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Original Research

Influence of Temperature Fluctuations in Intrathecal Bupivacaine on Shivering Among Parturients Undergoing Spinal Anesthesia

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ABSTRACT:
Background:Shivering is a common complication linked to neuraxial anesthesia, affecting as many as 55% of patients. This discomfort not only troubles patients but can also disrupt the monitoring of vital signs such as electrocardiogram, blood pressure, and oxygen saturation. The metabolic and hemodynamic impacts of shivering encompass heightened dispersion of cardiac and systemic energy, increased oxygen consumption, elevated carbon dioxide production, and a rise in cardiac workload.**Methods**:Following approval from the institutional ethics committee and obtaining written informed consent from patients, this prospective randomized double-blind study enrolled 160 parturients scheduled for elective Caesarean Section (CS) at a tertiary care center. The participants were randomly assigned to Group I and Group II, each comprising 80 members. In Group I, individuals received 2 ml of 0.5% heavy Bupivacaine at 22°C, while in Group II, 2 ml of 0.5% heavy Bupivacaine at 37°C was administered for spinal anesthesia. **Results**:Shivering occurred in 57.5% of patients in Group I and 32.5% in Group II, with a statistically significant difference. The overall shivering percentage was 45%, although the disparity in the mean onset time was not significant between the two groups. The grades of shivering were comparable in both groups. Additionally, there was no significant difference in the incidence of bradycardia, hypotension, nausea, and vomiting between the two groups.**Conclusion**:Shivering continues to be a prevalent issue for patients undergoing cesarean section with neuraxial anesthesia, causing discomfort for parturients. Various pharmacological and non-pharmacological interventions have been explored to prevent and address shivering, yet there is no universally accepted gold standard treatment. The current study reveals a reduced incidence of shivering when a warm local anesthetic solution is intrathecally injected, with no discernible difference in the level of blockade or occurrence of adverse effects.
Keywords:Shivering, neuraxial anaesthesia, electrocardiogram, oxygen saturation.

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INTRODUCTION

Shivering, a prevalent complication associated with neuraxial anesthesia, occurs in a substantial 55% of patients undergoing various procedures.[1] Its impact extends beyond mere discomfort, as it introduces challenges in the effective monitoring of critical parameters like electrocardiogram, blood pressure, and oxygen saturation. The cascade of metabolic and hemodynamic consequences resulting from shivering includes an augmented disbursement of cardiac and systemic energy, heightened levels of oxygen consumption and carbon dioxide production, and an increased workload on the cardiac system. These effects are particularly pronounced and concerning within the obstetrical population.Several interconnected mechanisms contribute to the occurrence of shivering in patients undergoing surgery.[2,3] These include the loss of intraoperative temperature, an upsurge in sympathetic tone, the presence of pain, systemic release of pyrogens, and the direct influence of local anesthetic temperature on temperature-sensitive neurons within the spinal cord. The central nervous system (CNS), encompassing the spinal cord, emerges as a critical player in this complex interplay, receiving thermal signals from the body and playing a pivotal role in the regulation and maintenance of body temperature.Despite the prevalence of shivering and its clinical significance,

the precise etiology remains elusive.[4] While numerous studies have been devoted to exploring interventions for managing shivering post-spinal anesthesia, a comprehensive understanding of its root causes and the most effective preventive strategies is still lacking.Within the realm of obstetric procedures, spinal anesthesia for cesarean sections remains a favored technique. This preference is attributed to its notable advantages, including rapid onset, a high success rate, minimal exposure of both the maternal and fetal systems to drugs, and a reduced level of maternal discomfort.[5] These attributes highlight the continued relevance and popularity of spinal anesthesia in the context of cesarean deliveries, as emphasized by the work of Mehta et al. and others in the field.

