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Comparison Study of Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Analgesia in Children Undergoing Infra-Umbilical Surgeries under General Anesthesia: A Prospective Randomised Study

Genel Anestezi Altında Göbek Altı Ameliyatları Geçiren Çocuklarda Postoperatif Analjezi için Quadratus Lumborum Bloğu ile Transversus Abdominis Plan Bloğunun Karşılaştırılması: Prospektif Randomize Çalışma

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ABSTRACT

Objective: Quadratus lumborum block (QL block) is a new addition to the truncal blocks used for postoperative analgesia of both upper and lower abdominal surgeries. We conducted this study to evaluate and compare the effect of the two truncal blocks QL-II block and transverses abdominis plane block on the of duration of effective analgesia in children undergoing infra umblical surgeries under general anesthesia.

Methods: A prospective randomised study in patients between 1-7 years of age undergoing infraumbilical surgeries. 33 patients in each group. Group A received ipsilateral ultrasound guided Quadratus lumborum (QL) block group (0.5 ml kg^{-1} 0.2% bupivacaine) and Group B received ipsilateral ultrasound guided Transversus abdominis plane block (TAP) (0.5 ml kg^{-1} 0.2% bupivacaine). The primary outcome was the duration of effective in the postoperative period and secondary outcomes were the distribution of FLACC scores and Parent Satisfaction score.

Results: The duration of effective analgesia was longer in group A (mean of 18.0 hours) when compared to group B (mean of 9.5 hours) in Quadratus lumborum (Type II) block group tends to have lesser pain scores (FLACC scale) and better parent satisfaction levels when compared with TAP block.

Conclusion: Quadratus lumborum-II block provides longer duration of effective analgesia in the post–operative period in children aged 1-7 years undergoing infra umbilical surgeries under general anaesthesia. It also tends to achieve lesser pain scores and better parent satisfaction levels when compared with TAP block.

Keywords: Bupivacaine, quadratus lumborum, satisfaction, analgesia, children

ÖZ

Amaç: Quadratus lumborum bloğu (QL blok) hem üst hem de alt abdominal cerrahilerde, postoperatif analjezi amacıyla kullanılan ve nispeten yeni bir trunkal bloktur. Bu çalışmanın amacı, genel anestezi altında göbek altı cerrahi geçiren çocuklarda iki farklı trunkal blok olan QL-II bloğu ve transversus abdominus plane blokların analjezi süresine olan etkilerini araştırmaktır.

Yöntem: Prospektif randomize olarak yapılan bu çalışmada, infraumblikal cerrahi geçiren 1-7 yaş arası çocuklar rastgele herbirinde 33 hasta olan 2 gruba ayrıldı. Grup A'da hastalara ultrason eşliğinde lateral QL bloğu uygulanırken (0,5 ml kg^{-1} %0,2 bupivakain) Grup B'de TAP blok (0,5 ml kg^{-1} %0,2 bupivakain) uygulandı. Çalışmanın birincil sonucu blok etki süresi olarak belirlenirken, ikincil sonuçlar için FLACC ve Ebeveyn Memnuniyet skorları değerlendirildi.

Bulgular: Grup B ile karşılaştırıldığında Grup A'da (ortalama 18,0 saat), Grup B'ye (ortalama 9,5 saat) göre analjezi süresinin daha uzun olduğu, ağrı düzeyinin daha düşük olduğu (FLACC skoru) ve ebeveyn memnuniyet düzeylerinin daha iyi olduğu saptandı.

Sonuç: Quadratus lumborum-II bloğu, genel anestezi altında göbek altı ameliyatı geçiren 1-7 yaş arası çocuklarda ameliyat sonrası dönemde daha uzun süreli etkili analjezi ve ağrı skorlarının daha düşük seyretmesini sağlar. Ayrıca TAP blok ile karşılaştırıldığında QL blok daha iyi ebeveyn memnuniyet skorlarına sahiptir.

