Section: Anaesthesiology

Original Research Article

EFFICACY OF PREEMPTIVE DEXAMETHASONE ADDED TO ROPIVACAINE IN ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK FOR POSTOPERATIVE ANALGESIA AFTER LAPAROSCOPIC SURGERIES - A OBSERVATIONAL COMPARATIVE STUDY

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ABSTRACT

Background: The aim of this study was to evaluate the efficacy of preemptive dexamethasone added to 0.25% ropivacaine in ultrasound-guided transversus abdominis plane blocks for postoperative analgesia after elective laparoscopic abdominal surgery. **Materials and Methods:** This prospective observational comparative study included 60 adult patients undergoing elective laparoscopic abdominal surgery. Patients received preemptive ultrasound-guided bilateral TAP block with either 0.25% ropivacaine alone (Group R, n=30) or 0.25% ropivacaine with 4 mg dexamethasone (Group RD, n=30). The primary outcome was duration of postoperative analgesia. Secondary outcomes included 24-hour tramadol consumption, numerical rating scale pain scores, incidence of postoperative nausea and vomiting, patient satisfaction, and complications. **Result:** The mean duration of analgesia was significantly longer in Group RD (19.8 ± 2.4 hours) than in Group R (12.6 ± 1.8 hours, p<0.001). Twenty-four-hour tramadol consumption was lower in Group RD (76.3 ± 24.5 mg vs. 126.7 ± 32.1 mg, p<0.001). Pain scores from 4 hours onward were significantly lower in Group RD. Patient satisfaction was higher in Group RD (86.7% very satisfied vs. 56.7%, p=0.01). No complications occurred in either group. **Conclusion:** The addition of dexamethasone 4 mg to ropivacaine in preemptive TAP blocks significantly prolongs postoperative analgesia, reduces opioid consumption, improves pain control, and enhances patient satisfaction without increasing complications.

INTRODUCTION

Effective postoperative pain control is a cornerstone of enhanced recovery protocols following surgical interventions.[1] Inadequate analgesia can result in increased morbidity, delayed mobilization, prolonged hospital stay, and higher healthcare costs.[2] Laparoscopic abdominal surgeries, although less invasive than open procedures, are still associated with significant postoperative discomfort, primarily due to abdominal wall incisions, visceral manipulation, and residual pneumoperitoneum.[3] While systemic opioids remain a mainstay for postoperative pain relief, their adverse effects, including nausea, vomiting, sedation, respiratory depression, pruritus, and delayed bowel function, have encouraged the use of multimodal and opioid-sparing analgesic techniques.[4]

Regional anesthesia techniques, particularly the transversus abdominis plane (TAP) block, have emerged as important components of multimodal analgesia for abdominal surgery. The TAP block involves deposition of local anesthetic in the fascial plane between the internal oblique and transversus abdominis muscles, thereby blocking the thoracolumbar nerves from T6 to L1 that supply the anterior abdominal wall. With the increasing availability of ultrasound guidance, TAP blocks can now be performed with greater accuracy and safety, improving block reliability while reducing the risk of complications.[5]

Ropivacaine is a long-acting amide local anesthetic widely used in regional anesthesia because of its

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favorable sensory blockade profile and relatively lower cardiotoxic and neurotoxic potential compared with some other long-acting local anesthetics.[6,7] In TAP blocks, 0.25% ropivacaine provides effective postoperative analgesia; however, the duration of analgesia may still be limited and may not adequately cover the entire period of peak postoperative pain after laparoscopic abdominal surgery.[8] This limitation has led to increasing interest in the use of adjuvants to prolong the duration and improve the quality of peripheral nerve blocks.

