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Original Article

# Impact of Post-Operative Analgesic Protocols on Early Maternal Recovery Following Caesarean Delivery

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## ABSTRACT

**Background:** Effective post-operative pain management following caesarean section is essential for early maternal recovery, improved breastfeeding, and enhanced maternal–infant bonding. Transverse Abdominis Plane Block (TAPB) has emerged as a promising component of multimodal analgesia.
**Objective:** To evaluate the effectiveness of ultrasound-guided TAP block in improving postoperative analgesia, reducing opioid requirement, and enhancing maternal recovery outcomes following caesarean delivery.
**Methods:** This prospective, randomized, double-blind, controlled study included 60 patients undergoing elective caesarean section under spinal anesthesia. Patients were divided into two groups: Group A received TAP block with bupivacaine in addition to standard analgesia, while Group B received standard analgesia alone. Pain scores (NPRS), analgesic requirements, postoperative nausea and vomiting (PONV), breastfeeding frequency, and maternal–infant bonding were assessed over 24 hours.
**Results:** Group A demonstrated significantly prolonged time to first analgesic request (12.1 ± 3.2 vs 3.8 ± 2.0 hours; $p<0.001$) and reduced rescue analgesic requirement (1.6 ± 0.7 vs 3.7 ± 0.5; $p<0.001$). Breastfeeding frequency and bonding were significantly improved in Group A ($p<0.001$). PONV incidence was significantly lower at multiple intervals.
**Conclusion:** TAP block significantly improves postoperative analgesia, reduces opioid requirement, enhances maternal recovery, and promotes early maternal–infant bonding following caesarean section.

***Keywords****: TAP block, caesarean section, postoperative analgesia, maternal recovery, bonding, breastfeeding.*

## INTRODUCTION

Caesarean section (CS) is one of the most frequently performed surgical procedures worldwide, with a steadily increasing incidence over the past few decades. According to global estimates, the rate of caesarean delivery has risen beyond the recommended levels in many countries, reflecting changes in obstetric practice, patient preference, and medico-legal considerations [1]. While caesarean delivery is often life-saving for both mother and fetus, it is associated with significant postoperative pain and delayed recovery when compared to vaginal delivery [2].

Postoperative pain following caesarean section is complex and multifactorial, involving both somatic and visceral components. The somatic pain arises from the surgical incision through the abdominal wall, while visceral pain originates from uterine contractions and manipulation during surgery [3]. If inadequately managed, postoperative pain can lead to delayed ambulation, increased risk of thromboembolic events, prolonged hospital stay, and impaired maternal psychological well-being [4,5].

Furthermore, effective pain control is critical for facilitating early initiation of breastfeeding and enhancing maternal–infant bonding. Pain and opioid-induced sedation can negatively affect maternal responsiveness, thereby interfering with early neonatal care and attachment [6,7]. Early skin-to-skin contact and breastfeeding are essential for neonatal thermoregulation, immune protection, and emotional development, as well as for reducing maternal stress and promoting uterine involution [8].

Traditionally, opioids have been the cornerstone of postoperative analgesia following caesarean section. However, opioid-based analgesia is associated with several adverse effects, including nausea, vomiting, pruritus, sedation, respiratory depression, and delayed gastrointestinal recovery [9,10]. These side effects not only compromise maternal comfort but also negatively impact neonatal outcomes, particularly when opioids are transferred through breast milk [11].

In recent years, there has been a paradigm shift toward multimodal analgesia, which involves the use of multiple analgesic agents and techniques targeting different pain pathways. This approach aims to enhance analgesic efficacy while minimizing opioid consumption and associated side effects [12]. Non-opioid analgesics such as paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs), along with regional anesthesia techniques, form the cornerstone of multimodal analgesia [13].

Among regional anesthesia techniques, the Transversus Abdominis Plane (TAP) block has gained considerable attention as an effective method for postoperative analgesia in abdominal surgeries, including caesarean section. First described by Rafi in 2001 and later popularized with ultrasound guidance, TAP block involves the deposition of local anesthetic in the fascial plane between the internal oblique and transversus abdominis muscles [14,15]. This results in blockade of the thoracolumbar nerves (T6–L1), which supply the anterior abdominal wall [16].

The introduction of ultrasound guidance has significantly improved the accuracy, efficacy, and safety of TAP block by allowing real-time visualization of anatomical structures and needle placement [17]. Numerous studies have demonstrated that ultrasound-guided TAP block provides effective postoperative analgesia, reduces opioid consumption, and improves patient satisfaction following caesarean section [18–20].

