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Original Research Article

Effect of a Single Dose Intravenous Dexamethasone on Postoperative Pain and Nausea in Patients Undergoing Surgery under Spinal Anesthesia

Sojitra Seema Jagdishbhai[1], Khushbu Dhameliya[2], Rajesh Gondalia[3]

[1]Senior Resident, Department of Anaesthesia, B.J Medical College, Ahmedabad, Gujarat, India
[2]Assistant Professor, Department of Anaesthesia, GMERS Medical College, Junagadh, Gujarat, India
[3]Associate Professor, Department of Department of Obstetrics and Gynecology, Matushri Prabhaben Khodabhai Boghara Medical College, Atkot, Gujarat

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Corresponding author: Dr. Khushbu Dhameliya
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Abstract

Background and Aim: Postoperative pain and postoperative nausea and vomiting (PONV) are frequent complications in patients undergoing surgery under spinal anesthesia. Various pharmacological strategies have been explored, with dexamethasone showing promise as an adjuvant. This study aimed to evaluate the effect of a single intravenous dose of dexamethasone on postoperative pain and PONV.

Material and Methods: A prospective randomized placebo-controlled clinical trial was conducted on 60 ASA I–II patients aged 18–50 years undergoing elective lower limb or gynecological surgeries under spinal anesthesia. Patients were randomized into two groups: Group A received 2 mL of intravenous normal saline, and Group B received 2 mL of intravenous dexamethasone (8 mg) immediately after spinal anesthesia. Pain was assessed using the Visual Analogue Scale (VAS), and PONV was evaluated using Belville's score for 24 hours. Rescue analgesia and antiemetic requirements were recorded.

Results: Patients in the dexamethasone group had significantly lower VAS scores at all recorded intervals compared to the control group (for example, 2.13 ± 0.35 vs. 3.13 ± 1.17 at 1 hour, $p < 0.001$). The incidence of PONV and the need for rescue antiemetics were reduced in the dexamethasone group. Rescue analgesic requirement was also significantly lower. No major adverse effects were observed.

Conclusion: Intravenous dexamethasone 8 mg administered after spinal anesthesia significantly reduces postoperative pain and PONV in the first 24 hours and can be considered a safe and effective adjuvant in perioperative management.

Keywords: Dexamethasone, Spinal Anesthesia, Postoperative Pain, PONV.

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Introduction

Effective management of postoperative pain and prevention of postoperative nausea and vomiting (PONV) remain central challenges in perioperative care. Poorly controlled pain contributes to delayed mobilization, increased hospital stay, risk of chronic pain, and greater opioid consumption; whereas PONV causes discomfort, risk of aspiration, electrolyte imbalance, and delays in recovery and discharge [1]. In settings where spinal (neuraxial) anesthesia is used, although the technique itself may reduce systemic anesthetic needs, patients still frequently experience postoperative pain and nausea–vomiting, especially when adjunctive sedatives or systemic analgesics are used.

Dexamethasone, a potent synthetic glucocorticoid with anti-inflammatory, antiemetic, and immunomodulatory effects, has garnered attention as a perioperative adjuvant to mitigate both pain and PONV. Its proposed analgesic mechanisms include inhibition of phospholipase A_2, suppression of inflammatory cytokines (e.g., interleukin-6, tumor necrosis factor), reduction of perineural edema, and modulation of central nociceptive transmission [2, 3]. Regarding antiemetic effect, dexamethasone is thought to decrease serotonin release in the gut and modulate central prostaglandin pathways and the nucleus tractus solitarii, thereby reducing emetic reflexes [4,5].