Mehta et al.'s insightful research has not only contributed significantly to our understanding but has also solidified the efficacy of employing warm parenteral fluids and warm local anesthetics concurrently, establishing a notable reduction in the incidence of shivering in clinical scenarios. Building upon this foundation, other researchers have delved into the intricate nuances of how the temperature of local anesthetics, specifically after their injection into the epidural space, influences the occurrence of shivering.A distinct study, for instance, illuminated the potential existence of thermo-sensory mechanisms within the intricate landscape of the human spinal canal.[6] This exploration suggested that the proactive warming of epidural anesthetic solutions before injection could serve as a preventive measure, effectively lowering the incidence of shivering. However, the intricate relationship between temperature, sensory mechanisms, and shivering is a multifaceted puzzle, and the solution seems to vary across different studies.In another investigative effort, Ponte et al. took a different angle, scrutinizing the hypothesis that cooling the extradural space might be a trigger for shivering. However, their findings contradicted the notion that shivering in extradural anesthesia is solely a consequence of the cooling of the extradural space. This disparity in outcomes underscores the complexity of the factors contributing to shivering during surgical procedures and the need for a nuanced understanding.[7]Amidst this diversity of perspectives and the absence of a definitive answer, the current study has been meticulously crafted with a central hypothesis in mind: that intraoperative shivering will be less prevalent when utilizing bupivacaine (heavy 0.5%) at 37°C compared to the same anesthetic at 22°C in the context of spinal anesthesia for patients undergoing elective Cesarean Section. By carefully examining the impact of anesthetic temperature on shivering, this investigation aims to add a valuable piece to the ongoing puzzle, fostering a more comprehensive understanding of the interplay between temperature modulation and shivering in the realm of surgical anesthesia.

MATERIALS AND METHODS

This prospective randomized double-blind study involved 160 parturients scheduled for elective Cesarean Section (CS) at a tertiary care center. The determination of the sample size was based on the observed proportion of shivering during CS at the particular hospital. The inclusion criteria encompassed participants with singleton pregnancies of American Society of Anesthesia (ASA) grade I and II, aged between 18 to 40 years, and scheduled for elective CS. Exclusion criteria involved parturients refusing participation, those aged over 40 years, ASA grade III & IV, cases with acute fetal distress, fever, pregnancy-induced hypertension (PIH), obesity with a body mass index (BMI) exceeding 35 Kg/m², and those requiring blood transfusion or having received one within 24 hours before CS. Also, cases where spinal anesthesia (SA) failed, necessitating conversion to general anesthesia, were excluded.Computer-generated randomization allocated participants into two groups. Group-I received an injection of bupivacaine 2 mL (heavy 0.5%) stored at 22°C, while Group-II received the same anesthesia stored at 37°C for the CS procedure. Separate anesthesiologists were assigned to drug preparation and injection, while another was responsible for observing parameters and collecting data. The operating room (OR) temperature was maintained at 23°C, and all intravenous fluids were warmed to 37°C. Standard monitoring was applied, including preoperative pulse rate, blood pressure, oxygen saturation (SpO2), and the basal temperature of parturients. Intravenous access was established, and Ringer's lactate was infused before the subarachnoid block.

Lumbar puncture was performed at L3-L4 or L2-L3 intervertebral space with a 25G spinal needle, injecting the study drug into the subarachnoid space. This marked time zero. Patients were positioned supine with a wedge pillow beneath the right buttock. Another anesthesiologist performed spinal anesthesia and assessed shivering post-procedure. Sensory and motor blocks were evaluated using pin prick tests and the Bromage Scale, respectively, at specified intervals. Various parameters, including time to reach maximum sensory block height, level of maximum sensory block dermatomal height, and time to achieve a Bromage score of 3, were recorded.

