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Research Article

Intravenous Granisetron Versus Ondansetron for Attenuation of Hypotension and Bradycardia During Spinal Anaesthesia in Caesarean Section: A Prospective Randomized Double-Blind Study

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Abstract

Background: Spinal anaesthesia for caesarean section is frequently associated with hypotension, which may adversely affect both maternal and fetal outcomes. Serotonin (5-HT_3) receptor antagonists such as ondansetron and granisetron have been suggested to attenuate spinal anaesthesia–induced hypotension and bradycardia. **Objective:** To compare the effectiveness of intravenous ondansetron and granisetron in preventing hypotension and bradycardia during spinal anaesthesia in patients undergoing caesarean section. **Methods:** This prospective, randomized, double-blind study included 96 parturients scheduled for elective caesarean section under spinal anaesthesia. Patients were randomly allocated into three groups (n = 32 each). Group A received intravenous ondansetron 4 mg diluted in normal saline, Group B received intravenous granisetron 1 mg diluted in normal saline, and Group C received 10 ml of intravenous normal saline. The study drugs were administered 5 minutes prior to subarachnoid block. Hemodynamic parameters including systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate were recorded at regular intervals. **Results:** Baseline systolic blood pressure was comparable among all three groups. At 5 minutes following spinal anaesthesia, systolic blood pressure was significantly lower in the granisetron group compared to the ondansetron group. Baseline diastolic blood pressure and mean arterial pressure were comparable across all groups. The incidence of hypotension, bradycardia, and vasopressor requirement was significantly lower in the ondansetron group compared to the granisetron and control groups. Both ondansetron and granisetron groups demonstrated a significantly lower

incidence of postoperative nausea and vomiting compared to the control group.

Conclusion: Intravenous ondansetron 4 mg administered prior to spinal anaesthesia effectively reduces the incidence of hypotension, bradycardia, and vasopressor requirement in patients undergoing lower-segment caesarean section. Granisetron did not show a significant protective effect on hemodynamic parameters. However, both ondansetron and granisetron were effective in reducing postoperative nausea and vomiting.

Keywords: Hypotension, Ondansetron, Granisetron, Hemodynamic parameters, Spinal anaesthesia

Introduction

Spinal anaesthesia is the preferred technique for elective lower segment caesarean section (LSCS) because of its rapid onset, reliable sensory and motor blockade, minimal drug exposure to the fetus, and lower risk of airway-related complications compared with general anaesthesia [1]. Despite these advantages, spinal anaesthesia is frequently associated with hypotension, with an incidence ranging from 55% to 100% in parturients [2]. This hypotension primarily results from sympathetic blockade leading to vasodilatation and reduced venous return, compounded by aortocaval compression from the gravid uterus.

Maternal hypotension during spinal anaesthesia can produce distressing symptoms such as nausea, vomiting, dizziness, and in severe cases, cardiovascular collapse. It may also adversely affect the fetus by reducing uteroplacental perfusion, potentially leading to fetal acidosis and compromised neonatal outcomes [3]. Several preventive measures, including fluid preloading or coloading and the use of vasopressors, are routinely employed; however, their effectiveness remains variable and inconsistent [4].

The principal objective of anaesthesia is to provide adequate analgesia during and after surgery while maintaining hemodynamic stability [5]. Subarachnoid block is widely favored for obstetric and gynaecological procedures as it is simple to perform, cost-effective, requires smaller drug doses, has a rapid onset, a low failure rate, and reduces the incidence of postoperative nausea and vomiting. Additionally, it allows the mother to remain awake and experience early bonding with her newborn immediately after delivery [6].

Hypotension caused by spinal anaesthesia is normally compensated by a reflex increase in heart rate. However, activation of vagally mediated cardiodepressor reflexes, such as the Bezold–Jarisch reflex (BJR), may shift the autonomic balance toward parasympathetic dominance, resulting in bradycardia and further exacerbation of hypotension [7]. Stimulation of BJR receptors increases parasympathetic activity while inhibiting sympathetic tone, leading to a decrease in heart rate and blood pressure, sometimes associated with apnea [11].

