

Research Article

A study of prevention of post-anaesthesia shivering (PAS) in patients undergoing LSCS under spinal anaesthesia in a tertiary hospital

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Abstract

Background: Postanesthesia shivering (PAS) is a common complication following spinal anesthesia, particularly in obstetric patients. 5-HT₃ receptor antagonists such as ondansetron and palonosetron have been studied for its prevention, but comparative data are limited. **Aim:** To compare the efficacy of palonosetron and ondansetron in preventing post-spinal shivering in patients undergoing elective lower segment cesarean section (LSCS). **Materials and Methods:** This prospective randomized study included 80 parturients (ASA I–II) aged 18–35 years undergoing elective LSCS under spinal anesthesia. Patients were randomly allocated into two groups: Group O (ondansetron 8 mg IV) and Group P (palonosetron 0.075 mg IV), administered 30 minutes prior to spinal anesthesia. Shivering was graded using the Wrench scale, and only Grade 3 and 4 shivering were considered significant. Data were analyzed using SPSS version 29.0. A p-value <0.05 was considered statistically significant. **Results:** Baseline characteristics were comparable between the groups ($p > 0.05$). The incidence of shivering was lower in the palonosetron group (10%) compared to the ondansetron group (25%). The temporal distribution of shivering episodes was similar between the groups ($p = 0.97$). No significant differences were observed in intraoperative hemodynamic parameters or adverse effects. **Conclusion:** Palonosetron is more effective than ondansetron in preventing post-spinal shivering in patients undergoing elective LSCS under spinal anesthesia. Further large-scale studies are recommended to confirm these findings.

Keywords:

Postanesthesia shivering, Palonosetron, Ondansetron, Spinal anesthesia, Cesarean section, 5-HT₃ antagonists

Introduction

Shivering is a common and distressing complication in the perioperative period, significantly affecting patient comfort and recovery. It is associated with a marked increase in metabolic rate, oxygen consumption, and carbon dioxide production. In severe cases, shivering may lead to lactic acidosis, hypoxemia, and adverse perioperative outcomes. The incidence of shivering following spinal and general anesthesia has been reported to range between 40% and 60% in various studies.[1,2]

Shivering is defined as an involuntary, repetitive activity of skeletal muscles and is commonly triggered by hypothermia. However, it may also occur in normothermic patients, suggesting the involvement of additional mechanisms. Proposed mechanisms include uninhibited spinal reflexes, postoperative pain, and increased sympathetic activity. The pattern and frequency of shivering may vary depending on the type of anesthesia administered.[1]

Thermoregulation is a complex physiological process influenced by endogenous peptides, biogenic monoamines, cholinomimetic pathways, and N-methyl-D-aspartate (NMDA) receptor-mediated mechanisms.[1–3] Several factors such as age, type and duration of surgery, baseline core temperature, and associated comorbidities independently affect the incidence and severity of shivering.[4]

A wide range of pharmacological agents, including opioids and non-opioid drugs, have been used for the prevention and management of perioperative shivering. However, their use is often limited by adverse effects such as hypotension, hypertension, sedation, respiratory depression, and postoperative nausea and vomiting.

In recent years, 5-hydroxytryptamine-3 (5-HT₃) receptor antagonists have gained attention as potential agents for preventing perioperative shivering due to their favorable safety profile and established antiemetic properties. Ondansetron, a first-generation 5-HT₃ antagonist, has been widely studied, whereas palonosetron, a newer second-generation agent with longer half-life and higher receptor affinity, may offer additional advantages. However, comparative evidence between these two agents, particularly in patients undergoing spinal anesthesia, remains limited.[5,6]

Therefore, the present study was designed as a prospective, randomized, double-blind trial to compare the efficacy of palonosetron and ondansetron in preventing postanesthesia shivering in patients undergoing elective lower segment cesarean section under spinal anesthesia.

MATERIALS AND METHODS

This prospective, randomized study was conducted in the Department of Obstetrics and Gynaecology at SGT Medical College Hospital & Research Institute, Budhera, Gurugram, Haryana, India, from March 2022 to December 2022. The study was

carried out in accordance with the principles of the Declaration of Helsinki, and prior approval was obtained from the Institutional Ethics Committee.

