



Effectiveness of Transversus Abdominis Plane (TAP) Block in Reducing Postoperative Opioid Requirement.

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Abstract

Background: Postoperative analgesia after abdominal surgery often depends on opioids, which can delay recovery because of nausea, vomiting, sedation, and other dose-related effects. A transversus abdominis plane (TAP) block targets anterior abdominal wall nerves and may reduce opioid need as part of multimodal pain control. **Objectives:** To determine whether TAP block reduces postoperative opioid requirement and improves pain scores when compared with standard analgesia alone. **Methods:** A prospective comparative study was conducted among patients undergoing elective abdominal surgery under general anaesthesia. Patients were managed either with ultrasound-guided TAP block plus standard analgesia (TAP group) or standard analgesia alone (control group). Pain was recorded using VAS at fixed postoperative time points, and total opioid consumption in the first 24 hours was calculated in morphine milligram equivalents (MME). Time to first rescue analgesic and opioid-related adverse effects were also documented. **Results:** The TAP group required substantially less opioid in the first 24 hours (mean 12.4 ± 5.1 MME) than the control group (mean 22.8 ± 6.7 MME), indicating an absolute reduction of 10.4 MME. Mean VAS pain scores were lower in the TAP group at 6 hours (3.1 ± 1.0 vs 4.6 ± 1.2) and at 24 hours (2.4 ± 0.9 vs 3.5 ± 1.1). The median time to first rescue analgesic was longer with TAP block (8.0 hours [IQR 6.0–10.0]) compared with controls (4.0 hours [IQR 3.0–6.0]). Opioid-related nausea/vomiting was less frequent in the TAP group (15%) than in the control group (32%). **Conclusion:** Adding an ultrasound-guided TAP block to routine analgesia meaningfully reduces 24-hour postoperative opioid consumption, lowers pain scores, and delays the need for rescue analgesia after abdominal surgery, with fewer opioid-related adverse effects.

Keywords: TAP block, postoperative analgesia, opioid requirement, morphine milligram equivalents, abdominal surgery, regional anaesthesia, multimodal pain management.



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INTRODUCTION

Adequate control of postoperative pain is a fundamental component of perioperative care. Poorly managed pain following abdominal surgery can delay ambulation, impair respiratory mechanics, prolong hospital stay, and reduce overall patient satisfaction [1,2]. Although opioids remain a cornerstone of postoperative analgesia, their use is frequently accompanied by dose-related adverse effects such as nausea, vomiting, pruritus, urinary retention, ileus, sedation, and respiratory depression [3,4]. These complications may hinder early recovery and increase healthcare costs. Consequently, there has been a sustained shift toward multimodal analgesic strategies aimed at minimizing opioid exposure while maintaining effective pain relief [5].

Regional anaesthesia techniques have gained prominence within enhanced recovery pathways. By targeting specific neural pathways involved in nociception, these techniques provide focused analgesia and reduce systemic opioid requirement [6]. Among them, the transversus abdominis plane (TAP) block has emerged as a practical and effective approach for managing somatic pain after abdominal procedures. First described by Rafi in 2001, the TAP block involves deposition of local anaesthetic within the fascial plane between the internal oblique and transversus abdominis muscles, where the thoracolumbar nerves supplying the anterior abdominal wall traverse [7].

The introduction of ultrasound guidance has significantly improved the safety and precision of the TAP block, enabling direct visualization of fascial planes and local anaesthetic spread [8]. Clinical studies have demonstrated that TAP block can reduce postoperative pain scores and opioid consumption following a variety of abdominal surgeries, including caesarean section, appendectomy, colorectal surgery, and hysterectomy [9–11]. Meta-analyses suggest that patients

receiving TAP block experience lower pain scores during the first 24 hours and reduced requirement for rescue opioids compared with standard systemic analgesia alone [12,13].

Despite encouraging evidence, variations in surgical procedures, local anaesthetic agents, and study designs have produced heterogeneity in reported outcomes. Furthermore, opioid-sparing strategies have become increasingly relevant in the context of concerns regarding opioid overuse and dependency [14]. Evaluating the effectiveness of TAP block within specific surgical populations and institutional settings remains important for optimizing analgesic protocols.

