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Comparative evaluation of ondansetron, palonosetron, and dexamethasone for antiemetic prophylaxis in cesarean section under spinal anaesthesia

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ABSTRACT

Background: Spinal anesthesia is the most common regional anesthesia used to provide surgical anesthesia for cesarean section. Nausea and vomiting are common symptoms experienced by patients undergoing cesarean section. **Aims and Objectives:** The aim of this study was to assess and compare the efficacy of dexamethasone, ondansetron, and palonosetron in prevention of nausea and vomiting. **Materials and Methods:** This prospective randomized study was conducted on total 90 patients undergoing cesarean section, divided in three groups of 30 patients each. Group O received 4 mg ondansetron i.v., Group P received palonosetron 075 mg i.v and Group D received 8 mg dexamethasone i.v. The incidence of nausea and vomiting was compared between the groups and side effects were assessed. **Results:** Antiemetic prophylaxis reduced the overall incidence of nausea and vomiting. However, Palonosetron had a lower incidence of nausea and vomiting as compared to dexamethasone and ondansetron. **Conclusion:** Our study concluded that Palonosetron had the lowest incidence of nausea and vomiting.

Key words: Ondansetron; Palonosetron; Dexamethasone; Cesarean section

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INTRODUCTION

Although combined spinal epidural approach[1] is being increasingly used in general surgery, lower limb orthopaedic, urologic, and gynecologic surgery (including caesarean sections), the best anesthetic technique for cesarean in terms of less fetal and maternal complication is spinal anesthesia, which has a quick onset and produces a dense nerve block.[2]

The most common complication of spinal anesthesia is hypotension. Untreated hypotension can lead to many clinical symptoms such as nausea and vomiting, difficulty breathing, and decreased blood flow to the placenta.[3] Nausea and vomiting are also common symptoms experienced by almost 80% of individuals who undergo a cesarean section.[4] Although nausea and vomiting are controlled spontaneously in most of the cases, they can invite complications such as aspiration, suture dehiscence, subcutaneous emphysema, and so on. These can lead to delayed discharge if severe and uncontrolled. The hormonal fluctuations that occur during pregnancy might influence the muscle tone of the sphincters in the esophagus and stomach, as well as the functioning of the small bowel and esophagus, potentially affecting them.[5] Other causes include psychogenic variables, traction on the visceral peritoneum, untreated hypotension, and the use of opioid and uterotonic medications.[6]

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The activation of the Bezold-Jarisch reflex due to hypotension involves peripheral serotonin receptors, specifically the 5-hydroxytryptamine-3 (5HT3) receptors. Several studies have noted that the use of a 5-HT3 receptor antagonist effectively suppressed bradycardia and hypotension due to inhibition of the Bezold-Jarisch reflex.[7]

Antiemetic medications are commonly employed for the treatment of intraoperative nausea and vomiting, to reduce the discomfort of patients and other complications; typically administered following the clamping of the umbilical cord.[8]

Ondansetron is highly effective in both preventing and treating nausea and vomiting due to its particular blocking action on 5-HT3 receptors, effective in reducing chemotherapy-induced,[9] intraoperative,[10] and post-operative nausea and vomiting (PONV).[11]

Palonosetron is a second-generation 5HT-3 receptor antagonist that has a greater binding affinity and a longer plasma half-life. However, there is limited knowledge regarding the efficacy of palonosetron in preventing PONV following spinal anesthesia. Studies have shown that palonosetron has a lower overall occurrence of PONV compared to ondansetron.[12]

Dexamethasone, a glucocorticoid, has been found to decrease the occurrence of nausea and vomiting after chemoradiotherapy and surgical procedures.[13] It is known to possess potent antiemetic and anti-inflammatory properties due to suppression of prostaglandin, and a reduction in endogenous opioid levels.

Hence, the present study was conducted to compare the antiemetic prophylaxis provided by ondansetron, palonosetron, and dexamethasone in the context of cesarean section procedures performed under spinal anesthesia.

