

## Case Report

# Impact of the Pericapsular Nerve Group (Peng) Block on Postoperative Analgesia in Pediatric Hip and Knee Surgery: Case Reports (2 Cases)

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## Introduction

The use of local anesthesia for perioperative analgesia in hip surgery is a widespread practice that has been shown to reduce pain, perioperative complications, and postoperative opioid use [6]. In pediatric anesthesia, regional techniques are the mainstay of perioperative analgesia, either alone or as part of a multimodal analgesia strategy. Perioperative pain management is paramount after pediatric hip surgery. Inadequate analgesia can lead to patient and parent dissatisfaction, longer recovery, and prolonged hospital stays [2]. Local anesthesia is beneficial because it relieves pain and reduces opioid side effects [3,4].

Developmental Dysplasia of the Hip (DDH) is a frequent musculoskeletal condition in children [1]. Early usage of abduction splinting devices does not entirely avoid the need for orthopedic surgery. Operative intervention, including extensive surgical incisions and corrective osteotomies, could cause severe postoperative pain. Given the limitation of analgesic drug application in pediatric patients, regional anesthesia plays an important role in multimodal analgesic modalities for children. Caudal epidural block is the most frequent regional anesthesia technique and is effective in providing reliable perioperative analgesia for open hip surgery in pediatric patients, despite technical chal-

## Abstract

The Pericapsular Nerve Group (PENG) block is a novel regional anaesthesia technique that aims to provide hipanalgesia with preservation of motor function, although evidence is currently lacking. A PENG (Pericapsular Nerves Group) blockade is effective in both adult and pediatric patients. However, no studies on patients under five are available in the literature. Herein, we describe our experience with two pediatric patients with hip dysplasia and spina bifida. Purpose: This study aimed to evaluate the analgesic effect of the Pericapsular Nerves Group (PENG) in preschool children undergoing hip surgery and spina bifida. Patients and methods: This study included two patients, aged 4 and 2 years old, who were qualified for hip surgery and spina bifida. general anesthesia with the addition of a PENG block was performed. Postoperative pain management after surgery for developmental dysplasia of the hip is a challenge for older children and pediatric patients with epidural block contraindications. Pericapsular Nerve Group (PENG) block is an innovative technique reported for pain control around the hip joint. We report the application of a PENG block in a child with spina malformation who underwent open hip surgery.

**Keywords:** Pain management; Paralytic dislocation of the hip; Developmental dysplasia of the hip; Pediatrics

lenges, position requirements, and possible side effects (e.g., intervascular/intrathecal injection, bilateral blockade, and urinary retention) [5]. and this paper, we report the application of a PENG block in a child aged 4 and 2 years old who underwent open hip surgery and periacetabular osteotomy concomitantly with spina malformation.

## Material and Methods

Written informed consent was obtained from the parents for this scientific contribution. Patients were admitted to Regional Hospital Center Hassan II Agadir with a hip pathology as a part of a multidisciplinary care pathway.

After discussion with the surgical team, treatment goals included 2 days of hospitalization in Resuscitation Department for postoperative pain relief and the complete removal of motor blockade.

In addition, we suggested a PENG block for postoperative pain relief instead of an epidural catheter. In both cases, after the induction of anesthesia, the PENG block was performed

### Case Report 1

A 4-year-old girl weighing 15kg was scheduled for open left hip surgery as the treatment for DDH. The preoperative CT scan shows spina bifida and myelomeningocele.

In the operative room, electrocardiography, pulse oximetry, and noninvasive blood pressure were monitored. After anesthesia induction was performed with cisatracurium (0.1 mg/kg), fentanyl (5 µg/kg), and propofol (3 mg/kg), #39 Streamlined Liner of the Pharynx Airway (SLIPA) was inserted. Then, anesthesia was maintained with 1.3 MAC sevoflurane with 40% oxygen and 60% air with volume control ventilation using 6–8 ml/kg tidal volume, and the end-tidal carbon dioxide pressure was kept at approximately 35–45 mmHg.

The PENG block was then performed using the ultrasound-guided technique described by Giron-Arango et al. with the patient in the supine position [7]. Under aseptic conditions, local anesthetics (0.2% ropivacaine 2.5 ml/kg) were deposited in the musculofascial plane between the iliopsoas muscle and ilio-pubic eminence, and good views of the needle (22 G\*50 mm) were verified.

