Comparison of transversus abdominis plane block versus local anesthetic wound infiltration for postoperative analgesia in lower abdominal surgery

✉ Shakya S[1], Rana RB[1], Shakya A[2]

1. Department of Anesthesiology and Critical Care, Nepalgunj Medical College Teaching Hospital, Kohalpur, Nepal
2. Department of Community Medicine, Kathmandu Medical College, Sinamangal, Nepal

ABSTRACT

Introduction: Adequate pain control after laparotomy enhances recovery, reduces opioid requirement and improves comfort. The Transversus Abdominis Plane (TAP) block anesthetizes T6–L1 nerves between the internal oblique and transversus abdominis muscles, providing longer-lasting analgesia than Local Anesthetic Wound Infiltration (LAWI). Although LAWI is simple and widely used, its analgesic effect is less consistent, making the TAP block a more effective option in multimodal pain management.This study compared postoperative pain scores, opioid use, analgesia duration, and PONV between TAP and LAWI groups after laparotomy.

Methods: This interventional study was conducted at Nepalgunj Medical College, Nepal (July to November 2025) after ethical approval. Adults aged 18–65 years with American Society of Anesthesiologists (ASA) physical status I-II undergoing elective or emergency lower abdominal surgery under general anesthesia were randomized (N=62) into two equal groups. Group A received LAWI with 20mL 0.25% bupivacaine before closure, while Group B received ultrasound guided TAP block with 10mL of 0.25% bupivacaine per side. Postoperative pain Visual Analogue Scale (VAS) score 0–10 was assessed at 0, 4, 8, 12 and 24 hours by a blinded investigator. Rescue tramadol (50mg IV) was given for VAS > 4. Total 24-hour tramadol use and adverse events were recorded. Data were analyzed using chi-square test, students unpaired t-test and Mann–Whitney U-test; $p < 0.05$ was considered significant.

Results: Both groups were comparable in age, gender, physical status and surgery duration. TAP block patients had statistically significant lower VAS scores at all time points. The mean time for first rescue analgesia was 348.39 ± 121.40 minutes in Group A while 461.54 ± 66.56 minutes in Group B($p<0.001$). Total 24-hr tramadol requirement was higher in Group A (82.26 ± 35.47mg) than Group B (50 ± 00mg)($p<0.001$). Eight patients in Group A and five in Group B developed postoperative nausea (PONV) with no significant difference ($p>0.05$).

Conclusion: Ultrasound-guided TAP block resulted in significantly lower VAS pain scores at all time points, reduced 24-hour tramadol consumption, and prolonged time to first rescue analgesia, without increasing PONV compared to LAWI.

Keywords: Lower abdominal surgery, postoperative analgesia, TAP block, visual analog scale.

INTRODUCTION

Postoperative pain management is crucial in improving recovery, reducing opioid consumption, and enhancing patient satisfaction following abdominal surgeries. Inadequate analgesia contributes to delayed mobilization, prolonged hospital stays, immunosuppression, and risk of chronic pain.[1] Effective regional analgesic techniques include Local Anesthetic Wound Infiltration (LAWI) and the Transversus Abdominis Plane (TAP) block. LAWI is a simple and widely available technique involving local anesthetic infiltration at the surgical site, whereas the TAP block provides sensory blockade of T6–L1 nerves, reducing postoperative pain more

Corresponding author
Dr. Shailendra Shakya
Dept of Anesthesiology and Critical Care
Nepalgunj Medical College Teaching Hospital
Email: drshailenshakya@gmail.com

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effectively in some cases.[2-4]

Pain experienced after abdominal surgery is primarily contributed by the incision made in the abdominal wall.[5] The TAP block anesthetizes the somatic supply of the anterior abdominal wall, which arises from the anterior rami of spinal nerves and runs along the fascial plane between the internal oblique muscle and the transversus abdominis muscle.[2,6] Local infiltration around the wound site has also been widely used, but its efficacy as a potent and useful adjunct in multimodal analgesia remains controversial.[3,7]

Limited data from Nepal exists on the effectiveness of LAWI versus TAP block in lower abdominal surgeries, and there is no consensus regarding time to first rescue analgesia, total opioid consumption or incidence of postoperative nausea and vomiting (PONV). Therefore this study aimed to compare postoperative pain scores, opioid consumption, duration of analgesia (time to first rescue analgesic), and incidence of PONV between LAWI and TAP block, providing evidence to optimize postoperative pain management strategies and enhance recovery following abdominal surgery.[8,9]

