ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 12 | December - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ERECTOR SPINAE PLANE BLOCK ACCELERATES EARLY MOBILIZATION AFTER SINGLE-LEVEL POSTERIOR LUMBAR FUSION: A RANDOMIZED CONTROLLED TRIAL

Orthopaedics

Dr. Santhanakrishnan S	MBBS., MS ORTHO., Head of the Department, Department of Orthopaedics, Bhaarath medical college and Hospital.
Dr. Dhinesh N. L.*	MBBS., MS Ortho., DNB Ortho., Assistant Professor, Department of Orthopaedics, Bhaarath medical college and Hospital. *Corresponding Author
Dr. Vibishek Raj P.	MBBS., MS ORTHO., Assistant Professor, Department of Orthopaedics, Bhaarath medical college and Hospital.
Dr. Avinash R. N.	MBBS., MS ORTHO., Assistant Professor, Department of Orthopaedics, Bhaarath medical college and Hospital.
Dr. Nithin Benito H	MBBS., DNB ORTHO., Assistant Professor, Department of Orthopaedics, Bhaarath medical college and Hospital.
Dr. Karthick R.	MBBS., MS ORTHO., Senior Resident, Department of Orthopaedics, Bhaarath medical college and Hospital.
Dr. Gokul Thambi Raghu	MBBS., D ORTHO., (DNB ORTHO)., Senior Resident, Department of Orthopaedics, Bhaarath medical college and Hospital.

ABSTRACT

Background: Effective analgesia after posterior lumbar fusion is essential for early mobilization, reduced complications, and improved recovery. The erector spinae plane block (ESPB) is a simple ultrasound-guided regional technique that may reduce opioid requirements and movement-evoked pain, but evidence linking ESPB to faster functional recovery after elective single-level fusion is limited. **Methods:** We performed a single-centre, prospective, randomized trial at Bharath Medical College and Hospital (2023–2025). One hundred thirty adult patients undergoing elective single-level posterior lumbar fusion were randomized 1:1 to receive bilateral ultrasound-guided single-shot ESPB (20 mL 0.4% ropivacaine + dexamethasone 4 mg per side) after induction plus standardized multimodal analgesia, or standardized multimodal analgesia alone (control). Primary outcome was time from post-anesthesia unit discharge to first supervised ambulation (hours). Secondary outcomes included 24- and 48-hour intravenous morphine equivalents, numeric rating pain scores at rest and movement, time to first rescue analgesic, proportion requiring rescue, Timed Up and Go (TUG) at postoperative day (POD) 1 and 2, incidence of PONV, length of hospital stay, and ESPB-related complications. Assessors and physiotherapists were blinded to allocation. **Results:** 130 patients completed 48-hour follow-up (ESPB n = 65; control n = 65). Median time to first ambulation was 18 h (IQR 14–22) in the ESPB group versus 28 h (IQR 22–36) in controls (median difference 10 h; $P < 0.001$). ESPB markedly reduced opioid consumption at 24 h (median 12 mg vs 30 mg morphine equivalents) and 48 h (20 mg vs 44 mg) ($P < 0.001$), lowered early movement-evoked NRS scores, prolonged time to first rescue analgesic, improved TUG at POD1–2, and decreased PONV (15% vs 33%; $P = 0.02$). No ESPB-related adverse events were observed. **Conclusions:** In patients undergoing single-level posterior lumbar fusion, bilateral single-shot ESPB added to multimodal analgesia significantly hastened ambulation, reduced opioid use and early pain, and improved early functional mobility without increasing complications. ESPB is a practical adjunct for enhanced recovery in elective lumbar fusion.

KEYWORDS

Erector spinae plane block, Lumbar fusion, Early mobilization, Multimodal analgesia, Postoperative functional recovery

INTRODUCTION

As surgeons we are judged not only by the technical success of decompression and fusion but by the speed and quality of our patients' return to function. Early mobilization after elective posterior lumbar fusion shortens hospital stay, reduces medical complications, accelerates rehabilitation and improves patient satisfaction. Pain control is the principal modifiable barrier to immediate postoperative mobilization. Systemic opioids, while effective, delay mobilization through sedation, nausea, pruritus and urinary retention and contribute to longer inpatient stays and opioid-related morbidity [26,27].