Aims and objectives

Primary objective

The study aimed to compare the efficacy of Dexamethasone, Ondansetron, and Palanosetron in prevention of post-operative nausea and vomiting.

Secondary objective

To compare hemodynamic variables-heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), Oxygen saturation (SpO_2) among the groups and side effects if any.

MATERIALS AND METHODS

This prospective study was carried out on patients undergoing caesarean section in J.A.H Hospital after getting approval from the Institutional Ethics Committee (114/IEC-GRMC/2022) over a period of 2 years.

From the study of Kalani et al.,[7] using O_2 saturation as parameter of the sample size, mean saturation in Group ondansetron was 94±2% whereas for dexamethasone, it was 96±2%, at 80% power of the study and 95% confidence interval, sample size was calculated using the formula as

$$n = \frac{(2S2(Z\alpha/2 + Z1-\beta)2}{(\mu1 - \mu2)2)}, \text{ where } \mu1=94, \mu2=96$$

$Z\alpha/2=1.96$ (at 5% level of significance)

$Z1-\beta=0.84$ (at 80% power of the test), putting all these values

$$n = 2 \times 6.205 \frac{[(1.96) + 0.84]2}{(94-96)2} = 24.32 \text{ approx. to } 25$$

Minimal sample size 25 was increased to 30 in each group. Hence, total sample size of the study was 90.

Inclusion criteria

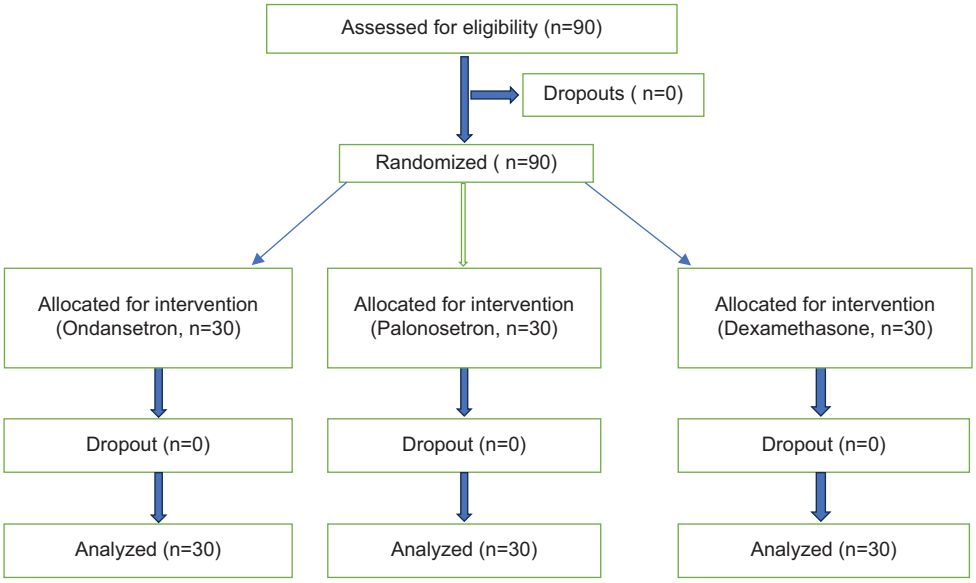
- Patient giving consent to participate in study
- Age between 18 and 35 years
- Patient of female sex, scheduled for elective cesarean section
- American society of anesthesiologists (ASA) grade I and II.

Exclusion criteria

- Patient with known hyperemesis
- Body mass index >35
- Any antiemetic treatment within 24 h before surgery
- History of motion sickness
- Gastrointestinal disease
- Allergy to the study drugs.

Methodology

This was a randomized controlled prospective study. Patients were enrolled according to the inclusion and exclusion criteria after signing a consent form and then randomly assigned by sealed envelope method preoperatively to three groups receiving Ondansetron, Palonosetron, and Dexamethasone. This was a double blinded study as the drug was prepared by one person whereas the characteristics in a proforma were noted by another.



