

Comparison of Forced-Air Warming Device and Standard Blanket Use on Body Temperature Stability in Post-Arthroscopy Patients in the Recovery Room

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ABSTRACT

Patients undergoing arthroscopic surgery are at risk of thermoregulation disturbances due to anesthesia, cold operating room exposure, and irrigation fluids. Postoperative hypothermia may increase morbidity, delay recovery, and cause patient discomfort. This study analyzed differences in body temperature stability between patients using forced-air warming (FAW) devices and those using standard blankets after arthroscopic surgery in the recovery room. A quasi-experimental method with a nonequivalent control group design was used. Forty respondents were selected through purposive sampling and divided into an intervention group receiving FAW and a control group receiving standard blankets, with 20 respondents in each group. Body temperature was observed on arrival in the recovery room and periodically for 20 minutes. Ethical approval was obtained under No. 045/KEPPKSTIKSC/IV/2025. Results showed that 85% of the intervention group and 35% of the control group maintained stable body temperature. The Chi-Square test showed $p = 0.003$, indicating a significant difference. FAW is recommended as a routine recovery room intervention

INTRODUCTION

Surgery is one of the important medical procedures in managing various diseases, injuries, and structural abnormalities of the body. According to the World Health Organization (2021), more than 313 million surgical procedures are performed annually worldwide. In Indonesia, the number of surgeries reached around 1.2 million cases in 2020, with orthopedic procedures occupying a sizable proportion (Winarni et al., 2024). One of the most widely performed orthopedic procedures is arthroscopy, which is a minimally invasive surgery performed by inserting an optical instrument into the joint with the aim of diagnosing and treating various joint abnormalities.

Surgical procedures are often accompanied by thermoregulatory disruptions, with 70–90% of patients experiencing hypothermia even if the surgery lasts less than 60 minutes (Bayter-Marín et al., 2017). Hypothermia, which is defined as the body's core temperature below 36°C, can trigger various serious complications such as increased risk of surgical wound infections, impaired heart function, coagulopathy, delayed anesthesia recovery, and discomfort in the form of chills. Patients who undergo arthroscopic surgery have a higher risk of hypothermia. The combination of the effects of anesthesia, exposure to cold operating room temperatures (18–20 °C), and the use of large amounts of irrigation fluid leads to a decrease in body temperature (Manners et al., 2025). This condition can continue until the postoperative phase in the recovery room. Research of Cho et al. (2021) shows that the incidence of hypothermia after orthopedic surgery reaches 40.6% upon admission to PACU, while other studies show hypothermia occurs in 91.3% of patients who use room-temperature irrigation fluid.

Various methods have been used to prevent hypothermia. A common conventional method is passive heating using a standard blanket. However, the effectiveness of this method is limited because it is not able to compensate for the rapid loss of body heat that occurs during surgery. In contrast, active warming methods such as the Forced-Air Warming Device have proven to be more effective, as they are able to distribute warm air evenly throughout the patient's body, thereby reducing the risk of heat loss due to radiation, convection, and evaporation. This warmer is able to increase the core body temperature by about 0.75°C per hour. Heating using Forced Air Warming for one hour is the same as using three cotton blankets for 4 hours or one cotton blanket for 10 hours to increase core body temperature. Therefore, this study was conducted to compare the use of Forced-Air Warming Device and standard blankets in maintaining body temperature stability among post-arthroscopic surgery patients in the recovery room.

THEORETICAL REVIEW

Thermoregulation

Thermoregulation is the body's physiological process to maintain core temperature within a normal range. This mechanism regulates the balance between heat production and heat loss. In normal conditions, the body maintains temperature stability through vasoconstriction, vasodilation, sweating, shivering, and metabolic heat production. However, this mechanism may be

disturbed during surgical procedures due to anesthesia, surgical exposure, intravenous fluids, and the cold operating room environment.

In perioperative care, thermoregulation is an important aspect because unstable body temperature can affect patient comfort and recovery. Aprianti et al. (2022) explained that postoperative patients may experience thermoregulation disturbances, especially decreased body temperature, which can cause hypothermia and discomfort. Therefore, temperature monitoring and warming intervention are needed to support thermal stability during the recovery period.

Postoperative Hypothermia

Postoperative hypothermia is a condition in which the patient's body temperature decreases below the normal range after surgery. This condition commonly occurs in the recovery room and is often related to the effects of anesthesia, length of surgery, room temperature, body mass index, and fluid exposure during the procedure. Hypothermia may trigger shivering as a physiological response to heat loss. Shivering can increase oxygen consumption, increase cardiac workload, worsen pain, and reduce patient comfort after surgery.

