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Comparative Efficacy of Ropivacaine 0.2% Versus Ropivacaine 0.2% Combined with Buprenorphine in Transversus Abdominis Plane Block for Postoperative Analgesia Following Cesarean Section: A Randomized Double-Blind Study

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ABSTRACT

Background: Cesarean section procedures frequently result in significant postoperative pain, necessitating effective multimodal analgesic strategies. The transversus abdominis plane (TAP) block has emerged as a valuable component of postoperative pain management protocols for abdominal surgeries.
Aims: This study aimed to compare the analgesic efficacy of 0.2% ropivacaine alone versus 0.2% ropivacaine combined with buprenorphine in TAP blocks for postoperative pain management following elective cesarean section under spinal anesthesia.
Methods: This prospective, randomized, double-blind, comparative clinical study was conducted over four months at a tertiary care hospital. Sixty patients scheduled for elective cesarean section under spinal anesthesia were randomized into two equal groups. Group A received bilateral TAP blocks with 15cc of 0.2% ropivacaine per side. Group B received bilateral TAP blocks with 14cc of 0.2% ropivacaine plus 1cc of buprenorphine (0.3 mg) per side. Pain assessment was performed using the Visual Analogue Scale (VAS) at predetermined intervals postoperatively.
Results: The mean duration of analgesia was significantly prolonged in Group B compared to Group A (9.3 ± 1.7 hours versus 5.6 ± 1.1 hours, $p < 0.001$). Visual Analogue Scale scores were significantly lower in Group B at 4, 6, 12, and 24 hours postoperatively. The total requirement for rescue analgesia was significantly reduced in Group B (68 ± 19 mg versus 109 ± 26 mg tramadol, $p < 0.01$). Mild sedation was observed in three patients in Group B, with no significant differences in other adverse effects between groups.
Conclusions: The addition of buprenorphine to ropivacaine in TAP blocks significantly enhances the duration and quality of postoperative analgesia following cesarean section, with minimal additional side effects. This combination represents an effective strategy for optimizing postoperative pain management in obstetric patients.

Keywords*: Buprenorphine, cesarean section, postoperative analgesia, ropivacaine, transversus abdominis plane block.*

INTRODUCTION

Cesarean section represents one of the most frequently performed surgical procedures globally, with postoperative pain management being a critical component of perioperative care. Effective analgesia facilitates early mobilization, reduces the risk of thromboembolic complications, enhances maternal-infant bonding, and improves overall patient satisfaction.

Regional anesthesia techniques, particularly neuraxial blockade, have become the preferred method for cesarean delivery, providing excellent intraoperative conditions while allowing the parturient to remain conscious during the procedure.

However, the duration of postoperative analgesia from neuraxial techniques is limited, necessitating supplementary analgesic interventions.[1]

The transversus abdominis plane (TAP) block has gained considerable attention as an effective adjuvant technique for managing postoperative pain following abdominal surgeries, including cesarean section. This technique involves the injection of local anesthetic agents into the fascial plane between the internal oblique and transversus abdominis muscles, targeting the thoracolumbar nerves that supply the anterior abdominal wall.

Ropivacaine, an amide local anesthetic with favorable pharmacokinetic properties, has emerged as a preferred agent for TAP blocks due to its prolonged duration of action and reduced potential for cardiac and central nervous system toxicity compared to bupivacaine. [2]

Buprenorphine, a partial μ-opioid receptor agonist with high receptor affinity and prolonged duration of action, has been investigated as a potential adjuvant to local anesthetics in peripheral nerve blocks. Its unique pharmacological profile provides analgesic effects that may extend beyond those achieved with local anesthetics alone. [4]

This study was designed to conduct a rigorous comparison of ropivacaine alone versus ropivacaine combined with buprenorphine in TAP blocks for postoperative analgesia following elective cesarean section.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized, double-blind, comparative clinical study was conducted at a tertiary care hospital over a period of four months. The study protocol received approval from the institutional ethics committee, and written informed consent was obtained from all participants prior to enrollment.

Participants

Sample Size: Sixty patients scheduled for elective cesarean section under spinal anesthesia were enrolled in the study and randomly allocated into two equal groups of thirty patients each.

Inclusion Criteria: [3]

- Pregnant women aged 18-35 years
- American Society of Anesthesiologists (ASA) physical status classification I or II
- Scheduled for elective cesarean section under spinal anesthesia
  Willing to provide informed consent
  Exclusion Criteria:
- History of chronic pain or long-term analgesic medication use
- Known allergies to study medications
- Coagulopathy or infection at the injection site
- Complicated pregnancies requiring emergency intervention
- Patient refusal to participate

Randomization and Blinding

Participants were randomized using computer-generated random number tables into two groups:

- Group A: TAP block with 15cc of 0.2% ropivacaine per side
- Group B: TAP block with 14cc of 0.2% ropivacaine plus 1cc of buprenorphine (0.3 mg) per side
  An independent anesthesiologist not involved in patient care prepared the study medications to ensure double-blind conditions.