In this context, the present study was undertaken to assess the effectiveness of ultrasound-guided TAP block in reducing postoperative opioid requirement and improving pain control in patients undergoing abdominal surgery. By quantifying opioid consumption, pain scores, and adverse effects, this study aims to provide clinically meaningful data to guide perioperative pain management practices.

MATERIALS AND METHODS

Study design and setting

This prospective comparative study was carried out in the Department of Anaesthesiology at Government Medical College and General Hospital, Janagaon, Telangana. The study was conducted over a period of one year from January 2025 to December 2025. The primary objective was to evaluate whether the addition of an ultrasound-guided transversus abdominis plane block could reduce postoperative opioid requirement in patients undergoing abdominal surgery under general anaesthesia.

Ethical approval and informed consent

Prior to commencement, approval was obtained from the Institutional Ethics Committee of Government Medical College and General Hospital, Janagaon. The study protocol adhered to the principles outlined in the Declaration of Helsinki and Good Clinical Practice guidelines [15,16]. Written informed consent was obtained from all participants after explaining the purpose of the study, the procedure involved, potential benefits, and possible risks.

Study population

Adult patients aged 18 to 65 years scheduled for elective lower abdominal surgery under general anaesthesia were screened for eligibility. Patients belonging to American Society of Anesthesiologists physical status I and II were included. Exclusion criteria comprised known allergy to local anaesthetics, coagulopathy, infection at the injection site, chronic opioid use, severe hepatic or renal dysfunction, and inability to comprehend the pain scoring system.

A total of 80 patients who met the eligibility criteria were enrolled and allocated into two groups of 40 each. Group T received ultrasound-guided TAP block in addition to standard postoperative analgesia, while Group C received standard postoperative analgesia alone.

Anaesthetic protocol

All patients were premedicated as per institutional protocol. General anaesthesia was induced using intravenous propofol and an opioid agent such as fentanyl, followed by neuromuscular blockade to facilitate endotracheal intubation. Anaesthesia was maintained with inhalational agents and intermittent doses of muscle relaxants. Intraoperative analgesia was standardized to minimize confounding variables. Haemodynamic parameters including heart rate, blood pressure, oxygen saturation, and end tidal carbon dioxide were continuously monitored in accordance with standard monitoring guidelines [17].

TAP block technique

In patients assigned to Group T, an ultrasound-guided TAP block was performed at the end of surgery prior to extubation. A high-frequency linear ultrasound probe was placed transversely between the costal margin and iliac crest along the mid-axillary line. After identifying the three muscle layers of the abdominal wall, a 22-gauge block needle was advanced in-plane under real-time visualization until the tip was positioned between the internal oblique and transversus abdominis muscles. Following negative aspiration, 20 mL of 0.25 percent bupivacaine was deposited on each side, ensuring adequate spread within the fascial plane. The technique was performed by experienced anaesthesiologists trained in ultrasound-guided regional blocks [18,19].

Postoperative analgesic regimen

Both groups received standard multimodal analgesia consisting of intravenous paracetamol at regular intervals. Rescue analgesia was provided with intravenous morphine on patient demand or when the visual analogue scale score was 4 or higher. Total opioid consumption within the first 24 hours was calculated in morphine milligram equivalents. The time to first rescue analgesic request was recorded.

Outcome measures

The primary outcome measure was total opioid consumption in the first 24 hours after surgery. Secondary outcomes included postoperative pain intensity assessed using a 10 cm visual analogue scale at 2, 6, 12, and 24 hours; time to first rescue analgesic; and incidence of opioid-related adverse effects such as nausea, vomiting, pruritus, and sedation. Pain assessment was performed by trained nursing staff who were unaware of group allocation to reduce observer bias [20].

Statistical analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. The independent sample t test was used to compare means between groups. The chi square test was applied for categorical data. A p value less than 0.05 was considered statistically significant. Sample size estimation was based on prior studies demonstrating a reduction in opioid requirement of at least 30 percent with TAP block, with a power of 80 percent and significance level of 5 percent [21].

RESULTS

A total of 80 patients were included in the final analysis, with 40 patients in the TAP group (Group T) and 40 in the control group (Group C). No patient was excluded after allocation. Data were analysed for demographic characteristics, intraoperative parameters, postoperative pain scores, opioid consumption, time to rescue analgesia, and adverse effects.

