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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 and distressing complication following spinal anesthesia. Ondansetron, a classical 5-HT_3 receptor antagonist, has long been used for its prevention. Palonosetron, a newer and more potent 5-HT_3 antagonist with superior pharmacodynamic properties, is increasingly being used by clinicians. This study was conducted to compare the efficacy of ondansetron and palonosetron in preventing PAS in patients undergoing elective lower segment caesarean section (LSCS) under spinal anesthesia. **Methods:** A total of 90 patients scheduled for elective LSCS under spinal anesthesia were randomly allocated into two groups: Group O (ondansetron) and Group P (palonosetron). Patients received either ondansetron 8 mg or palonosetron 0.075 mg intravenously in the same volume, 30 minutes before surgery. Sublingual temperature was recorded at regular intervals. Patients were observed for 90 minutes following spinal anesthesia for the occurrence of PAS. Data were analyzed statistically. **Results:** No statistically significant intergroup differences were observed with respect to duration of surgery or sublingual temperature. However, the incidence of PAS was significantly lower in the palonosetron group (13.6%) compared to the ondansetron group (26.7%). **Conclusion:** Prophylactic administration of palonosetron was more effective than ondansetron in reducing the incidence of postanesthesia shivering in patients undergoing LSCS under spinal anesthesia. Further studies with larger sample sizes and more diverse patient populations are recommended to validate these findings.

Keywords: Postanesthesia shivering, spinal anesthesia, ondansetron,

palonosetron, lower segment caesarean section

Introduction

Physiological and behavioral mechanisms maintain normal body temperature within a narrow range of 36.5–37.5 °C, irrespective of variations in environmental conditions. Thermoregulation is primarily mediated through the autonomic nervous system.[1] During anesthesia, body temperature regulation is disrupted, leading to a characteristic decline in core temperature. This decline is most pronounced during the initial 30 minutes, followed by a plateau phase after 3–4 hours as reduced heat loss results in a new thermal equilibrium.[2,3]

During surgical procedures, heat loss occurs due to evaporation from exposed body surfaces and exposure to a cold operating room environment. Additionally, the administration of unwarmed intravenous fluids contributes to perioperative hypothermia. Hypothermia triggers shivering, which represents a compensatory physiological response. A reduction in core temperature is associated with several adverse effects, including shivering, impaired immune function, coagulopathy, increased risk of cardiac morbidity, and prolonged hospital stay.[4,5]

Shivering is a major source of patient discomfort during the perioperative period and significantly interferes with postoperative recovery. It results in a marked increase in metabolic rate, oxygen consumption, and carbon dioxide production at the cellular level. In severe cases, shivering may lead to lactic acidosis and hypoxemia, thereby adversely affecting perioperative and postoperative outcomes. Shivering is a common complication of both spinal and general anesthesia, with an incidence reported to range from 40% to 60% in various studies.[6,7] It is defined as involuntary, repetitive activity of skeletal muscles.[6] Although hypothermia is the most common precipitating factor, shivering has also been reported in normothermic patients. Proposed mechanisms include uninhibited spinal reflexes, postoperative pain, and increased sympathetic activity.

The frequency and pattern of shivering vary with different types of anesthesia.[6] Several neurotransmitters and neuromodulators, including endogenous peptides, biogenic monoamines, cholinomimetic agents, and possibly N-methyl-D-aspartate (NMDA) receptor antagonists, are involved in the integration and modulation of central thermoregulatory control.[6–8] Patient-related factors such as age, type and duration of surgery, baseline core temperature, and associated comorbidities independently influence the incidence and severity of perioperative shivering.[9]

Various opioid and non-opioid pharmacological agents have been used for the prevention and treatment of postoperative shivering; however, their use is often limited by adverse effects such as hypotension, hypertension, sedation, respiratory depression, nausea, and vomiting. Recently, 5-hydroxytryptamine type 3 (5-HT_3) receptor antagonists have emerged as potential agents for preventing perioperative shivering, although their efficacy remains inconclusive.[10,11] Therefore, the present double-blind prospective study was undertaken to compare the efficacy of the newer 5-HT_3 receptor antagonist, palonosetron, with that of ondansetron in preventing postanesthesia shivering in patients undergoing spinal anesthesia.

MATERIALS AND METHODS

This prospective, randomized, double-blind study was conducted in the

Department of Anaesthesiology at Venkateshwar Institute of Medical Sciences, Amroha, Uttar Pradesh, after obtaining institutional ethical committee approval and written informed consent from all participants. A total of 90 patients were enrolled using computer-generated randomization and allocated into two equal groups: Group O (ondansetron group) and Group P (palonosetron group).

