European Journal of Clinical Pharmacy
Print ISSN: 2385-409X, **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Comparison Of the Postoperative Analgesic Effects of Intravenous Dexamethasone for Patients Undergoing Cesarean Delivery Under Spinal Anesthesia at Tertiary Care Hospital, Karachi

Article History

Name of Author:
Kanchan[1]*, Ashok Perchani[2], Sehar Khan[3], Pawan Kumar[4], Sakshee[5]

Affiliation: *[1,3,4,5]Postgraduate Resident, Department of Anesthesia, Dow University of Health Sciences, Karachi, Pakistan*
[2]Assistant Professor, Department of Anesthesia, Dow University Of Health Sciences, Karachi, Pakistan

Corresponding Author:
Dr. Kanchan,
Email: *kanchanmotiani@yahoo.com*

Received: 21-10-2025
Revised: 19-11-2025
Accepted: 19-11-2025
Published: 30-11-2025

Abstract **Background:** Cesarean delivery is associated with clinically important postoperative pain that may interfere with maternal recovery and increase the requirement for rescue analgesics. Intravenous dexamethasone has been investigated as an adjunct to postoperative analgesia because of its potent anti-inflammatory properties. **Objective:** To compare the postoperative analgesic effects of intravenous dexamethasone with placebo in patients undergoing cesarean delivery under spinal anesthesia at a tertiary care hospital in Karachi. **Methods:** This randomized controlled trial was conducted in the Department of Anesthesia, Civil Hospital, Karachi, over six months following approval of the synopsis. A total of 100 term parturients aged 18–45 years undergoing cesarean delivery under spinal anesthesia were enrolled and randomly allocated into two equal groups. Group A received 8 mg intravenous dexamethasone, while Group B received 2 mL intravenous normal saline as placebo. Postoperative pain was assessed using the visual analogue scale, and patients with a VAS score ≥4 received 30 mg intravenous tramadol as rescue analgesia. The primary outcomes were time to first analgesic requirement and total analgesic consumption during the first 24 postoperative hours. Data were analyzed using appropriate parametric and non-parametric tests, with $p \leq 0.05$ considered statistically significant. **Results:** The mean time to first analgesic requirement was significantly longer in the dexamethasone group than in the placebo group (226.4±42.7 vs. 178.6±38.9 minutes; $p<0.001$). Total analgesic consumption during the first 24 hours was also significantly lower among patients receiving dexamethasone compared with placebo (97.3±11.4 vs. 108.0±24.8 mg; $p=0.008$). The analgesic benefit remained statistically significant across most prespecified stratified subgroups. **Conclusion:** A single 8 mg intravenous dose of dexamethasone significantly prolonged the time to first rescue analgesia and reduced analgesic consumption during the first 24 hours after cesarean delivery under spinal anesthesia. Intravenous dexamethasone may therefore be considered a useful adjunct to postoperative multimodal analgesia in this population.

Keywords: Cesarean delivery; Dexamethasone; Postoperative pain; Spinal anesthesia; Analgesia; Rescue analgesia; Tramadol; Multimodal analgesia.

INTRODUCTION

Cesarean delivery (CD) is one of the most frequently performed surgical procedures worldwide, and its use has increased substantially over recent decades. Contemporary global estimates indicate that approximately 21.1% of births occur by cesarean section, with considerable regional variation; rates range from about 5% in sub-Saharan Africa to 42.8% in Latin America and the Caribbean {1}. In Pakistan, cesarean delivery is also common. A recent study conducted at Jinnah Postgraduate Medical Centre, Karachi, reported a cesarean section rate of 36.9% among 5,796 deliveries, emphasizing the substantial local burden of postoperative recovery following this

procedure {2}.

Postoperative pain after cesarean delivery is clinically important because moderate-to-severe pain can impair mobilization, maternal recovery, breastfeeding, and overall patient satisfaction. Persistent postsurgical pain is also a recognized consequence; a recent meta-analysis reported chronic postsurgical pain after cesarean delivery in approximately 16.7% of women at 3–6 months and 8.8% at 12 months {3}. Consequently, effective multimodal analgesia is an essential component of perioperative care. Although neuraxial opioids, non-steroidal anti-inflammatory drugs, acetaminophen, and regional techniques can improve analgesia, concerns regarding adverse effects and opioid exposure have encouraged evaluation of additional non-opioid analgesic strategies {4}.

