e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(6); 1898-1902

Original Research Article

Comparison of Ultrasound-Guided Transversus Abdominis Plane Block and Systemic Analgesia for Postoperative Pain Relief Following Lower Abdominal Surgery

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Received: 01-04-2026 / Revised: 25-05-2026 / Accepted: 12-06-2026
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Conflict of interest: Nil

Abstract

Background: Effective postoperative pain management is essential for early recovery, improved patient satisfaction, and reduction of postoperative complications. Although systemic analgesia remains the conventional method for pain control after abdominal surgery, it is associated with opioid-related adverse effects. Ultrasound-guided Transversus Abdominis Plane (TAP) block has emerged as an effective regional analgesic technique that may provide superior postoperative pain relief while reducing opioid consumption.

Aim: To compare the effectiveness of ultrasound-guided Transversus Abdominis Plane (TAP) block versus systemic analgesia for postoperative pain relief in patients undergoing lower abdominal surgery.

Materials and Methods: A hospital-based prospective randomized comparative study was conducted at a tertiary care teaching hospital in Gujarat over 12 months. Sixty patients undergoing elective lower abdominal surgery were randomly allocated to receive either ultrasound-guided TAP block (n=30) or systemic analgesia (n=30). Postoperative pain (VAS), time to first rescue analgesia, analgesic consumption, adverse effects, and patient satisfaction were assessed. Data were analyzed using SPSS version 26.0, with $p < 0.05$ considered statistically significant.

Results: Patients receiving ultrasound-guided TAP block had significantly lower postoperative VAS pain scores, longer time to first rescue analgesia (8.4 ± 2.1 vs. 3.6 ± 1.2 hours), and lower rescue analgesic consumption (72 ± 28 vs. 148 ± 36 mg) than the systemic analgesia group ($p<0.001$). Postoperative nausea and vomiting were less frequent (10.0% vs. 30.0%), patient satisfaction was higher (8.9 ± 0.8 vs. 6.8 ± 1.1), and no major TAP block-related complications were observed.

Conclusion: Ultrasound-guided TAP block is a safe and effective technique that provides superior postoperative analgesia, prolongs pain relief, reduces opioid requirements and related adverse effects, and improves patient satisfaction compared with systemic analgesia. It should be considered an integral component of multimodal postoperative pain management for lower abdominal surgery.

Keywords: Ultrasound-guided TAP block, Systemic analgesia, Postoperative pain, Visual Analogue Scale, Regional anaesthesia, Multimodal analgesia.

DOI: 10.25258/ijcpr.18.6.303

Introduction

Postoperative pain is a major concern following abdominal surgery and can delay recovery, increase postoperative complications, prolong hospital stay, and reduce patient satisfaction. Approximately 70–80% of surgical patients experience moderate to severe postoperative pain despite advances in perioperative care [1,2]. Although systemic analgesia using opioids and non-steroidal anti-inflammatory drugs [NSAIDs] remains the standard approach, it is frequently associated with adverse effects such as nausea, vomiting, sedation, and respiratory depression [2,3].

Ultrasound-guided Transversus Abdominis Plane (TAP) block is an effective regional anaesthetic technique that provides analgesia to the anterior abdominal wall by blocking the thoracolumbar nerves (T6–L1). Ultrasound guidance improves the accuracy and safety of the block and has made TAP

block an important component of multimodal postoperative analgesia [2,3].

McDonnell et al. demonstrated significantly lower postoperative pain scores and reduced 24-hour morphine consumption in patients receiving TAP block compared with conventional analgesia [1]. Similarly, Abdallah et al. and Brogi et al. reported that TAP block significantly reduces postoperative pain, opioid consumption, and opioid-related adverse effects while improving postoperative recovery [3,4]. Guo et al. also concluded that TAP block provides superior postoperative analgesia and facilitates early recovery following abdominal surgery [5].

Despite these advantages, systemic analgesia continues to be widely practiced in many hospitals. Therefore, the present study was undertaken to compare the effectiveness of ultrasound-guided TAP block with systemic analgesia for postoperative pain relief in patients undergoing lower abdominal surgery.

AIM: To compare the effectiveness of ultrasound-guided Transversus Abdominis Plane (TAP) block versus systemic analgesia for postoperative pain relief in patients undergoing lower abdominal surgery.

Objectives

1. To compare postoperative pain scores between patients receiving ultrasound-guided TAP block and those receiving systemic analgesia using the Visual Analogue Scale (VAS).
2. To compare the time to first rescue analgesia and the total postoperative analgesic requirement between the two groups.
3. To compare the incidence of postoperative adverse effects and patient satisfaction between the two groups.

Methodology

Study Design: Hospital-based prospective randomized comparative study.

Study Setting: The study will be conducted in the Department of Anaesthesiology at a tertiary care teaching hospital in Gujarat, India.

Study Duration: The study will be conducted over a period of 12 months.

Study Population: Adult patients undergoing elective lower abdominal surgery under general or spinal anaesthesia.

