



The effect of preemptive retrolaminar block on lumbar spinal decompression surgery

Kevser Peker¹ · Gülçin Aydın¹ · Işın Gençay¹ · Ayşe Gizem Saraçoğlu² · Ahmet Tuğrul Şahin³ · Mustafa Öğden⁴ · Seydi Ali Peker⁵

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Abstract

Purpose Spinal decompression surgery causes severe pain. Retrolaminar block (RLB) is block, which is done by infiltration of local anesthetic to block spinal nerves between the lamina and superior costotransversospinalis muscle. The primary aim of this study is to evaluate the effectiveness of RLB on postoperative analgesia in patients undergoing spinal surgery. Secondary aims are effects on additional anesthetic and analgesic consumption.

Methods The sixty (60) patients who underwent lumbar spinal surgery between May 2020 and May 2021 under general anesthesia with or without applied preemptive RLB for postoperative analgesia were included in this prospective observational study. Group I received ultrasound-guided preemptive RLB. In Group II, no intervention was performed. Postoperative VAS scores were compared in groups as primary outcome, perioperative additional anesthetic and analgesic needs were compared as secondary outcome.

Results There was a significant difference between the groups in favor of the RLB group in terms of postoperative VAS scores at rest [1.33 (0.33–3.509)] and movement [2.40 (1.20–4.00)] ($p < 0.001$). Perioperative sevoflurane consumption was significantly low in block group ($p < 0.001$). Postoperative tramadol consumption was lower in Group I compared with Group II [Group 1: 200 (100–300); Group 2: 37.5 (0–200); $p < 0.001$].

Conclusion Preemptive RLB may be used to reduce patients' pain in lumbar decompression surgery as well as to be part of a multimodal analgesia and anesthesia regimen to reduce anesthetic and analgesic drug consumption.

Trial registration number ClinicalTrials.gov (No. NCT04209907).

Keywords Retrolaminar block · Lumbar spinal surgery · Analgesia · Anesthesia

Introduction

Poorly controlled postoperative pain after spinal surgery may lead to increased morbidity as pulmonary and deep venous thrombosis, prolonged duration of hospital stay, increased opioid use, increased health-care expenditures and development of chronic pain [1]. Opioids are frequently used for postoperative spinal pain [2]. In order to reduce the side effects that may occur due to opioids (such as nausea, vomiting, respiratory depression), multiple methods are preferred instead of a single drug [3]. In recent years, the combination of nerve blocks with local anesthetics and non-steroidal anti-inflammatory drugs as multimodal analgesia is especially effective for patients for postoperative pain. They are also very effective in reducing the side effects that may occur due to opioids since the opioid sparing effect. Plane blocks are interventions

✉ Kevser Peker
kevserpeker1@gmail.com

¹ Department of Anesthesiology and Critical Care, Kirikkale University School of Medicine, Kirikkale, Türkiye

² Anesthesiology and Critical Care, Kirikkale Yuksek Ihtisas Hospital, Kirikkale, Türkiye

³ Anesthesiology and Critical Care, Tokat State Hospital, Kirikkale, Türkiye

⁴ Department of Neurosurgery, Kirikkale University School of Medicine, Kirikkale, Türkiye

⁵ Biochemistry, Kirikkale Yuksek Ihtisas Hospital, Kirikkale, Türkiye

that have started to be widely used for analgesic purposes with the widespread use of ultrasound. Retrolaminar block (RLB) is a new application called the paravertebral lamina technique, which was first performed by Pfeiffer for analgesia in a blind mastectomy patient [4]. On the other hand, successful analgesia in a patient with a rib fracture by touching the lamina with a needle under ultrasound guidance was provided in 2013 [5]. In this way, analgesia is performed by blocking the paraspinal nerves with a local anesthetic drug that spreads between the deep paraspinal muscles and the vertebral lamina [6]. Although there have been many studies on lung surgery, video-assisted thoracoscopic surgery and laparoscopic nephrectomy that have investigated the postoperative analgesic efficacy [7–9], there is no previously published prospective study about the analgesic effect of RLB in lumbar decompression surgery. This is the first prospective study with large participant related to pain reduced effect of RLB for lumbar decompression surgery with opioid sparing effect. Furthermore this is the first study that analysed the effect of RLB on perioperative inhaled anesthetic consumption. The aim of the present study is to investigate the effect of the preemptive RLB on postoperative pain scores, perioperative analgesic and anesthetic consumptions in lumbar decompression surgery.