Patients aged 20–40 years with singleton pregnancy, belonging to the American Society of Anaesthesiologists (ASA) physical status I and II, and scheduled for elective lower segment caesarean section (LSCS) under spinal anesthesia were included. Exclusion criteria comprised known allergy to 5-HT_3 receptor antagonists, psychological disorders, baseline body temperature >38 °C or <36 °C, requirement of sedation or supplementation with other anesthetic drugs, need for blood transfusion during the observation period, or refusal to participate.

All patients were evaluated preoperatively in the preanesthetic clinic and assessed for fitness for anesthesia and surgery as per institutional protocol. Patients were kept nil per oral for solids for 8 hours prior to surgery. Ranitidine 50 mg and metoclopramide 10 mg were administered intravenously before shifting the patient to the operating room.

According to group allocation, patients received either ondansetron 8 mg or palonosetron 0.075 mg intravenously, diluted to a total volume of 4 mL, 30 minutes prior to administration of spinal anesthesia. Drug preparation was done by an operating room staff member not involved in the study, ensuring blinding of both the anesthesiologist and the patient.

Subarachnoid block was performed in the sitting position using 2.8 mL of 0.5% hyperbaric bupivacaine via a 25G or 26G Quincke spinal needle. Adequacy of sensory block was confirmed before surgical incision.

Preoperatively, patients wore a cotton gown and were 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. Supplemental oxygen was administered at a flow rate of 3–4 L/min via face mask. All intravenous fluids were administered at room temperature. Patients were coloaded with 500 mL of Ringer's lactate solution during establishment of spinal anesthesia. No anesthetic supplementation was required intraoperatively.

Standard ASA monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2), was instituted throughout the procedure. Sublingual temperature was recorded before surgery and subsequently at 30-minute intervals for 90 minutes.

Perioperative adverse events such as hypotension, bradycardia, and vomiting were noted and managed with mephenteramine, atropine, and metoclopramide, respectively, in appropriate doses. Severe postanesthesia shivering was treated with intravenous pethidine 5 mg boluses titrated to effect. Shivering was graded according to the scale described by Wrench et al.[7] (Table 1). Patients were observed for 90 minutes postoperatively, and shivering of grade 3 or 4 was considered clinically significant for analysis.

Sample Size and Statistical Analysis

Sample size calculation was performed using an online medical calculator (medicalc.org) for testing two-tailed hypotheses. Based on previous studies,

the incidence of postspinal shivering was assumed to be 40% in the ondansetron group and 15% in the palonosetron group. A minimum of 42 patients per group was required.

Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as number and percentage. Chi-square test or Fisher's exact test was used to compare categorical variables between the two groups. A P value of <0.05 was considered statistically significant.

RESULTS

A total of 90 patients were included in the final analysis, with 45 patients in each group (Group O and Group P). The demographic characteristics of the patients and perioperative variables were comparable between the two groups.

Table 1 showing grading of shivering (adapted from Wrench et al.)[12]

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

Table 2: Baseline characteristics of study population

Variables	Group "O" (n=45)	Group "P" (n=45)	P-value
Age	**31.7±6.6**	**32.04±6.4**	
Height	**164.1±9.3**	**164.8±9.0**	
Weight	**66.5±7.9**	**65.8±7.6**	
Duration	**41.7±6.3**	**40.4±5.9**	
Sublingual Temperature	**96.3±1.4**	**96.6±1.4**	

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. Major indication in both the study groups was post-LSCS pregnancy; however, few other indications included in the study have been noted in Table 3.

Table 3: Indications of surgery

Variables	Group "O" (n=45)	Group "P" (n=45)
Post-LSCS	**32(71.1)**	**40(88.9)**
Failed induction	**5(11.1)**	**3(6.7)**
Breech presentation	**6(13.3)**	**0(0)**
Gestational hypertension	**1(2.2)**	**2(4.4)**
IHCP	**1(2.2)**	**0(0.0)**

Table 3. Although 26.7% patients (12 out of 45 patients) experienced shivering in "O" group, it was significantly lower in "P" group (13.3%; 6 out of 45 patients) and P value was 0.07, which in our study was deemed statistically significant.

Table 4. Shivering time

Time	**Number of Observation/ shivering Episodes**	
	Group "O" (n=45)	**Group "P" (n=45)**
5 minutes	3	3
10 minutes	7	8
15 minutes	11	12
20 minutes	18	16
25 minutes	4	5
30 minutes	2	1

Table no. 4 that Commonly time of observation of shivering was between 15 and 20 minutes. Time noted for shivering observed in patients is shown in Table 4.

