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RESEARCH

TAP block comfort for lower abdominal surgery in pediatric patients

Pediatrik hastalarda alt batın cerrahisi için TAP blok konforu

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Abstract

Purpose: The aim of this study was to examine the effect of The transversus abdominis plane (TAP) block after lower abdominal surgery on pain severity and additional analgesic requirement in a pediatric patient group.

Materials and Methods: In this retrospective study, 46 ASA I children aged 2-18 years undergoing abdominal surgery were divided into two groups. Group T (n: 20) patients who were under the general anesthesia received ultrasound-guided TAP block with 0.5 mL/kg of 0.25% bupivacaine immediately after the operation. Group O (n: 26) patients were administered intravenous (I.V.) 2 µcg/kg opioid (fentanyl) analgesia after recovery from general anesthesia. The patients were taken to the post-anesthesia care unit (PACU) for recovery and initial pain observation. Patients pain was assessed by using the Visual Analogue Scale (VAS) score within the first 24 hours following surgery.

Results: The incidence of the additional analgesic requirement in the TAP block(%15) group was statistically significantly lower than in the I.V. opioid group(%65). There was a difference between the first analgesic requirement and the discharging time according to TAP block administration, but it was statistically insignificant. The VAS scores at 4 hr and 8 hr in the TAP block group were statistically significantly lower than in the IV opioid group(4.VAS:4.90±1,21 5.90±0.85; 8.VAS:4.05±0.76 3.10±0.85). The VAS scores at postoperative 2 hr were decreased in both groups. However, the decrease in the VAS score at 2 hr was greater in the TAP block group.

Conclusion: TAP block was superior to IV opioids in reducing additional analgesic requirements in pediatric patients undergoing abdominal surgery. It will contribute further to early discharging a patient as it allows early mobilization.

Keywords:. TAP block, pediatric patient, abdominal surgery, VAS, opioid

Öz

Amaç: Bu çalışmada pediatrik hasta grubunda alt karın ameliyatı sonrası uygulanan transversus abdominis plan (TAP) bloğunun ağrı şiddeti ve ek analjezik ihtiyacına etkisini araştırmayı amaçladık.

Gereç ve Yöntem: Retrospektif gerçekleştirilen bu çalışmada abdominal cerrahi geçiren 2-18 yaş arası ASA I 46 çocuk iki gruba ayrıldı. Grup T(n:20) hastalarına genel anestezi altında operasyon tamamlandıktan hemen sonra 0.5 mL/kg %0.25 bupivakain ile ultrasonografik kılavuzluk eşliğinde TAP blok uygulandı. Grup O(n:26) hastalarına genel anesteziden ayılma sonrasında intravenöz(i.v.) 2 µcg/kg dozunda opioid(fentanil) analjezisi uygulandı. Derlenme ve ilk ağrı gözlemi için hastalar postanestezik bakım ünitesine(PACU) alındı. Ameliyat sonrası ağrı, ameliyattan sonra ki ilk 24 saat içinde Visual Analog Skala(VAS) skoru ile değerlendirildi.

Bulgular: TAP blok uygulanan olgularda ek aneljezik ihtiyacı görülme oranı(%15), I.V opioid uygulananlardan istatistiksel olarak anlamlı düzeyde daha düşüktü(%65). TAP blok uygulanma durumuna göre olguların ilk aneljezi ihtiyacı için geçen süreleri ve taburculuk süreleri arasında fark mevcut ancak istatistiksel olarak anlamlı değildi. TAP blok uygulanan olguların 4.saat ve 8. saat VAS skorları, I.V. opioid uygulanan gruba göre istatistiksel olarak anlamlı düzeyde daha düşük saptandı (4.VAS:4.90±1,21 5.90±0.85; 8.VAS:4.05±0.76 3.10±0.85). Her iki grupta da ameliyattan 2 saat sonra değerlendirilen VAS skorlarında azalma vardı. Ancak TAP blok uygulanan grupta 2. Saat VAS skorunda daha fazla düşme mevcuttu.