Materials and methods

This prospective observational study was approved by lokal ethics committee and Turkey Drug and Medical Device Agency (number: 66175679–514.05.03-E.50796; subject: 19-AKD-156). Written informed consent was obtained from all patients. This study is registered with ClinicalTrials.gov (NCT04209907).

Patients

Sixty patients (60) with American Society of Anesthesiologists (ASA) classification I–III, aged 18–75 years, who underwent for level 1 or 2 open lumbar decompression surgery in a university hospital between the dates of May 2020 and May 2021 in accordance with the Helsinki Declaration were included in the study.

Patients with severe liver, kidney, heart and hematological diseases, with infection, obese, with coagulation disorders, with infection at the intervention site, with severe central or peripheral neurologic disease, with a history of allergic reaction to drugs used during surgical duration, with psychological disorders, with a history of

preoperative chronic opioid use, with alcohol and drug addiction were excluded from the study.

Sample size calculation and grouping

The sample size was calculated with G power software (G*Power 3.1.9.3) using the VAS score results obtained from the previous study [10]. According to the result of this study, with 80% power, a two-way alpha error of 0.05 and 1:1 allocation ratio, it was sufficient to take at least 28 number of patients in each group to detect the difference. Taking into account the possibility of a 10% case being excluded from the study, 30 patients for each group were included in the study. Groups were randomized 1:1 using the closed opaque envelope technique and assigned randomly. The patients were divided into groups according to whether or not the block was performed; RLB group and non-RLB group.

RLB block technique

All patients who underwent block intervention were taken to a separate regional anesthesia room, where we performed block applications half an hour before the operation. Pulse oximetry, noninvasive arterial blood pressure and electrocardiogram observation were applied to the patients as standard monitoring methods and patients were placed in the prone position. Midazolam (0.02 mg/kg) (demizolam 5 mg/ml, Pharmada Drugs, Istanbul) was administered intravenously to the patients for preoperative sedation. The intervention area was sterilized with povidone iodine before the procedure, covered by sterile drapes and a sterile sheath was applied to the ultrasound. The 1–7 MHz convex array ultrasound probe (Esaote My Lab 6 US Machine, Florance, Italy) was placed sagittally in the midline at the level of the lumbar decompression area (Lumbar 1–2–3–4 level) by experienced anesthesiologist resident. After the spinous processes were seen, the ultrasound probe was moved laterally 1–2 cm and vertebral laminae were observed. A 22 G 100 mm needle (B. Braun, Germany) was inserted from cranial to caudal direction with in plane technique. When the needle touch the lamina (Fig. 1), 2 ml saline was injected for confirmation of the location. After the location was confirmed, a 20 ml % 0.25 bupivacain was administered with low pressure (Fig. 2). The same intervention was performed on the other side of the vertebra lamina. After 20 min of sensory examination and evaluation of efficacy, the patients were transferred to the operating room. No intervention was applied to the other group of the study.

