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Post-operative Pain Management with Erector Spinae Block under Ultrasound Guidance vs Local Anesthetic Instillation at Wound Site in Patients Undergoing Lumbar Spine Surgeries

Tarza Lateef Mohammed* Abdulhameed Al-dabbagh Rekawt Fadhil*****

Abstract

Background and objectives: Ultrasound-guided nerve blocks are becoming vital in postoperative pain management. This study compares the efficacy of Erector Spinae Plane Block with local anesthetic instillation at the wound site for postoperative pain management in lumbar spine surgeries. The aim is to identify effective pain management approaches, minimizing analgesic use.

Methods: This trial was done on 50 cases undergoing lumbar spine surgeries at Hawler Teaching Hospital, between April 2023 and January 2024. Patients were assigned into two groups, 25 in each. Group 1 patients received the Erector Spinae Plane Block, while Group 2 patients received local anesthetic instillation. Follow-up of patients' pain perception and analgesic usage were done through a questionnaire. Results were analyzed through frequency analysis and factor analysis.

Results: The analysis revealed patients who underwent Erector Spinae Plane Block were associated with a lower incidence of postoperative pain (72%, while 96% in instillation) and reduced reliance on analgesics (52%). Local anesthetic instillation at wound site was associated with more severe pain and more usage of analgesics (80%). Lumbar radiculopathy was not common in those who underwent the block (only 4%, while 76% in instillation). The percentages of variance for group 1 (72.52%) and group 2 (71.181%) shows effective results for both and successful capture of postoperative experiences by the principal components.

Conclusion: Erector Spinae Plane Block emerges as a promising postoperative pain management technique for lumbar spine surgeries, offering relief and minimizing analgesic usage.

Keywords: Erector spinae plane block, Local anesthetic instillation, Pain management, Spine surgery

*MBChB, Kurdistan Higher Council of Medical Specialties Anesthesiology Resident. Email: tooteslemani@yahoo.com
**MBChB, DA, MSc Phm, Consultant Anesthesiologist, Hawler Medical University, College of Medicine, Erbil, Kurdistan Region, Iraq. Email: h_dabbagh@gmail.com
***MBChB, FIBMS, Kurdistan Higher Council of Medical Specialties Anesthesiology Board Coordinator and Consultant Anesthesiologist. Email: rekawt300300@gmail.com
Corresponding author: Tarza Lateef Mohammed

Introduction

Pain is a crucial factor that most patients experience post-operatively, and especially post-spine surgeries. Minimizing postoperative pain will play an essential role in the recovery of patients.[1] There are several techniques of pain management, the first one being Lumbar Erector Spinae Plane Nerve Block (ESPB), which is a relatively new regional anesthetic, first introduced in 2016.[2,3] Its technique consists of identifying the transverse processes of the spine and then injecting the local anesthetic between these processes and the erector spinae muscles, using ultrasound, fluoroscopy, or anatomical landmarks (e.g., 3 cm lateral to the spinous process) to identify the transverse process.[4] Its mechanism of action is not fully understood yet; some studies indicate that the local anesthetic might diffuse forward into the paravertebral space. However, it is likely that the primary mechanism of action involves the spread between the fascial layers towards the posterior rami of spinal nerves, blocking both dorsal and ventral rami. The effectiveness of this nerve block technique has been demonstrated in various trunk surgeries, including breast, pulmonary, and cardiac surgeries. However, its effectiveness and safety remain controversial.[5] Erector Spinae Plane Nerve Block shows promise in effectively reducing post-operative pain and decreasing the necessity for rescue analgesics and total opioid usage in patients undergoing spinal surgery. However, more clinical trials are required to establish these findings more conclusively. ESPB has aroused the interest of many nerve block experts. However, there are few clinical studies on ESPB for lumbar surgery, and its effectiveness and safety are controversial.[5] Local anesthesia can block nerves at various points along the pathway from peripheral nerve endings to the central nervous system. The least invasive technique is topical anesthesia applied to the skin or other body surfaces. Additionally, both individual small and large peripheral nerves can be anesthetized separately through a method known as peripheral nerve block, or they can be anesthetized in bundles of anatomical nerves through plexus anesthesia. Infiltration anesthesia is the administration of local anesthetic directly into the tissue. When surface and infiltration anesthesia are combined, it's referred to as topical anesthesia. Field block is a subcutaneous injection of local anesthetic in an area surrounding the specific field that needs to be anesthetized. This allows for effective numbing of the intended region, making it suitable for various medical procedures and surgeries. Peripheral nerve block consists of injection of local anesthetic into the area of a peripheral nerve to anesthetize that nerve's area of innervation. Local instillation of surgical wound site is an effective and safe postoperative analgesia in patients undergoing laminectomy surgeries and better pain management than infiltration technique into the paravertebral muscles.[6] Multimodal analgesia approach is essential in the postoperative management of pain for patients undergoing spinal surgery. While opioids have a potent analgesic effect and are commonly used, they come with potential adverse effects. Therefore, it is necessary to incorporate other analgesic modalities to minimize opioid consumption and address the associated risks. Combining different pain-relief techniques can optimize pain relief and reduce the reliance on opioids and their potential adverse effects.[7] The objectives of this study aim at evaluating and comparing the efficacy, safety, and outcomes of pain management techniques in patients undergoing lumbar spine surgeries, to assess the effectiveness of ESPB versus local anesthetic instillation in managing postoperative pain. This study also seeks to understand the impact of these techniques on patient satisfaction, early mobilization, and hospital stay. Ultimately, we aim to

