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ORIGINAL ARTICLE

Retrolaminar Block for Post-Operative Analgesia in Patients Undergoing Lumbar Herniectomy Surgery

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Abstract

Introduction: Retrolaminar block (RLB) is a novel thoracic truncal block for analgesia for the thoracic and abdominal walls. However, the analgesic efficacy of RLB in patients undergoing selective lumbar herniectomy is not well known. The aim of this study is to determine the analgesic efficacy of RLB by measuring the pain intensity of patients with the Numeric Pain Rating Scale and evaluating the non-steroid anti-inflammatory drugs and opioid consumption after the surgery.

Methods: Thirty patients with the American Society of Anesthesiologists physical status 1, 2, and 3 undergoing lumbar herniectomy of less than three levels between June 2019 and December 2019 were included in the study. The patients were evaluated in two groups: the RLB group (group R, n=15) and the intravenous (IV) analgesics group (group C, n=15). 10 mL 0.25% bupivacaine was applied bilaterally at the RLB. Tenoxicam, tramadol, and aldolan were administered as post-operative IV analgesic treatment. Numeric Rating Scale scores were evaluated at 2, 8, 12, 24, and 48 h after the surgery. Ketorolac and opioid consumption were evaluated at 24th and 48th h.

Results: Compared with group C, group R exhibited lower pain scores at 2, 8, 12, and 24 h postoperatively ($p<0.05$ for each). Tenoxicam and tramadol doses at 24 and 48 h were lower in group R than the group C ($p<0.05$ for each).

Discussion and Conclusion: The retrolaminar block is an effective technique for post-operative analgesia in patients undergoing selective lumbar herniectomy within the first 24 h without significant complication.

Keywords: Lumbar herniectomy; post-operative pain; pain assessment; retrolaminar block; regional anesthesia.

Patients who underwent vertebral surgery have reported varying degrees of pain[1,2]. This pain can be moderate to severe affecting recovery and discharge from the hospital. Multimodal pain management is the most potent approach to treat pain. In this method, a combination of neuraxial and oral/intravenous (IV) medications is used as an effective technique for pain management[3]. Regional analgesia has a synergistic potential with systemic opioids with reducing the additional doses resulting in fewer side effects.

Recently, paravertebral blocks (PVBs) have been studied comparing with epidural blocks resulting in fewer adverse effects, such as hypotension, urinary retention, and pulmonary complications[1,4,5]. Using ultrasonography, visualization of the needle through real-time and, visualization of the PV space and surrounding structures, PVB has the advantage to epidural anesthesia. However, the advancing block needle in the immediate proximity to both pleura and intervertebral foramina is a risk of pleural puncture and even the possibility of epidural or intrathecal spread of local anesthetics is still present[5,6]. Therefore, in recent years, newer approaches include retrolaminar block (RLB) have been studied[7]. In this approach, the needle is

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inserted lateral to the target spinous process with an in-plane insertion technique and advanced until it contacts the lamina using ultrasound (US). The lamina is visualized as a flat hyperechoic structure with a linear US probe orientated sagittal to the spinous process. Local anesthetics are injected on the lamina with intermittent aspiration. The spread of the injected volume between the lamina and the paraspinal muscles was observed.

RLB has been reported to be an effective analgesic technic in rib fracture, breast surgery, and aortic valve implantation[8-10]. However, the use of RLB for lumbar vertebra surgery is limited and the effective local anesthetic volumes vary in the studies. This study aimed to evaluate the analgesic effect of the RLB using low-volume local anesthetic drugs (10 mL on each side) in patients undergoing lumbar herniectomy.

Materials and Methods

This study was a retrospective case–control study carried following the principles of the Helsinki Declaration and after ethical approval was obtained from the clinical trials ethics committee of the Erzincan Binali Yıldırım University (date: May 14, 2019; decision no: 05/06). The registered number of Clinical Trials is NCT04343937. This study was a single-center trial.

Between June 2019 and December 2019, patients who were classified as American Society of Anesthesiologists (ASA) physical status 1, 2, and 3 who had elective lumbar herniectomy of fewer than three levels were consecutively enrolled in the study. The exclusion criteria were the preoperative use of IV and or oral opioids, secondary surgery, and not enough information in the file. All information about the patients analyzed retrospectively was obtained from the patients' files.

