ORIGINAL ARTICLES
(CC BY-SA)

UDC: 617-089.5:616.8-009.7-08]:616.728.2-089
DOI: https://doi.org/10.2298/VSP231113026P

Comparison of effects of two analgesia methods on surgery for developmental dysplasia of the hip in children

Poređenje efekata dve metode analgezije u hirurškom lečenju razvojne displazije kuka kod dece

[1]Bing Peng*, Xifeng Zhang†, Li Gu†, [1]Wenxu Jiang†

***Nanjing Pukou People's Hospital, Jiangsu Province, Nanjing, China; †Children's Hospital of Nanjing Medical University, Department of Anesthesiology, Jiangsu Province, Nanjing, China**

[1] Both authors contributed equally to this study.

Abstract

Background/Aim. Surgery for developmental dysplasia of the hip (DDH) often needs acetabuloplasty and femoral osteotomy. This type of operation is characterized by long duration, major trauma, and severe postoperative pain. The aim of the study was to compare the analgesic effects of the caudal block (CB) and epidural block (EB) on the DDH surgery in children. **Methods.** A total of 100 children undergoing DDH surgery in our hospital from May 2018 to December 2021 were selected and randomly divided into two groups: an ultrasound-guided CB group and an EB group (each group consisting of 50 children). The dosage of ropivacaine, changes in blood pressure, heart rate, and intraoperative dosage of fentanyl were recorded. In addition, we recorded the values of several parameters after the surgery: the modified Face, Legs, Activity, Cry, and Consolability (FLACC) scale score at 2, 4, 6, 12, 24, 36, and 48 hrs after surgery; the time point of first-time request for acetaminophen and proportion of patients using pethidine; the sedation degree within 12 hrs after the operation (assessed using the Ramsay Sedation Scale – RSS); the incidence of nausea, vomiting, and urinary retention; the satisfaction degree of family members with the applied methods of postoperative analgesia in children. **Results.** The ropivacaine dosage used in the CB group exceeded that of the EB group ($p < 0.05$). The CB group had lower FLACC scores 12 and 24 hrs after the operation and a longer postoperative time until the first-time request for acetaminophen than the EB group ($p < 0.05$). No block-related complications occurred; the two groups had similar incidence rates of nausea, vomiting, and urinary retention. The RSS score within 12 hrs after operation was higher in the CB group than in the EB group, and the family members of the children in the CB group were more satisfied ($p < 0.05$). **Conclusion.** Both CB and EB can provide satisfactory intraoperative and postoperative analgesia for pediatric hip surgery. However, CB provides effective analgesia for 24 hrs after the operation and lasts longer than that accomplished by the EB.

Key words:
analgesia; anesthesia, caudal; anesthesia, epidural; child; developmental dysplasia of the hip; surgical procedures, operative.

Apstrakt

Uvod/Cilj. Za hirurško lečenje razvojne displazije kuka (RDK) često je potrebna acetabuloplastika i femoralna osteotomija. Ovu vrstu operacije karakteriše dugo trajanje, velika trauma i jak postoperativni bol. Cilj rada bio je da se uporede analgetski efekti kaudalne blokade (KB) i epiduralne blokade (EB) u hirurškom lečenju RDK kod dece. **Metode.** Ukupno je odabrano 100 dece, koja su bila podvrgnuta hirurškom lečenju RDK u našoj bolnici od maja 2018. do decembra 2021. godine, i nasumično podeljeno u dve grupe: grupu sa ultrazvučno vođenom KB i grupu sa EB (svaka grupa se sastojala od po 50 dece). Zabeležene su doze ropivakaina, promene krvnog pritiska, brzine otkucaja srca i intraoperativna doza fentanila. Osim toga, zabeležene su vrednosti još nekoliko parametara nakon operacije: procenjivan je skor modifikovane skale lica, nogu, aktivnosti, plača i utehe (*Face, Legs, Activity, Cry, and Consolability* – FLACC) 2, 4, 6, 12, 24, 36 i 48 sati nakon operacije; vreme prvog zahteva za acetaminofenom i procenat bolesnika koji su koristili petidin; stepen sedacije u toku 12 sati nakon operacije (procenjen korišćenjem Ramsay-eve skale sedacije – RSS); stopa učestalosti pojave mučnine, povraćanja i zadržavanja urina; stepen zadovoljstva članova porodice primenjenim metodama postoperativne analgezije kod

