



# Erector Spinae Blocks for Spine Surgery: Fact or Fad? Systematic Review of Randomized Controlled Trials

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## Key words

- Erector spinae plane block
- ESPB
- Postoperative pain
- Spine surgery
- Systematic review

## Abbreviations and Acronyms

**BMI:** Body mass index  
**ERAS:** Enhanced Recovery After Surgery  
**ESPB:** Erector spinae plane block  
**NRS:** Numeric rating scale  
**RCT:** Randomized controlled trial  
**VAS:** Visual analog scale

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Citation: *World Neurosurg.* (2022) 158:106-112.  
<https://doi.org/10.1016/j.wneu.2021.11.005>

Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)

Available online: [www.sciencedirect.com](http://www.sciencedirect.com)

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## INTRODUCTION

Patients undergoing spine surgeries may experience significant postoperative pain, increased opioid analgesic intake, and indirect side effects such as nausea, emesis, decreased cognition, and even impaired independent early ambulation. This can adversely affect clinical outcomes, even affect, and delay hospital discharges and overall recovery.<sup>1,2</sup> Effective early postsurgical pain control after spine surgery is therefore highly desirable but notoriously hard to achieve considering almost invariable side effects. The erector spinae plane block (ESPB) is a more recently introduced regional anesthesia technique first proposed in 2016.<sup>3</sup> It features local anesthetic injected into the fascial plane situated between the semispinalis and

■ **BACKGROUND:** Patients undergoing spine surgery may experience substantial postoperative pain. The aim of this systematic review is to examine the clinical efficacy of a newly introduced regional anesthetic block, the erector spinae plane block (ESPB), for adults undergoing posterior spine surgeries.

■ **METHODS:** A formal systematic database search was conducted in PubMed, Ovid Medline, Embase, Cochrane library, and Google Scholar for randomized controlled trials comparing ESPB with control or placebo.

■ **RESULTS:** Our systematic review demonstrates a reduction of postoperative pain and opioid consumption in patients who had ESPB compared with control groups for lumbar spine surgery. However, the effect obtained revealed only a short-term benefit.

■ **CONCLUSIONS:** Current evidence is insufficient to support the widespread use of ESPB for spine surgery. More studies are warranted to confirm or refute its role in clinical practice.

longissimus muscle planes posterior to the vertebral transverse processes of the vertebra.<sup>4</sup> The actual benefits of this technique are controversial, however, and the actual mechanism of action has not been fully explored. Our aim in this systematic review is to examine the efficacy of ESPB for adult spine surgeries.

## METHODS

### Guidelines

The present study was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA 2009).<sup>5</sup>

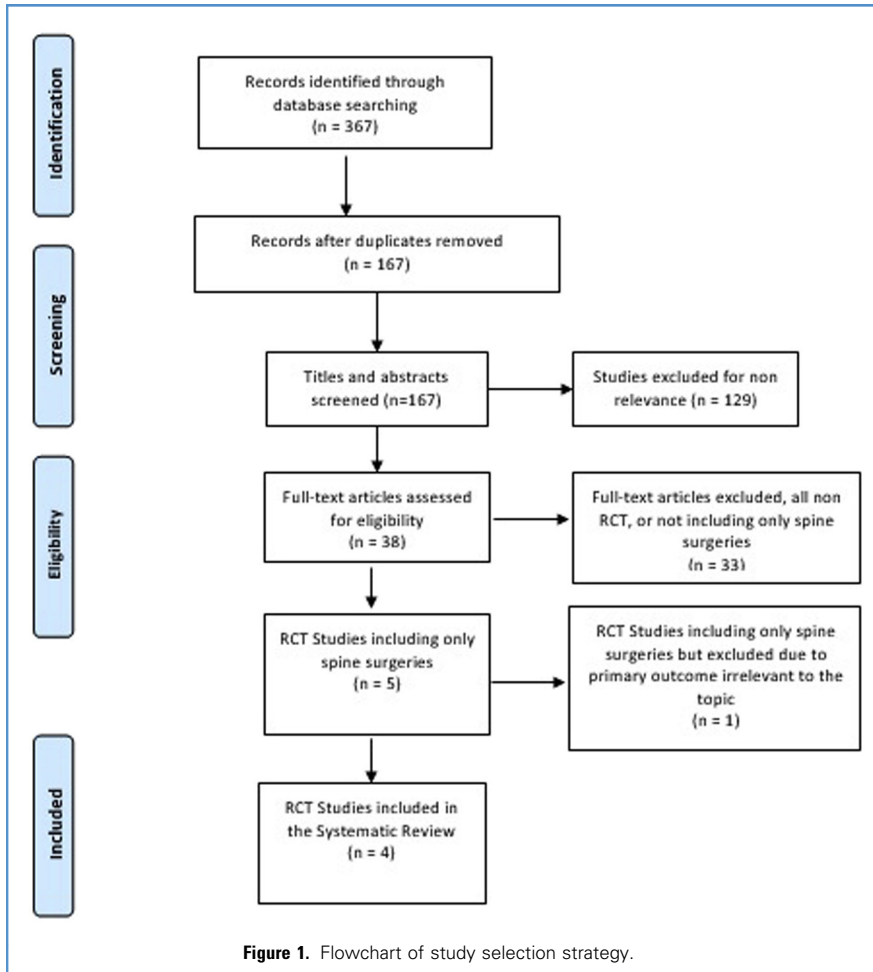
Our key questions regarding ESPB are mainly pertinent to spine surgeons in terms of benefit of the block and decreased length of hospital stay, ESPB and effect on early ambulation and early oral intake, ESPB and effect of decreased opioid intake and subsequently decreased post-operative constipation, total cost of ESPB procedure, its role in cervical, thoracic, and lumbar surgery, its role in complex deformities, the effect of patient body mass index and ESPB dosage, related complications of the ESPB, and its role in opioid-dependent patients.

