THE ROLE OF TRANSVERSUS ABDOMINIS PLANE BLOCK IN A MULTIMODAL ANALGESIA STRATEGY AFTER CESAREAN SECTION: A RANDOMIZED CONTROLLED CLINICAL TRIAL

Nguyen Quang Nhat[1*], Nguyen Minh Dung[1], Nguyen Thi Dieu Thao[1], Nguyen Van Huu[1], Nguyen Tran Thao My[1], Pham Thi Bich Van[1],Nguyen Thi Thuy Oanh[1], Hoang Thi Hue[1], Giang Thi Thu Ha[1], Pham Thi Thin[1]

ABSTRACT

Objective: *This study aimed to evaluate the effectiveness of the transversus abdominis plane (TAP) block in reducing postoperative pain after cesarean section.*

Materials and Methods: *A total of 46 parturients were enrolled in a randomized, controlled, single-blind clinical trial. The intervention group (n = 23) received a TAP block after surgery. Both groups used patient-controlled analgesia (PCA) with fentanyl when the visual analog scale (VAS) pain score was ≥ 4. Primary outcome measures included total fentanyl consumption, number of PCA demands, and VAS pain scores at rest and during movement at 6 hours and 24 hours postoperatively.*

Results: *The intervention group had significantly lower total fentanyl consumption within 24 hours compared with the control group (296 ± 121 mcg vs 362 ± 93.4 mcg; $p < 0.05$). The number of PCA activations was also lower in the intervention group. VAS pain scores at rest and during movement were significantly lower in the intervention group at 6 hours postoperatively. At 24 hours, VAS scores at rest remained significantly lower in the TAP group, whereas no significant difference was observed in VAS scores during movement.*

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[1] Military Hospital 175
Corresponding author: Nguyen Quang Nhật (anes175.nhat@gmail.com),
Mã Orchid id: 0009-0005-0566-903.
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Conclusion: *Ultrasound-guided TAP block is a safe and effective analgesic technique that significantly reduces opioid consumption and improves pain control during the first 24 hours following cesarean section.*

Keywords: *TAP block, ERAS.*

1. INTRODUCTION

Post–cesarean section (CS) pain significantly affects the psychological well-being and recovery of parturients, mother–infant bonding, and breastfeeding duration. It also causes disturbances in multiple organ systems (respiratory, circulatory, endocrine, etc.), suppresses immune function, increases inflammatory responses, delays wound healing, and prolongs hospital stay [1]. Therefore, postoperative pain management is a major concern for anesthesiologists and obstetric surgeons.

Various methods are available for post–cesarean analgesia, including epidural analgesia, intrathecal opioids, intravenous opioids, and nonsteroidal anti-inflammatory drugs. However, these techniques have certain limitations, such as reduced mobility, hemodynamic instability, nausea and vomiting, pruritus, urinary retention, respiratory depression, and local anesthetic toxicity. Some parturients have contraindications to neuraxial anesthesia and must undergo cesarean delivery under general anesthesia. Opioids, particularly morphine, provide effective central analgesia, but high doses may cause numerous adverse effects. In addition, opioids can be excreted into breast milk and may produce harmful effects in neonates [2].

To minimize these undesirable effects, multimodal analgesia has received increasing attention. By combining different classes of analgesic drugs and techniques, this approach aims to enhance postoperative analgesic efficacy while reducing total drug dosage and side effects. The transversus abdominis plane (TAP) block is one of the multimodal analgesia techniques designed to reduce opioid consumption [3].

Therefore, we conducted this study to evaluate the analgesic effectiveness of ultrasound-guided transversus abdominis plane (TAP) block in parturients undergoing cesarean section.

2. SUBJECTS AND METHODS

2.1 Study subjects

Parturients indicated for cesarean section under spinal anesthesia at the Department of Anesthesiology and Intensive Care, Military Hospital 175, from April 2023 to July 2025 were included. Inclusion criteria: parturients aged 18–50 years, ASA physical status II–III, who consented to participate, received spinal anesthesia, and underwent surgery via a Pfannenstiel incision. Exclusion criteria: parturients with chronic pain, contraindications to bupivacaine, failed spinal anesthesia, surgical complications unrelated to anesthesia, acute fetal distress, or umbilical cord prolapse.