Fentanyl (1 µg/kg) and propofol (2.5 µg/kg) were used for induction of general anesthesia, while neuromuscular blockage was achieved with rocuronium (0.6 mg/kg). Anesthesia was maintained with sevoflurane (1–2% in 50–50% oxygen) and remifentanil (0.05–0.2 mcg/kg/min). Additional 50-mcg fentanyl boluses were administered to maintain values within 30% of the first documented vital signs (blood pressure or heart rate) obtained when the patient entered the operating room. At the end of the surgery, muscle relaxation was reversed with atropine 0.01 mg/kg and neostigmine 0.05 mg/kg and after patients responded to verbal commands and having adequate breathing effort, they were extubated and transferred to the recovery room. They were moved to the ward after achieving an Aldrete Score >8 points.

In the ward, the patients we revisited regularly by nurses, and blood pressure and heart rates were measured intermittently. Nausea and vomiting and any other complications were recorded at each time visit.

Paracetamol 1 g was injected IV at 8-h intervals over the first 48 h post-operative period. Numeric Rating Scale (NRS) scores were evaluated at 2, 8, 12, 24, and 48 h postoperatively at rest and movement. In an NRS evaluation, patients were asked to circle the number between 0 and 10. All scores were recorded. A nurse in the ward, who was blinded to group allocation, assessed post-operative pain using a 0–10 NRS. When the patient felt pain after the surgery, they were told to rate their pain from 0 to 10, especially at movement. Zero represented "no pain at all" whereas ten represented "the worst pain ever possible." The pain intensity was evaluated as NRS 1–3, mild; 4–6, moderate; and 7–9, severe. Tenoxicam 20 mg intramuscular (IM) was administrated whether the NRS score was <4 points. If the patient continued to experience the same pain intensity, tenoxicam 20 mg IM was added twice a day. If the patient had mild pain (NRS 4–6), tenoxicam 20 mg IM and tramadol 100 mg IV were administrated. IV tramadol 100 mg 3 times a day was added to the treatment when the patient continued to experienced mild pain intensity. If the patient had severe pain (NRS 7–9), meperidine 50 mg IV 4 times a day was added to the tenoxicam IM and tramadol IV treatment. All of the IV analgesic drugs were administrated to the patients in 100 mL of 0.9% sodium chloride with a slow infusion. All patients were followed during treatment for any complications.

If the patients had nausea and vomiting, metoclopramide 10 mg was injected IV. When nausea and vomiting continued, the analgesic drug was discontinued.

The primary outcome measured in the study was to evaluate the difference in the NRS scores between groups at 24 h postoperatively. Furthermore, the secondary outcome measured in the study was the cumulative amount of opioids and tenoxicam as non-steroid anti-inflammatory drugs (NSAIDs) delivered to the patients through the postoperative period within 48 h after the end of surgery.

The patients were randomly allocated to one of two groups (R group, n=15 and C group, n=15). In the R group, bilateral RLB was performed on patients under general anesthesia with 10 mL 0.25% bupivacaine at the level in the dorsal root corresponding to the dermatome in the skin incision and paracetamol 1 g and fentanyl 50 mcg IV at the end of the surgery. In the C group, patients received paracetamol 1 g and fentanyl 50 mcg IV at the end of the surgery. RLB was done at the end of the surgery when the patients were in

the prone position and under general anesthesia. The skin was thoroughly cleaned with chlorhexidine. A 20-gauge Tuohy needle under the guidance of a linear probe of Esaote's MyLab Six CrystaLine US (Italy) system. After an aspiration with a 3-mL syringe is negative for blood, a small volume of local anesthetic was injected to confirm the position of the needle tip. Local anesthetic was injected bilaterally with intermittently repeated negative aspiration. Anesthesiologists who performed RLB blocks had experience in performing US-guided peripheral nerve blocks.

The data obtained in our study were evaluated in IBM SPSS (version 20.0) package program in the computer environment. The sociodemographic characteristics of the study group were presented with descriptive statistical information such as number, percentage, and standard deviation. The suitability of the data to normal distribution was analyzed by the Shapiro–Wilk test. In the study, Chi-square and Mann–Whitney U tests were used.

Results

In this study, 30 patients who underwent lumbar herniectomy were evaluated. There was no difference between the study groups in terms of age, weight, ASA classification score, anesthesia, and operation duration (p>0.050 for each) (Table 1). In addition, there was no difference between the study groups in terms of gender and level of surgery (p<0.050 for each) (Table 2).

