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Ultrasound-Guided Erector Spinae Plane Block for Postoperative Analgesia in Total Abdominal Hysterectomy: A Prospective Comparative Observational Study

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ABSTRACT

Background: Total abdominal hysterectomy is associated with significant postoperative pain, and optimal analgesia remains an important component of perioperative care. Ultrasound-guided erector spinae plane (ESP) block has emerged as a potential opioid-sparing regional analgesic technique for abdominal surgery.
Objective: To evaluate the effectiveness and safety of ultrasound-guided ESP block for postoperative analgesia in patients undergoing total abdominal hysterectomy.
Materials and Methods: This prospective comparative observational study included 100 patients undergoing elective total abdominal hysterectomy. Patients were allocated into two groups of 50 each: Group E received ultrasound-guided ESP block in addition to standard perioperative analgesia, and Group C received standard perioperative analgesia alone. Postoperative pain scores were assessed from PACU to 24 hours. Time to first rescue analgesia, total 24-hour tramadol requirement, rescue analgesic doses, hemodynamic parameters, patient satisfaction, and complications were recorded.
Results: Baseline characteristics were comparable between groups. Postoperative pain scores were significantly lower in the ESP group at all assessed time points (all $p < 0.001$). Time to first rescue analgesia was longer in the ESP group (10.37 ± 2.49 h vs 4.21 ± 1.32 h), while total tramadol requirement (91.60 ± 31.06 mg vs 149.20 ± 34.16 mg) and rescue analgesic doses (1.04 ± 0.70 vs 2.56 ± 0.91) were significantly lower (all $p < 0.001$). Patient satisfaction was higher, and postoperative nausea and vomiting was less frequent in the ESP group (12.0% vs 36.0%, $p = 0.009$). No major block-related complications were observed.
Conclusion: Ultrasound-guided ESP block provided effective postoperative analgesia with reduced opioid requirement, lower postoperative nausea and vomiting, and higher patient satisfaction after total abdominal hysterectomy.

Keywords*: erector spinae plane block, total abdominal hysterectomy, postoperative analgesia, tramadol requirement, patient satisfaction.*

INTRODUCTION

Total abdominal hysterectomy remains a regularly carried out major gynecological procedure and the postoperative pain after open hysterectomy can be significant due to both somatic pain that occurs due to the abdominal incision and visceral pain that occurs due to manipulation of the pelvis. Multimodal postoperative analgesia, such as the use of paracetamol and non-steroidal anti-inflammatory drugs, should be the focus of effective analgesia in abdominal hysterectomy, and opioids should be used, depending on the severity of pain.

Notwithstanding the improvements in multimodal analgesic approaches, opioid-based postoperative analgesia still carries with it the side effects of nausea, vomiting, sedation, delayed mobilization, and other undesirable effects, supporting the use of opioid-sparing regional methods as constituents of modern perioperative care.

The ultrasound-guided erector spinae plane (ESP) block is a comparatively recent type of interfascial plane block initially proposed by Forero et al. in 2016[4] and since its conception has received significant interest due to its technical simplicity under ultrasound guidance, a good safety profile, and potentially offering both somatic and visceral analgesia through the cranio-caudal spread

Increasing evidence shows that ESP block has an analgesic effect in abdominal surgery. Meta-analyses have also reported that ESP block, when compared to no block or placebo, decreases the postoperative pain scores and opioid use in adult surgical patients undergoing abdominal operations under general anesthesia, which are considered statistically significant and indicate clinically significant opioid-sparing effects with no significant safety concerns associated with block usage in not-only-abdominal operations [5-7].

There is also building evidence in the area of hysterectomy. A randomized controlled trial of patients who have undergone total abdominal hysterectomy has also indicated that bilateral ESP block may enhance postoperative analgesia and decrease analgesic use as an element of a multimodal analgesic approach[2,8].

