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Evaluation of the Efficacy of Posterior Approach Quadratus Lumborum Block for Postoperative Analgesia after Lumbar Discectomy Surgery; Retrospective Observational Study

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Abstract: Lumbar disc hernia is one of the most common diseases among intervertebral disc pathologies. Lumbar discectomy surgery is, therefore, one of the leading neurosurgery interventions. Opioids are frequently used in the postoperative pain management of these patients. However, to avoid the side effects of these drugs, current block techniques are frequently used today. Quadratus lumborum block (QLB) is one of the promising blocks in this context. This study aimed to evaluate the postoperative analgesic efficacy and safety of QLB performed under ultrasound guidance in single-level lumbar discectomy surgery. Bilateral QLB was applied, 20 patients were included in the study as the block group, and 25 patients who were not applied were included in the study as the control group. Patients were evaluated in pain scores and postoperative intravenous opioid consumption at 2-6-12-24 hours postoperatively. Pain scores were significantly lower in the QLB group in all periods ($p<0.05$). Opioid consumption at the 2nd and 6th hours after the operation was significantly lower in the block group than in the control group ($p= 0.004$ and $p= 0.011$, respectively). The results of our study showed that bilateral QLB can be used as a successful option in the management of analgesia after lumbar discectomy.

Keywords: lumbar discectomy, quadratus lumborum block, postoperative analgesia, numeric rating scale

Lomber Diskektomi Cerrahisi Sonrası Postoperatif Analjezi Amacıyla Uygulanan Posterior Yaklaşımlı Quadratus Lumborum Bloğunun Etkisinin Değerlendirilmesi; Retrospektif Gözlemsel Çalışma

Özet: Lomber disk hernileri intervertebral disk patolojileri içerisinde en sık görülen hastalıklardan birisidir. Lomber diskektomi, bu nedenle beyin cerrahisi girişimlerinin başında gelmektedir. Bu hastaların postoperatif dönemdeki ağrı

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yönetiminde opioidler sık olarak kullanılmaktadır. Bu ilaçlara ait yan etki insidansından kaçınmak için günümüzde güncel blok teknikleri sıklıkla kullanılır olmuştur. Quadratus lumborum bloğu da (QLB) bu bağlamda gelecek vaad eden bloklardan birisidir. Bu çalışmada, tek seviye lomber diskektomi cerrahisinde ultrason eşliğinde uygulanan QLB'nun postoperatif analjezik etkinliği ve güvenliğinin değerlendirilmesi amaçlanmıştır. Bilateral QLB uygulanan 20 hasta blok grubu olarak ve uygulanmayan 25 hasta ise kontrol grubu olarak çalışmaya dahil edildi. Ameliyat sonrası 2-6-12-24. saatlerde hastaların ağrı skorları ve postoperatif iv opioid tüketimleri değerlendirildi. Ağrı skorları tüm zaman dilimlerinde QLB grubunda anlamlı şekilde düşük saptandı ($p<0.05$). Operasyon sonrası 2. ve 6. saatlerde opioid tüketimi, kontrol grubuna kıyasla blok grubunda anlamlı olarak daha düşük bulundu ($p=0.004$ ve $p=0.011$, sırasıyla). Çalışmamızın sonuçları bilateral quadratus lumborum bloğunun lomber diskektomi operasyonu sonrası analjezi yönetiminde başarılı bir seçenek olarak kullanılabileceğini göstermiştir.

Anahtar kelimeler: lomber diskektomi, quadratus lumborum bloğu, postoperatif analjezi, sayısal derecelendirme ölçeği

