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Özgün Araştırma / *Research Article*

Quadratus Lumborum Block Versus Wound Infiltration for Pediatric Unilateral Inguinal Hernia Repair; A Prospective, Randomized Study

Pediatrik Unilateral İngüinal Herni Onarımında Kuadratus Lumborum Plan Bloğu ve Yara Yeri İnfiltrasyonunun Karşılaştırılması; Prospektif Randomize Çalışma

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ABSTRACT

Objective: *The inguinal hernia repair has an important place among the lower abdominal surgeries regarding the daily pediatric surgery practice. This study was aimed to compare the postoperative analgesic effects of the surgical wound infiltration and transmuscular quadratus lumborum (TQL) in inguinal hernia surgery in the pediatric age group.*
Method: *After ethical board approval was obtained, 50 patients between the ages of 2 months and 7 years undergoing elective unilateral inguinal hernia repair were randomized to TQL block (Group TQL, n=26) or to wound infiltration (Group I, n=24). Group TQL received ultrasound-guided transmuscular quadratus lumborum block with 0.25% bupivacaine 0.5 ml/kg and Group I received wound infiltration with 0.25% bupivacaine 0.5 ml/kg before surgery. Pain scores (FLACC), parental satisfication, block complications and additional analgesia requirements were recorded.*
Results: *It was determined a significant decrease in the FLACC pain scores in the TQL group for the 2nd ($p<0.001$) and 4th ($p<0.05$) hours compared to the infiltration group. However, there was no statistically significant difference between the groups for other time points ($p>0.05$). The paracetamol requirement was statistically lower in the Group TQL than Group I (6/20 vs 14/10 respectively, $p=0.020$). There was no statistically significant difference between groups for fentanyl consumption ($p>0.05$). There was no statistically significant difference between the groups regarding the parental satisfaction evaluation.*
Conclusion: *In this study which evaluated TQL it has been reported that TQL provided effective analgesic activity in the first hours after surgery and decrease analgesic consumption. We believe that TQL is an analgesic solution alone compared to infiltration analgesia in pediatric inguinal hernia surgery.*

Keywords: *Ultrasonography, Quadratus lumborum block, inguinal hernia, postoperative analgesia, parental satisfaction*

ÖZ

Amaç: *İngüinal herni onarımı, günlük çocuk cerrahisi pratiğinde alt batın ameliyatları arasında önemli bir yere sahiptir. Bu çalışmada pediyatrik yaş grubunda inguinal herni cerrahisinde cerrahi yara yeri infiltrasyonu ve transmusküler quadratus lumborum'un (TQL) ameliyat sonrası analjezik etkileri karşılaştırıldı.*
Yöntem: *Etik kurul onayı alındıktan sonra 2 ay ile 7 yaşları arasında, elektif tek taraflı inguinal herni tamiri olan 50 hasta randomize edilerek TQL bloğu (Grup TQL, n=26) veya yara infiltrasyonu (Grup I, n=24) olmak üzere 2 gruba ayrıldı. TQL grubuna ameliyat öncesi %0.25 bupivakain 0.5 mL/kg ile ultrason eşliğinde transmusküler kuadratus lumborum bloğu, infiltrasyon grubuna ise ameliyattan önce %0.25 bupivakain 0.5 mL/kg ile cerrahi yara yeri infiltrasyonu uygulandı. Ağrı skorları (FLACC), ebeveyn memnuniyeti, blok komplikasyonlar ve ek analjezi gereksinimleri kaydedildi.*
Bulgular: *İnfiltrasyon grubuna göre 2. ($p<0.001$) ve 4. ($p<0.05$) saatlerde TQL grubunda FLACC ağrı skorlarında anlamlı bir azalma saptandı. Ancak diğer saatler arasında gruplar arasında istatistiksel olarak anlamlı fark yoktu ($p>0.05$). Parasetamol gereksinimi TQL grubunda infiltrasyon grubuna kıyasla istatistiksel olarak daha düşüktü (sırasıyla 6/20 ve 14/10, $p=0.020$). Fentanil tüketimi açısından gruplar arasında istatistiksel olarak anlamlı bir fark yoktu ($p>0.05$). Gruplar arasında ebeveyn memnuniyeti değerlendirmesi açısından istatistiksel olarak anlamlı fark görülmedi.*
Sonuç: *Transmuscular kuadratus lumborum bloğunun etkinliğinin değerlendirildiği bu çalışmada ameliyattan sonraki ilk saatlerde etkili analjezik aktivite sağladığı ve hastalarda analjezik tüketimini azalttığı görülmüştür. TQL'in pediatrik ingüinal herni cerrahisinde infiltrasyon analjezisine kıyasla tek başına analjezik bir çözüm olduğuna inanıyoruz.*

