World Neurosurgery: X 19 (2023) 100209

Contents lists available at ScienceDirect

World Neurosurgery: X

journal homepage: www.journals.elsevier.com/world-neurosurgery-x

Ultrasonography guided erector spinae block in spinal surgery for pain management with enhanced recovery: A comparative study

Prashant Adhikari [a,*], Isha Amatya [b], Nishma Pokharel [a], Suraj Lamichhane [a], Murari Upreti [a], Manish Shrestha [c], Bhaskar Raj Pant [a], Sandeep Bhandari [a], Arun Dhakal [d], Emre Acaroğlu [e]

[a] HAMS (Hospital for Advance Medicine and Surgery) Hospital Dhumbarai, Kathmandu, Nepal
[b] Nepal Health Research Coucil, Ramshah Path, Kathmandu, Nepal
[c] B and B Hospital Lalitpur, Kathmandu, Nepal
[d] Birat Medical Collage, Biratnagar, Nepal
[e] Ankara Spine Center, Iran Caddesi 45/2 Kavaklidere, 06700, Ankara, Turkey

ARTICLE INFO

Keywords:
VAS
ESPB
ERAS

ABSTRACT

Background: Improved and efficient management of pain can certainly aid enhanced recovery after spinal surgery. Our aim is to evaluate the effect of ESPB in thoracic and lumbar surgeries where we have evaluated VAS for pain, cumulative analgesics consumptions, length of hospital stay and post-operative complications.

Methods: A cross-sectional comparative study done in HAMS among the erector spinae block group and control group. The analysis of different variable was done according to standard statistical analysis. For quantitative data, univariate and multivariate analysis was performed to determine statistically significant differences using student's t-test for continuous variables.

Results: 60 patients were analyzed, 30 got spinae block and 30 in control group.The mean pain score for spinae block group were 1.90 ± 0.712 and 3.27 ± 1.230 for control group ($p < 0.001$). Cumulative mean analgesic consumption values for spinae block vs. control groups were 0.030 ± 0.042 mg vs. 0.091 ± 0.891 mg ($p = 0.001$) for fentanyl; 1.06E4 ± 2833.300 mg vs. 1.53E4 ± 2848.349 mg ($p < 0.001$) for paracetamol; 213 ± 64.656 mg vs. 494 ± 58.816 mg ($p < 0.001$) for ketorol; 5440.00 ± 2060.064 mg vs. 8667.50 ± 2275.006 mg ($p < 0.001$) for ibuprofen and 121.67 ± 31.303 mg vs. 185.00 ± 51.108 mg ($p < 0.001$) for tramadol.

Conclusions: The ESPB technique shows early discharge from hospital and lower cumulative analgesics consumption which indicates enhanced recovery after spine surgery than control group. Improvement of pain using VAS shows immediate post-operative period recovery in those who receives spinae block.

1. Introduction

Physiological stress responses after major surgery have been linked to changes in organ function resulting in morbidity, complications, pain, and delayed recovery despite significant improvements in perioperative care.[1–4] Post-operative pain management is still inadequate despite substantial improvements in the knowledge of the mechanisms and treatment of pain.[5] Delay in recovery and return to daily living is evident, as a result of inadequate pain management due to compromised physiological and psychological factors which significantly increase morbidity and mortality.[6,7] Most importantly, it has been recognized that inadequately treated post-operative pain may lead to chronic pain, which is often misdiagnosed and neglected.[8,9]

Patient-controlled intravenous analgesia and epidural analgesia are common in spinal surgeries which have their own adversity and complications.[10,11] Side effects such as nausea and vomiting caused by postoperative opioid use result in poor post-operative experience, reduce patient satisfaction and are not conducive to rapid recovery.[12] In recent years, many researchers have administered Erector Spinae Plane Block (ESPB) for postoperative analgesia and found that local anesthetic spread well, was volume-dependent and extended into the neural foramina and epidural space normally. At the same time, local anesthetic may show significantly more epidural spread when the lamina and ligaments are