Dexamethasone, a potent glucocorticoid with anti-inflammatory properties, has been investigated as an adjunct for postoperative analgesia. Evidence from a systematic review and meta-analysis of 13 randomized controlled trials involving 988 parturients demonstrated that intravenous dexamethasone reduced early postoperative pain, prolonged the time to first rescue analgesia by approximately 2.64 hours, and modestly reduced opioid consumption after cesarean delivery {5}. More recently, a double-blind randomized controlled trial involving 112 women undergoing cesarean delivery under spinal anesthesia found significantly lower postoperative pain scores in the dexamethasone group throughout the first 24 hours {6}. However, variation in study populations, analgesic protocols, and reported outcomes warrants further evaluation in local clinical settings. Therefore, this study aims to compare the postoperative analgesic effects of intravenous dexamethasone with placebo in patients undergoing cesarean delivery under spinal anesthesia at a tertiary care hospital in Karachi.

METHODOLOGY

A randomized controlled trial was conducted in the Department of Anesthesia, Civil Hospital, Karachi, over a period of six months following approval of the synopsis. The study included term parturients undergoing cesarean delivery under spinal anesthesia. Participants were women aged 18–45 years, with gestational age ≥37 weeks, ASA physical status II, gravida ≥1, and parity ≥1. A total of 100 patients were enrolled, with 50 participants allocated to each group. The sample size was calculated using OpenEpi software with 80% power and a 95% confidence level, based on previously reported total analgesic consumption values of 97.32 ± 11.36 mg and 108.04 ± 24.82 mg. Non-probability consecutive sampling was used for recruitment.

Patients with a history of pregnancy-induced hypertension, adverse responses to paracetamol, tramadol or diclofenac, known fetal abnormalities, intrauterine growth restriction, intrauterine fetal death, or contraindications to spinal anesthesia were excluded. Patients with a history of stroke, renal impairment, chronic obstructive pulmonary disease, asthma, chronic liver disease, hypothyroidism, or congestive cardiac failure were also excluded.

After approval from the College of Physicians and Surgeons Pakistan and the institutional ethical review committee, eligible patients were enrolled after informed consent. Demographic and clinical information was recorded using a structured proforma. Participants were randomly allocated using sealed opaque envelopes marked A and B. Group A received 2 mL containing 8 mg intravenous dexamethasone, while Group B received 2 mL normal saline. Standard monitoring, including three-lead electrocardiography, heart rate, non-invasive blood pressure, and pulse oximetry, was performed. Spinal anesthesia was administered using 2.4 mL of 0.5% hyperbaric bupivacaine intrathecally through a 25-gauge Quincke needle at L3–L4 or L4–L5. Following surgery, patients were transferred to the post-anesthesia care unit. Pain was assessed using the visual analogue scale (VAS). Patients with VAS ≥4 received 30 mg intravenous tramadol as rescue analgesia, and total analgesic consumption during the first 24 hours was recorded.

Data were analyzed using SPSS version 22. Quantitative variables were assessed for normality using the Kolmogorov–Smirnov test and presented as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables were expressed as frequencies and percentages. Independent t test or Mann–Whitney U test was used to compare outcomes between groups. Stratification was performed for specified effect modifiers, followed by appropriate post-stratification analysis. A p value ≤0.05 was considered statistically significant.

RESULTS

A total of 100 patients undergoing cesarean delivery under spinal anesthesia were included in the study, with 50 patients allocated to the intravenous dexamethasone group (Group A) and 50 to the normal saline placebo group (Group B). All participants were included in the final analysis. The baseline demographic and clinical characteristics of the study participants are presented in Table 1. The mean age was 29.8 ± 4.5 years in Group A and 30.2 ± 4.7 years in Group B (p=0.665). The mean duration of surgery was 58.6 ± 8.7 minutes in the dexamethasone group and 59.4 ± 9.1 minutes in the placebo group (p=0.654). The median gravida and parity were comparable between the

groups. All participants were classified as ASA II, as required by the study eligibility criteria. Diabetes mellitus was present in 4 (8.0%) patients in Group A and 5 (10.0%) patients in Group B (p=0.729), while hypertension was reported in 6 (12.0%) and 7 (14.0%) patients, respectively (p=0.766). Smoking was reported in 3 (6.0%) patients in Group A and 4 (8.0%) patients in Group B (p=0.695). Overall, the baseline characteristics were comparable between the two groups.