Despite these advantages, there is limited literature evaluating the broader impact of TAP block on maternal recovery parameters such as breastfeeding frequency, maternal–infant bonding, and neonatal supplementation requirements. These outcomes are increasingly recognized as important indicators of quality of care in obstetric anesthesia [21].

Maternal–infant bonding is a critical process that begins immediately after birth and has long-term implications for the emotional, cognitive, and social development of the child [22]. Pain, discomfort, and opioid-related side effects can disrupt this process, leading to suboptimal bonding and breastfeeding practices [23-28]. Therefore, optimizing postoperative analgesia is essential not only for pain control but also for improving maternal and neonatal outcomes.

Given these considerations, the present study was designed to evaluate the effectiveness of ultrasound-guided TAP block as part of a multimodal analgesic regimen in improving postoperative pain control, reducing opioid requirements, minimizing postoperative nausea and vomiting (PONV), and enhancing maternal recovery outcomes including breastfeeding and bonding.

## MATERIAL AND METHODS

This study was designed as a prospective, randomized, double-blind, controlled clinical trial conducted over a period of 18 months from January 2019 to June 2020 at a tertiary care teaching hospital at Sharda University. Ethical approval was obtained from the Institutional Ethics Committee prior to initiation of the study, and all procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

### Study Population and Sampling

A total of 60 pregnant women scheduled for elective caesarean section under spinal anesthesia were recruited. Patients were selected using a computer-generated randomization method and allocated into two equal groups (n=30 each):

- **Group A (Experimental group):** Received TAP block along with standard postoperative analgesia
- **Group B (Control group):** Received standard postoperative analgesia alone

### Inclusion Criteria

1. ASA physical status I and II
2. Age between 20–35 years
3. Singleton pregnancy
4. Elective caesarean section under spinal anesthesia

**Exclusion Criteria**

1. Known allergy to local anesthetics
2. Coagulopathy or anticoagulant therapy
3. Infection at the injection site
4. Obesity (BMI >30 kg/m²)
5. Pregnancy-induced hypertension or uncontrolled diabetes mellitus
6. Conversion to general anesthesia

**Anesthetic Technique**

All patients received standardized spinal anesthesia using 0.5% hyperbaric bupivacaine (0.2–0.4 mg/kg) administered at the L3–L4 intervertebral space using a 25G Quincke spinal needle. Adequate sensory blockade up to T4–T6 was confirmed before initiation of surgery.

Standard intraoperative monitoring included electrocardiography (ECG), pulse oximetry, and non-invasive blood pressure (NIBP). Hypotension was managed with intravenous fluids and vasopressors (ephedrine). Ondansetron (4 mg IV) was administered for nausea and vomiting as required.

**TAP Block Technique**

In Group A, bilateral ultrasound-guided TAP block was performed postoperatively in the high dependency unit using a high-frequency linear ultrasound probe. The transducer was placed in the mid-axillary line between the iliac crest and costal margin to identify the three muscle layers: external oblique, internal oblique, and transversus abdominis.

A 25G needle was inserted using an in-plane technique, and after negative aspiration, 2 mg/kg of 0.125% bupivacaine was injected into the fascial plane on each side. Proper spread of local anesthetic was confirmed sonographically.

**Postoperative Management**

**All patients received:**

- IV Paracetamol 1 g every 8 hours
- Rescue analgesia: IV Tramadol 50 mg for NPRS ≥4

**Outcome Measures**

Patients were assessed at 30 min, 1, 2, 4, 6, 8, 12, and 24 hours postoperatively for:

- Pain intensity using Numeric Pain Rating Scale (NPRS)
- Time to first analgesic request
- Total opioid consumption
- Incidence of PONV
- Breastfeeding frequency
- Maternal–infant bonding

**Statistical Analysis**

Data were analyzed using SPSS software (version 21.0). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

- Independent t-test for continuous variables
- Chi-square test for categorical variables
- Mann–Whitney U test for non-parametric data
- Repeated measures ANOVA for hemodynamic variables

A p-value <0.05 was considered statistically significant.

