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Levobupivacaine for postoperative pain management in circumcision: caudal blocks or dorsal penile nerve block

Sünnetlerde postoperatif ağrı kontrolünde levobupivakain; kaudal blok veya dorsal penil sinir bloğu

Züleyha KAZAK BENGİSUN,[1] Perihan EKMEKCİ,[1] Ahmet Hakan HALİLOĞLU[2]

Summary

Objectives: In this study, we evaluated the analgesic efficacy and adverse effect profile of levobupivacaine in caudal and DPNB in postcircumcision pediatric patients.

Methods: Sixty boys between 2-10 years of age undergoing circumcision were enrolled. The patients were divided into two groups: Group C (n=30) and Group P (n=30) were applied caudal block or dorsal penile nerve block (DPNB), respectively. Blocks were performed before surgery as a supplement to general anesthesia with 1 mL kg-1 0.25% levobupivacaine. Postoperative pain and sedation scores were assessed on the 10th and 30th minutes, and hours 1-6. The number of pain free patients in the first 6 hours, the duration of analgesia, time to first analgesic administration, walking, micturition, and total paracetamol demands, and length of stay were recorded.

Results: Demographic data were similar between groups. The number of children who spent the first 6 hours pain-free was larger in Group C than Group P (p=0.0001). The time to first analgesic (p=0.000033) and walking (p=0.004) were longer in Group C. There were 14 patients with motor block in Group C (p=0.00007). In view of AUC, FPRS, OPS and MPOPS were significantly better in Group C on the first postoperative 6 hours.

Conclusion: Caudal block done using levobupivacaine for postoperative pain management in circumcision is more successful than penile block, however there is a significant delay in time to first walking and as might be expected there is an increased risk of motor block.

Key words: Caudal blocks; circumcision; levobupivacaine; penile block.

Özet

Amaç: *Bu çalışmada sünnet sonrası pediatrik hastalarda kaudal ve dorsal penil sinir bloğunda (DPSB) levobupivakainin analjezik etkinliği ve yan etki profili değerlendirildi.*

Gereç ve Yöntem: *2-10 yaşları arasında sünnet planlanan 60 çocuk çalışmaya alındı. Hastalar iki gruba ayrıldı; Grup K'daki (n=30) hastalara kaudal blok, Grup P'deki (n=30) hastalara ise DPSB uygulandı. Bloklar cerrahi öncesi, genel anesteziye destek olarak 1mL kg^{-1} %0.25 levobupivakain ile yapıldı. Postoperatif ağrı ve sedasyon skorları 10 ve 30. dakikalarda, 1, 2, 3, 4, 5 ve 6. saatlerde değerlendirildi. OPS veya MPOPS skorları 4 veya daha fazla olduğunda postoperatif ek analjezik yapıldı. İlk 6 saat boyunca ağrısı olmayan hasta sayısı, analjezi süresi, ilk analjezik zamanı, yürüme, idrara çıkma süreleri, toplam parasetamol ihtiyacı ve hastanede kalış süreleri kaydedildi. Motor blok, ajitasyon, bulantı ve kusma gelişen hastalar kaydedildi.*

Bulgular: *Gruplar arası demografik veriler benzerdi. İlk 6 saati ağrısız geçiren hasta sayısı Grup K'da Grup P'ye göre daha fazlaydı (p=0.0001). Grup K'da ilk analjezik zamanı (p=0.000033) ve yürüme zamanı (p=0.004) daha uzundu. Grup K'da 14 hastada motor blok gelişti (p=0.00007). Grup K'da FPRS, OPS ve MPOPS açısından eğri altında kalan alan postoperatif ilk 6 saatte anlamlı olarak daha iyiydi (p<0.05).*

Sonuç: *Sünnette levobupivakain ile yapılan kaudal blok postoperatif ağrı yönetimi açısından penil blok ile karşılaştırıldığında daha başarılı olmasına karşın ilk yürüme için geçen zaman anlamlı olarak uzun olmakta ve motor blok riski bulunmaktadır.*

Anahtar sözcükler: Kaudal blok; sünnet; levobupivakain; penil blok.

