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Efficacy of erector spinae plane block versus intravenous tramadol for pain management in acute pancreatitis: A randomized controlled study

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Abstract:

OBJECTIVES: Efficient pain control is important for patients with acute pancreatitis who visit the emergency department (ED). In this randomized controlled trial, the efficacy of erector spinae plane (ESP) block compared to intravenous tramadol was determined to provide effective pain relief in patients with acute pancreatitis in the ED.

METHODS: A single-blind randomized controlled study was conducted in the ED enrolling 18–70 years old patients with acute pancreatitis and a numerical rating scale score of > 4/10. Fifty patients were allocated to two different groups: the control group received IV tramadol (1 mg/kg every 6 h) and the ESP group received an ESP block with ropivacaine 0.375% (40 mL). Both groups received fentanyl (1 μg/kg) for rescue analgesia. Pain scores, hemodynamic parameters, and rescue analgesia were assessed. Data were analyzed using SPSS v20, utilizing *t*-tests and Chi-squared tests where appropriate.

RESULTS: Baseline demographics were similar between the ESP and control groups (age 41.56 ± 11.85 vs. 43.68 ± 11.55 years, $P = 0.367$). The ESP group had significantly lower pain scores up to 16 h (e.g. 1 h: 2.28 ± 1.08 vs. 6.12 ± 0.32; $P < 0.001$), reduced heart rate and mean atrial pressure at 1 h, and fewer patients requiring rescue analgesia (14% vs. 94%; $P < 0.001$) with lower analgesic consumption (66.14 ± 4.63 μg vs. 113.17 ± 33.24 μg; $P < 0.001$).

CONCLUSION: ESP block offers better pain relief and hemodynamic stability than IV tramadol in patients with acute pancreatitis, with significantly decreased opioid needs.

Keywords:

Acute pancreatitis, nerve block, pain management, ropivacaine, tramadol

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Introduction

Acute pancreatitis (AP) is among the most common causes of hospitalization in the emergency department (ED) and its incidence has been rising globally.[1] The severity of AP may range from mild, self-limiting disease to severe pancreatitis with organ failure and complications such as infected pancreatic necrosis.[2] Pain relief is vital in the management of AP, as it is often difficult to control with standard analgesics.[3] Opioid analgesics such as morphine and tramadol are traditionally used to control pain in patients with AP. Nonetheless, opioids have multiple side effects, which can complicate the clinical course, especially in critically ill patients.[4,5] Therefore, there is an emerging need for effective and safer alternative pain management for this group of patients.

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Box-ED section

What is already known about the topic of this study?

- Pain management is crucial in the treatment of acute pancreatitis in emergency settings
- Intravenous opioids, such as tramadol, are standard but have limitations, thus sparking interest in alternatives such as the erector spinae plane (ESP) block.

What is the conflict regarding this issue? Has it been important to readers?

- There is ongoing controversy regarding the best and safest analgesic technique, with concerns regarding unpredictable pain relief with IV opioids
- This is relevant because finding a better alternative, such as the ESP block, would enhance patient outcomes.

How was this study structured?

- This was a randomized controlled study comparing the effectiveness of ESP block and IV tramadol in 50 patients with acute pancreatitis, with pain scores, hemodynamic parameters, and rescue analgesia requirement evaluated over 24 h.

What does this study tell us about?

- The ESP block is considerably superior to IV tramadol in terms of pain relief within 24 h of ED admission
- ESP blocks enhance hemodynamic stability and reduce the need for additional analgesic administration.

The erector spinae plane (ESP) block has become popular in recent years because of its potential to offer effective analgesia in many acute pain conditions, such as abdominal and thoracic pain. The ESP block targets the erector spinae muscle at the transverse process level, where local anesthetics is deposited to block the dorsal and ventral rami of the spinal nerves, resulting in a multilevel analgesic effect.[6] The block has been promising in controlling pain related to a range of conditions, such as abdominal surgery, rib fractures, and even AP.[7] Earlier studies have proven the efficacy of ESP blocks in minimizing opioid use and enhancing pain scores in a range of clinical scenarios; however,[8] its application in controlling AP pain in the ED has not been widely explored. The research hypothesis for this work is that the ESP block can result in better relief from pain and decreased rescue analgesic demand compared to ordinary systemic analgesics in cases of AP.