Nevertheless, although these results are encouraging, published data in the field of open gynecological surgery are still relatively limited and outcomes could differ depending on the surgical practice, background analgesic regimen, ESP block timing, and patient satisfaction and safety profile of ultrasound-guided ESP block in women undergoing total abdominal hysterectomy.

Against this background, the current study was conducted to determine the efficacy and safety of ultrasound-guided erector spinae plane block in postoperative management of pain in patients undergoing total abdominal hysterectomy with specific focus on the postoperative pain scores, rescue analgesic demand, time to first rescue analgesia, hemodynamic stability, patient satisfaction, and complications.

AIM

To evaluate the effectiveness and safety of ultrasound-guided erector spinae plane block in providing postoperative analgesia among patients undergoing total abdominal hysterectomy.

OBJECTIVES

1. To compare postoperative pain scores at predefined time intervals during the first 24 hours after surgery between patients receiving ultrasound-guided ESP block and those receiving standard analgesic management.
2. To compare total postoperative analgesic requirement and time to first rescue analgesia between the two groups.
3. To assess safety and additional clinical benefits of ESP block by comparing hemodynamic stability, patient satisfaction, and block-related or drug-related complications between the two groups.

MATERIALS AND METHODS

Study design and setting

This prospective comparative observational study was conducted in the Department of Anaesthesiology at Sri Lalithambigai Medical College, Chennai, over a period of one year. The study was undertaken to evaluate the effectiveness and safety of ultrasound-guided erector spinae plane (ESP) block for postoperative analgesia in patients undergoing total abdominal hysterectomy.

Study population

A total of 100 patients scheduled for elective total abdominal hysterectomy were included in the study. Patients were allocated into two groups of 50 each:

- **Group E (ESP group):** patients who received ultrasound-guided ESP block in addition to standard perioperative analgesia
- **Group C (Control group):** patients who received standard perioperative analgesia without ESP block

Eligibility criteria

Patients were included if they were aged 18 years or older, were posted for elective total abdominal hysterectomy, belonged to ASA physical status I, II, or III, and were willing to provide written informed consent. Patients were excluded if they refused consent, had allergy to local anaesthetic drugs, infection at the proposed block site, coagulopathy or anticoagulant therapy, severe hepatic, renal, or cardiac disease, chronic opioid use, chronic pain disorder, psychiatric or neurological illness interfering with pain assessment, major intraoperative complications, or incomplete postoperative data.

Preoperative assessment
After obtaining written informed consent, all eligible patients underwent detailed preoperative evaluation. Demographic and baseline clinical data were recorded in a predesigned proforma, including age, body mass index, ASA class, indication for surgery, comorbidities, estimated blood loss, duration of surgery, and baseline hemodynamic parameters.

Intervention
Patients in Group E received ultrasound-guided erector spinae plane block under aseptic precautions using the standard institutional technique, in addition to routine perioperative analgesia. Patients in Group C received routine perioperative analgesia alone without ESP block. All patients underwent total abdominal hysterectomy under standard anaesthetic management and were monitored postoperatively according to institutional protocol.

Outcome measures
The primary outcome measures were:

1. postoperative pain scores during the first 24 hours,
2. time to first rescue analgesia, and
3. total postoperative analgesic requirement in the first 24 hours.

Secondary outcome measures included:

1. postoperative hemodynamic profile,
2. patient satisfaction with analgesia, and
3. block-related or drug-related complications.

Postoperative assessment
Postoperative pain was assessed using a standard pain scoring scale at predefined intervals during the first 24 hours: PACU, 2 hours, 4 hours, 6 hours, 12 hours, and 24 hours. Analgesic assessment included recording the time to first rescue analgesia, total tramadol requirement during the first 24 hours, and number of rescue analgesic doses.