Correspondence to: Bing Peng, Nanjing Pukou People's Hospital, Nanjing 211800, Jiangsu Province, China.
E-mail: qx8790982@163.com

dece. **Rezultati.** Doza ropivakaina koja je korišćena u grupi KB bila je veća od doze korišćene u grupi EB ($p < 0,05$). Grupa KB je imala niži FLACC skor 12 i 24 sata nakon operacije i duže postoperativno vreme do trenutka prvog zahteva za acetaminofenom u odnosu na grupu EB ($p < 0,05$). Nisu se pojavile nikave komplikacije povezane sa blokadama; obe grupe su imale slične stope učestalosti mučnine, povraćanja i zadržavanja urina. RSS skor tokom 12 sati nakon operacije bio je viši u grupi KB nego u grupi EB, a članovi porodice dece iz grupe KB bili su zadovoljniji ($p < 0,05$). **Zaključak.** I KB i EB mogu pružiti zadovoljavajuću intraoperativnu i postoperativnu analgeziju u pedijatrijskoj hirurgiji kuka. Međutim, KB pruža efikasnu analgeziju 24 sata nakon operacije i traje duže od one koju postiže EB.

Ključne reči:
analgezija; anestezija, kaudalna; anestezija, epiduralna; deca; kuk, razvojna displazija; hirurgija, operativne procedure.

Introduction

Surgery for developmental dysplasia of the hip (DDH) often needs acetabuloplasty and femoral osteotomy. This type of operation is characterized by long duration, major trauma, postoperative limitation of limb motion due to plaster fixation, and severe intraoperative and postoperative pain stimuli [1, 2]. Nowadays, regional block has been often applied as an auxiliary or supplementary means of general anesthesia in various operations, which can reduce the intraoperative dosage of general anesthetics, shorten postoperative recovery time, lower the incidence rate of complications caused by general anesthetics, and also offer long-term effective analgesia after operation [3, 4]. Ultrasound (US)-guided caudal block (CB) is simple to apply and renders a definite analgesic effect and few adverse reactions. Therefore, it has been applied for intraoperative and postoperative analgesia in various types of surgery [5]. However, its popularization and application are limited due to a longer learning curve. Moreover, epidural block (EB) is also a commonly used anesthesia method for pediatric lower limb and abdominal surgery [6], and it is relatively simple for anesthesiologists. The present study observed the intraoperative and postoperative analgesic and sedative effects and safety of US-guided CB and EB in DDH surgery.

Methods

General data

A total of 100 children undergoing DDH surgery in our hospital from May 2018 to December 2021 were selected, and they had proximal femoral (subtrochanteric) rotational osteotomy and acetabular (pelvic) corrective osteotomy. Ethical approval of the study protocol was obtained from the institutional Ethics Committee of the Children's Hospital of Nanjing Medical University, China (from May 06, 2014). All children's families signed the informed consent. The children were randomly divided into the US-guided CB group and the EB group, with 50 patients in each of them. Exclusion criteria were as follows: patients with infection at the puncture site or anatomic abnormalities; patients with complicated neurological diseases or coagulation dysfunction; patients allergic to ropivacaine, opioids, or acetaminophen; patients who used other drugs affecting the results within the 24 hrs before the operation; patients with a body mass index (BMI) > 30 kg/m^2.

Anesthesia preparation

The children in the two groups received no preoperative medication. The non-invasive blood pressure (BP), electrocardiogram (ECG), and pulse oximetry saturation (SpO_2) were routinely monitored in both groups, and the bispectral index (BIS) was continuously monitored using the AspectA-1000TM BIS monitor.

Anesthesia induction

All patients were intravenously administered 0.01 mg/kg atropine, 3 μg/kg fentanyl, 1.5 mg/kg propofol, and 0.7 mg/kg rocuronium. After the BIS declined below 60 and the lower jaw relaxed, a laryngeal mask was placed in the correct position. After confirming satisfactory ventilation and no leakage, an anesthesia machine was connected for mechanical ventilation, the pressure and respiratory rate were adjusted, and the partial pressure of end-tidal carbon dioxide was kept at 30–40 mmHg.