Methods

This single-blind randomized controlled study was conducted at ED of a medical college hospital located in Bangalore from August 2024 to March 2025. The annual footfall of ED is approximately 20,000 cases. The study included patients aged 18–70 years with AP and a pain score above 4/10 on the Numerical Rating Scale (NRS). Patients with allergies to local anesthetics/opioids, infection/hematoma/active bleeding at site, hemodynamic instability, pregnancy, a high INR of >2, psychiatric conditions, weight <50kg or refusal of the ESP block were excluded. A *post hoc* power analysis was conducted with the use of G* Power software version 3.1.9.7 (Developed by Heinrich-Heine-Universitat Dusseldorf, Germany) to assess the statistical power for a two-tailed independent samples *t*-test on comparing the means for two groups. Assuming a large effect size (Cohen's $d = 0.847$), an alpha value of 0.05, and equal-sized samples of 50 participants per group (total $n = 100$), the obtained statistical power value was 0.987 (98.7%). This shows a highly significant probability of correctly rejecting the null hypothesis in the presence of a true difference between groups.

A total of 100 cases were enrolled and randomized into a control group or an ESP group using computer-generated randomization, with 50 participants in each group. This study was approved by the Institutional Ethical Committee and registered with the Clinical Trials Registry-India (Reg. No: CTRI/2024/07/071544 on July 30, 2024). (URL: https://ctri.nic.in/Clinicaltrials/pmaindet2.php?EncHid=MTEyOTY4&Enc=&userName=). Informed consent was obtained from all the participants. The control group received tramadol 1 mg/kg IV bolus every 6 h as routine care. In cases of poor pain relief, a fentanyl 1 µg/kg IV bolus was used as a rescue analgesic. Poor pain relief is defined as persistent NRS scores of ≥4, any time after 1 h of intervention. The ESP group underwent ESP block. The ESP block was performed by an ED physician with >1 year of experience. It was performed in the ER within 1 h of patient arrival, following confirmation through blood investigations and/or ultrasound reports. The patients were placed in a lateral position, and vital monitors were secured. Anatomy was scanned using a high-frequency ultrasound probe (Siemens ACUSON NX3, 5–10 MHz linear probe), and important landmarks were marked. The skin and subdermal tissues at the injection site were infiltrated by 2% lignocaine. Ropivacaine 0.375% (40 mL) was used as the blocking agent. Under ultrasound guidance, a 22G Quincke spinal needle was inserted using the in-plane technique and the tip of the needle was directed to the dorsal aspect of the transverse process at the T7 vertebral level. Following negative aspiration, 20 mL of the solution was injected in increments of 3–5 mL across the fascial plane, noting hydro dissection between the erector spinae muscles and the transverse process. A similar ESP block was then completed on the opposite side, at the same level. Patients' vital signs, such as mean atrial pressure (MAP), blood pressure, and heart rate (HR), were measured immediately following the procedure and were observed for any complications.

NRS scores were measured at 5-, 10-, 15-, and 30-min and 1 h intervals initially and subsequently at 4, 8, 12, 16, and 24 h. Nurses who measured the patients' NRS scores were blinded to the study. In addition, the patients were blinded to ensure that their responses to the interventions were not influenced by their knowledge of the treatment they received. Fentanyl 1 μg/kg IV was administered as rescue analgesia if patient complained of poor pain relief. The requirement for, timing of, and cumulative dose of rescue analgesics within 24 h were recorded for both groups. The primary outcome of the study was the measurement of pain score reduction using the NRS at multiple time points postintervention. The secondary outcomes included changes in HR and MAP, the need for and total dose of rescue analgesia, and baseline group comparability.

The data were entered into Excel sheet and statistical analysis was performed using the SPSS software version 20 (IBM, Chicago, Illinois, USA). Descriptive analysis was carried out by mean and standard deviation for quantitative variables; frequency and proportion for categorical variables. The Chi-square test was carried out to find if there is any association for categorical data. Independent sample *t*-test was used to find there is in any significant difference in the mean between the groups. Value of $P < 0.05$ was considered statistically significant. This study was reviewed for compliance with the 2025 CONSORT guidelines, and any deviations have been noted and addressed accordingly [Figure 1].