Sonuç: Abdominal cerrahi geçiren pediatrik hastalarda TAP blok ek analjezik ihtiyacını azaltma açısından I.V. opioide kıyasla daha üstün bulundu. Erken mobilizasyona olanak sağladığı için erken taburculuğa da katkısı olacaktır.

Anahtar kelimeler: TAP blok, çocuk hasta, abdominal cerrahi, VAS, opioid

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INTRODUCTION

Abdominal surgeries such as inguinal hernia, appendectomy, and undescended testicle are common operations in pediatric surgery units and postoperative pain is a very serious problem, especially for pediatric patients. Postoperative pain is mainly caused by visceroperitoneal pain due to peritoneal tension and inflammation in the abdominal wall incision line[1] Even though several methods such as opioids, non-steroidal anti-inflammatory drugs, local wound site injections, and peripheral nerve blocks have been tried for pain management, unfortunately, there is no clear information about which one is more effective. Nerves feeding the abdominal wall run along the neurofascial transversus abdominis plane which is between the internal oblique and transversus abdominis muscles[2]. Furthermore, side effects of opioids such as sedation, respiratory depression, itching, nausea, and vomiting limit their use in pediatric patients. Therefore, it is believed that the TAP block, which anesthetizes this region, would be more effective in pain reduction, and studies are carried out in this respect[3].

The TAP block is a peripheral block which provides regional anesthesia by blocking the anterior branches of T6-L1 spinal nerves and it is performed using two methods. This method, first described by Rafi in 2001, is performed as a blind technique through the triangle of Petit by palpating the advancement through two fasciae and administering a local anesthetic[4]. The other method is the ultrasound (US)-guided technique which was first described by Hebbard et al. in 2007[5]. They reported that its use would be more reliable and effective especially in older adults due to the thinning of muscle layers and obese patients due to difficulties in identifying the correct localization as well as anatomical difficulties[5].

Recent studies have been demonstrated the efficacy of the TAP block in pain management after abdominal surgery, but there are not enough studies on pediatric patients[6,7]. In the present study, our aim was to compare the adequacy of analgesic efficacy and the additional analgesic requirement within the first 24 hours postoperatively in pediatric patients who receive US-guided TAP block compared to those who receive I.V. opioids. Tap block reduces the need for additional analgesics in children and it is more effective in postoperative pain control. In addition, this information can have important implications for pain management, early mobilization and early discharge in pediatric patients.

MATERIALS AND METHODS

This retrospective study was started in the Yozgat City Hospital pediatric service under the permission of Yozgat Bozok University Ethics Committee (Protocol no: 2017-KAEK-189_2022.01.27_02) and its written approval. The study was carried out in Yozgat city hospital. The study included 46 ASA (American Society of Anesthesiologists) I patients aged 2–18 years who underwent abdominal surgery. Patients who have additional disease and over 18 years old were excluded from the study as well as patients who were in need of intensive care and we could not obtain reliable data about their pain level. Therefore, 6 patients were excluded from the study. Patient records were obtained from the computer archive (with HIMSS level 7 validation) and nurse observation files. Patients with local anesthetic allergy, without family consent for TAP block administration, and with neuropsychiatric disorders preventing VAS assessment were also excluded from the study.

Procedure

Tap block application and data collection

The patients were divided into Group T for TAP block (n=20) and Group 0 for I.V. fentanyl (n=26). However, six patients in Group O were excluded due to insufficient data, so the study continued with 20 patients. General anesthesia was administered to all patients with 0.03 mg/kg midazolam, 1-2 mg/kg lidocaine, 3-4 mg/kg propofol, 0.8 mg/kg rocuronium bromide, and 2 μg/kg fentanyl, and endotracheal intubation was performed by using age-appropriate endotracheal tubes. The patients who received sevoflurane for maintenance anesthesia were administered additional doses of 0.2 mg/kg rocuronium bromide if required. Baseline parameters (SpO_2, pulse rate, blood pressure) were also recorded. Intraoperative hemodynamic parameters were recorded every 5 min throughout the surgery.