INTRODUCTION

Lumbar disc hernia is the most common intervertebral disc pathology and requires surgery when symptomatic (Parker et al., 2015). Lumbar disc herniation may be asymptomatic depending on the severity of the deformity, or it may cause symptoms that require an urgent operation, such as severe pain and a foot drop (Kortelainen et al., 1985). The main indications for surgical treatment are nerve compressions, weakness in the lower extremities, and low foot development (McGirt et al., 2009; Postacchini and Postacchini, 2011). Postoperative pain may prevent patient mobilization, leading to deterioration in the quality of daily life, postoperative pulmonary complications, and prolongation of hospital stay (Fjeld et al., 2019). Opioid agents are frequently preferred in the postoperative pain management of patients who have undergone lumbar discectomy (Krebs et al., 2010). However, these techniques can have many side effects such as nausea, vomiting, urinary retention, and sedation (Zhao et al., 2004). To avoid the incidence of side effects of these drugs, current block techniques are frequently used today. Erector spinae plane block (ESPB), one of the truncal blocks, has been used in many studies for pain management after lumbar discectomy surgery (Ueshima et al., 2019). In recent years, the quadratus lumborum block (QLB) defined by Blanco et al. (2015) has also been used for effective and safe postoperative analgesia after abdominal surgeries such as cholecystectomy, cesarian, and hysterectomy, and it has been reported to provide an effect (Blanco et al., 2015). Different studies have suggested that analgesia can be provided in the thoracic and lumbar areas after QLB and affects both somatic pain and visceral pain (Ishio et al., 2017; Okur et al., 2021). This study aimed to evaluate the postoperative analgesic efficacy and safety of ultrasound-guided QLB in patients who had a single-level lumbar disc herniation.

MATERIALS and METHODS

Study design

After obtaining approval from the Clinical Research Ethics Committee of the training and research hospital (2021/272), where the study will be conducted Sept 2020 – Dec 2020 dates patients between the ages of 18-70 who underwent lumbar discectomy with the microdissection technique and with physical status I-II of the American Society of Anesthesiologists (ASA) were included in the study. Patients operated on at more than one level had missing information on pain follow-up forms, had ASA ≥ 3, and patients with body mass index > 35kg/m^2 were excluded from the study (Fig. 1). Hospital computer documentation systems and patient pain follow-up forms were used to collect data. Since the study was retrospective, patient

records were reviewed retrospectively. Consecutive patients who met the inclusion criteria were analyzed in either intravenous (iv) opioid or QLB groups according to the analgesic method they received. The study was carried out following the principles set out in the Declaration of Helsinki.