Regional analgesic techniques that selectively reduce nociception from posterior spinal elements therefore have strong appeal to the spinal surgeon. The ultrasound-guided erector spinae plane block (ESPB) injects local anaesthetic into the fascial plane deep to the erector spinae muscle and produces analgesia by spread to the dorsal (and variably ventral) rami of spinal nerves. Since its first description in 2016, ESPB has been rapidly adopted across thoracic, breast and spinal procedures because it is technically straightforward, sonographically visible, and performed at a safe distance from neuraxial structures [1,18,19].

Several randomized trials and meta-analyses demonstrate ESPB reduces early postoperative pain scores and opioid consumption after lumbar spinal procedures [2–12,21–25]. However, pooled analyses have found heterogeneity across trials and limited data on functional, surgeon-relevant endpoints such as time to first ambulation and objective mobility tests [2,22,23]. Recent single-centre randomized work in Western cohorts reported opioid-sparing benefits and improved early pain control after thoraco-lumbar fusion [3]. Nevertheless, evidence directly linking ESPB to accelerated early mobilization and measurable functional recovery after elective single-level posterior lumbar fusion remains incomplete.

This manuscript reports a prospective, randomized, single-centre study performed at Bhaarath Medical College and Hospital (study period 2023–2025) from the point of view of the spine surgeon. We evaluated whether bilateral single-shot ESPB added to standardized general anaesthesia and a multimodal analgesic regimen shortens time to first ambulation and improves early functional recovery after single-level elective posterior lumbar fusion.

AIM

Primary Objective

To determine whether perioperative bilateral ESPB reduces time to first ambulation after single-level elective posterior lumbar fusion.

Secondary Objectives

To evaluate effects of ESPB on 24- and 48-hour opioid consumption (intravenous morphine equivalents), pain scores at rest and on movement, time to first rescue analgesic, proportion of patients requiring rescue analgesia, incidence of opioid-related adverse effects (PONV, pruritus, urinary retention), length of hospital stay, and early functional recovery measured by Timed Up and Go (TUG) at postoperative day (POD) 1 and POD 2.

To record ESPB-related complications and operational implications for the surgical team.

Methodology

Study Design And Setting

Single-centre prospective randomized parallel-group trial at Bhaarath Medical College and Hospital between January 2023 and June 2025. The institutional ethics committee approved the protocol and all patients provided written informed consent.

Participants

Inclusion: adults 18–75 years undergoing elective single-level posterior lumbar fusion for degenerative indications (spondylolisthesis, foraminal stenosis, discogenic disease), ASA I–III.

Exclusion: chronic opioid use (>3 months), prior instrumentation at the index level, allergy to local anaesthetics, coagulopathy, local infection at puncture site, BMI > 40, inability to cooperate with physiotherapy.

Rationale For Design

The study design and outcomes mirror prior RCTs and systematic reviews that evaluated ESPB in spine surgery and other trunk procedures, enabling comparison with published analgesic and safety data [2–6,21,22].

Randomization And Blinding

Patients were randomized 1:1 to ESPB + standard analgesia (ESPB group, n = 65) or standard analgesia alone (Control group, n = 65) using computer-generated blocks and sealed envelopes. Postoperative assessors and physiotherapists were blinded to allocation; anaesthesiologists performing blocks were not.

Anaesthetic And Perioperative Analgesic Protocol

General anaesthesia standardized: induction with propofol and fentanyl (1.5–2 μg·kg−1), maintenance per anaesthetist, and intraoperative fentanyl boluses titrated to hemodynamic response. At skin closure all patients received IV paracetamol 1 g and IV morphine 4 mg. Postoperative analgesia: PCA morphine (1 mg bolus, 15-min lockout, no background infusion), scheduled paracetamol 1 g q8h, and IV NSAID rescue when indicated. These multimodal measures reflect contemporary spine ERAS practices and align with recommendations on multimodal analgesia in spine surgery [26].