Hemodynamic parameters, including heart rate and mean arterial pressure (MAP), were monitored at the same postoperative intervals. Patient satisfaction regarding postoperative analgesia was assessed using a structured satisfaction score. Patients were also observed for adverse events and complications, including postoperative nausea and vomiting, excessive sedation, hypotension, bradycardia, block failure, local anaesthetic toxicity, pneumothorax, and any other clinically relevant complication.

Statistical analysis
Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Quantitative variables were expressed as mean ± standard deviation, and qualitative variables were presented as frequency and percentage. Continuous variables between the two groups were compared using the independent t-test or Mann–Whitney U test, as appropriate. Repeated postoperative pain scores were compared using repeated-measures analysis, and within-group temporal changes were assessed using the Friedman test. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. A p value <0.05 was considered statistically significant.

Ethical considerations
The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before inclusion in the study. Confidentiality of patient information was maintained throughout the study.

RESULTS

1. Baseline characteristics
A total of 100 patients undergoing total abdominal hysterectomy were analyzed, with 50 patients each in the control and ultrasound-guided ESP block groups. Baseline demographic, clinical, and surgical characteristics were comparable between the two groups, with no statistically significant intergroup differences in age, body mass index, ASA physical status, indication for surgery, duration of surgery, estimated blood loss, comorbidities, or preoperative hemodynamic parameters (Table 1). These findings indicate that the two groups were well matched at baseline, allowing postoperative differences to be interpreted with less likelihood of baseline confounding.

(Table 1).

Variable	Control (n=50)	ESP block (n=50)	p value
Age (years)	49.48 ± 7.21	49.36 ± 6.69	0.931
BMI (kg/m²)	27.17 ± 3.36	27.96 ± 4.09	0.290
Duration of surgery (min)	117.74 ± 22.96	120.52 ± 19.90	0.519
Estimated blood loss (mL)	350.62 ± 79.30	342.08 ± 77.44	0.587

Preoperative heart rate (bpm)	83.40 ± 9.83	83.26 ± 9.77	0.943
Preoperative MAP (mmHg)	92.36 ± 10.87	94.12 ± 11.17	0.426
Sex: Female	50 (100.0%)	50 (100.0%)	1.000
ASA class: I	8 (16.0%)	11 (22.0%)	0.525
II	30 (60.0%)	31 (62.0%)	
III	12 (24.0%)	8 (16.0%)	
Surgery indication: AUB	12 (24.0%)	17 (34.0%)	0.791
Adenomyosis	10 (20.0%)	8 (16.0%)	
Endometriosis	3 (6.0%)	4 (8.0%)	
Fibroid uterus	19 (38.0%)	15 (30.0%)	
Ovarian mass with hysterectomy	6 (12.0%)	6 (12.0%)	
Diabetes mellitus: No	40 (80.0%)	41 (82.0%)	1.000
Yes	10 (20.0%)	9 (18.0%)	
Hypertension: No	40 (80.0%)	41 (82.0%)	1.000
Yes	10 (20.0%)	9 (18.0%)	
Preoperative anemia: No	33 (66.0%)	34 (68.0%)	1.000
Yes	17 (34.0%)	16 (32.0%)	

2. Postoperative pain scores

Postoperative pain scores were consistently lower in the ultrasound-guided ESP block group throughout the first 24 hours after surgery, with statistically significant between-group differences at every assessed time point from PACU to 24 hours (all $p < 0.001$) (Table 2, Figure 1). Pain intensity declined over time in both groups, but the ESP block group maintained lower scores across the entire observation period. Within-group analysis also showed significant temporal change in pain scores in both the control and ESP block groups (Friedman test, $p < 0.001$ for both), indicating progressive postoperative pain reduction with a more favorable analgesic profile in patients receiving ESP block.