### Data Sources and Search Strategy

A systematic literature search was carried out to identify all randomized controlled trials (RCTs) in the English language up to February 2021 dealing with ESPB inclusive to spine surgery only. The following bibliographic databases were searched: PubMed, Ovid Medline, Embase, Cochrane library, and Google Scholar were systematically investigated for English studies published in peer-reviewed journals. A combination of the following key words was used: lumbar spine surgery, thoracic spine surgery, cervical spine surgery decompression, lumbar spinal stenosis, spondylolisthesis, spine instrumentation, Erector spinae block, Erector Spinae Plane block, interfascial plane blocks, erector spinae plane block, ESP block, ESB, ESPB. Keywords were combined using the Boolean operators OR and AND. Bibliography lists from all eligible articles were also hand-searched to identify additional papers potentially relevant for inclusion.

### Study Eligibility Criteria

Any RCTs published in the English language dealing only with ESPB and spine surgery were included in this systematic review. Observational studies such as



cross-sectional, case-control, cohort, narrative or systematic reviews, case reports, correspondence, editorials, expert opinions, comments (commentary), methodologic articles, conference abstracts, proceedings, or animal and basic science studies were excluded.

Identification of studies eligible for inclusion and data extraction were performed independently by 2 reviewers (Z.N. and C.E). Duplicate studies were removed. Detailed data such as basic study information (last author's surname, publication year, and country of study), study design and sample size, and participant characteristics were collected from each paper. Disagreements were resolved by consensus.

### Quality Assessment

The Cochrane Risk of Bias Tool is used by the Cochrane Collaboration to assess the

risk of bias for randomized controlled trials. Bias is assessed as a judgment (high, low, or unclear) for individual elements from 5 domains (selection, performance, attrition, reporting, and other). The bias risk diaphragm was generated using Revman 5.3.<sup>6</sup>

### Findings

**Figure 1** illustrates the flowchart of our study selection process. The literature search identified a total of 367 records. After exclusion of duplicate records, non-relevant abstracts, and studies including surgeries other than spine interventions, 5 published RCT studies were retained, with one of these RCTs having to be removed due to the lack of the recorded outcomes of interest (no pain scores or postoperative surgical related variables were presented).

### Study Characteristics and Results

The main characteristics of the 4 RCTs included in our systematic review are presented in **Table 1**. All were published between 2019 and 2021 in 3 different countries, namely, India, China, and Turkey. A total of 216 adults aged 17 years and older were included in our study. Three studies reported use of ultrasound-guided ESPB administered by an anesthesiologist; in the fourth publication, ESPB was administered by a surgeon using freehand technique after spine exposure.