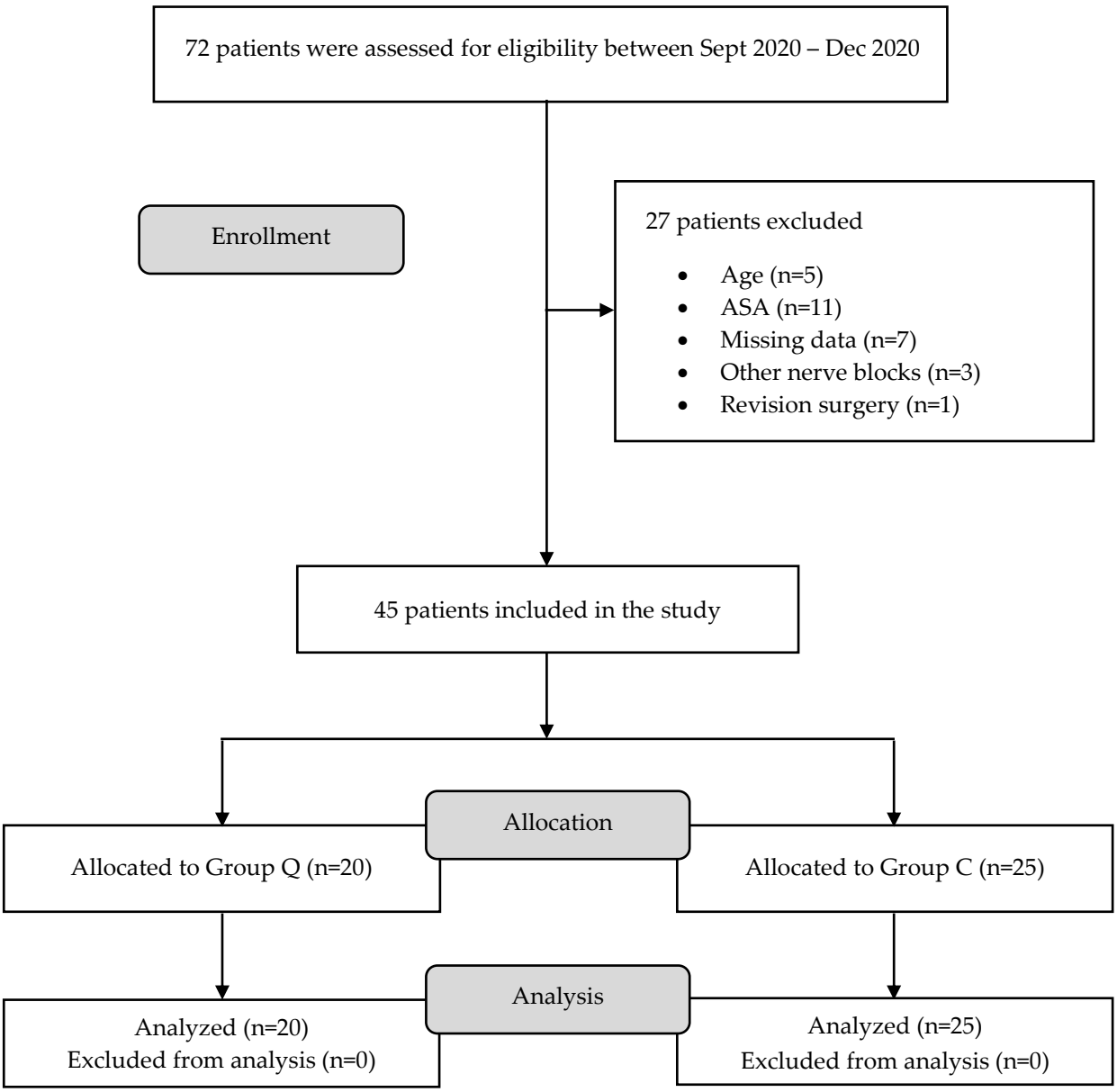

Figure 1. CONSORT flow chart of the study

General anesthesia technique

Before the operation, 22-gauge vascular access was established in all patients, and infusion was started with 2-4 mL/kg/h isotonic solution; standard monitoring was achieved with electrocardiography (ECG), noninvasive blood pressure, and peripheral oxygen saturation (SpO_2). 0.03-0.05 mg/kg midazolam was administered to all patients for premedication. After anesthesia induction was provided with 1.5 μg/kg fentanyl, 2-3 mg/kg propofol, and 0.6-0.8 mg/kg iv rocuronium, the patients were intubated. Anesthesia

was maintained with 3% desflurane in 40% oxygen in the air with a total inflow of 3 L/min and iv remifentanil infusion (0.05-0.1 μg/kg/min). All patients were administered 1 g iv paracetamol while the surgical field was closed and 4 mg ondansetron for postoperative nausea and vomiting prophylaxis. At the end of the surgery, all patients were kept in the recovery room in room air for 15 minutes. After being followed up, those with an Aldrete score ≥ 9 were sent to the service.

Quadratus lumborum block technique

Quadratus lumborum (QL) block was performed under ultrasound guidance before the surgical procedure, after the patients were placed in the prone position, following anesthesia and endotracheal intubation. A single anesthesiologist (GS) applied QL block to all patients with at least five years of experience. Block application was performed using a 100 mm 22 gauge needle (Stimuplex Ultra 360 30° - BRA-04892510-01 / B. Braun Melsungen AG, Japan) and a linear multifrequency 12L probe of the ultrasonography device (General Electric VIVID e model, GE Medical Systems, Phoenix-USA) after asepsis conditions were achieved in the operation area. While the patient was in the prone position, the QL muscle and the psoas major muscle were visualized 2-3 cm lateral to the midline at the lumbar vertebra level to be operated on, and the needle was advanced between these two muscles by entering with the in-plane technique (Fig. 2). The needle was offered up to the anterior thoracolumbar fascia between the middle layer of the thoracolumbar fascia and the posterior border of the QL muscle. After controlling the location of the needle with 2-3 ml of saline and then aspiration, 20 ml of 0.25% bupivacaine was injected into the posterior of the QL muscle. Then the same procedure was applied to the opposite side using the same dose.

