PRIMENA *PENG* I *LFCN* BLOKA ZA HIRURŠKU KOREKCIJU KONGENITALNE DISLOKACIJE KUKA KOD DETETA – PRIKAZ SLUČAJA

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CASE REPORT

PENG AND LFCN BLOCK FOR SURGICAL CORRECTION OF CONGENITAL HIP DYSPLASIA IN A CHILD – A CASE REPORT

Lazar Jakšić[1], Emil Bosinci[1], Mikan Lazović[1,2]

[1] Univerzitetska dečja klinika, Beograd, Srbija

[2] Univerzitet u Beogradu, Medicinski fakultet, Beograd, Srbija

[1] *University Children's Hospital, Belgrade, Serbia*

[2] *University of Belgrade, Faculty of Medicine, Belgrade, Serbia*

SAŽETAK

Uvod/Cilj: Kongenitalna dislokacija kuka (KDK) predstavlja najčešći muskuloskeletni deformitet ranog detinjstva. PENG (engl. *Pericapsular nerve group*) blok predstavlja relativno novu tehniku regionalne anestezije čiji je benefit u hirurgiji kuka kod odraslih definitivno dokazan, dok se kod dece i dalje ispituje. Slučajevi primene PENG bloka bez neuraksijalne anestezije su kod dece mlađe od 5 godina izuzetno retki, dok je kombinovana primena sa LFCN (engl. *lateral femoral cutaneus nerve)* blokom gotovo potpuno neispitana.

Prikaz slučaja: Pacijentkinja stara 5 godina primljena je radi operativnog lečenja KDK. Po uvodu u opštu anesteziju pod kontrolom ultrazvuka izvedeni su PENG i LFCN blok. Ukupna doza lokalnih anestetika iznosila je 1,5 mg/kg levobupivakaina i 3 mg/kg lidokaina, dok je ukupna doza opioida uvodnih 40 μg intravenskog fentanila. Tokom intervencije od 240 minuta pacijentkinja je bila potpuno hemodinamski i respiratorno stabilna. Po buđenju prevedena je na odeljenje gde je postoperativno bol praćen putem WBFPS (engl. *Wong-Baker Faces Pain Scale)*, a metamizol u dozi od 50 mg/kg je ordiniran u slučaju uočenog izraza lica koji odgovara intenzitetu bola 4 ili više. U prvih 24 časa data je jedna doza metamizola. Ukupna perioperativna doza opioida svedena je na uvodnih 2 μg/kg fentanila.

Zaključak: PENG i LFCN blok mogu obezbediti adekvatnu intraoperativnu i postoperativnu analgeziju kod dece do 5 godina starosti podvrgnute hirurškoj korekciji KDK. Njihova primena može značajno smanjiti perioperativnu potrošnju opioida.

Ključne reči: regionalna anestezija, periferni nervni blok, pedijatrija, kongenitalna dislokacija kuka, ortopedija

ABSTRACT

Introduction/Objective: Congenital hip dysplasia is the most common musculoskeletal disorder in early childhood. The pericapsular nerve group (PENG) block is a relatively novel regional anesthesia technique, proven useful for hip surgery in adults but still being evaluated in children. Cases of pure PENG block without neuraxial anesthesia in children under 5 years of age are very rare, while cases of combined use with lateral femoral cutaneous nerve (LFCN) block are virtually unexamined.

Case report: A 5-year-old girl was scheduled for corrective hip surgery. After induction of general anesthesia, an ultrasound-guided PENG and lateral femoral cutaneous nerve (LFCN) block were performed. The total local anesthetic dose was 1.5 mg/kg of levobupivacaine and 3 mg/kg of lidocaine, while the total opioid dose was 40 μg of intravenous fentanyl on induction. Throughout the 240-minute procedure, she maintained perfect hemodynamic and respiratory stability. Following awakening, she was referred back to the ward where pain was monitored via the Wong-Baker Faces Pain Scale, and 50 mg/kg of metamizole was administered if pain was reported at a 4 or higher. In the first 24 hours, patients received only one dose. The total dose of perioperative opioids was limited to the 2 μg/kg induction dose of fentanyl.

Conclusion: PENG and LFCN block may provide adequate analgesia intraoperatively and postoperatively for children under the age of 5 years scheduled for complex congenital hip dislocation surgery. Their use may significantly reduce the perioperative use of opioids.