The postoperative pain intensity was assessed in all RCTs using a numeric rating scale (NRS) or visual analog scale (VAS). One study showed that ultrasound-guided ESPB significantly decreased pain scores at all time intervals<sup>7</sup> and postoperative VAS scores were significantly lower in the ESPB group than in the control group. Compared with the ESPB group, a second RCT showed that pain scores were higher in the control group immediately after surgery and at 6 hours after surgery. Pain scores at 12 hours and 24 hours did not achieve statistical significance.<sup>8</sup> The third RCT reported that NRS pain scores at rest were significantly lower in the ESPB group than the control group at all 3 time points within 12 hours after surgery. The 2 groups showed similar pain scores at rest at 24 hours and 48 hours after surgery.<sup>9</sup> In the fourth RCT,<sup>10</sup> ESPB administration was carried out by the surgeon after exposure without ultrasound guidance. The results showed better pain control with ESPB up to 12 hours postoperatively, but no difference was reported at 24 hours.

All RCTs reported data on intravenous opioid consumption after surgery. Two studies showed that the cumulative opioid requirement in the 24 hours after surgery was significantly lower in the ESPB group compared with the controls.<sup>7,8</sup> A meta-analysis conducted by Liu et al. including 12 RCTs for a variety of surgeries showed that ultrasound-guided ESPB significantly reduced opioid consumption 24 hours after surgery, decreased pain scores at 1 hour and 6 hours postoperatively, but postoperative nausea or vomiting did not achieve statistical significant significance.<sup>11</sup>

Moreover, the ESPB using a freehand technique of administration after spine exposure showed that the opioid

**Table 1.** Characteristics and Main Findings of Studies Included in the Meta-Analysis

Study (year, Author, Country)	Sample Characteristics (Sample Size, Age)	Surgical Procedure	ESPB Group	Control Group	Outcomes
Yayik et al., 2019, Turkey <sup>7</sup>	60 (30/30), 18–65 years	Lumbar spinal decompression surgery	Ultrasound-guided bilateral ESPB with 0.25% bupivacaine 20 mL	No intervention was performed	Primary: postoperative tramadol consumption in the first 24 hours Secondary: Postoperative pain at 1, 2, 4, 8, 12, and 24 hours using VAS scores
Singh et al., 2020, India <sup>8</sup>	40 (20/20), 18–65 years of age	Lumbar spine surgery	Ultrasound-guided ESPB with 0.5% bupivacaine 20 ml	No intervention was performed	Primary: postoperative morphine consumption during the first 24 hours Secondary: postoperative pain at rest using NRS and patient satisfaction
Zhang et al., 2020, China <sup>9</sup>	60 (30/30), 20–75 years of age	Lumbar spinal fusion surgery	Ultrasound-guided ESPB with 20 mL 0.4% ropivacaine was injected	Sham blocks were performed by subcutaneous infiltration	Primary: pain intensity within 12 hours postoperatively using NRS Secondary: postoperative opioid consumption and proportions of patients requiring opioid during the first 48 hours after surgery Secondary: Oral intake time, ambulation time, LOS, intraoperative hypotensive events, duration of surgery
Yeşiltaş et al., 2021, Turkey <sup>10</sup>	56 (28/28)	Lumbar instrumentation and fusion for spondylolisthesis	Intraoperative freehand bilateral ESPB with a 20 mL mixture solution of 0.25% bupivacaine and 1.0% lidocaine	Physiologic saline was injected	Primary: morphine consumption in the first 24 hours Secondary: pain intensity using VAS scores, time-to-first rescue analgesia, patient satisfaction, ESPB-related adverse effects, surgery duration, and postoperative length of hospital stay

VAS, visual analog scale; NRS, numeric rating scale; LOS, length of stay.

consumption was significantly lower in the ESPB group within the first postoperative 24 hours compared with the control group.<sup>10</sup> On the other hand, 1 RCT showed that the median opioid cumulative consumption was significantly lower in the ESPB group than the control group at 4 hours and 12 hours postoperatively, but it was similar between the 2 groups at 24 hours and 48 hours.<sup>9</sup>

Regarding the other postsurgical outcomes, only 1 study reported that the postoperative length of hospital stay was shorter in ESPB group compared with the control group.<sup>10</sup> In terms of ESPB-related complications, all 4 randomized control trials reported no adverse events.

