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Original Research Article

ASSOCIATION OF PROPHYLACTIC INTRAVENOUS ONDANSETRON WITH THE INCIDENCE AND SEVERITY OF SHIVERING FOLLOWING SPINAL ANESTHESIA FOR EMERGENCY CESAREAN DELIVERY: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Shivering is a common complication following neuraxialanesthesia, particularly spinal anesthesia, with a reported incidence ranging from 40% to 70% in parturients undergoing cesarean delivery. Although often considered a minor adverse effect, shivering can lead to increased oxygen consumption, carbon dioxide production, metabolic demand, maternal discomfort, interference with monitoring, and difficulty in surgical performance. Pregnant women are particularly susceptible to perioperative hypothermia and shivering because of physiological alterations in thermoregulation, peripheral vasodilation induced by spinal anesthesia, administration of intravenous fluids, and exposure to the operating room environment. Various pharmacological interventions have been investigated to reduce the incidence and severity of post-spinal shivering. Ondansetron, a selective 5-hydroxytryptamine-3 (5-HT3) receptor antagonist commonly used for prevention of postoperative nausea and vomiting, has recently been shown to possess anti-shivering properties by modulating thermoregulatory pathways within the hypothalamus and spinal cord. However, data regarding its effectiveness in emergency cesarean deliveries remain limited, particularly in resource-constrained settings. The aim is to evaluate the association of prophylactic intravenous ondansetron administration with the incidence and severity of shivering following spinal anesthesia in parturients undergoing emergency cesarean delivery. The objective is to determine the incidence of shivering following spinal anesthesia among parturients receiving prophylactic intravenous ondansetron and those not receiving ondansetron, to assess the requirement of rescue anti-shivering medication and to evaluate associated perioperative adverse events including hypotension, bradycardia, nausea, vomiting, and maternal discomfort.

Materials and Methods: This prospective observational cohort study was conducted in the Department of Anaesthesiology, Government Medical College Srinagar, from March 2020 to August 2020 over a period of six months. A total of 200 ASA physical status II and III term parturients (gestational age ≥37 weeks) undergoing emergency cesarean delivery under spinal anesthesia were enrolled. Patients were categorized according to routine anesthetic management into two observational groups. Group O comprised 100 patients who received prophylactic intravenous ondansetron 8 mg before administration of spinal anesthesia, while Group C comprised 100 patients who did not receive ondansetron prophylaxis. The decision to administer ondansetron was made by the attending anesthesiologist as part of routine

clinical practice and was independent of study participation. Standard spinal anesthesia was administered using hyperbaric bupivacaine. Patients were monitored intraoperatively and during the immediate postoperative period for the occurrence of shivering. Shivering severity was assessed using the Crossley and Mahajan grading scale. Hemodynamic variables, incidence of nausea and vomiting, requirement for rescue anti-shivering treatment, maternal satisfaction, and perioperative adverse events were recorded. Statistical analysis was performed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results: The demographic characteristics and baseline clinical variables were comparable between the two groups. The overall incidence of shivering was significantly lower in the ondansetron group compared with the control group (22% vs 48%, $p<0.001$). Most episodes of shivering in the ondansetron group were mild (Grade I–II), whereas moderate-to-severe shivering (Grade III–IV) was more frequently observed in the control group. The mean shivering severity score was significantly lower among patients receiving ondansetron (0.39 ± 0.78) compared with controls (1.04 ± 1.16, $p<0.001$). Rescue anti-shivering medication was required in 4% of patients in Group O and 17% of patients in Group C ($p<0.01$). The incidence of nausea and vomiting was also significantly reduced in the ondansetron group. No significant differences were observed regarding maternal hypotension, bradycardia, or other serious adverse events between the groups. Maternal satisfaction scores were significantly higher among patients receiving ondansetron prophylaxis.

Conclusion: Prophylactic intravenous ondansetron 8 mg was associated with a significantly reduced incidence and severity of shivering following spinal anesthesia for emergency cesarean delivery. Additionally, ondansetron decreased the need for rescue anti-shivering therapy and reduced perioperative nausea and vomiting without increasing adverse maternal outcomes. These findings suggest that prophylactic ondansetron may serve as a simple, safe, and effective strategy for preventing post-spinal shivering in term parturients undergoing emergency cesarean section.

