JOURNAL OF COMPREHENSIVE MEDICAL-SURGICAL NURSING

Volume 01 Number 01 (June 2026)
https://ebsina.or.id/journals/index.php/JCMN
e-ISSN: xxxx-xxxx

The Effect of Active External Warming Using Electric Blankets on Post-Anesthetic Shivering and Hypothermia in Spinal Anesthesia Patients: A Quasi-Experimental Study

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Article Info:
Submitted:
18-04-2026
Revised:
20-05-2026
Accepted:
21-05-26

DOI: 10.58545/jcmn.v1i1.875

ABSTRACT

Introduction: Post-anesthetic shivering after spinal anesthesia may increase oxygen consumption, discomfort, pain, and difficulties in patient monitoring. Active external warming is a practical nursing intervention to reduce hypothermia-related shivering.

Objective: This study aimed to determine the effect of electric warming blankets on the incidence and severity of post-anesthetic shivering and hypothermia among patients undergoing spinal anesthesia.

Methods: This study analyzed the effect of an electric warming blanket on shivering among patients after spinal anesthesia. A quasi-experimental posttest-only control-group study was conducted in the operating room of Lavalette Hospital Malang. Thirty postoperative spinal-anesthesia patients were recruited by consecutive sampling and allocated to an intervention group (n=15) that received an electric warming blanket and a control group (n=15) that did not. Shivering was observed 60 minutes after spinal anesthesia, as assessed using the Alfonsi shivering scale. Data were analyzed using the Mann-Whitney test.

Result: No shivering was observed in 8 intervention patients (53.3%) compared with 3 control patients (20.0%). The most frequent control-group outcome was grade 2 shivering, observed in 5 patients (33.3%). The Mann-Whitney test showed a significant difference between groups (U=53.500; Z=-2.592; p=0.010).

Conclusion: Electric warming blankets significantly reduced shivering severity after spinal anesthesia and may support postoperative comfort and safety.

Keywords: Electric warming blanket, Post-anesthetic shivering, Spinal anesthesia, Post-operative, Hypothermia

Introduction

Shivering after spinal anesthesia is an important perioperative nursing problem because it reflects disruption of thermal balance and may cause patient discomfort, increased metabolic demand, increased oxygen consumption, wound pain, and difficulty in postoperative monitoring. Recent evidence-based recommendations emphasize that shivering after spinal anesthesia requires integrated prevention and management, including temperature monitoring, prewarming, active external warming, and warmed intravenous fluids when clinically indicated (Amsalu et al., 2022; Rauch et al., 2021).

Spinal and neuraxial anesthesia may contribute to hypothermia and shivering by impairing thermoregulatory vasoconstriction and promoting heat redistribution from the core to peripheral tissues. This condition can be aggravated by low operating-room temperature, prolonged surgery, surgical exposure, unwarmed fluids, patient age, body mass index, and other procedure-related factors. Recent reviews on neuraxial anesthesia and cesarean delivery also show that shivering remains a frequent and clinically relevant problem during and after spinal anesthesia (Mashitoh et al., 2018; Neaton et al., 2024). Previous studies have reported shivering after spinal anesthesia in approximately 30-57%

of surgical patients, indicating that the problem remains clinically frequent (Irawan, 2018; Lopez, 2018; Mashitoh et al., 2018).

Preliminary observations in the operating room at Lavalette Hospital, Malang, also showed a notable incidence of shivering after spinal anesthesia: 53% of 57 patients in August 2024, 63% of 62 patients in September 2024, and 48% of 56 patients in October 2024 experienced postoperative shivering. These local data suggest the need for a simple, feasible, and non-pharmacological warming strategy that can be integrated into perioperative nursing practice.

Active warming has gained attention as a non-pharmacological strategy to prevent perioperative hypothermia and reduce shivering. Evidence from recent randomized trials and meta-analyses indicates that active warming devices, including forced-air warming, warming blankets, and other conductive warming systems, can maintain body temperature more effectively than passive warming alone and may reduce the incidence of perioperative shivering (Yoo et al., 2022; Lopez, 2018; Mashitoh et al., 2018).

An electric warming blanket is an active external warming device that helps maintain body temperature by transferring heat to the patient. Compared with ordinary cloth blankets, active warming not only reduces further heat loss but also provides additional heat to support a return toward normothermia. This study aimed to determine the effect of electric warming blankets on the incidence and severity of shivering among patients after spinal anesthesia in the operating room of Lavalette Hospital, Malang.