* Corresponding author. HAMS (Hospital for Advance Medicine and Surgery) Hospital, Dhumbarai, Kathmandu, Nepal.
E-mail addresses: adhikariprashant@hotmail.com (P. Adhikari), ishaamatya.iom@gmail.com (I. Amatya), nishma123pokharel@gmail.com (N. Pokharel), suraj2041@gmail.com (S. Lamichhane), upretimd@yahoo.com (M. Upreti), dr.shresthamanish@gmail.com (M. Shrestha), bhpant@gmail.com (B.R. Pant), drsandeepbhandari@gmail.com (S. Bhandari), arundhakal18@gmail.com (A. Dhakal), acaroglue@gmail.com (E. Acaroğlu).

https://doi.org/10.1016/j.wnsx.2023.100209
Received 14 November 2022; Received in revised form 21 April 2023; Accepted 21 April 2023

Abbreviations

VAS	Visual analog score
n	Number
SD	Standard deviation
ESPB	Erector Spinae Plane Block
ERAS	Enhanced Recovery After Surgery
HAMS	Hospital for Advance Surgery and Medicine

compromised, which needs more attention.[13,14] The local anesthetics injected during ESPB spread widely and could produce the effect of a paraspinal block; therefore, the block range was wide and could last until a period of time after the operation.[15–17]

Improved and efficient management of pain can certainly aid in enhanced recovery after spinal surgery. The aim of this study is to evaluate the effect of ESPB in thoracic and lumbar surgeries where we have evaluated the Visual analog scale for pain, cumulative analgesics consumption, length of hospital stay, and post-operative complications. There has been very little research on this emerging technique which can help to improve enhanced recovery after surgery (ERAS) which itself is a topic of interest for many clinicians.

2. Methods

2.1. Study design

This study was conducted at HAMS (Hospital for Advance Surgery and Medicine) Hospital, Kathmandu, Nepal as a cross-sectional comparative study. The study participants were divided into two groups: the erector spinae block group and the control group. We utilized a census sampling method and obtained ethical approval from the Ethical Review Board of Nepal Health Research Council with reference number 123. To assign participants to the spinal block group, we used a simple random technique (Lottery method), while participants for the control group were selected conveniently in a similar number to the block groups. The study included patients undergoing lumbar spinal surgeries at the research institution, with exclusion criteria being patients with coagulation disorders, poly-trauma, head injury, and those undergoing concomitant extra-spinal surgeries. The patients were informed of the aims, objectives, procedures, risks, and benefits of the operation and research procedure, and written informed consent was obtained from them. Data were collected by using a pre-designed structural data collection form containing the variables of interest.

2.2. Statistical analysis

Data were collected, compiled, and tabulated according to key variables and functional assessment scoring. The analysis of different variables was done according to standard statistical analysis. Data were processed and analyzed using the software 'Statistical Package for Social Science version 16. Frequencies and percentages were used for nominal and dichotomous variables, and mean and standard deviation for continuous variables to present the data. For quantitative data, univariate and multivariate analysis was performed to determine statistically significant differences using the student's t-test for continuous variables. For all analysis level of significance were set at 0.05 and a p-value <0.05 was considered significant.

2.3. ESPB technique

An intravenous line was secured and lactated Ringer's solution was started at 5 ml/kg/h. Basic standard monitors were attached to the patient. Patients were pre-oxygenated with 100% oxygen for 3 min. In both groups (I) and (II), induction of anesthesia was carried out by intravenous administration of fentanyl 1 μg/kg, lidocaine 1.5 mg/kg, and propofol 2 mg/kg. After the loss of verbal communication, 0.1 mg/kg of rocuronium was administrated. Controlled ventilation was provided via a face mask with 100% O2 and isoflurane (1–2%) for 2 min. Subsequently, endotracheal intubation was achieved, and intermittent positive pressure ventilation was adjusted to maintain an end-tidal carbon dioxide partial pressure between 30 and 35 mmHg. Anesthesia was maintained with 1.5–2% isoflurane targeting expired isoflurane concentration of 1.2% by the anesthetic gas analyzer to ensure similar alveolar concentrations of inhalational anesthetic in all patients.