2.2 Study design and sample size

This was a randomized, controlled, single-blind clinical trial. Sample size calculation was based on the primary outcome: analgesic efficacy of TAP block measured by fentanyl consumption within 24 hours postoperatively.

According to Nguyen Van Minh [4], the mean morphine consumption in the non–TAP block group was 9.9 ± 3.1 mg over 24 hours. Assuming an equivalent morphine-to-fentanyl conversion, the study hypothesis was that fentanyl consumption during the first 24 hours would be reduced by 40% in the TAP block group. With a type I error of 5% ($\alpha = 0.05$) and a type II error of 10% ($\beta = 0.1$), a sample size of 22–25 parturients per group was required. All participants were sequentially numbered; odd numbers were assigned to the intervention group (T), and even numbers to the control group (R).

2.3 Study procedures

All parturients underwent pre-anesthetic evaluation, received explanations of potential risks, and were anesthetized using spinal anesthesia according to the hospital's cesarean section protocol. A 27-G spinal needle was inserted at the L3–4 interspace, and a mixture of bupivacaine and fentanyl was administered. Surgery commenced once the sensory block level reached T6–T4.

Postoperatively, parturients were transferred to the recovery room. Both groups received a standardized analgesic regimen consisting of paracetamol 1 g every 12 hours, alternating with rectal diclofenac suppositories administered 6 hours after paracetamol. During the first 24 postoperative hours, all parturients were connected to a patient-controlled analgesia (PCA) pump with fentanyl and were instructed to self-administer analgesia when the VAS score was ≥ 4. PCA settings included no basal infusion, a bolus dose of 20 μg fentanyl, a lockout interval of 30 minutes, and a maximum dose of 500 μg fentanyl within 24 hours.

The intervention group (T) received postoperative analgesia via ultrasound-guided TAP block performed by an experienced anesthesiologist using the in-plane needle technique. The injection site was along the midaxillary line, midway between the iliac crest and the inferior border of the 12th rib. Proper local anesthetic spread was confirmed by the appearance of a hypoechoic, lens-shaped image between the internal oblique and transversus abdominis muscle layers. Each side of the abdominal wall received 20 mL of 0.25% bupivacaine.

2.4 Study variables

Participants were monitored during the first 24 postoperative hours in the clinical ward. Primary outcome variables included total fentanyl dose, number of PCA activations, and pain intensity assessed using the Visual Analog Scale (VAS) at rest and during movement (coughing or knee flexion) at the following time points: at the end of surgery, 6 hours postoperatively, and 24 hours postoperatively.

2.5 Ethics in research

The study was approved by the hospital-level Scientific Council of Military Hospital 175 (Decision No. 3761/QĐ-BV dated October 2, 2023) and conducted with informed consent from all participating parturients.

3. STUDY RESULTS

Table 3.1. Characteristics of parturients participating in the study

Characteristics	Group	Group R (n_1=23)	Group T (n_2=23)
Age (years)	X ± SD	31 ± 4.85	31.6 ± 3.50
Height (cm)	X ± SD	157 ± 5.86	158 ± 6.60
Weight (kg)	X ± SD	70.7 ± 12.3	66.8 ± 7.81
BMI (kg/m²)	X ± SD	28.5 ± 4.22	26.9 ± 3.2
Gestational age (weeks)	X ± SD	38.4 ±1.03	38.1 ± 0.87
ASA	II (%)	23 (100%)	23 (100%)
	III (%)	0 (0%)	0 (%)
Parity	Primiparous	9 (39.1%)	9 (39.1%)
	Multiparous	14 (60.8%)	14 (60.9%)
Number of previous cesarean sections	0	9 (39.2%)	10 (43.5%)
	1	11 (47.8%)	10 (43.5%)
	2	3 (13.0%)	3 (130%)
Diagnosis	Previous cesarean section	13 (56.5%)	12 (52.2%)
	Others	12 (44.5%)	11 (47.8%)
Surgical duration (minutes)	X ± SD	75.2 ± 22.3	75.2 ± 13.4
Intrathecal bupivacaine dose (mg)	X ± SD	8.72 ± 0.47	8.50 ± 0.67
Intrathecal fentanyl dose (mcg)	X ± SD	20.2 ± 1.04	20.4 ± 1.44