Time point	Control, mean ± SD	ESP block, mean ± SD	p value
PACU	4.92 ± 1.00	2.36 ± 0.87	<0.001
2 h	5.25 ± 1.56	2.72 ± 1.01	<0.001
4 h	5.16 ± 1.15	2.96 ± 1.21	<0.001
6 h	4.60 ± 1.23	2.71 ± 1.08	<0.001
12 h	4.07 ± 0.85	2.34 ± 0.88	<0.001
24 h	2.74 ± 1.05	1.96 ± 0.82	<0.001

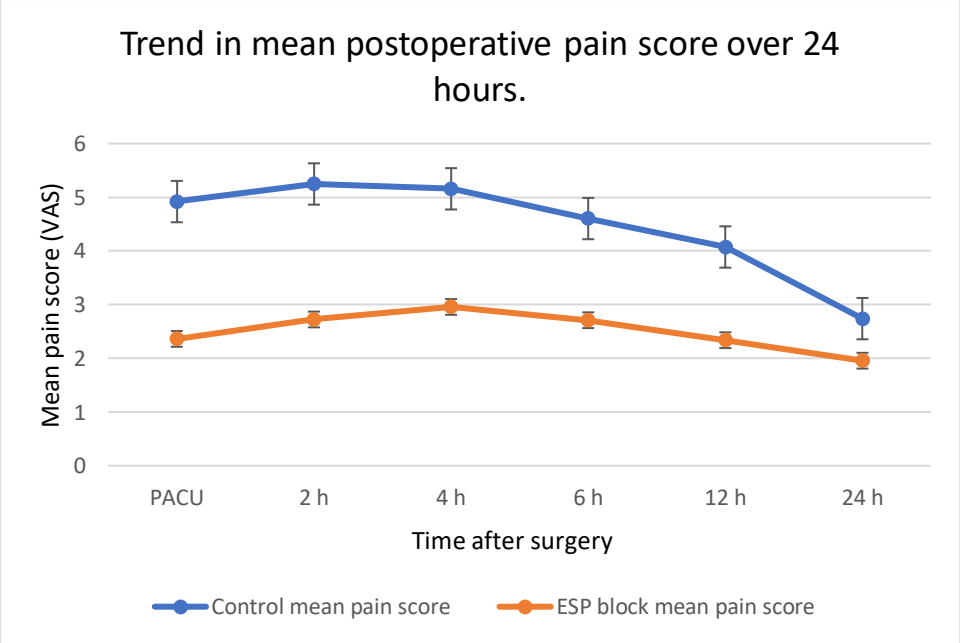

Figure 1. Trend in mean postoperative pain score over 24 hours

3. Postoperative analgesic requirement and patient satisfaction

Postoperative analgesic requirements were significantly lower in the ultrasound-guided ESP block group than in the control group (Table 3, Figure 2). Patients receiving ESP block had a significantly longer time to first rescue analgesia, lower total tramadol consumption during the first 24 hours, and fewer rescue analgesic doses (all $p < 0.001$). Patient satisfaction scores were also significantly higher in the ESP block group ($p < 0.001$), indicating that the improved analgesic profile was accompanied by better patient-perceived postoperative comfort.

Outcome	Control, mean ± SD	ESP block, mean ± SD	p value
Time to first rescue analgesia (h)	4.21 ± 1.32	10.37 ± 2.49	<0.001
Total tramadol requirement in 24 h (mg)	149.20 ± 34.16	91.60 ± 31.06	<0.001
Rescue analgesic doses in 24 h	2.56 ± 0.91	1.04 ± 0.70	<0.001
Patient satisfaction score (0–10)	6.91 ± 1.07	8.27 ± 0.87	<0.001

