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Original Article

Evaluating Analgesic Efficacy of Bilateral Ultrasound-Guided Lateral versus Posterior TAP Block after Abdominal Hysterectomy: A Comparative Study

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ABSTRACT

Background: Total abdominal hysterectomy (TAH) is associated with significant postoperative pain requiring effective multimodal analgesia. The transversus abdominis plane (TAP) block has emerged as a valuable regional technique for anterior abdominal wall analgesia. However, comparative evidence regarding the optimal approach—lateral versus posterior—remains limited.
Methods: This prospective, randomized comparative study included 90 female patients (ASA I-II) undergoing elective TAH under spinal anesthesia. Patients were randomly allocated to receive either bilateral lateral TAP block (Group L, n=45) or bilateral posterior TAP block (Group P, n=45) using 15 mL of 0.5% levobupivacaine per side. Primary outcomes included postoperative pain scores (Numerical Rating Scale) at 2, 4, 6, 12, and 24 hours, duration of analgesia, and rescue analgesic consumption. Secondary outcomes included hemodynamic parameters and adverse events.
Results: Pain scores were significantly lower in Group P compared to Group L at 4 hours (2.96 ± 0.37 vs. 3.33 ± 0.64, $p<0.01$), 6 hours (3.31 ± 0.93 vs. 3.73 ± 1.23, $p<0.01$), and 12 hours (2.38 ± 1.03 vs. 2.91 ± 1.04, $p=0.016$). The posterior approach provided significantly longer analgesia duration (9.44 ± 0.50 vs. 8.06 ± 1.57 hours, $p<0.01$) and reduced opioid consumption (1.04 ± 0.74 vs. 2.13 ± 0.59 doses, $p<0.01$). Hemodynamic parameters and adverse events were comparable between groups.
Conclusion: The posterior TAP block approach provides superior postoperative analgesia, longer duration of pain relief, and reduced opioid requirements compared to the lateral approach following TAH.

Keywords*: Transversus abdominis plane block, posterior TAP block, lateral TAP block, postoperative analgesia, abdominal hysterectomy, regional anesthesia, levobupivacaine.*

INTRODUCTION

Total abdominal hysterectomy (TAH) represents one of the most frequently performed major gynecological surgeries worldwide, with significant postoperative pain being a consistent clinical challenge [1]. Inadequate pain management following TAH not only compromises patient comfort but also delays mobilization, prolongs hospitalization, increases morbidity, and elevates the risk of developing chronic pain syndromes [2]. The complex nature of post-hysterectomy pain involves both somatic components arising from the abdominal wall incision and visceral components from intra-abdominal tissue manipulation [3].

Traditional postoperative pain management has relied heavily on opioid analgesics; however, their associated adverse effects—including respiratory depression, nausea, vomiting, sedation, and potential for dependence—have prompted a paradigm shift toward multimodal analgesia strategies [4]. Regional anesthesia techniques have emerged as valuable components of enhanced recovery protocols, offering targeted pain relief while minimizing systemic opioid requirements [5].

The transversus abdominis plane (TAP) block, first described by Rafi in 2001, involves injection of local anesthetic into the fascial plane between the internal oblique and transversus abdominis muscles, effectively blocking the sensory afferents (T6-L1) supplying the anterior abdominal wall [6]. The advent of ultrasound guidance has significantly enhanced the precision, safety, and efficacy of this technique [7]. Multiple randomized controlled trials have demonstrated the effectiveness of TAP blocks in reducing postoperative pain and opioid consumption following various abdominal surgeries, including cesarean sections, appendectomies, and hysterectomies [8,9].

Two primary approaches exist for performing TAP blocks: the lateral approach, where local anesthetic is deposited at the midaxillary line between the costal margin and iliac crest, and the posterior approach, where injection occurs along the posterior axillary line in the triangle of Petit [10]. Theoretically, the posterior approach may provide superior analgesia by intercepting thoracolumbar nerves before their extensive branching within the TAP and allowing retrograde spread toward the paravertebral space [11]. A meta-analysis by Abdallah et al. suggested that the posterior technique may offer prolonged analgesia compared to the lateral approach [12].

Despite these theoretical advantages, direct comparative studies evaluating both approaches specifically in TAH patients remain limited, particularly in diverse clinical settings [13]. Therefore, this study aimed to compare the postoperative analgesic efficacy and opioid consumption between ultrasound-guided bilateral lateral and posterior TAP blocks in patients undergoing total abdominal hysterectomy.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized, comparative study was conducted at the Department of Anesthesiology, Shaheed Hasan Khan Mewati Government Medical College, Nalhar, Nuh, Haryana, India, over a 12-month period following institutional ethics committee approval.