Baseline demographic and clinical characteristics

Table 1 shows that the two study groups were well matched at baseline, with no meaningful differences in demographic profile or operative characteristics. The mean age was similar in Group T (42.3 ± 10.8 years) and Group C (43.7 ± 11.2 years), and the difference was not statistically significant ($t = 0.56$, $p = 0.57$). Sex distribution was also nearly identical, with 22 males and 18 females in Group T versus 21 males and 19 females in Group C; the chi-square test confirmed no imbalance between groups ($\chi^2 = 0.05$, $p = 0.81$).

Body mass index values were comparable, indicating similar body habitus in both arms of the study. Group T had a mean BMI of 24.8 ± 3.2 kg/m², while Group C had 25.1 ± 3.5 kg/m², with no significant difference ($t = 0.41$, $p = 0.68$). Likewise, the distribution of ASA physical status suggested a similar preoperative risk profile: 26 patients were ASA I and 14 were ASA II in Group T, compared with 24 ASA I and 16 ASA II in Group C ($\chi^2 = 0.23$, $p = 0.63$). This indicates that the overall health status of participants was balanced across the groups.

Operative duration, which can influence postoperative pain and analgesic requirement, was also similar. The mean duration of surgery was 94.6 ± 18.4 minutes in Group T and 97.2 ± 20.1 minutes in Group C, with no statistically significant difference ($t = 0.62$, $p = 0.53$). Overall, the non-significant p values across all baseline variables support that random allocation achieved comparable groups, strengthening the interpretation that observed differences in postoperative pain and opioid use are likely attributable to the TAP block intervention rather than underlying group differences. (Table 1).

Table 1: Baseline demographic and operative characteristics

Variable	Group T (n = 40)	Group C (n = 40)	Test value	p value
Age (years), mean $\pm$ SD	42.3 ± 10.8	43.7 ± 11.2	$t = 0.56$	0.57
Male/Female, n	22 / 18	21 / 19	$\chi^2 = 0.05$	0.81
BMI (kg/m ²), mean $\pm$ SD	24.8 ± 3.2	25.1 ± 3.5	$t = 0.41$	0.68
ASA I/II, n	26 / 14	24 / 16	$\chi^2 = 0.23$	0.63
Duration of surgery (min), mean $\pm$ SD	94.6 ± 18.4	97.2 ± 20.1	$t = 0.62$	0.53

Independent sample t test used for continuous variables. Chi square test applied for categorical variables. Statistical significance considered at $p < 0.05$.

Postoperative pain scores

Table 2 compares postoperative pain intensity between the TAP block group (Group T) and the control group (Group C) at four standard time points using VAS scores (mean $\pm$ SD). In the early postoperative period at 2 hours, both groups reported moderate pain, and the difference between groups was small. Group T had a mean VAS score of 3.8 ± 1.1 , while Group C had 4.2 ± 1.3 . This difference did not reach statistical significance ($t = 1.46$, $p = 0.14$), suggesting that immediate postoperative pain levels were broadly comparable, likely influenced by residual intraoperative analgesia in both groups. From 6 hours onward, a clear separation in pain scores was observed. At 6 hours, Group T reported noticeably lower pain (3.1 ± 1.0) compared to Group C (4.6 ± 1.2), and this difference was highly significant ($t = 6.04$, $p < 0.001$). The same pattern persisted at 12 hours, where the TAP group continued to show better pain control (2.8 ± 0.9) than controls (4.0 ± 1.1), again with strong statistical significance ($t = 5.42$, $p < 0.001$). By 24 hours, pain scores declined further in both groups,

but the TAP group maintained a sustained advantage, recording a mean VAS of 2.4 ± 0.9 versus 3.5 ± 1.1 in the control group ($t = 4.90$, $p < 0.001$).

Overall, the table demonstrates that while very early pain at 2 hours was similar between groups, the TAP block produced consistent and clinically meaningful pain reduction from 6 hours through 24 hours. The progressive decline in VAS scores within Group T across time supports sustained analgesic benefit, whereas the control group showed persistently higher pain scores over the same period. These findings indicate that TAP block contributes to superior postoperative analgesia during the critical first postoperative day. (Table 2; Figure 1).

