ORIGINAL ARTICLE

Comparison of Mean Duration of Postoperative Analgesia in Patients Undergoing Cesarean Section Under Spinal Anesthesia with Bupivacaine Vs. Bupivacaine Plus Buprenorphine

Adil Ashraf[1], Kainat[2], Ahsan Ali Ghuari[3], Muhammad Salman Maqbol[4]

ABSTRACT

Objective: To compare the effect of intrathecal bupivacaine alone vs intrathecal buprenorphine as an adjuvant to bupivacaine on postoperative analgesia in cesarean section patients receiving spinal anesthesia.

Study Design: The Quasi experimental study.

Place and Duration of Study: "Department of Anesthesia", Lahore General Hospital, Lahore, from 1st May 2022 to 29th May 2023.

Materials and Methods: Sixty pregnant women (ASA I-II, aged between 20-35 years) scheduled for elective cesarean section were enrolled through non-probability consecutive sampling. "Group B" received 1.8ml of 0.5 % hyperbaric bupivacaine with 0.5ml normal saline, while "Group BB" was administered 1.8ml of 0.5% hyperbaric bupivacaine combined with 60µg buprenorphine. All participants were informed of study objectives and provided written consent. Postoperative pain was evaluated using the visual analog scale (VAS). The duration of analgesia, total rescue analgesic use, onset of sensory block, and adverse effects were recorded 24 h after surgery.

Results: Group BB showed significant longer duration of postoperative analgesia and reduced need for rescue analgesics. Maximum VAS scores were also significantly lower in Group BB, with 73.3% of patients reporting a score of 4. Mild sedation (16.7%) and nausea/vomiting (10%) were noted in Group BB, but no respiratory depression was observed. All neonates had Apgar scores > 7 at 1 and 5 minutes.

Conclusion: Intrathecal buprenorphine combined with bupivacaine in cesarean section significantly improves pain control and prolongs the analgesic effect. Given its favorable benefit-risk profile, it can be considered a safe and effective adjunct to spinal anesthesia.

Keywords: *Analgesia Bupivacaine, Buprenorphine, Cesarean Section, Spinal Anesthesia.*

Introduction

Effective management of postoperative pain remains a fundamental aspect of surgical care, particularly in cesarean sections (C-sections) among the most frequently performed surgeries worldwide.[1] Inadequate control of postoperative pain can delay recovery, hinder mobilization, impair maternal-neonatal bonding and increase the risk of persistent pain and postpartum depression.[2,3,4] Despite its transient nature, postoperative pain requires timely and appropriate intervention to prevent long term consequences.[5]

Regional anesthesia, especially spinal anesthesia, is widely used for cesarean delivery owing to its fast onset, dense sensory blockade, and lower systemic drug exposure in both the mother and neonate.[6,7,8] Bupivacaine, a long acting, amide local anesthetic, is commonly used in subarachnoid block (SAB); However, when used alone at higher doses (12-15mg), it may lead to profound hypotension and inadequate postoperative analgesia duration.[9] To address these limitations, opioids and various adjuvants —including opioids, α2 agonists, and NMDA antagonists— have been incorporated into spinal anesthesia regimens.[10,11,12,13]

Buprenorphine, a partial µ-opioid receptor agonist,

[1]*Department of* Anesthesia
Lahore General Hospital, Lahore
[2]*Department of Anesthesia*
Benazir Butto Hospital, Rawalpindi
[3]*Department of Surgery*
Hameed Latif Hospital, Lahore
[4]*Department of Anesthesia*
Akhtar Saeed Medical College, Lahore

Correspondence:
Dr. Ahsan Ali Ghuari
Senior Registrar
Department of Surgery
Hameed Latif Hospital, Lahore
E-mail: drahsanalighauri@gmail.com