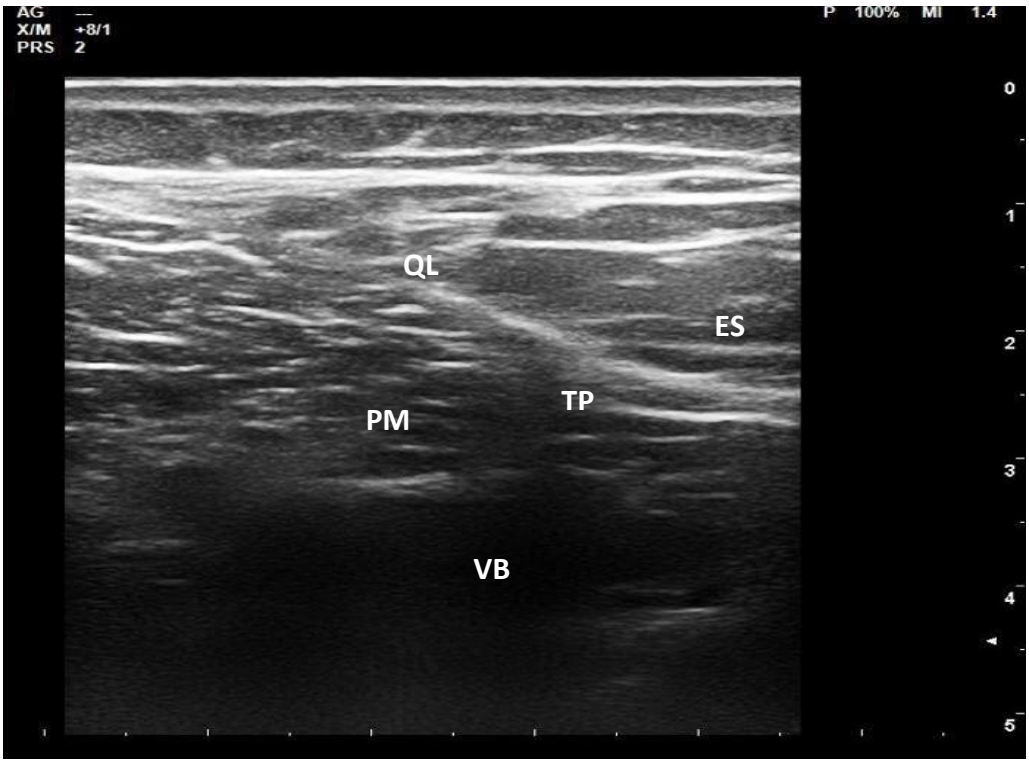

Figure 2: Sonographic anatomy of the QL block (QL: Quadratus lumborum muscle, PM: Psoas major muscle, ES: Erector spinae group of muscle, TP: Transverse process, VB: vertebral body).

Postoperative management

All patients were routinely administered 1 g of paracetamol at 12-hour intervals to provide analgesia in the postoperative period. Patients were evaluated in pain scores and analgesic needs at 2-6-12-24 hours postoperatively. Postoperative pain was assessed using a numeric rating scale (NRS, 0-10; 0 = no pain and 10 = excruciating pain). If the patients' pain scores were greater than four, 30 mg of tramadol hydrochloride was applied to a maximum of 120 mg within 24 hours. In addition, 20 mg of tenoxicam was administered as rescue analgesia in patients with a pain score of ≥ 4, as a maximum of two doses per day. Patients' total opioid and rescue analgesic doses and opioid-related complications such as nausea, vomiting, pruritus, and urinary retention were recorded in the first 24 hours.

Outcome measurements

The primary outcome measure of the study was the NRS scores in the first 24 hours postoperatively between the QLB and control groups. Secondary outcome measures were total opioid consumption and opioid-related complications.

Statistical analysis

The G*Power 3.1.9.2 program was used to calculate the sample size of the study. A pilot retrospective study was conducted with ten patients from each group to determine the minimal sample size for the primary outcome. The mean NRS value was 1.4±1.18 in Group Q and 2.95±1.54 in Group C. An α error = 0.05 with a power of 95% was assumed so that each group had at least seventeen participants. We included 20 patients in Group Q and 25 patients in Group C due to the possibility of dropouts. Patient data from the pilot study were not included in the main study.

The data collected in the study were evaluated with the SPSS 22.00 program for Windows 10. The Kolmogorov-Smirnov test was used to check the normality of the data distributions. Categorical variables are given as percentages (%) and numerical variables as mean ± standard deviation for descriptive statistics. In comparing the quantitative data of the two groups when the normality conditions are met, the Two-Sample Independent T-test was used. In contrast, Fisher's Exact Test was used when the variables were qualitative. Mann-Whitney U test was used for quantitative variable data comparisons where normality conditions were not met. The statistical significance level of alpha was accepted as $p<0.05$.

RESULTS

The files of 72 consecutive patients who underwent lumbar discectomy were reviewed retrospectively for the study. Twenty-seven patients were excluded from the study due to missing data, age, other truncal blocks, ASA, and revision surgery (Fig. 1). Demographic data and clinical features of both groups were similar (Table 1). Pain scores were significantly lower in the QLB group (Group Q) than the control group (Group C) in all periods (Table 2). When opioid consumption was compared between the groups, opioid consumption at the 2nd and 6th hours after the operation was significantly lower in the block group than the control group ($p=0.004$ and $p=0.011$, respectively) (Table 2). There was no significant difference between the two groups in the use of rescue analgesic requirements ($p=0.161$). The two groups were similar in opioid-related side effects such as nausea and vomiting ($p=0.260$ and $p=0.242$, respectively) (Table 3).

