Comparison of Efficacy of Intravenous Tramadol and Intravenous Dexmedetomidine on Post-Spinal Anesthesia Shivering in Caesarean Section

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ABSTRACT

Background: Post-aesthetic shivering is a common complication after neuraxial anaesthesia, often managed with agents like tramadol and meperidine, which are associated with adverse effects such as nausea and vomiting. Dexmedetomidine, a centrally acting alpha-2 adrenergic agonist, may offer a safer alternative.

Objective: To compare the efficacy of intravenous tramadol and intravenous dexmedetomidine in controlling post-spinal anaesthesia shivering in obstetric patients undergoing caesarean sections.

Methods: This quasi-experimental study was conducted from 20 February to 20 August 2024, involving 120 patients undergoing elective cesarean sections who developed post-spinal shivering. Patients were randomly assigned to receive either intravenous dexmedetomidine (0.5 mcg/kg) or tramadol (0.5 mg/kg). Outcomes measured included time to shivering cessation, recurrence, and adverse effects, analysed using independent sample t-tests and Chi-square tests with significance set at $p \leq 0.05$.

Results: The time to cessation of shivering was significantly shorter with dexmedetomidine (172.12 ± 14.26 seconds) compared to tramadol (278.06 ± 23.17 seconds, $p < 0.001$). Shivering recurrence was 5% in the dexmedetomidine group versus 16.66% in the tramadol group ($p = 0.03$).

Conclusion: Dexmedetomidine demonstrated superior efficacy in controlling post-spinal anaesthesia shivering with fewer adverse effects compared to tramadol, making it a preferred option in obstetric settings.

INTRODUCTION

Shivering is a frequent and undesirable complication of anesthesia, occurring in approximately 40% to 70% of patients undergoing neuraxial anesthesia (1, 2). This involuntary muscle activity is associated with increased oxygen consumption, carbon dioxide production, and potential alterations in cardiovascular and respiratory function, which can adversely affect patient comfort and safety (3, 4). Among the proposed mechanisms for post-spinal anesthesia shivering are intraoperative heat loss, increased sympathetic tone, pain, and the presence of systemic pyrogens. Although the thermoregulatory function of the hypothalamus remains intact under neuraxial anesthesia, the associated vasodilatory effects, impaired shivering response, and fluid preload significantly contribute to overall heat loss compared to general anesthesia (5, 6).

Shivering not only decreases patient satisfaction but also poses clinical challenges such as increased intracranial and intraocular pressures, potential interference with standard monitoring devices, particularly pulse oximetry, and can lead to complications including myocardial ischemia and arrhythmias due to the enhanced metabolic demands (7, 8). The management of shivering is thus critical, and several pharmacological agents have been utilized for its control, including tramadol and dexmedetomidine. Dexmedetomidine, a centrally acting alpha-2 adrenergic agonist, has been recognized for its anti-shivering properties along with sedative effects, which can improve patient comfort during the perioperative period (9, 10). Tramadol, an opioid receptor agonist, exerts its anti-shivering effects primarily through the inhibition of serotonin and norepinephrine reuptake in the spinal cord, facilitating thermoregulation (11, 12). However, its usage is often limited by adverse effects such as nausea and vomiting, which can further compromise the perioperative experience and increase patient morbidity (13, 14).

Recent studies have explored the comparative efficacy of dexmedetomidine and tramadol in the management of post-spinal anesthesia shivering, particularly in obstetric patients undergoing cesarean sections. Evidence suggests that dexmedetomidine provides a more rapid cessation of shivering with fewer adverse effects compared to tramadol (15, 16).

Additionally, dexmedetomidine's sedative properties, which are often seen as beneficial in enhancing patient comfort without excessive sedation, contribute to its preference in

clinical settings where patient cooperation is essential (17). Given the limited data directly comparing these agents in a targeted obstetric population, this study aims to evaluate and compare the efficacy profiles of intravenous dexmedetomidine and tramadol in managing post-spinal anesthesia shivering in patients undergoing cesarean sections, with a focus on shivering control, time to cessation, recurrence rates, and associated adverse effects. By delineating these parameters, the study seeks to provide clinicians with evidence-based guidance for selecting the optimal anti-shivering agent, thereby enhancing the overall safety and comfort of the obstetric population during the perioperative period.