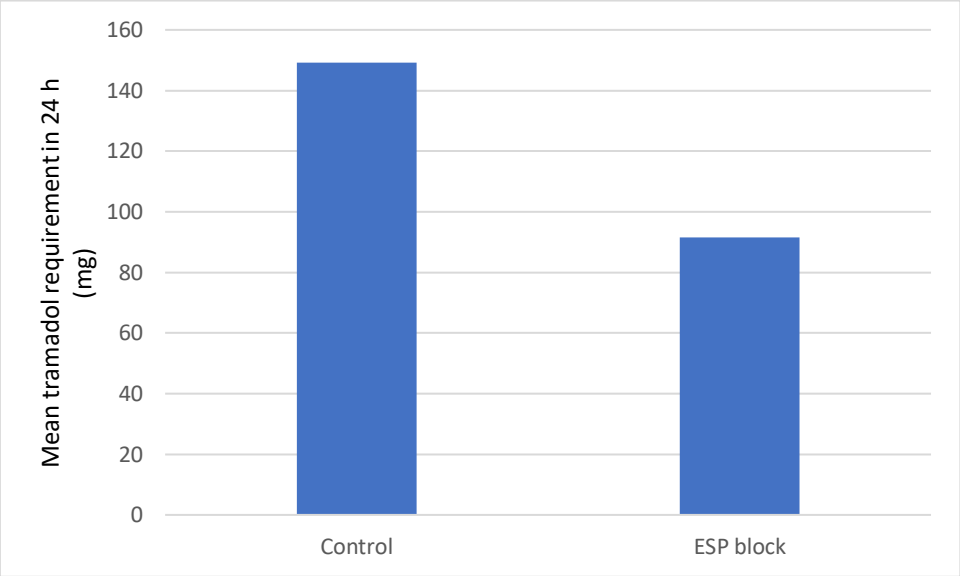

Figure 2. Comparison of 24-hour postoperative tramadol requirement.

4. Hemodynamic profile in the postoperative period

Postoperative hemodynamic parameters remained stable in both groups throughout follow-up (**Table 4**). Mean heart rate was significantly lower in the ESP block group during the early postoperative period, from PACU to 12 hours, whereas mean arterial pressure remained comparable between groups at all measured time points. These findings suggest that ultrasound-guided ESP block was associated with better pain-related physiological control without compromising overall hemodynamic stability.

Time point	Control HR, mean ± SD	ESP HR, mean ± SD	p value	Control MAP, mean ± SD	ESP MAP, mean ± SD	p value
PACU	93.68 ± 10.95	85.84 ± 10.33	<0.001	96.58 ± 12.00	94.14 ± 11.91	0.310
2 h	94.92 ± 12.33	87.06 ± 10.55	<0.001	96.92 ± 11.62	94.62 ± 11.96	0.332
4 h	94.20 ± 9.99	87.30 ± 10.75	0.001	95.58 ± 10.32	95.40 ± 13.11	0.939
6 h	92.62 ± 11.93	86.90 ± 11.74	0.018	95.86 ± 11.00	94.48 ± 11.66	0.544
12 h	90.84 ± 10.20	85.76 ± 10.95	0.018	95.42 ± 11.19	93.70 ± 13.02	0.480
24 h	86.72 ± 10.83	84.98 ± 9.95	0.405	91.84 ± 11.17	93.16 ± 11.58	0.563

5. Safety and complications

The ultrasound-guided ESP block was generally well tolerated, with no clinically important block-related complications observed (Table 5). Postoperative nausea and vomiting occurred significantly less frequently in the ESP block group than in the control group ($p = 0.009$), whereas rates of excessive sedation, hypotension, bradycardia, local anaesthetic toxicity, and pneumothorax were low and did not differ significantly between groups. Overall, these findings support the favorable safety profile of ESP block in this study population.

Complication	Control, n (%)	ESP block, n (%)	p value
PONV	18 (36.0%)	6 (12.0%)	0.009
Sedation excessive	5 (10.0%)	6 (12.0%)	1.000
Hypotension	6 (12.0%)	3 (6.0%)	0.487
Bradycardia	1 (2.0%)	0 (0.0%)	1.000
Block failure	0 (0.0%)	0 (0.0%)	1.000
Local anaesthetic toxicity	0 (0.0%)	2 (4.0%)	0.495
Pneumothorax	0 (0.0%)	0 (0.0%)	1.000

Values are presented as mean ± standard deviation or number (percentage), as appropriate. p values <0.05 were considered statistically significant.