Sample Size and Participants

Based on previous literature reporting differences in pain scores between TAP block approaches, with an expected mean difference of 1.0 in NRS scores, standard deviation of 1.5, alpha error of 0.05, and power of 80%, the calculated sample size was 40 patients per group. Accounting for potential dropouts, 45 patients were enrolled in each group, totaling 90 participants.

Inclusion and Exclusion Criteria

Inclusion criteria comprised female patients aged 40-75 years, ASA physical status I-II, scheduled for elective TAH under spinal anesthesia, and providing written informed consent. Exclusion criteria included allergy to local anesthetics, coagulation disorders or anticoagulant therapy, infection at the injection site, chronic opioid or corticosteroid use, body mass index ≥30 kg/m², emergency surgery, difficult airway, history of seizures or neurological deficits, and poor pulmonary compliance.

Randomization and Blinding

Patients were randomly allocated to two groups using computer-generated random numbers with sealed envelope technique: Group L (lateral TAP block, n=45) and Group P (posterior TAP block, n=45). The investigator assessing postoperative outcomes was blinded to group allocation.

Anesthetic Technique

All patients received standardized spinal anesthesia at L3-L4 interspace using 0.5% hyperbaric bupivacaine. Standard monitoring included electrocardiography, non-invasive blood pressure, and pulse oximetry. Upon surgery completion, patients were transferred to the recovery area where TAP blocks were performed within one hour.

TAP Block Technique

All blocks were performed using a portable ultrasound machine with a linear array transducer (6-13 MHz). For the lateral approach (Group L), the transducer was placed at the midaxillary line between the costal margin and iliac crest. The three muscle layers (external oblique, internal oblique, and transversus abdominis) were identified, and a 21-gauge, 100-mm block needle was advanced in-plane until the tip reached the fascial plane between internal oblique and transversus abdominis muscles.

For the posterior approach (Group P), the transducer was positioned along the posterior axillary line at the triangle of Petit. The needle was directed to the posterior aspect of the TAP, close to the aponeurosis of the transversus abdominis muscle.

Following negative aspiration, 15 mL of 0.5% levobupivacaine was injected on each side, with visualization of the characteristic hypoechoic lens-shaped spread confirming correct placement. The procedure was repeated bilaterally.

Outcome Measures

Primary outcomes included pain scores assessed using the Numerical Rating Scale (NRS: 0-10) at 2, 4, 6, 12, and 24 hours postoperatively, total duration of analgesia (time to first rescue analgesic request), and total rescue analgesic consumption in 24 hours. Rescue analgesia (intravenous tramadol 2 mg/kg) was administered when NRS exceeded 4. Secondary outcomes included hemodynamic parameters (heart rate, systolic and diastolic blood pressure) at specified intervals and adverse events (postoperative nausea and vomiting, local anesthetic toxicity).

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using independent t-test or Mann-Whitney U test based on normality assessment. Categorical variables were expressed as frequencies and percentages and compared using chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

All 90 enrolled patients completed the study. Demographic and surgical characteristics were comparable between groups (Table 1). Mean age was 39.04 ± 7.71 years in Group L and 40.84 ± 11.17 years in Group P (p=0.376). Mean body weight was 56.04 ± 9.14 kg and 57.27 ± 8.69 kg in Groups L and P, respectively (p=0.517). Duration of surgery was similar between groups (66.78 ± 19.02 vs. 67.44 ± 18.76 minutes, p=0.86).

Table 1: Baseline Demographic and Surgical Characteristics

Parameter	Group L (n=45)	Group P (n=45)	p-value
Age (years)	39.04 ± 7.71	40.84 ± 11.17	0.376
Weight (kg)	56.04 ± 9.14	57.27 ± 8.69	0.517
ASA I/II	28/17	26/19	0.673
Duration of surgery (min)	66.78 ± 19.02	67.44 ± 18.76	0.860

Postoperative Pain Scores and Analgesic Outcomes

Pain scores were comparable between groups at 1 and 2 hours postoperatively. However, from 4 hours onward, Group P demonstrated significantly lower NRS scores compared to Group L (Table 2). At 4 hours, mean NRS was 2.96 ± 0.37 in Group P versus 3.33 ± 0.64 in Group L (p<0.01). This significant difference persisted at 6 hours (3.31 ± 0.93 vs. 3.73 ± 1.23, p<0.01) and 12 hours (2.38 ± 1.03 vs. 2.91 ± 1.04, p=0.016).