Received: July 18, 2025; Revised: December 20, 2025
Accepted: December 24, 2025

https://doi.org/10.57234/jiimc.december25.2596

has shown promising results as an adjuvant due to its high lipid solubility, strong receptor affinity, and prolonged duration of action, with minimal risk of respiratory depression.[14] Its antihyperalgesic properties and favorable safety profile make it particularly suitable for intrathecal administration in obstetric patients. Studies suggest that buprenorphine combined with bupivacaine enhances postoperative analgesia and reduces the need for supplemental analgesics compared with bupivacaine alone.[15,16]

However, despite growing international evidence, there is a paucity of local data evaluating the analgesics efficacy and safety of this combination in cesarean sections. This study aims to compare the postoperative analgesic profile and analgesics requirements of bupivacaine alone, versus combined with buprenorphine in patients undergoing cesarean section under spinal anesthesia.

Materials and Methods

This quasi experimental study was conducted at the "Department of Anesthesia, Lahore General Hospital, Lahore" from 1st May 2022 to 29th May 2023 after receiving ethical approval from the Institutional Review Board (No: UHS/education/126-22/3033).

A total of 60 pregnant women, aged 20-35 years, scheduled for elective lower segment cesarean section (LSCS) under spinal anesthesia, were enrolled through non-probability consecutive sampling and allocated into two groups (B and BB, n= 30 each) after obtaining informed consent. Based on previous literature, the mean (±SD) postoperative analgesia duration in bupivacaine group was assumed to be 2.67±1.39 hours, and in the bupivacaine combined with buprenorphine group vs. 12.3±6.5 hours.[16] The sample size was calculated using these values by WHO sample size calculator with a confidence level of 95% and power of 80%, yielding fewer than 10 participants in each group. However, 30 patients in each group included 30 patients in each group to ensure adequate power and account for potential variability.

The inclusion criteria were ASA physical status I and II, gravid females >36 weeks undergoing elective cesarean section, and those who gave informed consent. The exclusion criteria were ASA III or IV, emergency surgeries, comorbidities (e.g. cardiac disease, diabetes and hypertension), use of beta-blockers, or anticoagulants (INR>1.5), placental abnormalities, eclampsia, fetal distress, known drug allergies to study drugs, contraindications to spinal anesthesia, and partial or failed spinal block.

All patients received aspiration prophylaxis with oral famotidine 40 mg the night before surgery and intravenous metoclopramide 10 mg with oral famotidine on the morning of the surgery. Standard monitoring was applied, and IV access was obtained with an 18-gauge cannula. The patients were preloaded with 20 ml/kg 0.9% saline. After urinary catheterization, spinal anesthesia was administered at the L3-L4 level in the sitting position using a 25G spinal needle under aseptic measures.

Group B received 1.8 ml of 0.5% hyperbaric bupivacaine combined with 0.2 ml normal saline, whereas Group BB was received the same volume of bupivacaine with 60 µg buprenorphine (measured using a Monoject tuberculin syringe). The study was single-blinded. The drugs were administered by anesthesiologists who were not involved in patient care or data collection. The principal investigator, who was blinded to group allocation, recorded all postoperative parameters.

After the subarachnoid block (SAB), patients in both groups were positioned supine with a right hip wedge. Surgery was started upon achieving the T4 sensory level. Intraoperative fluids were maintained with normal saline, and oxytocin was administered after delivery. Apgar scores were calculated at 1 and 5 minutes. No intraoperative sedatives or additional analgesics were administered.

After surgery, analgesia was monitored hourly using a visual analog scale (VAS) with duration defined as the time from the completion of surgery to the first VAS score ≥4 for 24 hours postoperatively. Rescue analgesia (IV tramadol 20 mg) was administered when needed. The VAS scores, total rescue analgesic use, adverse effects (nausea, vomiting, sedation and respiratory depression) and peak sensory levels were recorded. Sedation was scored from zero to 3. Nausea and vomiting were managed with ondansetron 4 mg IV and pheniramine maleate was given for pruritus when required.