Keywords: Ondansetron, Spinal anesthesia, Shivering, Emergency cesarean section, Parturients, Obstetric anesthesia, 5-HT3 receptor antagonist, Post-spinal complications.

INTRODUCTION

Cesarean section is among the most frequently performed surgical procedures worldwide and constitutes a major component of obstetric practice. Over the last few decades, spinal anesthesia has emerged as the preferred anesthetic technique for cesarean delivery because of its rapid onset of action, dense sensory and motor blockade, reduced maternal morbidity associated with airway manipulation, minimal fetal drug exposure, and high maternal satisfaction. In emergency cesarean deliveries, spinal anesthesia provides reliable surgical anesthesia within a short period while allowing the mother to remain awake during childbirth.[1]

Despite its widespread acceptance and numerous advantages, spinal anesthesia is associated with several adverse effects, including hypotension, bradycardia, nausea, vomiting, and shivering. Among these complications, perioperative shivering remains one of the most common and distressing events encountered during and after spinal anesthesia. Previous studies have reported an incidence ranging from 40% to 60% in patients receiving neuraxialanesthesia, with some obstetric series reporting even higher rates.[2] Although shivering is often considered a minor complication, it may significantly affect maternal comfort and can have important physiological consequences.

Shivering is defined as involuntary, repetitive skeletal muscle activity that occurs in response to hypothermia or alterations in thermoregulatory control mechanisms. It represents a physiological attempt by the body to increase heat production and restore normal core temperature. During spinal anesthesia, several mechanisms contribute to the development of shivering. Sympathetic blockade causes peripheral vasodilatation and redistribution of core body heat to peripheral tissues, resulting in a reduction in core temperature. In addition, impairment of thermoregulatory vasoconstriction below the level of the spinal block further compromises the body's ability to conserve heat.[2]

The physiological consequences of shivering may be substantial. Shivering can increase oxygen consumption and carbon dioxide production by as much as two- to six-fold, leading to increased metabolic demand and cardiovascular workload. It may also increase intracranial and intraocular pressures, elevate catecholamine concentrations, and exacerbate myocardial oxygen consumption. Furthermore, shivering may interfere with

electrocardiographic monitoring, pulse oximetry, blood pressure measurement, and effective communication between the patient and anesthesiologist.[3] These effects are particularly relevant in obstetric patients, where maternal comfort and physiological stability are of paramount importance.

Pregnancy itself predisposes women to alterations in thermoregulation. Increased peripheral blood flow, hormonal changes, and physiological vasodilation influence heat distribution throughout the body. During cesarean delivery, additional factors such as administration of intravenous fluids, exposure of body surfaces in a cool operating room environment, and blood loss may further contribute to heat loss. Consequently, parturients undergoing cesarean section under spinal anesthesia are especially vulnerable to perioperative hypothermia and shivering.[4]

Emergency cesarean deliveries present unique challenges. Unlike elective procedures, there is often limited opportunity for implementation of warming measures before anesthesia. Urgency of surgery, maternal anxiety, rapid fluid administration, and the need for expedited anesthetic management may increase susceptibility to thermoregulatory disturbances. Therefore, effective preventive strategies against shivering are particularly important in emergency obstetric anesthesia.[5]

Various non-pharmacological and pharmacological methods have been investigated for prevention and treatment of shivering. Non-pharmacological techniques include forced-air warming systems, warming blankets, warming of intravenous fluids, and maintenance of operating room temperature. Although these methods can be effective, they may not always be feasible in emergency settings and may require additional equipment and resources.[3]

Several pharmacological agents have been studied for prevention of post-spinal shivering, including pethidine, tramadol, clonidine, ketamine, dexmedetomidine, magnesium sulfate, and nefopam. While many of these drugs demonstrate anti-shivering properties, their use may be limited by adverse effects such as sedation, respiratory depression, hypotension, bradycardia, nausea, vomiting, and delayed recovery. Therefore, identification of a safe and effective alternative remains an important clinical objective.[6]

