



Original Research Article

Comparison of Multimodal versus Conventional Analgesia for Postoperative Pain and Early Recovery after Cesarean Section

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Abstract: Background: Cesarean section is associated with moderate-to-severe postoperative pain, which may interfere with early maternal mobilization, breastfeeding, oral intake, maternal-infant interaction and overall postoperative recovery. Multimodal analgesia, incorporating neuraxial opioid analgesia with scheduled non-opioid analgesics and limited rescue opioid administration, has become an important component of enhanced recovery after cesarean delivery (ERAC). However, implementation and effectiveness may vary according to institutional practice and available resources. This study compared postoperative pain and early recovery following cesarean section between women receiving a multimodal/ERAC analgesic protocol and those receiving conventional postoperative analgesic management. **Methods:** This comparative clinical study was conducted at the Department of Anesthesia, 250 Bedded Hospital, Lalmonirhat, Rangpur, Bangladesh, from July 2025 to June 2026. A total of 100 women undergoing elective or uncomplicated cesarean section under spinal anesthesia were equally allocated to multimodal/ERAC analgesia (Group A, n=50) or conventional analgesia (Group B, n=50). Pain was assessed using a 0–10 VAS/NRS at 2, 6, 12 and 24 hours. Secondary outcomes included recovery parameters, rescue analgesic use, adverse effects, breastfeeding, hospital stay and maternal satisfaction. **Results:** Baseline demographic and obstetric characteristics were comparable between groups. Mean pain scores were significantly lower in Group A at 6, 12 and 24 hours. At 24 hours, the mean pain score was 2.2 ± 0.8 in Group A compared with 3.1 ± 1.0 in Group B ($P < 0.001$). The multimodal group also demonstrated earlier ambulation (10.8 ± 3.1 vs. 14.7 ± 4.2 hours), earlier oral intake (3.8 ± 1.1 vs. 5.2 ± 1.5 hours), earlier catheter removal (10.4 ± 2.5 vs. 15.1 ± 3.8 hours), earlier spontaneous voiding (12.7 ± 3.0 vs. 17.5 ± 4.0 hours), lower rescue opioid requirement and shorter hospital stay. Maternal satisfaction was higher in the multimodal group. Nausea, vomiting and pruritus were slightly more frequent in Group A, consistent with exposure to neuraxial opioid, although serious adverse events were uncommon. **Conclusion:** A multimodal/ERAC analgesic strategy was associated with better postoperative pain control while facilitating earlier mobilization, oral intake, urinary recovery, breastfeeding and hospital discharge after uncomplicated cesarean section. Multimodal analgesia may therefore represent an effective opioid-sparing approach to postoperative cesarean care.

Keywords: Cesarean Section, Postoperative Pain, Multimodal Analgesia, Enhanced Recovery After Cesarean, Intrathecal Opioid, Paracetamol, NSAID, Opioid-Sparing Analgesia, Maternal Recovery.

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1. INTRODUCTION

Cesarean section is one of the most frequently performed major surgical procedures worldwide. Although advances in obstetric anesthesia, surgical technique and perioperative care have substantially improved maternal safety, postoperative pain remains an important clinical problem. Acute pain after cesarean delivery results from tissue trauma involving the abdominal wall, fascia, peritoneum and uterus and may be aggravated by uterine involution, movement, coughing and breastfeeding-related positioning. Poorly controlled postoperative pain can interfere with maternal mobility, infant care, breastfeeding and maternal satisfaction and may contribute to prolonged hospitalization and persistent postoperative pain [1, 2].

Effective post-cesarean analgesia therefore has objectives extending beyond reduction of pain scores. An optimal analgesic strategy should permit early mobilization, facilitate oral nutrition, support breastfeeding, minimize opioid-related adverse effects and permit timely removal of urinary catheters and discharge. Enhanced Recovery after Surgery (ERAS) principles have increasingly been incorporated into obstetric practice, resulting in the development of enhanced recovery after cesarean delivery (ERAC) pathways. These pathways integrate anesthetic, analgesic, nutritional, urinary, mobilization and discharge interventions to accelerate functional recovery [3, 4].

Current evidence supports multimodal analgesia as a central component of postoperative cesarean care. The approach uses medications with different mechanisms of action to achieve effective analgesia while reducing reliance on systemic opioids. The American College of Obstetricians and Gynecologists recommends a stepwise multimodal approach after cesarean delivery incorporating acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids when required [5]. Fixed or scheduled administration of non-opioid analgesics may provide more consistent analgesia and reduce opioid consumption compared with opioid-centered or purely as-needed regimens [5].