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contribute updated evidence to the existing body of literature regarding the efficacy and safety of ESPB and local anesthetic instillation in lumbar spine surgery patients.

Patients and methods

This study is a clinical trial with fifty cases who were undergoing lumbar spine surgeries at the Neurosurgical Operative theatre of Hawler Teaching Hospital. For the sample size determination, we used power analysis software, by setting the significance level (α) at the conventional threshold of 0.05, setting the desired power (1 - β) at 0.70, and estimating the effect size according to the expected difference between our 2 groups, based on findings from various previous research covering ESPB and local anesthetic instillation separately. The duration of the study was from April 2023 to January 2024. Consent was taken from the patients preoperatively and ethical approval from Kurdistan Higher Council of Medical Specialties Research Protocol Ethics Committee was obtained for this study according to administrative order number 2092 issued on November 11th, 2022.The cases were randomly assigned into two groups, based on a simple randomization, without any specific pattern or stratification: Twenty-five cases underwent erector spinae plane block, in the method shown in Figure (1). While the patient is under general anesthesia, pre-incisional, with the use of ultrasound guidance with a handheld curvilinear ultrasound probe (from Hochey Medical Brand) as shown in Figure (2). The other twenty-five cases underwent local anesthetic instillation at the wound site. All the procedures were done under aseptic condition, with the help of anesthetic assistants.

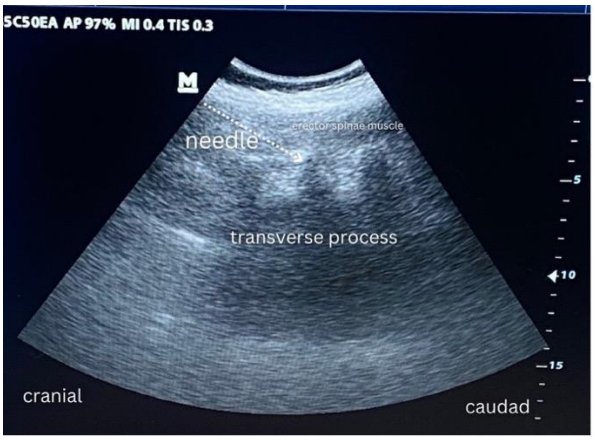

Figure (1): The method of carrying out an erector spinae plane block under ultrasound guidance.

Figure (2): Handheld curvilinear ultrasound probe used as guidance for carrying out an erector spinae plane block.

The local anesthetic used for both groups was Bupivacaine 0.5% 100mg (20 mL) diluted with 10mL of normal saline in two (20 mL) syringes, injected at multiple sites bilaterally in lumbar vertebral region.