Method

This study used a quantitative quasi-experimental design with a posttest-only control group. The study was conducted in the operating room at Lavalette Hospital, Malang, Indonesia, from 16 January to 16 February 2025. The target population comprised patients undergoing surgery with spinal anesthesia at Lavalette Hospital.

The sample consisted of 30 postoperative spinal anesthesia patients selected through nonprobability consecutive sampling. Fifteen respondents were assigned to the intervention group and 15 to the control group. Inclusion criteria were patients undergoing surgery with spinal anesthesia for more than one hour and patients with American Society of Anesthesiologists physical status I or II. Exclusion criteria were patients who, after spinal anesthesia, experienced shivering and received pharmacological treatment, and patients with ASA III status.

The independent variable was the provision of an electric warming blanket. The dependent variable was shivering after spinal anesthesia. In the intervention group, the electric warming blanket was applied five minutes after spinal anesthesia. In the control group, patients did not receive an electric warming blanket. Operating-room temperature was maintained at approximately 20-23 degrees Celsius.

Shivering was assessed 60 minutes after spinal anesthesia using an observation sheet based on the Alfonsi shivering scale: 0=no shivering; 1=piloerection or peripheral vasoconstriction without visible shivering; 2=muscle activity limited to one muscle group;

3=muscle activity in more than one muscle group; and 4=whole-body shivering (Dewi et al., 2024). Body temperature was also categorized after the intervention or observation period.

Data were analyzed descriptively using frequencies and percentages. Normality was assessed using the Shapiro-Wilk test because each group contained fewer than 50 participants. Because the shivering data were ordinal and the intervention-group data were not normally distributed, group differences were analyzed using the Mann-Whitney test at alpha=0.05. Ethical principles included informed consent, voluntary participation, confidentiality, and fair treatment of respondents.

Results

Thirty respondents were included in the analysis. In both groups, most respondents were older than 36 years (73.3%). Male respondents were more frequent in the control group (53.3%) and intervention group (66.7%). The highest educational category was college in the control group (46.7%) and senior high school in the intervention group (46.7%). Obesity was most frequent in the control group (46.7%), whereas normal body mass index was most frequent in the intervention group (40.0%).

Table 1. Respondent characteristics by group

Characteristic	Control group n (%)	Electric blanket invention group n (%)
Age		
21-30 years	4 (26.7)	3 (20.0)
Age 31-35 years	0 (0.0)	1 (6.7)
Age >36 years	11 (73.3)	11 (73.3)
Sex		
Female	7 (46.7)	5 (33.3)
Male	8 (53.3)	10 (66.7)
Education level		
Elementary school	1 (6.7)	1 (6.7)
Junior high school	2 (13.3)	3 (20.0)
Senior high school	5 (33.3)	7 (46.7)
College/university	7 (46.7)	4 (26.7)
Body Mass Index (BMI)		
Normal	6 (40.0)	6 (40.0)
Overweight	2 (13.3)	5 (33.3)
Obesity	7 (46.7)	3 (20.0)
Underweight	0 (0.0)	1 (6.7)

After the observation period, hypothermia was more frequent in the control group than in the intervention group. In the control group, 12 respondents (80.0%) were categorized as hypothermic, whereas in the intervention group, 8 respondents (53.3%) had normal body temperature.

Table 2. Body temperature category after observation

Body temperature	Control group n (%)	Electric blanket invention group n (%)
Hypothermia	12 (80.0)	7 (46.7)
Normal temperature	3 (20.0)	8 (53.3)
Hyperthermia	0 (0.0)	0 (0.0)

Note: Percentages are calculated within each group.

Shivering outcomes also favored the electric warming blanket group. In the control group, only 3 respondents (20.0%) had no shivering, and the largest category was grade-2 shivering, experienced by 5 respondents (33.3%). In the intervention group, 8 respondents (53.3%) had no shivering, and only 1 respondent (6.7%) had grade-3 shivering. Whole-body shivering was not observed in either group.