Data were analyzed using IBM SPSS Statistics for Windows, Version 28 (Released 2021; IBM Corp, Armonk, New York, USA). Continuous variables,

https://doi.org/10.57234/jiimc.december25.2596

including duration of postoperative pain, peak sensory level, surgery duration and maximum 24h VAS were reported as mean ± SD and analyzed using the independent t-test. Categorical variables such as the incidence of nausea, vomiting, sedation, and respiratory depression were expressed as frequencies and percentages and compared among groups using chi-square or Fisher's exact test depending on how the data were distributed. Statistical significance was defined as p-value < 0.05, with 95% confidence interval (CI) reported for all comparisons.

There were no dropouts or losses to follow-up during the study period; All 60 participants completed the study as per protocol. No serious complications related to anesthesia were recorded.

Results

Both groups had comparable baseline characteristics including age, height, weight, and duration of surgery, with no statistically significant differences (p > 0.05) (Table I). The peak sensory level attained was similar between groups with T4 being the most common level in both groups. In Group B, 63.3% reached T4, 30% reached T3, and 6.7% reached T2, while in Group BB, 40% reached T4, 50% reached T3, and 10% reached T2. The difference between groups was not statistically significant (p > 0.005) (Table II).

The onset of analgesia was slightly rapid in Group BB (3.22±0.71 min) than in Group B (3.95±0.7 min), but not significant (p > 0.005) (Figure I).

The duration of postoperative analgesia was also longer in Group BB (12.2±6.4 hours) as compared to Group B (2.75±1.4 hours) (p < 0.001).

Rescue analgesic requirements were lower in Group BB (mean dose = 1.02) than in Group B (mean dose = 2.1) (p < 0.001). The maximum VAS pain scores recorded during first 24 h after surgery were also lower in Group BB (p < 0.001). In Group B, 9 (30%) patients required additional analgesia versus only one (3.3%) in Group BB (p < 0.001). The most frequent highest VAS score in Group BB was 4, observed in 22(73.3%) patients (p < 0.001) (Table III).

No neonatal complications were noted, and all neonates had Apgar scores of >7 at 1 and 5 min in either group. In terms of side effects, 10% (n= 3) of Group BB had experienced nausea and vomiting, and 16.7% (n=5) reported mild to moderate sedation with a mean sedation score of (0.33±0.66). No respiratory depression was observed. In Group B, no side effects were recorded.

Table I: Demographic Characteristics of Study population

Characteristics	Group B (mean ± SD)	Group BB (mean ± SD)
Age (years)	26.1±2.04	27.21±1.55
Height (cm)	156.1±4.2	157±5.3
Weight (kg)	61±4.0	62±4.42
Duration of procedure (min)	53±12.2	50±12.2

SD: Standard deviation

Group B: patients receiving bupivacaine only

Group BB: patients receiving buprenorphine combined with bupivacaine

Table II: Comparison of Peak Sensory Block Levels between Group B and Group BB

Peak sensory level	Group B (n)	Group BB (n) %	*P* value
T2	2 (6.6%)	3 (10%)	0.19
T3	9 (30%)	15 (50%)	
T4	19 (63.3%)	12 (40%)	

Group B: bupivacaine

Group BB: buprenorphine + bupivacaine

Table III: Comparison of Highest Postoperative Pain Scores Between Group B and Group BB

VAS Score	Group B (n) %	Group BB (n) %	*p*-value
1	0	0	.0001
2	0	3 (10%)	
3	0	2 (6.6%)	
4	6 (20%)	22 (73.3%)	
5	16 (53.3%)	3(10%)	
6	8 (26.6%)	0	

