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ARAŞTIRMA / RESEARCH

Comparison of postoperative analgesic effectiveness of caudal block, dorsal penile nerve block, and pudendal nerve block in children undergoing circumcision

Sünnet cerrahisinde kaudal blok, dorsal penil sinir bloğu ve pudendal sinir bloğunun postoperatif analjezik etkinliğinin karşılaştırılması

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Abstract

Purpose: This study aimed at comparing the postoperative analgesic effectiveness of three types of nerve blocks (caudal block, dorsal penile nerve block (DPNB), and pudendal nerve block (PNB) in children undergoing circumcision.

Materials and Methods: In this retrospective study, patient records of those who underwent circumcision during an 18-month period were included in this study. Data collected included demographics, intraoperative hemodynamic parameters, nerve block application time, rescue analgesic time, duration of anesthesia and surgery, recovery time, and postoperative complications. Postoperative pain was evaluated using the Face, Legs, Activity, Cry, Consolability (FLACC) pain scale.

Results: A total of 216 male patients, aged 2-12 years, were included in this study. The majority received DPNB (n= 78), followed by caudal block (n= 72) and PNB (n= 66). The FLACC pain scores were significantly higher in the DPNB group. Rescue analgesics were required by 49 patients, all of whom were in the DPNB group. Postoperative complications were more frequently observed among those with the caudal block, compared to DPNB and PNB.

Conclusion: Caudal and pudendal nerve block had the highest effectiveness in terms of postoperative analgesia in patients undergoing circumcision. The decision of choosing between them should take into account the experience of the practitioner, as well as side effects.

Keywords:. Caudal block, circumcision, dorsal penile nerve block, postoperative analgesia, pudendal nerve block

Öz

Amaç: Bu çalışmada, sünnet cerrahisi geçiren çocuklarda kaudal blok, dorsal penil sinir bloğu (DPNB) ve pudendal sinir bloğunun (PNB) postoperatif analjezik etkinliğinin karşılaştırılması amaçlandı.

Gereç ve Yöntem: Bu retrospektif çalışmada 18 aylık süreçte sünnet cerrahisi olan hastaların kayıtları incelendi. Hastaların demografik bilgileri, intraoperatif hemodinamik parametreleri, sinir bloğu uygulama süresi, kurtarma analjezik süresi, anestezi ve cerrahi süresi, derlenme süresi ve postoperatif komplikasyonlar kaydedildi. Poastoperatif ağrı, Face, Legs, Activity, Cry, Consolability (FLACC) ağrı skalası kullanılarak değerlendirildi.

Bulgular: Çalışmaya yaşları 2-12 arasında değişen toplam 216 erkek hasta dahil edildi. Hastalara DPNB (n= 78), kaudal blok (n= 72) ve PNB (n= 66) uygulandı. FLACC ağrı skorları DPNB grubunda anlamlı olarak daha yüksekti. Tamamı DPNB grubunda olan 49 hastada ek analjeziklere ihtiyaç duyuldu. Postoperatif komplikasyonlar DPNB ve PNB'ye kıyasla kaudal bloğu olanlarda daha sık gözlendi.

Sonuç: Sünnet uygulanan çocuklarda postoperatif ağrı yönetiminde kaudal ve pudendal sinir bloğunun DPNB'ye göre daha etkin olduğu görülmüştür. Uygulanacak bloğun seçiminde anestezistin deneyimi ve yan etkiler dikkate alınmalıdır.

Anahtar kelimeler: Kaudal blok, sünnet, dorsal penil sinir bloğu, ameliyat sonrası analjezi, pudendal sinir bloğu

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INTRODUCTION

Circumcision is one of the most commonly performed minor surgical procedures in children and may cause severe postoperative pain[1]. The frequency of planned circumcisions in the ambulatory surgery setting reaches up to 80%, anticipating the need for controlling postoperative pain, as it can cause bleeding, crying, restlessness, and agitation[1,2]. Pain management leads to rapid recovery and reduces the risk of complications[3].

Topical and intravenous analgesics, as well as nerve blocks, are commonly used for pain relief in the postoperative period[4]. The caudal block is one of the most commonly used regional anesthesia techniques in circumcisions. Although it is effective in reducing postoperative pain, it may lead to complications such as weakness in the lower extremities, delay in mobilization, urinary retention, nausea, and vomiting[5]. Dorsal penile and pudendal nerve blocks are other regional anesthesia techniques[6,7]. In recent years, studies have shown that peripheral nerve blocks cause fewer complications compared to neuraxial blocks, and have longer analgesic efficacy[7].