Anahtar kelimeler: *Ultrasonografi, Kuadratus lumborum bloğu, ingüinal herni, postoperatif analjezi, ebeveyn memnuniyeti*

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INTRODUCTION

The inguinal hernia has an important place among the lower abdominal surgeries regarding the daily surgery practice. The primary inguinal hernia is encountered in 1-5% of all neonates, and it is more common in neonates with low birth weight and abdominal wall defects [1]. Most patients can be mobilized, and some suitable patients can be even discharged on the same day of surgery thanks to the implementation of appropriate surgery and analgesia [2]. However, inadequate postoperative analgesia may cause irritability in children due to pain and dissatisfaction in parents and may lead to chronic pain in the later stages of the children's life [3].

Several different analgesia technics are implemented by clinicians in inguinal hernia. Oral and/or intravenous analgesics, caudal anesthesia, wound infiltration anesthesia, ilioinguinal/iliohypogastric nerve block, and plane blocks with the gradually increasing popularity are the most commonly used techniques among them. The researchers reported that all of these techniques provided effective analgesia [4].

The quadratus lumborum block was first described by Blanco in 2007, and effective postoperative analgesia it provided was demonstrated in abdominal surgeries [5]. In the following years, other techniques related to QLB were introduced, and 4 different techniques; lateral, posterior, anterior (transmuscular-TQL) and intramuscular, are currently available [6]. In our clinic, we prefer TQL and we observed that it provides effective analgesia. Although its mechanism of action is not fully elucidated, studies in cadavers showed that local anesthetics injected into thoracolumbar and endothoracic fasciae spread to the paravertebral region. As T7-L1 dermatomes are usually involved, it is suggested to be a suitable method for lower and upper abdominal surgeries.

In this study, our objective was to compare the postoperative analgesic effects of the surgical wound infiltration and transmuscular quadratus lumborum (TQL) block depending on the suggestion that the TQL block, which provides an effective analgesia in abdominal surgery, may also provide an effective analgesia after unilateral inguinal hernia surgery in the pediatric age group.

MATERIAL and METHODS

The study was initiated after approval of the Local Ethics Committee for Clinical Researches and informed consent from parents were obtained. A total of 50 patients between the ages of 2 months and 7 years, who were in the ASA I-II groups, underwent elective unilateral inguinal hernia surgery and accepted to participate, were included in the study. Patients, who had a known history of heart, kidney, liver, hematological, central nervous system disease, peptic ulcer, gastrointestinal bleeding, allergy, chronic pain, used routine analgesics, and anticoagulants and had hypersensitivity to medication used in this study, were excluded from the study (Figure 1).

Patients were randomized using a software package into two groups as transmuscular QLB (Group TQL) group and wound infiltration group (Group I). Both groups received thiopental sodium (4-7 mg/kg) and fentanyl (1-2 mcg/kg) for the anesthesia induction. Mask ventilation was applied until the adequate depth of anesthesia was achieved, and a laryngeal mask was inserted after the achievement of the adequate depth of anesthesia. The anesthesia level (MAC 1) was maintained with sevoflurane and delivery of 50% O_2-50% air mixture. In Group TQL patients, the TQL plane block was implemented with the in-plane technique using a high-frequency linear ultrasound (USG) probe. Before surgery, a 22G 50 mm sonovisible block needle was inserted under ultrasonographic monitoring between the iliac wing and rib at the midaxillary line for the TQL block after the lateral decubitus positioning of the patient. The space between the quadratus lumborum and psoas major muscles was visualized with USG and 0.25% bupivacaine (0.5 ml/kg) was injected with an in-plane approach (Figure 2). In the infiltration group, 0.25% bupivacaine (0.5 ml/kg) was administered in to the incision site before the surgery. In both groups, the patients switched to the supine position after the injections were performed so that the surgical intervention could be started. The surgical procedure was