[1]**Department of Anesthesiology and Reanimation Ufuk University Faculty of Medicine, Ankara**
[2]**Department of Urology, Ufuk University Faculty of Medicine, Ankara**
[1]*Ufuk Üniversitesi Tıp Fakültesi, Anesteziyoloji ve Reanimasyon Anabilim Dalı, Ankara*
[2]*Ufuk Üniversitesi Tıp Fakültesi, Üroloji Anabilim Dalı, Ankara*

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Correspondence *(İletişim):* Dr. Züleyha Kazak Bengisun. Mevlana Bulvarı (Konya Yolu) No: 86-88, 06520 Balgat, Ankara, Turkey.
Tel: +90 - 312 - 204 40 98 **e-mail *(e-posta):*** kazakzuleyha@yahoo.com

Introduction

Optimal analgesia following ambulatory surgery is an important matter for patient satisfaction and it reduces unnecessary hospital admissions. Circumcision, which is performed on an outpatient basis is commonly performed operation in male children. Various methods are being used for postoperative pain of this operation such as dorsal penile nerve block (DPNB), caudal block, topical analgesia and also systemic non-steroidal anti-inflammatory drugs (NSAIDs) or opioids. It has been shown that local anesthetic techniques are more effective than opioids.[1] Especially, caudal block and DPNB both provide effective analgesia for circumcision.[2-5]

It has been known that amino-amide type local anesthetics which are widely used in caudal and DPNB have narrow therapeutic indexes. However; under general anesthesia levobupivacaine has a safer profile, because patients may tolerate larger doses, especially when using large amount of local anesthetics and in case of accidental intravenous injection. [6] At the present; there is no study which compares caudal block and DPNB with levobupivacaine; so in this sense this is a unique study which compares penile and caudal levobupivacaine blocks.

There have been some studies which compared caudal and DPNB by using bupivacaine in various doses; however the results are controversial.[7-9] In this study; our primary outcome was evaluating time to first analgesic requirement for paediatric circumcision. Our secondary outcomes were the number of children considered pain free in each group during the first 6 hrs, obtaining lower pain scores, making patients comfortable and satisfied by providing longer duration of analgesia without delayed walking, micturition and length of stay.

Methods

After approval from the University Research Ethics Committee, informed written consent was obtained from the parents of 60 American Society of Anesthesiology (ASA) physical status I or II male children. Patients between 2-10 ages, <35 kg scheduled for elective circumcision were enrolled in this single centre, prospective, randomized, controlled, blind study. Age, weight, surgery and anesthesia periods for the patients were recorded. Exclusion criteria were refusal by parent or child; inability to receive a caudal epidural block; cutaneus infections or anatomical malformation at the puncture site; hypersensitivity to amide local anesthetics, propofol or paracetamol; history of active and severe renal, hepatic, respiratory or cardiac diseases; history of seizures; neurological or neuromuscular disorders and blood-clotting disorders.

This was a blind study: patients, nurses and parents were blinded to the type of given block. All chidren were fasted before the operation. EMLA® cream (Astra Zeneca, Milano, Italy) was applied to the dorsum of both hands of all for comfortable peripheral vein insertions. Peripheral IV access with 22 G or 24 G i.v. cannula was secured and they received premedication with midazolam 0.5 $mg.kg^{-1}$ (maximum 15 mg) PO, 30 min before the surgery. Electrocardiogram (ECG), pulse oxymetry, noninvasive blood pressure (NIBP) and capnography were monitored. Propofol 2-3 $mg.kg^{-1}$ was administered intravenously. Anesthetic maintenance was with 2.5% sevoflurane in 70% nitrous oxide (N_2O) and 30% oxygen (O_2) breathing spontaneously via Laryngeal Mask Airway (LMA).

After induction of anesthesia, patients were randomly allocated into one of two groups. Randomization was done by computer generated random number sequence. The allocation was concealed in a sealed envelope until the child was anesthetized. Group C (n=30) was applied caudal block, Group P (n=30) was applied DPNB.