The equipment used for implementing the erector spinae plane block (ESPB) under ultrasound guidance consisted of a curvilinear handheld ultrasound probe along with gel for ultrasound imaging, a 22-gauge needle for administering local anesthetic, and an extension line to facilitate the injection process. Additionally, two syringes of 20 cc capacity were employed for drawing and administering the local anesthetic solution.

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For safety and infection control, all procedures were done under sterile conditions and none of the cases showed any form of infection, and none of the cases showed any adverse events or allergy. For the local anesthetic solution, 5 ampules of 0.5% bupivacaine were used, along with normal saline to dilute it to achieve the desired concentration. These were crucial for performing the ESPB effectively and safely, ensuring accurate placement of the needle under ultrasound guidance and optimal delivery of the local anesthetic solution to provide post-operative pain relief. The inclusion criteria were the patient's consent and no previous history of allergy to local anesthetics. The exclusion criteria were patient's refusal and any previous history of allergy to local anesthetics. A questionnaire was administered to gather patients' comprehensive data on post-operative pain experiences and parenteral analgesic usage, that comprised of several sections including demographic information such as name, age, gender, and phone number. Patients were asked if they experienced post-operative pain, with options for "Yes" or "No." If patients did experience post-operative pain, they were prompted to specify the timing of pain onset post-operatively (3 hours, 6 hours, or 12 hours) and the degree of pain (Mild, Moderate, or Severe). Additionally, patients were asked if they used any analgesics, with response options "Yes" or "No." If patients had used analgesics, they were asked to specify the timing of analgesic use post-operatively (3 hours, 6 hours, or 12 hours). Finally, patients were queried about whether they experienced lower limb radicular pain. The follow-up of pain was done 3 hours, 6 hours, and 12 hours post-operatively. Two types of statistical analyses were used, the first one being Frequency Analysis, which is a part of descriptive statistics that is defined as the number of times an event occurs. Frequency Analysis is an important area of statistics that deals with the number of occurrences, the frequency, and measures percentile. It helps summarizing categorical data and understanding the distribution of responses or outcomes, highlighting key patterns within the data. The other analysis used was Factor analysis, which is a statistical method that explains the variation in correlated variables by identifying a smaller set of hidden variables referred to as factors. It examines the loading pattern to determine the factor that has the most influence on each variable, loadings close to -1 or 1 indicate that the factor strongly influences the variable. Loadings close to 0 indicate that the factor has a weak influence on the variable.[8] It helps in identifying potential mediating variables that may influence the study findings.

Results

Patients who underwent Erector Spinae Plane Block (ESPB) were included in Group 1 and patients who underwent local anesthetic instillation were included in Group 2, each group consisted of 25 patients. The data of both groups were analyzed using frequency analysis and factor analysis which were then compared to conclude the results, as follows: The frequency analysis, as shown in table (1), of Group 1 patients who underwent Erector Spinae Plane Block (ESPB) revealed several notable findings. Firstly, the study represented diverse age groups, with patients ranging from 27 to 73 years old, the majority being between 40 to 50 years old. Gender distribution indicated a slight predominance of females (60%). Postoperative pain was reported by a significant majority of patients, with 72% experiencing mild and moderate pain, while 28% did not report any pain following the procedure. Among those experiencing pain, the majority (60%) reported feeling it at the 6-hour mark postoperatively, with 28% experiencing pain immediately after surgery. Pain severity varied, with 52% reporting mild pain, 20%

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reporting moderate pain, 28% experiencing no pain, and most importantly, 0% experiencing severe pain. Analgesic usage was common, only acetaminophen with no use of any opioid analgesics, with 52% of patients opting for postoperative pain relief, and the majority (48%) administering analgesics, immediately after surgery. Notably, only a small percentage of 4% of patients experienced lower limb radiculopathy post-surgery, which is a quite common symptom among patients who undergo lumbar spine surgeries. Based on the frequency analysis for group 2 patients who underwent local anesthetic instillation, as shown in table (1), the study represented diverse age groups, ranging from 21 to 73 years old, with the most prevalent age group falling between 37 and 52 years old. Gender distribution revealed a notable majority of female participants, constituting 84% of the study population compared to 16% male participants. A significant majority of participants, 96%, experienced varying degrees of post-operative pain, while only 4% reported no pain. Most participants, 68%, felt pain within 3 hours after surgery, with 24% experiencing pain after 6 hours. Among those in pain, 52% described it as moderate, and 24% as severe.80% of participants used analgesics for pain relief, such as acetaminophen and tramadol. The timing of analgesic usage varied, with 60% using analgesics within 3 hours postoperatively. Additionally, a notable 76% of participants experienced lower limb radicular pain postoperatively.