ESPB Technique

ESPB was performed after induction and patient positioning in prone under ultrasound guidance at the transverse process corresponding to the instrumented level. Each side received 20 mL 0.4% ropivacaine with dexamethasone 4 mg (20 mL per side). Sonographic spread between erector spinae and transverse process was confirmed. This timing and local anesthetic regimen follows pragmatic approaches used in RCTs that demonstrated analgesic benefit without increased complications [3,5,6,10,12,15].

Outcomes And Measurements

Primary: time (hours) from post-anesthesia care unit discharge to first supervised ambulation (standing and walking ≥10 m).

Secondary: cumulative IV morphine equivalents at 24 and 48 h; NRS pain (0–10) at rest and on movement at 2, 6, 12, 24, 48 h; time to first rescue analgesic; proportion needing rescue; incidence of PONV, pruritus, urinary retention within 48 h; length of stay (days); TUG at POD1 and POD2; ESPB-related complications (local anesthetic systemic toxicity, hematoma, infection, neurologic deficit). PCA logs and blinded physiotherapist assessments provided objective metrics.

Sample Size And Statistical Considerations

Sample size was determined from institutional pilot data and informed by effect sizes reported in recent RCTs and meta-analyses; methods for handling summary statistics followed accepted methodology [29]. Continuous variables were compared with t test or Mann-Whitney U test and categorical variables with $\chi 2$/Fisher exact; repeated measures assessed by mixed models. Evidence grading and risk-of-bias considerations mirror approaches described in systematic reviews of ESPB [2,22,30].

RESULTS:

Patient Flow And Baseline Characteristics

150 patients screened; 130 randomized and completed 48-hour follow-up (ESPB n = 65; Control n = 65). Groups were similar at baseline for age (mean 55 ± 11 y), sex distribution, BMI, ASA status and operative variables (operative time, estimated blood loss).

Primary Outcome: Time To Ambulation

Median time to first ambulation was significantly shorter in the ESPB group: 18 h (IQR 14–22) versus 28 h (IQR 22–36) in controls (median difference 10 h; 95% CI 6–14; P < 0.001). A greater proportion of ESPB patients ambulated within 24 h (78% vs 45%; RR 1.73; 95% CI 1.32–2.27; P < 0.001).

Analgesic Consumption And Pain Scores

Cumulative IV morphine equivalents at 24 h: median 12 mg (IQR 8–18) ESPB vs 30 mg (IQR 24–42) Control (P < 0.001). At 48 h: median 20 mg (IQR 14–30) ESPB vs 44 mg (IQR 36–60) Control (P < 0.001). These opioid-sparing effects mirror those reported in multiple RCTs and pooled analyses of ESPB for spinal surgery [2–6,10].

Early pain scores were lower in the ESPB group: movement-evoked NRS at 2 h mean 2.1 ± 1.2 vs 4.6 ± 1.6 (mean difference −2.5; 95% CI −3.1 to −1.9; P < 0.001). Significant differences persisted through 24 h and converged by 48 h, consistent with single-shot block pharmacodynamics and prior trials [3,4,6,9].

Time to first rescue analgesic longer in ESPB group (median 8.5 h vs 2.5 h; P < 0.001) and fewer ESPB patients required rescue within 48 h (23% vs 57%; P < 0.001).

Functional Recovery And Hospital Metrics

TUG at POD1: ESPB median 28 s (IQR 24–34) vs Control 40 s (IQR 34–48) (P < 0.001). TUG at POD2: ESPB 20 s (IQR 18–26) vs Control 28 s (IQR 24–36) (P < 0.001). Length of stay was shorter in ESPB group (median 4 vs 5 days; P = 0.04). These objective mobility improvements translate into clinically meaningful milestones for surgeons and physiotherapy teams and extend findings reported in single-centre RCTs [3].

Safety And Adverse Events

Incidence of PONV was lower in the ESPB group (15% vs 33%; P = 0.02), consistent with reduced opioid exposure and previous reports [2,3]. No significant differences in pruritus or urinary retention. No ESPB-related complications occurred (no reported systemic toxicity, hematoma, infection, or persistent new neurologic deficit), aligning with the favorable safety profile when ultrasound guidance is used and anatomical studies support spread away from critical structures [19,20].

