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Effectiveness of Erector Spinae Plane Block and Transversus Abdominis Plane Block Analgesia in Post-Hernia Surgery Patients

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ABSTRACT

Background: Many patients experience postoperative pain after hernia surgery, which can negatively affect recovery and patient comfort. Regional analgesia techniques such as the erector spinae plane block (ESPB) and transversus abdominis plane block (TAPB) have increasingly been used to control pain with minimal side effects. However, the comparative effectiveness of these two techniques in managing postoperative pain after hernia surgery still needs evaluation to determine the optimal method for improving pain quality and accelerating recovery. ***Methods:*** This study was a true experimental design using a single-blind randomized trial. Subjects included patients aged 18 to 65 undergoing hernia surgery in the surgical operating room. Data analysis was performed using SPSS version 26, including descriptive analysis and an independent t-test for mean comparison. ***Results:*** ESP block produced a longer analgesic duration, averaging 5.13±5.30 hours, compared to TAP block with an average analgesic duration of 3.93±1.78 hours, resulting in a mean difference of 1.2 hours (95% CI 0.52-2.15; p=0.030). There were significant differences in VAS pain scores at 6, 12, 24, and 48 hours postoperatively, with ESP showing lower scores than TAP. Morphine requirements were lower in the ESP group (1.62±0.71 mg) compared to the TAP group (3.11±1.44 mg), with a mean difference of 1.49 mg (95% CI 0.62-2.64 mg; p=0.001). The results of the difference in the value of NLR changes between before and after surgery between bilateral ESP and TAP blocks were found to have a significant difference with a mean difference of 0.36 (IK 95% 0.04-0.69; P=0.029). ***Conclusion:*** The ESP block demonstrated superior effectiveness compared to the TAP block as postoperative analgesia for hernia surgery patients.

Keywords: regional block; bilateral erector spinae plane block; bilateral transversus abdominis plane block; analgesia; hernia surgery.

INTRODUCTION

The management of postoperative pain is a critical component of patient care following hernia surgery, as inadequate pain control can delay recovery, prolong hospital stay, and negatively impact overall patient satisfaction [1]. Regional anesthesia techniques have gained prominence for providing targeted analgesia with fewer systemic side effects compared to opioids [2]. Among these, the erector spinae plane block (ESPB) and transversus abdominis plane block (TAPB) have emerged as promising modalities for controlling post-hernia surgery pain by blocking specific nerve pathways involved in abdominal wall sensation [3,4].

The ESPB involves injecting local anesthetic into the fascial plane deep to the erector spinae muscle, which results in a widespread analgesic effect covering multiple thoracic spinal nerves. This block is appreciated for its relative simplicity and safety profile, allowing for effective pain relief that extends into the visceral and somatic innervation areas of the abdomen [5]. On the other hand, TAPB targets the nerves between the internal oblique and transversus abdominis muscles, providing localized analgesia to the anterolateral abdominal wall. TAPB is widely used due to its efficacy and ease of performance, particularly in lower abdominal surgeries such as hernia repair [6].

Comparative studies examining ESPB and TAPB in hernia surgery patients highlight differences in analgesic duration and opioid-sparing effects [6,7]. While both blocks reduce postoperative pain and morphine consumption, ESPB has been shown in several trials to provide a longer duration of analgesia and lower pain scores at multiple postoperative time points.

This can be attributed to ESPB's potentially broader dermatomal coverage and involvement of deeper nerve structures, which may translate to a more comprehensive pain blockade [8,9].

Moreover, the requirement for rescue analgesics such as opioids is an important indicator of block effectiveness. Patients receiving ESPB often demonstrate reduced opioid requirements compared to those receiving TAPB, which not only improves pain management but also decreases the risk of opioid-related adverse effects like nausea, vomiting, and respiratory depression. This opioid-sparing benefit can contribute positively to patient recovery trajectories and overall satisfaction [10].

In addition to clinical outcomes, inflammatory markers such as the neutrophil-to-lymphocyte ratio (NLR) have been studied as surrogate indicators for the physiological stress response to surgery and pain. Variations in NLR following ESPB and TAPB suggest that effective regional blocks may also modulate the systemic inflammatory response, with ESPB potentially providing superior immunomodulatory effects by attenuating the surgical stress response more efficiently. This immunomodulation could translate into improved postoperative recovery, reduced opioid consumption, and lower incidence of inflammation-related complications in patients undergoing hernia repair surgery [11].