Table 1. Comparison of the demographical and clinical data between groups Q and C.

		Group Q (*n*=20) Mean ± SD/n-%	**Group C** (*n*=25) Mean ± SD/n-%	***p* value**
Age		48.70±14.31	46.72±12.86	0.628*
Gender				
	Female	10 (50%)	11 (14.03%)	0.688†
	Male	10 (50%)	14 (85.9%)	
BMI		24.47±2.56	23.63±2.76	0.305*
ASA				
	I	7 (17.6%)	9 (15.7%)	0.944†
	II	13 (77.9%)	16 (73.6%)	
Duration of surgery (min)		85.7±22.31	80.08±15.03	0.320*
Duration of anesthesia (min)		112.65±21.43	103.47±19.27	0.203*
Level of surgery (L_2-L_3 / L_3-L_4 / L_4-L_5 / L_5-S_1)		1/3/16/0	1/5/18/1	0.918†

Data are presented as mean±standard deviation (SD) or number (%).
BMI: body mass index, ASA: American Society of Anesthesiologists.
* Independent Sample t-test
† Chi-square test

Table 2. Comparison of opioid consumption and NRS scores between groups Q and C.

	Group Q (*n*=20) Mean ± SD/n	**Group C** (*n*=25) Mean ± SD/n	***p* value**
Opioid consumption			
PO 2nd h	1.50±6.70	13.20±15.19	0.004*
PO 6th h	4.50±10.99	15.60±15.29	0.011*
PO 12th h	7.5±13.32	14.40±15.29	0.118*
PO 24th h	6.0±12.31	13.20±15.19	0.093*
Rescue analgesic requirement	7/13	14/11	0.161†
NRS			
PO 2nd h	0.60±0.94	3.52±1.55	< 0.001*
PO 6th h	1.20±1.15	3.64±1.52	< 0.001*
PO 12th h	2.65±1.30	3.52±1.41	0.028*
PO 24th h	2.45±1.66	3.72±1.51	0.021*

Data are presented as mean±standard deviation (SD) or number.
NRS: numerical rating scale, PO: postoperative, h: hour
*Mann-Whitney u test, †Chi-square test (Fischer test)

Table 3. Comparison of incidence opioid related adverse effects between groups Q and C.

Opioid related complications	Group Q (n=20)	Group C (n=25)	p value
Breathing depression (Y/N)	0/20	0/20	1.000*
Sedation (Y/N)	0/20	0/20	1.000*
Nausea (Y/N)	2/18	7/18	0.260*
Vomiting (Y/N)	0/20	3/22	0.242*
Itching (Y/N)	0/20	0/20	1.000*

Data are presented as numbers. Y: Yes, N: No
*Fischer exact test

DISCUSSION and CONCLUSION

Ultrasound-guided QL block in single-level lumbar discectomy surgery provided more effective pain control and lower doses of opioid consumption compared to standard multimodal analgesic administration. The analgesic efficacy of this block has been determined in randomized controlled studies of QL block in abdominal surgeries such as cholecystectomy, inguinal hernia, sectional and colorectal procedures (Akerman et al., 2018; Gurbet et al., 2014; Postacchini and Postacchini, 2013). This retrospective cohort study is the first in the literature to investigate the efficacy of QL block in postoperative pain management in lumbar discectomy surgery.

Patients experience moderate to severe pain in the first 24 hours after lumbar discectomy (McGirt et al., 2009). Today, truncal blocks have started to be preferred over opioid analgesia due to lower complication risk and more stable hemodynamics. QLB is an "interfacial plane block" that was first described by Blanco in 2007 as an alternative to the TAP block (Blanco, 2007). In lumbar discectomy operations, iv analgesics with different action mechanisms such as paracetamol, non-steroidal anti-inflammatory drugs, and opioids have been combined. With the use of ultrasonography, truncal plane blocks, which have become more common in clinical practice and have decreased complication rates, have also become an indispensable part of multimodal analgesia protocols (Saadawi et al., 2021). QL block has also been frequently used for postoperative analgesia, especially in abdominal surgery (Kadam, 2013; Murouchi et al., 2016; Ueshima et al., 2017).

