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Original Research

Circumcision in children: postoperative analgesic efficiency of transversus abdominis plan block vs caudal epidural block: a prospective observational study

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Abstract

Background and objective: Circumcision is one of the most common operations and can cause postoperative pain, fear, and anxiety for children. This study aims to compare the effects of transversus abdominis plane (TAP) block and caudal epidural (CE) anesthesia on postoperative analgesia after circumcision in providing postoperative pain control. **Methods**: Eighty boys aged 1 to 14 years who underwent elective circumcision surgery under general anesthesia either with USG-guided TAP block or with CE block for postoperative analgesia were enrolled consecutively to this prospective observational study equally in each group. Postoperative pain scores and need for rescue analgesia were recorded and compared between the two groups. **Results**: There was no statistically significant difference between the groups in mean age and Aldrete scores ($p > 0.05$). Body mass index (BMI) of the caudal block group was statistically lower than the TAP group ($p < 0.05$). While there was no statistically significant difference between the groups in 30th-minute VAS values ($p > 0.05$), the CE block group's 1st, 2nd, 4th, 8th, 12th, 18th, and 24th hour VAS values were statistically lower than the TAP block group's ($p < 0.05$). **Conclusion**: USG-guided TAB block under general anesthesia was not associated with lower postoperative pain scores and delayed rescue analgesia need compared with CE block in patients who underwent elective circumcision surgery. CE block provided superior analgesia than the USG-guided TAP block after elective circumcision surgery in this study.

Keywords: Circumcision; Caudal epidural block; Transversus abdominis plane block; Postoperative pain

1. Introduction

Circumcision of boys is one of the most common operations performed by pediatric surgeons, and although it is performed daily, it can cause fear and anxiety in children. Therefore, anesthesia management is very important in this patient group [1,2]. Postoperative pain management is important. It can involve the intravenous use of various opioids and non-steroid anti-inflammatory analgesics. Regional anesthesia techniques are also used for postoperative analgesia in pediatric patients. Caudal epidural anesthesia (CEA) is accepted as the gold standard for postoperative pain control after lower abdominal and perineal pediatric surgeries [1,2]. Although CEA is highly effective and safe, its use can lead to complications related to dural damage, its ability to cause a motor block in the lower extremities, and impairment of bladder function, so limiting its use [3,4].

In the pediatric patient population, with ultrasound (USG) guidance, different regional anesthesia techniques have been applied, with similar indications. With USG guidance, transversus abodominis plane (TAP) block has become a widely used method for surgical anesthesia and postoperative analgesia under anesthesia or sedation, similar to CEA [3,5]. With TAP block, nerves belonging to the T7-L1 spinal afferents responsible for inguinal dermatomal innervation of the body can be blocked in the space between the transversus abdominis and the internal oblique muscles [6]. In providing postoperative pain control, transversus abdominis plane block can produce either equivalent or superior postoperative analgesia to caudal block [5,6].

This study aims to compare the effects of USG-guided TAP block and CEA on postoperative analgesia after circumcision in providing postoperative pain control.

2. Materials and methods

This prospective observational study, performed after local ethics committee approval (Decision no: 1046, Date: November 20, 2018) was conducted over 2 months from May 10, 2019, to July 10, 2019, at the Anesthesiology and Reanimation Department of the Okmeydanı Training and Research Hospital. Written informed consent was obtained from the parents of the participants who met the inclusion criteria for the study.

Eighty male patients aged between 1 and 14 with American Society of Anesthesiologists (ASA) Physical Status Classification I and II, scheduled for circumcision under general anesthesia and either USG-guided TAP block or caudal epidural (CE) block for postoperative analgesia were enrolled consecutively to this prospective observational study.

Patients with pre-existing neurological deficit or disorder, severe systemic disease, mental retardation, bleeding diathesis, psychiatric disorder, a history of hypersensitivity to local anesthetics (LA), and who refused to participate were excluded from the study.

Intravenous propofol at a dose of 2–4 mg/kg was used for general anesthesia. For maintenance of general anesthesia, sevoflurane was used with an oxygen/air-gas mixture. An appropriate laryngeal mask appropriate to the child's age and weight was inserted without using any neuromuscular blocking drug.