RESULTS

Demographic Characteristics

The demographic characteristics were comparable between groups, with no statistically significant differences observed (Table 1).

Table 1: Demographic Characteristics

Parameter	Group A (Ropivacaine)	Group B (Ropivacaine + Buprenorphine)	p-value
Mean Age (years)	26.4 ± 3.0	29.0 ± 3.2	> 0.05
Weight (kg)	60.2 ± 5.6	62.0 ± 6.1	> 0.05

Duration of Analgesia

The primary outcome measure demonstrated a statistically significant difference between groups (Table 2). [5]

Table 2: Duration of Analgesia

Group	Duration (hours) Mean ± SD	p-value
Group A (Ropivacaine)	5.6 ± 1.1	< 0.001
Group B (Ropivacaine + Buprenorphine)	9.3 ± 1.7	

Visual Analogue Scale Pain Scores

Pain intensity assessments revealed significant differences between groups at multiple time points (Table 3, Figure 1).

Table 3: VAS Pain Scores for Postoperative Pain

Time Post-op (hours)	Group A (Ropivacaine) Mean ± SD	Group B (Ropivacaine + Buprenorphine) Mean ± SD	p-value
2 hours	2.2 ± 0.8	1.7 ± 0.8	> 0.05
4 hours	3.3 ± 0.9	2.3 ± 0.6	< 0.01
6 hours	4.6 ± 1.0	3.5 ± 1.0	< 0.001
12 hours	5.2 ± 1.6	3.5 ± 1.0	< 0.001
24 hours	4.6 ± 1.0	3.2 ± 0.6	< 0.05

Rescue Analgesia Requirements

The total consumption of rescue analgesics differed significantly between groups (Table 4, Figure 3).

Table 4: Total Rescue Analgesia Requirement

Group	Mean ± SD (mg)	p-value
Group A (Ropivacaine)	109 ± 26	< 0.01
Group B (Ropivacaine + Buprenorphine)	68 ± 19	

Adverse Effects Profile

The safety profile of both interventions was assessed through systematic monitoring (Table 5).

Table 5: Occurrence of Side Effects

Side Effect	Group A (Ropivacaine)	Group B (Ropivacaine + Buprenorphine)	p-value
Nausea	1	2	> 0.05
Vomiting	1	2	> 0.05
Sedation (Grade 1-2)	0	3	< 0.05

DISCUSSION

This randomized controlled trial demonstrates that the addition of buprenorphine to ropivacaine in TAP blocks significantly enhances postoperative analgesia following cesarean section. The results provide compelling evidence for the clinical utility of this combination in optimizing pain management strategies for obstetric patients.

The prolonged duration of analgesia observed in the buprenorphine group (9.3 ± 1.7 hours versus 5.6 ± 1.1 hours) represents a clinically meaningful improvement that translates to enhanced patient comfort and reduced healthcare resource utilization. This finding aligns with the pharmacological properties of buprenorphine, which demonstrates high receptor affinity and prolonged receptor occupancy. [6]

The significant reduction in VAS pain scores observed from 4 hours postoperatively onward in the buprenorphine group indicates not only prolonged duration but also improved quality of analgesia. This finding is particularly relevant in the context of cesarean recovery, where effective pain control facilitates early mobilization, breastfeeding initiation, and overall maternal well-being.

The opioid-sparing effect demonstrated by the 38% reduction in rescue analgesic consumption in the buprenorphine group has important clinical implications. Reduced reliance on systemic opioids minimizes the risk of opioid-related adverse effects, which are of particular concern in the postpartum period. [5]

The safety profile of the buprenorphine combination appears acceptable, with only mild sedation occurring in a small number of patients. This side effect profile is consistent with buprenorphine's known pharmacological properties and did not require clinical intervention in any case

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CONCLUSIONS

The addition of buprenorphine (0.3 mg) to ropivacaine (0.2%) in TAP blocks significantly enhances the duration and quality of postoperative analgesia following cesarean section. This combination provides prolonged pain relief, reduces the requirement for rescue analgesics, and maintains an acceptable safety profile with minimal additional adverse effects. These findings support the clinical adoption of buprenorphine as an effective adjuvant to ropivacaine in TAP blocks for obstetric patients undergoing cesarean delivery. The demonstrated benefits of this approach contribute to the optimization of multimodal analgesia strategies and may improve overall patient outcomes in the postoperative period.

Declaration:
Conflicts of interests: The authors declare no conflicts of interest.
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