All caudal blocks were performed by one experienced anesthetist in left lateral decubitus position with a 22 G i.v. cannula and 1 $mg.kg^{-1}$ of 0.25% levobupivacaine was administered from the sacral hiatus. DPNB was applied in the supine position. All penile blocks were performed by one experienced urologist. For the penile block, 1 mg.kg-1 0.25% levobupivacaine was administered through a 21-G needle. This dose is parallel to the dose used by Dollberg et al.[10] It was inserted beneath the pubic arch to infiltrate the dorsal nerve of penis bilaterally as it pierces the perianal membrane lateral to the internal pudental artery and ventral infiltration was performed. Blocks were performed before surgery

and small spot dressings were applied to the sites of both caudal and penile injection to avoid observer bias postoperatively.

During surgery, a block was declared a failed block if a child's heart rate (HR) increased more than 30% of their baseline value despite an end-tidal sevoflurane concentration of 2.5% in N_2O and O_2 after 15 min. Then sevoflurane dose was increased.

After the end of surgery, the patients were sent to Post-Anesthesia Care Unit. Thereafter; if there was not any pain or adverse effect, they would have been dispatched to their rooms 30 minutes later.

Demographic data (age, weight, duration of surgery and duration of anesthesia), the number of patients who were pain free for the first 6 hours, duration of analgesia, the time to first analgesic administration, the rescue analgesic (paracetamol) demands in 24 hours, motor blocks, the time to first walking and micturition, length of stay were followed, postoperatively.

According to modified Bromage scale,[11] motor weakness was assessed as 0=able to stand or strong leg movement, 1=able to move legs but unable to stand, 2=no leg movement.

Postoperative pain and sedation scores were assessed on the 10th, 30th minutes, and 1-6 hours, by nurses and parents. Pain was evaluated by Faces Pain Rating Scale (FPRS),[12] Observer Pain Score (OPS)[13] and Modified Pediatric Objective Pain Scale (MPOPS).[14] OPS and MPOPS include 5 criteria such as crying, movements, agitation, systolic blood pressure and complains of pain. Nevertheless; sedation (time to waking) was defined as the time between the end of surgery (E0) and waking. It was assessed by the Modified Aldrete-Kroulik Recovery Scores[15] that consists of motor activity, respiration, circulation, consciousness and O_2 saturation.

Postoperative rescue analgesic (paracetamol 15 $mg.kg^{-1}$ PO every 4 hour if required) was given to children when their OPS or MPOPS reached to 4 or more, without exceeding a maximum dose of 90 $mg.kg^{-1}$.

The parents were educated to assess their child's pain using FPRS, OPS and MPOPS for the first 6 hours. Furthermore; they were advised to give paracetamol when their child is in pain and to note the count/dose of administrations down for the first 24 hours. They were also asked to take notes of adverse effects and unusual behaviours. All the boys were discharged home after being comfortable, mobile, tolerating oral fluids and passing urine (before 6 hours). Twenty-four hours later, the parents of the children were called by a member of anesthetic team who was unaware of the kinds of blocks. The parents were asked for their records.

Statistical analysis were performed using SPSS for Windows 11.5. Continuous variables were presented as mean±SD and median. Categorical variables were presented as frequencies and percentage. Normality was tested by Kolmogorov-Smirnov test. Normally distributed variables were analyzed using unpaired t test. Unequal variances were analyzed by Mann Whitney test. Chi square test was used for analyzing categorical variables. Significance level was stated at 0.05.