In this study, the core body temperature of the participants was measured using a rectal thermometer probe at intervals of 5 minutes for the initial 30 minutes and every 10 minutes thereafter until the conclusion of the surgery. The assessment of post-spinal shivering utilized the Crossly and Mahajan scale, where scores were assigned as follows: 0 for no shivering, 1 for no visible muscle activity but presence of piloerection or peripheral cyanosis (with other causes excluded), 2 for muscular activity in only one muscle group, 3 for moderate muscular activity in more than one muscle group but not generalized shaking, and 4 for violent muscular activity involving

the entire body. The onset time of shivering was defined as the duration between "time 0" and the appearance of score 1 on the scale.Preoperative and intraoperative vital signs, including systolic blood pressure (SBP) and heart rate, were recorded at specific intervals. Measurements were taken before the administration of the spinal drug, after the patient was positioned supine, every 1-2 minutes until the baby was delivered, and subsequently every 5 minutes until the completion of the surgery. Patients experiencing shivering, bradycardia, or hypotension were managed according to the hospital protocol, which involved interventions such as warming blankets, injection atropine, and injection mephentermine. Any instances of nausea, vomiting, or other intraoperative observations were documented.Hypotension was defined as a reduction in systolic blood pressure (SBP) by more than 20% or a decrease in SBP to less than 90 mm/Hg from the pre-anesthetic value. Such cases were addressed with injection mephentermine and crystalloid administration. Patients with profuse blood loss requiring blood transfusion were excluded from the study. The comprehensive documentation of these parameters aims to provide a thorough understanding of the effects of temperature modulation on various physiological aspects during spinal anesthesia for elective Cesarean Section.

RESULTS

The study encompassed 160 parturients scheduled for Cesarean Section (CS), evenly divided into two groups of 80 each. Group I received 0.5% hyperbaric bupivacaine at a temperature of 22°C, while Group II received the same anesthetic at a higher temperature of 37°C. Demographic and surgical parameters, as detailed in Table 1, were found to be comparable between the two groups.

The onset time of sensory blockade, maximum sensory blockade, and the time required to achieve maximum sensory and motor blockade were also similar in both groups, as indicated in Table 2. However, noteworthy differences emerged concerning the occurrence of shivering. In Group I, shivering was present in 57.5% of patients, whereas it occurred in only 32.5% of patients in Group II. This disparity was found to be statistically significant, resulting in an overall shivering percentage of 45%. Interestingly, the mean onset time of shivering did not exhibit a significant difference between the two groups, as elucidated in Table 3. The grades of shivering were comparable in both groups.Despite the notable contrast in shivering incidence, there were no significant differences in the occurrence of bradycardia, hypotension, nausea, and vomiting between the two groups. This observation suggests that while temperature modulation of the administered anesthetic influenced shivering rates, it did not manifest a discernible impact on other monitored physiological parameters during spinal anesthesia for Cesarean Section in this study population. The results contribute valuable insights into the potential implications of varying anesthetic temperatures in clinical settings.

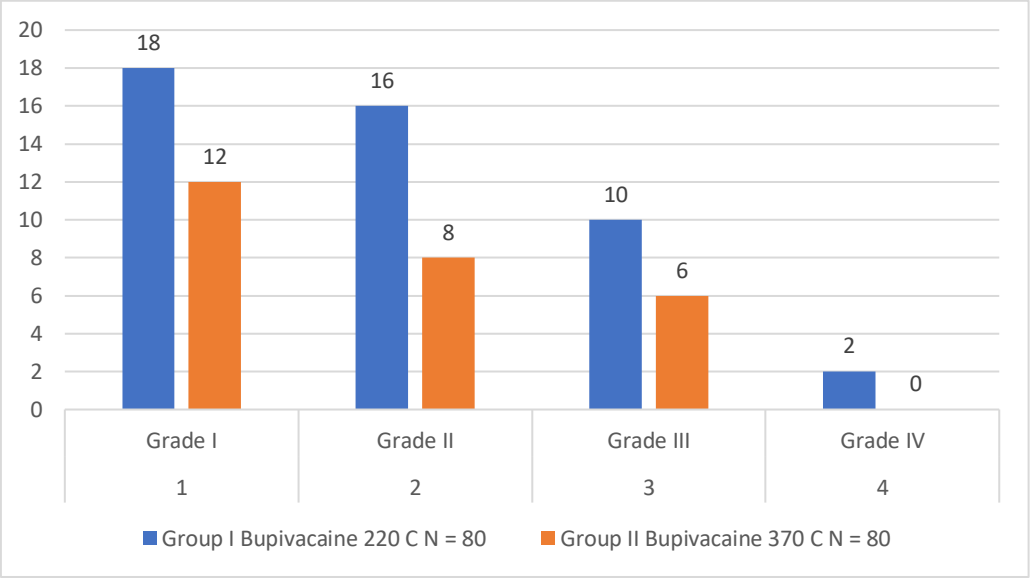
Table 1: Demographic and Surgical Parameters of Patients