VAS score: Visual Analogue Scale

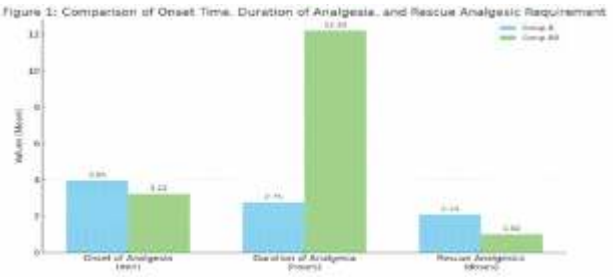

Figure I: Comparison of Onset Time, Duration and Rescue Analgesic Requirements in Both Groups

Group B: patients receiving bupivacaine only

Group BB: patients receiving buprenorphine combined with bupivacaine

Discussion

Subarachnoid block (SAB) with local anesthetics such as bupivacaine remains the standard choice for cesarean section; however, its use alone provides suboptimal postoperative pain control, increased requirement of rescue analgesics and maternal dissatisfaction.[9,10]The addition of intrathecal opioid adjuvants has been explored to extend analgesic duration while improving patient comfort minimizing systemic side effects.[15,16]

The present study demonstrates that administrating 60 µg intrathecal buprenorphine with bupivacaine significantly prolonged the duration of analgesia and reduced the need for rescue analgesia, without adverse impact on maternal or neonatal outcomes.

In this study, adding buprenorphine to bupivacaine (Group BB) extended the mean duration of postoperative analgesia compared to bupivacaine alone (Group B), thereby reducing the need for supplemental analgesia. Similar observations have been reported by other studies, even at varying doses, buprenorphine enhances analgesic duration with a faster onset of action.[17,20]

Visual analog scale (VAS) scores further confirmed improved pain control in the BB group, where 73.3% of patients reported a maximum VAS score of 4, significantly lower than those in Group B. Das et al. (2023) reported comparable analgesic superiority of intrathecal buprenorphine over fentanyl in cesarean delivery.[21]The faster onset of analgesia in Group BB can be attributed to its high µ-receptor affinity and lipophilicity facilitating rapid penetration into the spinal tissue[22,23]

Despite this, peak sensory levels remained comparable between groups, indicating that the dermatomal spread of anesthesia is predominantly governed by the fixed dose and volume of bupivacaine.[24]

Buprenorphine may cause adverse effects including sedation, nausea, and vomiting which generally increase at higher doses.[23,25] In this study, the BB group receiving 60µg intrathecally, experienced side effects including mild sedation (16.7%), nausea/vomiting (10%). Importantly, these effects were transient and manageable. No respiratory depression was noted. These side effects appear to be clinically acceptable considering their significant analgesic benefits.

All neonates had Apgar score >7 at 1- and 5-minutes, confirming no negative impact on neonatal condition when intrathecal buprenorphine was used at doses <75µg.[12,23]

This research is limited by its single-center approach, small sample size and absence of hourly pain measurements, only peak VAS scores were recorded due to nursing workflow realties in a high volume public hospital. While 60µg of buprenorphine was selected based on a balance between efficacy and safety, higher doses may yield different outcomes and warrant further investigation. Additionally, we did not evaluate maternal hemodynamics postoperatively or conduct an umbilical cord blood gas analysis, which could have provided more objective neonatal data.

Future research should include multicenter, large RCTs comparing intrathecal adjuncts with formal maternal satisfaction scoring, real-time pain mapping and detailed hemodynamic monitoring stratified dosing of buprenorphine to identify an optimal balance between analgesia and side effects.[23]

Conclusion

Intrathecal buprenorphine combined with bupivacaine in cesarean section significantly improves pain control and prolongs the analgesic effect. Given its favorable benefit-risk profile, it can be considered a safe and effective adjunct to spinal anesthesia.

Acknowledgement: None

Conflict of Interest: The authors declare no conflicts of interest.

Funding Disclosure: No financial support was received for this study.