Neuraxial opioids, particularly intrathecal morphine, are an important component of cesarean analgesia when spinal anesthesia is used. Evidence indicates that intrathecal opioids prolong postoperative analgesia and reduce the need for systemic rescue medication [6]. However, their use may also increase opioid-related adverse effects, including pruritus, nausea, vomiting and sedation. Consequently, neuraxial opioid therapy is generally most effective when integrated into a broader

multimodal regimen rather than used as the sole analgesic intervention [6, 7].

The PROSPECT guideline for elective cesarean delivery recommends neuraxial opioid administration, regular paracetamol and NSAIDs with systemic opioids reserved for rescue analgesia when required [2]. Similarly, ERAS Society recommendations emphasize regular non-opioid analgesia, early oral intake, early mobilization and timely urinary catheter management as components of postoperative recovery [3, 4]. Updated ERAS recommendations continue to support these principles while emphasizing implementation, measurement and multidisciplinary coordination [8].

Despite increasing evidence supporting multimodal analgesia, conventional postoperative analgesic practice remains common in many institutions. Conventional care may depend more heavily on intermittent parenteral or oral analgesics prescribed according to patient request or institutional routine. Differences in medication scheduling, opioid availability, monitoring practices and nursing protocols may influence postoperative pain and recovery.

The clinical relevance of comparing these approaches is particularly important in settings where enhanced recovery pathways are being introduced gradually. A practical multimodal protocol based on medications routinely available in hospital practice may provide meaningful benefits without requiring expensive equipment or specialized interventions. Such an approach may be particularly relevant to resource-constrained healthcare systems.

The present study was therefore designed to compare postoperative pain intensity and early maternal recovery among women undergoing uncomplicated cesarean section under spinal anesthesia who received either a multimodal/ERAC analgesic protocol or conventional postoperative analgesic management.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a prospective comparative clinical study involving 100 women undergoing elective or uncomplicated cesarean section under spinal anesthesia. The study was conducted at the Department of Anesthesia, 250 Bedded Hospital, Lalmonirhat, Rangpur, Bangladesh, from July 2025 to June 2026, according to institutional obstetric and anesthesia protocols. The study population consisted of women scheduled for cesarean delivery who fulfilled the predefined eligibility criteria. Written

informed consent was obtained from all participants before enrollment.

2.2 Participants

Women aged 18 years or older undergoing elective or uncomplicated cesarean section under spinal anesthesia were considered eligible. Women were excluded if they received general anesthesia, experienced major intraoperative complications or severe obstetric hemorrhage, had a known allergy or contraindication to study analgesics, had significant hepatic or renal dysfunction affecting analgesic selection, chronic opioid use or known opioid dependence, inability to communicate pain scores reliably, major postoperative complications requiring intensive care or other conditions requiring individualized analgesic management.

2.3 Group Allocation

A total of 100 participants were allocated equally into two groups:

- **Group A:** Multimodal/ERAC analgesia, n=50.
- **Group B:** Conventional postoperative analgesia, n=50.

Group a received spinal anesthesia containing an intrathecal opioid according to the institutional anesthesia protocol, followed by scheduled paracetamol/acetaminophen and an NSAID when not contraindicated. Rescue opioid analgesia was administered only when clinically required.

Group B received conventional postoperative analgesic treatment according to the routine institutional protocol. Rescue medication was administered according to clinical need. The same standard surgical and obstetric care was provided to both groups.

2.4 Outcome Assessment

Pain intensity was evaluated using a 0–10 visual analogue scale/rating scale, where 0 represented no pain and 10 represented the worst imaginable pain. Assessments were performed at 2, 6, 12 and 24 hours after surgery.

Secondary outcomes included:

1. Time to first ambulation.
2. Time to first oral intake.
3. Time to urinary catheter removal.
4. Time to spontaneous voiding.
5. Total rescue analgesic requirement.
6. Postoperative nausea and vomiting.
7. Maternal sedation.
8. Pruritus.
9. Hypotension.
10. Time to first breastfeeding.
11. Length of hospital stay.
12. Maternal satisfaction.
13. ICU/HDU requirement.
14. Postoperative complications and readmission.

Maternal satisfaction was assessed using a simple postoperative satisfaction scale with higher scores indicating greater satisfaction with pain management and recovery.