Various strategies have been proposed to prevent spinal anaesthesia–induced hypotension, including intravenous fluid preloading or coloading, vasopressor administration, and mechanical compression devices, with variable success rates [8–10]. Ephedrine has traditionally been preferred due to its ability to maintain heart rate and uteroplacental perfusion; however, its use is not without limitations.

Recent evidence suggests that serotonin ($5\text{-}HT_3$) receptor antagonists such as ondansetron and granisetron may attenuate spinal anaesthesia–induced hypotension and bradycardia by inhibiting the Bezold–Jarisch reflex. The present study was therefore undertaken to evaluate and compare the effectiveness of intravenous ondansetron and granisetron in preventing hypotension and bradycardia following spinal anaesthesia in patients undergoing LSCS.

Methods

This prospective, randomized, double-blind study was conducted in the Departments of Anaesthesiology and Obstetrics & Gynaecology at Venkateshwar Institute of Medical Sciences, Amroha, Uttar Pradesh, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

A total of 96 patients belonging to American Society of Anesthesiologists (ASA) physical status I and II, aged between 19 and 41 years, scheduled for elective lower segment caesarean section under spinal anaesthesia, were included in the study. Patients with refusal to participate, contraindications to spinal anaesthesia, known allergy to study drugs or bupivacaine, those receiving medications affecting heart rate or myocardial contractility, and patients with significant systemic illness were excluded.

Patients were randomly allocated into three groups using a computer-generated random number table, and allocation concealment was ensured using sealed opaque envelopes.

- **Group A (n = 32):** Received intravenous ondansetron 4 mg diluted in normal saline
- **Group B (n = 32):** Received intravenous granisetron 1 mg diluted in normal saline
- **Group C (n = 32):** Received 10 ml intravenous normal saline

The study drug was administered intravenously 5 minutes prior to subarachnoid block. A thorough pre-anaesthetic evaluation was performed for all patients. Under strict aseptic precautions, lumbar puncture was performed in the lateral decubitus position at the L3–L4 or L4–L5 interspace using a 25-gauge Quincke spinal needle via the midline approach. After confirmation of free flow of cerebrospinal fluid, 10 mg (2 ml) of 0.5% hyperbaric bupivacaine was injected intrathecally.

Oxygen was administered at a rate of 4 L/min via Venturi mask. The level of sensory block was assessed using the pin-prick method from caudal to rostral direction at 5 minutes and subsequently every 2 minutes until an adequate sensory block level was achieved.

Hemodynamic parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate, and the occurrence of adverse events such as hypotension, bradycardia, nausea, vomiting, shivering, and pain were recorded at predefined intervals.

Statistical Analysis

The collected data were entered into the data editor of SPSS software version 15.0. Quantitative data were expressed as mean ± standard deviation. A confidence level of 95% and a p-value <0.05 were considered statistically significant.

Results

The mean age, body weight, and duration of surgery were comparable among all three groups, with no statistically significant differences. Baseline clinical and hemodynamic parameters were also similar across the groups (Table 2).

Baseline systolic blood pressure did not differ significantly among the groups. At 5 minutes following spinal anaesthesia, SBP was significantly lower in the granisetron group compared to the ondansetron group. Baseline diastolic blood pressure was comparable among all groups. Following drug administration, DBP was significantly lower in Group A compared to Group B, and DBP was significantly lower in Groups A and C compared to Group B at most time intervals.

Mean arterial pressure was comparable among the three groups at baseline ($p > 0.05$). Following administration of the study drugs, MAP decreased in all groups; however, MAP was significantly lower in Groups A and C compared to Group B at all recorded time intervals up to 60 minutes.