Ultrasound-guided caudal block

US-guided CB was performed after induction. The patient was placed in a lateral position, with the midpoint of bilateral sacral horns as the positioning mark. First, the sacral hiatus in dark space (also referred to as the "frog eye sign") between two hyperechoic sacral horns was positioned by the short axis, and the black region between the vertebral body and the ligaments was the sacral cavity. At the time of drug injection (0.25% ropivacaine, 1 mL/kg), the thickest part of the sacral cavity between the two sacral horns was selected by long-axis positioning and marked as the puncture point [7]. The sacral promontory and deep sacral vertebral plane in a step-like shape (step sign) were identified, and the black region and band-shaped hyperechoic area above the vertebral body were the sacral cavity gap and sacrococcygeal ligament, respectively. Then, a 5 mL syringe needle was inserted by in-plane technique and connected to an injector containing local anesthetics by injection wires through a pump. When the sacrococcygeal ligament was perforated, characteristic folds and rebounds were shown on the US image, and it was observed that the needle tip was inserted into the sacral cavity. Widening of the sacral cavity after injection and lifting of dorsal sacrococcygeal ligament during injection and its recovery after injection displayed on US images indicated the correct puncture site.

Epidural block

The patient was placed in a lateral position. The puncture point was selected between the L3 and L4 spinal vertebra, and the catheter was inserted epidurally towards the head to a depth of 2 cm. After successful catheterization, the catheter was fixed on the skin, and local anesthetics were injected through the epidural catheter. For local anesthesia, 0.2% ropivacaine was used (the initial dose of epidural anesthesia was 0.5 mL/kg, and the additional dose of intraoperative analgesia was 0.25 mL/kg, making for the total dose ≤ 1.7 mg/kg) [7]. The epidural catheter was removed after the operation.

Anesthesia maintenance

During the operation, the sevoflurane inhalation anesthesia was kept at 0.7 of Minimum Alveolar Concentration, propofol was continuously infused using a micro-pump for anesthesia maintenance, and the dosage of propofol was adjusted to keep the BIS at 40–60. Rocuronium was injected intravenously and intermittently as needed to maintain muscle relaxation. The operation was conducted 30 min after the applied block. It was observed that the fluctuations in BP and heart rate (HR) were 20% higher than the basic values during deep and shallow anesthesia, and fentanyl was added intravenously at 0.5–1 μg/kg to maintain hemodynamic stability. Sevoflurane and propofol were discontinued after postoperative plaster fixation. When the spontaneous breathing was recovered, the tidal volume was > 7 mL/kg, the respiratory rate was 16–25 breaths/min, and the inhaled air SpO_2 was > 95%. The patient was sent to the anesthesia recovery room. The laryngeal mask was removed when the patient showed a response to speech or pain stimuli. The patient could be transferred from the anesthesia recovery room to the general ward provided their vital signs were stable and the general anesthesia recovery score was ≥ 4 points.

Postoperative analgesia

No analgesic pump was connected after the operation. Tylenol® (acetaminophen) at 1.5 mg/kg was given orally if the Face, Legs, Activity, Cry, and Consolability (FLACC) scale score was ≥ 4 points. The FLACC scale score was assessed again 30 min later. If it was still ≥ 4 points, pethidine was intramuscularly injected at 1 mg/kg for analgesia. The largest dose of pethidine in a single injection was 50 mg at most, and the minimum interval of administration of Tylenol® was 6 hrs. If there was a pain outbreak during the interval, pethidine was intramuscularly injected.