Results

The demographic and baseline profiles of the patients in both groups were similar and were not statistically significant [Table 1]. Baseline NRS scores between the ESP group (8.68 ± 1.20) and the control group (9.04 ± 0.75) did not show any statistically significant difference ($P = 0.076$). However, the ESP group showed a significantly greater decrease in pain scores at all subsequent time points, up to 16 h. At 1 h after the intervention, the NRS in the ESP group was significantly reduced (1.54 ± 0.67) when compared to the control group (3.18 ± 0.66; $P < 0.001$), and this trend was maintained at 4, 8, 12, and 16 h (all $P < 0.001$). After 24 h, the difference in pain scores between the groups was no longer statistically significant ($P = 0.742$) [Table 2 and Figure 2].

The HR and MAP were also significantly lower in the ESP group after the intervention. Baseline HR was the same in both groups (ESP: 105.6 ± 5.33 vs. control: 105.82 ± 3.57; $P = 0.809$), but decreased as early as 5 min following the intervention and was significant at all-time intervals measured up to 1 h (all $P < 0.001$) [Figure 3]. Similarly, MA*P* values, which were also comparable at baseline ($P = 0.742$), showed a significant decrease in the ESP group starting at 5 min and extending through 1 h (all $P < 0.001$) [Figure 4].

Notably, the demand for rescue analgesia was significantly lower in the ESP group. Seven patients (14%) in the ESP group required rescue analgesics than 47 patients (94%) in the control group, a difference that was statistically significant ($P < 0.001$) [Table 3]. In the control group, 27 participants (57.4%) received a second dose of rescue analgesia, while none in the ESP group did.

The mean dose of rescue analgesia given was 66.14 ± 4.63 μg in the ESP group ($n = 7$), while it was substantially higher in the control group (113.17 ± 33.24 μg; n = 47). This was statistically significant (95% confidence interval: 36.68–57.37; $P < 0.001$).

There were no complications or any adverse drug reactions in both the patient groups.

Table 1: Demographic and baseline characteristics

Variables	Control group (*n*=50)	ESP group (*n*=50)	95% CI	*P*
Age (years)	43.68±11.55	41.56±11.85	−2.52–6.76	0.367
Height (cm)	168.24±6.16	167.8±6.53	−2.07–2.95	0.729
Weight (kg)	69.34±5.16	68.72±4.11	−1.23–2.47	0.508
BMI (kg/m^2)	24.54±2.05	24.51±2.25	−0.81–0.89	0.917
Sex (%)				
Female	8 (16)	11 (22)	0.24–1.85	0.444
Male	42 (84)	39 (78)		

ESP: Erector spinae plane, BMI: Body mass index, CI: Confidence interval

Table 2: Assessment of Numerical Rating Scale between the groups

Variables	Control group (*n*=50)	ESP group (*n*=50)	95% CI	*P*
NRS[#] (h), mean±SD				
Baseline	9.04±0.75	8.68±1.2	−0.03–0.75	0.076
1	3.18±0.66	1.54±0.67	1.37–1.90	<0.001*
4	5.84±0.68	1.48±0.73	4.07–4.64	<0.001*
8	4.52±0.58	2.36±1.04	1.82–2.49	<0.001*
12	4.24±0.62	3.44±1.03	0.46–1.13	<0.001*
16	4.16±0.68	3.46±0.95	0.37–1.02	<0.001*
24	3.6±0.6	3.66±1.13	−0.42–0.30	0.742

*P<0.05 is statistically significant. ESP: Erector spinae plane, CI: Confidence interval, SD: Standard deviation, [#]NRS: Numerical rating scale

Table 3: Number of patients requiring rescue analgesia

Time (h)	Control group (%)	ESP group (%)
1–4	0	0
4–8	22 (46.8)	0
8–12	20 (42.6)	1 (14.3)
12–16	5 (10.6)	6 (85.7)
16–24	0	0
Total	47	7