METHODS

This hospital based interventional study was carried out in the Department of Anesthesiology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Nepal, from July to November 2025 after approval (No.295/082/83) from the Institutional Review Committee. A convenience, consecutive sampling technique was used to enroll eligible patients during the study period. Patients aged 18–65 years of any gender, classified as American Society of Anesthesiologists (ASA) I or II, and patients requiring general anesthesia for Elective or emergency lower abdominal surgery (e.g. umbilical hernia repair, incisional hernia repair, hollow viscus perforation,volvulus, hysterectomy, appendicular perforation, ovarian cyst, fibroid uterus, etc.) under general anesthesia were included after obtaining written informed consent. The type of surgery was recorded and compared between groups to ensure baseline comparability. Exclusion criteria included: known allergy to lignocaine and bupivacaine, hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), cardiovascular, renal, hepatic, or neurological diseases, or an abnormal coagulation profile and upper abdominal surgeries.

Sample Size Calculation:

Formula for Sample Size Calculation (Two-Sample Comparison of Means):

$$N=2\{(Z\alpha/2+Z\beta)^2\ \sigma^2\}/\Delta^2$$

Where:

N = required sample size for each group

$Z\alpha/2$ = Z-score corresponding to the significance level (e.g., for a 95% confidence level, $Z\alpha/2 = 1.96$)

$Z\beta$ = Z-score corresponding to the desired power (e.g., for 80% power, $Z\beta=0.84$)

σ^2 = pooled standard deviation of the two groups (a measure of variability)

Δ = minimum expected difference between the two means (effect size)

The sample size for each group would be:

$$N=2\{(Z\alpha/2+Z\beta)^2\ \sigma^2\}/\Delta^2$$

$$= 2\ x\{(1.96+0.84)^2\ x\ 2^2\}/1.5^2 = \{7.84\ x\ 8\}/2.25=28 \text{ per group}$$

The sample size was calculated to detect a minimum clinically significant difference of 1.5 in postoperative pain scores between the two groups, assuming a pooled standard deviation of 2 based on previously published study.[10-11]

Pooled standard deviation σ =2

Minimum detectable difference Δ=1.5 (mean pain score difference)

After allowing for a 10% dropout rate, 31 patients were included in each group. Patients (N=62) were randomly assigned to one of the two groups (n = 31 per group).

In the preoperative visit, written consent was taken and the Visual Analogue Scale for Pain (VAS score) was explained to the patient.

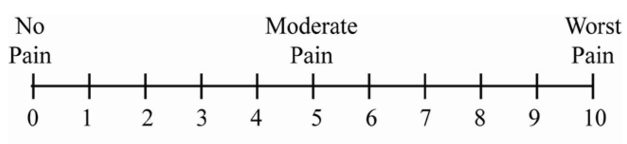

Fig. 1: A 10 cm baseline is recommended for VAS score.

0: No pain 1-3: Mild Pain 4-6: Moderate Pain

7-9: Severe pain 10: Worst possible pain

On arrival of the patients in operation theater, intravenous (IV) line was initiated with 18-G cannula; all patients were given general anesthesia. All patients were preoxygenated with 100% oxygen for 3 minutes and midazolam in the dose of 2mg and fentanyl 2mcg/kg was given as well. Anaesthesia was induced using propofol injection in the dose of one mg/kg. Endotracheal intubation was facilitated using rocuronium in the dose of one mg/kg IV. Laryngoscopy and endotracheal intubation were done with Macintosh laryngoscope. Anesthesia was maintained with 100% oxygen, Isoflurane (1-2%), and intermittent bolus doses of 0.01mg/kg IV vecuronium. Additional intraoperative fentanyl supplementation was planned when required. Intraoperatively, all the patients were given injection ketorolac 30mg and paracetamol 1gm. Study procedures were done accordingly

Patients (N = 62) were randomly assigned to one of two the groups (n = 31 per group)

Group A (LAWI – Local Anesthetic Wound Infiltration):

Patients received 20 mL of 0.25% bupivacaine infiltrated into the surgical wound site before closure on each side (10ml). The infiltration was performed by the surgical team at the end of surgery using a 10 mL syringe with the local anesthetic injected in and around the wound margins.[12]

Group B (Transversus Abdominis Plane (TAP) block):

Patients received an ultrasound-guided bilateral TAP block immediately after abdominal closure. The TAP block was performed by an experienced consultant anesthesiologist with expertise in regional anesthesia. Each side was administered 10 ml of 0.25% bupivacaine.[13-15] The TAP block was performed using a portable Sonosite machine with a linear probe (6–13 MHz), positioned transversely on the anterolateral abdominal wall where the three muscle layers are most clearly visualized.