REFERENCES

1. Crandon R, Storr N, Padhy S, Parker P, Lun S, Hughes I, et al. Enhanced recovery after caesarean section: Implementation of an ERAC protocol in a tertiary obstetric hospital. *J Perioper Pract.* 2024. https://doi.org/10.1177/17504589241256458.
2. Arroyo-Fernández FJ, Calderón Seoane JE, Torres Morera LM. Strategies of analgesic treatment after cesarean delivery: Current state and new alternatives. *Rev Esp Anestesiol Reanim (Engl Ed).* 2020;67(3):167–75. https://doi.org/10.1016/j.redar.2019.11.005.
3. Yun X, Ling-Qun H. Enhanced recovery after cesarean delivery. *Transl Perioper Pain Med.* 2023;10(2). https://doi.org/10.31480/2330-4871/174.

https://doi.org/10.57234/jiimc.december25.2596

4. Pinho B, Costa A. Impact of enhanced recovery after surgery (ERAS) guidelines implementation in cesarean delivery: A systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol.* 2024;292:201–9. https://doi.org/10.1016/j.ejogrb.2023.11.028.
5. Pombo A, Guimarães H, Araújo AM, Nunes CS, Cabido H, Lemos P. Anesthesia and postoperative analgesia for cesarean section: A retrospective observational study. *J Obstet Anaesth Crit Care.* 2025;15(1):53–8. https://doi.org/10.4103/joacc.joacc_25_24.
6. Ung TY, Jee YS, You HJ, Cho CK. Comparison of the effect of general and spinal anesthesia for elective cesarean section on maternal and fetal outcomes: a retrospective cohort study. Anesth Pain Med (Seoul). 2021;16(1):49-55. https://doi.org/10.17085/apm.20072.
7. Silverman M, Zwolinski N, Wang E, Lockwood N, Ancuta M, Jin E, et al. Regional analgesia for cesarean delivery: A narrative review toward enhancing outcomes in parturients. *J Pain Res.* 2023;16:3807–35. https://doi.org/10.2147/jpr.s428332.
8. Algarni RA, Albakri HY, Albakri LA, Alsharif RM, Alrajhi RK, Makki RM, et al. Incidence and risk factors of spinal anesthesia-related complications after an elective cesarean section: A retrospective cohort study. *Cureus.* 2023;15(1):e34198. https://doi.org/10.7759/cureus.34198.
9. Lim G, Facco FL, Nathan N, Waters JH, Wong CA, Eltzschig HK. A review of the impact of obstetric anesthesia on maternal and neonatal outcomes. *Anesthesiology.* 2018;129(1):192–215. https://doi.org/10.1097/aln.0000000000002182.
10. Swain A, Nag DS, Sahu S, Samaddar DP. Adjuvants to local anesthetics: Current understanding and future trends. *World J Clin Cases.* 2017;5(8):307–23. https://doi.org/10.12998/wjcc.v5.i8.307.
11. Dhawale TA, Sivashankar KR. Comparison of intrathecal fentanyl and buprenorphine as an adjuvant to 0.5% hyperbaric bupivacaine for spinal anesthesia. *Anesth Essays Res.* 2021;15(1):126–32. https://doi.org/10.4103/aer.aer_59_21.
12. Lorato SS, Reshad S, Seifu E, Gebrehiwot G, Achule A, Amsalu H, et al. Comparison of intrathecal bupivacaine with tramadol and bupivacaine with dexamethasone for post-cesarean section pain relief extension: A prospective observational study. *Ann Med Surg.* 2025;87(3):1159–64. https://doi.org/10.1097/MS9.0000000000003056.
13. Pascarella G, Ruggiero A, Garo ML, Strumia A, Difolco M, Papa MV, et al. Intrathecal dexamethasone as an adjuvant for spinal anesthesia: A systematic review. *Minerva Anestesiol.* 2024;90(7–8):662–71. https://doi.org/10.23736/s0375-9393.24.18054-6.