DISCUSSION

The ultrasound-guided ESP block was better in terms of postoperative analgesia following total abdominal hysterectomy in this prospective comparative observational study. Compared with controls, the ESP group had lower pain scores throughout the first 24 hours, a longer time to first rescue analgesia (10.37 ± 2.49 h vs 4.21 ± 1.32 h), lower 24-hour tramadol requirement (91.60 ± 31.06 mg vs 149.20 ± 34.16 mg), fewer rescue analgesic doses (1.04 ± 0.70 vs 2.56 ± 0.91), and higher patient satisfaction (8.27 ± 0.87 vs 6.91 ± 1.07). The ESP group also had lower rates of postoperative nausea and vomiting (12.0 vs 36.0).

These findings are consistent with hysterectomy-specific literature. Hamed et al. showed that ESP block improved postoperative analgesia and reduced opioid consumption after total abdominal hysterectomy.[9] Kamel et al. similarly reported significantly lower VAS scores with ESP block than with TAP block from 30 minutes to 24 hours, together with a longer time to first morphine requirement (14.81 ± 3.52 h vs 10.58 ± 2.35 h) and lower 24-hour morphine use.[10] Shukla et al. also found better postoperative analgesia with ESP block than with TAP block after abdominal hysterectomy.[11] Our results therefore align with growing evidence that ESP block provides clinically meaningful pain relief in this procedure.

The observed opioid-sparing effect in the current study can also be affirmed by the wider pooled evidence. In our meta-analysis of abdominal surgery in adults, Liu et al. reported that ESP block led to lower pain levels and decreased opioid use[12]. Viderman et al. also found that the analgesic benefit was reflected in the lower analgesic burden during the post-operative period[13].

The reduced postoperative nausea and vomiting in our ESP group is clinically significant and probably, at least partially, due to less exposure to opioids. This result is consistent with the meta-analysis by Cai et al., which involved 18 randomized trials and 1,041 patients and demonstrated that ESP block decreased the early and late postoperative pain, 24-hour opioid use, and PONV[14].

Our study had encouraging hemodynamic results. The ESP group had a lower mean heart rate in the early postoperative period, and mean arterial pressure was similar in the two groups, indicating better pain management without hemodynamic impairment. None of the pneumothorax or block failure was noted and no significant block complication was observed. These results are in line with the overall positive safety profile of ESP block in abdominal surgery that has been reported[12-14].

ESP block should also be considered within the framework of other truncal plane methods. Taken together, these results indicate that ESP block is a promising multimodal analgesia element in the case of open hysterectomy.

The strengths of this study are practical in nature, such as procedure-specific evaluation, several clinically relevant outcomes, and a real world comparative design. Nevertheless, the strength and generalizability of inference is limited by the observational design, single-center study, and 24-hour follow-up.

All in all, the use of ultrasound-guided ESP block was linked to improved postoperative pain control, decreased opioid use, decreased PONV, and increased satisfaction in total abdominal hysterectomy. These results justify its use in multimodal analgesia regimens in open gynecological surgery, although additional randomised comparative trials are justified.

CONCLUSION

Ultrasound-guided erector spinae plane block was associated with superior postoperative analgesia in patients undergoing total abdominal hysterectomy, as reflected by lower pain scores, prolonged time to first rescue analgesia, reduced 24-hour tramadol requirement, fewer rescue analgesic doses, and higher patient satisfaction. The block was also associated with a lower incidence of postoperative nausea and vomiting, while maintaining hemodynamic stability and an acceptable

safety profile. These findings support the use of ESP block as an effective component of multimodal analgesia for open abdominal hysterectomy. Further randomized controlled studies comparing ESP block with other regional analgesic techniques are warranted to better define its role in perioperative pain management.

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