The probe was then moved posterolateral towards the midaxillary line, just above the iliac crest (triangle of Petit), to identify the fascial plane between the internal oblique and transversus abdominis muscles. A 25G spinal needle was used for the block and inserted via an in-plane anterior approach, with advancement visualized in real time under ultrasound.

Following needle placement, the drug was injected, and correct deposition was confirmed by observing a hypoechoic spread of the injectate with hydrodissection of the transversus abdominis plane. Procedure similarly replicated on the contralateral side.

On admission to the Post Anesthetic Care Unit (PACU), a postoperative pain was assessed as soon as the subject becomes alert and able to answer questions and recorded (baseline / 0 hour). The level of pain was assessed using a 0 to 10 VAS, recorded at 0, 4, 8, 12 and 24 hours (hrs.) postoperatively hypertension, hypotension, shivering was assessed and recorded. In PACU, 30mg of the ketorolac and paracetamol 1gm was given 8 hourly for the first 24 hrs to keep the VAS score<7. If the patient still complained of pain, rescue analgesia 50mg of tramadol IV was given to maintain VAS score≤4 along with injection ondansetron 4mg.The total amount of postoperative Tramadol used over 24 hours was recorded.

Data thus recorded and collected were analyzed using SPSS version 20. The normality of continuous variables was assessed using the Shapiro–Wilk test. As VAS scores were not normally distributed, they were analyzed using the Mann–Whitney U-test. Normally distributed continuous variables were compared using Student's unpaired t-test, while categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

Both groups were comparable with regards to age, gender, ASA physical status, mean duration of surgery. There was no statistically significant difference between groups (p > 0.05). (Table 1)

The distribution of surgical procedures was comparable between Group A and Group B (p > 0.05), indicating no significant difference in surgical characteristics between the groups.

VAS scores were compared between groups at

Table 1: Study population demographic data

Variables	Group A	Group B	p-value
Age (yrs)	40.10 ± 16	37.32 ± 15.50	0.81[a]
Gender			
Male	11 (35.5)	18 (58.1)	0.08[b]
Female	20 (64.5)	13 (41.9)	
Weight (Kg)	59 ± 7.5	60.77 ± 8.00	0.95[a]
Physical Status			
ASA I	23 (74.2)	20 (64.5)	0.5[b]
ASA II	8 (25.8)	11 (35.5)	
Duration of Surgery(min)	108.06 ±17.014	102.58±21.60	0.07[a]

[a]Students unpaired t-test, [b]Chi-square test

Table 2: Comparison of surgical procedures between the two groups

Procedure	Group A	Group B	p-value
Adhesiolysis and appendectomy	8 (25.8%)	8 (25.8%)	0.21[b]
Adhesiolysis and primary repair (Volvulus)	2 (6.5%)	7 (22.6%)	
Cystectomy	5 (16.1%)	1 (3.2%)	
Omental patch repair	2 (6.5%)	2 (6.5%)	
Hernia Repair	3 (9.7%)	2 (6.5%)	
Hysterectomy	4 (12.9%)	1 (3.2%)	
Laparoscopic Appendectomy	5 (16.1%)	3 (9.7%)	
Laproscopic Cystectomy	0	1 (3.2%)	
Salphingectomy	2 (6.5%)	6 (19.4%)	

Table 3: Comparison of postoperative VAS Scores between the two groups

VAS (Hours)		Groups		Mean Rank		Mann-Whitney Test	
		Group A	Group B	Group A	Group B	Z	p-value
0hr	Range	1-3	1-3	36.34	26.66	-2.43	<0.015
	InterQuartile Range (Median)	2 (1)	2 (1)				
4hr	Range	3-7	2-5	43.24	19.76	-5.37	<0.001
	InterQuartile Range (Median)	5 (1)	3 (1)				
8hr	Range	4-7	3-6	42.40	20.60	-5.02	<0.001
	InterQuartile Range (Median)	5 (1)	4 (1)				
12hr	Range	3-5	1-6	40.50	22.50	-4.12	<0.001
	InterQuartile Range (Median)	4 (1)	3 (1)				
24hr	Range	1-4	1-4	40.05	22.95	-3.87	<0.001
	InterQuartile Range (Median)	3 (2)	2 (1)				

different time intervals. The Shapiro–Wilk test indicated that VAS scores were not normally distributed ($p < 0.05$), and hence the Mann–Whitney U-test was used.