Monitoring indices

The dosage of ropivacaine, changes in BP and HR before and after skin incision, and intraoperative dosage of fentanyl were recorded in the two groups. After the operation, another anesthesiologist was assigned for blind assessment of the parameters, which included: 1) FLACC score at 2, 4, 6, 12, 24, 36, and 48 hrs after operation (time points T1–T7) – the pain of patients was assessed by three grades of five aspects (facial expression, lower limb status, activity level, crying level, and consolability) with 0–10 points, and the higher the score, the more severe the pain; 2) the time point of first-time request for acetaminophen after operation and the proportion of patients using pethidine were recorded; 3) the degree of sedation within 12 hrs after the operation was assessed using the Ramsay Sedation Scale (RSS) – 1 point (not quiet and irritable), 2 points (quiet and cooperative), 3 points (lethargic and able to follow instructions), 4 points (sleepy state and able to be awakened), 5 points (slow response to call), 6 points (deep sleep state and unable to be awakened), hence, points 2–4 indicated satisfactory sedation and 5–6 excessive sedation; 4) the incidence of nausea, vomiting, and urinary retention was recorded (when the patient complained of nausea or vomiting, ondansetron was intravenously injected at 0.1 mg/kg and if the patient failed to urinate spontaneously 12 hrs after the operation, urethral catheterization was conducted once, and the urethral catheter was indwelled in case of necessity); 5) the degree of satisfaction of the children's families (parental satisfaction score) with postoperative analgesia was recorded (0 = dissatisfied, 10 = very satisfied).

Statistical analysis

SPSS 22.0 software was used for statistical analysis. Age, height, BMI, operation duration, changes in BP and HR before and after skin incision, intraoperative dosage of fentanyl, and time of first request for analgesics after the operation were expressed as mean ± standard error, and the postoperative FLACC score, RSS, and degree of satisfaction of the children's families were expressed as median (range). The general parameters of the patients were compared between the two groups using the Student's *t*-test or Fisher's exact probability test. The normal distribution of data was tested by the Kolmogorov-Smirnov test. The normal distribution of the repeated measures data (such as BP, HR, and FLACC score) was assayed by repeated measures of analysis of variance (ANOVA). Normally distributed data were compared by paired *t*-test at different time points, while data that were not distributed in a statistically normal pattern were compared by the Mann-Whitney *U* test between the two groups at each time point. The Mann-Whitney *U* test was also used for the comparison of RSS and the degree of satisfaction of the children's families. Intergroup comparison of numerical data (e.g., incidence of nausea, vomiting, and urinary retention) was conducted by Fisher's exact probability test. The time point of first-time requests for analgesics after the operation was compared using the log-rank test. A statistically significant difference was defined as $p < 0.05$.

Results

General conditions of patients and operation-related conditions

There were no significant differences in general and clinical characteristics [age, height, BMI, American Society of Anesthesiologists (ASA) grade, and operation time] between the two groups ($p > 0.05$) (Table 1). The anatomical structure of the sacral canal could be clearly seen under the US in all patients in the CB group. The block was smooth in the two groups, and no block-related complications (hemorrhage, hematoma, local anesthetic toxicity, dural puncture, cerebrospinal fluid leakage, and total spinal anesthesia) occurred. All patients received postoperative pain management as designed and were observed successfully.

Intraoperative and postoperative analgesia

The dosage of ropivacaine in the CB group was significantly larger than that in the EB group [(18.4 ± 3.4) mL vs. (17.0 ± 3.2) mL, respectively, $p = 0.036$]. No obvious changes were found in BP and HR before and after skin incision in the two groups, and the differences were not significant ($p > 0.05$) (Table 2). There was no significant difference between the two groups regarding the intraoperative dosage of fentanyl ($p > 0.05$). In the CB group, 45 patients requested acetaminophen at 18.3 ± 3.2 hrs after the operation, significantly later than in the EB group. In the EB group, 46 patients requested acetaminophen at 10.9 ± 2.3 hrs after the operation ($p < 0.05$). The FLACC score in the CB group was lower at 12 and 24 hrs after the operation, compared to that in the EB group, with a significant difference ($p < 0.05$), while there was no significant difference at 2, 4, 6, 36, and 48 hrs between the two groups. The FLACC score in the CB group was higher at 24, 36, and 48 hrs after the operation than at 2 hrs after the operation. The FLACC score in the EB group rose 12 hrs after the operation (Table 3).

Incidence of anesthesia-related adverse reactions and parents' satisfaction

The families of children in the CB group were more satisfied with postoperative analgesia than the parents of the

Table 1

Demographic and clinical characteristics of patients

Parameters	CB group	EB group	*t* or *U*	*p*-value
Gender (male/female)	14/36	13/37	0.051	0.822
Age (months)	48.6 ± 6.4	48.5 ± 6.1	0.080	0.936
Height (cm)	102.8 ± 10.3	103.2 ± 9.8	0.199	0.843
BMI (kg/m^2)	17.1 ± 3.2	18.2 ± 3.4	1.666	0.099
ASA grade (I/II)	42/8	41/9	0.071	0.790
Surgery duration (min)	229.7 ± 23.4	231.7 ± 24.1	0.421	0.675

CB – caudal block; EB – epidural block; BMI – body mass index; ASA – American Society of Anesthesiologists.
Results are shown as mean ± standard error or number.