This study aims to compare the effectiveness of the bilateral erector spinae plane block (ESPB) and the bilateral transversus abdominis plane block (TAPB) in providing postoperative analgesia for patients undergoing hernia surgery. Specifically, it seeks to evaluate which regional analgesia technique offers superior pain control, longer duration of analgesia, reduced opioid requirements, and a more favorable modulation of inflammatory responses as measured by changes in the neutrophil-to-lymphocyte ratio (NLR). The findings are intended to guide clinical decisions in optimizing pain management and enhancing recovery outcomes in hernia surgery patients.

METHOD

This study employed a true experimental design with a single-blinded randomized controlled trial methodology to objectively compare the analgesic effectiveness of erector spinae plane block (ESPB) and transversus abdominis plane block (TAPB) in patients undergoing hernia surgery. Eligible participants included adult patients aged between 18 and 65 years who were scheduled for elective hernia repair under general anesthesia. Subjects were randomly assigned to receive either bilateral ESPB or TAPB following standardized procedures to minimize bias and ensure methodological rigor. Pain assessments were conducted at predefined intervals during the postoperative period, with parameters such as the duration of analgesia, visual analogue scale (VAS) scores, and opioid consumption recorded as primary outcome measures.

Data collection included preoperative demographic and clinical variables, intraoperative anesthesia details, and postoperative pain evaluations using validated scales. The requirement for rescue analgesics was also documented to assess opioid-sparing effects. Inflammatory responses were measured by analyzing the neutrophil-to-lymphocyte ratio (NLR) changes before and after surgery to provide insights into systemic effects of the blocks. Statistical analysis was performed using SPSS software version 26, utilizing descriptive statistics to characterize the sample and inferential tests such as independent t-tests to compare mean outcomes between groups. A significance level of $p < 0.05$ was set for determining statistical differences. This methodical approach ensured a comprehensive evaluation of both blocks' efficacy and safety in the post-hernia surgery setting.

RESULT

In this study, 32 research subjects were obtained, which were divided into 2 groups, namely 16 subjects in the ESP group and 16 subjects in the TAP group, totaling 16 subjects with data characteristics presented in Table 1.

TABLE 1: Research Data Characteristics.

Variables	Group (mean ± SB)		P-value
	ESP	TAP	
Age (years)	48.87±6.88	48.31±8.64	0.840[a]
Body Weight (kg)	58.75±6.71	61.75±6.14	0.198[a]
Height (m)	1.61±0.05	1.59±0.06	0.361[a]
BMI (kg/m)[2]	22.78±3.12	23.12±2.46	0.106[a]
ASA			
I	4 (25%)	3 (18,8%)	0.669[b]
II	12 (75%)	13 (81,3%)	

[a] *Independent t-test;*[b] *Chi-Square.*

Table 2 shows and Figure 1 the difference in analgesia duration between the ESP and TAP groups. The mean analgesia duration for the ESP group was 5.13 ± 5.30 hours, compared to 3.93 ± 1.78 hours in the TAP group. The mean difference between the groups was 1.2 hours, with a 95% confidence interval ranging from 0.52 to 2.15. Statistical analysis using the independent t-test revealed that this difference was significant (p = 0.030), indicating that the ESP block provided a significantly longer duration of analgesia compared to the TAP block.

TABLE 2: Differences in Duration of Analgesia.

Variables	Group		Average difference	95% CI	P-value
	ESP	TAP			
Duration of analgesia (Hour)	5.13±5.30	3.93±1.78	1.2	0.52-2.15	0.030[a*]

[a]*Independent t-test;** significant.