The Group O patients received 2 μg/kg I.V. fentanyl after the surgery. The Group T patients received a TAP block after the surgery. After achieving the necessary antiseptic conditions in the supine position, the linear probe of the ultrasound was placed in to the middle of the costal margin and the iliac crest.

The ideal view of the fasciae was obtained by directing the probe, and a 22 gauge 80 mm needle was inserted into the skin in line with the probe. The needle was advanced through the area between the internal oblique and transversus abdominis muscles. To exclude vascular puncture, 0.5 ml kg - 0.25% bupivacaine solution was administered to the neurofascial plane by aspiration at frequent intervals.

Visual analog scale

Visual analogue scales (VAS) are psychometric measuring instruments designed to document the characteristics of disease-related symptom severity and it is used to achieve a rapid (statistically measurable and reproducible) classification of symptom severity and disease control in individual patients

After recovery from general anesthesia, the patients were followed up in the PACU for recovery and initial pain observations. As our hospital is aware of the importance of postoperative pain in pediatric patients, pain is monitored using VAS scores as a routine. All patients and their parents are given instructions on how to assess postoperative pain using the VAS, from 0 = no pain to 10 = worst pain, and the scores are noted on patient observation sheets. The first postoperative pain scores were recorded as VAS score at 0 hr and the VAS scores at 2^{nd} hr, 4^{th} hr, 8^{th} hr, 16^{th} hr, 24^{th} hr were also recorded as well as additional analgesic requirements of the patients who were taken to the pediatric service. Discharging time were retrieved from the computer data system. Both groups of patients were administered 10 mg/kg paracetamol at the postoperative at 4^{th} hr. All treatments and additional analgesic doses were obtained from nurse observation notes. When VAS values are 4 and above, additional cases; It was questioned whether he or she needed analgesics and 75 mg İ.V. NSAİİ was administered if needed. Our primary aim is to assess postoperative pain scores after a US-guided TAP block. Our secondary aim is to observe the requirement for additional postoperative analgesia after TAP block administration compared to opioids. In addition, there is no clear information about which techniques are more effective in pain management after such surgical procedures in pediatric patients and therefore, it is believed that our study will contribute to the literature.

Statistical analysis

Data obtained in the study were analyzed statistically using by the Statistical Package for the Social Sciences software package (SPSS Ver. 20.0, IBM). Conformity of the data for normal distribution was assessed by using the Kolmogorov-Simirnov test. The independent samples t-test was used to analyze normally distributed quantitative data. Data which did not show normal distribution and the non-parametric data were evaluated by using the Mann-Whitney U test. The chi-square ($\chi 2$) test was used to compare qualitative data. A value of $p < 0.05$ was accepted as statistically significant.

RESULTS

The study was conducted with a total of 40 cases, 30% (n=12) female and 70% (n=28) male. The participants were aged from 2 to 17 years, and the mean values of demographic characteristics were determined (Table 1). There was no statistically significant difference between the group T and group O ($p>0.05$) in gender, age, weight, BMI measurements, and length of surgery.

Table 1. Distribution of demographic characteristics.

Variable		n (%)
Sex	Female	12 (30.0)
	Male	28 (70.0)
Age(years)	Mean±Sd	9.28±4.71
	Median (Min-Maks)	8.5 (2-17)
Weight (kg)	Meant±Sd	28.32±18.19
	Median (Min-Maks)	22.5 (10-80)
BMI (kg/m^2)	Meant±Sd	19.73±3.90
	Median (Min-Maks)	19.7 (11.8-29.9)
Operation time (min)	Meant±Sd	48.88±15.63
	Median (Min-Maks)	45 (25-90)
Type of analgesia	I.V. Fentanyl	20 (50.0)
	TAP block	20 (50.0)

BMI: Body measure index, Min: minüte, kg: kilogram; I.V.: intravenous, TAP: Transversus abdominal plan

Duration of the first analgesic requirement varied between 60 and 240 min, with a mean time of 154.57 ± 68.80 min. The additional analgesic doses required by the participants ranged from 100 mg to 300 mg, with a mean dose of 158.75 ± 49.24 mg. It was found that 40% (n=16) of the cases required additional analgesics. The incidence of the additional analgesic requirement was statistically significantly lower in the group T than in the group O (p=0.001). There was no statistically significantly difference in duration of first analgesic requirement, the additional analgesic dose, and the discharging time according to TAP block administration (p>0.05). The discharging time of the study participants varied between 24 hours and 48 hours, with a mean discharging time of 32.90 ± 8.19 hours (Table 2).