Table 2

Blood pressure, heart rate, and perioperative dosage of analgesics

Parameters	CB group	EB group	*t*	*p*-value
Blood pressure, mmHg				
before skin incision	76.2 ± 5.4	76.5 ± 5.1	0.286	0.776
after skin incision	75.4 ± 4.2	75.5 ± 4.3	0.118	0.907
Heart rate, beats/min				
before skin incision	81.5 ± 5.3	79.8 ± 4.8	1.681	0.096
after skin incision	80.8 ± 5.1	79.7 ± 4.2	1.851	0.067
Dosage of ropivacaine (mL)	17.0 ± 3.2	18.4 ± 3.4	2.120	0.036
Intraoperative dosage of fentanyl (μg)	64.0 ± 4.6	63.9 ± 4.3	0.112	0.911
Acetaminophen after operation TPFTR (hrs)	18.3 ± 3.2	10.9 ± 2.3	13.278	< 0.001

TPFTR – time point of first-time request. For other abbreviations, see Table 1.
Results are shown as mean ± standard error.

Table 3

Face, Legs, Activity, Cry, and Consolability scale scores at different time points

Time points (T1-T7) after surgery, hrs	CB group	EB group	*t*	*p*-value
2 (T1)	1.4 ± 0.3	1.4 ± 0.2	0.000	1.000
4 (T2)	1.4 ± 0.3	1.3 ± 0.3	1.667	0.099
6 (T3)	1.5 ± 0.4	1.4 ± 0.2	1.581	0.117
12 (T4)	1.5 ± 0.3	4.4 ± 0.6	30.569	< 0.001
24 (T5)	3.5 ± 0.5	4.3 ± 0.6	7.243	< 0.001
36 (T6)	3.3 ± 0.4	3.4 ± 0.6	0.981	0.329
48 (T7)	2.1 ± 0.5	2.2 ± 0.4	1.104	0.272

For abbreviations, see Table 1. Results are shown as mean ± standard error.

Table 4

Postoperative prevalence of adverse reactions and postoperative scores

Parameters	CB group	EB group	*t* or *U*	*p*-value
Nausea	6 (12.0)	8 (16.0)	0.332	0.564
Vomiting	3 (6.0)	4 (8.0)	0.154	0.695
Urinary retention	5 (10.0)	4 (8.0)	0.1222	0.727
RSS	2 (2–3)	2 (2–2)	3.242	4.523
Parental satisfaction score	9 (9–9)	8 (7–9)	< 0.001	< 0.001

RSS – Ramsay Sedation Scale. For other abbreviations, see Table 1.
All results are shown as numbers (percentages), except RSS and parental satisfaction score which are shown as median (range).

children in the EB group, and the difference was significant ($p < 0.001$). There were no significant differences in the incidence rate of nausea and vomiting between the CB group and the EB group ($p > 0.05$), and the incidence rate of urinary retention was similar in both groups ($p > 0.05$) (Table 4). The RSS at 12 hrs after surgery was significantly higher in the CB group compared to the EB group. The parents' satisfaction score within 12 hrs after the operation was higher in the CB group than in the EB group, showing a significant difference ($p < 0.001$).

Discussion

Congenital dislocation of the hip is commonly seen in children, with an incidence rate of 1.1–3.8‰. The surgery involves the adductor muscle, proximal femur, acetabulum, and pelvis, and as a consequence, severe postoperative pain occurs. Good postoperative pain control is the basis of modern perioperative management and rapid postoperative recovery, which should not only enable the motion recovery of patients faster and reduce organ dysfunction but also make the patients take food as early as possible and, finally, be discharged [7, 8]. During the "enhanced recovery", various pain control modes are not applied individually, so selecting the optimal anesthesia and analgesia method combination is particularly important for anesthesiologists [9].