A total of 80 patients were enrolled and randomly allocated into two groups using computer-generated randomization: Group “O” (Ondansetron group) and Group “P” (Palonosetron group), with 40 patients in each group.

Inclusion Criteria

- Pregnant women aged 18–35 years
- Singleton pregnancy
- American Society of Anesthesiologists (ASA) physical status I and II
- Scheduled for elective lower segment cesarean section (LSCS) under spinal anesthesia

Exclusion Criteria

- Known hypersensitivity to 5-HT₃ receptor antagonists
- Presence of psychological disorders
- Baseline body temperature >38°C or <36°C
- Requirement of intraoperative sedation or additional anesthetic agents
- Requirement of blood transfusion during the observation period

All patients underwent preanesthetic evaluation as per institutional protocol. Standard preoperative fasting guidelines were followed, with patients kept nil per oral for solids for 8 hours.

Premedication included intravenous ranitidine 50 mg and metoclopramide 10 mg administered prior to shifting the patient to the operating room.

Study Intervention

In the operating room, patients received the study drug 30 minutes prior to administration of spinal anesthesia:

- Group “O”: Ondansetron 8 mg intravenously
- Group “P”: Palonosetron 0.075 mg intravenously

Both drugs were diluted to a total volume of 4 mL in identical 5 mL syringes. The preparation of study drugs was performed by operating room staff not involved in the study to ensure blinding.

Anesthetic Technique

Subarachnoid block was administered using 2.8 mL of 0.5% hyperbaric bupivacaine via a 25/26G Quincke needle under aseptic precautions. Adequacy of the block was confirmed before proceeding with surgery.

Intraoperative Management

Preoperatively, all patients were dressed in cotton gowns and covered with a single blanket. Intraoperatively, patients were covered with standard surgical drapes without active warming measures. The ambient operating room temperature was maintained between 22°C and 24°C.

All patients received supplemental oxygen at 3–4 L/min via face mask. Intravenous fluids at room temperature were administered, and all patients were co-loaded with 500 mL of Ringer's lactate during initiation of spinal anesthesia.

Standard monitoring was performed as per ASA guidelines, including:

- Pulse oximetry (SpO₂)
- Electrocardiography (ECG)
- Non-invasive blood pressure (NIBP)

Sublingual temperature was recorded preoperatively and subsequently at 30-minute intervals for 90 minutes.

Outcome Measures

Patients were monitored perioperatively for:

- Shivering
- Bradycardia
- Hypotension
- Nausea and vomiting

Bradycardia, hypotension, and vomiting were managed with intravenous atropine, mephentermine, and metoclopramide respectively in appropriate doses.

Shivering was graded according to the scale described by Wrench et al.[7]:

Table 1 showing grading of shivering (adapted from Wrench et al.)[8]

Grade	Features
Grade 0	No shivering
Grade 1	One or more of the following: Peripheral vasoconstriction, pilo-erection, and peripheral cyanosis without other cause, but without visible muscle activity.
Grade 2	Visible muscle activity confined to one muscle group
Grade 3	Visible muscle activity in more than one muscle group
Grade 4	Gross muscle activity involving the whole body

Severe shivering (Grade 3 or 4) was treated with intravenous pethidine 5 mg boluses titrated to effect. Only patients exhibiting Grade 3 or 4 shivering were included in the final analysis. All patients were observed for a total duration of 90 minutes postoperatively.

Sample Size Calculation and Statistical Analysis

Sample size was calculated using a medical calculator (medicalc.org) for testing a two-tailed hypothesis. Based on previous studies, the incidence of postspinal shivering was assumed to be 40% in the ondansetron group and 15% in the palonosetron group. Accordingly, a sample size of 40 patients per group was determined.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 29.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was applied for comparison of categorical variables between groups. A p-value of <0.05 was considered statistically significant.

RESULTS

The present study enrolled 40 patients in each study group (Group "O" and Group "P"). Patient characteristics are described in Table 2. Mean of the age, height, weight, duration of surgeries, and sublingual temperature was calculated in both the groups, as some of them are independent risk factors for development of postspinal shivering and others determine the extent of distribution of drug in subarachnoid space. No significant intergroup difference was observed in demographic variables (age, height, and weight), duration of surgery, and sublingual temperatures.