Operational Observations

Performing ESPB after induction in prone added a median ~10 minutes to anesthesia setup but did not delay incision scheduling. Anesthetists reported reduced intraoperative opioid requirements (mean fentanyl reduction ~80–100 μg), consistent with improved intraoperative analgesia reported in other trials [3,9].

Table 1: Baseline Characteristics (n = 130)

Characteristic	ESPB (n = 65)	Control (n = 65)	p value
Age, mean ± SD (years)	55 ± 11	56 ± 10	0.48
Male, n (%)	38 (58%)	36 (55%)	0.72
BMI, mean ± SD (kg/m²)	26.8 ± 4.2	27.1 ± 4.0	0.64
ASA I–II/III, n	52 / 13	50 / 15	0.67
Operative level L4–L5 or L5–S1, n (%)	44 (68%)	46 (71%)	0.70
Operative time, median (IQR) min	120 (100–140)	122 (102–145)	0.55
Estimated blood loss, median (IQR) mL	200 (150–300)	210 (150–320)	0.61

Table 2: Primary Outcome

Outcome	ESPB (n = 65)	Control (n = 65)	Effect (95% CI)	p value
Time to first ambulation, median (IQR) hours	18 (14–22)	28 (22–36)	Median diff 10 (6 to 14) hours	< 0.001
Ambulated within 24 h, n (%)	51 (78%)	29 (45%)	RR 1.73 (1.32–2.27)	< 0.001

Table 3: Key Secondary Outcomes

Outcome	ESPB (n = 65)	Control (n = 65)	Effect (95% CI)	p value
24-h opioid (IV morphine equiv), median (IQR) mg	12 (8–18)	30 (24–42)	Median diff −18 (−24 to −12) mg	< 0.001
48-h opioid (IV morphine equiv), median (IQR) mg	20 (14–30)	44 (36–60)	Median diff −24 (−32 to −16) mg	< 0.001
Movement NRS at 2 h, mean ± SD	2.1 ± 1.2	4.6 ± 1.6	Mean diff −2.5 (−3.1 to −1.9)	< 0.001
Time to first rescue analgesic, median (IQR) hours	8.5 (4–14)	2.5 (1–6)	Median diff 6 (4 to 9) hours	< 0.001
Patients requiring rescue within 48 h, n (%)	15 (23%)	37 (57%)	RR 0.40 (0.24–0.66)	< 0.001
TUG POD1, median (IQR) sec	28 (24–34)	40 (34–48)	Median diff −12 (−16 to −8) s	< 0.001
TUG POD2, median (IQR) sec	20 (18–26)	28 (24–36)	Median diff −8 (−11 to −5) s	< 0.001
Length of stay, median (IQR) days	4 (3–5)	5 (4–7)	Median diff −1 (−2 to 0) days	0.04

Table 4: Adverse Events And Operational Metrics

Outcome	ESPB (n = 65)	Control (n = 65)	p value
PONV within 48 h, n (%)	10 (15%)	21 (33%)	0.02
Pruritus within 48 h, n (%)	4 (6%)	6 (9%)	0.51
Urinary retention within 48 h, n (%)	2 (3%)	3 (5%)	0.65
ESPB-related complications, n	0	—	—
Median additional anaesthesia setup time for ESPB, min	10	—	—
Mean intraoperative fentanyl reduction (approx.) µg	85	—	0.01

IQR = interquartile range; NRS = numeric rating scale (0–10); TUG = Timed Up and Go; RR = risk ratio. Statistical tests: Mann-Whitney U for medians, t test for means, $\chi 2$ or Fisher exact for proportions.

DISCUSSION

Our study demonstrates that adding bilateral single-shot ultrasound-guided ESPB to a standardized multimodal analgesic regimen for single-level posterior lumbar fusion produces clinically meaningful improvements in early recovery: a median 10-hour reduction in time to first ambulation, substantial opioid sparing at 24 and 48 hours, lower movement-evoked and resting pain in the first 24 hours, better objective mobility (TUG) on POD1–2, and reduced PONV. These outcomes are directly relevant to the spine surgeon because earlier, safer mobilization shortens the window for physiotherapy initiation, permits earlier functional assessment under load, supports discharge planning, and may reduce perioperative morbidity linked to immobility [27,26].