2.5 Statistical Analysis

Continuous variables were expressed as mean $\pm$ standard deviation (SD). Between-group comparisons were performed using the independent-samples t test for approximately normally distributed continuous variables and the Mann–Whitney U test for non-normally distributed variables. Categorical variables were expressed as frequencies and percentages and were compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Serial postoperative pain scores measured at different time points were analyzed using repeated-measures analysis of variance when the underlying assumptions were satisfied. Pearson's or Spearman's correlation analysis was performed where clinically appropriate. All statistical tests were two-sided and a P value <0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

3. RESULTS

A total of 100 women were included in the analysis with 50 participants in each group. All participants completed the 24-hour postoperative assessment.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants

Variable	Group A: Multimodal (n=50)	Group B: Conventional (n=50)	P value
Age, years	27.8 $\pm$ 4.5	28.3 $\pm$ 4.7	0.59
BMI, kg/m ²	27.1 $\pm$ 3.2	27.5 $\pm$ 3.4	0.55
Gestational age, weeks	38.5 $\pm$ 0.9	38.4 $\pm$ 1.0	0.61
Primigravida	24 (48.0%)	22 (44.0%)	0.69
Multigravida	26 (52.0%)	28 (56.0%)	—
Elective cesarean	42 (84.0%)	41 (82.0%)	0.78
Uncomplicated cesarean	50 (100%)	50 (100%)	—
Operative duration, min	48.6 $\pm$ 8.7	49.8 $\pm$ 9.2	0.51

The two groups were broadly comparable with respect to age, body mass index, gestational age, parity, indication for cesarean delivery and operative duration. The mean age was 27.8 ± 4.5 years in Group

A and 28.3 ± 4.7 years in Group B ($P=0.59$). Similarly, mean operative duration did not differ significantly between groups.

Table 2: Postoperative Pain Scores at Different Time Points

Time after surgery	Group A	Group B	P value
2 hours	2.7 ± 0.9	3.0 ± 1.0	0.11
6 hours	2.4 ± 0.8	3.2 ± 1.0	<0.001
12 hours	2.1 ± 0.8	3.3 ± 1.0	<0.001
24 hours	2.2 ± 0.8	3.1 ± 1.0	<0.001

Postoperative pain was lower in the multimodal group throughout follow-up. The difference was relatively small and statistically nonsignificant at 2 hours, when the effects of neuraxial anesthesia and intrathecal opioid were

prominent. By 6 hours, mean pain was significantly lower in Group A. The difference persisted at 12 and 24 hours, indicating more sustained analgesic control with the multimodal regimen.

Table 3: Early Postoperative Recovery Parameters

Outcome	Group A	Group B	P value
First ambulation, hours	10.8 ± 3.1	14.7 ± 4.2	<0.001
First oral intake, hours	3.8 ± 1.1	5.2 ± 1.5	<0.001
Catheter removal, hours	10.4 ± 2.5	15.1 ± 3.8	<0.001
Spontaneous voiding, hours	12.7 ± 3.0	17.5 ± 4.0	<0.001
First breastfeeding, hours	4.9 ± 1.6	6.1 ± 2.0	0.002
Hospital stay, hours	55.4 ± 10.2	67.8 ± 13.4	<0.001

Women receiving multimodal analgesia demonstrated earlier functional recovery. Mean time to first ambulation was approximately four hours shorter in Group A than in Group B. Oral intake, urinary catheter removal and spontaneous voiding

also occurred earlier in the multimodal group. Time to first breastfeeding was approximately 1.2 hours shorter. Mean hospital stay was approximately 12.4 hours shorter in Group A.

Table 4: Rescue Analgesic Requirement

Analgesic outcome	Group A	Group B	P value
Required rescue opioid	14 (28.0%)	28 (56.0%)	0.006
Mean rescue opioid dose, mg morphine equivalent	4.8 ± 7.1	10.9 ± 9.8	<0.001
No rescue opioid required	36 (72.0%)	22 (44.0%)	0.006

Rescue opioid use was substantially lower in Group A. Only 28.0% of women in the multimodal group required rescue opioid analgesia compared

with 56.0% in the conventional group. The mean opioid requirement was also considerably lower in Group A.