A power calculation for time to first analgesic requirement showed that 30 patients in each group would give a power of 0.9 at a significance level of 0.05. Sample size calculation was based on an expected difference of 60 minute time to first analgesic requirement between group means, on a standard

Table 1. Demographic data (mean value±SD), anesthesia and operation time

	Group C (n=30)	Group P (n=30)	p
Age (years)	6±3	7±2	0.297
Weight (kg)	23±9	26±6	0.225
Duration of surgery (min)	26±9	33±2	0.078
Duration of anesthesia (min)	52±10	58±13	0.073

Table 2. Postoperative follow-up parameters

	Group C (n=30)	Group P (n=30)	p
The number of patients who were pain free for the first 6 hours	28 (93.3%)	13 (43.3%)	0.0001
The time to first analgesic administration (min)	458±73 (median=451)	376±68 (median=382)	0.000033
The number of paracetamol demand (in 24 hours)	2.1±0.6 (median=2)	2.4±0.7 (median=2)	0.102
The time to first walking (min)	163±32 (median=158)	134±27 (median=130)	0.004
The time to first micturation (min)	205±54 (median=190)	184±46 (median=172)	0.110
Motor block (0/1/2)	16/10/4	30/0/0	0.00007

deviation of 70, obtained from previous study with P=0.90 and α=0.05. A sample size of 30 patients per group was obtained.[8]

Results

None of the patients was withdrawn from the study with any reason and there was no difference in respect to demographic data (age, weight, duration of surgery and duration of anesthesia) (Table 1). Neither Group C nor Group P had failed blocks. All of them were deemed successful. None of the patients were reoperated due to bleeding, and required rescue analgesics in theatre or PACU.

The number of patients, who were pain free for the first 6 hours, was significantly higher in Group C (28/30 [93.3%]) than Group P (13/30 [43.3%]) (p=0.0001). The time to first analgesic administration were longer in Group C (Group C median=451, interquartile range 385-531 min; Group P median= 382, interquartile range 308-444) (p=0.000033). The rescue analgesic demands in 24 hours were similar between two groups (p=0.102). As might be expected, motor block occured in 14 of 30 patients in Group C (p=0.00007). There was a delay in time to first walking in Group C (C median=158 min, interquartile range 131-195; P median=130 min, interquartile range 107-161) (p=0.004). There was a delay in time to first micturation in Group C (C median=190 min, interquartile range 151-259; P median=172 min, interquartile range 138-230)

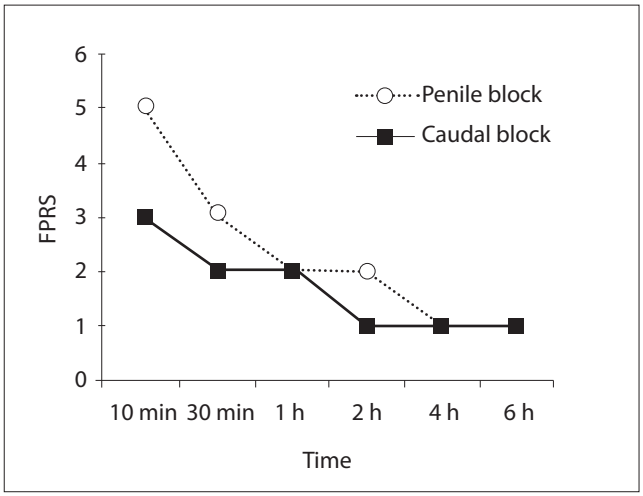

Figure 1. FPRS (Faces Pain Rating Scale) was lower in Group C on the 10th, 30 th minutes and 2nd hour (p<0.05).

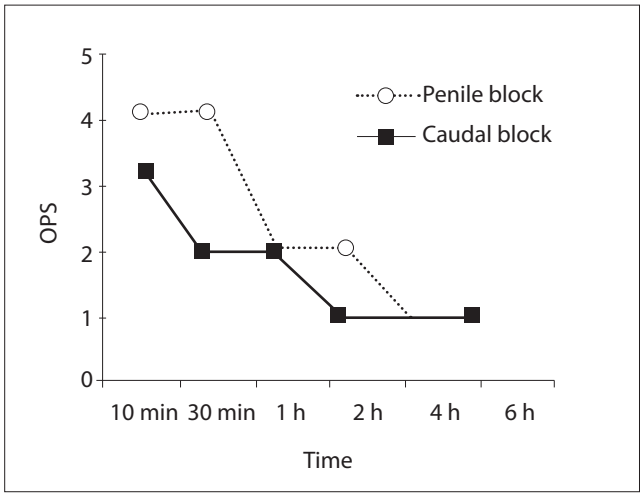

Figure 2. OPS (Observer Pain Score) was lower in Group C on the 10th, 30 th minutes and 2nd hour (p<0.05)