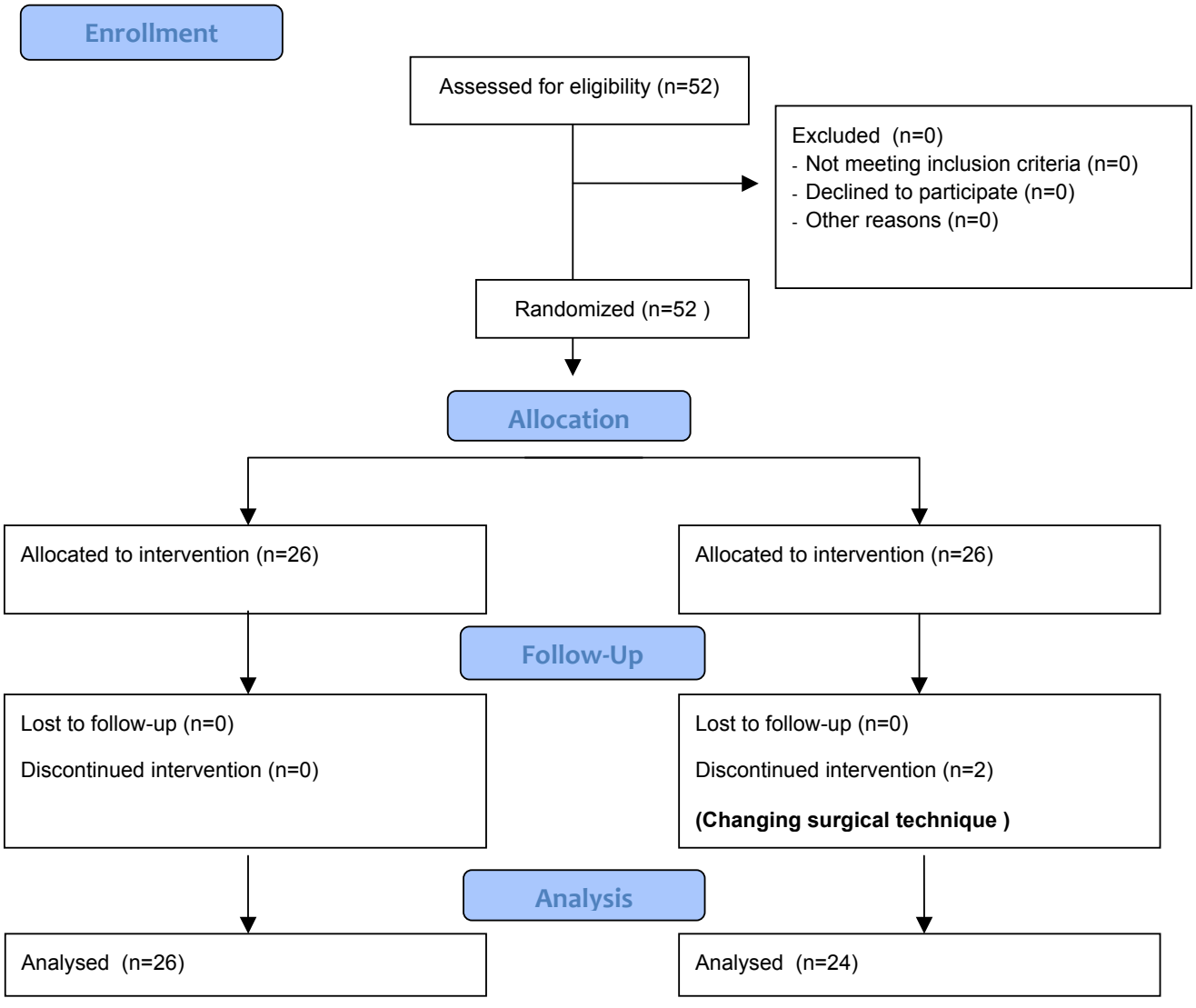


Figure 1. The consort flow diagram.

started with an inguinal skin crease incision, and a hernial sac was found without opening the inguinal canal, and a high ligation was performed with one transfiction and one free ligation. The surgical procedure was terminated by suturing the subcutaneous tissue and the skin separately with interrupted sutures. All patients were operated by the same surgical team.