Anahtar sözcükler: Bupivakain, kuadratus lumborum, memnuniyet, analjezi, çocuklar

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INTRODUCTION

The practice of regional anesthesia is rapidly changing with the introduction of ultrasound into the working domain of the operating rooms. Among the recent techniques, truncal blocks have benefited more from ultrasound real-time guidance. There has been a growing interest in ultrasound-guided Transversus Abdominis Plane (TAP) block as an alternative and valid postoperative analgesic method, particularly in pediatric patients undergoing lower abdominal surgery (1). Quadratus Lumborum-II block (QL-II block) is a new addition to the truncal blocks used for providing somatic analgesia of both upper and lower abdominal pain which was originally described by Blanco as a posterior variant of the TAP block (2). The QL-II block has a similar injectate spread like the posterior TAP block to the lumbar paravertebral space (3,4). The anatomical understanding of this plane blocks was described by the three layered model of the thoracolumbar fascia described in the literature (3). Review of literature shows that Quadratus Lumborum (QL) block produces better postoperative analgesia in adult patients undergoing abdominal surgeries than that of TAP block (5). Hence, the interest in the authors to compare the QL-II block and posterior TAP block in children undergoing infra-umbilical procedures.

We conducted this study to evaluate and compare the effect of the two truncal blocks QL-II block and TAP block on the quality of postoperative analgesia in terms of duration of effective analgesia in children undergoing infra umbilical surgeries under general anesthesia. We hypothesized that QL-II block would be more effective in improving the quality of postoperative analgesia in terms of duration of effective analgesia compared to TAP block in children coming for infra umbilical surgeries under general anesthesia.

MATERIAL and METHODS

After getting Institutional Ethics Committee approval [IEC/19/JUN/151/32], clinical trial registry [CTRI/2019/08/020620], and patient consent this prospective randomized study was conducted in a tertiary care hospital. The inclusion criteria include patients aged between 1 year to 7 years undergoing unilateral inguinal hernia repair, orchidopexy, orchidectomy, and processus vaginalis sac ligation. The exclusion criteria include parent refusal, signs of infection or wound near the block site, known allergies to local anesthetics, emergency procedures, hemodynamically unstable patients, and coagulopathies.

Patients who fit into the inclusion criteria were enrolled in the study and explained about the block and the consent obtained from the parents. A basic preoperative assessment was done on the previous day and baseline investigations were noted and were kept on NPO for at least 8 hours for solids and 2 hours for clear liquids. The patients enrolled in the study were block randomized into two groups by computer-generated random numbers and concealed by the sealed envelope technique. The two study groups are: Group A received ipsilateral ultrasound guided QL-II block group (0.5 mL kg^{-1} of 0.2% bupivacaine) and Group B received ipsilateral ultrasound guided TAP block group (0.5 mL kg^{-1} of 0.2% bupivacaine).

On the day of surgery, all the patients were pre-medicated with oral midazolam of 0.5 mg kg^{-1} in the holding area. In the operation room, electrocardiography, noninvasive blood pressure, and oxygen saturation were monitorized. The patient was induced with a face mask distributing 8% sevoflurane with a closed circuit system in 100% oxygen. Fentanyl was administered at 2 µg kg^{-1} intravenously after securing i.v cannulation and the patient was intubated with an appropriate endotracheal tube after neuromuscular relaxation with Atracurium 0.05 mg kg^{-1} intravenous. Anesthesia was maintained with sevoflurane 2% and 50% air in oxygen. All the patients received the corresponding type of block soon after induction of general anesthesia before the commencement of the surgical procedure by the same experienced anesthesiologist.

In the QL-II block group, a Linear transducer (10–18 MHz) of bedside USG machine (Ultrasonix, Sonosite, Bothell, WA, USA) was used with strict aseptic precautions. Patients were placed in a lateral position. A linear transducer is placed in the axial plane in the midaxillary line and moved posteriorly until the posterior aponeurosis of the transversus abdominis muscle becomes visible until the lateral interfascial triangle (LIFT), which encapsulates the paraspinal muscles, becomes visible between the latissimus dorsi and QL muscles. The needle is inserted from the lateral end of the transducer and the needle tip is advanced until it is inside the middle layer of the TLF close to the LIFT. The local anesthetic is injected intrafascially and targeted the middle layer of the TLF. An injection of 0.5 ml kg^{-1} of 0.2% bupivacaine was applied between the QL muscles and the thoracolumbar fascia.