Keywords: regional anesthesia, peripheral nerve block, pediatrics, congenital hip dysplasia, orthopedics

Autor za korespondenciju:
Lazar Jakšić
Univerzitetska dečja klinika
Tiršova 10, 11000 Beograd, Srbija
Elektronska adresa: lazar.jaksic@udk.bg.ac.rs

Corresponding author:
Lazar Jakšić
University Children's Hospital
10 Tiršova Street, 11000 Belgrade, Serbia
E-mail: lazar.jaksic@udk.bg.ac.rs

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UVOD

Kongenitalna dislokacija kuka (KDK) je najčešći muskuloskeletni poremećaj u ranom dečjem uzrastu [1]. Hirurško zbrinjavanje najčešće se izvodi do 4. godine života, u zavisnosti od uzrasta pacijenta i opsežnosti deformiteta, ali se može izvesti čak i do 8. godine [2]. PENG (engl. *pericapsular nerve group – PENG)* blok je relativno nova tehnika regionalne anestezije koja se uspešno primenjuje u hirurgiji kuka kod odraslih a sve češće i kod dece [3–5]. Pod kontrolom ultrazvuka prikazujemo iliopektinealnu eminenciju i tetivu mišića psoasa koja prelazi preko nje (Slika 1). Cilj nam je da usmerimo vrh igle između kosti i tetive psoasa što zahteva strm ugao pristupa, kako ne bismo akcidentalno povredili femoralnu arteriju smeštenu medijalno. Obično se upotrebljava niskofrekventna konveksna ultrazvučna sonda. Primenljivost PENG bloka kod dece i dalje se aktivno ispituje [6].

Operativno lečenje KDK uglavnom podrazumeva pristup kroz rez na spoljašnjoj strani natkolenice u predelu velikog trohantera, što je inervaciono područje LFCN (engl. *lateral femoral cutaneus nerve – LFCN)*. Postavljanjem ultrazvučne sonde, obično linearne visokofrekventne, neposredno ispod prednje-godnje bedrene bodlje prikazuje se terzijski mišić (*lat. m. sartorius),* na čijoj se prednjoj površini LFCN uočava u vidu hiperehogene ovoidne formacije (Slika 2).

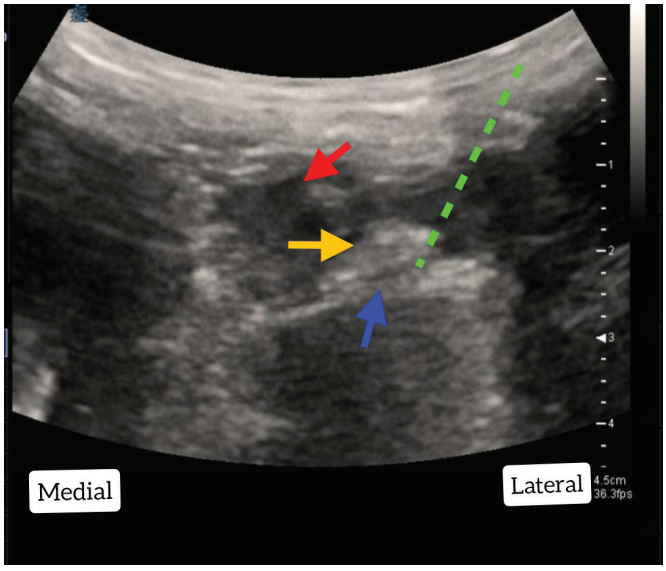
Prema dostupnoj literaturi, u trenutku pripreme ovog prikaza, objavljeno je manje od 10 slučajeva primene PENG bloka kod dece mlađe od 5 godina bez istovremene primene spinalne anestezije [7]. Od tih 10

INTRODUCTION

Congenital dislocation of the hip (CDH) is the most common musculoskeletal disorder in early childhood [1]. Surgical management is most commonly performed by the age of 4, depending on the patient's age and the extent of the deformity, but it can be performed as late as 8 years of age [2]. The PENG (pericapsular nerve group) block is a relatively new regional anesthesia technique that has been successfully applied in adult hip surgery and increasingly in children [3–5]. Under ultrasound guidance, the iliopectineal eminence and the psoas tendon crossing over it are visualized (Figure 1). We aim to direct the needle tip between the bone and the psoas tendon, which requires a steep approach angle to avoid accidental injury to the medial femoral artery. A low-frequency convex ultrasound probe is usually used. The applicability of the PENG block in children is still being actively investigated [6].