Parameters	Group I	Group II	P-Value
	Bupivacaine 22^0C	Bupivacaine 37^0C	
Mean age (years)	27 ±3.59	26.05 ± 2.97	0.61
Mean weight (Kg) ± SD	58.75 ± 6.03	57.52 ± 3.22	0.25
Mean height (cm) ± SD	146.57 ± 3.69	146.28 ± 4.7	0.759
Mean Gestational Weeks ± SD	35.65 ± 1.44	35.3 ± 2.17	0.39
ASA Grade I: Grade II	30 : 10	27 : 13	0.458
Mean duration of surgery in minutes	40.65 ± 3.81	40.67 ± 4.71	0.001

Table 4: Grades of Shivering in Group I and Group II

Sl. No.	Shivering Grades	Group I Bupivacaine 22^0 C N = 80 (%)	Group II Bupivacaine 37^0 C N = 80 (%)	P-Value
1	Grade I	18	12	0.5679
2	Grade II	16	8	0.3482
3	Grade III	10	6	0.7119
4	Grade IV	2	0	1.0

Figure 1: Grades of Shivering in Group I and Group II



DISCUSSION

Shivering remains a prevalent complication associated with spinal anesthesia, yet its exact causes remain shrouded in mystery, with reported incidence rates reaching up to 55% according to existing literature. The management of shivering has been a subject of exploration, with various pharmacological interventions employed, each yielding different degrees of success. While the mechanisms triggering shivering are not fully understood, several factors have been proposed as potential explanations.[8,9] These include the loss of vasomotor tone above the level of the block, leading to the absence of vasoconstriction that would normally prevent heat loss. Additionally, there is the redistribution of heat from the core body to the periphery and alterations in thermoregulation involving an increased sweating threshold and decreased vasoconstriction.In the current study, the focus was on comparing the effects of varying the temperature of intrathecal bupivacaine, with adjustments made to temperatures at 22°C and 37°C. The results demonstrated an average shivering incidence of 45%, with Group I exhibiting a notably higher incidence (57.5%) compared to Group II (32.5%). These findings echo a similar study conducted by Najafianaraki et al., where a significant difference in shivering incidence was observed between groups receiving cold and warm bupivacaine, with the cold bupivacaine group experiencing a higher incidence of shivering.The presence of thermoreceptors in the spinal cord across all mammalian species is a well-established fact. The injection of a relatively cool epidural local anesthetic solution, as explored in this study, may indeed provoke shivering by activating local temperature sensors.[10] This intriguing observation suggests a potential interplay between the temperature of administered intrathecal anesthesia and the physiological response of shivering. These findings contribute valuable insights into the multifaceted dynamics of temperature modulation and its influence on the intricate processes occurring during spinal anesthesia.