In the TAP block group, a linear transducer (10–18 MHz) of the bedside USG machine (Ultrasonix, Sonosite, Bothell, WA, USA) was used with strict aseptic precautions. The patients were placed in a lateral position. The skin at the puncture site will be disinfected. A linear transducer is placed in the axial plane on the midaxillary line between the subcostal margin and the iliac crest. The three layers of abdominal wall muscles are visualized as external oblique, internal oblique, and transversus abdominis muscles. The target is the fascial plane between the internal oblique and the transversus abdominis muscles. The needle tip is advanced until it reaches the fascial

plane between the internal oblique and transversus abdominis muscles approximately in the midaxillary line. An injection of 0.5 ml kg^{-1} of 0.2% bupivacaine was applied between the internal oblique and the transversus abdominis muscles. At the end of surgery both the groups received. Fentanyl of 1 µg kg^{-1} intravenous. Patients were extubated after adequately reversed with Neostigmine 0.05 mg kg^{-1} and Glycopyrrolate 0.01 mg kg^{-1} intravenous and the patient was shifted to the recovery room.

Face, Leg, Activity, Cry, Consolability (FLACC) score was assessed when the patient was brought to the recovery room and this was taken as the baseline or 0 min FLACC score. Then FLACC score was measured at 0 minute, 30 minutes, 2nd hour, 4th hour, 8th hour, and 24 hours of the postoperative period by the anesthesiologist who was blinded for the group assignment. If the FLACC score is ≥4 or more paracetamol of 15 mg kg^{-1} intravenously was given and observed for 15 minutes. After 30 minutes the patients were reassessed and if still found to have a pain score of ≥4, oral Ibuprofen 7 mg kg^{-1} was administered to patients in the ward.

The primary outcome was the duration of effective analgesia in hours-the duration from the time of extubation to the FLACC pain score of 4 and above in the postoperative period and secondary outcomes were the distribution of FLACC scores among the two groups at the study intervals and parent satisfaction score. The satisfaction levels of the parents were given verbally at a level from 1 to 10, with the lowest level of satisfaction at a value of 1 and the highest level at 10.

The sample size was calculated based on a pilot study with 10 patients in each group and duration of effective analgesia as the primary outcome variable. With a power of 80% and alpha error of 5% to detect an effect size of 0.73 in terms of the duration of effective analgesia (Mean ± SD of 9.26 ± 1.8 and 10.5 ± 1.2 hours) between the two groups a sample size of 33 patients in each group was calculated. The expected dropouts are the duration of surgery of more than one hour, cancellation of surgery due to any other cause, and any technical difficulty in performing the block. A total of 66 patients were randomized into the QL-II block group and TAP block group. All the patients completed the study protocol as shown in the consort diagram in Figure 1. There were no dropouts in the recruited participants.

Statistical Analysis

The collected data were analyzed with IBM SPSS statistics software 23.0 Version. To describe the data descriptive statistics frequency analysis, and percentage analysis was used for categorical variables and the mean & SD were used for continuous variables. The normality of distribution of the study parameters done with Shapiro-Wilk test and was found to be p>0.05. Hence, parametric test of independent unpaired sample t test was used to analyse the two study parameters namely duration of effective analgesia and the FLACC score distribution at various time intervals. To find the significant difference between the bivariate samples in Independent groups (Group A & Group B) the unpaired sample T-test was used. To find the significance in categorical data Chi-Square test was used. In both the above statistical tools the probability value 0.05 is considered a significant level.

RESULTS

All the recruited participants completed the study protocol as shown in the consort diagram (Figure 1). The distribution of age, gender and weight was also comparable between the two groups as shown in Table I. The duration of effective analgesia was longer in group A (mean of 18.0 hours) when compared to group B (mean of 9.5 hours). This showed a statistically significant difference with p value= 0.0005. The percentage of patients who required rescue analgesics in terms of the FLACC score criteria was 13.6% (5 patients) in group A and 66.7% (22 patients) in group B which was found to be statistically significant as shown in Figure 2.