Remark: The characteristics of the parturients participating in the study - including age, height, weight, BMI, gestational age, ASA classification, obstetric history, surgical diagnosis, surgical duration, and anesthetic drug doses - were randomly distributed and comparable between the two study groups.

Table 3.2. Analgesic effectiveness of the TAP block technique

Time point / **Group**		**End of surgery** X ± SD	**6 hours** X ± SD	**24 hours** X ± SD
Fentanyl (mcg)	Group R	**0**	137 ± 50,3	362 ± 93.4
	Group T	**0**	112 ± 46.6	**296 ± 121 †**
Number of PCA presses (24 h)	Group R	**0**	X	37.1 ± 13.3
	Group T	**0**	X	**31.5 ± 29.1 †**
VAS at rest	Group R	**0**	2.87 ± 0.69	3.26 ± 0.45
	Group T	**0**	**2.48 ± 0.59 †**	**2.74 ± 0.96 †**
VAS during movement	Group R	**0**	4.22 ± 1.04	4.70 ± 1.06
	Group T	**0**	**3.48 ± 0.67 †**	4.39 ± 1.44

†: Independent t-test between groups R and T at the same time point showed $p < 0.05$.

Remark: Group T showed a marked reduction in total fentanyl consumption at 24 hours, with a statistically significant difference compared to Group R. Although the number of PCA button presses in Group T had a large standard deviation, the mean value remained lower than that of Group R, and the difference was statistically significant. VAS scores at rest were consistently lower in Group T and reached statistical significance at both 6-hour and 24-hour time points. At 24 hours, VAS scores during movement decreased, and the difference between the two groups was no longer statistically significant.

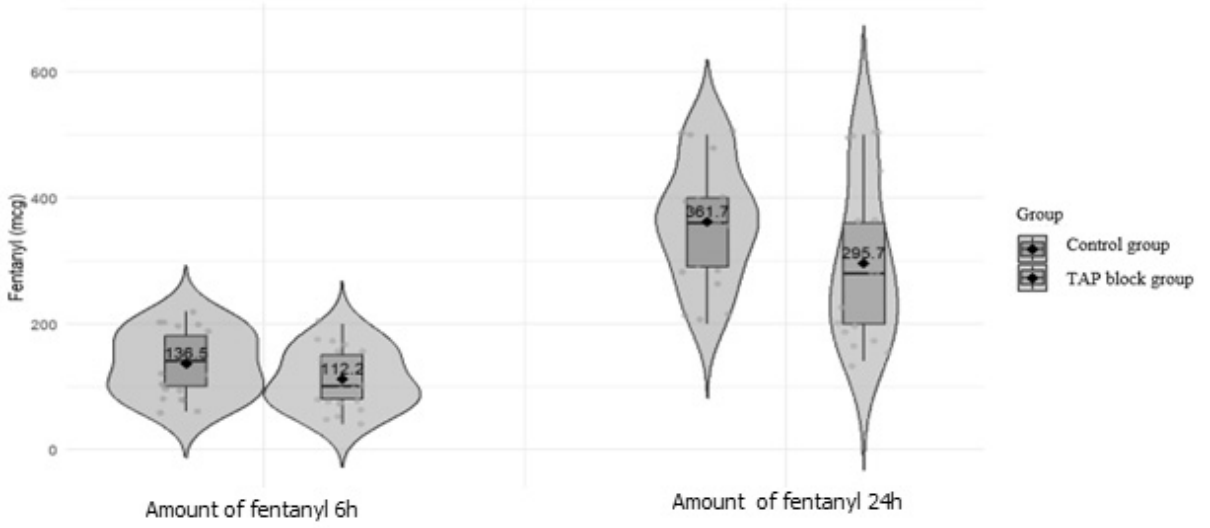

Chart 3.1: Amount of Fentanyl Used by Postpartum Women After Surgery

Remark: At 6 hours and 24 hours, the T group used significantly less Fentanyl. Specifically, the Fentanyl dose in the T group at 6 hours was about 24 mcg (~18%) lower, and at 24 hours it was about 66 mcg (~18%) lower.