Flowchart 1: Consort flowchart showing randomisation of study participants

Demographic information, blood pressure, HR, and arterial SpO_2 was recorded, and then, a 20 cc/kg Ringer's solution was infused to all patients. Spinal anesthesia was performed with a 23-gauge Quincke needle at the L3-L4 intervertebral space, and a fixed dose of 10 mg of hyperbaric bupivacaine 0.5% was injected after ensuring that the needle was positioned in the subarachnoid space and the cerebrospinal fluid was aspirated. Patients were immediately placed in the supine position and supplemented with oxygen 5–6 L/min through facemask. Before surgery, a 20-gauge needle pinprick was performed in the midaxillary line and surgery was started after ensuring the appropriate level of sensory block (T4-T6). A decrease in SBP (more than 20% below baseline) or <90 mmHg was recorded as hypotension, and the following routine treatments were used as follows: Semi-trendelenburg position, increasing intravenous fluid administration, or administering intravenous mephentermine 6 mg. After the delivery of the newborn, 20 units of oxytocin was administered as an infusion in the saline. After umbilical cord clamping, patients already assigned to the groups were given the study drug as shown. The first group received Ondansetron, the second group received Palonosetron and third group received Dexamethasone.

- Group O (Ondansetron)-Ondansetron 4 mg in 20 mL of normal saline
- Group P (Palonosetron)-Palonosetron 0.075 mg in 20 mL normal saline
- Group D (Dexamethasone)-8 mg Dexamethasone in 20 mL normal saline.

Following characteristics and outcomes were recorded and entered into proforma for statistical analysis.

1. The frequency and severity of nausea and vomiting were recorded on the basis of a visual analog scale (VAS)[13] after umbilical cord clamping for up to 24 h after surgery. The VAS consists of a 10 cm ruler extending longitudinally between 0 and 10, which represent "no nausea" and "the most severe possible condition," respectively.[14]
2. Blood pressure, HR, and arterial SpO_2 was recorded every 15 min until discharge from recovery room.
3. Side effects such as hypotension and shivering were observed in the groups.

Statistical analysis

The study data were formatted in EXCEL and SPSS. After compilation, data analysis was conducted using SPSS software. Chi-square and unpaired t test were applied for comparison of the groups.

$P>0.05$ was statistically insignificant, $P<0.05$ was statistically significant and $P<0.01$ was statistically highly significant.

RESULTS

Table 1 showed comparison of various demographic characteristics such as age, weight, height, and ASA grade among the groups. $P>0.05$ was not statistically significant.

Figure 1 showed that the administration of Ondansetron, Palonosetron, and Dexamethasone did not significantly affect HR, $P>0.05$ was statistically insignificant.

Figure 2 compared MAP between the three groups-Group O (Ondansetron), Group P (Palonosetron), and Group D (Dexamethasone). There was no statistically significant difference in the intraoperative MAP between the three groups at any measured time intervals.

Table 1: Demographic characteristics comparison among the groups

Demographic characteristics	Group O (n=30)	Group P (n=30)	Group D (n=30)	P-value
Mean age (±SD)	25.97±3.01	25.43±3.04	26±2.67	0.7
ASA grade	Grade I=22 Grade II=8	Grade I=22 Grade II=8	Grade I=22 Grade II=8	1
Weight (kg) Mean±SD	59.83±7.35	57.2±6.56	59.37±7.12	0.305
Duration of surgery (minutes) Mean±SD	54.03±3.92	51.83±5.41	51.80±4.34	0.104