Several Indonesian studies have shown that hypothermia and shivering remain important problems in postoperative care. Hidayah et al. (2021) stated that shivering is one of the common complications after general and spinal anesthesia in the recovery room. Dewi et al. (2024) also reported that shivering may occur after general anesthesia and needs proper monitoring during recovery. These findings indicate that postoperative temperature stability is an important indicator in nursing care and anesthesia recovery management.

Arthroscopic Surgery

Arthroscopic surgery is a minimally invasive orthopedic procedure used to diagnose and treat joint disorders. Although arthroscopy uses smaller incisions than open surgery, patients undergoing this procedure still have a risk of thermoregulation disturbance. This risk may occur because arthroscopic surgery often uses irrigation fluid, involves exposure to operating room temperature, and requires anesthesia. These factors can contribute to decreased body temperature during and after surgery.

Post-arthroscopic patients require close observation in the recovery room because changes in body temperature may continue after the procedure. Similar to other surgical patients, patients after arthroscopic surgery may experience discomfort, shivering, and delayed recovery when body temperature is not maintained properly. Yulianita et al. (2023) emphasized that non-pharmacological interventions, including forced-air warmers, warm intravenous fluids, electric blankets, and hot packs, can help prevent hypothermia in postoperative patients. Therefore, warming intervention is relevant for patients undergoing arthroscopic surgery, especially during the early recovery phase.

Forced-Air Warming

Forced-Air Warming (FAW) is an active warming method used to prevent and manage perioperative hypothermia. This device works by delivering warm air through a special blanket or warming cover placed on the patient's body. The warm air helps transfer heat to the skin surface and reduces heat loss through

radiation, convection, and evaporation. Unlike passive warming, FAW actively provides external heat to support body temperature stability.

The effectiveness of FAW has been supported by studies from Indonesian health journals. Meliana et al. (2025) found that Forced-Air Warming can reduce the incidence of perioperative hypothermia and maintain body temperature in surgical patients. Aini (2023) also reported that FAW was effective in reducing shivering among postoperative sectio caesarea patients with spinal anesthesia in the recovery room. These findings support the use of FAW as an active warming intervention for postoperative patients who are at risk of hypothermia.

Standard Blanket

A standard blanket is a passive warming method commonly used in recovery rooms. This method works by covering the patient's body to reduce heat loss. Standard blankets are simple, inexpensive, easy to apply, and widely available in hospitals. However, standard blankets do not actively generate or transfer heat to the patient's body. They only help retain existing body heat.

The effectiveness of standard blankets may be limited when the patient has already experienced decreased body temperature after surgery. Kurniawan et al. (2024) found that warm intravenous fluids were more effective than warm blankets in reducing shivering among postoperative sectio caesarea patients with spinal anesthesia. Similarly, Aprianti et al. (2022) showed that a combination of warm infusion fluids and warm electric blankets was effective in increasing body temperature among post-sectio caesarea patients in the recovery room. These findings indicate that passive warming alone may not be sufficient for patients at higher risk of hypothermia. Therefore, compared with standard blankets, active warming methods such as FAW may provide better support in maintaining postoperative body temperature stability.

METHODOLOGY

This study applied a quasi-experimental design using a nonequivalent control group approach. The study involved 40 patients who underwent arthroscopic surgery in July 2025. Respondents were selected through purposive sampling and assigned into two groups: 20 respondents in the intervention group who received Forced-Air Warming Device treatment and 20 respondents in the control group who received standard blanket care.

Data were collected using a structured observation sheet. Body temperature was measured with a digital tympanic thermometer upon the patient's arrival in the recovery room at minute 0, followed by repeated measurements every 10 minutes until minute 20. Body temperature stability was determined when the patient's temperature remained within the normal range of 36.0-37.2°C during the observation period.

The collected data were analyzed using the Chi-Square test with a significance level of $\alpha = 0.05$. This study was approved by the Health Research Ethics Commission of STIK Sint Carolus with ethical clearance number 045/KEPPKSTIKSC/IV/2025.

RESEARCH RESULTS

The findings of this study are presented based on univariate and bivariate analyses. The univariate analysis describes the distribution of respondents' demographic and clinical characteristics, including age, gender, body mass index, type of anesthesia, and body temperature stability. Meanwhile, the bivariate analysis examines the difference in body temperature stability between patients who received forced-air warming (FAW) and those who received standard blankets in the recovery room.