Ondansetron is a selective serotonin 5-hydroxytryptamine type-3 (5-HT3) receptor antagonist that is routinely used for the prevention and treatment of postoperative nausea and vomiting. Increasing evidence suggests that ondansetron may also possess anti-shivering properties. Serotonin plays a significant role in central thermoregulation, particularly within the hypothalamus. By antagonizing 5-HT3 receptors, ondansetron may influence thermoregulatory pathways and reduce the shivering response associated with spinal anesthesia.[7]

Interest in the use of ondansetron for prevention of perioperative shivering has grown considerably during the past decade. Multiple clinical studies have demonstrated a reduction in the incidence and severity of shivering following prophylactic administration of intravenous ondansetron. Furthermore, because ondansetron is already widely used in obstetric anesthesia for prevention of nausea and vomiting, its potential anti-shivering effect may provide an additional clinical benefit without substantially increasing medication burden.[8]

Evidence supporting the role of ondansetron has been strengthened by systematic reviews and meta-analyses. A meta-analysis by Tie and colleagues demonstrated that ondansetron significantly reduced the incidence of post-anesthetic shivering compared with placebo while maintaining a favorable safety profile.[9] An updated meta-analysis further confirmed that prophylactic ondansetron effectively decreases the occurrence of postoperative shivering without increasing major adverse effects.[10] These findings suggest that ondansetron may represent a simple, inexpensive, and readily available intervention for prevention of shivering in patients undergoing neuraxialanesthesia.

However, despite increasing international evidence, prospective observational data from tertiary care centers in North India remain limited. Variations in patient characteristics, anesthetic techniques, operating room conditions, and perioperative practices may influence both the incidence of shivering and the effectiveness of prophylactic interventions. Therefore, evaluation of ondansetron in local clinical settings is warranted.

The present prospective observational study was undertaken in the Department of Anaesthesiology, Government Medical College Srinagar, to evaluate the association of prophylactic intravenous ondansetron with the incidence and severity of shivering following spinal anesthesia in parturients undergoing emergency cesarean delivery. The study also aimed to assess the requirement for rescue anti-shivering treatment and the occurrence of perioperative adverse effects associated with this intervention.

Aims and Objectives

Aim

To evaluate the association of prophylactic intravenous ondansetron with the incidence and severity of shivering following spinal anesthesia in parturients undergoing emergency cesarean delivery.

Primary Objective

1. To compare the incidence of shivering following spinal anesthesia between parturients receiving prophylactic intravenous ondansetron and those not receiving ondansetron.

Secondary Objectives

1. To compare the severity of shivering between the two study groups.
2. To evaluate the requirement for rescue anti-shivering medication in both groups.

3. To assess the incidence of perioperative nausea and vomiting.
4. To evaluate maternal satisfaction regarding perioperative comfort and shivering control.

MATERIALS AND METHODS

Study Design: This study was designed as a prospective observational cohort study.

Study Setting: The study was conducted in the Department of Anaesthesiology, Government Medical College Srinagar, a tertiary care teaching hospital catering to a large population of obstetric patients from various regions of Jammu and Kashmir.

Study Duration: The study was conducted over a period of six months from March 2020 to August 2020.

Study Population: The study population consisted of term pregnant women undergoing emergency lower segment 1663aesarean section under spinal anesthesia.

Sample Size: Sample size was determined by convenience sampling. All eligible parturients fulfilling the inclusion criteria and presenting during the study period from March 2020 to August 2020 were considered for enrollment. A total of 200 patients were included in the final analysis. Of these, 100 patients had received prophylactic intravenous ondansetron as part of routine anesthetic management, while 100 patients had not received ondansetron before spinal anesthesia.

Sampling Technique: Consecutive eligible patients fulfilling the inclusion criteria during the study period were enrolled after obtaining written informed consent.