Table 2. Distribution of findings related to the disease

Time to first request analgesic (min)	Meant±Sd	Group O 156.75±72.91	Group T 140.00±34.64	P [b]*0.741*
	Median (Min-Maks)	150 (60-240)	120 (120-180)	
Rescue analgesia requirement dosage (mg)	Meant±Sd	162.31±51.83	143.33±40.41	[c]*0.566*
	Median (Min-Maks)	150 (110-300)	150 (100-180)	
The need for rescue analgesics	No	7 (35.0)	17 (85.0)	[a]*0.001***
	Yes	13 (65,0)	3 (15.0)	
Discharge time	Meant±Sd	34.40±8.07	31.40±8.24	[c]*0.143*
	Median (Min-Maks)	34 (24-48)	28 (24-48)	

Min: minute, mg: miligram

Table 3. Evaluation of the VAS score between the two groups

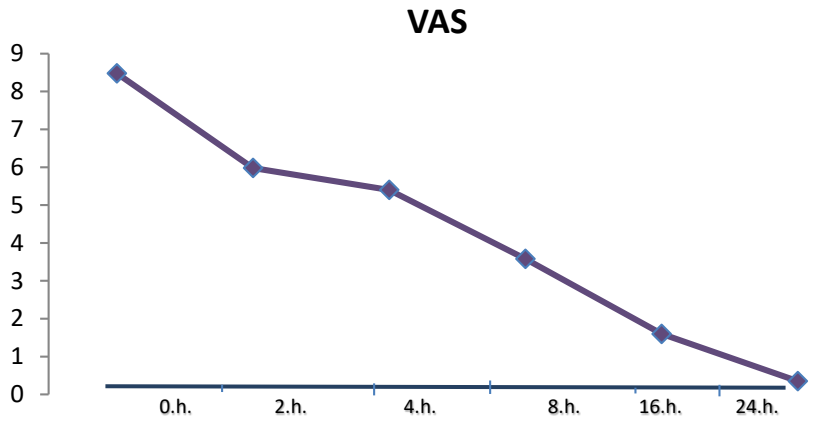
VAS			Type of Analgesia		
		Total	I.V Opioid (n=20)	TAP Block (n=20)	*p*
0.hour	Mean±Sd	8.48±0.93	8.25±0.91	8.70±0.92	c0.129
	Median (Min-Max)	8 (7-10)	8 (7-10)	9 (7-10)	
2.hours	Mean±Sd	5.98±1.14	6.25±1.07	5.70±1.17	c0.130
	Median (Min-Max)	6 (4-8)	6 (5-8)	5.5 (4-8)	
4. hours	Mean±Sd	5.40±1.15	5.90±0.85	4.90±1.21	c0.004**
	Median (Min-Max)	5 (3-8)	6 (5-8)	5 (3-8)	
8. hours	Mean±Sd	3.58±0.93	4.05±0.76	3.10±0.85	c0.001**
	Median (Min-Max)	4 (2-5)	4 (3-5)	3 (2-4)	
16. hours	Mean±Sd	1.60±0.74	1.75±0.72	1.45±0.76	c0.206
	Median (Min-Max)	1.5 (0-3)	2 (1-3)	1 (0-3)	
24. hours	Mean±Sd	0.35±0.48	0.45±0.51	0.25±0.44	b0.190
	Median (Min-Max)	0 (0-1)	0 (0-1)	0 (0-1)	
	p	d0.001**	d0.001**	d0.001**	
Değişim Δ					
0.h-2. h	Mean±Sd	-2.50±1.66	-2.00±1.56	-3.00±1.65	b0.069
	p	dd0,075	dd0,638	dd0,779	
0.h-4.h	Mean±Sd	-3.08±1.54	-2.35±1.27	-3.80±1.47	b0.003**
	p	dd0,002**	dd0,240	dd0,031*	
0.h-8.h	Mean±Sd	-4.90±1.52	-4.20±1.28	-5.60±1.43	b0.004**
	p	dd0,001**	dd0,001**	dd0,001**	
0.h-16.h	Mean±Sd	-6.88±1.36	-6.50±1.10	-7.25±1.52	b0.041*
	p	dd0.001**	dd0.001**	dd0.001**	
0.h-24.h	Mean±Sd	-8.13±1.20	-7.80±1.11	-8.45±1.23	b0.066
	p	dd0.001**	dd0.001**	dd0.001**	