The posterior approach provided significantly longer duration of analgesia (9.44 ± 0.50 hours vs. 8.06 ± 1.57 hours, p<0.01). Mean opioid consumption was significantly lower in Group P (1.04 ± 0.74 vs. 2.13 ± 0.59 doses, p<0.01). Notably, 22.2% of patients in Group P required no rescue analgesia within 24 hours compared to none in Group L.

Table 2: Postoperative Pain Scores (NRS) and Analgesic Outcomes

Parameter	Group L (n=45)	Group P (n=45)	p-value
NRS at 2 hours	1.62 ± 0.75	1.51 ± 0.51	0.411
NRS at 4 hours	3.33 ± 0.64	2.96 ± 0.37	<0.01
NRS at 6 hours	3.73 ± 1.23	3.31 ± 0.93	<0.01
NRS at 12 hours	2.91 ± 1.04	2.38 ± 1.03	0.016
NRS at 24 hours	2.24 ± 0.71	2.51 ± 0.87	0.120
Duration of analgesia (hours)	8.06 ± 1.57	9.44 ± 0.50	<0.01
Opioid consumption (doses)	2.13 ± 0.59	1.04 ± 0.74	<0.01
No rescue analgesia required	0 (0%)	10 (22.2%)	<0.01

Hemodynamic Parameters and Adverse Events

Hemodynamic parameters remained stable and comparable between groups throughout the 24-hour observation period (p>0.05 at all time points). The incidence of postoperative nausea and vomiting was similar between groups (13.3% in Group L vs. 11.1% in Group P, p=1.0). No cases of local anesthetic systemic toxicity or other serious complications were observed.

Table 3: Adverse Events

Parameter	Group L (n=45)	Group P (n=45)	p-value
PONV	6 (13.3%)	5 (11.1%)	1.000
Local anesthetic toxicity	0 (0%)	0 (0%)	-

DISCUSSION

This study demonstrates that the posterior approach for ultrasound-guided TAP block provides superior postoperative analgesia compared to the lateral approach in patients undergoing total abdominal hysterectomy. The posterior technique resulted in significantly lower pain scores during the critical 4-12 hour postoperative period, extended duration of analgesia, and reduced opioid consumption.

Our findings align with the anatomical rationale underlying the posterior approach. Jankovic et al. demonstrated that a more posterior injection site allows interception of thoracolumbar nerve branches before their extensive branching and anastomoses within the TAP [14]. Additionally, cadaveric studies by Carney et al. revealed that the posterior approach facilitates retrograde local anesthetic spread toward the paravertebral space, potentially providing partial sympathetic blockade [15]. This mechanism may explain the prolonged analgesic duration observed in our posterior group.

The meta-analysis by Abdallah et al., encompassing 641 patients across twelve randomized trials, concluded that the posterior TAP block technique reduces opioid consumption and pain scores up to 48 hours postoperatively compared to the lateral approach [12]. Our results corroborate these findings, demonstrating a 51% reduction in opioid consumption with the posterior technique.

Yoshiyama et al. reported similar outcomes in laparoscopic gynecologic surgery, with the posterior TAP group showing lower visual analog scale scores and reduced supplemental analgesic requirements within 24 hours [16]. Faiz et al. specifically examined cesarean section patients and found significantly lower pain scores at 6, 12, and 24 hours with the posterior approach [17]. Our study extends these findings to the TAH population, confirming the generalizability of the posterior approach's superiority across various lower abdominal surgeries.

The reduced opioid consumption in the posterior group likely contributed to fewer opioid-related side effects and improved postoperative recovery. Effective pain management influences multiple dimensions of patient recovery, including psychological well-being, sleep quality, and early mobilization [18].

The comparable incidence of adverse events between groups confirms the safety profile of both approaches when performed under ultrasound guidance. The low overall complication rate (12.2% PONV, no local anesthetic toxicity) aligns with established literature on TAP block safety [10].

Study limitations include the single-center design, which may limit generalizability, and the 24-hour follow-up duration, which precluded assessment of long-term outcomes. Additionally, the unblinded nature of block performance, though outcome assessment was blinded, represents a potential source of bias.

CONCLUSION

The posterior approach for ultrasound-guided bilateral TAP block provides superior postoperative analgesia compared to the lateral approach in patients undergoing total abdominal hysterectomy. This technique offers significantly lower pain scores during the intermediate postoperative period, extended duration of analgesia, and substantially reduced opioid requirements. Both approaches demonstrate comparable safety profiles with stable hemodynamics and minimal adverse events. These findings support the preferential use of the posterior TAP block approach as part of multimodal analgesia protocols for lower abdominal surgeries with transverse incisions.

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