The FLACC score was compared between the two groups at various time intervals and found to be statistically significant at time 0 minute (p=0.005), at 30 minutes (p=0.001), second hour (p=0.0005), fourth hour (p=0.0005), and eighth hour (p=0.020) as shown in Table II. Parent satisfaction levels were compared between the two groups and the difference is statistically significant at the 4th hour (p=0.001) between the two groups as shown in Table III. It was also found that the differ-

Table I: Distribution of Demographic Data (Age, Sex, Weight) and Duration of Effective Analgesia among Two Groups

Variables		Group A	Group B	Statistical parameter	p-value
Gender	Female	5 (15.2%)	7 (21.21%)	0.764	0.683#
	Male	28 (84.8%)	26 (78.72%)		
Age (in years)		3.3 ± 1.7	3.1 ± 1.4	t=2.426	0.093*
Weight (in kilograms)		16.2 ± 4.1	16.5 ± 3.7	t=0.247	0.723*
Duration of effective analgesia (in hours)		18.0 ± 1.3	9.5 ± 1.7	t=22.124	0.0005*

n=33 in each group Group-A QL-II block Group-B TAP block; *analyzed with independent sample t test, # Chi square test.

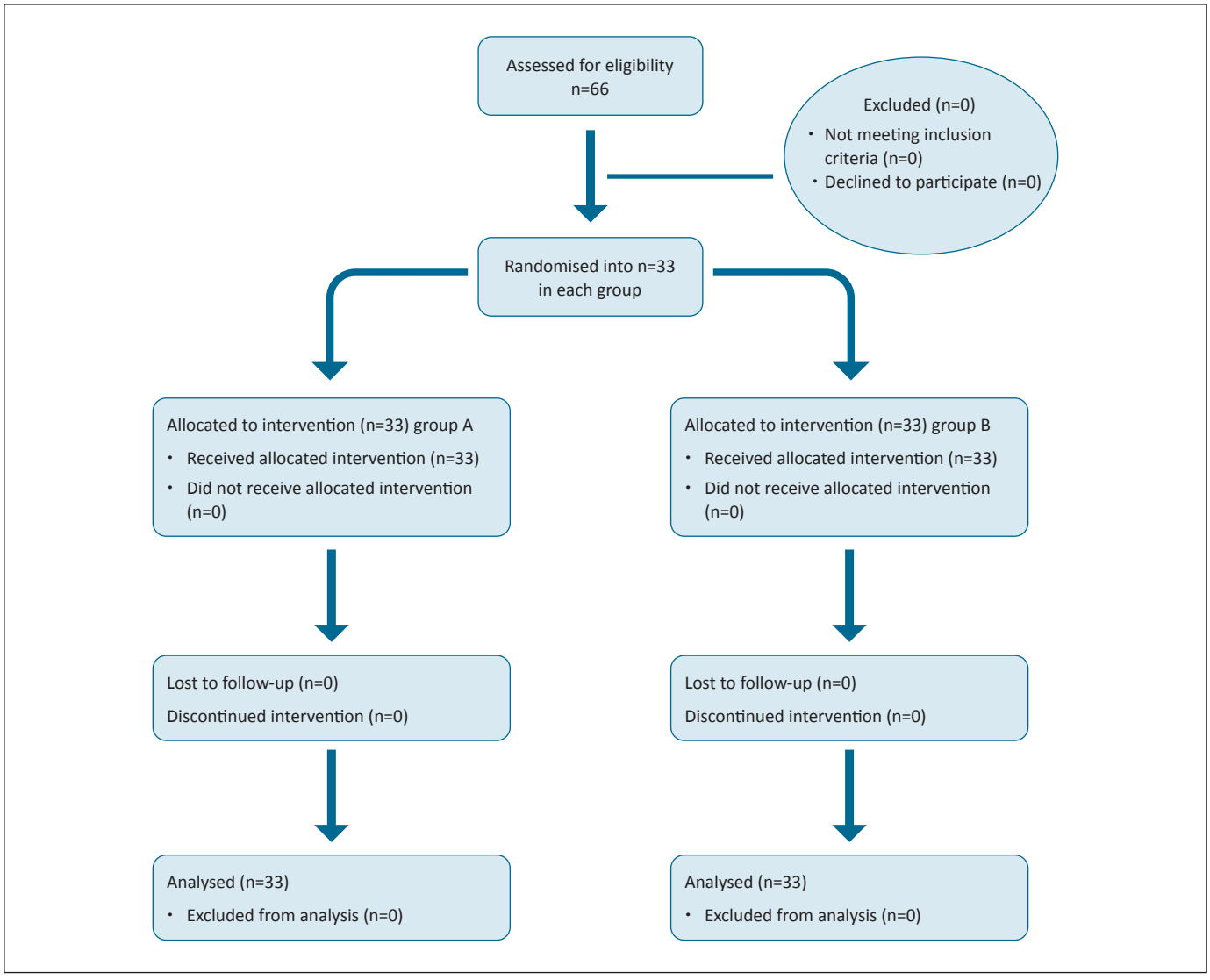

Figure 1: Consort diagram.