Dexamethasone, a synthetic corticosteroid with potent anti-inflammatory and antiemetic properties, has been studied extensively as an adjuvant in regional anesthesia. Its mechanism in prolonging analgesia is thought to involve multiple pathways, including reduction of local inflammation, suppression of ectopic neuronal discharge, and local vasoconstriction, which may delay systemic absorption of the local anesthetic.[9] In addition, dexamethasone has a well-established role in reducing postoperative nausea and vomiting, thereby improving patient comfort and recovery.[10]

However, evidence regarding the efficacy of dexamethasone as an adjuvant in truncal blocks, particularly TAP blocks for laparoscopic abdominal surgery, remains variable. Some studies have reported clinically meaningful prolongation of analgesia and reduction in postoperative opioid requirements, while others have shown modest benefits. Differences in surgical procedures, block techniques, local anesthetic agents, adjuvant doses, and outcome assessment methods may account for these variations.[11]

Given the increasing use of laparoscopic abdominal surgery and the continued emphasis on minimizing opioid exposure, evaluating dexamethasone as an adjuvant to ropivacaine in preemptive TAP blocks is clinically relevant. A preemptive TAP block, administered after induction of anesthesia but before surgical incision, may further improve postoperative analgesia by reducing nociceptive input and limiting central sensitization.

MATERIALS AND METHODS

This prospective observational comparative study was conducted in the Department of Anesthesiology, Tezpur Medical College and Hospital, Assam, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all eligible patients prior to participation.

The study included 60 adult patients of either sex, aged between 18 and 60 years, with American Society of Anesthesiologists physical status I or II, scheduled for elective laparoscopic abdominal surgery under general anesthesia. Patients with known hypersensitivity to local anesthetics or corticosteroids, infection at the injection site, coagulopathy, uncontrolled systemic illness, chronic opioid or analgesic use, pregnancy, or refusal to participate were excluded from the study.

The sample size was calculated using the formula for comparing two independent means:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times 2 \times \sigma^2}{(\mu_1 - \mu_2)^2}$$

where:

n = required sample size per group

Z_(α/2) = 1.96 (standard normal deviate for a two-tailed test at 5% significance level, α=0.05)

Z_β = 0.84 (standard normal deviate for 80% power, β=0.20)

σ = pooled standard deviation of the primary outcome variable (duration of analgesia)

μ_1-μ_2 = clinically detectable difference in mean duration of analgesia between the two groups

Based on the findings of a previous study by Chen et al., which reported a mean difference in analgesia duration of approximately 3 hours with a pooled standard deviation of 2.5 hours when dexamethasone was added to local anesthetics in transversus abdominis plane blocks, the following assumptions were made: a clinically detectable difference in mean duration of analgesia of 3.0 hours and a pooled standard deviation of 2.5 hours.11 Using the above formula, the calculated sample size was 22 patients per group. Accounting for a 20% dropout rate, the sample size was inflated to 28 patients per group. Therefore, a total of 30 patients per group (60 patients overall) were enrolled in the study to ensure adequate statistical power.

Group R: Patients receiving ultrasound-guided bilateral TAP block with 0.25% ropivacaine alone.

Group RD: Patients receiving ultrasound-guided bilateral TAP block with 0.25% ropivacaine combined with dexamethasone 4 mg as an adjuvant.

The TAP block was performed preemptively after induction of general anesthesia but before surgical incision. All blocks were performed by experienced anesthesiologists trained in ultrasound-guided regional anesthesia. A high-frequency linear ultrasound probe was positioned in the midaxillary line between the costal margin and iliac crest to identify the external oblique, internal oblique, and transversus abdominis muscle layers. A 22-gauge blunt-tip regional block needle was advanced using an in-plane technique until the tip was positioned in the fascial plane between the internal oblique and transversus abdominis muscles. After negative aspiration, the study drug was injected. A total volume of 20 ml was administered on each side for bilateral TAP blocks.

General anesthesia was standardized for all patients. Premedication included midazolam and fentanyl. Induction was achieved with propofol, and neuromuscular blockade was provided with vecuronium. Anesthesia was maintained with oxygen, nitrous oxide, and isoflurane. Intraoperative analgesia was supplemented with fentanyl as

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clinically indicated. At the end of surgery, neuromuscular blockade was reversed, and patients were extubated after meeting standard recovery criteria.