Table 1. Distribution of Respondent Characteristics (n=40)

Respondent Characteristics	Frequency (f)	Percentage (%)
Age		
18-40 years old	16	40
> 40-60 years old	24	60
Gender		
Male	20	50
Female	20	50
Body Mass Index (BMI)		
Underweight	0	0
Normal	8	20
Overweight	14	35
Obesity	18	45
Types of Anesthesia		
General's Anesthesia	25	62,5
Spinal Anesthesia	15	37,5
Body Temperature Stability		
Stable	24	60
Unstable	16	40
Number of Respondents	40	100

A total of 40 respondents participated in this study. Demographic and clinical characteristics are presented in Table 1. The majority of respondents were in the age group >40–60 years old (60%). The gender distribution is balanced between males and females (50% each). Most respondents had a Body Mass Index (BMI) in the categories of obesity (45%) and *overweight* (35%). The most widely used type of anesthesia is general anesthesia (62.5%). Most of the respondents had a stable body temperature when in the recovery room, namely 24 respondents (60%).

Table 2. Comparison of Body Temperature Stability between the Intervention and Control Groups

Use of FAW	Stable n (%)	Unstable n (%)	Total n (%)	p-value
Yes	17 (85.0)	3 (15.0)	20 (100.0)	0.003
No	7 (35.0)	13 (65.0)	20 (100.0)	
Total	24 (60.0)	16 (40.0)	40 (100.0)	

After identifying the characteristics of the respondents, further analysis was conducted to determine whether the use of FAW was associated with better body temperature stability compared with standard blankets. The comparison between the intervention and control groups is presented in Table 2.

The results of the bivariate analysis showed significant differences in body temperature stability between the intervention group and the control group (Table 2). In the group that used FAW, as many as 17 out of 20 respondents (85%) managed to maintain a stable body temperature. In contrast, in the group that only used standard blankets, only 7 out of 20 respondents (35%) had a stable temperature. The results of the *Chi-Square* test showed a *p value* of 0.003 (*p value* < 0.05) so that H_a was accepted.

DISCUSSION

The results of this study confirm that the use of Forced-Air Warming (FAW) Device is more effective than standard blankets in maintaining the stability of body temperature in patients after arthroscopic surgery, with a success rate of 85% in the FAW group and only 35% in the control group. This effectiveness is in line with the literature that states that FAW is able to increase body core temperature by about 0.75°C per hour (Abd-Elsayed, 2024), much faster than passive heating using a cotton blanket (Heitz, 2016).

These findings are in line with a study Özsaban & Acaroğlu, (2020) using a quasi-experimental post-test control group design, by comparing the effectiveness of the active heating method with forced air warming and cotton blankets using a quasi-experimental post-test control group research design. The study showed that the use of FAW was significantly more effective in preventing hypothermia after surgery and was able to improve patients' perception of comfort.

In the study entitled Yin et al., (2022) "Comparison of two different uses of underbody forced-air warming blankets for the prevention of hypothermia in patients undergoing arthroscopic shoulder surgery: a prospective randomized study", it was stated that thermoregulatory disturbances in arthroscopic patients occurred due to low ambient temperature in the operating room, intravenous fluids and irrigation, exposure to surgical procedures and anesthesia procedures. This prospective study with a randomized controlled trial design shows that the use of FAW, especially with the over-body warming method, is significantly effective in preventing postoperative hypothermia and maintaining body temperature within the normothermic range in patients undergoing shoulder arthroscopy surgery.

Another study conducted by Maryam et al., (2024) the entitled "Active Versus Passive Warming in the Prevention of Inadvertent Intraoperative Hypothermia", showed that active heating using forced air heating was effective in reducing the incidence and severity of intraoperative and postoperative hypothermia. This is in line with research conducted by Aini, (2023) Temanggung Hospital showing that the use of FAW significantly reduces the degree of shivering in postoperative cesarean section patients. Although the types of surgery are different, these two studies support that FAW can help

maintain body temperature stability effectively in different types of surgical procedures.

Clinically, maintaining postoperative normothermy has a wide impact, not only on patient comfort but also in preventing complications, accelerating the metabolism of anesthesia drugs, and supporting optimal recovery. Therefore, the implementation of FAW as part of standard care procedures in recovery rooms can be considered to improve the safety and quality of perioperative nursing services.

CONCLUSIONS AND RECOMMENDATIONS

This study aims to compare Forced Air Warming Device and standard blankets in maintaining the stability of body temperature in post-arthroscopic surgery patients. The results showed that the use of Forced Air Warming Device was significantly more effective in maintaining the stability of the patient's body temperature after arthroscopic surgery in the recovery room compared to the use of standard blankets. Based on these findings, it is recommended that hospitals consider making the use of FAW a standard operating procedure (SPO) in the recovery room, especially for patients undergoing procedures with a high risk of hypothermia. The limitations of the study include short observation durations and limited populations, so further studies are suggested with longer time and more heterogeneous samples to reinforce the findings.

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