In group (I), after prone positioning and before surgery, the erector spine plane block was performed bilaterally using a low-frequency-curved ultrasound transducer placed in a longitudinal orientation 3 cm lateral to the spinous process one vertebral level above a predetermined marked surgical incision. A low-frequency curvilinear ultrasound transducer was placed in a sagittal position against the target vertebral level in the prone position and moved in approximately 3 cm lateral to the spinous process.[18] The erector spinal muscle and transverse muscle were then identified. The block was performed by inserting an 8-cm 22-gauge needle in a cephalad-to-caudad direction until it reached the inter-fascial plane beneath the Erector spinae muscle. Subsequently, 20 ml of 0.25% bupivacaine was injected into the fascial plane between the deep surface of the Erector spinae muscle and the transverse processes of the lumbar vertebrae [Fig. 1].

Prior to the surgical stimulus, both groups were given intravenous ketorolac 0.5 mg/kg and paracetamol 15 mg/kg. Additionally, fentanyl 1 μg/kg was given as rescue analgesia in both groups based on hemodynamic parameters. Ephedrine 6 mg was administered if the mean arterial blood pressure fell below 65 mmHg, while an intravenous bolus of 0.5 mg atropine was administered in the case of bradycardia. At the end of the surgery, the isoflurane vaporizer was turned off, and the muscle relaxant was reversed with neostigmine 0.04 mg/kg and atropine 0.02 mg/kg. The tube was removed once the patient regained consciousness, breathed spontaneously, and responded to verbal commands.

After surgery, patients were admitted to the post-operative ward and given IV Paracetamol 1 gm every 6 h and IV Ketorolac 30 mg every 8 h for 24 h, followed by an as-needed basis. The pain was assessed using the VAS score every 6 h, and patients with a score of more than 4 were given Inj. Fentanyl 25 mcg. If the pain score remained above 4 after 10 min, Inj. Fentanyl 25 mcg was repeated, and if the pain was still not relieved, Inj. Tramadol 50 mg was given. The average daily use of analgesics was then calculated, and pain assessment and analgesic delivery were done by postoperative ward nurses who were not involved in the study.

3. Results

In a sample of 60 patients who underwent spinal surgery, 30 received Erector spinae block while the other 30 formed the control group. The mean ages of the Erector spinae block, and control groups were 43.60 ± 19.541 years and 49.43 ± 20.698 years, respectively, and the male-to-female ratio was roughly equivalent in both groups. Table 1 presents the patient demographics and surgical variables. Trauma was the most common etiological factor for spinal surgeries (Lumber) spinalErector spinae block group, accounted for 40%, followed by degenerative changes at 36.7%. Similarly, in the control group, degenerative changes and trauma were the most common factors, both accounting for 36.7% and 36.6%, respectively. The number of smokers was equal in both groups. The mean length of hospital stay was 5.53 ± 4.183 days in the Erector spinae block group and 7.90 ± 4.229 days in the control group, while the mean estimated blood loss (ml) was 447.33 ± 162.012 ml and 476.67 ± 333.925 ml, respectively (Table 1).

Mean VAS scores of the patient groups at baseline (pre-operative), immediately after surgery (at the post-anesthesia care unit), post-