After the block was defined, two different studies have been published comparing the posterior QL block with the TAP block, reporting that the posterior approach is more effective than the lateral approach and provides less opioid consumption. The posterior QLB is a posterior abdominal wall block targeting the mid-thoracolumbar fascia (TLF). Due to the character of the fascia, dermatomal spread in the QL block may be greater due to distribution to the lumbar plexus or paravertebral region (Elsharkawy et al., 2017). In the posterior QL block, a local anesthetic is injected behind the QL muscle, more precisely between the medial lamina of the TLF and the QL muscle, which separates the QL muscle from the latissimus dorsi and paraspinal muscles. This method can produce an effective analgesic in lumbar spine surgery because the local anesthetic can spread to the transverse process and block the posterior branches of the lumbar spinal nerve.

In the studies published so far on this block, the authors agree that QLB generally produces an analgesic effect with long duration and low pain scores. In a study in which posterior QLB was applied, the spread of local anesthesia applied to the paravertebral area was suggested as a potential mechanism of action due

to the anatomical connection between the fascia transversalis and the endothoracic fascia. In this published cadaver study, however, the opposite opinion was expressed, and they stated that in previous studies, a paravertebral local anesthetic applied did not spread to the lumbar region, and the effect of QLB on visceral pain was realized through the sympathetic chain or celiac ganglion blockade (Kumar et al., 2017). In another cadaveric study, it was stated that lumbar plexus involvement is possible with posterior QLB (Carline et al., 2016).

In the present study, similar to previous studies, patients who underwent QLB for postoperative analgesia had lower pain levels and opioid consumption in the first 24 hours (Hansen et al., 2019). This is also important in early mobilization, shortening hospital stay, and reducing costs. In another study, QL block was compared with systemic analgesia in patients who underwent, supporting our results. In addition, it was reported that opioid use and pain scores were significantly lower in the block group (Ökmen et al., 2018).

In this study, postoperative opioid consumption was significantly lower in the Group Q, especially at the 2nd and 6th hours. Although opioid consumption was lower at 12 and 24 hours compared to Group C, no significant difference was found. It can be said that the reason for this is the effect of iv analgesic applied to the patients at the end of the surgery. The detection of similar opioid consumption between the two groups at the 24th hour indicates that the block's effect did not reach until the 24th hour, despite the use of long-acting local anesthetics in the study. In some studies, it has been shown that opioid use gradually increases towards the 24th hour in different types of peripheral nerve blocks performed with bupivacaine (Bramlett et al., 2012).

The findings obtained in the study showed that QL block might provide benefit as regional analgesia in patients who underwent single-level lumbar discectomy. USG guided QLB is an easy to apply and safe block in the prone position. It can be used quickly when the patient is returned to the prone position after induction. In this study, although the duration of anesthesia was longer in Group Q, no statistically significant difference was found between the two groups. Although it is stated that complications such as intravascular or retroperitoneal injection may rarely develop, performing the procedure under ultrasound will minimize the risk of complications. In the present study, similar to the literature, no procedure-related difficulties were experienced in the patients.

The study has some limitations. Since the study was in a retrospective cohort design, randomization could not be done to select patients in the study, and the patients were included in the study consecutively according to the order of admission. In addition, due to the small number of patients in the study and the fact that the study was carried out in a single center, the results may not reflect the general population. Finally, dermatomal evaluation of the patients could not be performed after the procedure since the blocks were performed after the induction of anesthesia.

The presented study showed that bilateral single shut QL block in single-level lumbar discectomy surgery can be used as a successful option in postoperative analgesia management by significantly reducing opioid consumption and pain scores. However, more studies are needed to evaluate the effectiveness of the block to include QL block in multimodal analgesia procedures in lumbar discectomy surgery.

Author contribution: All authors contributed to the study's conception and design. Conception and design, Provision of study materials, Data collection or management, Manuscript writing, Final approval: GS, Study design, Manuscript preparation, Language editing, Statistical analysis: GOY. All the authors contributed to the interpretation of the results and the proofreading of the manuscript.

Ethics approval: The trial was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of the Bakirkoy Dr. Sadi Konuk Training and Research Hospital (approval number: 2021/272, approval date:03/05/2021).

Conflict of interest: There is no conflict of interest among the authors.

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