Table (1): Frequency analysis of both group 1 and 2, side by side.

Group 1: ESPB			Group 2: Local Anesthetic Instillation		
Variable	Frequency	Percent	Variable	Frequency	Percent
X1: Ages			X1: Ages		
27.00	1	4.0%	21.00	1	4.0%
34.00	1	4.0%	23.00	1	4.0%
35.00	1	4.0%	30.00	1	4.0%
37.00	1	4.0%	37.00	4	16.0%
39.00	1	4.0%	40.00	2	8.0%
40.00	2	8.0%	42.00	1	4.0%
44.00	1	4.0%	44.00	1	4.0%
45.00	2	8.0%	49.00	2	8.0%
47.00	1	4.0%	50.00	3	12.0%
48.00	1	4.0%	51.00	1	4.0%
49.00	1	4.0%	52.00	3	12.0%
50.00	1	4.0%	55.00	1	4.0%
54.00	1	4.0%	60.00	2	8.0%
55.00	1	4.0%	63.00	1	4.0%
57.00	1	4.0%	73.00	1	4.0%
59.00	1	4.0%			
60.00	1	4.0%			
62.00	1	4.0%			
65.00	2	8.0%			
66.00	1	4.0%			
70.00	1	4.0%			
73.00	1	4.0%			

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Group 1: ESPB			Group 2: Local Anesthetic Instillation		
X2: Gender			X2: Gender		
Male	10	40.0%	Male	4	16%
Female	15	60.0%	Female	21	84%
X3: Post op. pain experienced or not			X3: Post op. pain experienced or not		
No	7	28.0%	No	1	4.0%
Yes	18	72.0%	Yes	24	96.0%
X4: Time of pain (hours post op.)			X4: Time of pain (hours post op.)		
None	7	28.0%	-ve pain	2	8.0%
6hrs.	15	60.0%	3hrs	17	68.0%
12hrs.	3	12.0%	6hrs	6	24.0%
X5: Degree of pain			X5: Degree of pain		
-ve pain	7	28.0%	-ve pain	2	8.0%
Mild	13	52.0%	Mild	4	16.0%
Moderate	5	20.0%	Moderate	13	52.0%
Severe	0	0.0%	Severe	6	24%
X6: Use of any analgesics or not post op			X6: Use of any analgesics or not post op		
-ve pain	7	28.0%	-ve pain	2	8.0%
No	5	20.0%	No	3	12.0%
Yes	13	52.0%	Yes	20	80.0%
X7: Time of analgesics used (hours post op.)			X7: Time of analgesics used (hours post op.)		
-ve pain	12	48.0%	-ve pain	4	16.0%
3hrs	0	0.0%	3hrs	15	60.0%
6hrs	10	40.0%	6hrs	6	24.0%
12hrs	3	12.0%	12hrs	0	0.0%
X8: Lower limb radicular pain			X8: Lower limb radicular pain		
No	24	96.0%	No	6	24.0%
Yes	1	4.0%	Yes	19	76.0%

In Factor Analysis by Principal Component Analysis, Components are ordered by the amount of variance they explain, with Component 1 explaining the most. Component 1 represents the primary factor that is responsible for the largest portion of variance in the data set, it typically includes the most influential variables and provides a general summary of the main data patterns. Component 2 represents the second most important factor that accounts for an additional portion of the variance not explained by Component 1, it often highlights secondary patterns and can capture factors that independent to those in Component 1. Component 3 represents yet another distinct factor, capturing additional variance in the data set beyond what is explained by Components 1 and 2, it may uncover more subtle patterns or relationships