Numerous randomized controlled trials and meta-analyses in general surgical populations under various anesthesia modalities have suggested that a single perioperative intravenous dose of dexamethasone can modestly reduce pain scores, delay time to first analgesic request, and decrease opioid consumption [6, 7]. For example, a recent

systematic review and meta-analysis found that dexamethasone use was associated with reduced early (≤ 4 h) pain scores (mean difference –0.42 on a 0–10 scale) and lower opioid requirements in the first 24 h postoperatively [7]. Another meta-analysis similarly showed that dexamethasone effectively lowered the incidence of postoperative vomiting (risk ratio ~0.37) and overall PONV (RR ~0.49) compared to control [4]. In addition, high-dose glucocorticoid regimens (e.g. > 0.1 mg/kg) have been reviewed as promising adjuncts for postoperative pain control and PONV prophylaxis [8].

However, the evidence is not uniformly positive. In the obstetric surgery (cesarean delivery) context under spinal anesthesia (often with intrathecal morphine), one randomized trial of 8 mg IV dexamethasone given before incision did not reduce postoperative analgesic consumption or pain scores, likely due to the potent analgesic effect of neuraxial opioids overshadowing any incremental benefit [9]. In minimally invasive thoracic surgery, a study found no significant reduction in morphine consumption with a single dose of dexamethasone, though it appeared safe and well tolerated [10]. Thus, the analgesic effect of dexamethasone may depend on the surgical type, anesthesia method, baseline analgesic regimen, and dose.

Importantly, there is comparatively little evidence specifically addressing the use of dexamethasone in spinal anesthesia settings across a broad range of surgeries. Some studies in patients under spinal anesthesia (e.g. in lower segment cesarean section) have suggested that a single 8 mg IV dose prolongs duration of analgesia and reduces pain scores [11]. The benefits in such settings may also extend to lowering PONV, particularly when systemic opioids or other emetogenic stimuli are present. Nonetheless, the magnitude of effect, optimal timing, and safety profile (e.g. hyperglycemia, wound healing) remain uncertain in this population.

Given the gaps in current knowledge, particularly in the spinal anesthesia context, our study is designed to evaluate the effect of a single dose intravenous dexamethasone on both postoperative pain and PONV across various surgical procedures conducted under spinal anesthesia. We hypothesize that administration of dexamethasone will reduce early and intermediate postoperative pain, extend time to first rescue analgesic, reduce opioid rescue requirements, and lower the incidence of PONV, without increasing adverse outcomes.

Material and Methods

After obtaining approval from the Institutional Ethical Committee, the study was initiated as a prospective randomized placebo-controlled clinical trial at Civil Hospital, Ahmedabad, attached to B.J. Medical College, Ahmedabad. The study was conducted over a period of six months, from January 2024 to June 2024. A total of 60 eligible and consenting patients, aged between 18 and 50 years, scheduled for elective surgeries under spinal anaesthesia were included. Written informed consent was obtained from all participants prior to enrolment, and the patients were selected using a simple random sampling technique.

The study population comprised patients fulfilling the inclusion criteria, which were voluntary written consent, age between 18 and 50 years, either gender, belonging to American Society of Anesthesiologists (ASA) Grade I or II, and undergoing lower limb or gynaecological surgeries under spinal anaesthesia. Patients were excluded if they refused consent, belonged to ASA Grade III, IV, or V, were pregnant or lactating, had a history of motion sickness, were allergic to the study medications, had received antiemetics within 24 hours prior to surgery, or had associated comorbid conditions.

The drug under investigation was intravenous dexamethasone, supplied by the Government of Gujarat through Civil Hospital, Ahmedabad. Patients who satisfied the inclusion criteria underwent pre-anaesthetic assessment with necessary investigations a day before surgery. Randomization was performed using the odd–even method, and the 60 participants were divided equally into two groups. Group A (control) received 2 mL of normal saline intravenously, whereas Group B (study group) received 2 mL of intravenous dexamethasone (8 mg).

Intravenous access was secured with an 18G or 20G cannula, and all patients were preloaded with Ringer Lactate solution over 10–15 minutes. None of the patients had received antiemetic medication within 24 hours before surgery.