Table 5: Postoperative Adverse Effects

Adverse event	Group A (n=50)	Group B (n=50)	P value
Nausea	9 (18.0%)	6 (12.0%)	0.41
Vomiting	4 (8.0%)	3 (6.0%)	0.69
Pruritus	8 (16.0%)	3 (6.0%)	0.11
Mild sedation	5 (10.0%)	4 (8.0%)	0.73
Hypotension	4 (8.0%)	3 (6.0%)	0.69
Urinary retention	2 (4.0%)	3 (6.0%)	0.65
Respiratory depression	0	0	—
ICU/HDU admission	0	0	—

Adverse events were generally mild and self-limited. Nausea, vomiting and sedation occurred in both groups. Pruritus was more frequent in the multimodal group, although the difference did not

reach statistical significance. No participant experienced clinically significant respiratory depression or required ICU/HDU admission.

Table 6: Maternal Satisfaction with Postoperative Analgesia

Satisfaction level	Group A	Group B
Very satisfied	28 (56.0%)	15 (30.0%)
Satisfied	17 (34.0%)	20 (40.0%)
Neutral	4 (8.0%)	9 (18.0%)
Dissatisfied	1 (2.0%)	6 (12.0%)
Overall satisfied	45 (90.0%)	35 (70.0%)

Maternal satisfaction was higher among women receiving multimodal analgesia. Overall satisfaction was reported by 90.0% of women in Group A compared with 70.0% in Group B.

4. DISCUSSION

The present comparative study evaluated whether a multimodal/ERAC analgesic strategy could improve postoperative pain and early recovery following uncomplicated cesarean section under spinal anesthesia. Multimodal analgesia was associated with lower pain scores after the early postoperative period, reduced rescue opioid requirements and earlier achievement of several functional recovery milestones. These findings support the concept that postoperative cesarean analgesia should be considered as part of a broader recovery pathway rather than as an isolated pain-control intervention.

The most important finding was the lower pain intensity observed in the multimodal group at 6, 12 and 24 hours. At 2 hours, the difference between groups was small and not statistically significant. This is clinically plausible because early postoperative pain after spinal anesthesia may remain relatively well controlled by the residual effects of neuraxial anesthesia and intrathecal opioid. As the effect of spinal anesthesia diminishes, the contribution of scheduled systemic non-opioid analgesia becomes increasingly important. The progressive separation of pain scores between groups at later time points therefore suggests sustained analgesic benefit from the multimodal strategy.

These findings are consistent with current evidence-based recommendations. The PROSPECT guideline recommends regular paracetamol and NSAIDs after cesarean delivery with opioids reserved for rescue analgesia, while neuraxial opioids are recommended as an important component of analgesia when neuraxial anesthesia is used [2]. ACOG similarly recommends a stepwise multimodal approach incorporating acetaminophen, NSAIDs and opioids according to clinical need [5].

An important finding in the present analysis was the lower rescue opioid requirement in the multimodal group. Only 28% of women in Group A required rescue opioid medication compared with 56% in Group B. The mean morphine-equivalent dose was also considerably lower. Opioid-sparing is a major advantage of multimodal analgesia because systemic opioids may cause nausea, vomiting, sedation, constipation and maternal-infant safety concerns, particularly during breastfeeding. ACOG recommends using opioids for the shortest reasonable duration and optimizing non-opioid agents first [5].

The role of intrathecal opioid analgesia is well established. A systematic review and network meta-analysis of randomized trials found that intrathecal opioids significantly prolong analgesic duration after cesarean delivery, although opioid-related adverse effects such as pruritus remain important considerations [6]. The present findings are compatible with this pharmacological principle because Group A combined neuraxial opioid analgesia with scheduled systemic agents rather than relying on systemic opioid rescue alone.

The multimodal group also demonstrated earlier ambulation. This is clinically important because early mobilization is a core component of enhanced recovery after cesarean delivery. Early ambulation may reduce the functional consequences of surgery, facilitate maternal self-care and infant care and contribute to shorter hospitalization. ERAS recommendations specifically incorporate early mobilization, analgesia, nutrition and urinary management into the postoperative recovery pathway [3-7].

Time to oral intake was also shorter in the multimodal group. Modern ERAS pathways encourage early return to oral nutrition when clinically appropriate rather than prolonged postoperative fasting [8]. Earlier oral intake can improve maternal comfort and may facilitate

medication administration by the oral route, reducing the need for parenteral therapy.

Urinary recovery was similarly improved. Women in Group A underwent catheter removal and spontaneous voiding earlier than those in Group B. This finding may reflect the broader effect of an enhanced recovery pathway rather than analgesia alone. Early catheter removal reduces the duration of urinary instrumentation and may improve maternal mobility. The ERAS Society has identified urinary management and early catheter removal as important postoperative elements of cesarean recovery [4-8].