MATERIAL AND METHODS

This quasi-experimental study was conducted at PNS Shifa Hospital over a six-month period, from 20 February to 20 August 2024, after obtaining approval from the institutional ethical review board, ensuring compliance with the ethical principles outlined in the Declaration of Helsinki. The study aimed to compare the efficacy of intravenous tramadol and intravenous dexmedetomidine in controlling post-spinal anesthesia shivering in obstetric patients undergoing elective cesarean sections. A total of 120 female patients aged 18 to 35 years, belonging to the American Society of Anesthesiologists (ASA) Grade I and II categories, were enrolled using non-probability consecutive sampling. Inclusion criteria were based on patients presenting with post-spinal anesthesia shivering after providing informed written consent. Exclusion criteria included patients with coagulation disorders, bradycardia (heart rate <60 beats per minute), pre-existing heart disease, or known allergies to the study drugs.

Participants were randomly allocated into two groups, Group D (dexmedetomidine) and Group T (tramadol), each containing 60 patients. Randomization was performed using computer-generated numbers, and double blinding was ensured through anonymous labeling of identical 50 mL syringes, handled by personnel who were not directly involved in the study. Standard monitoring protocols were followed, including non-invasive blood pressure, pulse rate, oxygen saturation, and axillary temperature, with readings taken at baseline and every 10 minutes after the onset of shivering. The subarachnoid block was administered at the L2-L3 or L4-L5 intervertebral spaces using 0.5% bupivacaine, without the use of fluid warming, while maintaining a constant operating room temperature of 24°C. Upon the onset of shivering of grade III or IV severity, defined according to a standardized grading scale, patients in Group D received intravenous dexmedetomidine at a dose of 0.5 mcg/kg diluted to a concentration of 1 mcg/mL, administered over 10 minutes. Patients in Group T received intravenous tramadol at a dose of 0.5 mg/kg diluted to a concentration of 1 mg/mL, also administered over 10 minutes (11-16).

The primary outcome measures included the time to cessation of shivering, recurrence rates, and any adverse effects, which were systematically recorded. Treatment failure was defined as the inability to terminate shivering within 15 minutes of drug administration. Adverse effects such as nausea, vomiting, pruritus, bradycardia (defined as heart rate <60 beats per minute), and hypotension (defined as a decrease in mean arterial blood pressure by more than 20% from baseline) were documented (17).

In cases of bradycardia or hypotension, intravenous atropine or ephedrine was administered, respectively. Sedation levels were assessed using the Modified Ramsay Sedation Scale, with scores ranging from 1 (anxious and restless) to 6 (no response) (13). Motor response was evaluated using the Bromage scale to assess the extent of motor block (14).

Data were collected through standardized forms and entered into IBM SPSS version 25 for statistical analysis. Descriptive statistics were utilized to summarize demographic and baseline characteristics, while independent samples t-tests were employed to compare continuous variables such as the time to cessation of shivering. Chi-square tests were used to analyze categorical variables including recurrence rates and adverse effects. A p-value of ≤0.05 was considered statistically significant (18).

The study aimed to provide a comprehensive analysis of the efficacy and safety profiles of tramadol and dexmedetomidine in the management of post-spinal anesthesia shivering, contributing to evidence-based clinical decision-making in obstetric anesthesia settings.

RESULTS

The results of this study included 120 female patients who underwent elective cesarean sections under spinal anesthesia, with a mean age of 23 ± 13.00 years (range 18–35 years). The study cohort's mean weight was 75.60 ± 9.24 kilograms. Among the patients, 74 (61.66%) were categorized as ASA status I, and 46 (38.34%) as ASA status II. The incidence of shivering recurrence was significantly lower in Group D (dexmedetomidine) at 5% (3 patients) compared to 16.66% (10 patients) in Group T (tramadol), with a p-value of 0.03.

The onset of shivering, cessation time, recurrence of shivering, and severity were compared between the two groups. The time to cessation of shivering was significantly shorter in Group D (172.12 ± 14.26 seconds) compared to Group T (278.06 ± 23.17 seconds), with a p-value of <0.001, indicating superior efficacy of dexmedetomidine in shivering control.

The onset of shivering and recurrence times were similar between the groups, with no significant differences noted (p-values 0.95 and 0.67, respectively). Regarding adverse effects, 28.33% of patients in Group T reported nausea and vomiting, while no such cases were observed in Group D. Two patients (3.33%) in Group D experienced bradycardia, but no instances of hypotension were reported in either group.

The maximum sedation score recorded in Group D was 2, reflecting moderate sedation, which was considered clinically manageable and beneficial for enhancing patient comfort without significant adverse effects.