[b]Mann Whitney U Test; [c]Student T Test; [d]Friedman Test & Friedman Test & Bonferroni corrected pairwise comparisons
*p<0.05; *p<0.01; VAS: Visual analog scala

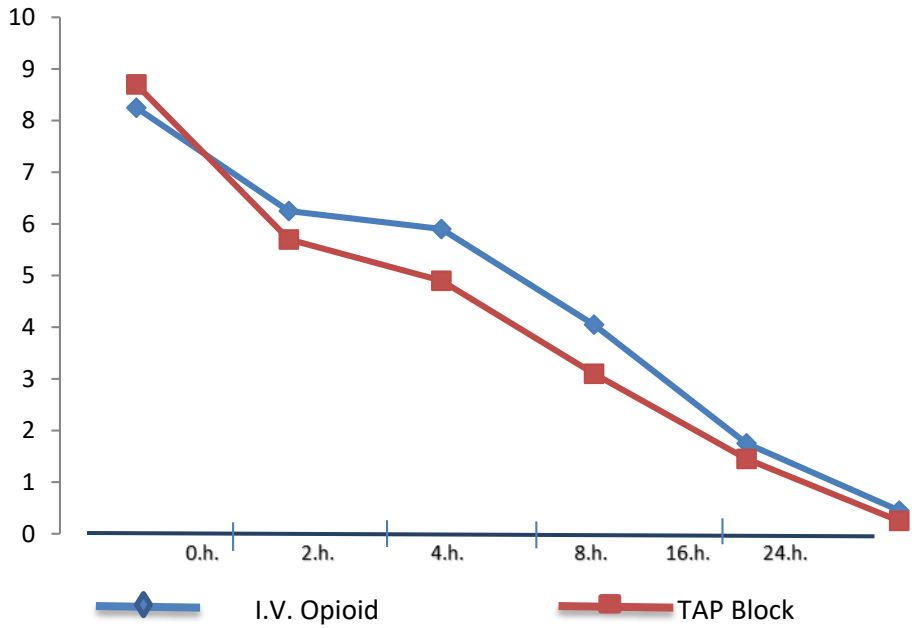
The VAS scores at 4 hr were statistically significantly lower in the group T than in the group O(p=0.004). As well, the VAS scores at 8 hr were statistically significantly lower in the group T than in the group O(p=0.001). The VAS scores at 0 hr, 2 hr, 16 hr, and

24 hr did not statistically significantly differ according to the TAP block administration (p>0.05) (Table 3).

For all cases (Graph 1), there was a statistically significant difference between 0 hours and 2, 4, 8, 16, and 24 hours (p=0.001) in the VAS scores. The mean decrease of 3.08 ± 1.54 units in the VAS scores at 4 hr compared to 0 hr was statistically significant (p=0.002). The mean decrease of 4.90 ± 1.52 units in the VAS scores at 8 hr compared to 0 hr was statistically significant (p=0.001). The mean decrease of 6.88 ± 1.36 units in the VAS scores at 16 hr compared to 0 hr was statistically significant (p=0.001). The mean decrease of 8.13 ± 1.20 units in the VAS scores at 24 hr compared to 0 hr was statistically significant (p=0.001).