After the completion of the surgery, the inhaler anesthetic drugs were discontinued and ventilation was started with 100% O_2. The laryngeal mask was removed after the establishment of adequate spontaneous breathing, and the patients let to recover in

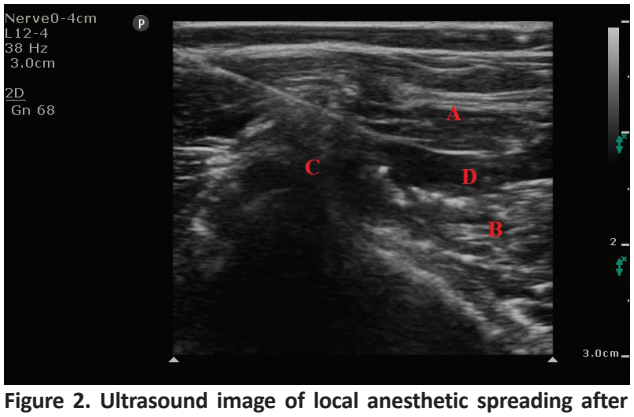


Figure 2. Ultrasound image of local anesthetic spreading after block procedure and TQL block intervention. A: m. quadratus lumborum B: m. psoas major C: transvers process of the lumbar vertebrae D: Spread of the local anesthetic.

patients were referred to the clinic and patients with a FLACC score higher than 2 received an additional 15 mg/kg IV paracetamol The FLACC scores at the 1st, 2nd, 4th, 8th, 12th, and 24th hours, presence of nausea and vomiting, the University of Michigan sedation scale for children (UMSS) score (0: Awake and alert, 1: Minimally sedated, 2: Moderately sedated, 3: Deeply sedated, 4: Unarousable), need for additional analgesia and parental satisfaction level (perfect-good-moderate-poor) were evaluated and recorded. The postoperative follow-up and assessments were performed by a researcher who was blind to the interventions implemented in the study groups.

Study Sample size

In the power analysis performed with the 2nd-hour FLACC score, in which the efficacy of the local anesthetic agent starts to diminish, it was determined that the effect size was 0.86 in the 95% confidence interval and the statistical power was 0.90 at the significance level. This result indicated that the study sample size was sufficient.

Statistical Analysis

The statistical analysis of the data was done with the IBM SPSS 20.0 software package. The Kolmogorov-Smirnov test was used to evaluate the data distribution. For normally distributed continuous variables, we used the Mann Whitney-U tests to check differences between the groups at a significance level of 5%. The intergroup comparison of the categorical data was performed with the Pearson's Chi-square test. Descriptive statistics were expressed in mean± SD.

RESULTS

There was no statistically significant difference between the groups for the demographic characteristics, duration of surgery and anesthesia (p>0.05), (Table 1).

The postoperative FLACC scores were evaluated at the 1st, 2nd, 4th, 8th, 12th, and 24th hours. We determined a significant decrease in the FLACC pain scores in the TQL group for the 2nd (p<0.001) and 4th (p<0.05) hours compared to the infiltration group. However, there was no statistically significant difference between the groups for other time points (p>0.05), (Table 2).

The evaluation of fentanyl consumption in PACU showed that fentanyl was needed in one patient in the TQL and five patients in the infiltration groups, without any statistically significant intergroup difference (p>0.05), (Table 3).

We also evaluated the paracetamol consumption in the clinic and found that 6 patients in the TQL, and 15 patients in the infiltration group needed paracetamol treatment and a significant decrease was noted in the TQL group (p<0.05), (Table 3).

There was no statistically significant difference between the groups regarding the parental satisfac-

Table 1. Demographic datas and comparison of operative procedures between groups.