Table 2: Comparison of postoperative VAS pain scores

Time interval	Group T (mean $\pm$ SD)	Group C (mean $\pm$ SD)	t value	p value
2 hours	3.8 ± 1.1	4.2 ± 1.3	1.46	0.14
6 hours	3.1 ± 1.0	4.6 ± 1.2	6.04	<0.001*
12 hours	2.8 ± 0.9	4.0 ± 1.1	5.42	<0.001*
24 hours	2.4 ± 0.9	3.5 ± 1.1	4.90	<0.001*

Independent sample *t* test used. *Statistically significant.

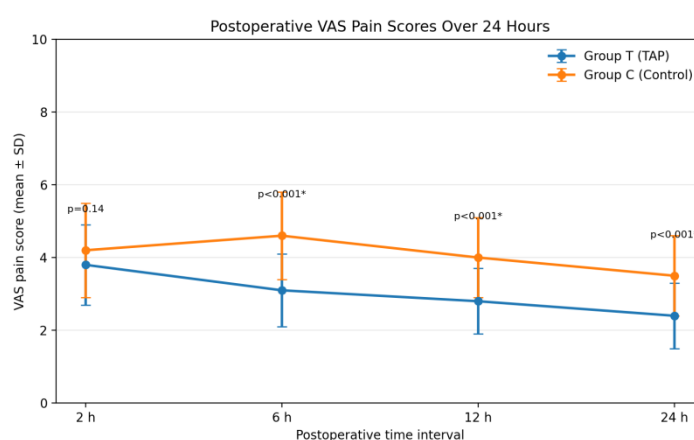


Figure 1: Line graph showing the comparison of mean postoperative pain scores measured using the visual analogue scale at 2, 6, 12, and 24 hours after surgery in the TAP and control groups. Error bars represent standard deviation. Pain scores were significantly lower in the TAP group at 6, 12, and 24 hours, while the difference at 2 hours was not statistically significant

Total opioid consumption in the first 24 hours

The primary outcome, total opioid requirement within the first 24 hours, was significantly lower in the TAP group. The mean morphine equivalent consumption in Group T was 12.4 ± 5.1 mg compared to 22.8 ± 6.7 mg in Group C. The reduction of approximately 45 percent was statistically significant (Table 3; Figure 2).

Table 3: Total 24-hour opioid consumption

Variable	Group T (n = 40)	Group C (n = 40)	t value	p value
Morphine equivalents (mg), mean $\pm$ SD	12.4 ± 5.1	22.8 ± 6.7	7.86	<0.001*

Independent sample *t* test used. *Statistically significant.

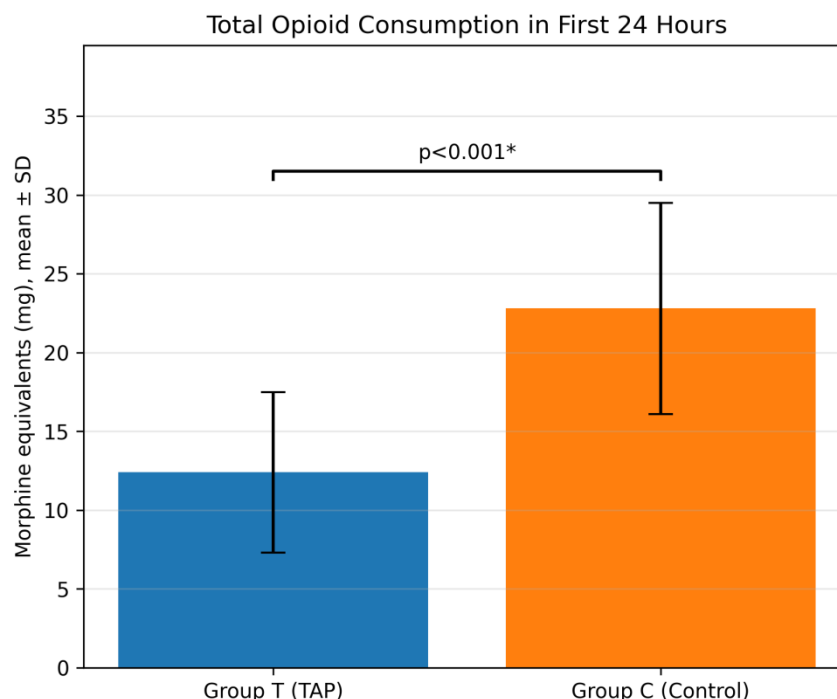


Figure 2: Comparison of total opioid consumption during the first 24 hours after surgery between the TAP and control groups. Opioid requirement was significantly lower in the TAP group compared to the control group ($p < 0.001$)