**RESULTS**

A total of 60 patients were included and evenly distributed between the two groups. Baseline characteristics such as weight and duration of surgery were comparable between groups, although Group A had a slightly higher mean age (p=0.04). The TAP block group demonstrated significantly improved postoperative outcomes. The mean time to first analgesic request was significantly prolonged in Group A (12.1 ± 3.2 hours) compared to Group B (3.8 ± 2.0 hours; p<0.001). Additionally, the total number of rescue analgesic doses required was significantly lower in Group A (1.6 ± 0.7) compared to Group B (3.7 ± 0.5; p<0.001), indicating superior analgesic efficacy.

Breastfeeding outcomes were significantly better in Group A, with a higher frequency of breastfeeding sessions (8.5 ± 1.2 vs 6.8 ± 1.0; p<0.001) and a lower requirement for supplementary feeding (6.7% vs 43.4%; p=0.001). Maternal–infant

bonding was significantly enhanced in the TAP block group, with earlier initiation (17.7 vs 27.3 minutes; p<0.001) and higher bonding frequency. Over time, bonding rates remained significantly higher in Group A at 4, 6, 8, and 12 hours.

The incidence of PONV was significantly lower in Group A, particularly at 2 hours (0% vs 23.3%; p=0.005), 6 hours (6.7% vs 43.3%; p=0.001), and 8 hours (0% vs 13.3%; p=0.038). Overall, TAP block resulted in better pain control, reduced opioid requirement, improved maternal recovery, and enhanced neonatal care outcomes.

**Overall response rate: 93.8%**

**Table (1): Socio-demographic details of study participants**

| Parameter | Group A [n=30] Mean (SD) | Group B [n=30] Mean (SD) | p value+ |
|---|---|---|---|
| Age (in years) | 28.5 (3.8) | 26.3 (4.4) | 0.04 |
| Weight (in kg) | 67.4 (6.2) | 69.2 (4.7) | 0.2 |
| Duration of surgery (in min) | 64.2 (12.0) | 67.0 (16.3) | 0.4 |
| No. of times breast feeding done | 8.5 (1.2) | 6.8 (1.0) | <0.001 |
| Supplement given to baby n (%) | 2 (6.7%) | 13 (43.4%) | 0.001* |
| First Child bonding time (in min) | 17.7 (4.5) | 27.3 (5.0) | <0.001 |
| Total no. of time child bonded with mother during breastfeeding (1-10) | 8.5 (1.2) | 6.8 (1.0) | <0.001 |
| First time of requirement of analgesia (in hours) | 12.1 (3.2) | 3.8 (2.0) | <0.001 |
| No. of rescue analgesia given | 1.6 (0.7) | 3.7 (0.5) | <0.001 |

**Table (2): Post-operative nausea / vomiting (PONV) at all-time intervals among study participants**.

| Post-operative nausea / vomiting | Group A [n=30] n(%) | Group B [n=30] n(%) | p value* |
|---|---|---|---|
| at 30 mins | 0 (0) | 0 (0) | - |
| at 1 hr | 0 (0) | 0 (0) | - |
| at 2 hr | 0 (0) | 7 (23.3) | 0.005 |
| at 4 hr | 2 (6.7) | 6 (20) | 0.12 |
| at 6 hr | 2 (6.7) | 13 (43.3) | 0.001 |
| at 8 hr | 0 (0) | 4 (13.3) | 0.038 |
| at 12 hr | 5 (16.6) | 7 (23.3) | 0.519 |
| at 24 hr | 0 (0) | 3 (10) | 0.08 |

* chi Square ($\chi^2$) test

**Table (3): Child bonding – at different time intervals among study participants**

| Child bonding | Group A [n=30] n(%) | Group B [n=30] n(%) | p value* |
|---|---|---|---|
| at 30 mins | 30 (100) | 30 (100) | - |
| at 1 hr | 30 (100) | 30 (100) | - |
| at 2 hr | 30 (100) | 30 (100) | - |
| at 4 hr | 29 (96.7) | 22 (73.3) | 0.01 |
| at 6 hr | 27 (90) | 12 (40) | <0.001 |
| at 8 hr | 26 (86.7) | 2 (6.7) | <0.001 |
| at 12 hr | 10 (33.3) | 1 (3.3) | 0.003 |
| at 24 hr | 2 (6.67) | 0 (0) | 0.15 |

chi Square ($\chi^2$) test

## DISCUSSION

Effective postoperative pain management following caesarean section remains essential for enhanced maternal recovery, and the findings of the present study clearly demonstrate that ultrasound-guided Transversus Abdominis Plane (TAP) block significantly improves postoperative analgesia, reduces opioid consumption, and enhances maternal–infant outcomes. These findings are consistent with earlier literature demonstrating the opioid-sparing effect and improved analgesic efficacy of TAP block as part of multimodal analgesia [21].