To the best of our knowledge, no previous study has compared caudal, dorsal penile, and pudendal nerve blocks together in terms of postoperative analgesic effectiveness in circumcisions. Our hypothesis is to compare the efficacy and complications of these 3 blocks applied in circumcision surgery. The study aims at comparing the postoperative analgesic effectiveness of the three nerve block types using the Face, Legs, Activity, Cry, Consolability (FLACC) pain scale, need for rescue analgesics, block application time, duration of recovery and postoperative complications.

MATERIALS AND METHODS

Study group

This retrospective study, conducted at the Erciş State Hospital in Turkey, was approved by the Local Ethical Committee (Zonguldak Bulent Ecevit University Clinic Research Ethics Committee, Meeting Protocol No. 2020/24-6). Data was collected from the records of patients and hospital database who underwent circumcision between January 2017 and June 2018. Inclusion criteria: Patients who underwent circumcision surgery with any of the caudal, dorsal penile, or pudendal blocks under general anesthesia by inserting a laryngeal mask (LMA). Exclusion criteria: Incomplete records and circumcisions performed under sedation. A total of 304 patients were eligible for inclusion in our study, however, 88 were excluded due to incomplete records and circumcisions performed under sedation.

Procedure

All patients were put under standardized general anesthesia and premedication was not administered to any of them. After the patients were transferred to the operating room, they were monitored for vitals (pulse oximetry, non-invasive blood pressure measurement) and cardiac activity (electrocardiography). After obtaining vascular access, atropine 0.02 mg/kg, propofol 2.5-3 mg/kg, and fentanyl 1 mcg/kg were administered for induction. Face mask ventilation with sevoflurane was initiated until loss of consciousness was achieved. Following adequate mandibular relaxation, a suitable LMA was inserted. After successful airway management, anesthesia was maintained in all patients using a mixture of sevoflurane with FiO_2 (0.4) and air. Nerve blocks were administered to all the patients after general anesthesia.

The first group had received a caudal block (group CB). With the patient in the lateral decubitus position, the sacral hiatus area was sterilized with an antiseptic solution. The sacral hiatus and sacral cornua were palpated under sterile conditions. A 22-gauge hypodermic caudal needle (Egemen, Izmir, Turkey) was advanced in the skin at a 45-degree angle until the sacrococcygeal ligament was punctured (confirmed by the popping sensation). The needle was then reduced to a 30-degree angle and advanced into the sacral canal. After confirming the absence of blood and cerebrospinal fluid by aspiration, 0.5 mL/kg of 0.25% bupivacaine was slowly administered.

The second group had received a dorsal penile nerve block (group DPNB). With the patient in the supine position, the area was sterilized. The symphysis pubis was palpated under sterile conditions. Scarpa's fascia was punctured with a 22-gauge needle until a popping sensation was felt. At 2 and 10 o'clock of the penis, 0.25% bupivacaine (0.5 mL/kg) was administered.

The third group had received a pudendal nerve block (group PNB). With the patient in the lithotomy position, the area was sterilized. The neurostimulator was set to a current output of 3 mA and a frequency

of 2 Hz. A 22-gauge-block needle (50 mm, Stimuplex Ultra, B Braun, Melsungen AG, Germany) was advanced from the inferomedial side of the ischial tuberosities while palpating the tuberosities located at positions 3 and 9 o'clock of the anus. After the contraction of the perineal muscles and penis, 0.25% bupivacaine (0.5 mL/kg) was administered bilaterally and equally.

After administering the nerve blocks, the circumcision commenced. The nerve block application time was determined from the needle puncture to the end of the local anesthetic injection. All circumcisions were performed by the same surgeon using the same surgical technique. All block procedures were performed by the same anesthesiologist (EÇ). The surgical procedure duration was defined as the time from the first incision to the last suture. After the end of the procedure, general anesthesia was terminated and the patients were transferred to the postoperative recovery room. Patients with the Modified Aldrete Score of ≥ 9 were transported to the clinic. The recovery time was defined as the time from admission to the postoperative recovery room to transport to the clinic.

Assessment parameters

The collected data included patients' demographics, intraoperative hemodynamic parameters, nerve block application time, rescue analgesic time, duration of anesthesia and surgery, recovery time, and postoperative complications. Lower extremity motor blocks were evaluated using the Bromage scale. The FLACC pain scale was used to evaluate pain of the patients. The postoperative FLACC scores at 0, 1, 4, and 6 hours were recorded. Patients with a score of ≥ 5 were administered 10 mg/kg of paracetamol orally as a rescue analgesic.