ESP: Erector spinae plane

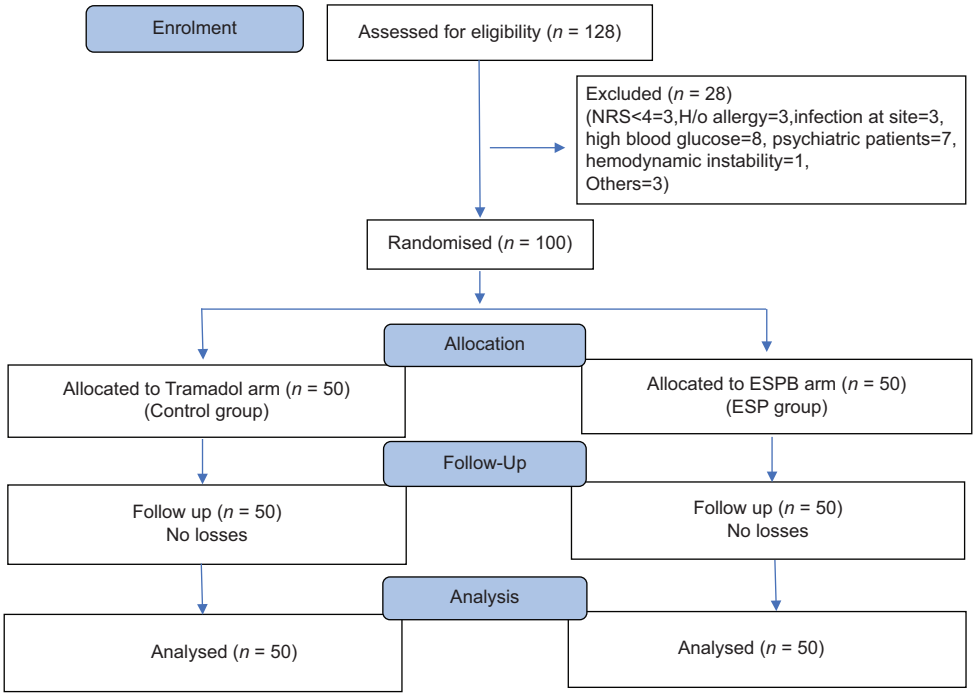

Figure 1: CONSORT 2025 flow diagram. NRS: Numerical Rating Scale, ESPB: Erector spinae plane block

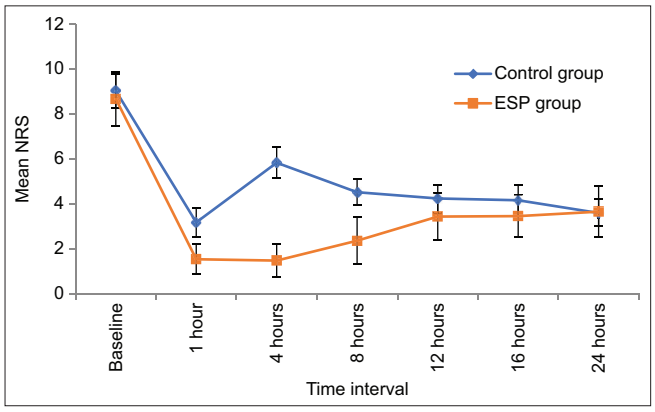

Figure 2: Assessment of Numerical Rating Scale between the groups. NRS: Numerical Rating Scale, ESP: Erector spinae plane

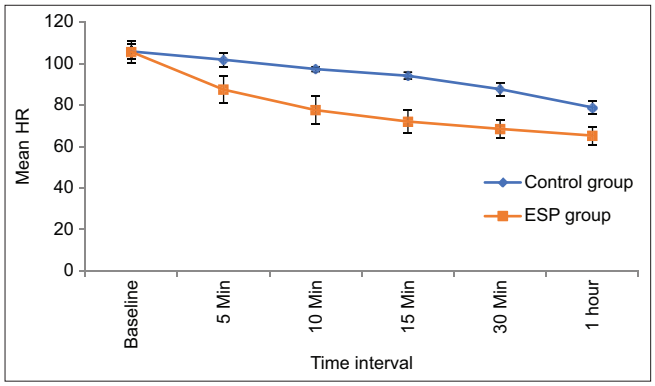

Figure 3: Assessment of heart rate between the groups. HR: Heart rate, ESP: Erector spinae plane