### Quality Assessment

Assessment of the risk-of-bias summary of all RCTs is presented in **Figure 2**. The randomization procedure was adequately generated in all trials. Two trials were at low risk of bias,<sup>9,10</sup> 1 trial showed a lack of blinding,<sup>7</sup> and 1 trial showed that patients, surgeons, anesthesiologists, and

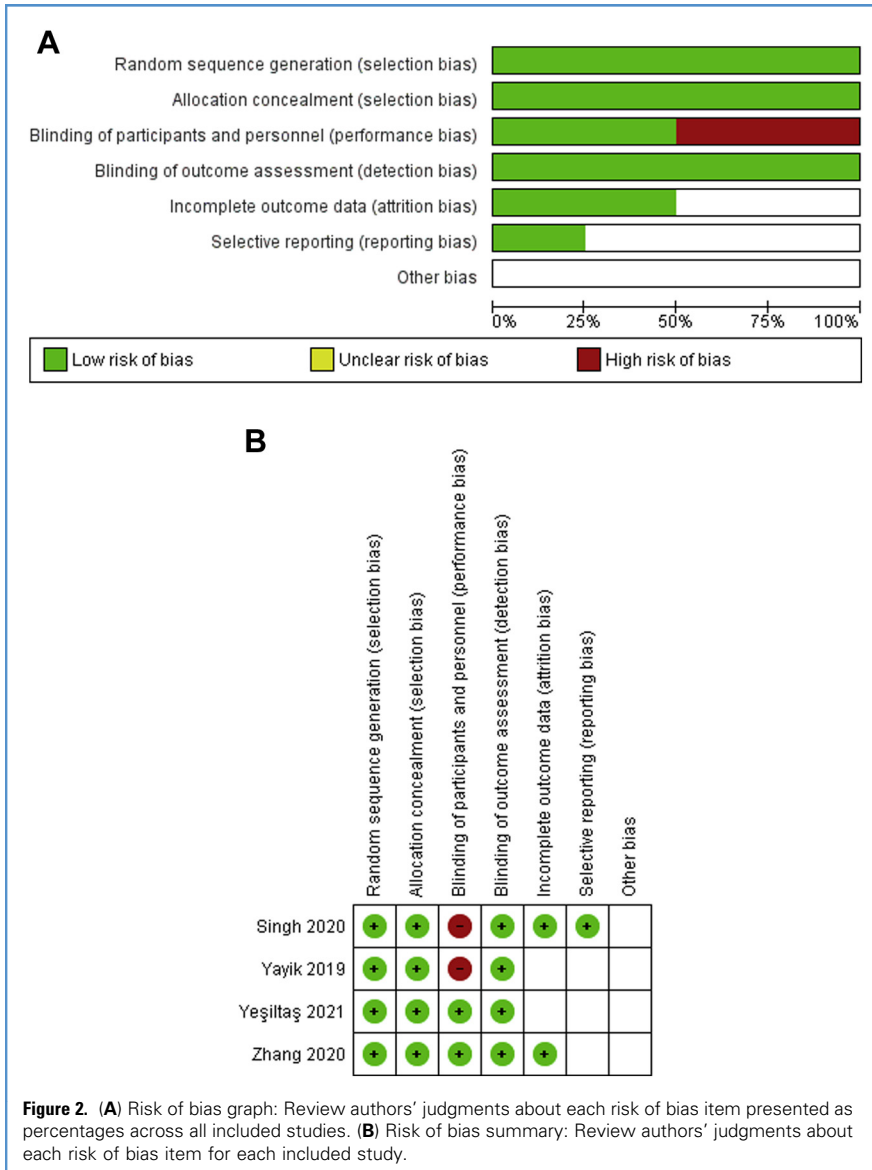
investigators could not be blinded to the intervention.<sup>8</sup>

### DISCUSSION

Posterior lumbar surgeries such as decompression and fusion surgery are common procedures for a variety of conditions such as degenerative lumbar diseases. These types of surgeries can rank among the more painful surgical procedures. To minimize the ill effects of analgesic opiates and sedatives, alternative and adjuvant strategies, such as the ERAS (Enhanced Recovery After Surgery) concepts,<sup>12</sup> have been increasingly used. A more novel regional anesthesia technique has been introduced more recently in form of ESPBs. This novel technique utilizes a local anesthetic that is injected into the deep fascial plane along the erector spinae muscles under ultrasonic guidance and appears to be a safe and reproducible technique (**Figure 3**).