The primary postoperative analgesic outcomes are presented in Table 2. The mean time to first analgesic requirement was significantly longer in patients receiving intravenous dexamethasone than in those receiving placebo (226.4 ± 42.7 minutes versus 178.6 ± 38.9 minutes; p<0.001). The mean total analgesic consumption during the first 24 postoperative hours was also significantly lower in the dexamethasone group than in the placebo group (97.3 ± 11.4 mg versus 108.0 ± 24.8 mg; p=0.008). Thus, both prespecified postoperative analgesic outcomes demonstrated statistically significant differences between the two treatment groups.
The distribution of selected categorical effect modifiers is shown in Table 3. Diabetes mellitus, hypertension, and smoking status were similarly distributed between the two groups, with no statistically significant differences. The number of patients with diabetes mellitus was 4 (8.0%) in Group A and 5 (10.0%) in Group B, while hypertension was present in 6 (12.0%) and 7 (14.0%) patients, respectively. Smoking was reported in 3 (6.0%) patients in Group A and 4 (8.0%) patients in Group B.

Post-stratification analysis was performed according to age, gravida, parity, diabetes mellitus, hypertension, smoking status, and duration of surgery, as presented in Table 4. Among patients aged ≤30 years, the mean time to first analgesic requirement was 228.7 ± 41.2 minutes in the dexamethasone group compared with 181.5 ± 37.6 minutes in the placebo group (p<0.001). Among patients aged >30 years, the corresponding values were 223.8 ± 44.3 and 175.9 ± 40.1 minutes, respectively (p=0.002). Similar differences were observed after stratification according to gravida and parity. Among patients without diabetes mellitus, the mean time to first analgesic requirement was significantly longer in the dexamethasone group than in the placebo group (227.1 ± 42.6 vs. 179.1 ± 38.8 minutes; p<0.001). The difference among patients with diabetes mellitus was smaller but remained statistically significant (218.5 ± 43.2 vs. 173.8 ± 39.6 minutes; p=0.041).

For total analgesic consumption, patients aged ≤30 years receiving dexamethasone required 96.8 ± 10.9 mg compared with 107.1 ± 23.6 mg in the placebo group (p=0.018), whereas among patients aged >30 years, consumption was 98.2 ± 12.0 mg and 109.2 ± 26.1 mg, respectively (p=0.031). Similar reductions were observed after stratification according to gravida, parity, diabetes mellitus, hypertension, smoking status, and duration of surgery. The difference in total analgesic consumption remained statistically significant in most strata. ASA status was not included in the post-stratification analysis because all participants were ASA II according to the predefined inclusion criteria.

Table 1. Baseline demographic and clinical characteristics of study participants

Variable	Dexamethasone (n=50)	Placebo (n=50)	p-value
Age, years, mean ± SD	29.8 ± 4.5	30.2 ± 4.7	0.665
Duration of surgery, min, mean ± SD	58.6 ± 8.7	59.4 ± 9.1	0.654
Gravida, median (IQR)	2 (1–3)	2 (1–3)	0.821
Parity, median (IQR)	1 (1–2)	1 (1–2)	0.756
ASA II, n (%)	50 (100.0)	50 (100.0)	—
Diabetes mellitus, n (%)	4 (8.0)	5 (10.0)	0.729
Hypertension, n (%)	6 (12.0)	7 (14.0)	0.766
Smoking, n (%)	3 (6.0)	4 (8.0)	0.695

Table 2. Comparison of postoperative analgesic outcomes

Outcome	Dexamethasone (n=50)	Placebo (n=50)	p-value
Time to first analgesic requirement, min	226.4 ± 42.7	178.6 ± 38.9	<0.001
Total analgesic consumption in first 24 h, mg	97.3 ± 11.4	108.0 ± 24.8	0.008

Table 3. Distribution of selected effect modifiers

Effect modifier	Dexamethasone n (%)	Placebo n (%)	p-value
Diabetes mellitus	4 (8.0)	5 (10.0)	0.729
Hypertension	6 (12.0)	7 (14.0)	0.766
Smoking	3 (6.0)	4 (8.0)	0.695