Exposure Assessment and Group Allocation: This study was purely observational in nature and no intervention was assigned by the investigators. The decision to administer prophylactic intravenous ondansetron before spinal anesthesia was made solely by the attending anesthesiologist as part of routine clinical practice. Some anesthesiologists routinely administered ondansetron prophylaxis before spinal anesthesia, whereas others did not.

Eligible patients were enrolled consecutively and observed prospectively throughout the perioperative period. Based on the anesthetic management received during routine clinical care, patients were categorized into two observational groups:

Group O (Ondansetron Group): Parturients who received prophylactic intravenous ondansetron 8 mg before administration of spinal anesthesia.

Group C (Control Group): Parturients who did not receive prophylactic intravenous ondansetron before administration of spinal anesthesia.

The investigators did not influence treatment decisions, perform randomization, or allocate patients to any intervention. They only observed the exposure status, recorded perioperative variables, and compared outcomes between the two groups.

Inclusion Criteria

1. Pregnant women undergoing emergency lower segment cesarean section under spinal anesthesia.
2. Gestational age ≥37 weeks.
3. ASA physical status II and III.
4. Age between 18 and 40 years.
5. Patients willing to provide written informed consent.

Exclusion Criteria

1. Refusal to participate in the study.
2. Known hypersensitivity to ondansetron.
3. Preoperative hypothermia (axillary temperature <36°C).
4. Preoperative fever (axillary temperature ≥38°C).
5. Significant cardiovascular disease.
6. Severe hepatic dysfunction.
7. Uncontrolled thyroid disorders affecting thermoregulation.
8. Patients receiving medications known to alter body temperature regulation.
9. Patients requiring conversion to general anesthesia after enrollment were excluded from the final analysis.
10. Incomplete perioperative data.

Ethical Considerations

Approval for the study was obtained from the Institutional Ethics Committee of Government Medical College Srinagar before commencement of the study. Written informed consent was obtained from all participants. Confidentiality and anonymity of patient information were maintained throughout the study.

Pre-Anaesthetic Evaluation

All patients underwent a detailed pre-anaesthetic assessment including:

1. Detailed medical, surgical, and obstetric history.
2. General physical examination.
3. Airway assessment.
4. Baseline vital parameter assessment.
5. Review of laboratory investigations including hemoglobin concentration, platelet count, blood grouping, and other relevant investigations as indicated.

Study Protocol

Upon arrival in the operating room, standard monitoring was instituted for all patients, including:

1. Electrocardiography (ECG).
2. Non-invasive blood pressure monitoring.
3. Pulse oximetry.
4. Heart rate monitoring.
5. Temperature monitoring (axillary temperature).

Baseline values of systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate, oxygen saturation, and axillary temperature were recorded before administration of spinal anesthesia.

Anaesthetic Technique: All patients received spinal anesthesia under standard aseptic precautions. With the patient in the sitting position, lumbar puncture was performed at the L3-L4 or L4-L5

intervertebral space using a 25-gauge Quincke spinal needle.

Following confirmation of free flow of cerebrospinal fluid, 0.5% hyperbaric bupivacaine was administered intrathecally according to the attending anesthesiologist's routine clinical practice.

Immediately after spinal injection, patients were positioned supine with a wedge under the right hip to achieve left uterine displacement and minimize aortocaval compression.

Sensory block level was assessed using loss of pinprick sensation. Surgery was commenced after achieving a sensory block level of T4–T6.

Perioperative Management: All patients received supplemental oxygen at a rate of 4–5 L/min through a face mask.

Operating room temperature was maintained as uniformly as possible throughout the study period.

Intravenous fluids were administered according to routine departmental practice.

Hemodynamic parameters were recorded every 2 minutes during the first 10 minutes after spinal anesthesia and every 5 minutes thereafter until completion of surgery.

Management of Hypotension and Bradycardia: Hypotension was defined as a reduction in systolic blood pressure greater than 20% from baseline or systolic blood pressure less than 90 mmHg.

Hypotension was managed with intravenous crystalloid administration and incremental doses of intravenous mephentermine 6 mg as required.

Bradycardia was defined as heart rate less than 50 beats per minute and was treated with intravenous atropine 0.6 mg.