Mechanistic rationale and anatomical context ESPB likely exerts its effect by spread of local anaesthetic in the paraspinal fascial plane with subsequent blockade of the dorsal rami and variable spread to ventral rami or paravertebral space, attenuating nociceptive input from the paraspinal musculature and posterior bony work of fusion [1,19]. This anatomical distribution explains the pronounced effect on movement-evoked pain—a key determinant of ambulation ability—and the relatively short-lived nature of benefit consistent with single-shot local anaesthetic pharmacokinetics and the single-shot design used here and in many RCTs [3,4,6].

Our results align with randomized trials and pooled analyses showing early analgesic benefit and reduced opioid consumption after ESPB for lumbar procedures [6,4,5,11,21,22,24,2,7,9,10,12,23,8,3]. Whereas prior meta-analyses documented heterogeneity and called for objective recovery endpoints, our study contributes surgeon-centric, objective metrics—time to ambulation and TUG—that quantify functional recovery and confirm that analgesic benefits translate into earlier mobilization and improved early mobility [2,22,23]. The magnitude of opioid reduction and PONV decrease we observed mirrors that reported in both Asian and Western RCTs, suggesting reproducibility across settings when technique and multimodal background therapy are standardized [3,10,21].

Implications for enhanced recovery after spine surgery (ERAS) pathways Early mobilization is a cornerstone of ERAS. By reducing movement-evoked pain and opioid burdens, ESPB can remove a primary barrier to same-day or POD1 physiotherapy in selected patients, facilitating protocolized milestones (ambulation, independent transfers, and early rehabilitation exercises) and potentially shortening LOS and resource use [26]. For surgical teams, this means earlier safe neurologic assessment under mobilization and the ability to start functional rehabilitation sooner, both of which can improve patient satisfaction and throughput.

Single-shot ESPB performed after induction in the prone position is pragmatic, fits operating theatre workflows, and was safe in our hands-consistent with other pragmatic RCTs [3,5,6,10,15]. However, technique details matter: level selected, local anaesthetic agent, volume, concentration, and use of adjuvants (we used ropivacaine 0.4% + dexamethasone) influence duration and spread and therefore clinical effect [19,20]. Continuous ESPB catheters or higher volumes may prolong benefit for longer or more extensive procedures, but catheter techniques add complexity and potential infection risk and require evaluation in RCTs. Our results apply to single-shot ESPB for single-level elective fusion and should not be assumed for high-complexity deformity or multilevel reconstruction without further data.

Incorporating ESPB required modest additional anaesthesia time (~10 minutes) and posed no delay to incision in our protocol; anaesthesiology and surgical teams can integrate block timing (after induction, before incision) to preserve theatre efficiency. Reduced intraoperative opioid requirement also aided maintenance anaesthesia and may help intraoperative hemodynamic stability. From a systems perspective, improving early ambulation rates increases physiotherapy efficiency and can lower bed-day consumption if discharge criteria are met earlier-an attractive proposition for high-volume spine services.

We observed no ESPB-related adverse events; this is concordant with anatomical studies showing a safe distance from neuraxial structures and RCTs reporting low complication rates when ultrasound guidance is used [19,20]. Nevertheless, adverse effects (local anaesthetic systemic toxicity, hematoma in anticoagulated patients, or infection) remain theoretically possible; stringent patient selection (coagulopathy, anticoagulation status), aseptic technique, appropriate local anaesthetic dosing, and monitoring protocols are essential. Routine documentation of block onset and sensory/functional checks in awake patients (if performed preinduction) improves quality assurance.

Important limitations temper interpretation. Single-centre conduct and selection of single-level elective cases limit external validity to multilevel, revision, deformity, or chronic opioid-dependent cohorts. Anaesthesiologists were not blinded to allocation, potentially affecting intraoperative opioid administration despite objective postoperative PCA logs and blinded physiotherapy assessments mitigating reporting bias. Our follow-up targeted early recovery; longer-term outcomes such as persistent postoperative pain, functional scores at 3–12 months, and opioid use trajectories were not assessed and require future study. Heterogeneity across published trials-differences in block level, timing, local anaesthetic, background analgesia, and surgical mix-explains why earlier meta-analyses reported variable pooled effects and underlines the need for standardization in future trials [2,22,23].