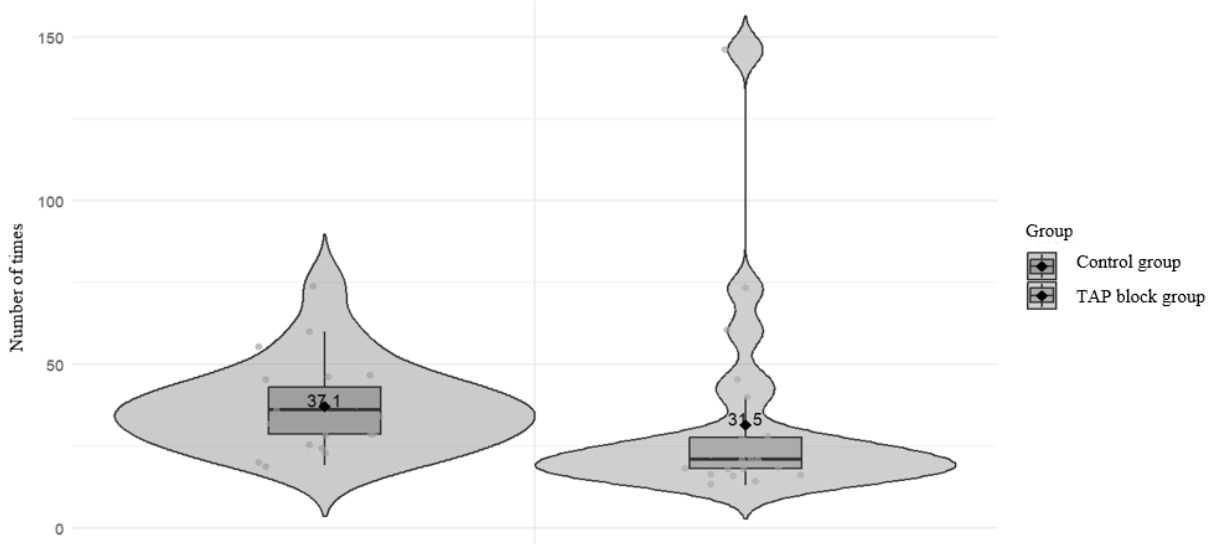

Chart 3.2: Number of PCA Presses in the First 24 Hours After Surgery

Remark: There are a few outliers in the distribution; however, most values are concentrated around 20–40 presses in both groups. The T group had about 6 fewer PCA presses than the control group.