Table 1 Study Parameters

Parameters	Group D (Dexmedetomidine)	Group T (Tramadol)	P-value
Onset of Shivering (minutes)	73.30 ± 41.35	72.66 ± 41.64	0.95
Cessation of Shivering (seconds)	172.12 ± 14.26	278.06 ± 23.17	<0.001*
Recurrence of Shivering (minutes)	70.00 ± 17.32	73.75 ± 21.17	0.67
Severity of Shivering	3.92 ± 0.21	3.96 ± 0.19	0.41

Table 2 Comparison of Surgical and Anesthetic Parameters

Parameters	Group D (Dexmedetomidine)	Group T (Tramadol)
Duration of Surgery (minutes)	78.62 ± 30.18	86.40 ± 34.02
Duration of Anesthesia (minutes)	122.90 ± 29.26	133.30 ± 32.36

The surgical and anaesthetic durations were also evaluated, revealing no significant differences between the groups. The duration of surgery and anesthesia were slightly longer in Group T compared to Group D, but these differences did not reach statistical significance. Overall, dexmedetomidine demonstrated a favourable profile for controlling post-spinal anesthesia shivering with fewer adverse effects compared to tramadol, highlighting its potential as a preferred agent in obstetric patients undergoing caesarean sections.

DISCUSSION

The findings of this study demonstrated that intravenous dexmedetomidine was more effective than tramadol in controlling post-spinal anesthesia shivering in patients undergoing elective cesarean sections. The time to cessation of shivering was significantly shorter with dexmedetomidine compared to tramadol, and the incidence of shivering recurrence was also lower in the dexmedetomidine group. These results align with previous studies that have reported the superior efficacy of dexmedetomidine over tramadol for shivering management in the perioperative setting. For instance, Singla et al. found that dexmedetomidine effectively terminated shivering without the need for additional rescue medication, while tramadol required supplemental intervention in some cases (15). Similarly, Singh et al. observed that dexmedetomidine had a higher success rate in controlling shivering during transurethral resection of the prostate compared to tramadol, with lower recurrence rates (16). These studies, along with the present findings, reinforce the potential of dexmedetomidine as a more reliable agent for managing post-spinal anesthesia shivering.

The mechanism by which dexmedetomidine exerts its anti-shivering effects involves its action as a centrally acting alpha-2 adrenergic agonist, which not only inhibits norepinephrine release but also provides sedative effects that contribute to overall patient comfort. This dual action is particularly beneficial in obstetric patients who require stable hemodynamics and minimal adverse effects during the perioperative period (9, 10).

In contrast, tramadol, although effective in reducing shivering through its opioid agonist and serotonin-norepinephrine reuptake inhibition properties, is frequently associated with side effects such as nausea and vomiting, which were evident in this study and have been consistently reported in the literature (11, 12). The adverse effects associated with tramadol can negatively impact patient satisfaction and may complicate the perioperative course, particularly in obstetric settings where patient comfort is a priority.

One of the strengths of this study was the rigorous randomization and double-blinding process, which minimized bias and enhanced the reliability of the findings. The use of standardized dosing regimens and the inclusion of clear outcome measures allowed for a direct comparison of the efficacy and safety profiles of the two agents. However, the study was not without limitations. The assessment of core body temperature using non-invasive methods may have introduced some variability, and the inability to measure core temperature via more invasive but accurate methods such as esophageal or bladder probes could have influenced the evaluation of shivering severity and recurrence (18). Additionally, the study population was limited to obstetric patients undergoing elective cesarean sections, which may affect the generalizability of the results to other surgical populations or different anesthesia modalities.

Despite these limitations, the study provides valuable insights into the comparative efficacy of dexmedetomidine and tramadol in managing post-spinal anesthesia shivering. The findings suggest that dexmedetomidine offers a more favorable profile, with rapid shivering control and minimal adverse effects, making it a suitable choice for obstetric patients.

Future research could explore the use of dexmedetomidine in a broader range of surgical contexts and investigate optimal dosing strategies to further enhance its efficacy and safety. Moreover, studies assessing the cost-effectiveness of dexmedetomidine compared to other anti-shivering agents could provide additional support for its widespread adoption in clinical practice. Overall, the current study underscores the importance of selecting appropriate anti-shivering interventions to improve patient outcomes and satisfaction in the perioperative period.

CONCLUSION

In conclusion, dexmedetomidine demonstrated superior efficacy in controlling post-spinal anesthesia shivering compared to tramadol, with faster cessation times and fewer adverse effects, making it a preferable choice for obstetric patients undergoing caesarean sections.

The findings suggest that dexmedetomidine's sedative properties and favorable safety profile can enhance patient

comfort and satisfaction during the perioperative period, reducing complications associated with shivering such as increased oxygen consumption and hemodynamic instability. These results have significant implications for human healthcare, emphasizing the need for targeted shivering management strategies that optimize patient outcomes and improve the overall quality of perioperative care, particularly in sensitive populations such as obstetric patients.

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