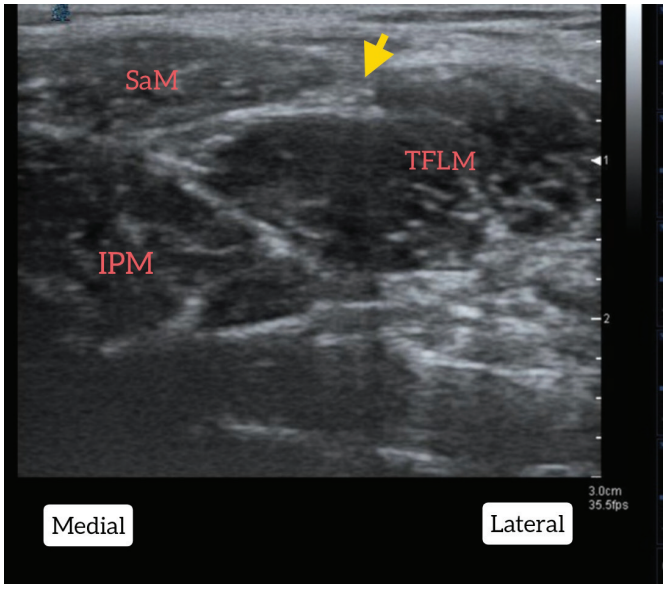
Surgical treatment of CDH generally involves an approach through an incision on the lateral aspect of the thigh in the region of the greater trochanter, which corresponds to the innervation territory of the LFCN (lateral femoral cutaneous nerve). By positioning an ultrasound probe, usually a high-frequency linear probe, immediately inferior to the anterior superior iliac spine, the sartorius muscle (lat. *m. sartorius*) is visualized, with the LFCN identified on its anterior surface as a hyperechoic ovoid structure (Figure 2).

According to the available literature, at the time of preparation of this report, fewer than 10 cases of PENG



Slika 1. Ultrazvučni prikaz anatomije PENG bloka.
Crvena strelica – femoralna arterija, žuta strelica – tetiva psoasa, plava strelica – iliopektinealna eminencija, isprekidana bela linija – putanja igle.

Figure 1. Ultrasound visualization of the anatomy for the PENG block.
Red arrow – femoral artery; yellow arrow – psoas tendon; blue arrow – iliopectineal eminence; dashed white line – needle trajectory



Slika 2. Ultrazvučni prikaz anatomije LFCN bloka.
SaM – m. sartorius, TFLM – m. tensor fasciae latae, IPM – m. iliopsoas, žuta strelica – n. cutaneus femoris lateralis.

Figure 2. Ultrasound visualization of the anatomy for the PENG block.
Red arrow – femoral artery; yellow arrow – psoas tendon; blue arrow – iliopectineal eminence; dashed white line – needle trajectory

slučajeva, samo 2 slučaja podrazumevaju istovremenu primenu LFCN bloka, te procenu efekta njihove kombinovane primene na intraoperativnu i postoperativnu analgeziju u hirurgiji KDK [7,8].

Izvođenje PENG i LFCN bloka takođe može biti praćeno komplikacijama poput neuspelog bloka, oštećenja nerava, akcidentalne intravaskularne primene lokalnog anestetika i sledstvene sistemske toksičnosti [9]. Primena PENG bloka u pedijatrijskoj populaciji ima jasan opioidno-poštedan efekat [10], dok bi istovremena primena LFCN bloka mogla u potpunosti da eliminiše postoperativnu upotrebu opioida nakon hirurške korekcije kongenitalne dislokacije kuka.

PRIKAZ SLUČAJA

Petogodišnja devojčica teška 20 kg primljena je na Odeljenje ortopedske hirurgije i traumatologije Univerzitetske dečje klinike radi operativnog lečenja desnostrane KDK. Hirurški zahvat podrazumevao je subtrohanteričnu osteotomiju femura, fiksaciju pločom, kapsulotomiju zgloba kuka i njegovu repoziciju, ekstrakciju grafta ilijačne kosti i njenu fiksaciju sa dve igle (Slika 3). Pacijentkinja nije imala druge komorbiditete od značaja, te je klasifikovana kao ASA (engl. *American Society of Anesthesiology*) status 1.