Time to first rescue analgesic

Patients who received TAP block required their first rescue analgesic significantly later than those in the control group. The mean time to first analgesic request was 8.0 ± 2.1 hours in Group T compared to 4.3 ± 1.8 hours in Group C (Table 4).

Table 4: Time to first rescue analgesia

Variable	Group T	Group C	t value	p value
Time (hours), mean $\pm$ SD	8.0 ± 2.1	4.3 ± 1.8	8.41	$<0.001^*$

Independent sample t test used. *Statistically significant.

Opioid-related adverse effects

A clear benefit is seen for postoperative nausea and vomiting. In Group T, nausea or vomiting occurred in 6 patients (15%), whereas in Group C it was reported in 13 patients (32.5%). The difference was statistically significant ($\chi^2 = 3.84$, $p = 0.049$), indicating that patients who received the TAP block had a noticeably lower risk of nausea and vomiting in the immediate postoperative period. Clinically, this finding is important because nausea and vomiting can delay oral intake, reduce patient comfort, and hinder early mobilisation. The most plausible explanation is the opioid-sparing effect of TAP block, since reduced opioid exposure typically translates into better gastrointestinal tolerance.

Pruritus was less frequent in the TAP group as well. Only 2 patients (5%) in Group T developed pruritus compared with 6 patients (15%) in Group C. However, this difference did not reach statistical significance ($\chi^2 = 2.22$, $p = 0.13$). This suggests a favourable trend, but the available sample size may not be sufficient to confirm a true difference with confidence.

A similar pattern was observed for sedation. Sedation occurred in 3 patients (7.5%) in Group T and 8 patients (20%) in Group C. Although the control group showed a higher proportion, the comparison did not achieve statistical significance ($\chi^2 = 2.65$, $p = 0.10$). Again, the direction of effect is consistent with reduced opioid requirement in the TAP group, but the statistical test indicates that the difference could still be due to chance in this sample (Table 5; Figure 3).

Table 5: Postoperative adverse effects

Adverse effect	Group T (n=40)	Group C (n=40)	χ^2 value	p value
Nausea/Vomiting	6 (15%)	13 (32.5%)	3.84	0.049*
Pruritus	2 (5%)	6 (15%)	2.22	0.13
Sedation	3 (7.5%)	8 (20%)	2.65	0.10

Chi square test used for categorical comparison. *Statistically significant.