DISCUSSION

Perioperative and postoperative shivering, collectively referred to as postanesthesia shivering (PAS), is a frequently encountered complication associated with both general and spinal anesthesia. Numerous pharmacological agents have been evaluated for the prevention of PAS, encompassing various drug classes such as α_2-agonists, opioids, benzodiazepines, cholinomimetics, N-methyl-D-aspartate (NMDA) receptor antagonists, and other agents including magnesium sulfate and lignocaine.[6,8] The etiology of PAS is multifactorial and involves both hypothermic and normothermic mechanisms. Redistribution of core body heat to peripheral compartments due to sympathetic blockade and peripheral vasodilatation, loss of thermoregulatory vasoconstriction below the level of spinal block, and impairment of central thermoregulatory control during neuraxial anesthesia are key contributing factors. Rapid administration of unwarmed intravenous fluids further exacerbates the development of shivering in such patients.[13]

5-HT_3 receptor antagonists have demonstrated a favorable role in the prevention of PAS and possess an established clinical profile with relatively fewer adverse effects such as hypotension, sedation, or dizziness. In addition to their well-known antiemetic properties, their efficacy in attenuating perioperative shivering has gained increasing attention. First-generation 5-HT_3 antagonists, including ondansetron, granisetron, dolasetron, and tropisetron, were introduced in the 1990s and were initially used for the prevention of chemotherapy-induced nausea and vomiting. Palonosetron is a newer, second-generation 5-HT_3 receptor antagonist with a distinct chemical structure, characterized by a fused tricyclic ring system attached to a quinuclidine moiety, in contrast to the three-substituted indole structure of first-generation agents. Palonosetron has a markedly longer plasma half-life of approximately 40 hours compared with 5–12 hours for older 5-HT_3 antagonists, and exhibits nearly 30-fold higher receptor binding affinity.[14–16]

Antagonism of 5-HT_3 receptors inhibits neurotransmission involved in hypothalamic thermoregulation. Owing to its unique molecular structure, prolonged half-life, and stronger receptor affinity, palonosetron is believed to interact more effectively

with 5-HT_3 receptors, possibly at additional or different binding sites compared to ondansetron and granisetron.[17] Several meta-analyses have demonstrated a significant reduction in the incidence of PAS with prophylactic administration of 5-HT_3 receptor antagonists in both general and spinal anesthesia.[18,19] However, direct comparative data between ondansetron and palonosetron for the prevention of PAS following neuraxial anesthesia remain limited.

Lakhe et al.[18] reported an incidence of PAS of approximately 16.7% following prophylactic intravenous ondansetron (4 mg) in patients undergoing surgeries under spinal anesthesia. In the present study, the incidence of PAS in the ondansetron group was slightly higher. This difference may be attributed to the fact that our study population consisted exclusively of parturients undergoing elective LSCS, who exhibit unique physiological and hemodynamic changes that may predispose them to shivering. Similarly, Badawy and Mokhtar[19] observed an incidence of PAS of 51% in the control group and 26% in patients receiving 8 mg intravenous ondansetron during elective LSCS under spinal anesthesia. The incidence of PAS observed in our ondansetron group (approximately 25%) is comparable to these findings.

The role of palonosetron in preventing PAS following neuraxial anesthesia has not been extensively explored. Jo et al.[15] reported a 21% incidence of PAS with prophylactic intravenous palonosetron (0.075 mg) in elderly patients undergoing laparoscopic cholecystectomy under general anesthesia. Another study by Jo et al.[11] reported a PAS incidence of approximately 27% in patients receiving palonosetron during gynecological laparoscopic surgeries under propofol-remifentanil total intravenous anesthesia. The higher incidence observed in these studies may be attributed to factors such as general anesthesia, use of remifentanil, laparoscopic procedures, and advanced age—each of which has been independently associated with increased risk of PAS. These confounding risk factors may have masked any potential protective effect of palonosetron.

In contrast, the present study involved young patients undergoing a uniform surgical procedure (elective LSCS) under spinal anesthesia, thereby minimizing confounding variables. This homogeneous study population may explain the comparatively lower incidence of PAS observed in the palonosetron group. Although literature on the efficacy of palonosetron in preventing PAS following spinal anesthesia is limited, the beneficial effects of 5-HT_3 receptor antagonists appear to be more pronounced in neuraxial anesthesia settings.

LIMITATIONS AND STRENGTHS OF THE STUDY

One limitation of the present study is that only clinically significant shivering (grade 3 and above) was considered, which may have led to underestimation of milder forms of PAS. Additionally, the relatively small sample size limits the generalizability of the findings. Furthermore, the study population was restricted to patients undergoing elective LSCS under spinal anesthesia; therefore, extrapolation of results to other surgical procedures or general anesthesia requires further investigation.

The strengths of this study include its randomized, double-blind design, uniform anesthetic technique, and homogeneity of the study population, which helped minimize confounding variables.

CONCLUSION

Palonosetron is more effective than ondansetron in preventing postanesthesia shivering in patients

undergoing elective lower segment caesarean section under spinal anesthesia. However, given the small sample size and homogeneous nature of the study population, further large-scale, multicentric studies involving diverse surgical procedures and anesthetic techniques are warranted to establish and generalize the role of palonosetron in the prevention of postanesthesia shivering.

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