All blocks were performed in the operating room, with standard monitoring, under general anesthesia, and with the aseptic technique by an anesthesiologist especially interested in pediatric regional anesthesia and blind to the study to avoid block failure. Patients in the TAP block group underwent a bilateral ultrasound-guided (USG) TAP block (Mindray Medical International Co., Ltd., Shenzhen, China) with a linear probe and using a 25 G, 50 mm block needle (Stimuplex®, B.Braun, Melsungen, Germany) to confirm appropriate needle placement and local anesthetic spread between the transversus abdominis and internal oblique muscles. In the CE block group, the CE block was performed with the landmark technique in the lateral decubitus position, with caudal epidural space identified by palpation and corrected by the 23-gauge needle. For TAP block, 0.5 mL/kg of 0.25% bupivacaine was introduced on each side of the anterior abdominal wall and for CE block 0.5 mL/kg of 0.25% bupivacaine was used. If appropriate LA spread and needle placement were not observed, the patient was excluded from the study. An increase in intraoperative heart rate of $\geq$20% after the incision was accepted as an exclusion criterion for the patient from the study.

After surgery, all patients were discharged from the operating room to the Post Anesthesia Care Unit (PACU) where the study was started. An anesthesiologist blinded to the study enrolled consecutively 40 male patients with TAP block to the USG-guided TAP block group and 40 patients with CE block to the CE block group. All patients were observed by a nurse, who was blind to the study, for pain score, need for rescue analgesia, heart rate (HR), Aldrete scores (5th and 20th minute), and complications at first 30th minute, 1st, 2nd, 4th, 8th, 12th, 18th, and 24th hours after discharge from the operating room to PACU and into the ward. Pain assessment of patients under the age of 3 years was performed with the Face, Legs, Activity, Cry and Consolability (FLACC) scale and for other patient's with the Faces Pain Scale—Revised (FPS-R) over 10 (where a score of 10 means the most severe pain and 0 means the absence of pain). When the pain scores were above 5, patients in both groups received paracetamol as a first rescue analgesic at a standard intravenous (iv) dose of 10 mg/kg. Demographic characteristics were also collected.

The primary outcome was to compare pain scores between groups. The secondary outcome was to compare the time of first rescue analgesics in each group and complications.

2.1 Statistical analysis

The Statistical Package for Social Science (SPSS Inc., Chicago, IL, USA) for Windows, Version 22.0 was used for statistical analysis of the data. The compliance of the measurement values obtained within the scope of the research to the normal distribution was examined with the Shapiro-Wilk Test. In the display of descriptive statistics, mean $\pm$ standard deviation was used for variables conforming to the normal distribution, median (25th percentile – 75th percentile) for data not conforming to the normal distribution, and n values and percentages were used for displaying categorical variables. In the comparison of continuous measurements between groups, if the assumptions were met, the Student's *t*-test was used in independent groups, and the Mann Whitney U test was used if the assumptions were not met. The statistical significance was $p < 0.05$ in all tests.

2.2 Power analysis

The study of Sethi *et al*. [3] was taken into consideration for performing power analysis for our study. As a result of the power analysis using the G*Power program, when effect size d is 0.903 and SD 1.3 for the postoperative VAS parameter, the number of samples needed for power of 0.80 and significance level of 0.05 was found to be a minimum of n = 21 for each group.

3. Results

The study was conducted using two groups with 80 patients, 40 (50%) in the CE block and 40 (50%) in the TAP block group. The mean age and mean body mass index (BMI) were (4.53 $\pm$ 2.22) years and (16.19 $\pm$ 2.18) kg/m^2, respectively (Table 1). No statistically significant intergroup difference was found between the 5th and 20th minute Aldrete scores ($p > 0.05$) [7].

The mean age of groups was also similar ($p = 0.087$). The BMI values were significantly higher in the TAP group than in the CE group ($p < 0.001$). The 30th-minute VAS scores were similar ($p = 1.00$), but the pain scores in the CE block group at the 1st, 2nd, 4th, 8th, 12th, 18th, and 24th hours were significantly lower than in the TAP block group ($p < 0.001$) (Table 2).

