 0.46°C. Overall, mean body temperature remained above 36°C throughout the surgical procedure, indicating a trend of thermal recovery during the intraoperative period.

IV. DISSCUSION

The mean age of patients in our study was 70.92 years. This value is significantly higher than those reported in previous studies by Pham Thi Minh Thu (53.2), Kao Nguyen Mai Linh (54.9), Cao Phi Loan (54.2), Jie Yi (53.5), Kongsayreepong (58.1), and Kleimeyer (51.4) [3,5,16,17,18]. This discrepancy can be attributed to our study's inclusion criteria, which required patients to be at least 60 years old. Furthermore, age stratification revealed that patients over 70 years old accounted for the highest proportion (56%), contributing to the higher mean age observed in our study. In contrast, Yang Lu's study reported that only 22.8% of patients were over 60 years old [10], while the proportion of patients over 65 years old in Jie Ji's study was 20.1%, and in Nguyen Duc Nam's study, it was 33% [19]

The mean body mass index (BMI) in our study was 21.71 kg/m², which was higher than that reported by Pham Thi Minh Thu (21.7) and Nguyen Duc Nam (21.6), comparable to Kao Nguyen Mai Linh (22.4) and Cao Phi Loan (22.3), slightly lower than Jie Yi (23.6), and significantly lower than Mehta (28.7) and Kleimeyer (27.9). Notably, it was much lower than the study by Ninh T. Nguyen, whose inclusion criteria focused on obese patients with a BMI of 40–60 kg/m² [3,16,17,19]. This discrepancy can be attributed to racial differences, as Vietnamese individuals—and Asians in general, who primarily belong to the Mongoloid race—tend to have smaller body frames compared to the Caucasian populations in Europe and Australia. Additionally, variations in inclusion criteria across different study designs also contribute to these differences.

The proportion of male and female patients in our study was nearly equal, with 34 male patients (45.3%) and 41 female patients (54.7%). The male proportion was comparable to that reported by Nguyen Duc Nam (49%) and higher than those in the studies by Ho Kha Canh (45%), Cao Phi Loan (45.5%), and Kao Nguyen Mai Linh (41.1%). However, it was lower than the findings of Kongsayreepong (56%), Jie Yi (60.2%), Pham Thi Minh Thu (55.4%), and Tran Thi Tuyet Chi (68.6%) [5,16,18,19,20]. Overall, the anthropometric characteristics in our study were relatively similar to those reported by authors in Vietnam and other Asian countries. However, these characteristics differed from studies conducted on European and Australian populations.

The incidence of hypothermia in our study was 38.67%, with mild hypothermia accounting for 25.3%, moderate hypothermia for 13.3%, and no cases of severe hypothermia recorded. Perioperative hypothermia is a common complication with potentially severe consequences, yet it can be effectively prevented through various combined measures. General anesthesia significantly increases the risk of hypothermia due to multiple contributing factors, particularly in elderly patients. The use of anesthetic agents impairs the autonomic nervous system's thermoregulatory control by substantially lowering the body's response threshold to cold. Prolonged surgery exceeding two hours has been identified as an independent risk factor for perioperative hypothermia. For these reasons, elderly patients undergoing hip arthroplasty are at high risk of developing hypothermia. Compared to other studies, the incidence of hypothermia in our study was lower than that reported by Ninh T. Nguyen (41%), Jie Yi (44.3%), and Karalapillai (46%), as well as lower than that observed by Nguyen Duc Nam (66.2%), Kao Nguyen Mai Linh (57.3%), Cao Phi Loan (59%), and Luck (60.6%). It was also significantly lower than in Pham Thi Minh Thu's study, but notably higher than in Ho Kha Canh's research [3,5,16,17,18]. The variation in hypothermia rates across studies is primarily attributed to differences in the definition of hypothermia, the temperature thresholds used, and the time points at which measurements were recorded. In 2019, Nguyen Duc Nam conducted a study on 100 patients undergoing elective surgery lasting more than two hours. The incidence of hypothermia in patients over 65 years old was 66.6%, which was higher than in our study (66.6% vs. 54.1%) [19]. This discrepancy may be due to differences in the age criteria for study inclusion—65 years and older in Nguyen Duc Nam's study, compared to 60 years and older in ours. Additionally, Nguyen Duc Nam's study included

factors that influenced hypothermia risk, such as concurrent epidural anesthesia. Furthermore, increased awareness and preventive measures for hypothermia over time may have contributed to the differences in findings between studies.

The intraoperative temperature distribution revealed that elderly patients in our study experienced a rapid decline of 0.5°C within the first hour following anesthesia induction, reaching 36.10 ± 0.51°C. This rapid temperature drop was also observed in the studies conducted by Nguyen Duc Nam and Kao Nguyen Mai Linh [16,19]. Subsequently, body temperature gradually increased toward the end of surgery, with an average final intraoperative temperature of 36.19 ± 0.46°C. This final temperature was higher than that reported by Kao Nguyen Mai Linh (35.5 ± 0.8°C) but lower than that observed by Nguyen Duc Nam (36.29 ± 0.8°C). According to Just's findings, the difference between our study and that of Kao Nguyen Mai Linh can be reasonably explained by the fact that Kao Nguyen Mai Linh did not implement active warming methods for all patients, applying them in only 22.2% of cases [16].

Regarding the severity of hypothermia, our study's rate of mild hypothermia (73.07%) was not significantly different from that reported by Kao Nguyen Mai Linh (72.6%) and Cao Phi Loan (78%) [16,18]. However, the proportions of moderate and severe hypothermia in our study were markedly different compared to these authors. Specifically, our study recorded 26.93% for moderate hypothermia and 0% for severe hypothermia, whereas Kao Nguyen Mai Linh reported 20.8% and 6.6%, respectively, and Cao Phi Loan reported 18.6% and 3.4% [16,17,18]. This discrepancy can be attributed to the fact that, despite focusing on elderly patients, our study proactively implemented preventive measures against hypothermia and eliminated additional risk factors that could contribute to its exacerbation

V. CONCLUSION

Although our findings revealed a certain rate of hypothermia in elderly patients undergoing hip replacement surgery, further investigation is needed to establish its clinical significance and the necessity for enhanced preventive strategies.

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