Outcomes

The primary outcomes included pain scores evaluating by FLACC pain scale, and required rescue analgesics and the first analgesic time. Secondary outcomes included block application time, duration of recovery and postoperative complications (nausea, vomiting, motor block, and urinary retention).

Statistical analysis

The SPSS 22 Windows program (Statistical Package for Social Sciences, Armonk, New York, USA) was used for the statistical analysis. Quantitative data were summarized by calculating the mean standard deviation, whereas, for qualitative data, percentage values were used. The Kolmogorov-Smirnov test was used to determine the distribution of the variables. Analysis of variance (ANOVA) test were used to analyze the data that had a normal distribution. Mann-Whitney U, Kruskal-Wallis, and Chi-squared tests were used to analyze data that did not follow a normal distribution. Statistical significance was set at P-value < 0.05.

RESULTS

A total of 216 male patients, aged 2-12, were included in this study. The majority were in group DPNB (n= 78), followed by group CB (n= 72) and group PNB (n= 66). The demographic data of these patients, as well as the duration of surgery, were statistically similar among the groups (Table 1). No complications occurred during the administration of the blocks. None of the patients underwent reoperation due to bleeding or any other complications. There was no statistically significant difference in the intraoperative hemodynamic parameters among the groups (p > 0.05).

Table 1. Demographic data and duration of surgery

	Group CB (n=72)	Group DPNB (n=78)	Group PNB (n=66)	p
Age(Years) #	7.18 ± 3.20	6.63 ± 3.34	7.27 ± 3.19	0.440
Weights (kg) #	23.96 ±9.44	22.33 ±9.3	24.83 ±8.58	0.133
Duration of Surgery (min) #	11.44 ± 1.35	11.36 ± 1.15	11.62 ± 1.14	0.388

CB: Caudal Block, **DPNB:** Dorsal Penile Nerve Block, **PNB:** Pudendal Nerve Block, **#:** Mean±Standart Deviation

Table 2. FLACC-D scores

	FLACC 0	FLACC 1	FLACC 4	FLACC 6
Group CB	0.00 ±0.00[a,b]	0.92 ± 1.00[a,b]	0.93 ± 0.99[a,b]	0.99 ± 1.00[a,b]
Group DPNB	4.74 ± 1.12[a,c]	2.91 ± 0.80[b]	2.90 ± 0.89[b]	3.04 ± 0.87[a,c]
Group PNB	2.47 ± 1.15[a,b,c]	2.56 ± 1.11[a]	2.59 ± 1.13[a]	2.50 ± 1.12[a,b,c]
p	<0.001*	<0.001*	<0.001*	<0.001*

CB: Caudal Block, DPNB: Dorsal Penile Nerve Block, PNB: Pudendal Nerve Block, FLACC-D: Dynamic Face, Legs, Activity, Cry, Consolability *p<0.05

The symbols a, b, c represent the statistical difference between the groups. There is a significant difference between groups containing the same symbol.

Secondary outcomes

There were significant differences among the groups in terms of nerve block application time. The DPNB required the shortest application time (49.40 ± 69.89 s), followed by the caudal block (114.65 ± 8.05 s) and the PNB (288.48 ±19.07 s). Significant differences were also found in terms of postoperative complications (Table 3) and recovery times (p= 0.001). The group CB patients more likely to experience nausea, vomiting, motor block, and urinary retention were observed in the postoperative period after caudal block application. While there was no statistical difference in the recovery times between groups CB and PNB, the longest was for those in group DPNB (group CB: 7.00 ± 1.28 min, group DPNB: 23.49 ± 5.41 min, group PNB: 7.77 ± 1.68 min).

Table 3. Postoperative Complications

	Group CB (n=72)	Group DPNB (n=78)	Group PNB (n=66)	p
Urinary retention	15(%20,8)	0	0	<0.001*
Motor Block	7(%9,7)	0	0	0.001*
Nausea	6(%8,3)	0	0	0.002*
Vomitting	6(%8,3)	0	0	0.002*
Additional NSAİDs	0	49 (%62,8)	0	<0.001*

CB: Caudal Block, DPNB: Dorsal Penile Nerve Block, PNB: Pudendal Nerve Block, NSAİDs: Non-Steroidal Anti-Inflammatory Drugs, *p<0.05

DISCUSSION

In the postoperative pain management of children undergoing circumcision, the caudal and pudendal nerve blocks showed better analgesic effectiveness compared to the DPNB.