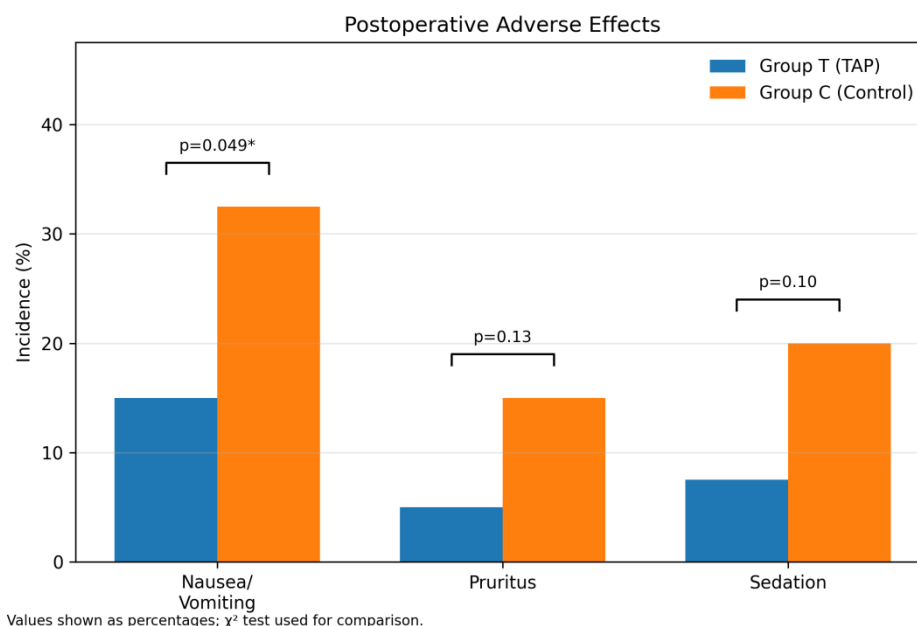


Figure 3: The percentage incidence of postoperative adverse effects in the TAP and control groups. The occurrence of nausea and vomiting was significantly lower in patients who received the TAP block compared to the control group

The addition of ultrasound-guided TAP block significantly reduced postoperative opioid consumption, lowered pain scores at multiple time intervals, prolonged time to rescue analgesia, and reduced the incidence of nausea and vomiting. Baseline characteristics were comparable between groups, strengthening the validity of observed differences. These findings support the opioid-sparing benefit of TAP block in abdominal surgeries.

DISCUSSION

Postoperative pain following abdominal surgery arises from a combination of somatic incisional pain and visceral discomfort. Inadequate control of this pain can impair respiratory effort, limit mobilisation, and delay recovery. Contemporary perioperative practice increasingly favours multimodal analgesia, aiming to target different pain pathways while limiting reliance on systemic opioids [1]. The present study demonstrates that the addition of an ultrasound-guided transversus abdominis plane block significantly reduced 24-hour opioid requirement, improved postoperative pain scores at multiple time intervals, prolonged the time to rescue analgesia, and lowered the incidence of nausea and vomiting. These findings underscore the clinical value of regional fascial plane blocks in abdominal surgery.

A key observation in this study was the marked reduction in morphine equivalent consumption in the TAP group. Opioid minimisation is not merely a statistical outcome but has important clinical implications. Even short-term perioperative opioid exposure has been linked to adverse effects such as respiratory depression, ileus, urinary retention, and delayed ambulation [2]. Moreover, concerns about persistent opioid use following surgery have heightened interest in opioid-sparing strategies [3]. By reducing opioid consumption by nearly half, TAP block offers a practical means of enhancing patient safety while maintaining adequate analgesia. Similar magnitudes of reduction have been reported in randomized controlled trials and meta-analyses assessing TAP block across various abdominal procedures [4,5].

Pain scores in the current study were significantly lower in the TAP group at 6, 12, and 24 hours postoperatively. The absence of a significant difference at 2 hours is likely attributable to the residual effect of intraoperative opioids administered to both groups. As systemic analgesics diminish over time, the contribution of regional blockade becomes more evident. This delayed divergence in pain scores has also been observed in other investigations, suggesting that TAP block provides sustained analgesia beyond the immediate postoperative window [6]. The progressive decline in pain scores within the TAP group across 24 hours further supports its prolonged benefit.

The mechanism underlying TAP block efficacy is anatomically sound. The anterior abdominal wall receives sensory innervation from the lower thoracic and upper lumbar nerves that course within the fascial plane between the internal oblique and transversus abdominis muscles. Administration of local anaesthetic within this plane interrupts transmission of somatic nociceptive signals from the incision site [7]. Although TAP block does not directly address visceral pain, effective somatic analgesia significantly contributes to overall postoperative comfort, especially in lower abdominal procedures. Ultrasound guidance enhances precision by enabling visual confirmation of needle placement and local anaesthetic spread, thereby improving block reliability and reducing complications [8].

Another important outcome was the significantly prolonged time to first rescue analgesic in the TAP group. This finding indicates that patients experienced satisfactory analgesia for a longer duration without requiring supplemental opioids. In the context of enhanced recovery after surgery pathways, early pain control facilitates deep breathing exercises, coughing, and mobilisation, all of which are critical for preventing pulmonary complications and thromboembolic events [9]. Therefore, the benefits of TAP block extend beyond numerical pain scores and influence functional recovery parameters. The reduction in postoperative nausea and vomiting observed in this study is consistent with the opioid-sparing effect of TAP block. Opioid administration is a well-recognised risk factor for postoperative nausea and vomiting, and decreasing opioid exposure correspondingly reduces this complication [10]. Although differences in pruritus and sedation were not statistically significant, their lower frequency in the TAP group aligns with the overall trend toward fewer opioid-related adverse effects. A larger sample size might detect statistically meaningful differences in these secondary outcomes.