Discussion

Pancreatitis pain results from sensory neuron sensitization, releasing tachykinins, and substance P. The referred pain occurs at the dermatomal level T6–T9. Interventional nerve blocks effectively relieve pain, reduce opioid use, and improve patient satisfaction for thoracic neuropathic and postsurgical pain.[9] Several regional anesthesia methods, such as thoracic epidural block, celiac plexus block, quadratus lumborum block, and transversus abdominis plane block, have been investigated for pain relief in pancreatitis with differing success.[10]

In recent years, considerable progress has been made in regional anesthesia and pain control, especially with the advent of fascial plane blocks. The ESP block is a new method documented in the medical literature. Interest in this method has grown, with publications on the ESP block rising dramatically in the last 2 years.[11] The postintervention results in the current study found that the ESP block group obtained significantly better pain relief at all-time points than the control group. In addition, the HR and MAP were lower in the ESP group at several time points. The need for rescue analgesia was also significantly lower in the ESP group, indicating the effectiveness of ESP block in improving pain control and hemodynamic stability. Studies have demonstrated that ESP block is an effective pain control method for patients with pancreatitis in the ED.[12-14] To date, only

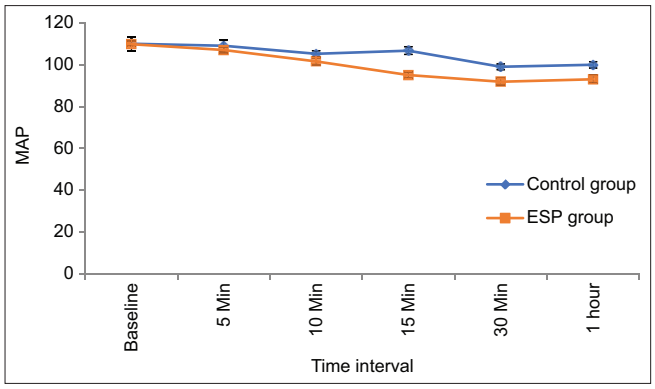

Figure 4: Assessment of mean arterial pressure between the groups. MAP: Mean arterial pressure, ESP: Erector spinae plane

a few comparative studies have directly assessed the ESP block in AP. There are some primary case reports available that restrict direct comparison. Nonetheless, evidence from the current study, as well as previous reports, indicates that ESP block is a potent analgesic method in different clinical situations. Forero *et al*.'s study indicates its effectiveness in analgesia of the upper or lower limbs when administered at the high thoracic and lumbar levels, respectively.[15] The ESP block has almost exclusively been used for postoperative pain relief at the thoracic level and is associated with a low rate of complications.[16] In the present study, no procedure-related complications, such as pneumothorax or hematoma, occurred in the patients. The EASIER trial compared ultrasound-guided ESP blocks with intravenous morphine for acute hepatopancreaticobiliary pain in the ED, finding that the ESP block provided effective pain relief with fewer opioid-related side effects.[14] The current study also demonstrate the overall systemic benefits of ESP block, such as decreased HR, MAP, and rescue opioid requirement. This is especially important, considering the increased focus on limiting opioid use in clinical practice.

Most practitioners believe that the ESP block has important advantages over traditional neuraxial methods. First, it is a fairly easy technique because ultrasound visualization of the region of interest is easy and needle guidance is not difficult.[9] Second, the risk of complications is low because important structures such as large blood vessels, the pleura, or the spinal cord are situated at a distance away from the point of injection.[9] While others have suggested that the ESP block is one and the same as the retrolaminar block[17,18] or is an "accidental paravertebral block,"[19] anatomical and clinical investigations (*in vivo* and cadaveric) establish that it is, in fact, a separate technique.[20,21]