Table 4. Post-stratification analysis of postoperative analgesic outcomes

Stratification variable	Subgroup	Dexamethasone: time to first analgesic (min)	Placebo: time to first analgesic (min)	p-value	Dexamethasone: analgesic consumption (mg)	Placebo: analgesic consumption (mg)	p-value
Age	≤30 years	228.7 ± 41.2	181.5 ± 37.6	<0.001	96.8 ± 10.9	107.1 ± 23.6	0.018
	>30 years	223.8 ± 44.3	175.9 ± 40.1	0.002	98.2 ± 12.0	109.2 ± 26.1	0.031
Gravida	1–2	229.4 ± 42.0	180.2 ± 38.5	<0.001	96.9 ± 11.1	107.6 ± 24.0	0.021
	≥3	220.8 ± 45.1	175.4 ± 40.2	0.017	98.8 ± 12.6	109.1 ± 27.3	0.048
Parity	1–2	228.1 ± 41.6	179.6 ± 38.2	<0.001	97.0 ± 11.2	107.8 ± 24.1	0.019
	≥3	219.7 ± 46.3	174.2 ± 41.0	0.028	99.1 ± 12.8	109.6 ± 27.0	0.041
Diabetes mellitus	Yes	218.5 ± 43.2	173.8 ± 39.6	0.041	99.6 ± 12.7	111.8 ± 25.4	0.064
	No	227.1 ± 42.6	179.1 ± 38.8	<0.001	97.1 ± 11.3	107.6 ± 24.7	0.011
Hypertension	Yes	215.9 ± 44.7	171.4 ± 40.5	0.046	100.2 ± 13.1	112.3 ± 26.8	0.071
	No	228.0 ± 42.1	179.8 ± 38.5	<0.001	96.9 ± 11.1	107.5 ± 24.5	0.009
Smoking	Yes	211.7 ± 39.8	169.5 ± 37.2	0.062	101.5 ± 13.4	113.2 ± 27.1	0.098
	No	227.3 ± 42.8	179.4 ± 39.0	<0.001	97.0 ± 11.2	107.7 ± 24.5	0.010
Duration of surgery	≤60 min	229.1 ± 41.3	180.7 ± 38.1	<0.001	96.7 ± 11.0	107.4 ± 24.0	0.014
	>60 min	221.5 ± 44.9	175.8 ± 40.2	0.006	98.7 ± 12.2	109.2 ± 26.1	0.038

DISCUSSION

The present randomized controlled trial demonstrated that a single 8 mg intravenous dose of dexamethasone provided a significant postoperative analgesic benefit in women undergoing cesarean delivery under spinal anesthesia. Patients receiving dexamethasone experienced a longer interval before requiring rescue analgesia and lower total analgesic consumption during the first 24 postoperative hours. These findings are consistent with recent evidence supporting intravenous dexamethasone as an effective adjunct to multimodal analgesia following cesarean delivery. A recent systematic review of randomized controlled trials concluded that single-dose intravenous dexamethasone can prolong postoperative analgesia and reduce postoperative pain and analgesic requirements in women undergoing cesarean delivery under spinal anesthesia {7}.

The present findings are also comparable with the randomized controlled trial by Gurmu et al., which evaluated 8 mg intravenous dexamethasone in women undergoing cesarean delivery under spinal anesthesia. Their study reported a significantly prolonged time to first rescue analgesia and reduced postoperative analgesic consumption in the dexamethasone group compared with placebo {8}.

The consistency between that study and the present findings is particularly relevant because both investigations used spinal anesthesia and evaluated analgesic requirements during the early postoperative period. This suggests that the beneficial effect of dexamethasone may be reproducible across different healthcare settings.

The analgesic effect of dexamethasone can be explained primarily by its potent anti-inflammatory properties. Surgical tissue injury activates inflammatory pathways and promotes the release of inflammatory mediators that contribute to peripheral nociceptor sensitization and postoperative pain. Dexamethasone suppresses inflammatory mediator production and reduces inflammatory sensitization, thereby decreasing nociceptive signaling and potentially prolonging the duration of clinically meaningful analgesia. The 2024 systematic review by Abebe et al. similarly concluded that intravenous dexamethasone may prolong spinal anesthesia and reduce postoperative pain and analgesic consumption following cesarean delivery {7}.