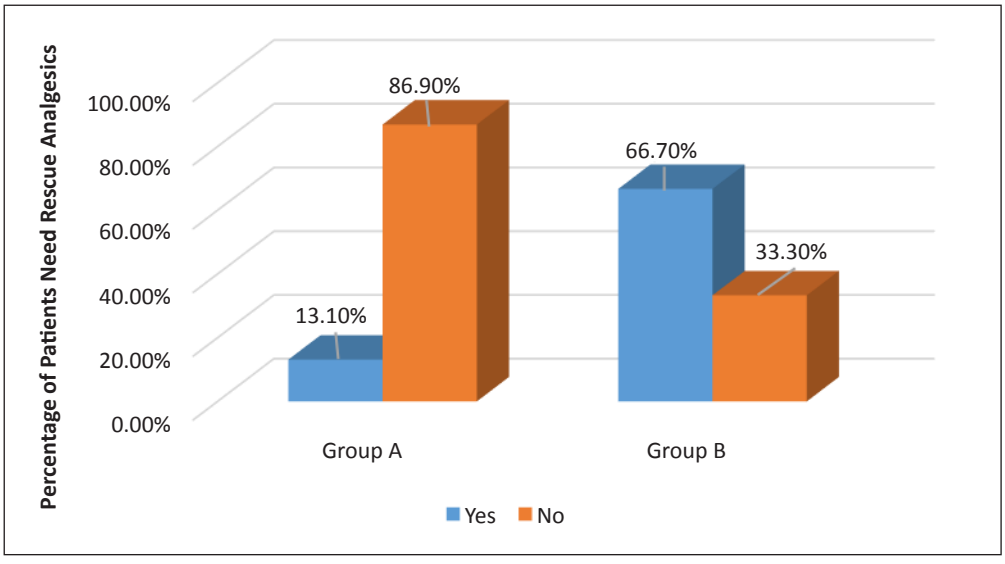

Figure 2: Distribution of percentage of patients who needed rescue analgesic requirement among the two groups.

ence was not statistically significant at the 24th hours into the postoperative period (p=0.144) between the two groups.

There were no intraoperative complications observed during the study as shown in Figure 1.

DISCUSSION

We observed that QL-II block had a longer duration of effective analgesia than the TAP block in children coming for infra umbilical surgeries under general anesthesia and the difference was found to be statistically significant. This observation was comparable to the observation in the earlier study (6). The various post-operative analgesic modalities available for children undergoing infra umbilical surgeries are intra-venous analgesia, neuraxial techniques, TAP block, Ilioinguinal nerve, and QL block (6-8). The use of neuraxial anesthesia has been an integral part of pain management intra-operatively, and also in the postoperative period in children undergoing infra-umbilical surgery (9). With the advent of ultrasound-guided nerve block techniques, truncal blocks have become a mainstay in multimodal analgesia approaches in abdominal surgeries. The QL block is an abdominal truncal block where the local anesthetic spread is even more proximal to the origination of the innervation from the spinal cord as confirmed by the study of Carney et al (10,11).

A recent study studied the relationship between the efficacy of the TAP and QL-II block and local anesthetics blood levels in adults and reported that the level of local anesthetics was higher in the patients who received TAP block (12,13). In addition, the superficial anatomical location, less invasiveness, the lesser local anesthetics blood levels, and the effective form of postoperative analgesia led us to compare QL (Type II) block with that of the traditional TAP block. The QL block has been shown to deliver more successful pain relief, has an extended period of analgesic actions, extends interval to 1st analgesic necessity, and is accompanied by lesser morphine consumptions following laparoscopic surgeries (12). Though the QL block looks safe it has several anatomical differences from the TAP block apart from the site of injection, posterior QL block is associated with the abdominal branches of the lumber arteries and sympathetic innervation to the blood vessel and other structures also leads to hypotension and enhanced pain relief (3,11).