Graph 1. Variation of VAS score over time



Graph 2. Variation of VAS scores according to analgesia type and time

The change in 4-hr VAS score compared to 0 hr was statistically significantly greater in the group T than in the group O(p=0.003). The change in 8-hr VAS score was statistically significantly greater in the group T than in the other group when it was compared at 0 hr (p=0.004). The change in 16-hr VAS score compared to 0 hr was statistically significantly greater in the group T than in the other group (p=0.041). The changes in the 2-hr VAS score compared to 0 hr and the 24-hr VAS score compared to 0 hr did not statistically significantly differ according to the groups (p>0.05) (Graph 2).

DISCUSSION

This study was conducted to assess the analgesic efficacy of the TAP block and the requirement for additional analgesics. A multimodal analgesic approach has become essential for pain management and accelerated recovery after abdominal surgery in children. Opioids with high analgesic efficacy but with too many side effects were compared with the TAP block administration, which provides more controlled analgesia under US guidance. Our study statistically and clinically shows that the TAP block is more effective in reducing postoperative pain and it reduces the rate of additional analgesic use compared to IV opioids. A similar study reported a reduction in the 48-hr morphine requirement and a longer time to the first morphine requirement in children who received a unilateral TAP block with ropivacaine[8]. At the same time, another study by Wu et al. compared the TAP block with IV opioids and it is demonstrated that the TAP block was more effective in reducing pain and achieving prolonged relief[9]. Our findings are compatible with the literature.

Fentanyl is an opioid receptor agonist. It has a wide margin of safety and it has minimal effects on the cardiovascular and respiratory systems, and thus this is an effective and safe analgesic agent[10]. Several studies show that IV fentanyl is an effective analgesic in the management of pain in pediatric patients. E. Rawlinson et al. demonstrated that intraoperative IV fentanyl not only provided good analgesia in tonsillectomy patients but it was also equivalent to morphine in terms of the analgesic effect[11]. It has been shown that opioids are among the most common analgesics preferred for pain management in children as well as in all age groups, and may cause serious side effects such as nausea, vomiting, respiratory depression, and urinary retention[12]. Given the fact that motor blockade methods such as spinal anesthesia delay mobilization and thus discharge, the TAP block administration in children has recently become more popular[13]. In addition, Erbacan et al. divided the patients who will undergo lower abdominal surgery into 2 groups in their study, and they applied 0.5% bupivacaine and 1% lidocaine with 30 mL of TAP block to one group and PCA with IV morphine to the other group. They observed similar analgesic efficacy in both groups. However, they concluded that TAP block could be an alternative to avoid the side effects of morphine[14]. Therefore, such studies in the literature allow more widespread use of tap block.

The TAP block, which was previously performed using a blind technique but then became more reliable with the introduction of the US, it has become one of the most preferred methods for pain management, especially after pediatric abdominal surgery. A previous study which compares US-guided TAP block and caudal block for postoperative analgesia in children undergoing inguinal hernia surgery shows that the TAP block provided prolonged analgesia and a lower total amount of rescue analgesic consumption 6-24 hours after the block placement compared to caudal block[15]. Priyanka P Karnik et al. observed that the pain scores in the TAP block group were considerably lower in the first 2 hours compared to the local infiltration group[16].

In our study, there was a decrease in the VAS scores at 0 hr in the TAP block group, but the difference was insignificant. This was attributed to the pain-relieving effect of the TAP block through a nociception blockade and thus the delayed effect[8]. The significant difference in the VAS scores at 4 hr and 8 hr between the two groups suggests that the efficacy of the TAP block begins in the following hours and provides prolonged pain management compared to opioids. In line with our findings, a previous study reported that half of the patients who received a TAP block required no IV opioids postoperatively[17].

In the study of Nomaqhawe et al., after hysterectomy performed under general anesthesia, 21 mL of 0.25% bupivacaine and 4 mg of dexamethasone was administered to one group, and to the other group (control) was TAP block with 21 mL of 0.9% saline, and also postoperative intramuscular pethidine

injections was applied to all patients[18]. It has been reported that the pain scores measured at the 2nd and 4th hours of postoperative rest were the same, but the pain scores were lower in the group that received bupivacaine and TAP block during movement and after the 4th hour. In the same study, the first analgesic administration time was later in the group with bupivacaine and TAP block. The lower pain scores in the TAP group after the 4th hour postoperatively were explained by performing the block at the end of the operation. In our study, in accordance with the literature, there was a significant decrease in VAS scores in the group we applied tap block in the following hours. The decrease in Vas scores allowed us to mobilize earlier and contributed to the early mobilization of the patients. However, due to the small sample size, no statistically significant difference was observed.