The primary outcome measure was duration of postoperative analgesia, defined as the time from completion of the TAP block to the first request for rescue analgesia or the time at which the numerical rating scale score was 4 or more. Rescue analgesia consisted of intravenous tramadol 50 mg, repeated as required.

Secondary outcome measures included total tramadol consumption during the first 24 postoperative hours, numerical rating scale pain scores at rest and on movement at 1, 2, 4, 6, 12, and 24 hours postoperatively, incidence of postoperative nausea and vomiting, patient satisfaction with analgesia, and any adverse events. Patient satisfaction was assessed using a 4-point Likert scale and categorized as very satisfied, satisfied, neutral, or dissatisfied. Block-related complications, local anesthetic systemic toxicity, hematoma, infection, and other adverse events were documented.

Data were collected prospectively using a standardized proforma. Statistical analysis was performed using SPSS version 22. Continuous variables were expressed as mean ± standard deviation and compared between groups using the independent t-test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test as appropriate. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were included in the study, with 30 patients in Group R and 30 patients in Group RD. The demographic characteristics of the two groups were comparable. Mean age in Group R was 39.4 ± 10.2 years, while in Group RD it was 38.1 ± 9.8 years. Sex distribution was similar between the groups, with a male-to-female ratio of 16:14 in Group R and 15:15 in Group RD. Body mass index, ASA physical status, and mean duration of surgery were also comparable between the two groups, indicating baseline similarity.

The mean duration of postoperative analgesia was significantly longer in Group RD than in Group R. Patients receiving 0.25% ropivacaine with dexamethasone had a mean analgesia duration of 19.8 ± 2.4 hours, compared with 12.6 ± 1.8 hours in patients receiving 0.25% ropivacaine alone. This difference was statistically significant, with a p-value of less than 0.001. Thus, the addition of dexamethasone to ropivacaine significantly delayed the time to first rescue analgesia.

Total tramadol consumption during the first 24 postoperative hours was also significantly lower in Group RD. Patients in Group RD required 76.3 ± 24.5 mg of tramadol, whereas patients in Group R required 126.7 ± 32.1 mg. The reduction in tramadol requirement was statistically significant, with a p-value of less than 0.001, demonstrating a clear opioid-sparing effect of dexamethasone when added to ropivacaine in TAP blocks.

Postoperative numerical rating scale pain scores were comparable between the two groups during the early postoperative period at 1 and 2 hours, suggesting adequate initial analgesia in both groups. However, from 4 hours postoperatively onward, Group RD showed significantly lower NRS pain scores compared with Group R. This trend was observed both at rest and on movement. The difference was most evident during the later postoperative period, when analgesic effects in the ropivacaine-only group began to decline, while patients in the ropivacaine-dexamethasone group continued to experience better pain relief.

The incidence of postoperative nausea and vomiting was lower in Group RD compared with Group R. PONV occurred in 3 patients in Group RD, representing 10%, and in 8 patients in Group R, representing 26.7%. Although the incidence was lower in the dexamethasone group, the difference did not reach statistical significance, with a p-value of 0.12. Most episodes were mild and responded to a single dose of intravenous ondansetron.

Patient satisfaction with postoperative analgesia was significantly higher in Group RD. In Group RD, 26 patients, representing 86.7%, reported being very satisfied with their pain control, compared with 17 patients, representing 56.7%, in Group R. This difference was statistically significant, with a p-value of 0.01. No patient in either group reported dissatisfaction with analgesia.

No block-related complications were observed in either group. There were no cases of local anesthetic systemic toxicity, hematoma, infection at the injection site, or visceral injury. All TAP blocks were successfully performed under ultrasound guidance.