A prophylactic antimicrobial, 1 g ceftriaxone, was administered intravenously 30 minutes prior to anaesthesia. Baseline parameters, including heart rate, systolic, diastolic and mean arterial blood pressure, respiratory rate, and oxygen saturation, were recorded before induction.

All patients underwent spinal anaesthesia under strict aseptic precautions. Patients were placed in either the sitting or lateral position, the lumbar area was painted and draped, and local infiltration with 2 mL of 2% lignocaine was given. Using a 23G Quincke's spinal needle via the midline approach, 3–4 mL of 0.5% heavy bupivacaine was injected into the L3–L4 subarachnoid space after confirming free flow of cerebrospinal fluid. Patients were then placed in the supine position, provided oxygen via a simple face mask at 5–8 L/min, and intravenous fluids were continued. A

stable sensory block up to the T8–T10 level was ensured before administration of the study drug.

Following spinal anaesthesia, patients in Group A received 2 mL of intravenous normal saline, while those in Group B received 2 mL of intravenous dexamethasone (8 mg). Postoperatively, pain was assessed using the Visual Analogue Scale (VAS), while postoperative nausea and vomiting (PONV) were evaluated using Belville's scoring system. The incidence of emetic episodes, the requirement for rescue antiemetics, the need for rescue analgesia, sedation, and any adverse effects were recorded for 24 hours in the postoperative ward. Rescue analgesia in the form of intramuscular diclofenac 75 mg was administered whenever the VAS score exceeded 4, and rescue antiemetic therapy was given with intravenous ondansetron 4 mg if the PONV score was greater than 2.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean with standard deviation, and qualitative data were expressed as frequency and percentage. Comparisons of postoperative pain and PONV between the two groups were performed using the Chi-square test. One-way analysis of variance was applied where more than two means were compared, and the Chi-square test of significance was used to compare proportions between qualitative parameters. A p-value of ≤ 0.05 was considered statistically significant, while a p-value of ≤ 0.001 was regarded as highly significant. Values greater than 0.05 were considered not significant.

The primary endpoint of the study was to analyze the efficacy of a single dose of intravenous dexamethasone in reducing postoperative pain and postoperative nausea and vomiting in comparison with placebo during the first 24 hours following surgery.

Results

Table 1 shows the demographic characteristics of patients in both groups. The mean age of patients in Group A was 34.63 ± 8.81 years, whereas in Group B it was slightly higher at 39.40 ± 8.99 years, and this difference was statistically significant (p = 0.043). Gender distribution was similar between groups, with Group A comprising 43% males and 57% females, and Group B having 47% males and 53% females (p = 0.795).

The ASA physical status distribution was also comparable; 73% of Group A and 80% of Group B were ASA I, while 27% of Group A and 20% of Group B were ASA II (p = 0.542). Thus, both groups were demographically well matched except for age, where Group B patients were older. Table 2 demonstrates that the baseline vital parameters were comparable between the two groups. The mean pulse rate was 75.27 ± 4.91 beats/min in Group A and 74.33 ± 4.52 beats/min in Group B (p = 0.447). The mean systolic blood pressure (SBP) was 116.27 ± 5.48 mmHg in Group A compared to 115.40 ± 6.33 mmHg in Group B (p = 0.573). Diastolic blood pressure (DBP) values were also nearly identical: 78.13 ± 4.00 mmHg in Group A and 78.20 ± 3.21 mmHg in Group B (p = 0.943). Mean arterial pressure (MAP) was 90.84 ± 3.61 mmHg in Group A versus 90.60 ± 3.26 mmHg in Group B (p = 0.784). Oxygen saturation (SpO_2) remained stable in both groups (98.73 ± 0.52% vs. 98.77 ± 0.57%, p = 0.814). However, a statistically significant difference was observed in respiratory rate, with Group A averaging 14.40 ± 0.93 breaths/min and Group B 13.70 ± 0.79 breaths/min (p = 0.003). Overall, baseline hemodynamic parameters were similar, confirming comparability between the groups before intervention.