Table 3. The modified Aldrete-Kroulik recovery scores of Group C and P; E0: At the end of surgery

	Group C (n=30)	Group P (n=30)	p
E0+1 min	4.8±2.8 (median=4)	6±2.3 (median=6)	0.094
E0+3 min	6.1±2.5 (median=6)	6.9±2.2 (median=8)	0.158
E0+5 min	7.7±2.5 (median=8)	7.9±1.8 (median=8)	0.913
E0+7 min	8.1±2.5 (median=9)	8.2±1.8 (median=8)	0.633

Table 4. AUC for FPRS, OPS, MPOPS, percentages of complications and length of stay

	Group C (n=30)	Group P (n=30)	p
AUC (FPRS)	2.1±0.4	2.8±0.6	0.046
AUC (OPS)	2±0.5	3.2±0.8	0.031
AUC (MPOPS)	2.4±0.6	6.7±1.2	0.001
Agitation (in 24 hours)	1 (4.2%)	2 (7.7%)	1.000
Nausea-vomiting (in 24 hours)	2 (6.7%)	3 (10%)	1.000
Length of stay (min)	234±57 (median=220)	216±54 (median=207)	0.214

AUC: Area under curve, FPRS: Faces Pain Rating Scale, OPS: Observer Pain Score, MPOPS: Modified Pediatric Observer's Pain Scale (mean value±SD).

as well; however it was not statistically significant (p=0.110) (Table 2). No child developed urinary retention.

Sedation scores (time to waking) were similar in both groups according to the Modified Aldrete-Kroulik Recovery Scores at all times (p>0.05) (Table 3). FPRS and OPS were less in Group C on the 10th, 30 th minutes and 2nd hour; however it was similar on the 1st hour and between the 4th and 6th hours (Figure 1, 2). MPOPS was also less in Group C on the first postoperative 6 hours (on the 10th, 30 th min, 1st, 2nd, 4th and 6th hours) and similar on 6th hour (Figure 3). In view of area under curve (AUC); FPRS, OPS and MPOPS were significantly less in Group C than Group P on the first postoperative 6 hours (p<0.05) (Table 4).

There were no statistically significant differences between the groups for incidence of postoperative agitation, nausea and vomiting in first 24 hours (p>0.05) (Table 4). Two children vomitted in Group C and 3 in Group P (p>0.05). One patient was agitated in Group C and 2 in Group P (p>0.05) (Table 4). There was no difference in length of stay (C median=220 min, interquartile range 177-291; P median=207 min, interquartile range 162-270). All of the patients were discharged on the same day after being comfortable, mobile, tolerating oral fluids and passing urine (before 6 hours).

Discussion

Caudal block or DPNB with local anesthetics combined with general anesthesia in infants and children provide effective postoperative pain control for circumcision. Although, local anesthetics are generally quite safe and effective, they may have toxic effects on the heart and brain. Therefore; excessive doses of drugs, intravascular absorption and inadvertent intravascular or intraosseous application become more important.[16]

When compared to bupivacaine, levobupivacaine appears to have a larger margin of safety in terms of

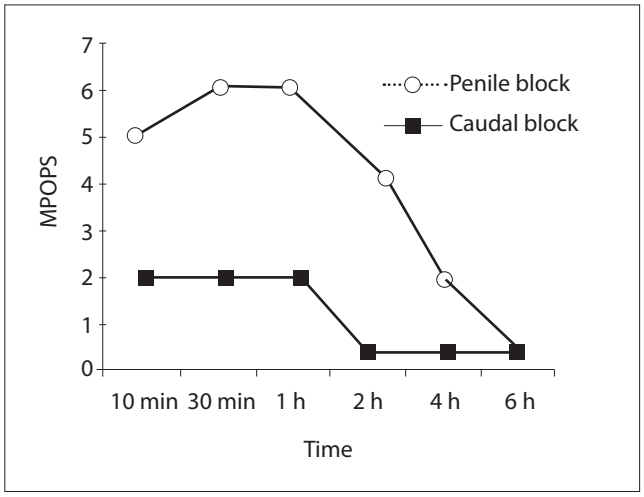

Figure 3. MPOPS (Modified Pediatric Objective Pain Scale) was lower in Group C on the first postoperative 6 hours (on the 10th, 30 th min, 1st, 2nd, 4th) ($p<0.05$).