Compared with group C, group R exhibited lower pain scores at 2, 8, 12, and 24 h postoperatively (p<0.050 for each) (Table 3). However, there was no difference between the groups in terms of 48-h NRS score (p=0.486).

The tenoxicam and tramadol doses at 24 and 48 h were lower in group R than the group C (p<0.050 for each). When the meperidine doses were evaluated, there was no difference between the doses of the patients at the 24th h, while it was less in group R at the 48th h (p=0.015) (Table 4). However, this difference was not statistically significant.

Table 2. Comparison of the gender and the level of surgery

	Group R	Group C	Chi-square; p
Gender			
Female	7 (46.7)	8 (53.3)	0.000; 1.000
Male	8 (53.3)	7 (46.7)	
Level of surgery			
1	2 (28.6)	5 (71.4)	0.390*
2	13 (56.5)	10 (43.5)	
Total	15 (50.0)	15 (50.0)	

Group R: Patients received RLB Group C: Patients received IV analgesics. *Fisher's exact test.

Table 3. Comparison of the NRS scores of the groups

	Group R (n=15) mean (SD)**	Group C (n=15) mean (SD)	p*
NRS at 2th h	2.6 (0.6)	4.1 (0.8)	<0.001
NRS at 8th h	3.3 (0.6)	5.1 (0.7)	<0.001
NRS at 12th h	4.7 (0.6)	5.9 (0.6)	<0.001
NRS at 24th h	4.9 (0.6)	5.7 (0.5)	0.002
NRS at 48th h	5.3 (0.7)	5.5 (0.8)	0.486

Group R: Patients received RLB; Group C: Patients received IV analgesics;*p: ExcatSig. **SD: Standard deviation; NRS: Numeric Rating Scale.

Table 4. Comparison of the groups according to the analgesic doses

	Group R (n=15)	Group C (n=15)	p
NSAID (Tenoxicam, mg)			
24th h	25.3 (9.2)	37.3 (10.3)	0.009
48th h	30.7 (10.3)	56.0 (15.5)	<0.001
Tramadol (mg)			
24th h	213.3 (64.0)	293.3 (25.8)	0.001
48th h	320.0 (86.2)	493.3 (96.1)	<0.001
Meperidine (mg)			
24th h	26.7 (25.8)	46.7 (12.9)	0.061
48th h	30.0 (25.4)	60.0 (20.7)	0.015

Group R: Patients received RLB; Group C: Patients received IV analgesics. All data were presented as mean (standard deviation) NSAID: Non-steroid anti-inflammatory drugs.

Table 1. Demographic data of the patients

	Group R (n=15)	Group C (n=15)	p*
Age (year)	57.0 (56.0–63.0)	58.0 (56.0–64.0)	0.624
Weight (kg)	75.0 (68.0–80.0)	75.0 (65.0–85.0)	0.595
ASA** classification	2.0 (1.0–2.0)	2.0 (1.0–2.0)	0.653
Anesthesia duration (min)	130.0 (120.0–140.0)	130.0 (130.0–140.0)	0.653
Operation duration (min)	120.0 (110.0–130.0)	115.0 (105.0–120.0)	0.305

Values are presented as a median (interquartile range). Group R: Patients received RLB Group C: Patients received IV analgesics. *p-value<0.050 was accepted as statistically significant. **ASA: American Society of Anesthesiologists.

Discussion

In this study, we evaluated the efficacy of the RLB with low-volume (10 mL) local anesthetic in patients undergoing lumbar surgery for the treatment of disk herniation. The results indicate that the addition of the bilateral RLB with 10 mL of 0.25% bupivacaine to general anesthesia improved the pain scores during the first 24 h and decreased the amount of opioid requirement during the first 48 h after the surgery.

The RLB blocks the dorsal rami of the thoracolumbar nerves and provides effective analgesia for pain originating from the back. Similar studies of RLB for spinal surgery or back pain have been reported[1,2]. However, the spread of paravertebral space and epidural space is possible according to the volume used.