	QLB Block (n:26)	Infiltration (n:24)	p
Age (years)	3.76±2.04	3.29±1.78	0.433$^{\alpha}$
Gender (f/m)	15/11	12/12	0.777$^{\beta}$
Weight (kg)	15.76±4.79	14.66±5.57	0.386$^{\alpha}$
ASA (I/II)	25/1	21/3	0.340$^{\beta}$
Duration of Surgery (min)	51.53±47.89	31.33±13.35	0.081$^{\alpha}$
Duration of Anesthesia (min)	63.07±49.09	41.95±13.36	0.107$^{\alpha}$

Values are expressed mean ± standart deviation or number, ASA: American Society of Anesthesiologist, f: female, m: male, kg: kilogram, min; minutes.
$^{\alpha}$ p>0,05 Mann-Whitney U test between groups.
$^{\beta}$ p>0.05 Chi-square test between groups.

Table 2. Comparisons of FLACC assessment between groups.

FLACC	QLB Block (n:26)	Infiltration (n:24)	p
PACU	0 (0-0)	0 (0-0)	0.066$^{\alpha}$
1st	0 (0-0)	0 (0-2)	0.076$^{\alpha}$
2nd	0 (0-0)	1 (0-4)	<0.001$^{\beta}$
4th	0 (0-0)	0 (0-1.5)	0.031$^{\gamma}$
6th	0 (0-0)	0 (0-1)	0.605$^{\alpha}$
12th	0 (0-0)	0 (0-2)	0.052$^{\alpha}$
24th	0 (0-0)	0 (0-0)	0.205$^{\alpha}$

Values are expressed median (25-75 percentile) ± standart deviation, FLACC: Face, Legs, Activity, Cry, Consolability behavioural pain scale, PACU: Postanesthesia care unit
$^{\alpha}$ p>0.05 Mann-Whitney U test between groups
$^{\beta}$ p<0.001 Mann-Whitney U test between groups
$^{\gamma}$ p<0.05 Mann-Whitney U test between groups

tion evaluation that showed the scores as perfect, good, moderate, and poor (p>0.05). We did not detect any statistically significant difference between the groups neither for nausea/vomiting nor for UMSS score (p>0.05), (Table 3).

Table 3. The comparison of groups parents satisfaction, opioid and paracetamol usage and side effects between groups.

	QLB Block (n:26)	Infiltration (n:24)	p
Parents Satisfaction (excellent/good/moderate/bad)	13/12/1/0	6/15/2/1	0.243$^{\alpha}$
Opioid Usage (y/n)	1/25	5/19	0.093$^{\alpha}$
Paracetamol Usage (y/n)	6/20	14/10	0.020$^{\beta}$
Nause (y/n)	0/26	1/23	0.480$^{\alpha}$
UMSS Score (0/1/2/3/4)	21/3/1/1/0	17/7/0/0/0	0.267$^{\alpha}$

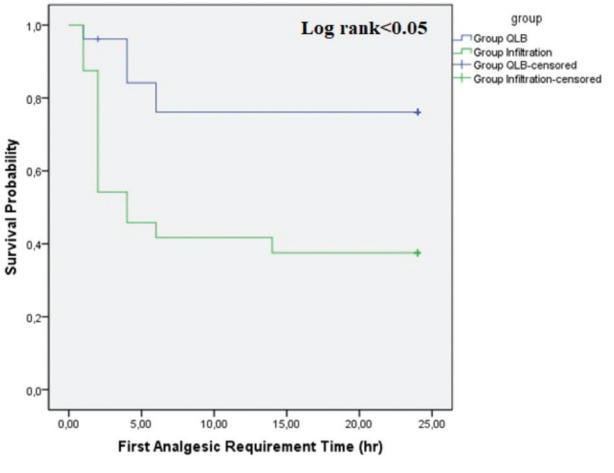
Values are expressed mean ± standart deviation or number, y: yes, n: no
$^{\alpha}$ p>0.05 Chi-square test
$^{\beta}$ p<0.05 Chi-square test

DISCUSSION

In this study, the transmuscular quadratus lumborum (TQL) block and wound infiltration with a local anesthetic, which were implemented for postoperative pain in inguinal hernia surgery, were compared. The results showed that there was a statistically significant difference between the groups for the 2nd and 4th-hour- FLACC scores, while the differences at other time points were not significant. In addition, the results displayed that paracetamol consumption was lower in the TQL group after 24 hours. As far as we know, our study is the first randomized prospective study focused on the comparison of the transmuscular quadratus lumborum block and wound infiltration analgesia in pediatric inguinal hernia surgery.