Table 1: Demographic and baseline clinical characteristics of patients

Variable	Group R: 0.25% ropivacaine n = 30	Group RD: 0.25% ropivacaine + dexamethasone n = 30	p-value
Age, years	39.4 ± 10.2	38.1 ± 9.8	0.62
Sex, Male/Female	16/14	15/15	0.79
Body mass index, kg/m²	23.7 ± 2.8	24.1 ± 3.1	0.60
ASA physical status I, n (%)	18 (60.0%)	17 (56.7%)	0.79
ASA physical status II, n (%)	12 (40.0%)	13 (43.3%)	0.79
Duration of surgery, minutes	72.4 ± 15.6	74.1 ± 16.2	0.68

Table 2: Distribution of laparoscopic abdominal surgical procedures

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Surgical procedure	Group R n = 30	Group RD n = 30	p-value
Laparoscopic cholecystectomy, n (%)	12 (40.0%)	11 (36.7%)	0.79
Laparoscopic appendicectomy, n (%)	8 (26.7%)	9 (30.0%)	0.77
Laparoscopic hernia repair, n (%)	5 (16.7%)	5 (16.7%)	1.00
Diagnostic/gynecologic laparoscopy, n (%)	5 (16.7%)	5 (16.7%)	1.00

Table 3: Primary and secondary analgesic outcomes

Outcome variable	Group R n = 30	Group RD n = 30	p-value
Duration of analgesia, hours	12.6 ± 1.8	19.8 ± 2.4	<0.001
24-hour tramadol consumption, mg	126.7 ± 32.1	76.3 ± 24.5	<0.001
Patients requiring rescue analgesia within 12 hours, n (%)	18 (60.0%)	1 (3.3%)	<0.001
Patients requiring rescue analgesia within 24 hours, n (%)	30 (100.0%)	25 (83.3%)	0.02

Table 4: Postoperative NRS pain scores at rest

Time after surgery	Group R n = 30	Group RD n = 30	p-value
1 hour	1.3 ± 0.6	1.2 ± 0.5	0.49
2 hours	1.6 ± 0.7	1.4 ± 0.6	0.24
4 hours	3.0 ± 0.8	2.3 ± 0.7	0.001
6 hours	3.6 ± 0.8	2.5 ± 0.7	<0.001
12 hours	4.2 ± 0.9	2.8 ± 0.8	<0.001
24 hours	3.4 ± 0.8	2.6 ± 0.7	<0.001

Table 5: Postoperative NRS pain scores on movement

Time after surgery	Group R n = 30	Group RD n = 30	p-value
1 hour	2.0 ± 0.7	1.8 ± 0.6	0.24
2 hours	2.4 ± 0.8	2.1 ± 0.7	0.13
4 hours	3.8 ± 0.9	3.0 ± 0.8	0.001
6 hours	4.5 ± 0.9	3.2 ± 0.8	<0.001
12 hours	5.1 ± 1.0	3.5 ± 0.9	<0.001
24 hours	4.2 ± 0.9	3.2 ± 0.8	<0.001

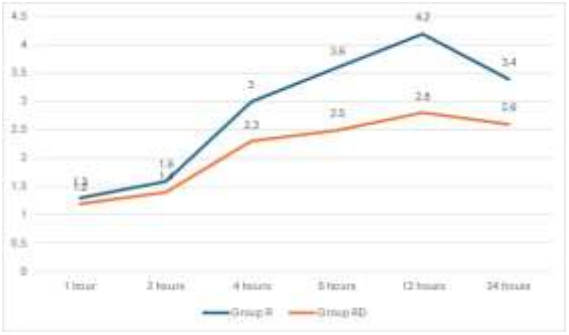

Figure 1: Postoperative NRS pain scores at rest

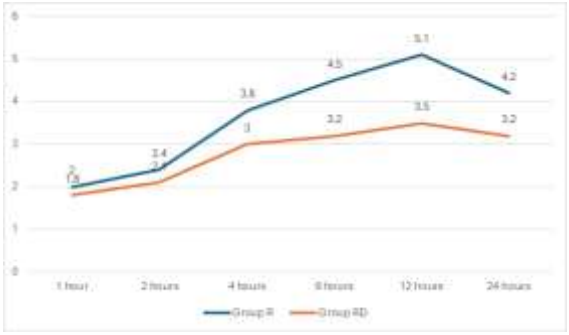

Figure 2: Postoperative NRS pain scores on movement.