Assessment of Shivering: Patients were continuously observed for the occurrence of shivering from initiation of spinal anesthesiauntil completion of surgery and for 30 minutes in the postoperative recovery room.

Severity of shivering was graded according to the Crossley and Mahajan scale:

Grade 0: No shivering.

Grade 1: Piloerection or peripheral vasoconstriction without visible muscular activity.

Grade 2: Visible muscular activity confined to one muscle group.

Grade 3: Visible muscular activity involving more than one muscle group.

Grade 4: Gross muscular activity involving the whole body.

For analysis, the highest shivering grade observed during the perioperative period was recorded.

Rescue Anti-Shivering Therapy

Patients developing Grade 3 or Grade 4 shivering received intravenous tramadol 50 mg as rescue anti-shivering treatment.

Assessment of Nausea and Vomiting

The occurrence of intraoperative and postoperative nausea and vomiting during the first 30 minutes in the recovery room was recorded. Episodes requiring treatment were documented.

Maternal Satisfaction Assessment: Maternal satisfaction regarding perioperative comfort was assessed 24 hours after surgery using a 5-point Likert satisfaction scale. Assessment was performed by an anaesthesiology resident who was not directly involved in intraoperative patient management. The scale ranged from 1 (very dissatisfied) to 5 (very satisfied).

Outcome Measures

Primary Outcome

Incidence of perioperative shivering following spinal anesthesia.

Secondary Outcomes

1. Severity of shivering.
2. Requirement for rescue anti-shivering medication.
3. Incidence of nausea and vomiting.
4. Incidence of hypotension.
5. Incidence of bradycardia.
6. Maternal satisfaction score.
7. Occurrence of any adverse events.

Data Collection

Data were collected using a predesigned structured study proforma.

All perioperative observations were documented by anaesthesiology residents under the supervision of consultant anaesthesiologists.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as frequencies and percentages. Continuous variables were compared using Student's independent t-test. Categorical variables were compared using Chi-square test or Fisher's exact test wherever appropriate. A p-value less than 0.05 was considered statistically significant.

Level of Significance

$P < 0.05$ was considered statistically significant.

$P < 0.001$ was considered highly statistically significant.

RESULTS

A total of 200 parturients undergoing emergency cesarean delivery under spinal anesthesia were included in the study. Among them, 100 patients received prophylactic intravenous ondansetron 8 mg before spinal anesthesia (Group O), while 100 patients did not receive ondansetron prophylaxis (Group C). All enrolled patients completed the study and were included in the final analysis.

The baseline demographic and clinical characteristics of the two groups were comparable. No statistically significant differences were observed with regard to age, weight, height, body mass index, gestational age, ASA physical status, or duration of surgery.

Table 1: Demographic and baseline characteristics of study participants

Variable	Group O (n=100)	Group C (n=100)	P value
Age (years)	28.9 ± 4.8	29.4 ± 5.1	0.468
Weight (kg)	69.8 ± 7.4	70.6 ± 8.1	0.453
Height (cm)	159.4 ± 5.2	158.9 ± 5.5	0.511
BMI (kg/m²)	27.4 ± 2.8	27.9 ± 3.1	0.238
Gestational Age (weeks)	38.8 ± 1.1	38.9 ± 1.2	0.562
Duration of Surgery (min)	58.6 ± 9.7	60.1 ± 10.3	0.287
ASA II, n (%)	84 (84%)	82 (82%)	0.703
ASA III, n (%)	16 (16%)	18 (18%)	0.703

The incidence of shivering following spinal anesthesia was significantly lower among patients who received prophylactic intravenous ondansetron compared with those who did not receive ondansetron. Shivering was observed in 22 (22%) patients in Group O, whereas 48 (48%) patients in Group C experienced shivering during the perioperative period. Conversely, absence of shivering was noted in 78 (78%) patients in the ondansetron group compared with 52 (52%) patients in the control group. The difference in shivering incidence between the two groups was statistically highly significant ($p<0.001$), suggesting a beneficial association between prophylactic ondansetron administration and prevention of post-spinal shivering.