Caudal block is a safe method that is frequently used to relieve postoperative pain after circumcision and lower abdominal surgeries in pediatric patients [8]. Kazak Bengisun et al [9]. found that caudal block was more effective in pain management than the DPNB, similar to the results of our study. Long et al. investigated pain sensation after DPNB and found that the sense of pain on the ventral side of the penis did not disappear [10]. The dorsal penile nerve is one of the three branches of the pudendal nerve that originates from the sacral plexus. After the pudendal nerve leaves the pudendal canal, it divides into three branches: the dorsal penile nerve, the perineal nerve, and the inferior rectal nerve [11]. The ventral side and frenulum of the penis are enervated by the perineal nerve[12], and this nerve is not blocked during a DPNB. This could explain why, in our study, postoperative pain scores and analgesic consumption were higher in the DPNB group than in the other groups, and required a longer recovery time.

In recent years, there have been several publications regarding the use of DPNB and PNB as alternatives to caudal block for patients undergoing circumcision[7,13]. Studies have reported that DPNB has a similar effect to caudal block on postoperative pain in circumcisions[14,15]. These are contradicting

with the results of our study. A possible explanation for this difference is the use of ultrasound (US) in the application of these blocks. Ozen et al. found that US-guided DPNB was as effective as a caudal block for postoperative analgesia in patients undergoing circumcision[16]. Moreover, Aksu et al. observed that US-guided DPNB provides more effective and more prolonged postoperative analgesia than the neurostimulator-guided PNB in hypospadias surgery[17]. It is important to note that DPNB in our study were not administered under US-guidance.

When comparing the two peripheral nerve blocks, the literature seems to favor the PNB over the DPNB. Tütüncü et al. reported that PNB had better analgesic efficacy than the DPNB and reduced analgesic requirement in circumcision[18]. Naja et al. found that the analgesic efficacy of PNB was better in the first 12 hours and that additional analgesic consumption was lower in the first 6 hours when compared to a DPNB[19]. In our study, rescue analgesic need and postoperative 0-hour FLACC scores were found to be higher in the DPNB group than in the PNB group, which is in line with the previous studies. This can be further explained by the blind administration of the DPNB, whereas the PNB was performed by neurostimulator-guidance. Additionally, DPNB does not block perineal nerves, as previously mentioned, but the PNB does. Predictably, after additional analgesic administration to the DPNB group, the FLACC scores became similar.

In a study comparing analgesic effectiveness after hypospadias surgery, the PNB was shown to have similar efficacy to the caudal block [20]. Okoro et al. compared the US-guided caudal block with the anatomical landmark-guided PNB. They showed that both nerve blocks were equally effective [21]. In our study, the FLACC scores were found to be lower in group CB, but there was no need for any rescue analgesics in either group. FLACC scores within the first 6 h were found to be less than four in both groups. Although there was a difference, it was clinically insignificant.

Caudal blocks have been shown to have multiple side effects, including urinary retention and dose-dependent motor block[5,8,22]. The greatest advantage of peripheral nerve blocks, when they are compared to neuraxial blocks, is fewer complications and side effects[23]. Although anal sphincter tone loss can be observed after PNB, Shafik et al. found, through an electrophysiological evaluation, that bilateral PNB did not affect the anal sphincter tonus[24]. Bleeding and ischemic glans edema can be seen after the DPNB[7,25]. Our study was compatible with the literature in that complications such as motor block, difficulty in urination, nausea, and vomiting were observed more frequently in group CB than in the other group. Major complications such as motor block, local anesthetic systemic toxicity, bleeding, and edema were not observed in either the PNB or the DPNB groups.

In our study, the duration of the PNB application was longer than that of any of the other blocks. This could be due to the bilateral PNB administration, as well as the patient's positioning that prolongs the application time. The DPNB application time was shorter compared to the caudal block because of the easier identification of the anatomical landmarks.

This study has some limitations. Firstly, this was a retrospective study. The absence of randomization and inability to perform the nerve blocks under US-guidance are other limitations. Another limitation is that the power analysis of the study is not performed before the study.

In conclusion, although circumcision is considered a minor surgical procedure, postoperative pain has an impact on the recovery process. Caudal and pudendal nerve blocks had the highest analgesic effectiveness. The decision of choosing between them should take into account the experience of the practitioner, as well the side effects. In addition, we consider that randomized-controlled studies are needed evaluating these three blocks in circumcision surgery.

Yazar Katkıları: Çalışma konsepti/Tasarımı: ÇB; Veri toplama: ÇB, EÇ; Veri analizi ve yorumlama: ÇB, EÇ; Yazı taslağı: ÇB, EÇ; İçeriğin eleştirel incelenmesi: ÇB, EÇ; Son onay ve sorumluluk: EÇ, ÇB; Teknik ve malzeme desteği:EÇ; Süpervizyon: ÇB, EÇ; Fon sağlama (mevcut ise): yok.
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