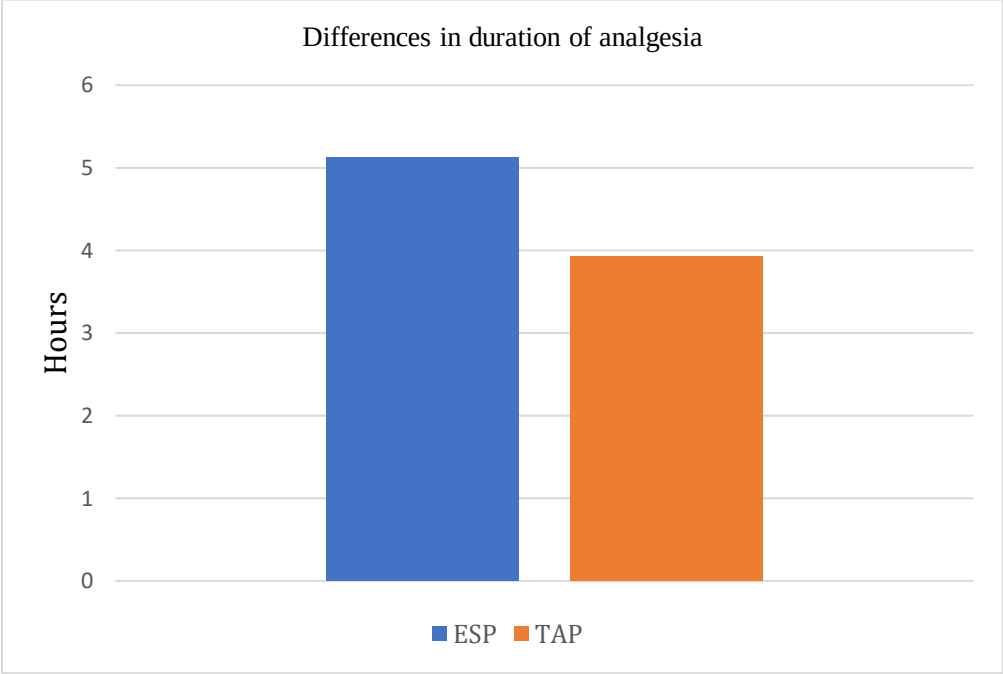

FIGURE 1: Difference in Duration of Analgesia.

The results of pain intensity presented in Table 3 and Figure 2 showed that in the first 1 hour after blocking, there was no significant difference in VAS values between the two groups. Whereas at the 6th, 12th, 24th, and 48th hours, there were significant differences between the two groups. The ESP group had a lower mean VAS compared to the TAP group.

TABLE 3: Pain Intensity.

Variables	Group		Average difference	95% IK	P-value
	ESP	TAP			
VAS 1 hour	0.37±0.88	0.56±1.03	0.18	0.51-0.88	0.585
VAS 6 hours	0.75±1.39	3.18±1.10	2.43	1.52-3.34	<0.001
VAS 12 hours	2.31±1.25	3.81±1.27	1.50	0.58-2.41	0.002
24-hour VAS	2.43±0.63	3.06±0.68	0.62	0.15-1.09	0.011
VAS 48 hours	1.68±0.70	2.75±0.85	1.06	0.49-1.63	0.001

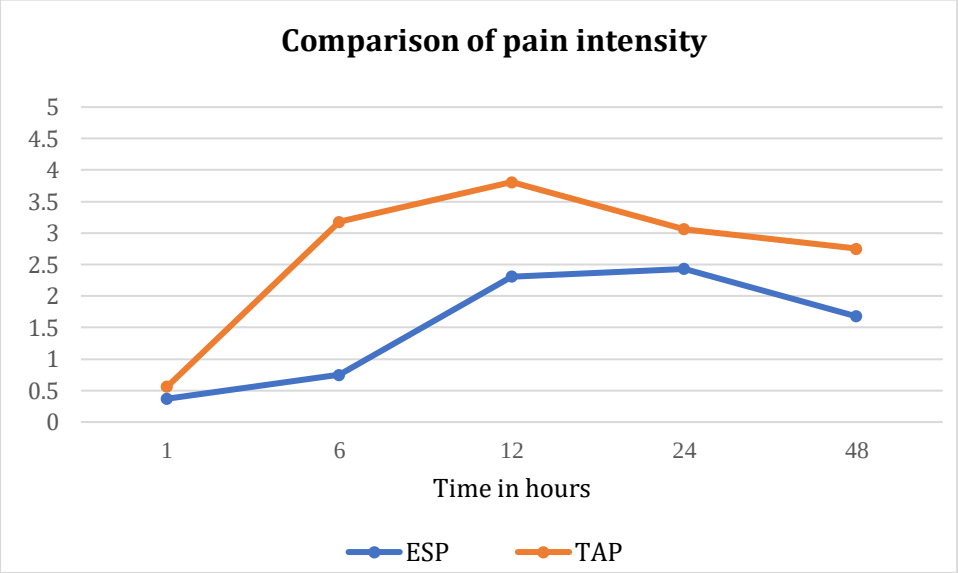

FIGURE 2: Comparison Chart of Pain Intensity.