The study findings revealed a significant difference in the onset of shivering between the two groups. Group I, which received bupivacaine at 22°C, exhibited a faster onset compared to Group II at 37°C. This contrasts with a study by Nandkishor et al., where earlier onsets were observed in a cold bupivacaine group without a statistical difference between groups at 22°C and 37°C. The variation in onset times underscores the potential influence of intrathecal bupivacaine temperature on shivering initiation.Shivering intensity, assessed through a grading system, demonstrated a higher proportion of higher-grade shivering in Group I compared to Group II. This aligns with a study by Ponte et al., where shivering intensity was comparable between groups exposed to cold and warm bupivacaine. The study highlights the importance of considering not only the incidence but also the intensity of shivering concerning the temperature of administered bupivacaine.No significant differences were noted in maximum sensory and motor levels between the two groups, along with the time required to achieve these levels. This concurs with previous studies by Nandkishor et al. and Najafianaraki et al., indicating that the temperature variation of intrathecal bupivacaine does not significantly impact the extent or speed of sensory and motor blockade.[11]

Hemodynamic parameters were comparable in both groups, suggesting that variations in the temperature of intrathecal bupivacaine did not result in significant differences in blood pressure and heart rate. This consistency aligns with the findings of previous studies conducted on healthy volunteers and non-pregnant patients, emphasizing the stability of hemodynamic parameters irrespective of the local

anesthetic solution used.In summary, the study provides valuable insights into the nuanced relationship between the temperature of intrathecal bupivacaine and the onset and intensity of shivering. The findings contribute to the ongoing discourse on refining anesthesia protocols for optimal patient outcomes.[12]

Shivering, a reflexive and involuntary physiological response, manifests as rhythmic, oscillating tremors in skeletal muscles. This phenomenon plays a crucial role as a compensatory mechanism to generate heat through muscular activity. In medical contexts, particularly during procedures like cesarean sections under spinal anesthesia, shivering is a common occurrence, with reported incidences reaching as high as 56.7%. Despite its seemingly adaptive nature, shivering can present challenges for both patients and medical practitioners.[13]The distress caused by shivering is not only subjective but also has objective implications. It interferes with the accurate measurement of vital parameters, including peripheral arterial saturation, blood pressure, and electrocardiogram readings. The rhythmic muscle contractions can introduce artifacts and inaccuracies in these measurements, complicating the monitoring of patients during critical procedures. Consequently, the management of shivering becomes imperative not only for patient comfort but also for the precision and reliability of vital sign assessments.Beyond its immediate impact on monitoring, shivering induces a rise in metabolic rate. This heightened metabolic activity translates to an increased demand for oxygen, along with elevated production of carbon dioxide and lactic acid. For patients with compromised cardiopulmonary reserves, such as those with pre-existing cardiovascular or respiratory conditions, this added physiological stress can be detrimental.[14] Therefore, mitigating shivering becomes crucial to prevent undue strain on the cardiovascular and respiratory systems, promoting better outcomes and safety during medical interventions.In conclusion, understanding the multifaceted nature of shivering goes beyond its visible manifestations. It underscores the importance of addressing this physiological response during medical procedures, not only to enhance patient comfort but also to ensure the accuracy of vital parameter measurements and safeguard individuals with underlying health concerns. Developing effective strategies to manage and minimize shivering is essential for optimizing the overall success and safety of medical interventions, particularly those involving spinal anesthesia.[15]

CONCLUSION

Shivering continues to be a prevalent concern for patients undergoing caesarean section under neuraxial anesthesia, contributing to discomfort among parturients. Addressing this issue has prompted the exploration of various pharmacological and non-pharmacological interventions aimed at both prevention and treatment. Despite numerous approaches, a universally accepted gold standard treatment for shivering in this context has yet to be defined.The current study contributes to this ongoing discourse by showcasing a reduced incidence of shivering when utilizing a warm local anesthetic solution administered intrathecally. Notably, this reduction in shivering incidence occurred without any discernible differences in the level of blockade achieved or the occurrence of adverse effects. This finding underscores the potential efficacy of temperature modulation in the local anesthetic solution as a strategy for mitigating shivering during neuraxial anesthesia for caesarean sections.The study's implication is significant as it suggests that optimizing the temperature of the administered local anesthetic solution may represent a viable approach to enhance patient comfort without compromising the procedural aspects, such as the level of anesthesia achieved or introducing additional adverse effects. By shedding light on the impact of temperature in this specific context, the study contributes to the broader understanding of shivering management during caesarean sections and provides a valuable perspective for clinicians seeking to refine anesthesia protocols for improved patient outcomes.