There was a significantly lower VAS at all postoperative time points with TAP block patients compared with local infiltration group. (Table 3)

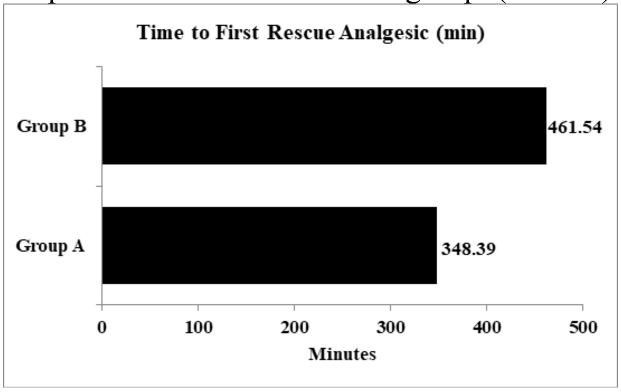

Fig. 2: Comparison of first rescue analgesia between two groups.

In the present study, the first rescue analgesia was given when the VAS score was >4. The mean time for first rescue analgesia during postoperative period in patients of Group A was 348.39 ± 121.40 minutes while in patients of Group B, was 461.54 ± 66.56 minutes with statistically significant difference between the groups (Students unpaired t-test, $p<0.001$) (Fig.2).

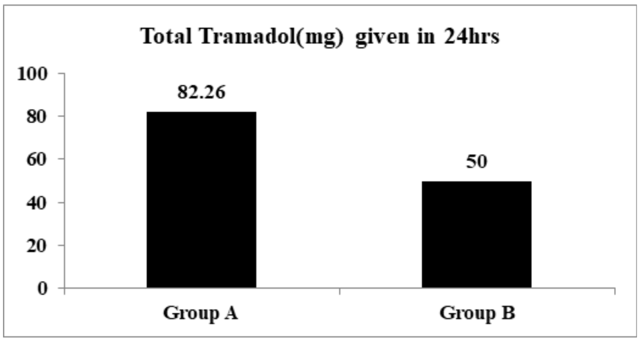

Fig. 3: Comparison of Total Tramadol(mg) given in 24hrs between two groups.

The mean total postoperative intravenous tramadol requirement of the patients to maintain VAS score <4 was more in the patients of Group A is (82.26 ± 35.47mg) compare to Group B (50 ± 00mg) with statistically highly significant difference (Students unpaired t-test, $p<0.001$) (Fig.3).

Eight (25.8%) patients in Group A developed PONV while 5(16.1%) patients in Group B. However, there wasn't any statistical difference between two groups (Students unpaired t-test, $p=0.35$) (Fig. 4).

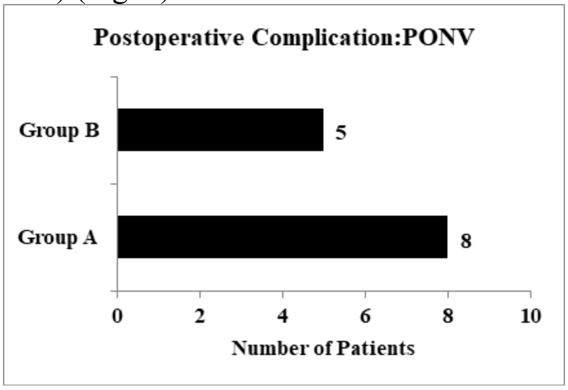

Fig. 4: Comparison of the postoperative complications between two groups.

DISCUSSION

One of the key concerns for patients is postoperative pain control. We practiced pain management with TAP block with 10 ml of local anesthetics of 0.25% either side of the incision after abdominal closure and found satisfactory. This effectiveness may primarily be due to close approximation of surgical nerves under direct USG guidance. TAP block is a regional analgesic technique to provide postoperative analgesia after abdominal surgeries. While many earlier studies used larger volumes (20 ml per side), the present study demonstrates that 10 ml per side of 0.25% bupivacaine provides effective analgesia when administered under ultrasound guidance. This approach may offer a safer alternative by reducing the total local anesthetic dose without compromising analgesic efficacy. Despite using a lower volume compared to previous studies,[13-15] our results demonstrated significantly lower postoperative VAS scores and reduced opioid requirement compared to local wound infiltration. Similar concentrations have been effectively utilized in both international and regional studies evaluating postoperative analgesia following abdominal surgeries.[14,15] These findings suggest that 10 ml per side may be sufficient when accurately administered under ultrasound guidance, offering effective analgesia while minimizing total local anesthetic exposure. The effective pain relief lies in deposition of local anesthetic into the relatively avascular fascial plane, ensuring longer drug retention and consistent blockade of T6–L1 intercostal nerves and ilio-inguinal nerve with ilio-hypogastric nerve compared to rapid absorption and short-lived analgesia with wound infiltration.[9] The use of ultrasound has overcome the limitations of blind landmark techniques by enabling direct visualization of the target plane.