Time to first breastfeeding was shorter in the multimodal group. Pain can make positioning and handling the infant difficult, while sedation and nausea may also interfere with early maternal-infant interaction. Effective opioid-sparing analgesia may therefore have indirect benefits for breastfeeding. Current guidance emphasizes the use of acetaminophen and NSAIDs as preferred postpartum analgesics for breastfeeding individuals and recommends minimizing systemic opioid exposure [5].

The reduction in hospital stay observed in Group A is another potentially important finding. Mean hospitalization was approximately 12 hours shorter. Although discharge timing is influenced by institutional policy, obstetric status, neonatal factors, social circumstances and patient preference, better pain control and earlier functional milestones can contribute to discharge readiness. ERAS pathways are specifically designed to coordinate these factors rather than viewing hospital discharge as an isolated outcome [3, 4].

Adverse effects deserve consideration. Pruritus was more frequent in Group A. This finding is consistent with the known association between neuraxial opioid administration and pruritus [6, 7]. Nausea and vomiting were also more frequent in Group A, although the differences were not statistically significant. These effects emphasize that multimodal analgesia does not mean eliminating opioid exposure completely; rather, it seeks to use neuraxial and systemic opioids strategically while minimizing unnecessary systemic opioid doses.

The current literature also suggests that the relative benefit of regional techniques depends on the background analgesic regimen. A recent meta-analysis comparing TAP block with intrathecal morphine found broadly similar pain outcomes but lower postoperative opioid consumption with intrathecal morphine and more pruritus associated

with neuraxial opioid use [9-14]. This supports the present study's emphasis on a practical multimodal strategy based on neuraxial opioid plus scheduled non-opioid medication rather than routinely adding invasive regional techniques to every patient.

The strengths of this study include standardized pain assessment at predefined time points and evaluation of several functional recovery outcomes rather than pain alone. The inclusion of breastfeeding, urinary recovery, ambulation, oral intake and maternal satisfaction provides a more comprehensive assessment of postoperative recovery.

However, several limitations should be acknowledged. First, the study included a relatively small sample size of 100 participants, which may limit statistical power for uncommon adverse events. Second, the conventional analgesia protocol may vary among institutions, which could affect external validity. Third, blinding is difficult in comparative postoperative analgesic studies, potentially introducing performance or reporting bias. Fourth, pain scores are subjective and may be influenced by individual expectations, anxiety and cultural factors. Fifth, the study was limited to early postoperative outcomes and did not evaluate longer-term outcomes such as persistent postsurgical pain or opioid use after discharge. Finally, the observed improvements in oral intake, urinary recovery, breastfeeding and hospital stay may reflect the combined effect of the broader ERAC pathway rather than analgesic treatment alone.

Overall, the findings support the clinical rationale for implementing multimodal analgesia after uncomplicated cesarean delivery. The principal benefit appears to be not simply a lower pain score but a coordinated improvement in postoperative function, opioid-sparing and maternal experience.

5. CONCLUSION

A multimodal/ERAC analgesic strategy was associated with superior postoperative pain control and facilitated earlier functional recovery following uncomplicated cesarean section under spinal anesthesia. Women receiving multimodal analgesia had lower pain scores after 6 hours, required fewer rescue opioids, ambulated earlier, resumed oral intake earlier, underwent earlier urinary catheter removal and spontaneous voiding, initiated breastfeeding earlier, had shorter hospital stays and reported greater maternal satisfaction.

The strategy is consistent with contemporary ERAC principles emphasizing neuraxial analgesia, scheduled

paracetamol/acetaminophen and NSAIDs with systemic opioids reserved for breakthrough pain. Implementation of a multimodal analgesic pathway may therefore improve maternal recovery while reducing unnecessary systemic opioid exposure after cesarean delivery.

6. DECLARATIONS

Ethics Approval and Consent: The study was conducted following approval from the relevant institutional ethics committee. Written informed consent was obtained from all participants before enrollment.

Consent for Publication: Not applicable.

Availability of Data: The underlying patient-level dataset should be made available in accordance with institutional ethical approval and journal policy.

Conflict of Interest: The authors declare that there are no financial or non-financial conflicts of interest related to this study.

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Authors Contributions

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of findings, manuscript preparation and critical revision of the final manuscript. All authors approved the final version of the manuscript.

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