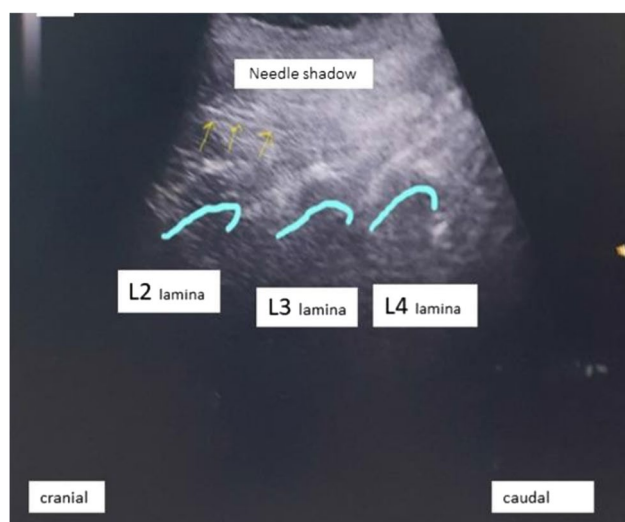


Fig. 1 Needle shadow during retrolaminar block

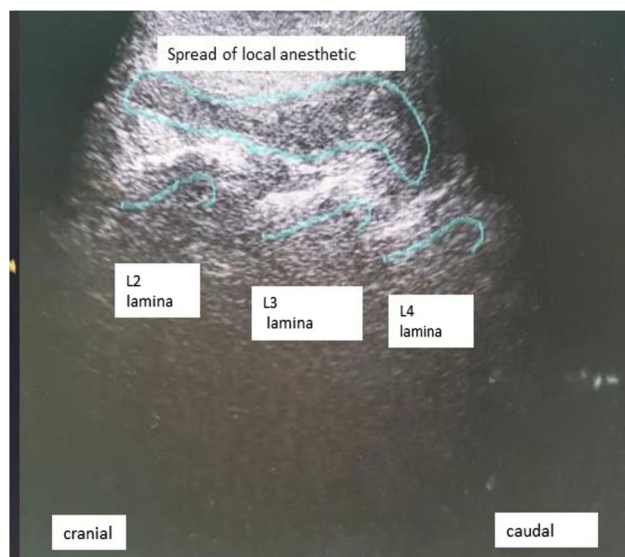


Fig. 2 Spread of local anesthetic during retrolaminar block

Anesthesia technique

Standard monitoring (peripheral oxygen saturation [sPO₂], heart rate [HR], noninvasive mean blood pressure [MBP]) and standard general anesthesia (2 mg/kg propofol [Propofol, Fresenius Kabi, Melsungen, Germany] i.v., 1.5–2 mg/kg fentanyl [Fentanyl Citrate, Hospira, Lake Forest, Illinois, USA] and 0.6 mg/kg rocuronium [Esmeron, Organon, Kloosterstraat, the Netherlands] i.v.) was applied to all patients. After tracheal intubation, anesthesia was maintained with 1–2% sevoflurane (Sevorane, Abbott, Chicago, Illinois, USA) in 50% air and 50% O₂ in 4L fresh gas flow, and if

necessary 0.25–1 mcg/kg/minute remifentanyl. The bispectral index (BIS, A-2000, Aspect medical Systems) was kept between 40 and 50 values by changing the concentration of sevoflurane. The hemodynamic control was achieved by administering or changing remifentanyl. Muscle relaxation was controlled by the train-of-four (TOF) and 0.2 mg/kg rocuronium was added when needed. Minimum alveolar concentration (MAC) values of sevoflurane, characteristics of anesthesia and surgery, total consumption of sevoflurane and remifentanyl were recorded during the procedure. Thirty minutes before the end of the surgery, for postoperative analgesia, 1 g paracetamol and dextketoprofen trometamol 50 mg i.v. was administered to all patients. After the end of the surgery, 2.5 mg neostigmine and 0.02 mg/kg atropine was administered and the patients were extubated. Then all patients were observed at postoperative recovery unit and they transferred to the wards after the 9 and more Aldrete scores were seen.

Pain assessment

Postoperative pain was evaluated by a researcher who was blinded to group allocation by using visual analog scale (VAS) indicating the pain severity (0–3; no to mild pain, 4–7; moderate pain, 8–10; severe pain) at 1st, 2nd, 4th, 6th, 12th and 24th hours of postoperative period at rest and with active movement by a blinded researcher to the study groups. If the VAS score of the patients was 4 or more, 1 mg/kg tramadol was administered. First analgesic requirement time and total analgesic consumption were also recorded.

Statistical analysis

Statistical analysis was performed by using package programme (SPSS) of version 20.0 (IBM Corporation, Armonk, NY). Kolmogorov–Smirnov test was used for the normality distribution analysis of variables. According to the distribution variables were presented as mean $\pm$ standard deviation (for parametric variables) and median [(min–max) for non-parametric variables]. Categorical variables were expressed as number and percentage. The analysis of the parametric data was made by independent t-test and nonparametric data was made by Mann–Whitney U test. $p < 0.05$ value was considered statistically significant.