REFERENCES

1. De Witte J, Sessler DI. Perioperative shivering: Physiology and pharmacology. Anesthesiology. 2002;96:467–84.
2. Piper SN, Fent MT, Röhm KD, Maleck WH, Suttner SW, BoldtJ. Urapidil does not prevent postanesthetic shivering: A dose- ranging study. Can J Anaesth. 2001;48:742–7.
3. Roy JD, Girard M, Drolet P. Intrathecal meperidine decreases shivering during cesarean delivery under spinal anesthesia. AnesthAnalg. 2004;98:230–4.
4. Jeon YT, Jeon YS, Kim YC, Bahk JH, Do SH, Lim YJ. Intrathecal clonidine does not reduce post-spinal shivering. Acta Anaesthesiol Scand. 2005;49:1509–13.
5. Gozdemir M, Usta B, Demircioglu RI, Muslu B, Sert H, Karatas OF. Magnesium sulfate infusion prevents shivering during transurethral prostatectomy with spinal anesthesia: A randomized, double-blinded, controlled study. J Clin Anesth. 2010; 22:184–9.
6. Pauca AL, Savage RT, Simpson S, Roy RC. Effect of Pethidine, Fentanyl and Morphine on Post-Operative Shivering in Man. Acta Anaesthesiol Scand. 1984;28:138–43.
7. Panzer O, Ghazanfari N, Sessler DI, Yücel Y, Greher M, Akça O, et al. Shivering and shivering-like tremor during labor with and without epidural analgesia. Anesthesiology. 1999;90:1609– 16.
8. Doufas AG, Morioka N, Maghoub AN, Mascha E, Sessler DI. Lower-body warming mimics the normal epidural-induced reduction in the shivering threshold.AnesthAnalg. 2008; 106: 252–6.
9. Mehta P, Theriot E, Mehrotra D, Patel K, Zarbalian A. Shivering following epidural anesthesia in obstetrics. Reg Anesth Pain Med. 1984;9:83–5.
10. Han JW, Kang HS, Choi SK, Park SJ, Park HJ, Lim TH. Comparison of the effects of intrathecal fentanyl and meperidine on shivering after cesarean delivery

under spinal anaesthesia. Korean J Anesthesiol. 2007;52:657–62.
11. Ponte J, Collett BJ, Walmsley A. Anaesthetic temperature and shivering in epidural anaesthesia. Acta Anaesthesiol Scand. 1986;30:584–7.
12. Vanderstappen I, Vandermeersch E, Vanacker B, Mattheussen M, Herijgers P, Van AH. The effect of prophylactic clonidine on postoperative shivering. Anaesthesia 1996;51:351–5.
13. Honarmand A, Rahmanikhah E, Safavi M, Attari M, Badiei S. Intrathecal meperidine versus intrathecal fentanyl for prevention of shivering in lower limb orthopedic surgeries under spinal anesthesia:A randomized double-blind placebo-controlled trial. J Res Pharm Pract2014;3:137–41.
14. Techanivate A, Rodanant O, Tachawattanawisal W, Somsiri T. Intrathecal fentanyl for prevention of shivering in caesarean section. J Med Assoc Thai 2005;88:1214–21.
15. Khan ZH, Zanjani AP, Makarem J, Samadi S. Antishivering effects of two different doses of intrathecal meperidine in caesarean section:A prospective randomized blinded study. Eur J Anaesthesiol2011;28:202–6.