As the types of surgical procedures (Table 2) were comparable between the two groups (p>0.05), the observed difference in postoperative VAS scores is unlikely to be attributable to differences in surgical trauma and more likely reflects the analgesic efficacy of the intervention. In our study, postoperative VAS pain scores at 0, 4, 8, 12 and 24 hours were significantly higher in group A compared to group B (p<0.05) as shown in Table 3.

The first rescue analgesia was administered when the VAS score exceeded 4.The median time to first rescue analgesia was significantly longer in Group B (461.54 ± 66.56 minutes) than in Group A (348.39 ± 121.40 min, p<0.001). The mean total postoperative tramadol requirement was also significantly higher in Group A (82.26 ± 35.47mg) compared to Group B (50 ± 00mg, p<0.001), demonstrating clear opioid- sparing effect in Group B.

Sanad et al. conducted a randomized study on 70 patients undergoing inguinal or infra-umbilical incisional hernia repair under general anesthesia.[8] Patients received either ultrasound-guided TAP block with 20 mL of 0.25% bupivacaine on each side or local wound infiltration with the same drug and volume. They reported that the TAP block group had significantly lower mean VAS scores at 2 hours (2.1 ± 0.8 vs 4.6 ± 0.9), 4 hours (2.8 ± 0.7 vs 5.2 ± 0.8), 6 hours (3.1 ± 0.6 vs 5.7 ± 0.7), and 12 hours (3.5 ± 0.9 vs 6.1 ± 0.8, all p < 0.001) compared to LAWI. These findings were consistent with our study although we used lower volume.

Similarly, Shokri & Elsaeed et al. conducted a randomized trial in 60 urological surgery patients comparing ultrasound-guided transversus abdominis plane (TAP) block with deep wound infiltration.[16] TAP block produced significantly lower postoperative VAS pain scores as shown by Mann–Whitney U test. Likewise, Jamil et al. demonstrated that TAP block resulted in significantly lower VAS scores both at rest and during movement in infra-umbilical hernia repairs, corroborating our results.[17]

Arik et al. observed that patients receiving TAP block experienced much lower pain scores one hour postoperatively, with no statistically significant difference in pain levels between the two groups until six hours.[18] Their results align with our findings regarding early postoperative pain control.

Another study by Jamil et al. also reported prolonged analgesia duration (413.2 ± 63.8 min vs 274.1 ± 41.3 min, p < 0.001) and lower VAS scores with TAP block.[17]

Kaushik et al. compared TAP block with wound infiltration in laparoscopic cholecystectomy and found significantly longer time to first rescue analgesia (7.8 ± 1.2 h vs 4.3 ± 0.9 h, p < 0.001) and reduced 24-hour analgesic consumption in the TAP group, reinforcing our findings.[19]

The lower tramadol requirement in Group B further demonstrates the opioid-sparing benefit of TAP block, reducing opioid-related side effects such as postoperative nausea, vomiting, sedation, and delayed recovery.

This study population included patients from the Tharu community, in whom sociocultural influences may affect pain reporting behavior. Cultural attitudes toward pain expression and prior exposure to physically demanding lifestyles could contribute to variability in subjective pain scores, representing a potential confounding factor in assessing analgesic efficacy.

In our study, PONV occurred in eight patients of Group A versus five in Group B. The reduced incidence of PONV in Group B may be attributed to lower opioid consumption, consistent with previous studies showing reduced 24-hour opioid requirement and PONV with TAP block.[20-23]

Limitations: Limitations of our study include a small sample size and single-center design, and we did not assess long-term outcomes such as chronic postoperative pain. The inclusion of heterogeneous surgical procedures with varying pain profiles may have introduced variability in analgesic outcomes. Although no block-related complications were observed, potential adverse events such as local anesthetic toxicity, hematoma, or organ injury should be considered. Future larger, multicenter trials with adequately powered and stratified patient populations are warranted to confirm the efficacy and safety of TAP blocks versus wound infiltration, including procedure-specific analyses.

CONCLUSION

Ultrasound-guided TAP block with 0.25% bupivacaine provided effective postoperative analgesia for lower abdominal surgeries and reduced the requirement for additional opioids. The TAP block was associated with a lower incidence of postoperative nausea and vomiting. However, due to the inclusion of heterogeneous procedures involving different abdominal regions and dermatomes, the findings should be interpreted with caution, and procedure-specific studies are warranted.

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