ASA: American society of anesthesiologists

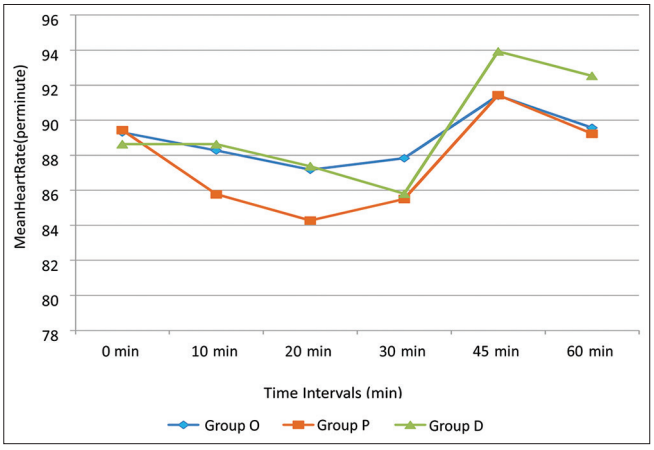


Figure 1: Comparison of mean intraoperative heart rate between the three

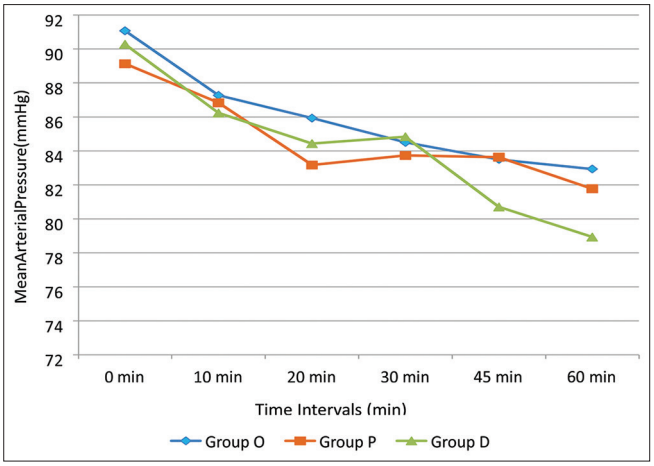


Figure 2: Comparison of intraoperative mean arterial pressure between the three groups

Table 2 compared the incidence of post-operative nausea at different time intervals. At 30 min, 1 h, 4 h, and 24 h postoperatively, the difference was statistically insignificant (P>0.05). At 12 h postoperatively, However, 3 (10.3%) patients in Group D experienced nausea (P<0.05) which was statistically significant.

Table 3 compared the incidence of postoperative vomiting at different time intervals. Although Group D (Dexamethasone) had a higher incidence of vomiting at several time points, the difference was not statistically significant (P>0.05).

Figure 3 showed that in Group D, 4 (13.4%) patients had hypotension and 2 patients (6.7%) experienced shivering; in Group O, 2 patients (6.7%) experienced hypotension and shivering was observed in 1 patient (3.3%) whereas Group P showed the lowest incidence of hypotension and shivering, with only 1 patient (3.3%) affected.

DISCUSSION

In our study patients, all groups were comparable (P>0.05) with respect to age (in year), ASA grade (I and II) and weight (Table 1). Our study coincided with the findings of Mondal et al.[15]

In our study, mean intraoperative pulse rate (Figure 1), SBP, DBP, MAP (Figure 2) respiratory rate, and SpO_2 was comparable and the difference was statistically insignificant among the three groups (P>0.05). Our findings are similar with the study conducted by Ahmed et al.,[16] and Imeh et al.[17]

As per Table 2, in Group O (Ondansetron), Group P (Palonosetron), and Group D (Dexamethasone) overall, total 14 patient population experienced nausea at different time intervals. The P>0.05, indicating no statistically significant difference in nausea between the groups. At 12 h, 3 (10.3%) of the patients in Group D experienced nausea, P=0.045, indicating a statistically significant difference in nausea incidence at 12 h. This is due to 5-HT antagonism property of group O and P.[8] Specifically, Group D had a significantly higher incidence of nausea compared to Groups O and P, whereas group P had the least incidence of nausea due to higher affinity for 5HT-3 receptors and longer half-life as compared to group O.