Table 4 shows the difference in total opioid requirements within 48 hours postoperatively between the two groups. Patients who received the erector spinae plane block (ESP) required significantly less morphine, with an average consumption of 1.62 ± 0.71 mg, compared to 3.11 ± 1.44 mg in the transversus abdominis plane block (TAP) group. The mean difference in morphine use between the groups was 1.49 mg, with a 95% confidence interval of 0.62 to 2.64 mg, indicating statistical significance (p = 0.001). These results suggest that the ESP block provides better opioid-sparing effects than the TAP block in patients undergoing hernia surgery.

TABLE 4: Difference in Total Opioid Requirements within 48 Hours.

Variables	Group		Average difference	95%CI	P-value
	ESP	TAP			
Morfin (mg)	1.62±0.71	3.11±1.44	1.49	0.62-2.64	0.001

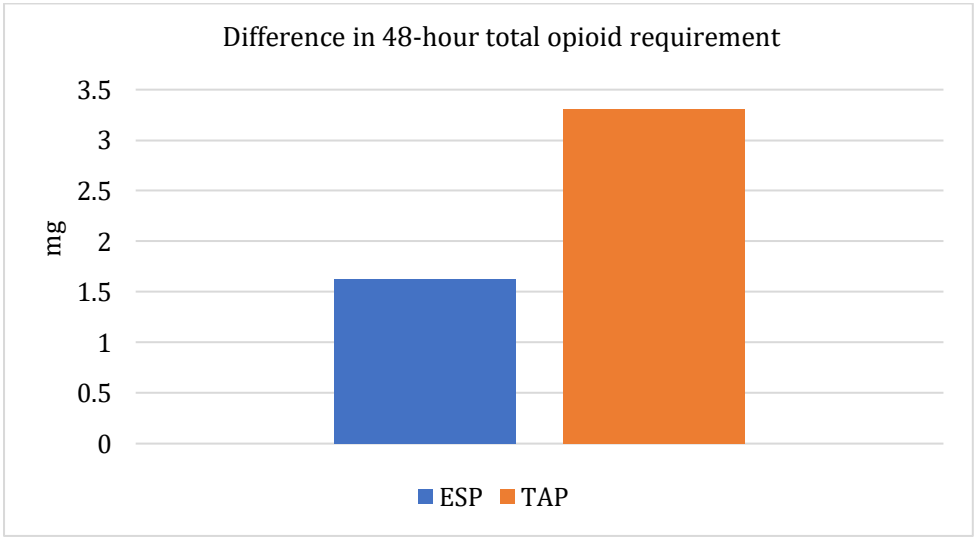

FIGURE 3: Difference in 48-hour Total Opioid Requirement.

The number of NLR before and after the study in both groups was not found to be significantly different, but the delta NLR obtained showed differences in the value of NLR changes presented in Table 5.5. The result of NLR in the ESP group before was 2.35±1.59 and after was 2.76±1.37, while in the TAP group, before was 2.05±0.97 and after was 2.82±1.02. The results of the difference in the value of NLR changes between before and after surgery between ESP and TAP bilateral blocks were found to have a significant difference with a mean difference of 0.36 (IK 95% 0.04-0.69; P=0.029).

TABLE 5: Differences in NLR Change Values Between Before and After Surgery Between Bilateral ESP and TAP Blocks.

Variables	Group		Average difference	95% IK	P-value
	ESP	TAP			
NLR before	2.35±1.59	2.05±0.97	0.30	0.66-1.26	0.522
NLR after	2.76±1.37	2.82±1.02	0.65	0.81-0.94	0.881
Delta (Δ) NLR	0.40±0.35	0.77±0.53	0.36	0.04-0.69	0.029

DISCUSSION

The present study evaluated the effectiveness of erector spinae plane block (ESP) compared to transversus abdominis plane block (TAP) in providing postoperative analgesia for patients undergoing hernia surgery. Analysis of 32 subjects, equally divided between the ESP and TAP groups, revealed significant differences in analgesic outcomes. Specifically, the duration of analgesia was significantly longer in the ESP group (5.13 ± 5.30 hours) compared to the TAP group (3.93 ± 1.78 hours; p=0.030). This finding is consistent with previous research indicating that the ESP block can provide extended pain relief postoperatively [12]. The longer duration may be attributed to the anatomical spread of local anesthetics in the ESP block, which targets the dorsal and ventral rami of spinal nerves, allowing a broader sensory blockade over multiple dermatomes [13].