14. Gudin J, Fudin J. A narrative pharmacological review of buprenorphine: A unique opioid for the treatment of chronic pain. *Pain Ther.* 2020;9(1):41–54. https://doi.org/10.1007/s40122-019-00143-6.
15. Saleh M, Malik S, Memon GN, Rehman M. Comparative study on analgesia duration with bupivacaine–buprenorphine combination vs. bupivacaine alone for cesarean delivery. *Anaesth Pain Intensive Care.* 2023;27(5):501–5. https://doi.org/10.35975/apic.v27i5.2303.
16. Shrinivas TR, Ali L, Jamagond S. Comparative evaluation of intrathecal bupivacaine 0.5% with intrathecal bupivacaine 0.5% and 60-µg buprenorphine for postoperative analgesia in elective cesarean section patients. *J Pharm Bioallied Sci.* 2022;14(Suppl 1):S167–8. https://doi.org/10.4103/jpbs.jpbs_879_21.
17. Ravindran R, Sajid B, Ramadas K, Susheela I. Intrathecal hyperbaric bupivacaine with varying doses of buprenorphine for postoperative analgesia after cesarean section: A comparative study. *Anesth Essays Res.* 2017;11(4):952–6. https://doi.org/10.4103/aer.aer_82_17.
18. Kosel J, Bobik P, Tomczyk M. Buprenorphine – the unique opioid adjuvant in regional anesthesia. *Expert Rev Clin Pharmacol.* 2016;9(3):375–83. https://doi.org/10.1586/17512433.2016.1141047.
19. Ture P, Ramaswamy AH, Shaikh SI, Alur JB, Ture AV. Comparative evaluation of anesthetic efficacy and hemodynamic effects of a combination of isobaric bupivacaine with buprenorphine vs. isobaric levobupivacaine with buprenorphine for spinal anesthesia – A double-blinded randomized clinical trial. *Indian J Anaesth.* 2019;63(1):49–54. https://doi.org/10.4103/ija.IJA_667_17.
20. Das N, Lahkar B, Brahma H, Borah B. Analgesic efficacy in cesarean section: A comparison between fentanyl and buprenorphine as an adjuvant to bupivacaine under subarachnoid block. *New Indian J OBGYN.* 2023;10(1):77–83. https://doi.org/10.21276/ obgyn.2023.10.1.13.
21. Pande LJ, Arnet RE, Piper BJ. An examination of the complex pharmacological properties of the non-selective opioid modulator buprenorphine. *Pharmaceuticals (Basel).* 2023;16(10):1397. https://doi.org/10.3390/ph16101397.
22. Cansian JM, D'Angelo Giampaoli AZ, Immich LC, Schmidt AP, Dias AS. The efficacy of buprenorphine compared with dexmedetomidine in spinal anesthesia: A systematic review and meta-analysis. *Braz J Anesthesiol (Engl Ed).* 2024;74(6):844557. https://doi.org/10.1016/j.bjane.2024.844557.
23. Huang YY, Chang KY. Sensory block level prediction of spinal anesthesia with 0.5% hyperbaric bupivacaine: A retrospective study. *Sci Rep.* 2021;11(1):9105. https://doi.org/10.1038/s41598-021-88726-2.
24. Jacob AR, Paul J, Rajan S, Ravindran GC, Kumar L. Effect of injection speed of heavy bupivacaine in spinal anesthesia on quality of block and hemodynamic changes. Anesth Essays Res. 2021;15(4):348-51. https://doi.org/10.4103/aer.aer_1_22.
25. White LD, Hodge A, Vlok R, Hurtado G, Eastern K, Melhuish TM. Efficacy and adverse effects of buprenorphine in acute pain management: systematic review and meta-analysis of randomised controlled trials. Br J Anaesth. 2018;120(4):668-78. https://doi.org/10.1016/j.bja.2017.11.086.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

Authors have declared no specific grant for this research from any funding agency in public, commercial or nonprofit sector.

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

https://doi.org/10.57234/jiimc.december25.2596