Table 2: Incidence of shivering following spinal anesthesia

Shivering Status	Group O (n=100)	Group C (n=100)	P value
Shivering Present	22 (22%)	48 (48%)	
Shivering Absent	78 (78%)	52 (52%)	
			<0.001

The severity of shivering was assessed using the Crossley and Mahajan grading scale. Patients receiving ondansetron experienced predominantly mild shivering (Grade I and II), whereas moderate-to-severe shivering (Grade III and IV) occurred more frequently in the control group.

Table 3: Comparison of shivering severity between groups

Shivering Grade	Group O (n=100)	Group C (n=100)
Grade 0	78 (78%)	52 (52%)
Grade 1	10 (10%)	15 (15%)
Grade 2	8 (8%)	16 (16%)
Grade 3	3 (3%)	11 (11%)
Grade 4	1 (1%)	6 (6%)
Mean Shivering Score	0.39 ± 0.78	1.04 ± 1.16
P value	<0.001	

Patients who developed moderate-to-severe shivering required rescue anti-shivering treatment with intravenous tramadol. The need for rescue medication was significantly lower among patients receiving ondansetron prophylaxis. The incidence of nausea and vomiting was significantly lower in the ondansetron group. However, no statistically significant differences were observed between the groups regarding the incidence of hypotension or bradycardia.

Table 4: Requirement of rescue anti-shivering treatment and perioperative adverse events

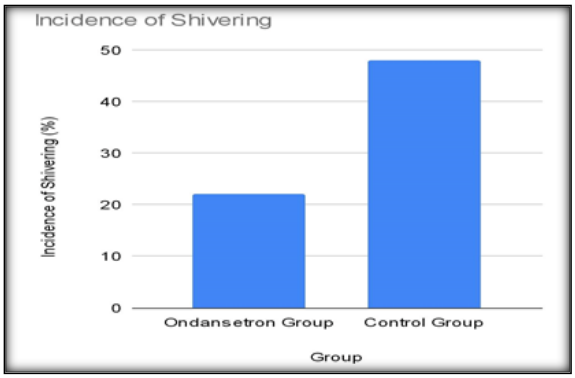
Variable	Group O (n=100)	Group C (n=100)	P value
Rescue Tramadol Required	4 (4%)	17(17%)	0.001
Nausea	9 (9%)	24 (24%)	0.004
Vomiting	5 (5%)	18 (18%)	0.003
Hypotension	29 (29%)	35 (35%)	0.362
Bradycardia	6 (6%)	8 (8%)	0.579

Maternal satisfaction scores were higher among patients who received prophylactic ondansetron. Reduced shivering and lower incidence of nausea and vomiting contributed to improved perioperative comfort in these patients.

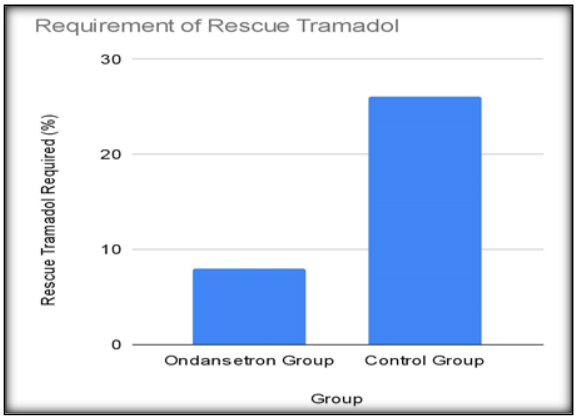
Table 5: Maternal satisfaction scores

Satisfaction Category	Group O (n=100)	Group C (n=100)
Very Satisfied (5)	48 (48%)	22 (22%)
Satisfied (4)	36 (36%)	31 (31%)
Neutral (3)	12 (12%)	25 (25%)
Dissatisfied (2)	4 (4%)	16 (16%)
Very Dissatisfied (1)	0 (0%)	6 (6%)
Mean Satisfaction Score	4.28 ± 0.82	3.47 ± 1.11
P value	<0.001	

Summary
The present study demonstrated that prophylactic intravenous ondansetron 8 mg administered before spinal anesthesia was associated with a significantly lower incidence of perioperative shivering in parturients undergoing emergency cesarean delivery. Ondansetron also significantly reduced the severity of shivering, decreased the requirement for rescue anti-shivering medication, and lowered the incidence of perioperative nausea and vomiting. Maternal satisfaction scores were significantly higher among patients receiving ondansetron. No significant differences were observed regarding hypotension or bradycardia between the two groups.