Table 2: Baseline characteristics of study population

Variable	Group "O" (Mean $\pm$ SD)	Group "P" (Mean $\pm$ SD)	P-value
Age (years)	28.1 $\pm$ 3.1	28.5 $\pm$ 2.6	0.48
Height (cm)	162.5 $\pm$ 7.4	162.9 $\pm$ 7.4	0.79
Weight (KG)	69.8 $\pm$ 6.3	68.5 $\pm$ 6.1	0.31
Duration (Minutes)	40.2 $\pm$ 3.4	39.9 $\pm$ 3.7	0.66
Sublingual Temperature	94.5 $\pm$ 2.7	95.1 $\pm$ 2.7	0.29

All baseline characteristics including age, height, weight, duration of procedure, and sublingual temperature were **comparable between Group O and Group P**, with **no statistically significant difference ($p > 0.05$)**. This indicates that both groups were **well matched at baseline**, ensuring validity of further comparative analysis.

Graph no.1:

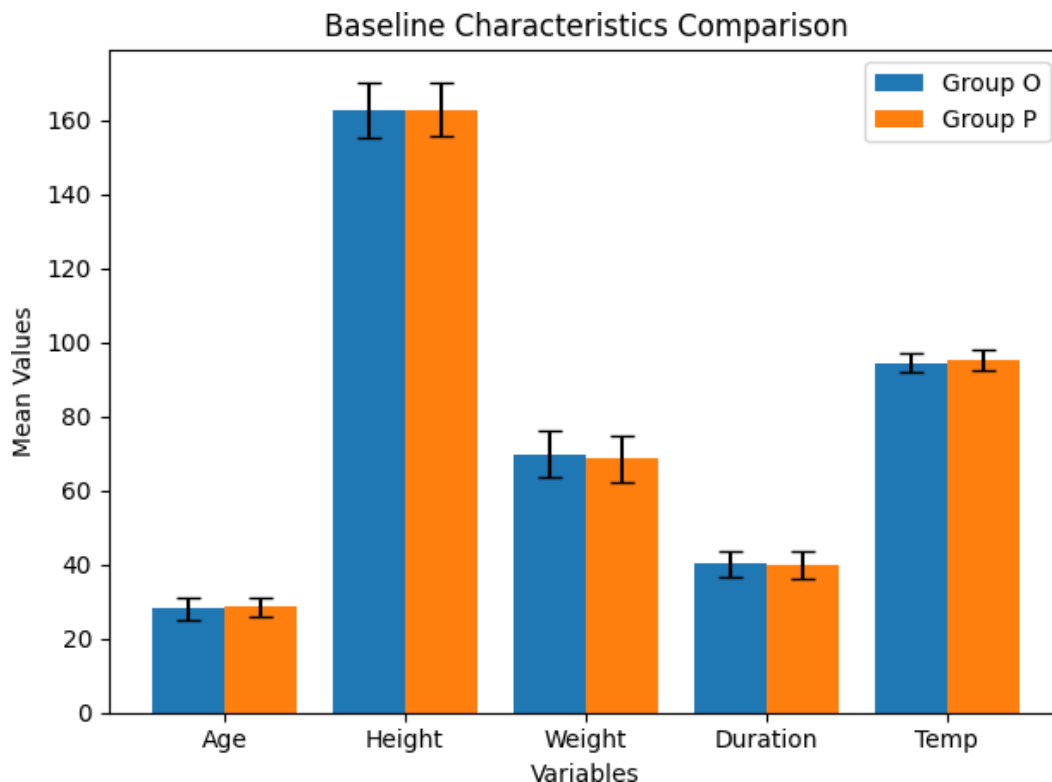


Table 3: Indications of surgery

Indication for LSCS	Group “O” (n=40)		Group “P” (n=40)		P-value
	N	%	N	%	
Post-LSCS	30	75	36	90	0.12
Failed induction	3	7.5	2	5	1.00
Breech presentation	5	12.5	0	0	0.02
Gestational hypertension	1	2.5	2	5	1.00
IHCP	1	2.5	0	0	1.00

The most common indication for LSCS in both groups was previous LSCS, observed in 75% of Group O and 90% of Group P, with no statistically significant difference ($p = 0.12$). Failed induction and gestational hypertension were comparable between the groups ($p > 0.05$). Breech presentation was noted only in Group O (12.5%) and was absent in Group P, showing a statistically significant difference ($p = 0.02$). IHCP was observed in a small proportion of Group O (2.5%) and none in Group P, which was not statistically significant.