Table 3 highlights the perioperative and postoperative heart rate trends between the two groups. At baseline, heart rates were similar (75.27 ± 4.91 vs. 74.33 ± 4.52 beats/min, p = 0.447). However, significant differences emerged intraoperatively and postoperatively. At 0 minutes, Group A had a higher mean heart rate (93.70 ± 4.36) compared to Group B (88.53 ± 5.30, p < 0.001). This difference persisted at 15 minutes (95.00 ± 3.53 vs. 88.57 ± 4.41, p < 0.001). By 1 hour postoperatively, the heart rate was significantly lower in Group B (79.33 ± 3.34) than in Group A (85.13 ± 6.78, p < 0.001). Similar statistically significant reductions in Group B were noted at 2 hours (83.27 ± 7.13 vs. 79.40 ± 6.08, p = 0.028), 2.5 hours (81.53 ± 4.80 vs. 77.67 ± 5.44, p = 0.005), and 3 hours (84.00 ± 4.08 vs. 77.67 ± 4.64, p < 0.001). Postoperatively, differences became more pronounced, with Group B consistently maintaining a lower heart rate at 1 hour (72.13 ± 2.56 vs. 81.87 ± 3.64), 2 hours (71.27 ± 1.20 vs. 77.70 ± 6.24), and up to 24 hours (81.97 ± 2.06 vs. 92.33 ± 7.74), all with p < 0.001. This indicates dexamethasone contributed to better hemodynamic stability.

Table 4 presents the systolic blood pressure distribution. At baseline, SBP was comparable between Group A (116.27 ± 5.48 mmHg) and Group B (115.40 ± 6.33 mmHg, p = 0.573). Intraoperatively, no significant difference was seen at 0 minutes (124.87 ± 10.21 vs. 123.67 ± 9.77, p = 0.644) and 15 minutes (125.60 ± 7.60 vs. 123.80 ± 8.49, p = 0.391). However, a significant difference was observed at 45 minutes, with Group A at 120.73 ± 7.76 mmHg and Group B at 124.20 ± 4.18 mmHg (p = 0.035). Postoperatively, Group B maintained significantly lower SBP compared to Group A, with values at 1 hour (107.73 ± 1.80 vs. 111.07 ± 6.34, p = 0.008), 2 hours (109.20 ± 3.47

vs. 116.53 ± 6.32, $p < 0.001$), and continuing up to 24 hours (111.80 ± 2.80 vs. 119.53 ± 4.38, $p < 0.001$). This demonstrates that dexamethasone was associated with a more stable postoperative SBP profile compared to placebo.

Table 5 evaluates the pain intensity using the Visual Analogue Scale (VAS) at different time intervals. At 1 hour postoperatively, Group A reported a mean VAS score of 3.13 ± 1.17 compared to a significantly lower score of 2.13 ± 0.35 in Group B ($p < 0.001$). This trend continued at 2 hours (3.37 ± 1.13 vs. 2.20 ± 0.41, $p < 0.001$), 4 hours (3.23 ± 1.14 vs. 2.33 ± 0.55, $p < 0.001$), and 6 hours (3.47 ± 1.07 vs. 2.40 ± 0.62, $p < 0.001$). At 12 hours, the mean VAS score remained significantly higher in Group A (4.17 ± 0.87) than in Group B (3.53 ± 0.57, $p = 0.002$).

By 24 hours, pain persisted in both groups, but was still markedly higher in Group A (4.60 ± 0.89) compared to Group B (3.67 ± 0.76, $p < 0.001$). These findings clearly show that a single intravenous dose of dexamethasone effectively reduced postoperative pain intensity throughout the 24-hour observation period.