Table 3 showed that the incidence of postoperative vomiting varied at different time intervals, with no statistically significant differences observed at 30 min, 1 h, 4 h, 12 h, and 24 h postoperatively. Although Group D (Dexamethasone) had a higher incidence of vomiting at several time points, the differences were not statistically significant, P>0.05. Similar results were found in the study conducted by Sane et al.,[18] and Majhi et al.[19]

As per Figure 3, in Group O, 2 patients (6.7%) experienced hypotension and shivering was observed in 1 patient (3.3%);

Table 2: Comparison of postoperative nausea between the three groups

Time intervals	Groups						Total		P-value
	Group O		Group P		Group D				
	No	%	No	%	No	%	No	%	
30 min	1	3.3	1	3.3	2	6.7	4	4.4	0.770
1 h	1	3.3	0	0.0	1	3.3	2	2.2	0.600
4 h	2	6.7	0	0.0	1	3.3	3	3.3	0.355
12 h	0	0.0	0	0.0	3	10.3	3	3.3	0.045
24 h	1	3.3	0	0.0	1	3.3	2	2.2	0.439

Table 3: Comparison of post-operative vomiting between the three groups

Time intervals	Groups						Total		P-value
	Group O		Group P		Group D				
	No	%	No	%	No	%	No	%	
30 min	0	0.0	0	0.0	1	3.3	1	1.1	0.364
1 h	0	0.0	0	0.0	2	6.7	2	2.2	0.129
4 h	1	3.3	0	0.0	1	3.3	2	2.2	0.600
12 h	1	3.3	0	0.0	2	6.7	3	3.3	0.355
24 h	0	0.0	0	0.0	1	3.3	1	1.1	0.364
Time intervals	**Groups**						**Total (%)**		**P-value**
	Group O (n=30) (%)		**Group P (n=30)**		**Group D (n=30) (%)**				
30 min	0		0		1 (3.3)		1 (1.1)		0.364
1 h	0		0		2 (6.7)		2 (2.2)		0.129
4 h	1 (3.3)		0		1 (3.3)		2 (2.2)		0.600
12 h	1 (3.3)		0		2 (6.7)		3 (3.3)		0.355
24 h	0		0		1 (3.3)		1 (1.1)		0.364

No: Number of patients

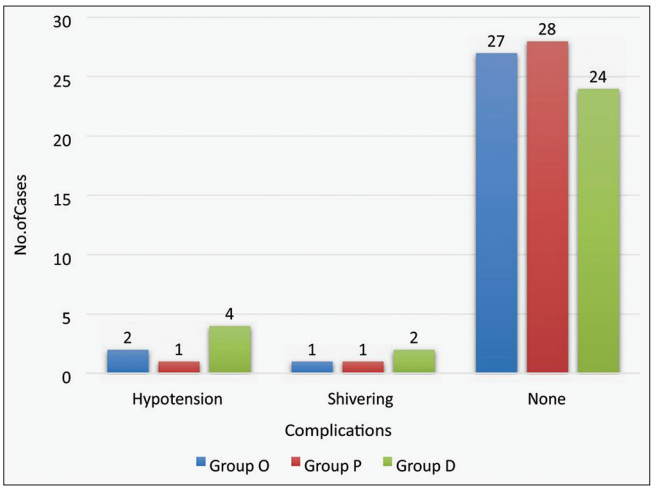


Figure 3: Comparison of postoperative complications between the three groups

Group P showed the lowest incidence of hypotension and shivering with only 1 patient (3.3%) affected. Our findings were similar to the study done by Krishnan et al.,[8] and Sadhoo et al.[9] They founded that Palanosetron is a second generation 5HT3 receptor antagonist, reported to be superior to the first generation because it has greater binding affinity at the allosteric site of the receptor[8] and prevents the attachment of 5HT at the orthosteric site which inhibits serotonin mediated Ca2+influx and confers a long lasting functional effect.[9]

In Group D, the incidence of hypotension was higher, with 4 patients (13.3%) experiencing this complication. Shivering was observed in 2 patients (6.7%), a higher rate than in Groups O and P, though still relatively low. Moreover, 24 out of 30 patients (80.0%) did not experience any complications, this indicates that Group D had the highest overall incidence of postoperative complications. However, P>0.05, indicating no statistically significant difference among the groups.