Primenjen je osnovni monitoring vitalnih funkcija (EKG, pulsna oksimetrija, neivazvnio merenje krvnog pritiska, kapnografija). Pacijentkinja je premedicirana intravenskom primenom 0,2 mg atropina i 2 mg deksametazona, a potom uvedena u opštu anesteziju intravenskom primenom 40 mg propofola, 20 mg rokuronijuma, i 40 µg fentanila. Po endotrahealnoj intubaciji, u leđnom položaju je u uslovima asepse i pod kontrolom ultrazvuka (aparat eZono 4000, igla 22G/10mm, konveksna niskofrekventna sonda, *in-plane* tehnika) izveden PENG blok (0,25% levobupivakain, 10 ml, i 2% lidokain, 2 ml) i LFCN blok (0,25% levobupivakaina, 2ml, i 2% lidokaina, 1 ml). Ukupna doza lokalnih anestetika iznosila je 1,5 mg/kg levobupivakaina i 3 mg/kg lidokaina. Sedacija je održavana kontinuiranom primenom propofola u dozi od 8 mg/kg/h.

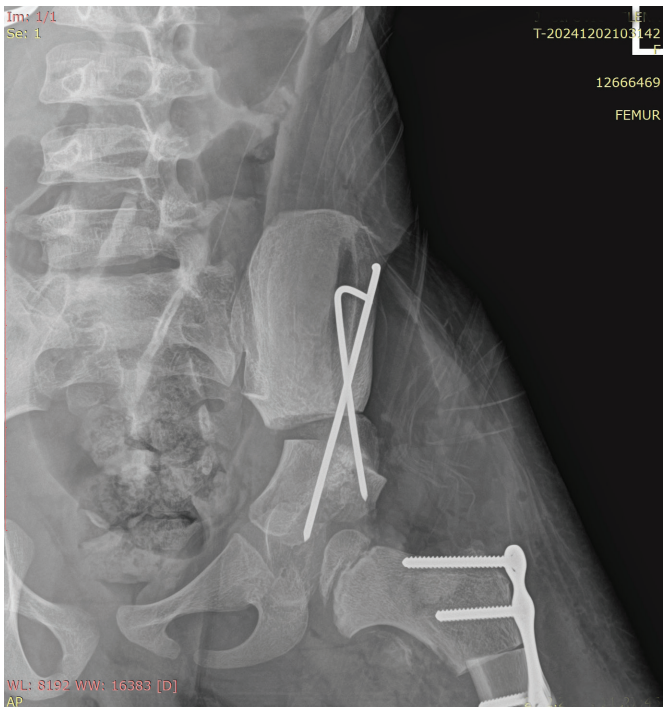
Tokom intervencije koja je trajala 240 minuta pacijentkinja je bila u potpunosti hemodinamski i respiratorno stabilna, održavajući srednji arterijski pritisak između 70–75 mmHg, srčanu frekvencu 80–90 otkucaja u minuti, kao i saturaciju hemoglobina kiseonikom od 97–99%. Sledstveno tokom intervencije nije bilo ponavljanih doza opioida niti mišićnog relaksanta. Prilikom buđenja nije bilo uočljivih komplikacija, te je pacijentkinja prevedena na odeljenje. Odlukom nadležnog anesteziologa postoperativno bol je praćen primenom WBFPS (engl. *Wong-Baker Faces Pain Scale – WBFPS)*

block application in children younger than 5 years of age without concomitant spinal anesthesia had been published [7]. Of these 10 cases, only 2 involved the concomitant use of an LFCN block, with an assessment of the effect of their combined application on intraoperative and postoperative analgesia in CDH surgery [7,8].

Performance of PENG and LFCN blocks may also be associated with complications such as block failure, nerve injury, accidental intravascular administration of the local anesthetic, and consequent systemic toxicity [9]. The use of the PENG block in the pediatric population has a clear opioid-sparing effect [10], while the concomitant use of an LFCN block could eliminate the need for postoperative opioid administration following surgical correction of congenital dislocation of the hip.

CASE REPORT

A five-year-old girl weighing 20 kg was admitted to the Department of Orthopedic Surgery and Traumatology of the University Children's Hospital for surgical treatment of right-sided CDH. The surgical procedure consisted of subtrochanteric femoral osteotomy, plate fixation, hip joint capsulotomy and reduction, iliac bone graft harvesting and fixation with two pins (Figure 3). The patient had no other significant comorbidities and was classified as ASA (American Society of Anesthesiologists) physical status 1.



Slika 3. Radiografija kuka.
A. Pre operacije.
B. Posle operacije

Figure 3. Hip radiograph.
A. Preoperative.
B. Postoperative.