CB, a commonly used anesthesia and analgesia method, has definite intraoperative and postoperative analgesic effects, can reduce the dosage of general anesthetics and opioid analgesics, and enable the vital signs of children to be more stable [10]. However, it also has potential risk factors, such as puncture positioning error, drug toxicity, abnormally extensive block, and total spinal anesthesia, while urinary retention is a clinically common postoperative complication. According to recent studies, local anesthetics may cause poisoning in about 25% of patients undergoing CB. Therefore, accurate positioning should be paid attention to during CB injection in children in order to prevent systemic toxicity caused by intravascular injection and total spinal anesthesia due to injection into the subarachnoid space. The US assessment is characterized by accurate positioning and clear observation of drug diffusion in the correct area. That is why it has been applied in CB in children [11]. Besides accurate positioning, the volume and concentration of local anesthetics should be also controlled to minimize the incidence of adverse reactions. Therefore, the dosage should be determined according to the level of anesthesia, generally 0.5 mL/kg to the sacral spine, 1 mL/kg to the lumbar spine, and 1.25 mL/kg to the lower thoracic spine. Some scholars suggest using 0.2% ropivacaine or 0.25% levobupivacaine/bupivacaine in a single CB injection in children, and the concentration should not exceed the aforementioned level. Low-concentration ropivacaine has minimized the risk of urinary retention [12]. To prevent the occurrence of toxic reactions, a test dose of local anesthetics is recommended, and adrenaline can be added to local anesthetics to prevent the local anesthetics from being mistakenly injected into the blood vessels in children. However, regional anesthesia is mostly performed under general anesthesia or deep sedation of children. The increase in resting HR in children indicates the controversy over the effectiveness and accuracy of the test dose. Therefore, it remains inconclusive whether to use the test dose as stated in the guidelines. However, local anesthetics should be injected slowly, in small doses (0.1–0.2 mL/kg), and intermittently withdrawn. ECG monitoring should also be paid attention to. Imaging methods, such as US and fluoroscopy, may be helpful for preventing the puncture needle from mistakenly entering the blood vessel during peripheral nerve block, but there is a lack of data supporting the application value of these techniques in regional block [7]. In the present study, all children in the CB group successfully underwent US-guided CB, and no complications occurred. The intraoperative and postoperative analgesic effects were satisfactory, and the postoperative analgesic effect could last for up to 24 hrs, proving that CB is safe and effective in DDH surgery. Moreover, it was found that the duration of analgesia after CB was obviously longer than that after EB (later time of first request for acetaminophen after operation in the CB group compared to the EB group), and the FLACC score at 12 and 24 hrs after the operation was significantly lower in the CB group than that in the EB group. The reasons are as follows: 1) the concentration and volume of local anesthetics used in the study were in strict accordance with the recommendations in the guidelines (0.25% ropivacaine for CB and 0.2% ropivacaine for EB), so the effect of ropivacaine lasted for a longer time in the CB group; 2) the volume of local anesthetics used in CB was larger than that in EB, so that the effective time of the former may be longer; 3) the pharmacokinetic characteristics of ropivacaine may vary from site to site, so the postoperative analgesic effect of CB

was better than that of EB based on the concentration and volume used in this experiment.

EB, a block technique commonly used by anesthesiologists, can also be successfully applied to abdominal and lower limb surgeries. Due to poor cooperation of children, however, it often needs to be performed under general anesthesia or sedation [13]. Nowadays, multiple large-sample prospective observational studies worldwide have proven that EB is safe for children under general anesthesia and deep sedation, which can be conducted as a standard procedure. Nevertheless, severe complications may still occur, so it is necessary to remain highly skeptical of nerve injury and promptly take appropriate diagnosis and treatment measures if suspected. The results of this study showed that even though EB could also provide effective intraoperative and postoperative analgesia for DDH surgery, the duration of its postoperative analgesia was relatively shorter than that of CB. In addition, the patients might suffer from postoperative lumbago, back pain, and nerve injury. Hence, it may have no advantage after all.

In this study, there was no excessive sedation in either of the groups, but the RSS within 12 hrs after operation was higher in the CB group than in the EB group. The possible reason is that the analgesic effect was better in the CB group, so the patients were quiet and cooperative. No significant difference was found in the incidence of postoperative nausea, vomiting, and urinary retention between the two groups. Due to the longer duration of analgesia, the children's families in the CB group were more satisfied with postoperative analgesia than those in the EB group. Therefore, CB is more suitable for DDH surgery than EB.