Regarding the literature, different analgesia techniques have been used for lower abdominal surgery in the pediatric age groups. Most authors consider the truncal blocks like erector spinae plane block, transversus abdominis plane block with the quadratus lumborum block as a component of the multimodal analgesia in abdominal surgery [7-9]. In the last two decades, especially plane blocks provided effective analgesia results in lower abdominal surgery. Therefore, plane blocks are particularly preferred by many clinics and clinicians. There are also studies reporting that the block of the ventral branches of the nerve roots passing through the intervertebral foramina achieved with QLB provides analgesia in the skin, muscle, parietal peritoneum of the anterior abdominal wall and even lumbar plexus block depending on the volume load [10].

In the pediatric age groups, the quadratus lumborum block is used for postoperative analgesia particularly in abdominal and hip surgery [10]. On the other hand, although it is also used for the somatic analgesia of the anterior abdominal wall in adults, there are also studies, in which it was preferred for the visceral organ analgesia in the abdomen and hip surgeries [11]. Balanco et al. [5] compared TAP and QLB blocks in the cesarean section and demonstrated that QLB was superior to TAP regarding block success, pain scores, duration of activity and opioid consumption. In the randomized controlled studies, which were conducted in the pediatric population undergoing transversus abdominis plane (TAP) block, it was determined that posterior QLB decreased significantly the FLACC scores [12]. These studies demonstrated that QLB was effective in abdominal



Time (hr)	0-5	5-10	10-15	15-20	20-25	25
Group QLB (n=26)	21	19	19	19	19	19
Group Infiltration (n=24)	11	10	9	9	9	9

Figure 3. Kaplan-Meier survival curves of the paracetamol consumption of the patients during first 24 hour (log rank p<0.05).

surgeries performed in both pediatric and adult populations. In a study, researchers used transmuscular QLB for inguinal hernia surgery in a pediatric patient and reported that QLB provided effective analgesia and high parental satisfaction in the postoperative period [13]. In our study, TQL was not compared with another plane block; however it was compared with the surgical wound infiltration analgesia. The statistical analysis showed that the FLACC scores decreased significantly at the 2nd and 4th hours in the TQL group, while no difference between the groups was reported in other evaluation hours. The intergroup comparisons also showed that the need for paracetamol decreased significantly in the TQL group compared to the wound infiltration group. In other words, patients in the wound infiltration group needed more rescue analgesia including paracetamol (Figure 3). This result indicated that paracetamol administrated concomitantly with the TQL block and infiltration analgesia provided a comparable efficacy on the pain scores after inguinal hernia surgery. The high FLACC scores seen in the infiltration group at the 2nd and 4th hours were also consistent with the finding that paracetamol administration was mostly preferred at these hours. This finding indicated that the efficacy of wound infiltration analgesia decreased in the first hours and consequently the FLACC score increased over 2 in some patients. On the other hand, there was no statistically significant difference between the groups for the rescue analgesia consisting of opioid derivatives. The evaluation of parental satisfaction including all these findings did not display any statistically significant difference between the groups. The parental satisfaction level (good-perfect) was 96.2% and 87.5% in TQL and wound infiltration groups, respectively.

Our study had some limitations. First of all, we could not perform a dermatomal examination as the study was conducted in the pediatric population, so the success of the block could not be assessed. Secondly, we did not use a double-blind study design. Finally, we did not observe any complications related to the block at the end of the study. Our sample size was determined according to the primary endpoint of analgesic consumption and a larger sample size might be necessary for the evaluation of the complications. Complications might not be observed in a limited study sample.

In conclusion, the present study evaluated the TQL and wound infiltration blocks, and TQL was reported to provide effective analgesic activity in the first hours after surgery and decrease analgesic consumption in patients. We believe that TQL is an outstanding analgesic solution alone compared to infiltration analgesia in pediatric inguinal hernia surgery.

Ethics Committee Approval: Approval was obtained from the Atatürk University Faculty of Medicine Clinical Research Ethics Committee (30.11.2017/B.30.2.ATA.0.01.00/130).

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Informed Consent: Written informed consents were obtained from the adolescents and their parents.

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