Sample Size: The sample size was calculated based on the difference in the 24-hour postoperative Visual Analogue Scale (VAS) pain scores reported by McDonnell et al. (2007), who observed a mean VAS score of 1.7 ± 1.7 in the ultrasound-guided TAP block group and 3.1 ± 1.5 in the control group [1]. Using the formula for comparison of two independent means, with a 95% confidence level, 80% power, and 5% level of significance, the minimum required sample size was 21 patients per group. After accounting for a 10% dropout rate, the sample size was increased to 23 patients per group. To improve the statistical power and reliability of the study, 30 patients were included in each group, resulting in a total sample size of 60 patients.

Sampling Technique: Simple random sampling.

Randomization: Eligible patients will be randomly allocated into two groups using a computer-generated randomization sequence.

- Group A (n = 30): Ultrasound-guided Transversus Abdominis Plane (TAP) block.
- Group B (n = 30): Systemic analgesia.

Inclusion Criteria

- Patients aged 18–65 years.
- ASA physical status I or II.
- Patients undergoing elective lower abdominal surgery.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Patients refusing to participate.
- Known allergy to local anaesthetic agents.
- Coagulopathy or anticoagulant therapy.
- Infection at the proposed injection site.
- Chronic opioid use or chronic pain syndrome.
- Body mass index (BMI) >35 kg/m².
- Pregnancy.
- Severe hepatic or renal dysfunction.

Study Procedure: Written informed consent will be obtained from all eligible patients before enrolment in the study. Patients fulfilling the inclusion criteria will undergo a detailed pre-anaesthetic evaluation, including demographic details, medical history, clinical examination, and routine laboratory investigations. Standard intraoperative monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and respiratory rate, will be maintained throughout the surgical procedure.

Patients will be randomly assigned into one of the following groups:

Group A (Ultrasound-Guided TAP Block): At the completion of surgery, an ultrasound-guided bilateral TAP block will be performed under aseptic precautions using a high-frequency linear ultrasound probe. A 22-G block needle will be inserted using the in-plane technique between the internal oblique

and transversus abdominis muscles. After negative aspiration, 20 mL of 0.25% bupivacaine will be injected on each side under direct ultrasound visualization.

Group B (Systemic Analgesia): Patients will receive postoperative systemic analgesia according to the institutional protocol. Intravenous paracetamol 1 g every 8 hours will be administered, and intravenous tramadol 50–100 mg will be given as rescue analgesia when the Visual Analogue Scale (VAS) score is ≥4.

Outcome Measures

Primary Outcome

- Postoperative pain intensity measured using the Visual Analogue Scale (VAS) at 2, 4, 6, 12, and 24 hours after surgery.

Secondary Outcomes

- Time to first rescue analgesia.
- Total rescue analgesic consumption during the first 24 hours.
- Incidence of postoperative nausea and vomiting.
- Patient satisfaction with postoperative pain management.

Data Collection: Data will be collected using a predesigned and pretested case record form. Baseline demographic and clinical characteristics, including age, sex, body mass index (BMI), ASA physical status, type and duration of surgery, and duration of anaesthesia, will be recorded. Postoperative outcomes including Visual Analogue Scale (VAS) pain scores, time to first rescue analgesia, total rescue analgesic consumption during the first 24 hours, postoperative adverse effects (such as nausea, vomiting, and sedation), and patient satisfaction score will also be documented for all study participants.

Statistical Analysis: Data will be entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables will be expressed as mean ± standard deviation (SD) and categorical variables as frequency and percentage. Comparisons between the two groups will be performed using the Independent Student's t-test and the Chi-square test/Fisher's exact test, as appropriate. A p-value <0.05 will be considered statistically significant.

Observations and Results

A total of 60 patients were included in the study and randomly allocated into two groups: Group A (Ultrasound-Guided TAP Block, n = 30) and Group B (Systemic Analgesia, n = 30). The baseline demographic characteristics were comparable between the two groups, with no statistically significant differences (p > 0.05).

Table 1: Baseline Characteristics of the Study Population

Variable	TAP Block (n=30)	Systemic Analgesia (n=30)	p-value
Age (years), Mean ± SD	42.8 ± 11.3	44.1 ± 10.8	0.64
Male, n (%)	16 (53.3)	17 (56.7)	0.79
Female, n (%)	14 (46.7)	13 (43.3)	
BMI (kg/m²), Mean ± SD	24.6 ± 2.9	24.9 ± 3.1	0.72
ASA I, n (%)	18 (60.0)	17 (56.7)	0.79
ASA II, n (%)	12 (40.0)	13 (43.3)	

The postoperative pain scores assessed using the Visual Analogue Scale (VAS) were significantly lower in the TAP block group at all postoperative time intervals compared with the systemic analgesia group (p < 0.001). Patients receiving TAP block also experienced a significantly longer duration before requiring rescue analgesia and required a lower total dose of rescue analgesics during the first 24 hours.