Table 4. Shivering time

Time	Number of Observation/ shivering Episodes	
	Group “O” (n=40)	Group “P” (n=40)
5 minutes	2	2
10 minutes	6	7
15 minutes	10	11
20 minutes	17	15

25 minutes	4	4
30 minutes	1	1

The distribution of shivering episodes over time was comparable between Group O and Group P. The majority of shivering episodes in both groups occurred at 20 minutes (42.5% in Group O vs 37.5% in Group P). The pattern of shivering onset and progression was similar across all time intervals, with no statistically significant difference observed between the two groups ($p = 0.97$). This indicates that both groups had a similar temporal profile of shivering.

DISCUSSION

Perioperative shivering, also known as postanesthesia shivering (PAS), is a common complication associated with both general and spinal anesthesia. It is not only uncomfortable for patients but may also increase oxygen consumption, carbon dioxide production, and cardiovascular stress. Various pharmacological agents have been studied for its prevention, including α_2 -agonists, opioids, benzodiazepines, NMDA antagonists, and 5-HT₃ receptor antagonists.[1,3]

The pathophysiology of PAS is multifactorial. Redistribution of core body heat to peripheral compartments due to sympathetic blockade, loss of thermoregulatory vasoconstriction below the level of spinal anesthesia, and impairment of hypothalamic thermoregulation contribute significantly. Additionally, rapid infusion of cold intravenous fluids further predisposes patients to shivering.[8]

5-HT₃ receptor antagonists have gained attention due to their dual role as antiemetics and anti-shivering agents. Drugs such as ondansetron, granisetron, and palonosetron act by inhibiting serotonin-mediated thermoregulatory pathways in the hypothalamus. Among these, palonosetron is a newer agent with a longer half-life (~40 hours) and approximately 30 times higher receptor binding affinity compared to first-generation agents.[9–11]

In the present study, palonosetron demonstrated superior efficacy in preventing PAS compared to ondansetron. The incidence of shivering in the ondansetron group was slightly higher, which may be attributed to the unique physiological state of pregnancy and hemodynamic changes during LSCS.

Lakhe et al.[13] reported a 16.7% incidence of PAS with 4 mg intravenous ondansetron, whereas our study showed a slightly higher incidence, possibly due to differences in patient population. Similarly, Badawy and Mokhtar[14] reported a reduction in shivering incidence from 51% in controls to 26% with ondansetron, which aligns closely with our findings (25%).

Studies evaluating palonosetron are limited. Jo et al.[10] reported a 21% incidence of PAS in elderly patients undergoing laparoscopic surgery under general anesthesia. Another study by Jo et al.[6] observed a 27% incidence in gynecological laparoscopic procedures. These higher incidences may be due to factors such as general anesthesia, use of remifentanyl, and elderly patient population, all of which are known risk factors for PAS.

In contrast, our study demonstrated a lower incidence (10%) with palonosetron, likely due to the use of spinal anesthesia and a relatively younger patient population. This suggests that 5-HT₃ antagonists may be more effective in neuraxial anesthesia settings.

Limitations

The present study has certain limitations. Only shivering of Grade 3 and above was included, which may have led to underestimation of the true incidence of PAS. The sample size was relatively small, limiting the statistical power of the study. Additionally, the study was confined to elective LSCS under spinal anesthesia, which may restrict the generalizability of the findings to other surgical populations and anesthetic techniques.

CONCLUSION

Palonosetron appears to be more effective than ondansetron in preventing postspinal shivering in patients undergoing elective LSCS under spinal anesthesia. Its longer half-life and higher receptor affinity may contribute to its superior efficacy. However, given the limited sample size and homogeneity of the study population, further large-scale, randomized controlled trials across diverse surgical settings are recommended to validate these findings.

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