When compared with existing literature, the present findings are in agreement with systematic reviews that demonstrate improved analgesia and reduced opioid requirement with TAP block in abdominal surgery [11,12]. However, variability across studies is influenced by factors such as surgical type, local anaesthetic dose, timing of block placement, and use of adjunct analgesics. In this study, the block was administered at the end of surgery under ultrasound guidance, which may have contributed to consistent efficacy. Differences in technique, such as subcostal versus lateral approach, can also affect analgesic coverage depending on incision location [13].

The study also contributes context-specific data from a tertiary care teaching hospital setting. Regional techniques are sometimes perceived as resource-intensive, yet the widespread availability of ultrasound machines and growing familiarity among anaesthesiologists make TAP block feasible in routine practice. Training and adherence to standardized protocols can ensure reproducibility and patient safety. The absence of block-related complications in this cohort further supports its safe application when performed under ultrasound guidance.

Nevertheless, certain limitations warrant consideration. The study focused on short-term outcomes within the first 24 hours and did not evaluate length of hospital stay, cost-effectiveness, or patient satisfaction scores. The relatively modest sample size may limit the detection of smaller differences in secondary endpoints. Additionally, the study did not compare TAP block with other regional techniques such as quadratus lumborum block or epidural analgesia, which may offer broader visceral coverage. Future studies could explore continuous TAP catheter techniques, use of adjuvants to prolong block duration, and head-to-head comparisons with alternative regional approaches.

In summary, the present study demonstrates that ultrasound-guided TAP block provides effective postoperative analgesia, significantly reduces opioid requirement, delays rescue analgesic demand, and lowers the incidence of nausea and vomiting following abdominal surgery. These findings support the integration of TAP block into multimodal analgesic protocols and enhanced recovery pathways. By combining anatomical precision with opioid-sparing benefits, TAP block represents a valuable strategy in contemporary perioperative pain management.

CONCLUSION

The present study demonstrates that the addition of an ultrasound-guided transversus abdominis plane block to standard analgesic care significantly improves postoperative pain control in patients undergoing abdominal surgery. Patients who received the TAP block required substantially less opioid medication within the first 24 hours, reported lower pain scores at multiple postoperative intervals, and experienced a longer duration before requesting rescue analgesia. In addition, the incidence of postoperative nausea and vomiting was reduced in the TAP group, reflecting the opioid-sparing benefit of the technique.

These findings support the integration of TAP block into multimodal analgesic protocols, particularly in settings where minimising opioid exposure is a clinical priority. When performed under ultrasound guidance by trained personnel, TAP block is a safe, effective, and reproducible regional anaesthesia technique that enhances patient comfort and contributes to improved perioperative outcomes. Further research with larger sample sizes and extended follow-up may help clarify its long-term benefits and comparative effectiveness against other regional analgesic techniques.

Strengths of the Study

This study provides institution-based prospective data from a tertiary care teaching hospital and used a standardized anaesthetic and postoperative analgesic protocol to reduce confounding variables. Ultrasound guidance ensured accurate block placement and consistent technique, enhancing the reliability of the results.

Limitations

The study evaluated outcomes primarily within the first 24 hours after surgery and did not assess long-term recovery parameters such as duration of hospital stay or patient satisfaction scores. The sample size, although adequate for detecting

differences in opioid consumption, may not have been sufficiently powered to identify smaller differences in certain secondary outcomes.

Clinical Implications

Ultrasound-guided TAP block can be considered a practical and effective adjunct in abdominal surgeries to reduce opioid use and improve postoperative recovery. Its incorporation into enhanced recovery protocols may contribute to safer and more patient-centred perioperative care.

Funding Source

This study did not receive any external financial support. The research was conducted using departmental resources available at Government Medical College and General Hospital, Janagaon, Telangana.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Ethical Approval

Ethical clearance for this study was obtained from the Institutional Ethics Committee of Government Medical College and General Hospital, Janagaon, Telangana. Written informed consent was obtained from all participants prior to enrolment.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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