Results

Sixty patients were enrolled in this study. Flow diagram of the patients is shown in Table 1. Characteristics of patients and surgery are presented in Table 2. There was not any significant difference between the 2 groups in terms of age, weight, height, sex, ASA status, duration of surgery, duration

Table 1 Flow diagram of the patients

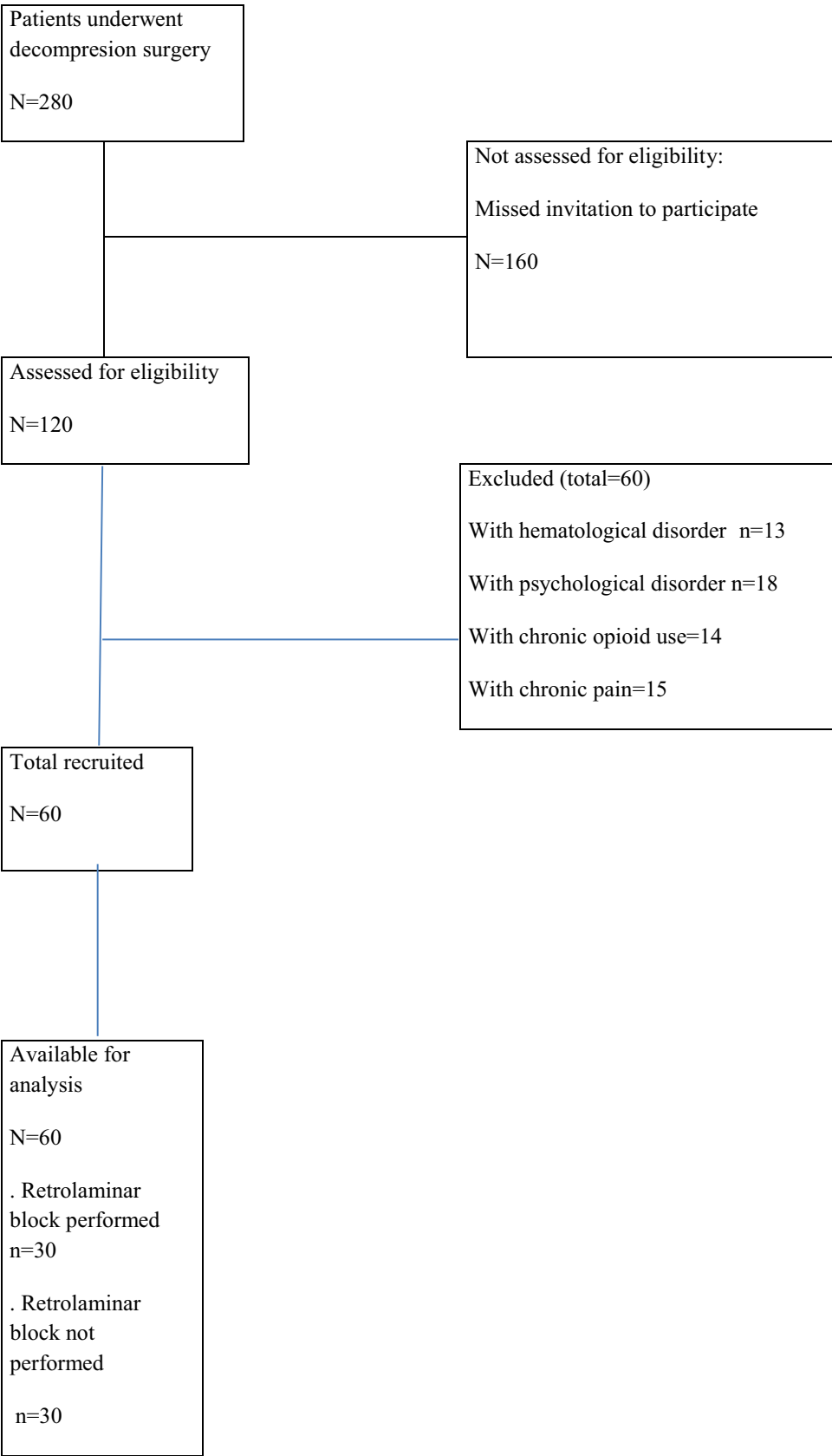


Table 2 Characteristics of patients

	Non-RLB block group (<i>n</i> =30)	RLB block group (<i>n</i> =30)	<i>P</i> value
Age (years)	54.96 ± 11.62	54.50 ± 13.01	0.85
Sex F/M	18/12	20/10	0.53
Weight (kg)	77.31 ± 11.32	82.26 ± 11.50	0.07
Height (cm)	167 (150–180)	170 (160–180)	0.16
ASA status (I/II/III)	6/20/4	8/19/3	0.51
Duration of Anesthesia (minutes)	90 (80–97)	91 (75–95)	0.44
Duration of Surgical Time (minutes)	80 (80–86)	82 (66–90)	0.12

RLB: Retrolaminar block; F: Female; M: Male; ASA: American society of anesthesiologists