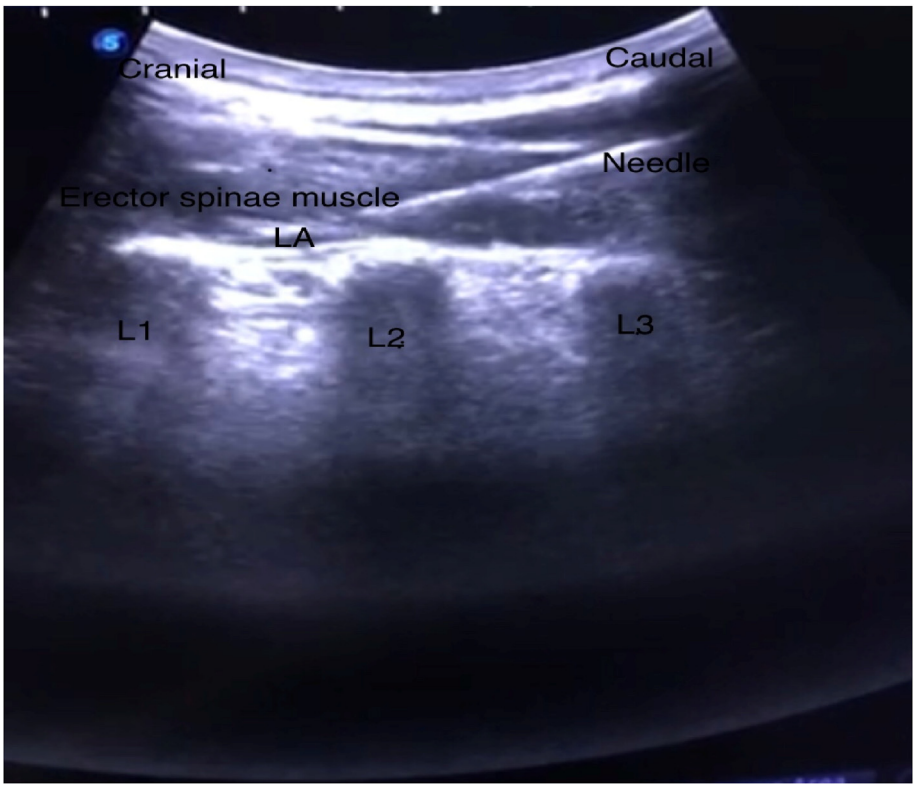

Fig. 1. Erector Spinae muscle where Needle was advanced through the Interfascial plane between the erector spinae and the underlying transverse process with the administration of local anesthetic.

Table 1
Demographical and surgical characteristics of the patients (N = 60).

Variable	Spinae block group[a]	Control group[a]
Mean Age (Years)	43.60 ± 19.541	49.43 ± 20.698
Gender (Male: Female)	1.5:1	1.3:1
Mean body mass index (kg/m2)	25.20 ± 4.405	25.73 ± 4.548
Etiology		
Degenerative	11 (36.7%)	11 (36.7%)
Trauma	12 (40%)	11 (36.6%)
Infection	5 (16.7%)	6 (20%)
Tumor	2 (6.6%)	2 (6.7%)
Smoking	9 (30%)	9 (30%)
Surgical characteristic		
Mean surgical time (min)	253.33 ± 90.946	226.33 ± 83.273
Mean number of levels fused	3.87 ± 2.255	3.80 ± 2.140
Mean estimated blood loss (ml)	447.33 ± 162.012	476.67 ± 333.925
Mean length of hospitalization (day)	5.53 ± 4.183	7.90 ± 4.229

[a] Values are presented as mean ± standard deviation.

Table 2
Visual analog scale (VAS) scores for control and Erector spinae block groups.

VAS, back pain	Spinae block group[a]	Control group[a]	p-value^
Baseline	7.50 ± 0.938	7.47 ± 0.937	0.891
Post-anesthesia care unit	1.90 ± 0 0.712	3.27 ± 1.230	<0.001
Post-operative every 6 h			
6 h	2.43 ± 0.817	3.37 ± 0.765	<0.001
12 h	2.63 ± 0.850	3.23 ± 0.679	0.004
18 h	2.53 ± 0.730	3.13 ± 0.860	0.005
24 h	2.50 ± 0.861	3.40 ± 0.621	<0.001
30 h	2.93 ± 0.691	2.67 ± 0.606	0.118
36 h	2.73 ± 0.785	2.70 ± 0.750	0.867
42 h	2.27 ± 0.740	2.73 ± 0.583	0.009
48 h	2.10 ± 0.712	2.40 ± 0.563	0.075
54 h	2.13 ± 0.776	2.17 ± 0.592	0.852
60 h	1.93 ± 0.640	2.03 ± 0.615	0.539
66 h	1.93 ± 0.691	1.97 ± 0.556	0.838
72 h	1.53 ± 0.507	1.47 ± 0.507	0.613
Discharge	1.00 ± 0.695	0.70 ± 0.702	0.102
Follow Up at 6 weeks	0.60 ± 0.498	0.63 ± 0.615	0.818