Table II: Distribution of Pain Score (FLACC Scale) at Varying Time Intervals among the Two Groups

Distribution of Pain Score (FLACC Scale) among the Two Groups						
FLACC scale	**Groups**	**n**	**Mean**	**SD**	**t-value**	**p-value**
0 Min	Group A	33	0.0	0.0	2.935	0.005*
	Group B	33	0.2	0.4		
30th min	Group A	33	0.0	0.0	3.714	0.001*
	Group B	33	0.4	0.6		
2nd hour	Group A	33	0.0	0.2	5.742	0.0005*
	Group B	33	0.8	0.8		
4th hour	Group A	33	0.1	0.3	6.535	0.0005*
	Group B	33	1.2	1.0		
8th hour	Group A	33	1.7	0.6	2.393	0.020*
	Group B	33	2.2	1.1		
24th hour	Group A	33	2.5	0.8	0.000	1.00*
	Group B	33	2.5	0.8		

n: Number of patients (n=33 in each group), **SD:** Standard deviation, **FLACC:** Facial expression, leg movement, activity, cry, and consolability scale
***analysed with independent sample t test.**

Table III: Distribution of Parent Satisfaction Scores among the Two Groups

Distribution of Parent Satisfaction Score among the Two Groups						
Time intervals	Groups	n	Mean	SD	t-value	p-value
4th hour	Group A	33	9.9	0.3	3.6540	0.001*
	Group B	33	9.2	1.0		
24th hour	Group A	33	9.6	0.5	1.4800	0.144*
	Group B	33	9.4	0.5		

n: Number of patients, **SD:** Standard deviation; ***analysed with independent sample t test.**

In terms of parental satisfaction scores, we have found the scores to be better at the 4th postoperative hour than that at the 24th hour in children who received QL block. This could be attributed to the requirement of additional analgesics as the block starts regressing in its intensity with time. Shamim F et al, have compared four pain assessment scales, Children's Hospital of Eastern Ontario Pain Scale (CHEOPS), Toddler Preschool Postoperative Pain Scale (TPPPS), Objective Pain Scale (OPS), and Face, Legs, Activity, Cry, Consolability (FLACC), FLACC scale had high sensitivity and specificity, so they have validated that FLACC scale for assessment of postoperative pain will be more effective for children up to 7years of age (14). Similarly, Minas et al. evaluated the correlation of the FLACC pain assessment scale with the Visual Analogue Scale, in assessing pain for pediatric patients in the Post Anesthesia Care Unit (PACU) and concluded that the FLACC scale can be an appropriate and valid alternative tool for assessing pain in children in the PACU (15).

To consider, our limitations of the study include: Firstly, blinding is not possible. The data was collected by a patient who is blinded to the study protocol. Secondly, the failed block was not possible to define. So we assumed that all the ultrasound guided planar blocks are providing analgesia in the postoperative period. The other limitation was that we didn't analyze the hemodynamic effects in the two groups, our inclusion criteria included surgical types with overlapping surgical dermatomal distribution and the FLACC scale at specified time interval has been compared between the groups. This study, provides a direction for future studies by comparing the type of QL blocks and the volume of local anesthetics required in each type of block.

To summarise, in this prospective randomized study, the QL-II block with 0.5 mL kg^{-1} of 0.2% bupivacaine given post-induction in children aged 1-7 years undergoing infra umbilical surgeries under general anesthesia was found to have a longer duration of effective analgesia, lesser pain scores at corresponding periods in the postoperative period and better parent satisfaction scores than TAP block which was also found to be statistically significant.

CONCLUSION

From our study we have concluded that the QL-II block provides longer duration of effective analgesia in the post–operative period in children aged 1-7 years undergoing infra umbilical surgeries under general anesthesia. Our study also showed that patients in the QL-II block group tend to have lesser pain scores (FLACC scale) and better parent satisfaction levels when compared with TAP block.

AUTHOR CONTRIBUTIONS

Conception or design of the work: GA, VS
Data collection: GA, VS
Data analysis and interpretation: GA, VS
Drafting the article: GA, VS
Critical revision of the article: GA, VS
The author (GA, VS) reviewed the results and approved the final version of the manuscript.

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