Table 3 Perioperative monitoring parameters of the patients

	Non-RLB block group (<i>n</i> =30)	RLB block group (<i>n</i> =30)	<i>P</i> value
MBP (mmHg)	77.37 ± 6.68	78.86 ± 9.05	0.44
HR (beat/minutes)	77.28 ± 7.54	81.21 ± 8.71	0.06
MAC	1.05 (1.00–1.17)	0.90 (0.77–1.05)	< 0.001 ^x
First analgesic time (hours)	2 (1–3)	4 (2–12)	< 0.001 ^x
Total paracetamol consumption (gr)	0.55 ± 0.46	0.26 ± 0.38	0.01 ^y
Total dexketoprofene consumption (mg)	50 (0–100)	50 (0–100)	0.73
Total contramal consumption (mg)	200 (100–300)	37.5 (0–200)	< 0.001 ^x
Total sevoflurane consumption (ml)	45.48 ± 8.37	29.70 ± 5.99	< 0.001 ^y
Total remifentanyl consumption (mikrogr)	60 (0–300)	0 (0–120)	0.01 ^x

MBP: Mean blood pressure; MAC: Minimum alveolar concentration; RLB: Retrolaminar block, X: Significantly low *p* values according to Mann–Whitney U test; y: Significantly low *p* values according to Student-t test

of anesthesia ($P > 0.05$). Perioperative hemodynamic parameters (MBP and HR) were similar between groups ($P > 0.05$). However MAC values were different in favor RLB group (lower than non-RLB, $p < 0.001$) (Table 3). Total sevoflurane and remifentanyl consumption during operation was significantly lower in RLB group ($p < 0.001$ and $p = 0.01$ respectively) (Table 3). Tramadol and paracetamol consumption was significantly lower in the RLB group compared with the non-RLB group at postoperative period ($p < 0.001$ and $p = 0.01$ respectively) (Table 3). However total dexketoprofen consumption were not different ($P = 0.73$). The first analgesic requirement time was significantly longer in the RLB Group than in the non-RLB Group [(2 (1–3) hour and 4 (2–12) hour respectively, $P < 0.001$)] (Table 3). Postoperative VAS scores were assessed at rest and with active movement. Scores were significantly lower in the RLB Group than in the non-RLB Group at all time intervals ($P < 0.001$) (Table 4, Fig. 3). There was not any complication in both groups.

Discussion

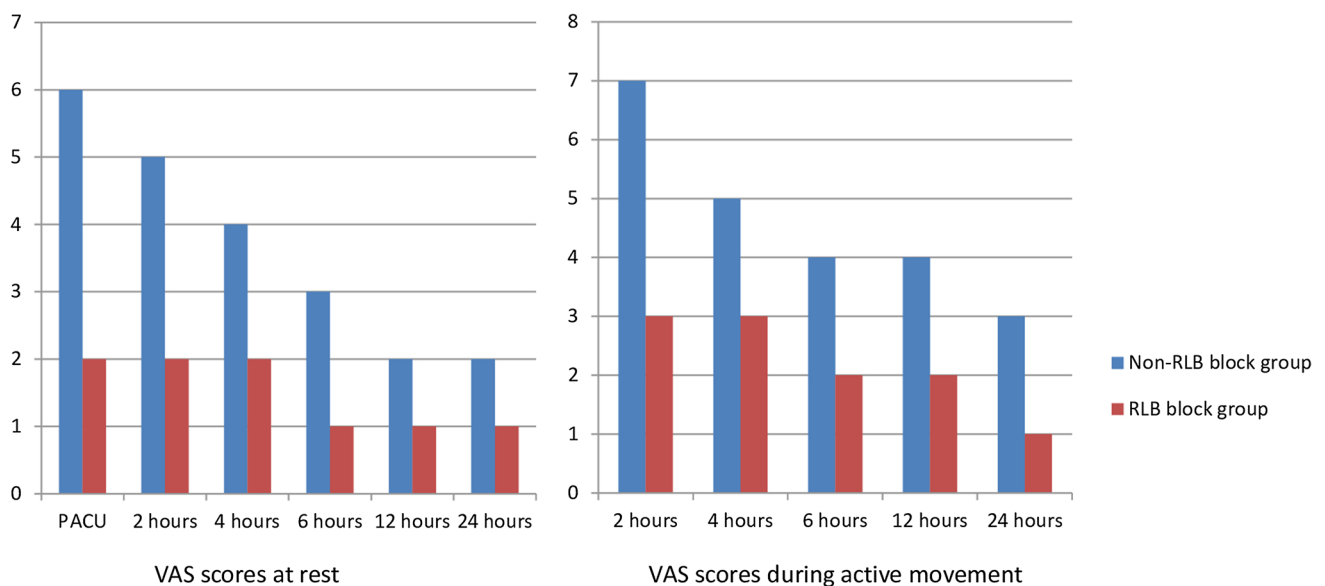
In the present study, we found that pain scores were lower in RLB block group compared with the non-block group and application of RLB block reduced perioperative analgesic and anesthetic consumption in patients underwent lumbar decompression surgery.