Our findings are like study conducted by Sane et al.,[18] who concluded that there was no significant difference seen in postoperative complications between group O (ondansetron), group D Dexamethasone and group OD (ondansetron+dexamethasone). (P>0.05) and D Khuo et al.,[20] who concluded that incidence of adverse effects was comparable in group P (palonosetron) and group PD (palonosetron+dexamethasone) (P>0.05).

Limitations of the study

The investigator was unable to quantify nausea which being a subjective experience can be a major limiting factor in comparing the effectiveness of various modalities of treatment.

CONCLUSION

The current study concludes that administering antiemetic prophylaxis reduces the risk of both

intraoperative and PONV during cesarean sections performed under spinal anesthesia. Although all the drugs were effective in reducing nausea and vomiting, intravenous palonosetron 0.075 mg had a lower incidence of Nausea and Vomiting than ondansetron 4 mg and dexamethasone 8 mg.

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REFERENCES

1. Gadekar IR, Rawat HS and Paul A. A comparative study of combined spinal epidural anesthesia versus spinal anesthesia in major lower limb orthopedic surgeries. Cureus. 2024;16(8):e67354.
https://doi.org/10.7759/cureus.67354
2. Ranjbar MS, Sheybani S and Jahanbin F. Prophylactic effects of ephedrine, ondansetron and ringer on hemodynamic changes during Cesarean section under spinal anesthesia - a randomized clinical trial. Ginekol Pol. 2018;89(8):453-458.
https://doi.org/10.5603/GP.a2018.0078
3. Shitemaw T, Jemal B, Mamo T and Akalu L. Incidence and associated factors for hypotension after spinal anesthesia during Cesarean section at Gandhi Memorial Hospital Addis Ababa, Ethiopia. PLoS One. 2020;15(8):e0236755.
https://doi.org/10.1371/journal.pone.0236755
4. Griffiths JD, Gyte GM, Popham PA, Williams K, Paranjothy S, Broughton HK, et al. Interventions for preventing nausea and vomiting in women undergoing regional anaesthesia for caesarean section. Cochrane Database Syst Rev. 2021;5(5):CD007579.
https://doi.org/10.1002/14651858.CD007579
5. Voigt M, Fröhlich CW, Hüttel C, Kranke P, Mennen J, Boessneck O, et al. Prophylaxis of intra- and postoperative nausea and vomiting in patients during Cesarean section in spinal anesthesia. Med Sci Monit. 2013;19:993-1000.
https://doi.org/10.12659/MSM.889597
6. Kim MK, Kim I, Kang H, Wi W, Park YH, Jung YH, et al. Effect of intravenous palonosetron on hypotension induced by spinal anesthesia for Cesarean section: A randomized controlled trial. PLoS One. 2024;19(6):e0305913.
https://doi.org/10.1371/journal.pone.0305913
7. Kalani N, Zabetian H, Sanie MS, Deylami M, Radmehr M, Sahraei R, et al. The effect of ondansetron and dexamethasone on nausea and vomiting under spinal anesthesia. World J Plast Surg. 2017;6(1):88-93.
8. Krishnan D, Asokan A, Muthalu A, Suganya S and Sujatha C. A comparative study on the efficacy of intravenous palonosetron versus a combination of ondansetron and dexamethasone as prophylaxis for prevention of postoperative nausea and vomiting after laparoscopic surgeries. Cureus. 2024;16(10):e72214.
https://doi.org/10.7759/cureus.72214
9. Sadhoo N, Prakash J, Kumar V, Kharwar RK, Ahmad S and Sethi BK. A comparison of prophylactic antiemetic therapy with palonosetron and dexamethasone as single-agents or in combination in adult patients undergoing laparoscopic surgery: A randomized trial. Int J Crit Illn Inj Sci. 2023;13(1):4-10.
https://doi.org/10.4103/ijciis.ijciis_150_20