cardiovascular and central adverse effects when used in large doses as in the caudal block. Toxic effects may be mediated by its less affinity for brain tissue resulting in less CNS depressant effects as well as for myocardial tissue, which leads to a higher dose necessary before being lethal in comparison to bupivacaine.[17-19]

In connection with these data, in this study we compared two regional techniques as caudal block and DPNB with the same dose of levobupivacaine, which are commonly employed for postoperative analgesia after circumcision.

In a previous study, 0.25% levobupivacaine 2 $mg.kg^{-1}$ produced adequate analgesia during operation (circumcision, hernia repair or orchidopexy) in 90% of children aged less than 2 years old. The mean time to the use of additional analgesia was 7.3 hours and it was demonstrated that levobupivacaine is effective and well tolerated by caudal route in children.[20] Nevertheless; in another study the authors compared caudal injection of 1mL kg^{-1} of 0.25% levobupivacaine with 0.2% ropivacaine and 0.25% bupivacaine. They found that levobupivacaine is effective; but there was no difference between these 3 agents.[21] Similarly; Locatelli et al.[22] presented a similar result in terms of analgesia; but bupivacaine group had a higher motor block incidence. They also reported two cases of sinus bradycardia which is thought to be caused by bupivacaine. Therefore; they concluded caudal levobupivacaine 0.25% provided reliable analgesic efficacy during sub-umbilical surgery in children. Frawley et al.[23] compared caudal levobupivacaine and bupivacaine in lower abdominal surgery for the purpose of determining the clinical and postoperative motor blockade effects of these agents. They used 1 $mL.kg^{-1}$ of 0.25% bupivacaine or levobupivacaine for the groups and concluded that levobupivacaine has an equivalent potency to racemic bupivacaine in children.

Demiraran et al.[9] and Vater et al.[3] have found that caudal epidural block and DPNB are generally effective and safe when applied for circumcision. Although Gauntlett[8] used lower dose of bupivacaine in caudal analgesia than in DPNB; he reported statistically significant motor blocks and delayed micturition with no difference in the incidence of nausea and vomiting. They preferred DPNB technique to caudal block due to the incidence of complications. But; DPNB provides analgesia just on the ¾ dorsal side of the penis, so caudal block should be superior in circumcision surgery.[24] Margetts et al.[7] used higher dose of caudal bupivacaine and compared with DPNB. Bupivacaine provided better analgesia and did not effect the time to micturition or increase the incidence of adverse effects; but they reported delayed walking. Therefore; they concluded that both techniques provided effective postoperative analgesia; but caudal block had a longer postoperative analgesia period. In a Cochrane review published in 2003, it is reported that in children old enough to walk, DPNB can be preferred over caudal block due to temporary leg weakness, which is parallel to our study.[25] In this study, the time to first analgesic requirement and walking were longer in patients with caudal block. Delayed time to first walking and better analgesia in the caudal block are also supported findings.

Different doses of caudally administered levobupivacaine were investigated and they were also compared to bupivacaine and ropivacaine in previous studies. Moreover, penile block with levobupivacaine was compared to IV fentanyl (2 $\mu g.kg^{-1}$) and rectal paracetamol (30 $mg.kg^{-1}$).[26] At the present; there is no study which compares caudal block and DPNB with levobupivacaine; so in this sense this is a unique study which compares penile and caudal levobupivacaine blocks.

This study supports the fact that these two methods provide adequate and efficient analgesia after circumcision. The caudal block with levobupivacaine was better than DPNB in terms of postoperative circumcision analgesia in children, however time to first walking was delayed.

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