Its advantages over conventional nerve block are multiple. It consists of a single injection that will spread in both cephalad

and caudal directions to achieve a block at multiple levels (**Figure 4**).<sup>13</sup> The procedure is relatively easy to perform and as the target area is around the transverse processes, there are no surrounding vulnerable vital anatomic structures.<sup>3</sup> Its mechanism of action is purported to block both the dorsal and the ventral rami of the spinal nerves.<sup>14</sup> It has been increasingly applied in different surgical specialties such as breast, thoracic, and abdominal surgeries to improve postoperative analgesia.<sup>15</sup> In terms of its efficacy, this type of anesthetic technique would ideally lend itself to a double-blind randomized prospective trial with controlled variables to assess the actual impact of this emerging technique. Further, a rather simple comparison study that looks a ESPB compared to a more conventional formal postoperative infiltration of the paraspinal muscles around the surgical site would help our understanding of the actual benefits of this more elaborate and time and resource consuming technique.

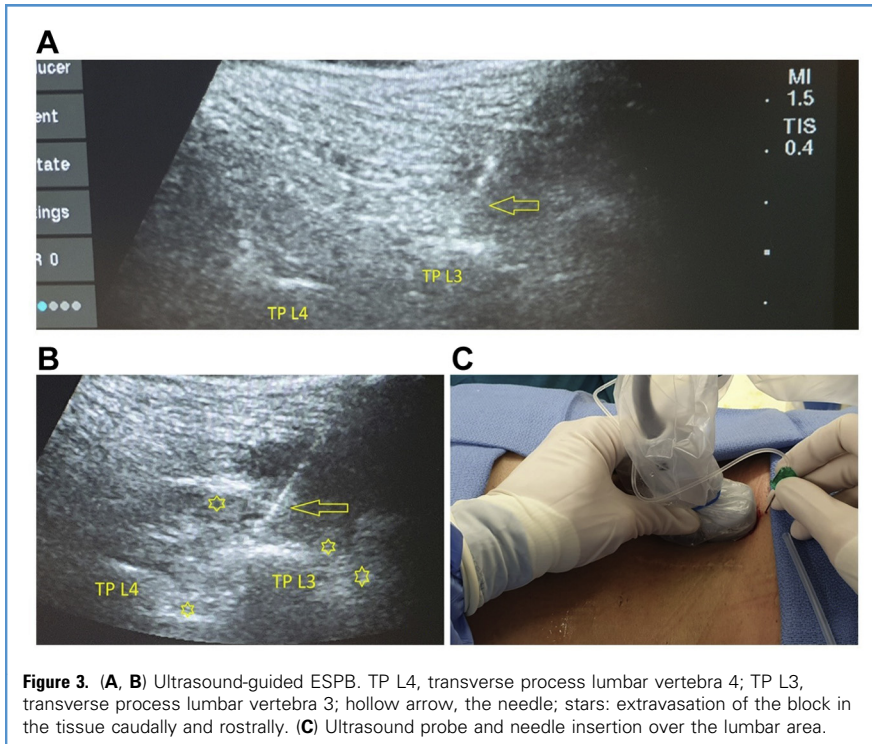


The main findings of our systematic review confirmed a consistent reduction of postoperative pain and opioid analgesic utilization in patients who had ESPB compared with patients in a control group for a variety of lumbar spine surgeries. Despite the lack of more detailed and larger trials, the results in terms of pain alleviation reported with the use of ESPB has been reported to be substantial. However, the pain relief effect obtained with conventional local anesthetics unfortunately revealed only a relatively short-term benefit. The duration of ESPB outcome might be related to the type and dose of local anesthetics used. Mediations

used in the studies were short-acting, which might explain the reason for very time limited results, and lack of any demonstrable benefit beyond a 12- or 24-hour postsurgical window. Eventually, local ESPB anesthetics applied prior to incision are likely be washed out during a longer duration surgery or in cases where the surgical dissection is carried out to the transverse process plane, as is commonly done for conventional open posterolateral fusion surgery.<sup>14</sup> It would therefore stand to reason that if the pharmaceutical dose amount, concentration, or local tissue persistence time could be increased, then the analgesia effect duration time could