Conclusion

Both the CB and EB can reduce the dosage of general anesthetics and opioids and offer satisfactory postoperative analgesia in pediatric hip surgery, with the intraoperative vital signs kept stable. However, the CB has a long duration of postoperative analgesia and is less likely to cause nerve injury, which makes it more suitable for DDH surgery.

Conflict of interest

The authors declare no conflict of interest.

R E F E R E N C E S

1. *Zhou Y, Li R, Li C, Zhou P, Li Y, Ke YH,* et al. Tübingen hip flexion splints for developmental dysplasia of the hip in infants aged 0-6 months. BMC Pediatr 2020; 20(1): 280.
2. *Ashoor M, Abdulla N, Elgabaly EA, Aldlyami E, Alshryda S*. Evidence based treatment for developmental dysplasia of the hip in children under 6 months of age. Systematic review and exploratory analysis. Surgeon 2021; 19(2): 77–86.
3. *Volk T, Kubulus C*. Regional anesthesia - are the standards changing? Anaesthesist 2017; 66(12): 904–9. (German)
4. *Chen N, Qiao Q, Chen R, Xu Q, Zhang Y, Tian Y*. The effect of ultrasound-guided intercostal nerve block, single-injection erector spinae plane block and multiple-injection paravertebral block on postoperative analgesia in thoracoscopic surgery: A randomized, double-blinded, clinical trial. J Clin Anesth 2020; 59: 106–11.
5. *Yang H, Fan W, Yang Y, Zhou J, Zhang H, Sun J,* et al. Application of dexmedetomidine combined with ropivacaine in axillary brachial plexus block in children and its effect on inflammatory factors. Cell Mol Biol (Noisy-le-grand) 2020; 66(5): 73–9.
6. *Wang X, Xu S, Qin X, Li X, Feng SW, Liu Y,* et al. Comparison Between the Use of Ropivacaine Alone and Ropivacaine With Sufentanil in Epidural Labor Analgesia. Medicine (Baltimore) 2015; 94(43): e1882.
7. *Lönnqvist PA, Ecoffey C, Bosenberg A, Suresh S, Ivani G*. The European society of regional anesthesia and pain therapy and the American society of regional anesthesia and pain medicine joint committee practice advisory on controversial topics in pediatric regional anesthesia I and II: what do they tell us? Curr Opin Anaesthesiol 2017; 30(5): 613–20.
8. *Rove KO, Brockel MA, Saltzman AF, Dönmez MI, Brodie KE, Chalmers DJ,* et al. Prospective study of enhanced recovery after surgery protocol in children undergoing reconstructive operations. J Pediatr Urol 2018; 14(3): 252.e1–9.
9. *McEvoy MD, Scott MJ, Gordon DB, Grant SA, Thacker JKM, Wu CL, et al.* American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative (POQI) joint consensus statement on optimal analgesia within an enhanced recovery pathway for colorectal surgery: part 1-from the preoperative period to PACU. Perioper Med (Lond) 2017; 6: 8.
10. *Trifa M, Tumin D, Tobias JD*. Dexmedetomidine as an adjunct for caudal anesthesia and analgesia in children. Minerva Anestesiol 2018; 84(7): 836–47.
11. *Vargas A, Sawardekar A, Suresh S*. Updates on pediatric regional anesthesia safety data. Curr Opin Anaesthesiol 2019; 32(5): 649–52.
12. *Sultan P, Murphy C, Halpern S, Carvalho B*. The effect of low concentrations versus high concentrations of local anesthetics for labour analgesia on obstetric and anesthetic outcomes: a meta-analysis. Can J Anaesth 2013; 60(9): 840–54.
13. *Boric K, Dosenovic S, Jelicic Kadic A, Batinic M, Cavar M, Urlic M,* et al. Interventions for postoperative pain in children: An overview of systematic reviews. Paediatr Anaesth 2017; 27(9): 893–904.

Received on November 13, 2023
Revised on December 15, 2023
Revised on December 26, 2023
Accepted on January 9, 2024
Online First April 2024