In the 4th hour after surgery, the pain scores of 40% of the patients in the TAP block group were $\geq$5 indicating a requirement for rescue analgesia in the postoperative period. During 24-hour follow-up all patients in the TAP block group needed pain relief. Just one of the patients who underwent CE block required rescue analgesia in the postoperative 24-hour follow-up and this was administered at the 18th hour.

The HR levels were similar between groups in the first 30th minutes and 24th hour ($p = 0.12$ and $p = 0.34$, respec-

Table 1. Assessment of age, BMI and Aldrete scores between groups.

	CE block group (40)	TAP block group (40)	Total (80)	*p*-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Age, years	4.1 ± 2.44	4.95 ± 1.91	4.53 ± 2.22	0.087
BMI, kg/m^2	14.8 ± 2.21	17.6 ± 0.92	16.19 ± 2.18	<0.001*
Aldrete scores, (5th min)	8.67 ± 0.14	8.74 ± 0.19	8.71 ± 0.18	0.22
Aldrete scores, (20th min)	9.95 ± 0.03	9.97 ± 0.02	9.96 ± 0.03	0.52

Student *t*-test *$p < 0.05$, BMI, body mass index; SD, standard deviation; Min, Minute.

Table 2. Comparison of pain scores between groups.

Pain scores	CE block group (n = 40)	TAP block group (n = 40)	Total (n = 80)	*p*-value
	Mean ± SD	Mean ± SD	Mean ± SD	
30th min	0 ± 0 (0)	0 ± 0	0 ± 0	1.000
1st hour	0.10 ± 0.44	0.60 ± 0.67	0.35 ± 0.62	<0.001*
2nd hour	0.40 ± 0.98	2.15 ± 0.86	1.28 ± 1.27	<0.001*
4th hour	0.95 ± 1.22	4.40 ± 0.67	2.68 ± 1.99	<0.001*
8th hour	1.45 ± 0.99	5.05 ± 1.30	3.25 ± 2.14	<0.001*
12th hour	1.50 ± 1.09	3.20 ± 0.88	2.35 ± 1.30	<0.001*
18th hour	1.15 ± 0.80	2.35 ± 0.58	1.75 ± 0.92	<0.001*
24th hour	0.45 ± 0.68	1.10 ± 0.63	0.78 ± 0.73	<0.001*

Mann Whitney U test *$p > 0.05$; SD, standard deviation.

Table 3. Evaluation of heart rate between groups.

Heart rates	CE block group (40)	TAP block group (40)	Total (80)	*p*-value
	Mean ± SD	Mean ± SD	Mean ± SD	
30th min	102.7 ± 4.6	100.9 ± 5.5	101.8 ± 5.1	0.12
1st hour	97.7 ± 4.3	101.4 ± 5.8	99.55 ± 5.4	0.002*
2nd hour	98.0 ± 5.3	105.6 ± 4.1	101.8 ± 6.1	<0.001*
4th hour	100.6 ± 5.6	112.8 ± 4.4	106.7 ± 7.9	<0.001*
8th hour	103.9 ± 6.3	115.2 ± 8.0	109.5 ± 9.2	≤0.001*
12th hour	105.1 ± 6.9	107.8 ± 4.0	106.4 ± 5.7	0.037*
18th hour	101.9 ± 4.2	104.5 ± 2.5	103.2 ± 3.7	0.002*
24th hour	97.5 ± 3.4	98.2 ± 2.9	97.8 ± 3.2	0.34

Student's *t*-test *$p < 0.05$; SD, standard deviation.

tively), just as the VAS scores, but the HR levels were significantly higher in the TAP block group at the 1st, 2nd, 4th, 8th, 12th, and 18th hours than in the CE block group (Table 3).

4. Discussion

In this prospective observational study, we compared the analgesic effects of USG-guided TAP block and CE block on postoperative pain management of male children undergoing circumcision surgery. Our data analysis showed that the USG-guided TAB block under general anesthesia was not associated with lower pain scores and the need for delayed rescue analgesia compared with CE block in boys aged 1–14 years who underwent elective circumcision surgery.