be prolonged and therefore patients could get through the most painful postsurgical stage after operation. Hence, the idea of adding other medications, such as dexmedetomidine, to prolong the effect of bupivacaine, ropivacaine, and lidocaine appears promising but has yet to be studied in a more controlled fashion.<sup>16</sup> Our anesthesiologist recommends and uses the following combination of drugs: bupivacaine 0.35% 20 mL/side (0.25% in patient's weighing <60 kg, with hepatic or renal comorbidities, or age >65 years). This concentration allows for better analgesia than bupivacaine 0.25%<sup>17</sup> and less hip weakness from anterior spread into the lumbar plexus.<sup>18</sup> The dose of bupivacaine is down-titrated to 0.25% in patients listed above to reduce the likelihood of local anesthetic systemic toxicity. Epinephrine 5 µg/mL to reduce systemic absorption from the erector spinae plane, which thereby prolongs block duration and also reduces the risk for local anesthetic systemic toxicity.<sup>19</sup> Finally, dexmedetomidine 25 µg/side is used to prolong block duration.<sup>20-22</sup>

None of the RCTs proved the benefit beyond 24 hours after surgery and were able to support a more routine clinical application from a surgical standpoint. Only short construct lumbar surgeries ranging from 1- to 3-level fusions were included; surprisingly, there were no decompression surgeries assessed, arguably one of the most immediately relevant target populations. Also, there was no attempt made to differentiate so-called less invasive surgery from more established midline fusion surgery. There were no studies addressing outcomes for long construct spine surgeries, such as thoracolumbar, lumbopelvic, or even cervical and thoracic procedures. Length of hospital stay was reported to be shorter (average by 1 day) in the ESPB group in a study by Yeşiltaş et al.<sup>10</sup> The study impact, however, is limited due to the failure of the authors to subcategorize the length of stay and the type of surgery, which means the statistical significance obtained could be merely attributed to confounders such as the number of instrumented levels (single-level transforaminal lumbar interbody fusion vs. 3-level constructs) and not to the ESPB intervention. Even relatively simple

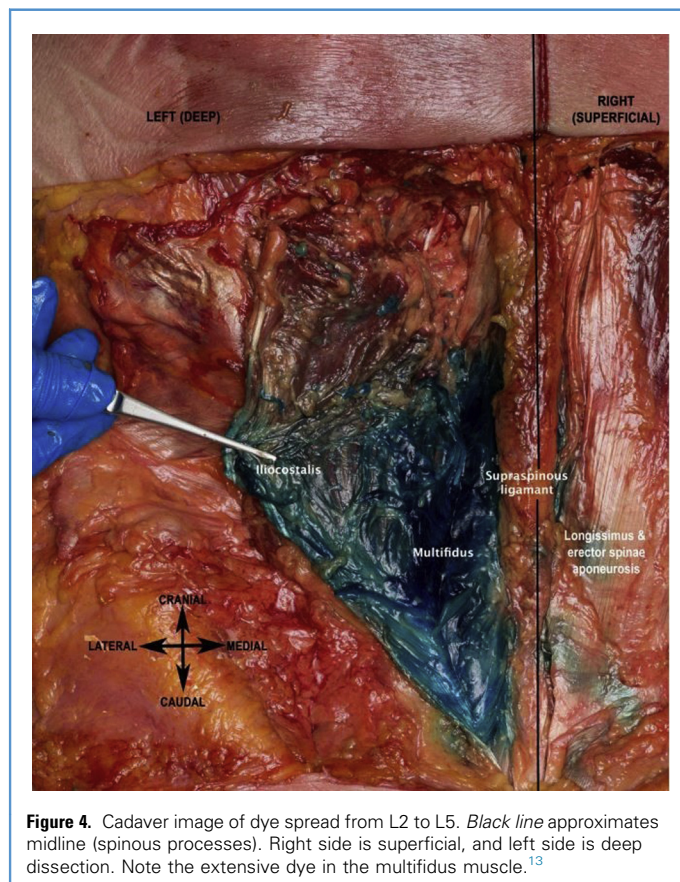


**Figure 3.** (A, B) Ultrasound-guided ESPB. TP L4, transverse process lumbar vertebra 4; TP L3, transverse process lumbar vertebra 3; hollow arrow, the needle; stars: extravasation of the block in the tissue caudally and rostrally. (C) Ultrasound probe and needle insertion over the lumbar area.