Anatomical studies demonstrated that the injectate distribution from the retrolaminar plane to surrounding tissue spaces is volume-dependent. In a case reported by Yoshida et al.,[1] 30 mL of 0.5% ropivacaine was injected for T12-L5 unilateral fractures of transverse processes. Moreover, this was accompanied by a spread of local anesthetics to the paravertebral space and by loss of cold sensation in the T9-L5 dermatomes. Another anatomical study indicated that 20 mL volume resulted in an adequate blockade of the dorsal rami at the affected spinal level[5]. Damjanovska et al.[11] conducted an anatomical study. In this study, the low volume (10 mL) and high volume (30 mL) were injected in porcine models. While the spread of high volume from retrolaminar to PV space was observed, in the low volume group, no spread to the PV space was detected. Hence, the dorsal rami of the spinal nerves carrying sensation of the human back[5] were blocked whereas no spread into the paravertebral space. In this study, RLB was performed using 10 mL of 0.25% bupivacaine with a single injection for surgeries including one or two levels were performed successfully. As our hypothesis, we focused on that the dorsal rami of nerves were blocked providing adequate analgesia for post-operative pain without paravertebral or epidural spread.

Spinal surgeries may be performed only with general anesthesia without any regional anesthesia. However, it leads to increased pain after surgery and, of course, increased requirement of opioid-based analgesia. It is well known that spine surgery patients report high-severity post-operative pain[8,9]. After surgery, a multi-drug approach may lead to better patient satisfaction and decreased doses of opioids. The use of NSAIDs as the only medication for pain management after spine surgery is not sufficient to provide adequate analgesia,[12] but when combined with opioids, the combination results in much better results than with alone[12]. A meta-analysis offered a shred of evidence that NSAIDs provide superior analgesia (reduced VAS pain scores and reduced narcotic consumption) in comparison with conventional therapy[11]. In our study, paracetamol and tenoxicam were used as adjuvants to the opioid-based regimen without any adverse events. A placebo-controlled study indicated that, following spine surgery, IV tenoxicam-induced morphine-sparing effect (41%) while offering glower rest and dynamic pain scores similar to the results of our study[13].

Alternative nerve blocks such as PVB, thoracolumbar interfascial plane block (TLIP), and erector spinae plane block (ESPB) have been reported as perioperative pain management during lumbar spinal surgery[14-18]. A study comparing the RLB with ESPB reported that RLB had a better analgesic effect than ESPB for the management of perioperative pain following posterior lumbar surgery[18]. There were no reports which compared the RLB with the alternative blocks about the analgesic efficacy in herniectomy surgeries. The TLIP block is a novel peripheral nerve block. Dorsal rami of the spinal nerves were blocked at the upper level of the vertebra lamina between paraspinal muscles. Inappropriate local injection space is a major issue due to it may cause out-of-fascia administration and inadequate block in contrast to RLB injection easily applied on the lamina. This is important when the block was done postoperatively. In this period, the integrity of the fascia may be lost and the desired spread may not be achieved. Therefore, our opinion is that RLB is an easier applicable technic than the alternative blocks, especially when applied after surgery.

This study has some limitations. In this study, RLB block was done postoperatively. The spread of the local anesthetics in the injection site at the surgery area and the duration of the analgesic effect of the block may vary before and after the surgery. Hence, the volume and the concentration of the anesthetic drug used may differ. Another limitation is the sample size. Since the sample size is not enough, the findings may not be generalized to the sample population. Therefore, studies involving more patients should be conducted and the results should be compared with our results. The other important limitation is the low spinal vertebra levels operated on. Since we included lumbar herniectomy patients with less than three levels in our study, analgesic needs were also low in the first 24 h. Hence, patients do not need a stronger opioid such as meperidine because their pain in the first 24 h is not so much. However, analgesic needs increasing with the decreasing effect of the RLB in

the period after 24 h. Different results can be obtained in studies involving surgeries that performed a larger number of vertebrae.

Conclusion

The addition of bilateral RLB at the level in the dorsal root corresponding to the dermatome in the skin incision with a small volume to general anesthesia provides effective post-operative pain relief for patients undergoing lumbar spinal surgery than general anesthesia alone without complication.

Ethics Committee Approval: This study was a retrospective case–control study carried following the principles of the Helsinki Declaration and after ethical approval was obtained from the clinical trials ethics committee of the Erzincan Binali Yıldırım University (date: May 14, 2019; decision no: 05/06). The registered number of Clinical Trials is NCT04343937.

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