In their study, Cansız et al. applied TAP block with 20 mL of levobupivacaine at a concentration of 0.25% (40 mL in total) bilaterally to one group after the cesarean section performed under spinal anesthesia, and they did not apply TAP block to the other group. Similarly, the first analgesic administration time was longer in the TAP group compared to the control group. They found the need for postoperative analgesics to be higher in the control group[19]. In another study comparing the effects of patient-controlled analgesia (PCA), IV morphine and TAP block applications on postoperative pain control in patients with nephrectomy, it was reported that the need for additional analgesics was less in those who underwent TAP block, and the need for first analgesia was later compared to other groups[20].

Noelle et al., in their study, applied TAP block to half of 65 patients who underwent renal transplantation with 20 mL of 0.375% levobupivacaine and to the other half using a blind technique with 20 mL of 0.9% saline. Both groups were given morphine with PCA. When the postoperative morphine requirement and pain scores were compared, no significant difference was observed between the two groups, unlike our study. In this study, it was reported that this result may be due to the blind technique of Tap block application[21]. In the literature, there are studies showing that TAP block application with USG requires longer duration of analgesia and less additional analgesic requirement compared to caudal block application[22].

In our study, 40% of the patients required rescue analgesia and 82% of them were in the group in which we gave IV fentanyl. This statistically significant difference between the two groups supports the idea that TAP block has a longer effect and less need for additional analgesics. In addition, the high requirement for rescue analgesia for group o patients suggests that fentanyl alone is not an adequate pain reliever for abdominal surgery, and studies with larger patient participation are needed. Our study identified a higher level of total additional analgesic doses in the opioid group, but the difference was statistically insignificant. It is believed that the older age and higher weight of the pediatric group who received the TAP block contributed to this finding. This was supported by a literature review concluding that the TAP block was more effective in early age children than in older children[23]. This is strongly due to the effect of subcutaneous adipose tissue and organomegaly with increasing age and weight. In our study, the time to first analgesic requirement was shorter in children under 5 years of age. This may be due to the difficulties in distinguishing pain from other problems in this age group.

There were some limitations in our study. No drug-related side effects were observed in each group. While other studies mentioned the side effects such as respiratory distress or nausea and vomiting due to opioids, the absence of such effects in our cases might have been occurred due to the small sample size. Further research is needed in this regard. Another limitation was experienced during the VAS assessment. In our country, children often pain scales used, FLACC (Face, Legs, Movement, Crying, Consolation), VAS and Wong Baker Faces Pain Rating Scale are face scales. This scales are visual pain measurement tools and only facial expressions are evaluated. The development of children in adolescence self-reported visual pain tools can be used safely. In our study, all pediatric patients up to the age of 18 were targeted. Pain was evaluated with VAS evaluation, predicting that children in the adolescence period can make voluntary positivity or negativity in pain scales. Pain assessments of children under the age of 5 were carried out under the supervision of their parents. This did not allow an objective pain assessment as much as the assessment in older children. Finally, sevoflurane is known to cause emergence agitation in children[24]. Anesthesia was maintained with sevoflurane after induction in all patients. Accordingly, the effect of emergence

agitation induced by sevoflurane could not be included in the study.

With effective postoperative pain management, surgical stress and morbidity are reduced. The development of regional anesthesia methods offers an effective option in the treatment of pain. In addition, the high level of patient satisfaction with TAP block encouraged us to work with different protocols on these issues.

In conclusion both practices were effective in reducing pain in the early period after pediatric abdominal surgery, but the US-guided TAP block provided prolonged analgesia and less requirement for additional analgesics compared to IV opioids.

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