[11], a parenteralni metamizol u dozi od 50 mg/kg propisan je u slučaju uočenog izraza lica koji odgovara intenzitetu bola 4 ili više. U toku prvih 24 časa postoperativno primenjena je jedna doza metamizola, i to 16 sati posle operacije. U postoperativnom toku nisu uočene komplikacije po tipu oštećenja nerava, infekcije ubodnog mesta, kao ni toksičnih efekata lokalnih anestetika. Ukupna perioperativna potrošnja opioda svedena je na uvodnu dozu fentanila od 2 μg/kg.

DISKUSIJA

Iako značajno dobija na popularnosti, primena PENG bloka i dalje se ne smatra široko rasprostranjenom u pedijatrijskoj populaciji, a naročito kod dece mlađe od 5 godina. Donedavno nije bilo nikakvih većih studija koje su se bavile efektima ovog bloka kod dece, sve dok *Reysner i sar*. nisu objavili rezultate svoje randomizovane dvostruko slepe kliničke studije 2025. godine [12]. Treba naglasiti da su u ovoj studiji poredili efekat PENG bloka i ESP (engl. *Erector spinae plane – ESP)* bloka na analgeziju posle operacije kuka kod dece koja su po uvodu u opštu anesteziju, a pred intervenciju, dobila spinalnu anesteziju. Samim tim rezultati ove studije ne mogu govoriti o samostalnom analgetskom efektu ovih blokova tokom i nakon datog hirurškog zahvata. Tehnike neuraksijalne anestezije, konkretno kaudalni blok, kod dece ovog uzrasta predstavljaju klinički smislenu i proverenu alternativu. Ipak, dosadašnjim ispitivanjima utvrđeno je da je PENG blok u hirurgiji kuka kod dece pruža bolju postoperativnu analgeziju i manju potrošnju opioida u odnosnu na kaudalni blok [10].

Pregledom ranijih slučajeva primene PENG bloka u uslovima opšte anestezije kod dece može se doći do zaključka da ona obezbeđuje značajno bolju intraoperativnu i postoperativnu analgeziju u odnosnu na slučajeve kada blok nije primenjen [7,13]. Samim tim smanjuje perioperativnu potrošnju opioida i njene komplikacije (produženo buđenje, respiratorne komplikacije na buđenju, postoperativna mučnina i povraćanje, odložen postoperativni unos vode i hrane, postoperativni hipomotilitet creva, itd.), ali je prema dostupnoj literaturi ne eliminiše u potpunosti. Činjenica koja tome može doprineti jeste da, kao u našem slučaju, hirurški pristup podrazumeva rez i u spoljašnjem aspektu proksimalne trećine natkolenice, što je upravo inervaciono područje LFCN. Cilj ovog prikaza jeste da skrene pažnju na moguću analgetsku efikasnost kombinovane primene PENG i LFCN bloka u hirurgiji KDK. Na osnovu dostupne literature do sada su objavljena samo dva takva slučaja kod dece mlađe od 5 godina [7,8], pri čemu oba slučaja jasno ukazuju na benefit primene ovih blokova. Jedna kadaverična studija koju su sproveli *Ciftci i sar.* [14] pokazala je da primenom veće

Standard vital-function monitoring was used (ECG, pulse oximetry, non-invasive blood pressure measurement, and capnography). The patient was premedicated with intravenous administration of 0.2 mg of atropine and 2 mg of dexamethasone, followed by induction of general anesthesia with intravenous administration of 40 mg of propofol, 20 mg of rocuronium, and 40 μg of fentanyl. Following endotracheal intubation, with the patient in the supine position, under aseptic conditions and ultrasound guidance (eZono 4000, 22G/10 mm needle, low-frequency convex probe, *in-plane* technique), a PENG block (0.25% levobupivacaine, 10 mL, and 2% lidocaine, 2 mL) and an LFCN block (0.25% levobupivacaine, 2 mL, and 2% lidocaine, 1 mL) were performed. The total dose of local anesthetics was 1.5 mg/kg of levobupivacaine and 3 mg/kg of lidocaine. Sedation was maintained with continuous propofol at 8 mg/kg/h.