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within the data that are not immediately apparent from the first two components. The sum of the variances explained by all components provides an indication of how much of the total variability in the data is captured by the factor analysis. According to factor analysis for group 1 patients who underwent Erector Spinae Plane Block, as shown in Table (2), the results showed 'use of analgesics' with the highest positive contribution (0.952) being the loading value having the most influence among the other variables. Time of pain (hours post-op) and pain experience or not (post-op) had significant positive contributions as well. The percentage of variance of this group is (72.52%) which indicates a good proportion of variance in this sample of data with effective results. According to factor analysis for group 2 patients who underwent local anesthetic instillation, as shown in Table (2), the results showed 'use of analgesics' with the highest positive contribution (0.864) having the most influence among the other variables being the loading value, similar to group 1 results. Time of pain (hours post-op) and time of analgesics used (hours post-op) also have significant positive contributions.

The percentage of variance among group 2 (patients who underwent local anesthetic instillation at wound site) is 71.181% which shows effective results, same as for group 1. Based on the results provided, the factors with more influence in the principal component analysis of the factor analysis are those with higher loading values. Loading values represent the correlation between the original variables and the principal components. Therefore, variables with higher loading values have more influence on the principal components. These variables have the most influence on the first principal component and are considered important in explaining the variance in the data. The age of patients had the least influence among all the variables in both groups. In contrast, the significant differences between group 1 and group 2 include, "Age" having a notably higher contribution in the first group compared to the second one, and "post-operative pain experienced or not" and "Lower limb radicular pain" have higher contributions in the second group compared to the first one. The percentage of variance in principal component analysis represents the amount of variability in the data that is extracted by each principal component. A higher percentage of variance indicates that the principal components are more effective in summarizing the original variables. This is crucial for identifying the most influential variables and understanding their relationships. The percentage of variance determines the effectiveness of the principal components in explaining the variability in postoperative experiences among patients who underwent different pain management techniques. A higher percentage of variance suggests that the extracted principal components successfully capture the key aspects of postoperative experiences, aiding in the interpretation and analysis of the data. There's a difference in the variance between group 1 and group 2, with the first dataset having a slightly higher percentage of variance explained by the first two components compared to the second dataset.

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Table (2): Factor Analysis by Principal Component, for both groups side by side.

Group 1: ESPB				Group 2: Local Anesthetic Instillation				
Variables	Component 1	Component 2	Component 3	Variables	Component 1	Component 2	Component 3	
X1: Age	0.271	0.761		X1: Age	-0.307	-0.310	-0.352	
X2: Gender	0.579	-0.031		X2: Gender	0.234	0.691	-0.523	
X3: Pain experienced or not (post op.)	0.889	0.238		X3: Pain experienced or not (post op.)	0.672	-0.317	0.327	
X4: Time of pain (hours post op.)	0.929	-0.054		X4: Time of pain (hours post op.)	0.806	0.282	0.143	
X5: Degree of pain	0.869	-0.003		X5: Degree of pain	0.738	-0.403	0.015	
X6: Use of any analgesics or not post op.	0.952	0.110		X6: Use of any analgesics or not post op.	0.864	-0.215	-0.085	
X7: Time of analgesics used (hours post op.)	0.823	-0.212		X7: Time of analgesics used (hours post op.)	0.838	0.400	-0.113	
X8: Lower limb radicular pain	0.367	-0.755		X8: Lower limb radicular pain	-0.241	0.512	0.681	
Variance %	56.684 %	15.836%	72.520%	Variance %	41.275 %	17.311%	12.595%	71.181%

Discussion

The majority of the patients who showed up to the operative theatre during the time of the study were females and no specific consideration were done in terms of gender differences and their results. The findings align with research conducted by Liang et al. aimed to evaluate the clinical benefits of ESPB in patients undergoing spinal surgery.[4] By analyzing data from twelve studies involving 696 subjects, the authors were able to draw that ESPB provides beneficial pain relief from spinal surgery and allows for reduced opioid consumption postoperatively. Additionally, ESPB demonstrated efficacy in prolonging the time to the first rescue analgesic, reducing the need for rescue analgesia. In a meta-analysis study,