Key next steps include multicentre randomized trials powered for functional recovery endpoints and longer follow-up, direct comparisons between single-shot versus continuous catheter ESPB, and head-to-head comparisons with alternative regional techniques (e.g., thoracolumbar interfacial plane blocks) to identify the optimal regional strategy for various spine procedures [11]. Economic evaluations quantifying cost per bed-day saved, physiotherapy resource implications, and the threshold at which ESPB is cost-effective for different health systems will be valuable. Finally, consensus on block reporting (technique details, local anaesthetic dosing, adjuvants, timing) will improve interpretability and reduce

heterogeneity in pooled analyses [28,30].

Spine teams considering ESPB implementation should: (1) adopt standardized block protocols in collaboration with anaesthesiology; (2) document block timing, level, agent, and volume; (3) integrate physiotherapy milestones with expected analgesic windows (e.g., prioritize early mobilization within the first 24 hours); (4) audit ambulation, PCA consumption, PONV, and complications; and (5) participate in or initiate multicentre registries/RCTs to expand generalizability beyond single-level fusion.

CONCLUSION

From a surgeon's viewpoint, perioperative bilateral ultrasound-guided ESPB is a low-risk, high-value adjunct that shortens time to first ambulation, reduces perioperative opioid consumption, lowers early pain scores and improves early functional mobility after single-level elective posterior lumbar fusion. The block integrates into routine theatre workflow with minimal delay and supports enhanced recovery goals; adoption should be pursued within multidisciplinary pathways while continuing rigorous multicentre evaluation.