Bar graph: Incidence of Shivering.



Bar graph: Requirement of Rescue Tramadol.

DISCUSSION

Shivering remains one of the most frequent complications encountered during and after spinal anesthesia for cesarean delivery. Although often considered a minor adverse event, it is associated with significant maternal discomfort and may increase oxygen consumption, carbon dioxide production, and metabolic demand. Prevention of perioperative shivering is therefore an important component of quality obstetric anesthesia care. The present prospective observational study was conducted to evaluate the association of prophylactic intravenous ondansetron with the incidence and severity of shivering in parturients undergoing emergency cesarean delivery under spinal anesthesia.

In the present study, the demographic characteristics of both groups were comparable. There were no statistically significant differences between the ondansetron and control groups with respect to age, weight, height, body mass index, gestational age, ASA physical status, or duration of surgery. This indicates that the two groups were well matched and that the observed differences in outcomes were unlikely to be influenced by baseline patient characteristics.

The principal finding of the present study was a significant reduction in the incidence of shivering among patients who received prophylactic intravenous ondansetron. Shivering occurred in 22% of patients in the ondansetron group compared with 48% in the control group ($p<0.001$). These findings suggest that prophylactic ondansetron administration is associated with a clinically meaningful reduction in post-spinal shivering.

The significant reduction in shivering observed in the present study is consistent with previous studies by El-Deeb,[11] and Kelsaka et al,[12] both of whom demonstrated that prophylactic ondansetron significantly decreases the incidence of shivering following spinal anesthesia. Similar findings have been reported in systematic reviews and meta-analyses by Tie et al,[9] and He et al.[10] Collectively, these studies support the hypothesis that antagonism of 5-HT3 receptors influences central thermoregulatory pathways and lowers the shivering threshold during neuraxialanesthesia, thereby reducing both the incidence and severity of perioperative shivering.

The severity of shivering was also significantly lower among patients receiving ondansetron in the present study. Most patients in the ondansetron group experienced either no shivering or only mild shivering, whereas moderate-to-severe shivering occurred predominantly in the control group. The mean shivering score was significantly lower in the ondansetron group (0.39 ± 0.78) compared with the control group (1.04 ± 1.16). The reduction in shivering severity observed in the present study is consistent with previous investigations evaluating ondansetron as an anti-shivering agent during neuraxialanesthesia. The reduction in shivering severity is clinically important because severe shivering is associated with greater metabolic stress, increased oxygen consumption, and patient discomfort.

An important finding of the present study was the significantly lower requirement for rescue tramadol therapy in the ondansetron group. Only 4% of patients receiving ondansetron required rescue treatment compared with 17% in the control group. This reduction indicates that prophylactic ondansetron not only decreases shivering occurrence but also minimizes the need for additional pharmacological interventions. The lower requirement for rescue medication corresponds with the reduced frequency of moderate-to-severe

shivering observed among patients who received prophylactic ondansetron.

The anti-shivering effect observed in our study may be explained by the role of serotonin in central thermoregulation. Serotonergic pathways within the hypothalamus and spinal cord play a crucial role in maintenance of body temperature. Ondansetron, through antagonism of 5-HT3 receptors, may modify thermoregulatory responses and attenuate the shivering reflex triggered by spinal anesthesia-induced heat redistribution.[13]

In addition to reducing shivering, ondansetron significantly decreased the incidence of nausea and vomiting in the present study. Nausea occurred in 9% of patients in the ondansetron group compared with 24% in the control group, while vomiting occurred in 5% and 18% of patients, respectively. These findings are not surprising because ondansetron is a well-established antiemetic agent and is routinely used in obstetric anesthesia practice. Sahoo and colleagues demonstrated that prophylactic ondansetron administered before spinal anesthesia reduced perioperative complications and improved maternal comfort during cesarean delivery.[14] The dual benefit of reducing both nausea-vomiting and shivering makes ondansetron particularly attractive in obstetric anesthesia.