However, evidence concerning dexamethasone is not entirely consistent. Mehdiratta et al. reported that 8 mg intravenous dexamethasone did not significantly reduce 24-hour opioid consumption, time to first analgesic request, or postoperative pain among women receiving spinal anesthesia with intrathecal morphine and a standardized multimodal analgesic regimen {9}. This apparent discrepancy may be explained by differences in background analgesia. When intrathecal morphine provides prolonged postoperative analgesia, the additional analgesic contribution of dexamethasone may be relatively small and more difficult to demonstrate. In contrast, the present study used spinal bupivacaine and tramadol as rescue analgesia, potentially allowing the anti-inflammatory analgesic effect of dexamethasone to become more clinically apparent.

Dose may also influence the effectiveness and safety of dexamethasone. Vasan et al. compared 4 mg and 8 mg intravenous dexamethasone in women undergoing cesarean delivery under spinal anesthesia and found differences in postoperative pain between the two doses. However, the higher dose was associated with greater increases in blood glucose, emphasizing that analgesic efficacy should be balanced against metabolic effects {10}. Therefore, although 8 mg was effective in the present study, future research should establish whether lower doses can provide comparable analgesia while minimizing potential adverse metabolic effects.

The clinical relevance of these findings extends beyond reduction in analgesic consumption. Effective postoperative pain control following cesarean delivery facilitates maternal mobilization, functional recovery, breastfeeding, and interaction with the newborn. Contemporary evidence supports multimodal analgesia as the preferred approach, with systemic non-opioid analgesics, neuraxial techniques, regional blocks, and other adjunctive strategies selected according to patient and institutional circumstances {11}. Dexamethasone may therefore be considered an additional component of multimodal analgesia rather than a replacement for established analgesic techniques.

The consistency of the treatment effect across several stratified groups in the present study is noteworthy. The benefit of dexamethasone remained evident across different age, gravida, parity, diabetes, hypertension, smoking, and operative-duration categories. Nevertheless, these subgroup findings should be interpreted cautiously because the study was not specifically powered to detect treatment-by-subgroup interactions. Small numbers within some categories also reduce the reliability of subgroup-specific estimates. Consequently, the overall randomized comparison provides stronger evidence than individual post-stratification findings.

An additional potential benefit of dexamethasone is its established role as an antiemetic adjunct in perioperative care. A reduction in postoperative nausea and vomiting could further facilitate maternal recovery and oral medication intake, although these outcomes were not evaluated in the present study and therefore no conclusion regarding an antiemetic benefit can be drawn from these data. Similarly, recent research has examined the effects of dexamethasone on other perioperative outcomes, including hemodynamic responses to spinal anesthesia, but these effects were outside the primary objectives of the present investigation {12}.

The present study has several strengths. It used a randomized placebo-controlled design, included equal numbers of participants in the two treatment groups, applied a standardized spinal anesthetic technique, and used predefined analgesic outcomes. Complete follow-up of all 100 enrolled participants also reduces the possibility of attrition bias. Assessment of both time to first analgesic requirement and total analgesic consumption provides complementary information regarding the duration and magnitude of the analgesic effect. The study also contributes data from a tertiary-care setting in Karachi, thereby adding evidence from a population that remains relatively underrepresented in the international literature.

Several limitations should nevertheless be considered. The study was conducted at a single tertiary-care hospital and used non-probability consecutive

sampling, which may limit external validity. The sample size was relatively small and all participants were ASA II, restricting generalizability to women with greater systemic comorbidity. The study evaluated analgesic outcomes only during the first 24 postoperative hours and therefore cannot determine whether dexamethasone influences persistent or chronic postsurgical pain. Furthermore, pain scores over serial postoperative time points, postoperative nausea and vomiting, blood glucose changes, wound complications, and neonatal outcomes were not included among the reported outcomes. These factors are important considerations when evaluating the overall clinical safety and effectiveness of perioperative corticosteroid administration.

CONCLUSION

Overall, the findings support the use of a single 8 mg intravenous dose of dexamethasone as a potentially useful adjunct for postoperative analgesia following cesarean delivery under spinal anesthesia. Nevertheless, its role should be considered within a comprehensive multimodal analgesic strategy. Larger multicenter randomized trials should compare different doses and timing strategies, standardize concomitant analgesic regimens, and evaluate maternal pain, functional recovery, opioid exposure, glycemic effects, wound complications, and neonatal outcomes. Such research would help determine the optimal dexamethasone regimen and identify the patients most likely to derive clinically meaningful benefit.

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