REFERENCES

1. 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;41:621–7.
2. Liang X, Zhou W, Fan Y. Erector spinae plane block for spinal surgery: a systematic review and meta-analysis. Korean J Pain. 2021;34:487–500.
3. Bellantonio D, Bolondi G, Cultrera F, Lofrese G, Mongardi L, Gobbi L, et al. Erector spinae plane block for perioperative pain management in neurosurgical lower-thoracic and lumbar spinal fusion: a single-centre prospective randomized controlled trial. BMC Anesthesiol. 2023;23:187.
4. Singh S, Choudhary NK, Lalin D, Verma VK. Bilateral ultrasound-guided erector spinae plane block for postoperative analgesia in lumbar spine surgery: a randomized controlled trial. J Neurosurg Anesthesiol. 2020;32:330–4.
5. Zhang TJ, Zhang JJ, Qu ZY, Zhang HY, Qiu Y, Hua Z. Bilateral erector spinae plane blocks for open posterior lumbar surgery. J Pain Res. 2020;13:709–17.
6. Yayik AM, Cesur S, Ozturk F, Ahiskalioglu A, Ay AN, Celik EC, et al. Postoperative analgesic efficacy of the ultrasound-guided erector spinae plane block in patients undergoing lumbar spinal decompression surgery: a randomized controlled study. World Neurosurg. 2019;126:e779–85.
7. Goel VK, Chandramohan M, Murugan C, et al. Clinical efficacy of ultrasound-guided bilateral erector spinae block for single-level lumbar fusion surgery: a prospective, randomized, case-control study. Spine J. 2021;21:1873–80.
8. Avis G, Gricourt Y, Vialatte PB, et al. Analgesic efficacy of erector spinae plane blocks for lumbar spine surgery: a randomized double-blind controlled clinical trial. Reg Anesth Pain Med. 2022;47:610–6.
9. Yu Y, Wang M, Ying H, Ding J, Wang H, Wang Y. The analgesic efficacy of erector spinae plane blocks in patients undergoing posterior lumbar spinal surgery for lumbar fracture. World Neurosurg. 2021;147:e1–7.
10. Zhang Q, Wu Y, Ren F, Zhang X, Feng Y. Bilateral ultrasound-guided erector spinae plane block in patients undergoing lumbar spinal fusion: a randomized controlled trial. J Clin Anesth. 2021;68:110090.
11. Ciftci B, Ekinci M, Celik EC, Yayik AM, Aydin ME, Ahiskalioglu A. Ultrasound-guided erector spinae plane block versus modified thoracolumbar interfascial plane block for lumbar discectomy surgery: a randomized, controlled study. World Neurosurg. 2020;144:e849–55.
12. Yeşiltaş S, Abdallah A, Uysal Ö, Yilmaz S, Çinar İ, Karaaslan K. The efficacy of intraoperative freehand erector spinae plane block in lumbar spondylolisthesis: a randomized controlled study. Spine (Phila Pa 1976). 2021;46:E902–10.
13. Wu Z, Xue F, Wang Z, Yang L, Chen X, Yao S. Analgesic efficacy of ultrasound-guided bilateral erector spinae plane block in patients undergoing posterior lumbar interbody fusion. J Clin Anaesthesiol. 2019;35:842–5. (Chinese)
14. Liu T, Hua L, Wan L. Comparison of ultrasound-guided erector spinae plane block and retrolaminal block combined with general anesthesia for patients undergoing vertebral surgery. J Clin Anaesthesiol. 2019;35:289–93. (Chinese)
15. Wang W, Liu Y, Zhang Y. Ultrasound-guided erector spinae block as an adjuvant to general anesthesia and postoperative analgesia in patients undergoing lumbar spine surgery. J Clin Anaesthesiol. 2018;34:1172–5. (Chinese)
16. Yu Q, Guo X. Ropivacaine erector spinae plane block assisting general anesthesia in lumbar spine surgery of 30 cases. Her Med. 2018;37:63–6. (Chinese)
17. Prakash PS, Jain V, Dash HH. Erector spinae plane block at the T12 level may not provide good postoperative pain relief following lumbosacral spine surgery. J Neurosurg Anesthesiol. 2021;33:93–4.
18. Tulgar S, Ahiskalioglu A, De Cassai A, Gurkan Y. Efficacy of bilateral erector spinae plane block in the management of pain: current insights. J Pain Res. 2019;12:2597–613.
19. Bonvicini D, Boscolo-Berto R, De Cassai A, et al. Anatomical basis of erector spinae plane block: a dissection and histotopographic pilot study. J Anesth. 2021;35:102–11.
20. De Cassai A, Geraldini F, Carere A, et al. Complications rate estimation after thoracic erector spinae plane block. J Cardiothorac Vasc Anesth. 2021;35:3142–3.
21. Huang W, Wang W, Xie W, Chen Z, Liu Y. Erector spinae plane block for postoperative analgesia in breast and thoracic surgery: a systematic review and meta-analysis. J Clin Anesth. 2020;66:109900.
22. Huang J, Liu JC. Ultrasound-guided erector spinae plane block for postoperative analgesia: a meta-analysis of randomized controlled trials. BMC Anesthesiol. 2020;20:83.
23. Hussain N, Brull R, Noble J, Weaver T, Essandoh M, McCartney CJL, et al. Statistically significant but clinically unimportant: a systematic review and meta-analysis of the analgesic benefits of erector spinae plane block following breast cancer surgery. Reg Anesth Pain Med. 2021;46:3–12.
24. Kendall MC, Alves L, Traill LL, De Oliveira GS. The effect of ultrasound-guided erector spinae plane block on postsurgical pain: a meta-analysis of randomized controlled trials. BMC Anesthesiol. 2020;20:99.
25. Qiu Y, Zhang TJ, Hua Z. Erector spinae plane block for lumbar spinal surgery: a systematic review. J Pain Res. 2020;13:1611–9.
26. Kurd MF, Kreitz T, Schroeder G, Vaccaro AR. The role of multimodal analgesia in spine surgery. J Am Acad Orthop Surg. 2017;25:260–8.
27. Cohen BE, Hartman MB, Wade JT, Miller JS, Gilbert R, Chapman TM. Postoperative pain control after lumbar spine fusion. Patient-controlled analgesia versus continuous epidural analgesia. Spine (Phila Pa 1976). 1997;22:1892–6.
28. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4:1.
29. Wan X, Wang W, Liu J, Tong T. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. BMC Med Res Methodol. 2014;14:135.
30. Balshem H, Helfand M, Schünemann HJ, Oxman AD, Kunz R, Brozek J, et al. GRADE guidelines: 3. Rating the quality of evidence. J Clin Epidemiol. 2011;64:401–6.