In the present study, no statistically significant differences were observed regarding hypotension and bradycardia between the two groups. Hypotension occurred in 29% of patients in the ondansetron group and 35% in the control group, whereas bradycardia occurred in 6% and 8% of patients, respectively. Although a trend toward lower incidence was observed in the ondansetron group, the difference did not reach statistical significance.

Several investigators have suggested that ondansetron may attenuate spinal anesthesia-induced hypotension by blocking the Bezold–Jarisch reflex. Studies by Sahoo et al. Demonstrated a reduction in spinal-induced hypotension following administration of ondansetron before cesarean section under spinal anesthesia.[14] However, the magnitude of this effect appears to vary across different patient populations and study designs.

Maternal satisfaction scores were significantly higher among patients receiving ondansetron in the present study. Nearly half of the patients in the ondansetron group reported being very satisfied with their perioperative experience. This finding likely reflects the combined reduction in shivering, nausea, vomiting, and overall discomfort achieved through prophylactic ondansetron administration.

The results of the present study therefore add to the growing body of evidence supporting the use of ondansetron as an anti-shivering agent. In a busy obstetric unit, ondansetron offers several practical advantages. It is inexpensive, widely available, easy to administer, familiar to anesthesiologists, and associated with a favorable adverse-effect profile. Furthermore, because it is already commonly administered for prevention of postoperative nausea and vomiting, its anti-shivering benefits can be achieved without introducing additional medications into the perioperative regimen.

The present study has certain limitations. Being an observational study, allocation of patients was not randomized and the possibility of residual confounding cannot be completely excluded. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Core body temperature monitoring was not performed. Future multicenter prospective studies involving larger patient populations may provide stronger evidence regarding the role of ondansetron in prevention of post-spinal shivering.

Despite these limitations, the study demonstrates a significant association between prophylactic intravenous ondansetron administration and reduced incidence and severity of shivering following spinal anesthesia for emergency cesarean delivery. The findings support incorporation of ondansetron into routine obstetric anesthesia practice, particularly in settings where prevention of shivering and improvement of maternal comfort are important clinical goals.

CONCLUSION

The present prospective observational study evaluated the association of prophylactic intravenous ondansetron with the incidence and severity of shivering following spinal anesthesia in parturients undergoing emergency cesarean delivery. The findings demonstrated that administration of intravenous ondansetron 8 mg before spinal anesthesia was associated with a significant reduction in both the incidence and severity of perioperative shivering.

Patients receiving prophylactic ondansetron experienced substantially fewer episodes of shivering compared with those who did not receive ondansetron. Furthermore, the occurrence of moderate-to-severe shivering was markedly reduced, resulting in a significantly lower requirement for rescue anti-shivering medication. In addition to its anti-shivering effect, ondansetron was associated with a lower incidence of perioperative nausea and vomiting, thereby contributing to improved maternal comfort and overall perioperative experience.

No significant increase in adverse maternal events such as hypotension or bradycardia was observed following ondansetron administration, indicating a favorable safety profile. Maternal satisfaction scores were significantly higher among patients who received ondansetron prophylaxis, further supporting its clinical utility in obstetric anesthesia practice.

Based on the findings of the present study, prophylactic intravenous ondansetron 8 mg appears to be a safe, effective, inexpensive, and easily

available intervention for reducing shivering associated with spinal anesthesia in emergency cesarean deliveries. Its routine use may improve maternal comfort, decrease the need for additional anti-shivering medications, and enhance the overall quality of perioperative care.

The study supports the incorporation of prophylactic ondansetron into standard anesthetic protocols for emergency cesarean section performed under spinal anesthesia. However, larger multicenter randomized controlled trials are recommended to further validate these findings and establish definitive clinical guidelines regarding its use for prevention of post-spinal shivering in obstetric patients.

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