Table 3. Shivering grade after spinal anesthesia

Shivering grade	Control group n (%)	Electric blanket invention group n (%)
Grade 0: No shivering	3 (20.0)	8 (53.3)
Grade 1: Piloerection/peripheral vasoconstriction	4 (26.7)	3 (20.0)
Grade 2: Muscle activity in one group	5 (33.3)	3 (20.0)
Grade 3: Muscle activity in >1 group	3 (20.0)	1 (6.7)
Grade 4: Whole-body shivering	0 (0.0)	0 (0.0)

Note: Percentages are calculated within each group

The Shapiro-Wilk normality test showed non-normal distribution in the electric warming blanket group (p=0.000), supporting the use of the Mann-Whitney test for between-group comparison. The Mann-Whitney test showed a statistically significant difference in shivering scores between groups (U=53.500; Z=-2.592; p=0.010). Because lower scores indicate less shivering, the lower mean rank in the electric warming blanket group indicated lower shivering severity than in the control group.

Table 4. Normality and Mann-Whitney analysis

Analysis	Statistic	df/N	p value
Shapiro-Wilk: electric warming blanket	0.649	15	0.000
Shapiro-Wilk: no electric warming blanket	0.889	15	0.064
Mann-Whitney U	53.500	-	0.010
Z score	-2.592	-	0.010

Analysis	Statistic	df/N	p value
Mean rank: electric warming blanket	11.57	15	-
Mean rank: no electric warming blanket	19.43	15	-

Note: Percentages are calculated within each group.
Lower shivering scores indicate better outcomes. Mean-rank values are presented from the Mann-Whitney analysis.

Discussion

The findings of this study indicate that electric warming blankets were associated with lower shivering severity after spinal anesthesia. More than half of the patients in the intervention group had no shivering, whereas the most frequent outcome in the control group was grade-2 shivering. This finding is clinically meaningful because post-anesthetic shivering can increase metabolic demand, oxygen consumption, discomfort, wound pain, and the complexity of postoperative observation (Amsalu et al., 2022; Rauch et al., 2021).

The result is physiologically plausible. Spinal anesthesia reduces vasoconstriction and shivering thresholds and promotes heat redistribution from the core to peripheral tissues. When the patient is exposed to cold operating-room temperature for a prolonged period, the risk of heat loss increases. An electric warming blanket supplies active external heat and may reduce the depth or duration of hypothermia, thereby decreasing the stimulus for shivering. Ordinary passive blankets mainly prevent further heat loss, whereas active warming can also transfer heat to the body surface (Ji et al., 2024; Rositasari & Dyah, 2017).

These findings support the use of non-pharmacological warming as part of postoperative nursing management after spinal anesthesia. Nevertheless, shivering is multifactorial; therefore, warming blankets should be integrated with broader temperature management, including operating-room temperature control, appropriate temperature monitoring, consideration of warmed fluids, procedure duration, patient exposure, age, body mass index, and other patient-specific risk factors (Aloysius et al., 2023; Ji et al., 2024).

The present finding is also consistent with recent evidence on warming blankets and forced-air warming interventions. The use of a warm blanket in patients after subarachnoid block anesthesia has been reported to increase central temperature over time, whereas randomized and meta-analytic evidence shows that forced-air or combined warming strategies reduce perioperative hypothermia and shivering compared with passive warming or standard care (Ekorini & Lumadi, 2021; Yoo et al., 2022).

This study has limitations. The sample size was small, the study was conducted in a single hospital, and the use of consecutive sampling limits generalizability. The study did not fully control for or quantify several potential confounders, including total intraoperative intravenous fluid volume, the temperature of fluids, the exact duration and extent of surgery, and drugs that may influence temperature regulation or shivering. Future research should use a larger randomized design, include more detailed temperature monitoring, and evaluate clinical outcomes such as comfort, oxygen saturation, recovery-room length of stay, and analgesic or anti-shivering medication use.

Conclusion

Electric warming blankets significantly reduced shivering severity among patients after spinal anesthesia in the operating room of Lavalette Hospital, Malang. The intervention group had a higher proportion of patients without shivering and lower overall shivering severity than the control group. Electric warming blankets are a practical non-pharmacological nursing intervention to improve postoperative comfort and patient safety after spinal anesthesia.

Acknowledgement

The authors thank Lavalette Hospital Malang, Sekolah Tinggi Ilmu Kesehatan Majapahit Mojokerto, the operating-room nursing team, and all respondents who participated in this study.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding Sources

This research received no external funding.

Author Contributions

FWA: contributed to conceptualization, methodology guidance, data collection, formal analysis, and writing-original draft. IS: contributed to data processing, supervision, validation, and manuscript review. All authors approved the final manuscript.

Data Availability Statement

The authors declare no conflict of interest with respect to the research, authorship, and/or publication of this article..

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