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comparing 11 studies involving 775 patients, the use of ESPB significantly decreased 24-h opioid consumption (97.5%) compared with the non-block. Erector Spinae Plane Block reduced pain scores at postoperative time-points up to 24 h. ESPB prolonged first analgesic requirement time by 6.93 h on average.[9] The mechanism of action of lumbar ESPB remains unclear. A previous cadaveric study revealed that Lumbar ESP at L4 acted on the posterior branches of the spinal nerves, but seldom spread to the paravertebral space to block the spinal nerve.[10] A systematic review conducted by Qiu et al. studied a total of 171 participants from 11 publications, including two randomized controlled trials, one retrospective cohort study, four case reports, and four cases series, aiming to investigate ESPB's effectiveness and safety in lumbar spine surgeries. The data collectively suggested a potential benefit of ESPB in reducing postoperative pain scores and analgesic consumption.[5] However, the review concluded the importance of conducting high-quality randomized controlled trials to establish a clearer understanding of ESPB's role in postoperative analgesia for spine surgeries. Anatomical dissection indicates that the likely mechanism of action of ESPB is diffusion of local anesthetic anteriorly through the connective tissues and ligaments spanning the adjacent transverse processes and into the vicinity of the spinal nerve roots. ESP block has been recently reported to be able to block the sympathetic nerve fibers. However, the mechanism of sympathetic block is unknown.[11] Overall, our study contributes to the growing body of evidence supporting the efficacy of ESPB as a superior pain management technique for lumbar spine surgeries.

Conclusions

Erector Spinae Plane Block under ultrasound guidance showed better efficacy in the management of postoperative pain. Patients who underwent nerve block had less severe pain perception, while patients of local anesthetic instillation had more severe pain. According to the follow-up, the patients of ESPB had no radicular pain that happens post-spine operations which is an excruciating pain. Further trials and studies must be done on larger groups to see more of its efficacy and longer follow-up of the patients to check for the longer-term effects.

Conflict of Interest

The authors declare no conflicts of interest.

References

1. Horn R, Kramer J. Postoperative pain control. StatPearls; 2023 January. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK544298/
2. Krishnan S, Cascella M. Erector spinae plane block. StatPearls; 2023 January. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK545305/
3. 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(5):621-627. doi:10.1097/AAP.0000000000000451/
4. Liang X, Zhou W, Fan Y. Erector spinae plane block for spinal surgery: a systematic review and meta-analysis. Korean J Pain. 2021 October 1;34(4):487-500. doi:10.3344/kjp.2021.34.4.487/
5. Qiu Y, Zhang T-J, Hua Z. Erector spinae plane block for lumbar spinal surgery: a systematic review. J Pain Res. 2020; 13:1611-1619. doi:10.2147/JPR.S256205/
6. Kumar M, Srivastava S, Singh D, Yadav JBS, Kumar V. Wound infiltration and instillation technique for postoperative analgesia using bupivacaine in patients undergoing lumbar spine surgeries.

Cureus. 2022 March 28;14(3): e23592. doi:10.7759/cureus.23592/
7. Kurd MF, Kreitz T, Schroeder G, Vaccaro AR. The role of multimodal analgesia in spine surgery. J Am Acad Orthop Surg. 2017;25(4):260-268. doi:10.5435/JAAOS-D-16-00049/
8. Bhuyan KC. A note on factor analysis applied in medical research. Arch Biomed Eng Biotechnol. 2019;1(4). ABEB.MS.ID. doi:10.33552/ABEB.2019.01.000516/
9. Sun Q, Zhang C, Liu S, Lv H, Liu W, Pan Z et al. Efficacy of erector spinae plane block for postoperative analgesia lumbar surgery: a systematic review and meta-analysis. BMC Anesthesiol. 2023, 54. https://doi.org/10.1186/s12871-023-02013-3/
10. De Lara Gonzalez SJ, Pomes J, Prats-Galino A, Gracia J, Martinez-Camacho A, Sala-Blanch X. Anatomical description of anaesthetic spread after deep erector spinae block at L-4. Rev Esp Anestesiol Reanim (Engl Ed). 2019;66(8):409–16.
11. Cadórniga, Suárez, González, Gómez, Miramontes. Erector Spinae Block. A Narrative Review. Central European Journal of Clinical Research. (2018). 1. 28-39. 10.2478/cejcr-2018-0005.