Lumbar decompression surgery is frequently performed in patients to relieve low back pain, reduce radiculopathy, and improve overall function. Inadequate pain management in the postoperative period may lead to delayed discharge or rehospitalization after surgery [11, 12]. At the same time, effective pain control increases postoperative results and patient satisfaction. Multimodal analgesia is a recommended practice to accelerate postoperative recovery [13]. The specific treatment of each procedure is important. Regional anesthesia techniques have

Table 4 Visual analogue pain scores of patients at postoperative period

	Non-RLB block group (n=30)	RLB block group (n=30)	P value
<i>At rest</i>			
PACU	6 (2–8)	2 (0–5)	<0.001
2 h	5 (4–8)	2 (0–5)	<0.001
4 h	4 (3–5)	2 (0–4)	<0.001
6 h	3 (2–7)	1 (0–4)	<0.001
12 h	2 (0–5)	1 (0–4)	<0.001
24 h	2 (0–4)	1 (0–3)	<0.001
VAS-mean rest	3.66 (2.67–5.17)	1.33 (0.33–3.50)	<0.001
<i>During active movement</i>			
PACU	–	–	
2 h	7 (3–9)	3 (0–6)	<0.001
4 h	5 (4–7)	3 (0–4)	<0.001
6 h	4 (3–6)	2 (0–5)	<0.001
12 h	4 (1–5)	2 (1–5)	<0.001
24 h	3 (1–4)	1.5 (0–4)	<0.001
VAS-mean active	4.60 (2.80–5.80)	2.40 (1.20–4.00)	<0.001

RLB: Retrolaminar block; PACU: Post anesthesia care unit; VAS: Visual analogue scale

**Fig. 3** Postoperative VAS scores of groups. VAS: Visual analogue scale

increasingly become a part of multimodal analgesia in recent years. Thus, initiatives to reduce opioid consumption and its associated adverse effects in the postoperative period are supported [14]. At this point, different interventional methods can be applied [15–17]. The retrolaminar block we used in our study is one of these interventions.

Actually, RLB is a type of modified paravertebral block like other paravertebral fascial plane blocks. However, in RLB, as in classical paravertebral blocks, the target of the needle is not the paravertebral space. The needle targets the

retrolaminar area closer to the midline, more medially [18]. Therefore, the risk of pleural damage is lower in terms of anatomy and needle placement compared to erector spinae plane block [15]. Again, from an anatomical point of view, besides its analgesic effectiveness, it can be said that it is easier to see the lamina with the help of ultrasound compared to thoracolumbar interfascial plane block (TLIP) and modified TLIP block [16, 17]. Because the acoustic window between the transverse processes is a narrow area, observing the paravertebral anatomy (muscle structure and fascial

spaces) and inserting the needle is more difficult in other paravertebral area blocks [19].

The clinical effect is presumed to occur in RLB as the local anesthetic diffuses into the paravertebral space, epidural space, or intervertebral foramen via the superior costotransverse ligament [20]. In addition, in the cadaver study, the spread of local anesthetic given via the superior costotransverse ligament was also observed [21]. It was also stated that this spread changed with the amount of local anesthetic given. However, it was emphasized that compared to other paravertebral blocks, 20 ml solutions may accumulate more in RLB, especially in the posterior area, and affect the posterior muscle structures more [22, 23]. The analgesic efficacy of RLB in patients, especially in spinal surgical interventions, as in the present study, can be explained in this way.