During the 240-minute procedure, the patient remained hemodynamically and respiratorily stable, with a mean arterial pressure of 70–75 mmHg, a heart rate of 80–90 beats per minute, and an oxygen saturation of 97–99%. Consequently, no additional doses of opioids or muscle relaxants were administered during the procedure. No complications were observed during emergence from anesthesia, and the patient was subsequently transferred to the ward. At the discretion of the attending anesthesiologist, postoperative pain was assessed using the WBFPS (Wong-Baker Faces Pain Scale – WBFPS) [11], and parenteral metamizole at a dose of 50 mg/kg was prescribed in the event of an observed facial expression corresponding to a pain intensity score of 4 or higher. During the first 24 postoperative hours, a single dose of metamizole was administered 16 hours after surgery. No postoperative complications were observed, including nerve injury, infection at the injection site, or toxic effects of local anesthetics. Total perioperative opioid consumption was limited to the induction dose of fentanyl, 2 μg/kg.

DISCUSSION

Although the PENG block is gaining popularity, it is still not widely used in the pediatric population, particularly in children younger than 5 years. Until recently, no major studies had addressed the effects of this block in children, until Reysner et al. published the results of their randomized, double-masked clinical trial in 2025 [12]. This study compared the effects of the PENG block and ESP (Erector Spinae Plane) block on analgesia following hip surgery in children who received spinal anesthesia after induction of general anesthesia and before surgery. Therefore, the results of this study cannot provide information on the independent anal-

zapremine lokalnog anestetika kod PENG bloka i LFCN može da bude zahvaćen, ali bi to podrazumevalo istovremeno zahvatanje femoralnog nerva i sledstvenu motornu slabost natkolenice. Iako ovo konkretno područje zahteva dodatna ispitivanja, kliničko iskustvo sa primenom ovog bloka u našoj ustanovi upućuje na primenu zapremine od 0,5 ml/kg a najviše 20 ml lokalnog anestetika za PENG blok uz zasebnu injekciju za blok LFCN. Deksametazon, ukoliko ne postoje kontraindikacije, može se primeniti intravenski zbog dokazanog efekta produženja trajanja perifernog nervnog bloka kao i prevencije postoperativnog povratnog bola [15].

Zaključujemo da je moguća bezbedna i efikasna kominovana primena PENG i LFCN bloka kod dece uzrasta 5 godina za hirurško lečenje KDK. Potrebne su dalje studije u ovoj uzrasnoj grupi radi poređenja alagetskog efekta ove kombinacije blokova u odnosu na druge tehnike regionalne anestezije i multimodalne analgezije.

Sukob interesa: Nije prijavljen.

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gesic effect of these blocks during and after the given surgical procedure. Neuraxial anesthesia techniques, specifically the caudal block, represent a clinically reasonable and established alternative in children of this age. Nevertheless, previous studies have demonstrated that the PENG block in pediatric hip surgery provides better postoperative analgesia and lower opioid consumption compared with the caudal block [10].

A review of previous cases involving the PENG block under general anesthesia in children suggests it provides significantly better intraoperative and postoperative analgesia than cases in which the block was not performed [7,13]. Consequently, it reduces perioperative opioid consumption and opioid-related complications (prolonged emergence, respiratory complications during emergence, postoperative nausea and vomiting, delayed postoperative intake of fluids and food, postoperative intestinal hypomotility, etc.). However, according to the available literature, it does not eliminate opioid use. One factor that may contribute to this is that, as in our case, the surgical approach involves an incision on the lateral aspect of the proximal third of the thigh, which corresponds precisely to the LFCN innervation territory. This case report highlights the potential analgesic efficacy of combining PENG and LFCN blocks in CDH surgery. Based on the available literature, only two such cases have been published to date in children younger than 5 years of age [7,8], with both cases clearly demonstrating the benefit of using these blocks. A cadaveric study conducted by *Ciftci et al.* [14] demonstrated that the LFCN may also be affected when a larger volume of local anesthetic is used for the PENG block; however, this would imply simultaneous involvement of the femoral nerve and consequent motor weakness of the thigh. Although this area requires further investigation, clinical experience with this block at our institution supports administering 0.5 mL/kg of local anesthetic for the PENG block, up to a maximum of 20 mL, with a separate injection for the LFCN block. If there are no contraindications, dexamethasone may be administered intravenously because it prolongs peripheral nerve blockade and helps prevent rebound postoperative pain [15].

We conclude that combined PENG and LFCN blocks in a 5-year-old child undergoing surgical treatment of CDH are potentially safe and effective. Further studies in this age group are required to compare the analgesic effect of this combination of blocks with other regional anesthesia techniques and multimodal analgesia.

Conflict of interest: None declared

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