Table 6: Postoperative nausea and vomiting

PONV outcome	Group R n = 30	Group RD n = 30	p-value
PONV present, n (%)	8 (26.7%)	3 (10.0%)	0.12
PONV absent, n (%)	22 (73.3%)	27 (90.0%)	—
Mild PONV requiring single-dose antiemetic, n (%)	7 (23.3%)	3 (10.0%)	0.17
Recurrent PONV, n (%)	1 (3.3%)	0 (0.0%)	0.31

Table 7: Patient satisfaction with postoperative analgesia

Satisfaction score	Group R n = 30	Group RD n = 30	p-value
Very satisfied, n (%)	17 (56.7%)	26 (86.7%)	0.01
Satisfied, n (%)	10 (33.3%)	4 (13.3%)	0.07
Neutral, n (%)	3 (10.0%)	0 (0.0%)	0.07
Dissatisfied, n (%)	0 (0.0%)	0 (0.0%)	—

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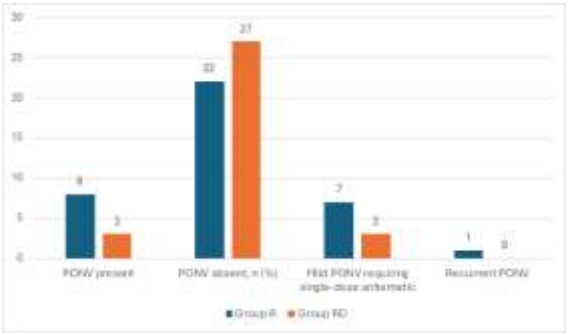

Figure 3: Postoperative nausea and vomiting

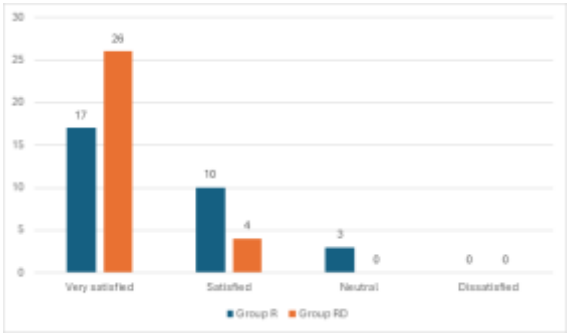

Figure 4: Patient satisfaction with postoperative analgesia

Table 8: Block-related and drug-related complications

Complication	Group R n = 30	Group RD n = 30
Local anesthetic systemic toxicity	0	0
Hematoma at injection site	0	0
Infection at injection site	0	0
Visceral injury	0	0
Failed block	0	0
Neurological complication	0	0
Any documented complication	0	0

DISCUSSION

The present study compared the analgesic efficacy of preemptive ultrasound-guided transversus abdominis plane (TAP) block using 0.25% ropivacaine alone versus 0.25% ropivacaine with 4 mg dexamethasone in 60 patients undergoing elective laparoscopic abdominal surgery. The primary objective was to compare the duration of postoperative analgesia, with secondary objectives including 24-hour tramadol consumption, pain scores, postoperative nausea and vomiting (PONV), patient satisfaction, and complications.

The two study groups were comparable with respect to baseline demographic and clinical characteristics. The mean age in the ropivacaine-only group (Group R) was 39.4 ± 10.2 years and in the ropivacaine-dexamethasone group (Group RD) was 38.1 ± 9.8 years, with a similar sex distribution (16:14 and 15:15, respectively). Body mass index, ASA physical status, and mean duration of surgery (72.4 ± 15.6 minutes in Group R vs. 74.1 ± 16.2 minutes in Group RD) were also comparable between groups ($p > 0.05$ for all). This similarity in baseline parameters across the laparoscopic cholecystectomy, appendicectomy, hernia repair, and gynecologic procedures ensured that any differences observed in analgesic outcomes could be attributed to the intervention rather than to confounding variables.