Table 1: Demographic Data

Parameters	Group A Mean/No SD/%	Group B Mean/No SD/%	p Value
Age (years)	34.63 ± 8.81	39.40 ± 8.99	0.043
Gender			
Male	13 (43%)	14 (47%)	0.795
Female	17 (57%)	16 (53%)	
ASA			
ASA 1	22 (73%)	24 (80%)	0.542
ASA 2	8 (27%)	6 (20%)	

Table 2: Baseline Vitals

VARIABLES	Group A Mean ± SD	Group B Mean ± SD	p Value
PR	75.27 ± 4.91	74.33 ± 4.52	0.447
SBP	116.27 ± 5.48	115.40 ± 6.33	0.573
DBP	78.13 ± 4.00	78.20 ± 3.21	0.943
MAP	90.84 ± 3.61	90.60 ± 3.26	0.784
RR	14.40 ± 0.93	13.70 ± 0.79	0.003
SpO_2	98.73 ± 0.52	98.77 ± 0.57	0.814

Table 3: Mean Heart Rate Wise Distribution

HR	Group A Mean ± SD	Group B Mean ± SD	p Value
Baseline	75.27 ± 4.91	74.33 ± 4.52	0.447
0 MIN	93.70 ± 4.36	88.53 ± 5.30	0.000
15 MIN	95.00 ± 3.53	88.57 ± 4.41	0.000
30 MIN	85.53 ± 5.27	86.67 ± 5.57	0.421
45 MIN	86.10 ± 3.34	88.10 ± 5.10	0.078
1 HR	85.13 ± 6.78	79.33 ± 3.34	0.000
1.5 HR	83.77 ± 7.36	87.53 ± 5.93	0.033
2 HR	79.40 ± 6.08	83.27 ± 7.13	0.028
2.5 HR	77.67 ± 5.44	81.53 ± 4.80	0.005
3 HR	77.67 ± 4.64	84.00 ± 4.08	0.000
Post op 1 HR	81.87 ± 3.64	72.13 ± 2.56	0.000
2 HR	77.70 ± 6.24	71.27 ± 1.20	0.000
4 HR	77.40 ± 6.39	72.50 ± 2.37	0.000
6 HR	81.10 ± 5.76	72.43 ± 1.25	0.000
12 HR	88.53 ± 8.11	77.37 ± 1.69	0.000
24 HR	92.33 ± 7.74	81.97 ± 2.06	0.000

Table 4: Systolic Blood Pressure Wise Distribution

SBP	Group A Mean ± SD	Group B Mean ± SD	p Value
Baseline	116.27 ± 5.48	115.40 ± 6.33	0.573
0 MIN	124.87 ± 10.21	123.67 ± 9.77	0.644
15 MIN	125.60 ± 7.60	123.80 ± 8.49	0.391
30 MIN	122.07 ± 9.30	124.47 ± 5.14	0.221

45 MIN	120.73 ± 7.76	124.20 ± 4.18	0.035
1 HR	118.77 ± 7.96	123.00 ± 6.47	0.028
1.5 HR	118.73 ± 7.23	121.27 ± 6.31	0.154
2 HR	118.27 ± 6.98	121.47 ± 7.48	0.092
2.5 HR	117.53 ± 6.68	119.07 ± 5.84	0.348
3 HR	117.40 ± 5.78	118.80 ± 5.72	0.350
Post op 1 HR	111.07 ± 6.34	107.73 ± 1.80	0.008
2 HR	116.53 ± 6.32	109.20 ± 3.47	0.000
4 HR	113.40 ± 5.85	107.87 ± 1.57	0.000
6 HR	113.00 ± 5.55	108.60 ± 1.50	0.000
12 HR	120.53 ± 4.42	110.53 ± 2.10	0.000
24 HR	119.53 ± 4.38	111.80 ± 2.80	0.000

Table 5: VAS Score Wise Distribution

VAS	Group A Mean ± SD	Group B Mean ± SD	p Value
1 HR	3.13 ± 1.17	2.13 ± 0.35	0.000
2 HR	3.37 ± 1.13	2.20 ± 0.41	0.000
4 HR	3.23 ± 1.14	2.33 ± 0.55	0.000
6 HR	3.47 ± 1.07	2.40 ± 0.62	0.000
12 HR	4.17 ± 0.87	3.53 ± 0.57	0.002
24 HR	4.60 ± 0.89	3.67 ± 0.76	0.000

Discussion

The present study demonstrated that a single intravenous dose of dexamethasone significantly reduced postoperative pain and decreased the incidence of postoperative nausea and vomiting compared with placebo. These findings are consistent with previous evidence suggesting that dexamethasone prolongs the duration of analgesia when used in spinal anesthesia.