[a] Values are presented as mean ± standard deviation, ^Independent sample t-test.

operative every 6 h, at discharge, and 6 weeks after the surgery are given in Table 2. The mean pain score (VAS score) for the Erector spinae block group in the post-anesthesia care unit was 1.90 ± 0.712 and for the control group was 3.27 ± 1.230 which was also statistically significant ($p < 0.001$). The pain score decreased after post-operative every 6 h and during discharge and in follow-up at six weeks for both groups (Table 2).

Cumulative mean analgesic consumption values for spinae block vs. control groups were 0.030 ± 0.042 mg vs. 0.091 ± 0.891 mg ($p = 0.001$) for fentanyl; 1.06E4 ± 2833.300 mg vs. 1.53E4 ± 2848.349 mg ($p < 0.001$) for paracetamol; 213 ± 64.656 mg vs. 494 ± 58.816 mg ($p < 0.001$) for ketorolac, 5440.00 ± 2060.064 mg vs. 8667.50 ± 2275.006 mg ($p < 0.001$) for ibuprofen and 121.67 ± 31.303 mg vs. 185.00 ± 51.108 mg ($p < 0.001$) for tramadol (Table 3).

4. Discussion

The beneficiary effect of the ERAS program has been extensively researched and established in thoracoabdominal surgeries. However, post-operative challenges and interventions need to be addressed differently in spinal surgeries. Typically, patients experience severe pain during the early postoperative period, and inadequate pain management can reduce patient comfort and mobility and lead to complications such as deep vein thrombosis, pulmonary embolus, and pneumonia. These complications can increase the hospital's length of stay and reduce

Table 3
Cumulative analgesic consumption for control and spinal block groups.

Cumulative analgesic consumption (mg)	Spinae block group[a]	Control group[a]	p-value^
Fentanyl	0.030 ± 0.042	0.091 ± 0.891	0.001
Paracetamol	1.06E4 ± 2833.300	1.53E4 ± 2848.349	<0.001
Ketorolac	213 ± 64.656	494 ± 58.816	<0.001
Ibuprofen	5440.00 ± 2060.064	8667.50 ± 2275.006	<0.001
Tramadol	121.67 ± 31.303	185.00 ± 51.108	<0.001

[a] Values are presented as mean ± standard deviation, ^Independent sample t-test.

patient satisfaction. Pain management in spinal surgeries usually involves the use of paracetamol, non-steroidal anti-inflammatory drugs, and opioids, each of which can cause serious side effects such as hepatotoxicity, nephrotoxicity, gastrointestinal bleeding, confusion, and respiratory depression. For this reason, various multi-modal analgesia regimens have been introduced to manage pain, particularly to reduce opioid consumption after spinal surgery.

In this current study, the effect of the ESPB technique was compared with a control group of similar demographic and etiological characteristics. Key outcome variables considered were pain characteristics using the VAS scale, length of hospital stay, and cumulative analgesic consumption. The study found that the improvement in VAS scale pain assessment was statistically significant in the ESPB group during the immediate postoperative period, but both groups had similar improvements in the long term after spinal surgery. Furthermore, cumulative analgesic consumption was lower in the ESPB group, leading to early discharge from the hospital compared to the control group. Overall, the study had a positive effect on enhanced recovery after spinal surgery.

5. Conclusion

The ESPB technique shows early discharge from the hospital and lower cumulative analgesics consumption which indicates enhanced recovery after lumbar spine surgery than the control group along with putting limitations on analgesic use. Improvement of pain using VAS shows immediate postoperative period recovery in those who receive Erector spinae block during surgery.