variables, such as length of surgery, blood loss, and BMI were not made available. It should also be noted that “length of stay” data are notoriously influenced by the prevailing medical care culture in different societies and can be very difficult to transpose between various regions or health care systems. For instance, discectomies may be treated as outpatient surgeries in some health care systems, whereas in other cultures some hospital stay is the expected norm.<sup>23</sup> A reasonable new standard that would be helpful is the “time to first ambulation”, which could be seen as an extrapolation of more effective initial pain management.<sup>24</sup> In reviewing the published literature on the subject, many of the authors have been quite enthusiastic about this new technique and have advocated the use of ESPB mainly based on empirical evidence of what amounts to improved short-term pain management. However, the authors failed to address questions of long-term outcome, length of stay, cost utility (such as resource costs, additional operating room time used, timing of injection relative to pre- and postoperative period) and largely disregarded surgically relevant questions, such as level of surgery, duration of surgery with estimated blood loss, type of instrumentation technique used and the influence of clinical variable such as body mass and spine condition for which the surgery is performed. Lastly, none of the RCTs reported actual ESPB-related complications, which may be due to the small sample size of each study, which can mask the occurrence of more rare adverse events, or which may be the result of author bias relative to an emerging technique (Table 2).

### Limitations

To our knowledge, this is the first systematic review to evaluate the efficacy of ESPB in adults undergoing spine surgeries. However, we note several limitations. The number of included studies was limited, reflecting the scarcity of high-level evidence data addressing ESPB in spine surgery. The question of why we limited our study to RCTs was borne out of the inconsistency of reporting and a strong suspicion of undue author bias in the retrospective studies available on the topic. Sadly, the sample sizes in each of the RCTs were small, which limits



**Figure 4.** Cadaver image of dye spread from L2 to L5. Black line approximates midline (spinous processes). Right side is superficial, and left side is deep dissection. Note the extensive dye in the multifidus muscle.<sup>13</sup>

**Table 2.** Variables Mentioned in the Literature Versus Variables Pertinent to Spine Surgeons but Not Analyzed

Variables Mentioned in the Literature	Variables Not Mentioned and Pertinent to Spine Surgeons
Anatomic level of surgery	Type of surgery (instrumentation/cage/construct level/decompression only)
Visual analogue score	
Numeric rating scale	
Length of stay	Correlation between LOS and specific type of surgery (instrumented fusion vs. decompression)
	Cost of ESPB intervention
	Time to first ambulation
	Time to first oral intake
Lumbar surgery	Thoracic and cervical surgery
	Effect of body mass on ESPB outcome and dosages
Short-term benefit pain outcome (12 or 24 hours)	ESPB role after 24 hours from its administration
Duration of surgery between ESPB and control groups	
	Blood loss
	Time it takes for the ESPB procedure
	ESPB administered under Ultrasound guidance with anesthesiologist versus open free hand techniques by the surgeons
	Correlation between the block and decreased risk of constipation
	ESPB related complications
	Effect of patients BMI and ESPB dosage
	ESPB role in opioid dependent patients

LOS, length of stay.

estimation of the treatment effect and potency of the intervention. Another limitation was the paucity of data pertinent to the surgery and specific technique applied in terms of persistent pain after 24 hours, preoperative opioid tolerance, length of stay, time to first ambulation, return to normal urination, avoidance of ileus, reduction of voiding problems, and the actual cost of the ESPB intervention on the health care system and payors. Finally, none of the included studies used thoracic or cervical spine intervention.

## CONCLUSIONS

Despite the growing number of ESPB publications, not enough data could be collected to make a solid recommendation

for its routine use in spine surgery. Bilateral lumbar ESPB blocks were shown to have short term effect in elective lumbar surgeries. When put into clinical context, the benefits of the statistical significance of perioperative ESPB administration lose their importance to their beneficial impact on overall care outcomes for lumbar spine surgery. Consequently, the de facto advantage of ESPB on spine surgery is unfortunately largely left unanswered at this time. Current evidence is insufficient to support the widespread use of ESPB for spine surgery. Studies that address the questions raised in the preceding text relative to the spine surgeon's perspective would be needed to support more regular use. Conversely, it would take a larger number of well-performed studies to

change the practice recommendation including the variables we mentioned regarding this subject.

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*Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.*

*Received 12 September 2021; accepted 1 November 2021*

*Citation: World Neurosurg. (2022) 158:106-112.*

*<https://doi.org/10.1016/j.wneu.2021.11.005>*

*Journal homepage: [www.journals.elsevier.com/world-neurosurgery](http://www.journals.elsevier.com/world-neurosurgery)*

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