10. Srivastava VK, Khan S, Agrawal S, Deshmukh SA, Shree P and Misra PP. Comparison of palonosetron-dexamethasone and ondansetron-dexamethasone for prevention of postoperative nausea and vomiting in middle ear surgery: A randomized clinical trial. Braz J Anesthesiol. 2020;70(5):477-483.
https://doi.org/10.1016/j.bjan.2020.04.016
11. Davolos FJC, Modolo NS, Braz LG and Nascimento Junior PD. Palonosetron versus ondansetron for prophylaxis of postoperative nausea and vomiting in laparoscopic cholecystectomy: A non-inferiority randomized controlled trial. Braz J Anesthesiol. 2024;74(1):744216.
https://doi.org/10.1016/j.bjane.2021.06.020
12. Balyan R, Kumar S, Lalitha K, Aneja S and George JS. A comparative study of palonosetron with ondansetron for prophylaxis of postoperative nausea and vomiting (PONV) following laparoscopic gynaecological surgeries. Rom J Anaesth Intensive Care. 2022;29(1):32-40.
https://doi.org/10.2478/rjaic-2022-0005
13. Nejadi JR, Shamseh M, Ronasi N, Birjandi M and Karimi A. Comparison of the effects of dexamethasone and ondansetron on the reduction of postoperative nausea and vomiting following Cesarean section under spinal anesthesia. Curr Rev Clin Exp Pharmacol. 2021;16(1):117-122.
https://doi.org/10.2174/1574884715666200302122800
14. Baxter AL, Watcha MF, Baxter WV, Leong T and Wyatt MM. Development and validation of a pictorial nausea rating scale for children. Pediatrics. 2011;127(6):e1542-e1549.
https://doi.org/10.1542/peds.2010-1410
15. Mondal S, Shukla U, Saxena S and Singh D. A comparative study between ondansetron and dexamethasone as antiemetic during elective Caesarean section done under spinal anaesthesia. Int J Sci Res. 2016;5(4):1262-1266.
https://doi.org/10.21275/NOV162806
16. Mohamed AK, Mahran MM and Ibrahim RM. Dexamethasone versus ondansetron on post-operative nausea and vomiting in Caesarean section. Minia J Med Res. 2020;31(2):88-96.
https://doi.org/10.21608/mjmr.2022.220843
17. Imeh A, Olaniyi O, Simeon O and Omotola O. Dexamethasone versus a combination of dexamethasone and ondansetron as prophylactic antiemetic in patients receiving intrathecal morphine for Caesarean section. Afr Health Sci. 2014;14(2):453-459.
https://doi.org/10.4314/ahs.v14i2.23
18. Sane S, Hasanlui MV, Abbasivash R, Mahoori A, Hashemi ST and Rafiei F. Comparing the effect of intravenous dexamethasone, intravenous ondansetron, and their combination on nausea and vomiting in Cesarean section with spinal anesthesia. Adv Biomed Res. 2015;4:230.
https://doi.org/10.4103/2277-9175.167030
19. Majhi D and Das M. A comparative study of metoclopramide, dexamethasone and ondansetron in control of nausea and vomiting after spinal anesthesia for Cesarean section. Int Arch Integr Med. 2021;8(1):50-57.
20. Khuo D, Singh ST, Kumaragurubaran TR, Samjetsabam L, Nahakpam S, Wahab Z, et al. A comparative study of palonosetron and palonosetron with dexamethasone for prevention of postoperative nausea and vomiting in patients undergoing caesarean section: A double blinded, randomized control study. Paripex Indian J Res. 2020;9(2):59-62.
https://doi.org/10.36106/paripex

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VB- Interpreted the results, reviewed the literature and manuscript preparation; **JA-** Concept and design of the study, prepared the first draft of manuscript; **AG-** Concept, coordination, statistical analysis and interpretation; **AMM**- Preparation of manuscript and revision of the manuscript.

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