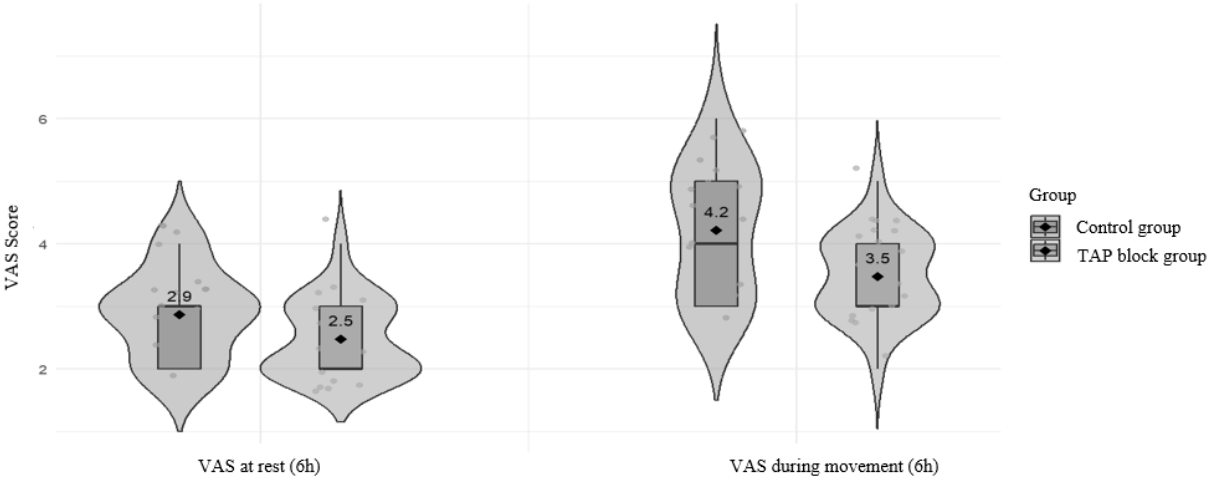

Chart 3.3: VAS Scores 6 Hours Post-Surgery

Remark: At 6 hours after C-section, the resting VAS score in group T was lower than in group R (~0.4 units), and the movement VAS score was also lower (~0.7 units). This difference was statistically significant.

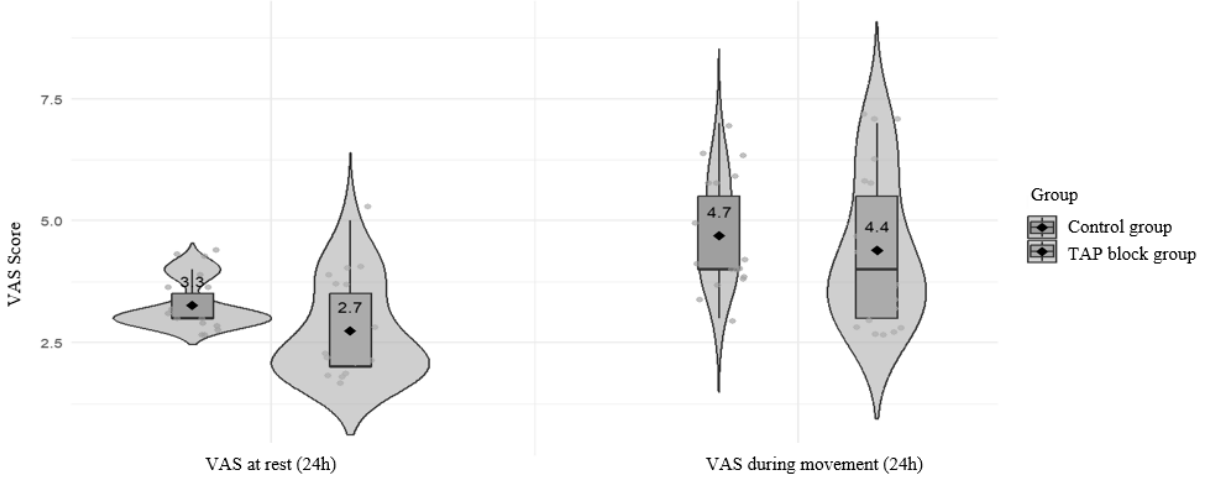

Chart 3.4: VAS Scores 24 Hours Post-Surgery

Remark: Group T had lower VAS scores both at rest and during movement, but the difference was no longer pronounced. The resting VAS score in Group T was about 0.6 points lower. The movement VAS scores of the two groups were approximately the same after 24 hours.

4. DISCUSSION

The study was conducted on 46 parturients who were indicated for cesarean section (CS) at Military Hospital 175 between 2023 and 2025. The participating parturients had similar anthropometric indices, clinical conditions, and surgical indications, as well as comparable surgical and anesthesia procedures in both the intervention and control groups.