A randomized controlled trial reported that intravenous dexamethasone 8 mg significantly prolonged spinal block duration and improved postoperative pain control in cesarean section patients [11]. Another study evaluating dexamethasone as an adjuvant to bupivacaine and sufentanil in spinal anesthesia demonstrated a marked prolongation of analgesia without affecting the onset time or hemodynamic stability [12].

Similarly, the administration of intravenous dexamethasone in hyperbaric spinal anesthesia was shown to increase the time to first rescue analgesic requirement, further supporting its analgesic role [13]. A meta-analysis also reported that intravenous dexamethasone significantly improved postoperative analgesia following spinal anesthesia, corroborating the analgesic potential of systemic corticosteroid administration [14]. In addition, a meta-analysis of glucocorticoid administration in spinal fusion surgery revealed reduced pain intensity and a decreased incidence of PONV, further supporting systemic anti-inflammatory contributions to analgesia and antiemesis [15].

The mechanism underlying these effects can be attributed to dexamethasone's ability to inhibit phospholipase A_2, suppress pro-inflammatory cytokines, stabilize neuronal membranes, and reduce central sensitization. Anti-emetic actions are linked to decreased serotonin turnover, modulation of prostaglandin pathways, and central receptor activity [16]. Importantly, the timing of administration has been highlighted as a key factor influencing efficacy, as the genomic effects of glucocorticoids require time to manifest. Early administration, at least 60 minutes before surgical incision, has been associated with improved analgesic and antiemetic outcomes compared with administration immediately before induction [17].

Not all studies, however, have confirmed significant benefits. In patients undergoing minimally invasive thoracic surgery, perioperative dexamethasone did not significantly reduce postoperative morphine consumption, although overall safety was maintained [18]. Systematic reviews and meta-analyses across diverse surgical populations confirm that dexamethasone effectively reduces postoperative vomiting and overall PONV, although results for nausea alone remain inconsistent due to heterogeneity across trials [19]. In neuraxial anesthesia with intrathecal opioids, intravenous dexamethasone has been shown to provide effective antiemetic prophylaxis, decreasing rescue antiemetic requirements [20]. Furthermore, the combination of dexamethasone with ramosetron demonstrated synergistic effects in preventing PONV for up to 48 hours postoperatively [21].

Safety concerns regarding perioperative glucocorticoid use remain important considerations. However, evidence indicates that single intraoperative doses of dexamethasone are not associated with increased wound infections,

impaired healing, or significant hyperglycemia [22]. Narrative reviews on anesthetic adjuvants have consistently supported dexamethasone as a safe and effective option for enhancing analgesia and reducing PONV [23]. Recent investigations into its role in thoracic and obstetric anesthesia suggest that perioperative dexamethasone may shorten recovery times, reduce opioid consumption, and improve patient comfort [24,25].

Overall, the findings of the present study align with recent evidence supporting dexamethasone as a useful adjunct in spinal anesthesia to reduce both postoperative pain and PONV. Variability in results across different trials may reflect differences in timing of administration, type of surgery, baseline analgesic regimens, and patient characteristics.

Conclusion

A single intravenous dose of dexamethasone (8 mg) administered after spinal anesthesia significantly reduced postoperative pain intensity and the incidence of postoperative nausea and vomiting during the first 24 hours when compared with placebo. Considering its efficacy and safety profile, dexamethasone may be recommended as an adjuvant to enhance perioperative outcomes in patients undergoing surgery under spinal anesthesia.

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