The addition of dexamethasone significantly prolonged the duration of postoperative analgesia. The mean duration in Group RD (19.8 ± 2.4 hours) was markedly longer than in Group R (12.6 ± 1.8 hours), a difference that was statistically significant ($p < 0.001$). This finding aligns closely with the meta-analysis by Zhang et al. (2019), who reported that adding dexamethasone prolonged the time to first rescue analgesia by approximately three hours.[12] Similarly, Chen et al. (2018) found a mean prolongation of 2.98 hours.[11] The present study's finding of a 7.2-hour extension is more substantial, which may reflect the preemptive administration of the block before surgical incision, thereby reducing central sensitization. Comparable prolongation was observed by Akkaya et al. (2014) in cesarean section patients, where dexamethasone significantly delayed the first analgesic request.[13] The results are also consistent with Abdel-wahab et al. (2021), who demonstrated that both 4 mg and 8 mg of dexamethasone provided prolonged relief for up to 24 hours after inguinal hernia repair.[14]

Total tramadol consumption during the first 24 hours was significantly lower in Group RD (76.3 ± 24.5 mg) compared to Group R (126.7 ± 32.1 mg, $p < 0.001$), demonstrating a clear opioid-sparing effect. This finding is supported by Sinha et al. (2023), who reported significantly lower mean pethidine consumption (119.44 ± 62.16 mg vs. 160 ± 55.25 mg) when dexamethasone was added to bupivacaine in subcostal TAP blocks after upper abdominal surgery. The meta-analysis by Zhang et al. (2019) also confirmed reduced 24-hour opioid requirements with dexamethasone.[12] Regarding pain scores, the present study found that NRS scores at rest and on movement were comparable between groups at 1 and 2 hours but became significantly lower in Group RD from 4 hours onward (e.g., at rest at 4 hours: 3.0 ± 0.8 vs. 2.3 ± 0.7, $p = 0.001$). This pattern mirrors the findings of Zhang et al. (2019), who observed significantly lower VAS scores at rest at 4, 6, and 12 hours, and Chen et al. (2018), who noted reduced pain scores at 2, 6, and 12 hours postoperatively.[11,12]

The incidence of PONV was lower in Group RD (10.0%) compared to Group R (26.7%), although this difference did not reach statistical significance ($p = 0.12$). This trend, however, is consistent with the meta-analyses of Zhang et al. (2019) and Chen et al.

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(2018), both of which reported a markedly lower incidence of PONV with dexamethasone.[11,12] The lack of significance in the present study may be attributable to the relatively small sample size. Patient satisfaction was significantly higher in Group RD, with 86.7% of patients reporting being "very satisfied" compared to 56.7% in Group R ($p = 0.01$). This improved satisfaction likely reflects the longer duration of pain relief, lower tramadol requirements, and reduced opioid-related side effects. No block-related complications were observed in either group, confirming the safety of adding perineural dexamethasone, a finding consistent with studies by Sobhy et al. (2022), Seervi et al. (2019), and Kiasari et al. (2025), who reported no major adverse events.[16-18]

CONCLUSION

The addition of dexamethasone 4 mg to 0.25% ropivacaine in preemptive ultrasound-guided transversus abdominis plane blocks significantly prolonged postoperative analgesia after elective laparoscopic abdominal surgery. It also reduced 24-hour tramadol consumption, improved postoperative pain scores from 4 hours onward, and enhanced patient satisfaction without increasing complications. Although the incidence of postoperative nausea and vomiting was lower in the dexamethasone group, the difference was not statistically significant.

Thus, dexamethasone appears to be an effective, safe, and inexpensive adjuvant to 0.25% ropivacaine in TAP blocks and may be useful as part of a multimodal opioid-sparing analgesic strategy for patients undergoing laparoscopic abdominal surgery.

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