This broader coverage contrasts with the TAP block, which primarily anesthetizes the anterior abdominal wall and is therefore sometimes limited in duration and extent of analgesia. ESP's ability to provide more durable analgesia can significantly impact postoperative recovery, reducing the frequency and intensity of breakthrough pain episodes. These characteristics made ESP an attractive alternative for pain management in abdominal surgeries, and our results provide further evidence supporting its clinical use. Moreover, the comparable baseline demographics between the two groups (age, BMI, ASA status) strengthen the validity of the findings by minimizing confounding factors.

Furthermore, pain intensity measured by the Visual Analog Scale (VAS) was significantly lower in the ESP group at multiple postoperative timepoints (6, 12, 24, and 48 hours). This aligns well with clinical trials where ESP block demonstrated more effective pain control over the first 48 hours after surgery than TAP block in abdominal procedures [14]. Early pain control is critical not only for patient comfort but also for facilitating early mobilization, reducing risks such as deep vein thrombosis and pulmonary complications. The sustained lower VAS scores in the ESP group suggest a prolonged sensory blockade and better management of nociceptive input.

The lower pain scores in the ESP group also correlated with a significantly reduced morphine requirement over 48 hours (1.62 ± 0.71 mg vs. 3.11 ± 1.44 mg; p=0.001), highlighting a valuable opioid-sparing effect. Reduced opioid consumption is associated with fewer opioid-related adverse effects, such as nausea, vomiting, sedation, and respiratory depression, which can delay postoperative recovery and prolong hospital stays. Various studies have shown that ESP block's opioid-sparing benefits can improve patient outcomes and reduce the burden on healthcare systems [15]. Thus, ESP not only improves pain control but also potentially decreases the risks associated with opioid use in postoperative care.

Additionally, the study observed a significant difference in the delta neutrophil-to-lymphocyte ratio (NLR) between groups, with a smaller increase in the ESP group (0.40 ± 0.35) compared to TAP (0.77 ± 0.53; p=0.029). NLR is increasingly recognized as a biomarker for systemic inflammation and surgical stress response. The attenuated rise in NLR after surgery in the ESP group may indicate that this block technique modulates the inflammatory response more effectively than the TAP block. Such anti-inflammatory effects of regional anesthesia have been previously documented and are thought to contribute to better postoperative outcomes [16].

This finding is important because the inflammatory response to surgery can lead to complications, including delayed wound healing, increased pain, and systemic physiologic disturbances. By limiting such inflammation, the ESP block could not only improve pain control but also promote faster recovery and reduce morbidity. These physiological insights add a valuable dimension to the clinical benefits observed and suggest a holistic advantage of the ESP block in perioperative care. Future studies may explore this anti-inflammatory mechanism more deeply to optimize analgesic protocols.

CONCLUSION

This study demonstrates that the erector spinae plane block (ESP) provides superior postoperative analgesia compared to the transversus abdominis plane block (TAP) in patients undergoing hernia surgery. The ESP block yielded a significantly longer duration of analgesia, lower pain scores at multiple postoperative time points, and substantially reduced opioid consumption. These findings highlight the analgesic efficacy and opioid-sparing benefits of ESP block, supporting its use as an effective component of multimodal pain management protocols.

Moreover, the smaller increase in neutrophil-to-lymphocyte ratio (NLR) in the ESP group suggests a potential modulatory effect on the postoperative inflammatory response, which may contribute to improved recovery outcomes beyond pain control. Taken together, the results encourage the consideration of ESP block as a preferred regional anesthesia technique for abdominal surgeries, warranting further investigation in larger and varied populations to confirm these advantages and explore long-term benefits.

Conflict of Interest

The author declares that there is no conflict of interest related to the publication of this research article.

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