The prolonged duration before the first requirement of rescue analgesia and reduced total opioid consumption observed in this study can be explained by the mechanism of TAP block, which targets thoracolumbar nerves (T6–L1) supplying the anterior abdominal wall. This leads to effective attenuation of somatic pain following surgical incision. Similar findings have been consistently reported in previous randomized trials [16,21].

Another significant finding of the present study is the reduction in postoperative nausea and vomiting (PONV), which is primarily attributable to decreased opioid consumption. Opioids are well known to increase the risk of PONV, and

minimizing their use improves postoperative comfort and recovery [10]. The reduced incidence of PONV in the present study further supports the role of TAP block as an opioid-sparing technique.

The present study also demonstrated significantly improved maternal–infant bonding and breastfeeding outcomes in the TAP block group. Effective pain relief without sedation allows early mobilization, increased maternal responsiveness, and improved neonatal care. This aligns with earlier studies showing that inadequate pain control and opioid-induced sedation can impair breastfeeding initiation and bonding [6,7].

A **2025 randomized controlled trial by Yang et al.** demonstrated that addition of TAP block to multimodal analgesia significantly reduced postoperative pain scores at rest and during mobilization, decreased opioid consumption, improved maternal satisfaction, and facilitated earlier ambulation and breastfeeding [29].

These findings strongly support the present study, particularly regarding improved recovery parameters and reduced analgesic requirement.

Similarly, another **2025 randomized controlled study by Cao et al.** comparing dual-level TAP block with conventional TAP block showed that enhanced block coverage resulted in better analgesic outcomes and improved postoperative pain control [30].

This highlights that modifications in TAP block technique may further enhance its clinical effectiveness.
A **2025 prospective clinical study by Khalid et al.** reported that ultrasound-guided TAP block significantly reduces postoperative opioid requirement and improves pain scores following caesarean section [31]. This finding is directly consistent with the reduced analgesic consumption observed in our study.

From **2024 evidence**, a review by Qin et al. highlighted that regional nerve blocks, including TAP block, play a crucial role in reducing postoperative pain and minimizing opioid-related adverse effects in caesarean patients [32]. Additionally, a randomized study comparing quadratus lumborum (QL) block and TAP block reported that while both techniques are effective, TAP block remains a simple, safe, and widely applicable method for postoperative analgesia.

From **2023 literature**, TAP block continues to be recognized as a standard regional technique for abdominal surgeries, providing effective somatic analgesia and forming an important component of multimodal pain management strategies [33].

Although TAP block provides excellent somatic analgesia, some studies suggest that newer regional techniques such as quadratus lumborum (QL) block and erector spinae plane (ESP) block may provide additional visceral analgesia. A recent 2025 study comparing ESP block and TAP block showed improved early pain scores with ESP block, although overall opioid consumption and patient satisfaction were comparable Similarly, studies comparing QL block with TAP block suggest that QL block may provide longer duration of analgesia; however, TAP block remains easier to perform and has a well-established safety profile .

The findings of this study reinforce that TAP block is an effective, safe, and opioid-sparing technique that improves not only postoperative pain but also broader maternal recovery outcomes. Its ability to reduce opioid-related side effects, enhance breastfeeding, and improve maternal–infant bonding makes it highly valuable in obstetric anesthesia practice.

Ultrasound guidance further enhances the accuracy and safety of TAP block, making it a reliable and reproducible technique. Given its simplicity and effectiveness, TAP block can be routinely incorporated into multimodal analgesia protocols, especially in settings where minimizing opioid use is a priority.

## CONCLUSION

Ultrasound-guided TAP block is an effective component of multimodal analgesia for caesarean section. It significantly reduces postoperative pain, delays the need for rescue analgesia, decreases opioid consumption, minimizes PONV, and enhances maternal–infant bonding and breastfeeding. Incorporation of TAP block into routine clinical practice can improve maternal recovery and neonatal outcomes.

## LIMITATIONS

- Small sample size (n=60)
- Single-center study
- Short follow-up period (24 hours only)
- Subjective pain assessment (NPRS)
- Long-term neonatal outcomes not assessed

**DECLARATIONS:**

**Conflicts of interest: There is no any conflict of interest associated with this study**

**Consent to participate:** There is consent to participate.

**Consent for publication:** There is consent for the publication of this paper.

**Authors' contributions: Author equally contributed the work.**

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