In our study, the TAP block technique was performed immediately after surgery while the spinal anesthesia was still effective, and the parturients were also fitted with a PCA pump. Therefore, the patients did not experience immediate pain; pain gradually increased as the spinal anesthesia wore off, and they could actively use PCA for analgesia as needed. The peak pain period usually occurs around 6–12 hours postoperatively [5]. However, to minimize potential adverse effects on the neonate, we limited the maximum PCA dose in the first 24 hours to 500 mcg of Fentanyl [2],[6]. Postoperative pain control using opioids—particularly Fentanyl via patient-controlled analgesia (PCA)—is a common method that allows individualized pain management.

4.1 Regarding opioid dose and PCA presses

At 6 hours postoperatively, the Fentanyl dose in the TAP block group (T group) was 112 ± 46.6 mcg, lower than the control group (R group) at 137 ± 50.3 mcg. This indicates that the T group consumed less Fentanyl (24 mcg ~18%) and that the intervention technique in the T group may provide better analgesic efficacy than in the R group.

At 24 hours, the Fentanyl dose in the T group was 296 ± 121 mcg, significantly lower than the R group at 362 ± 93.4 mcg (difference of 66 mcg ~20%, $p < 0.05$). To minimize opioid-related side effects in neonates, we controlled the maximum 24-hour Fentanyl dose to 500 mcg. This caused the 24-hour PCA Fentanyl dose distribution to be uneven and skewed (Chart 3.1); however, t-test analysis, with or without bootstrap, still showed a statistically significant difference between the two groups. This reinforces the hypothesis that the T group's treatment method provides better pain relief and reduces opioid-related side effects such as nausea, vomiting, pruritus, respiratory depression, and urinary retention. These results are consistent with studies by Nguyen Van Minh [4], Baaj [7], and McDonell [8].

Similarly, the number of PCA presses in 24 hours was lower in the T group (31.5 ± 29.1) than in the R group (37.1 ± 13.3) with statistical significance. Although the T group had some outliers with 60–140 presses (possibly due to TAP block failure), the overall average was still lower than the R group. This indicates that the T group had lower analgesic demand and that TAP block helped better control baseline pain.

Additionally, during the study, no adverse events were reported, including nausea, vomiting, pruritus, maternal or neonatal opioid overdose, or TAP block-

related complications such as infection, local anesthetic toxicity, peritoneal puncture, or organ injury.

4.2 Regarding the level of pain in VAS

Another important criterion for evaluating the effectiveness of the TAP block in postoperative pain relief is its impact on functional recovery, complication reduction, and patient satisfaction. In this study, we used the VAS score at rest and during movement to assess pain levels at 6 and 24 hours postoperatively.

At 6 hours, the mean VAS at rest in the T group was 2.48 ± 0.59, significantly lower than the R group (2.87 ± 0.69), showing better early postoperative pain relief in the T group (pain is usually highest during this period due to inflammation and tissue response after surgery). At 24 hours, the VAS at rest remained lower in the T group (2.74 ± 0.96) compared to the R group (3.26 ± 0.45), and the difference was statistically significant. This demonstrates that the T group's analgesic method provides not only rapid but also sustained pain relief for at least the first 24 hours after surgery.

VAS during movement reflects functional pain control more clearly, as patients experience mechanical stimulation at the surgical site. At 6 hours, the T group had a mean score of 3.48 ± 0.67, significantly lower than the R group (4.22 ± 1.04), facilitating easier early mobilization and supporting recovery. However, at 24 hours, VAS during movement increased in both groups (T group: 4.39 ± 1.44; R group: 4.70 ± 1.06). Although the difference remained, it gradually decreased.

4.3 Study limitations

Our study has some limitations: the sample size was relatively small (46 parturients), the local anesthetic dose and volume were the same for all participants, follow-up indices were short-term and did not assess long-term efficacy or complications, and the TAP block failure rate was not recorded.

5. CONCLUSION

Based on the results of this study (46 parturients), ultrasound-guided transversus abdominis plane (TAP) block provides significantly better pain control in the first 24 hours postoperatively (lower Fentanyl dose, fewer PCA presses, lower VAS at rest and during movement compared to the control group). It reduces pain-related complications and increases patient satisfaction with recovery. These findings align with modern recommendations for early recovery after surgery (ERAS) [3],[9].

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