Table 2: Comparison of Postoperative Outcomes

Variable	TAP Block (n=30)	Systemic Analgesia (n=30)	p-value
VAS Score at 2 hours	2.1 ± 0.8	4.3 ± 1.0	**<0.001**
VAS Score at 6 hours	3.0 ± 1.0	5.2 ± 1.2	**<0.001**
VAS Score at 24 hours	2.8 ± 0.9	3.9 ± 1.0	**0.001**
Time to first rescue analgesia (hours)	8.4 ± 2.1	3.6 ± 1.2	**<0.001**
Total rescue analgesic consumption (mg)	72 ± 28	148 ± 36	**<0.001**

The incidence of postoperative nausea and vomiting was lower in the TAP block group than in the systemic analgesia group (10.0% vs. 30.0%). Patient satisfaction scores were significantly higher among patients receiving ultrasound-guided TAP block (8.9 ± 0.8 vs. 6.8 ± 1.1; p < 0.001). No block-related complications, including hematoma, local anaesthetic toxicity, or infection, were observed during the study.

Table 3: Comparison of Duration of Surgery and Rescue Analgesic Requirement

Variable	TAP Block (n=30)	Systemic Analgesia (n=30)	p-value
Duration of surgery (minutes)	88.4 ± 16.5	90.2 ± 17.1	0.68
Patients requiring rescue analgesia, n (%)	12 (40.0)	25 (83.3)	**<0.001**
Number of rescue analgesic doses (24 hours)	1.2 ± 0.6	2.5 ± 0.8	**<0.001**

The mean duration of surgery was comparable between the two groups (p>0.05). However, significantly fewer patients in the TAP block group required rescue analgesia, and the mean number of rescue analgesic doses during the first 24 hours was significantly lower compared with the systemic analgesia group (p<0.001).

Table 4: Comparison of Postoperative Adverse Effects

Adverse Effect	TAP Block (n=30)	Systemic Analgesia (n=30)	p-value
Nausea	2 (6.7%)	7 (23.3%)	0.072
Vomiting	1 (3.3%)	5 (16.7%)	0.085
Sedation	1 (3.3%)	6 (20.0%)	**0.044**
Respiratory depression	0 (0.0%)	1 (3.3%)	0.313
TAP block-related complications	0 (0.0%)	—	—

Postoperative adverse effects were less frequent in the TAP block group. Sedation was significantly lower among patients receiving ultrasound-guided TAP block (p=0.044). No complications related to the TAP block procedure, including hematoma, infection, or local anaesthetic toxicity, were observed.

Discussion

In the present study, patients receiving ultrasound-guided TAP block had significantly lower postoperative VAS pain scores and reduced analgesic requirements compared with those receiving systemic analgesia. These findings are comparable with those of McDonnell et al., who reported significantly lower pain scores and markedly reduced 24-hour morphine consumption in the TAP block group (21.9 ± 8.9 mg) compared with the control group (80.4 ± 19.2 mg) [1]. The mean time to first rescue analgesia in the present study was significantly longer in the TAP block group (8.4 ± 2.1 hours) than in the systemic analgesia group (3.6 ± 1.2 hours). Petersen et al. also reported that ultrasound-guided TAP block provides prolonged postoperative analgesia with reduced opioid requirements following abdominal surgery [2].

The total rescue analgesic consumption in our study was significantly lower in the TAP block group (72 ± 28 mg) than in the systemic analgesia group (148 ± 36 mg). Similarly, Brogi et al., in a meta-analysis of randomized controlled trials involving 31 studies and more than 2,000 patients, demonstrated that TAP block significantly reduced postoperative opioid consumption and pain scores compared with conventional analgesia [4].

The incidence of postoperative nausea and vomiting was lower in the TAP block group (10.0%) than in the systemic analgesia group (30.0%). Abdallah et al., in their systematic review of 31 randomized controlled trials, also concluded that TAP block significantly reduces postoperative pain intensity and opioid consumption, thereby decreasing opioid-related adverse effects [3].

Patient satisfaction was significantly higher in the TAP block group in the present study. Similar findings were reported by Guo et al., whose meta-analysis of 10 randomized controlled trials involving 633 patients demonstrated that TAP block provides superior postoperative analgesia, lower analgesic requirements, and improved postoperative recovery compared with conventional analgesic techniques [5].

Overall, the findings of the present study are in agreement with previously published randomized controlled trials and systematic reviews, supporting ultrasound-guided TAP block as a safe and effective component of multimodal postoperative analgesia [1–5].

Conclusion

The present study demonstrated that ultrasound-guided Transversus Abdominis Plane (TAP) block provides superior postoperative analgesia compared with systemic analgesia in patients undergoing lower abdominal surgery. It was associated with lower postoperative pain scores, prolonged duration of analgesia, reduced rescue analgesic requirement, fewer opioid-related adverse effects, and higher patient satisfaction. Therefore, ultrasound-guided TAP block is an effective and safe component of multimodal postoperative pain management.

Limitations

1. The study was conducted at a single tertiary care teaching hospital, which may limit the generalizability of the findings.
2. Only short-term postoperative outcomes (up to 24 hours) were evaluated.

Recommendations

1. Ultrasound-guided TAP block should be routinely considered as part of multimodal analgesia for lower abdominal surgeries.
2. Larger multicentric studies with longer follow-up are recommended to validate these findings.
3. Future studies should evaluate the long-term outcomes and cost-effectiveness of ultrasound-guided TAP block.

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