Credit author statement

Sandeep Bhandari: Writing – review & editing. Bhaskar Raj Pant: Writing – review & editing. Manish Shrestha: Software, Writing – original draft. Nishma Pokharel: Data curation, Software, Writing – review & editing. Emre Acaroğlu: Supervision, Writing – review & editing. Arun Dhakal: Writing – review & editing. Murari Upreti: Supervision, Writing – review & editing. Suraj Lamichhane: Software, Writing – review & editing. Isha MBBS, MD Amatya: Formal analysis, Investigation, Methodology, Writing – review & editing. Prashant Adhikari: Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth*. 1997;78:606–617.
2. Bellomo R, Goldsmith D, Uchino S, et al. Prospective controlled trial of effect of medical emergency team on postoperative morbidity and mortality rates. *Crit Care Med*. 2004;32:916–921.
3. Story DA. Postoperative complications in elderly patients and their significance for long-term prognosis. *Curr Opin Anaesthesiol*. 2008;21:375–379.
4. McNicol L, Story DA, Leslie K, et al. Postoperative complications and mortality in older patients having noncardiac surgery at three Melbourne teaching hospitals. *Med J Aust*. 2007;186:447–452.
5. Apfelbaum JL, Chen C, Mehta SS, et al. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. *Anesth Analg*. 2003;97:534–540.
6. Liu SS, Carpenter RL, Mackey DC, et al. Effects of perioperative analgesic technique on rate of recovery after colon surgery. *Anesthesiology*. 1995;83:757–765.
7. Wu CL, Naqibuddin M, Rowlingson AJ, et al. The effect of pain on health-related quality of life in the immediate postoperative period. *Anesth Analg*. 2003;97:1078–1085.
8. Perkins FM, Kehlet H. Chronic pain as an outcome of surgery: a review of predictive factors. *Anesthesiology*. 2000;93:1123–1133.
9. Macrae WA. Chronic pain after surgery. *Br J Anaesth*. 2001;87:88–98.
10. Gessler F, Mutlak H, Tizi K, et al. Postoperative patient-controlled epidural analgesia in patients with spondylodiscitis and posterior spinal fusion surgery. *J Neurosurg Spine*. 2016;24(6):965–970.
11. Waldrop R, Cheng J, Devin C, McGirt M, Fehlings M, Berven S. The burden of spinal disorders in the elderly. *Neurosurgery*. 2015;77(Suppl 4):S46–S50.
12. Graffigna G, Barello S. Patient Health Engagement (PHE) model in enhanced recovery after surgery (ERAS): monitoring patients' engagement and psychological resilience in minimally invasive thoracic surgery. *J Thorac Dis*. 2018;10(Suppl 4):S517–S528.
13. Chin KJ, Malhas L, Perlas A. The erector spinae plane block provides visceral abdominal analgesia in bariatric surgery: a report of 3 cases. *Reg Anesth Pain Med*. 2017;42(3):372–376.
14. Xu JL. Paraneuraxial nerve blocks: a well-defined novel terminology that is clinically essential for regional anesthesia. *J Clin Anesth*. 2017;43:14.
15. Tseng V, Xu JL. Erector spinae plane block for postoperative analgesia in lumbar spine surgery: is there a better option. *J Neurosurg Anesthesiol*. 2019. https://doi.org/10.1097/ANA.0000000000000631.
16. Tseng V, Tara A, Hou J, Xu JL. Erector spinae plane block unbound: limits to safety in a patient with laminectomy. *Saudi J Anaesth*. 2019;13(3):253–254.
17. Gurkan Y, Aksu C, Kus A, Yorukoglu UH. Erector spinae plane block and thoracic paravertebral block for breast surgery compared to IV-morphine: a randomized controlled trial. *J Clin Anesth*. 2019;59:84–88.
18. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. *Reg Anesth Pain Med*. 2016;41:621–627.