Shivering was observed in 4 patients each in Groups A and B, while 8 patients in Group C experienced shivering. There was no statistically significant difference among the three groups with respect to the incidence of pain and bradycardia. The incidence of nausea and vomiting was significantly higher in the control group (Group C) compared to the ondansetron (Group A) and granisetron (Group B) groups

Table 1: Demographic variables

Variable	Ondansetron Group (Mean±SD)	Granisetron Group (Mean±SD)	Normal saline Group (Mean±SD)	P -value
Age (Years)	30.7±5.5	28.7±4.9	28.3±4.4	NS
Weight (Kg)	62.9±9.8	64.7±10.3	65.7±10.4	NS
Duration of Surgery (minutes)	60.1±7.3	60.2±6.8	59.8±6.2	NS

Table 2: Baseline Clinical Variables

Variable	Ondansetron Group (Mean±SD)	Granisetron Group (Mean±SD)	Normal saline Group (Mean±SD)	P -value
Heart Rate	93.4±3.4	98.2±2.5	94.2±4.2	NS
Systolic BP	130.5±12.6	129.3±11.5	131.5±11.9	NS
Diastolic BP	80.1±7.4	82.4±6.8	78.9±7.1	NS
MAP	95.5±4.6	96.3±3.8	96.1±3.5	NS

Statistically significant at $p \leq 0.05$

Discussion

Spinal anaesthesia is one of the most commonly used regional anaesthetic techniques for caesarean section, as it avoids many of the risks associated with general anaesthesia [12]. Despite its advantages, spinal anaesthesia is frequently complicated by hypotension

and bradycardia, with hypotension being the most common adverse effect, occurring in approximately 55–100% of parturients [13,14]. Maternal systolic blood pressure below 100 mmHg may be associated with fetal bradycardia of hypoxic origin, thereby highlighting the clinical significance of preventing hypotension during caesarean delivery.

Physiological changes during pregnancy, including endothelium-dependent alterations in vascular smooth muscle function and increased production of vasodilatory mediators such as prostaglandins and nitric oxide, predispose parturients to vasodilatation following sympathetic blockade [15]. In addition, activation of the Bezold–Jarisch reflex (BJR) through stimulation of left ventricular mechanoreceptors and serotonin-sensitive chemoreceptors may result in sudden bradycardia and further hypotension due to a shift in cardiac autonomic balance toward parasympathetic dominance [16].

Various strategies have been employed to reduce the incidence of spinal anaesthesia–induced hypotension and bradycardia, including intravenous fluid preloading or coloading, patient positioning, and the use of vasopressors. More recently, prophylactic administration of 5-HT_3 receptor antagonists such as ondansetron, granisetron, and ramosetron has been proposed as an effective preventive measure [17].

In the present study, ondansetron and granisetron were evaluated for their ability to attenuate maternal hypotension and bradycardia following spinal anaesthesia. The demographic characteristics, including mean age and duration of surgery, were comparable among all three groups, indicating homogeneity of the study population. The mean age in Groups A, B, and C was 30.7 ± 5.5 years, 28.7 ± 4.9 years, and 28.0 ± 4.4 years, respectively, while the duration of surgery was similar across groups.

Baseline hemodynamic parameters were comparable among all three groups. Following administration of the study drugs, systolic, diastolic, and mean arterial pressures were significantly lower in the ondansetron and control groups compared to the granisetron group. Although mean arterial pressure decreased in all groups after spinal anaesthesia, the reduction was significantly greater in Groups A and C compared with Group B. Shivering was observed more frequently in the control group, while the incidence of nausea and vomiting was significantly higher in Group C than in Groups A and B.

The findings of the present study are consistent with those reported by Terkawi et al., who observed no significant effect of intravenous ondansetron on spinal anaesthesia–induced hemodynamic changes when using an intrathecal bupivacaine–opioid combination [20]. Furthermore, a meta-analysis by Terkawi et al. involving 14 randomized controlled trials demonstrated that ondansetron had an insignificant effect on reducing hypotension and bradycardia following spinal anaesthesia in non-obstetric patients [21,22]. However, differences in patient population, drug dosing, and anaesthetic technique may account for variations in outcomes across studies.

Conclusion

Intravenous administration of ondansetron 4 mg prior to spinal anaesthesia significantly reduces the incidence of hypotension, bradycardia, and vasopressor requirement in patients undergoing lower segment caesarean section. Granisetron did not demonstrate a significant protective effect on hemodynamic parameters in this study.

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