We see that the amount of perioperative analgesics and anesthetics decreased in the RLB applied patient group. In our study, we have seen the opioid sparing effect, which has been on the agenda in recent years, especially in order to avoid side effects related to opioids [24]. In order to reduce opioid use, regional anesthesia methods are very important as a part of multimodal analgesia in spinal surgery [25]. In this study, we observed that there was less perioperative opioid consumption in the block group. Therefore, combination therapy or multimodal treatment for control of pain seems as the best approach in this regard. Again, we observed that the amount of inhalation anesthetic consumed in the group that underwent block during the intraoperative period was less. In this context, our study also supported the idea that the analgesic efficacy of regional anesthesia is a part of multimodal anesthesia [26]. The majority of the anesthetic agent used in a patient receiving inhalation anesthesia goes to the waste gas system and the atmosphere. Therefore, with the results of our study, another issue that may be useful in clinical practice will be discussed. Thus, the low amount of sevoflurane we use is important both economically and in terms of environmental pollution. By using less inhalation anesthetic, less damage to the atmosphere is provided, thus contributing to sustainable anesthesia [27]. Improved and ongoing awareness of practitioners regarding the climate impact of inhaled anesthetics is essential to bring change to routine practice [27]. In addition, inhaled anesthetics constitute a significant part of the costs of administering anesthesia to the patient. The cost of anesthesia for any surgical procedure depends on the type of anesthetic used and the volatile anesthetic concentration in the targeted patient. Different experiences with cost savings have already been reported [28]. Applying the regional anesthesia method as part of multimodal anesthesia, as in the present study, would be a cost-effective practical clinical approach.

Considering the clarity of the sonographic image, post-surgical anatomical changes would not give us a clear image. Therefore, in our study, we applied RLB in

the preoperative period. Observation of at least 5 levels of spread of the given solution (20 ml) in the anatomical cadaver study [22] made us think that the analgesic efficacy will be at the entire lumbar level (L1-5) in the block procedure we performed at the level of lumbar 3 vertebra.

No complications were observed in any of our patients in our study. Retrolaminar block is ultimately a paravertebral block. Therefore, the risk of pneumothorax cannot be ignored. However, considering all paravertebral blocks, the least risk is with retrolaminar block. Because it is the PVB type performed anatomically furthest from the pleura. In addition, when the needle is entered 1–1.5 cm lateral to the spinous process with USG, it directly contacts the lamina. So it is easy to apply. The risk of hematoma or nerve damage may be considered during retrolaminar block application. However, there are no major vessels or nerves in the location of the needle. The possible risk may be in the form of intramuscular hematoma, which is not clinically significant. At the same time, as in all regional anesthesia applications, the retrolaminar block procedure is not performed or performed with appropriate procedures for patients receiving anticoagulation within the framework of the regional anesthesia and pain medicine evidence-based guidelines [29]. There may also be a risk of systemic toxicity due to local anesthetics used during retrolaminar block. However, as long as the dose of local anesthetic used does not exceed the systemic toxicity limit, it will not pose a problem. Considering the effect mechanism of retrolaminar block, it is reported that it also has epidural spread (20). Therefore, there will be epidural spread of the local anesthetic we use. This may present as motor weakness in the postoperative period. However, considering the width of the epidural space and the low dose of medication used, it may be a very rare situation. In such a case, low drug concentration will not affect hemodynamics. In addition, the effect of the drug on muscle strength will end until the patient is mobilized in the postoperative period.

There were some limitations in our study. First of all, we could not show exactly how many levels of local anesthetic that we gave was spread under ultrasound due to technical reasons. Although we perform dermatomal sensory examination, showing this spread would be a guide in future studies. Secondly, we did not follow the pain levels of the patients in the preoperative period. At the same time, we did not evaluate the psychological state of the patients. Factors such as these can affect patients' postoperative pain. Therefore, it can be considered as a limitation. In addition, the block operation we apply is a fairly new method. For this reason, it would be more appropriate to work with a larger sample number in order to observe the complications that may occur and to fully reflect the population. Many future studies are needed.

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Author contributions Conception or design of the work: KP, SAP; Data collection: KP, MÖ, GA, IG, AGS, ATş, SAP; Data analysis and interpretation: KP, SAP; Drafting the article: KP, SAP; Critical revision of the article: KP, MÖ, GA, IG, AGS, ATş, SAP; Other (Study supervision, fundings, materials...): KP, MÖ, GA, IG, AGS, ATş, SAP.

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Declarations

Conflict of interest All authors have not any conflict of interest, financial or otherwise.

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