Postoperative pain has special importance for male children after circumcision [1]. For postoperative analgesia after pediatric surgeries, regional anesthesia techniques are performed very commonly. CE anesthesia is accepted as a gold standard for analgesia after lower abdominal pediatric surgeries [8,9]. Its vulnerability to serious complications such as dural damage, and ability to cause a motor block in the lower extremities resulting in impairment of bladder function limit its use. After understanding the anterior and posterior anatomy of the abdominal wall, different regional anesthesia approaches such as quadratus lumborum block and TAP block with similar indications to CEA in the lower abdominal surgeries have become widely used with ultrasound guidance [10,11].

Although the USG-guided TAP block is safe and efficient for analgesia after lower abdominal and perineal surgeries, concerns remain about its indications [12–16]. The

number of studies is insufficient for comparing directly the efficacy of TAP block with CE block in children [8,17]. This led us to evaluate the effectiveness of TAP block, which is easy to perform with ultrasound, for postoperative analgesia after circumcision [10,18].

In our study, we prospectively compared USG-guided TAP block with CE block for pain management after circumcision in male children for whom both blocks are well suited. Our study is the first prospective observational study to compare TAP block with CE block for postoperative analgesia after circumcision of male children [17,19].

While the major drawback of this study is the lack of patient randomization for the interventions tested, in this prospective observational study we tried to measure the effectiveness of the two different regional anesthesia techniques used for postoperative analgesia after circumcision surgery in pediatric patients in daily routine clinical settings. So we did not use randomization and we did not want the anesthesiologist to be involved with the study because it would have affected his attitude to the patient and to the block he performed. If we performed randomization, the anesthesiologist would have tried to do his best contradicting what we wanted. We did not evaluate the block success rate of the anesthesiologist. We tried to evaluate the postoperative analgesic effects of the two successful different blocks that we use in our clinic after pediatric circumcision surgery. Randomization would also limit our patient number in each group and we would also have to evaluate the block success rate of the anesthesiologist, which was something that was not the topic of this study. So for these reasons, we did not perform randomization in our study. Instead, participants were allocated consecutively into the groups.

USG-guided TAP block is safe and effective after lower abdominal and perineal surgeries for postoperative analgesia. There are, however, insufficient studies and evidence to determine the correct indications in children [5,17,19]. None of the previous studies have directly compared the efficacy of USG-guided TAP block with either CE or USG-guided dorsal penile nerve block (DPNB) for postoperative analgesia after male pediatric circumcision surgery. USG-guided TAP block was compared with CE block after lower abdominal surgery for postoperative analgesia in one study and was found more effective [8]. In another study, the USG-guided TAP block provided superior analgesia with less demand for rescue analgesia dose than the CE block in children after inguinal herniotomy [6]. As well, in the pediatric patient population, the postoperative analgesic benefits of USG-guided DPNB and CE block were compared after distal hypospadias surgery and circumcision, and in both studies, USG-guided DPNB provided superior analgesia than CE block [20,21].

In another study, after lower abdominal surgery, CE block provided longer postoperative analgesia than TAP block [3]. This study also demonstrated that CE block is more effective than USG-guided TAP block for postoperative analgesia in patients undergoing circumcision surgery. Our results showed that CE block provided better analgesia than USG-guided TAP block from the 1st to 24th hour after surgery, with statistically significant lower pain scores, which was our primary endpoint. The need for the first rescue analgesia in the TAP block group was at the 4th hour postoperatively, and the pain score of 16 patients (40%) in the TAP group was $\geq$5 at the 4th hour, which was our second endpoint. Just one of the patients with CE block (2.5%) required rescue analgesia at the 18th hour in the postoperative 24-hour follow-up. However, there were no side effects or complications in either group.

5. Conclusion

In conclusion, CE block provided superior analgesia than USG-guided TAP block after male elective circumcision surgery.

Author contributions

Study Design: MM, ST. Data Collection: MM, ST. Data Analysis: BBG, MM. Writing Original Draft: BBG, MM. Manuscript Review and Editing: MM, BBG, ST. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The participants were informed about the study procedures and a written informed consent was signed. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the local ethics committee of Okmeydanı Training and Research Hospital (approval number: 1046, November 2018).

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Conflict of interest

The authors declare no conflict of interest.

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