Various studies have compared the efficacy of ESP block for postoperative pain in various surgeries. Tulgar *et al*. studied the effectiveness of ultrasound-guided ESP block in patients undergoing laparoscopic cholecystectomy and revealed that tramadol intake, NRS pain scores were reduced in the ESP group in the initial 3 h after surgery.[22] Similarly, Gürkan *et al*. evaluated 50 patients undergoing breast surgery, with cumulative morphine intake in the ESP group reduced by 65% within 24 h.[23] Oksuz *et al*. evaluated 43 patients by comparing bilateral ESP block with tumescent anesthesia who underwent reduction mammoplasty, with significantly lower NRS scores and decreased requirements for additional analgesia in the ESP group.[24] Altıparmak *et al*. compared ESP block with the modified pectoral nerve (PECS) block after radical mastectomy, with the PECS block being more effective in decreasing tramadol intake and NRS scores at 1, 2, 12, and 24 h after surgery.[25]

Nagaraja *et al*. compared continuous thoracic epidural analgesia with bilateral ESP blocks in 50 patients who had undergone cardiac surgery. They identified substantially lower NRS scores in the ESP group at 24, 36, and 48 h during the postoperative period with no between-group differences in incentive spirometry, ventilator days, or ICU stay.[26] Macaire *et al*. evaluated 67 patients undergoing cardiac surgery in two groups, 20 patients in the control group were administered intravenous morphine (0.5 mg/h) and nefopam (100 mg/24 h) compared with a group of 47 patients who received continuous bilateral ESP block. The ESP group experienced significantly lower pain scores and reduced opioid consumption (40 mg compared to [25–45] mg in the control group versus [0-0] mg in the ESP group [$P < 0.001$]), along with quicker patient mobilization and earlier removal of thoracic tubes.[27] Tulgar *et al*. also compared the outcomes of single-level and bi-level ESP block in 12 thoracotomy patients. The bi-level group showed lower NRS scores in the first 12 h and had less fentanyl use and lower tramadol use.[28]

Therefore, ESP block is a very efficient analgesic method at many levels and in various surgical operations. Their broad applicability makes them suitable for use in most clinical situations. Although it is not always the first choice in emergency situations, it may be a valuable alternative, particularly when first-line interventions are risky or contraindicated. The ESP block has also been found to be useful in high-risk patients, where complications of more invasive techniques are a major concern. More randomized controlled trials are needed to establish optimal indications for acute trauma, critical illness, and emergency pain management.

Limitations

The study included only 50 patients; therefore, it may be less generalizable to other patient populations. A larger multicenter study would provide stronger evidence and

greater applicability to various patient populations. Pain scores and outcomes were measured only for 24 h after the intervention. The restricted follow-up interval might not reveal possible delayed effects, complications, or long-term effectiveness of ESP block versus intravenous tramadol.

Conclusion

This study proved that the ESP block is considerably superior to IV tramadol in terms of pain relief within 24 h of ED admission. The ESP group had significantly reduced pain scores, HR, and MAP at different time points, underscoring its efficacy in providing prolonged analgesia and hemodynamic stability. The requirement for rescue analgesia was substantially diminished in the ESP group with fewer doses during the 24-h period. The results favor the use of ESP block as an effective substitute for routine pain management methods in AP, providing enhanced pain relief and decreased opioid use.

Author contribution statement

Priyanka V N: Conceptualization (lead); writing – original draft, review and editing (lead); formal analysis (lead) writing – review and editing (supporting). Sriranga R Joshi: Conceptualization (equal); Data curation (lead) formal analysis (equal); writing – review and editing (equal). Mohammed Sajad: Methodology (lead); Supervision (equal), Validation (supporting), writing – review and editing (supporting). Shinu Shincy: Software (lead); Data curation (supporting) writing – review and editing (equal).

Conflicts of interest

None Declared.

Ethical approval

This study was conducted in accordance with the principles of Good Clinical Practice (GCP) and was registered with the Clinical Trials Registry – India (CTRI), registration number CTRI/2024/07/071544 on July 30, 2024. Ethical committee approval was obtained from East Point College of Medical Sciences and Research Centre-Institutional Ethical Committee on 07/06/2024 with a reference number EPCMSRC/ADM/IEC/2024-25/10. (Registered under The Indian Council of Medical Research [ICMR] and The Central Drugs Standard Control Organization [CDSCO]).

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