There was no hemodynamic instability during the operation. The surgical procedure lasted 100 minutes, and then the airway device was removed once the patient's spontaneous breathing recovered without neuromuscular block.

The patient did not cry awake or report pain, after extubation.

The total dose of fentanyl was 70 µg.

In the postoperative recovery area, the patient did not report pain, vomiting or nausea. Up to 24 h after surgery, the pain level was 2/10.

### Case Report 2

A 2 year-old, 12 kg, boy with developmental dysplasia due to myelomeningocele and paralytic dislocation of the left hip joint, with no other comorbidities, was walking independently and did not require urine catheterization. Apart from the primary disease, he was not hospitalized. The boy did not take medications permanently. He had no drug allergies and no history of convulsions. Due to his primary disease, he was under the care of an orthopedic, rehabilitation, and urological clinic. In July 2020, he underwent surgery for meningomyelocele.

The course of the procedures and anesthesia occurred without complications. His neurological development was expected according to age. He qualified for Dega transiliac osteotomy with femoral subtrochanteric osteotomy.

The ASA physical status classification was 3. An hour before the planned surgery, 7.5 mg of midazolam po and 4 mg of IV HSHC were administered. In addition, 200 mg of paracetamol was given intravenously before surgery. General anesthesia was performed with a continuous infusion of propofol and fentanyl and airway potency was maintained using a laryngeal mask. The lung-sparing mechanical ventilation with Air/O<sub>2</sub> mixture was used, under the control of SpO<sub>2</sub> > 94% and pCO<sub>2</sub>, within the 35–45 mmHg range.

After the induction of general anesthesia, the PENG block was performed. During the procedure, the hemodynamic parameters were monitored.

In the first 24h postoperative, the patient's hemodynamic parameters were stable and within the normal range according to age. After the surgery, the pain was measured every 2h using a FLACC score.

There was no evidence of block complications, like mobility disorders, bleeding, neuropathy, or systemic toxicity from local anesthetic deposition. Muscle weakness or mobility of the hip joint was difficult to observe due to the plaster cast. However, parents and caregivers did not keep any mobility or sensory disturbances.

### Results

The patient's hemodynamic parameters were stable and within normal range. During the surgery, neither patient required extra doses of opioids. The time of the procedure was 105 and 75 minutes; the difference was due to the surgical technique. Blood loss was 200 mL and 170 mL.

Postoperatively, the patients appeared comfortable with numeric pain scores of 2/3 of 10. Paracetamol was administered every 6h to prevent rebound pain. Overnight, both patients did not require breakthrough opioids or muscle relaxants.

On the first postoperative day, the patients could participate in physical therapy. There was no proof of block complications, like mobility disorders, bleeding, neuropathy, or systemic toxicity from large-volume local anesthetic deposition [8].

### Discussion

Effective management and control of intraoperative and postoperative pain are essential in perioperative hip disease to minimize opioid use and its side effects. In our facility, most pediatric hip surgeries are performed under spinal anesthesia and propofol sedation, with preserved spontaneous ventilation. However, the 4-year-old boy had general anesthesia due to the myelomeningocele [12,13]. In addition, spinal and epidural anesthesia is inappropriate for patients with spinal malformations [14].

In this case report, ultrasound-guided PENG block was performed in a toddler as a postoperative pain modality for open surgery as the treatment of DDH, concurrent with spina bifida and myelomeningocele, and it is shown to be an alternative and satisfactory method for open hip surgery in DDH patients.

Caudal block was thought to be the gold standard pain management for most surgical procedures below the umbilicus in children and was first introduced as a landmark-based, blind technique despite contraindications and adverse effects. It has been reported that the success rate of this blind technique is over 96% in young children. However, with increasing age, because of the thickened sacrococcygeal ligaments or difficulty locating landmark points, it drops to 68–75%, even in the experienced hands. In addition, epidural anesthesia is not appropriate for patients with sacral malformations. As an alternative, ultrasound-guided PENG block provides adequate postoperative analgesia in pediatric hip open surgery.

Due to its simplicity and perceived low complication risks, this peripheral nerve block is considered to be safer than the neuraxial techniques, notably in patients who have contraindications and difficulty performing neuraxial block. The technique describes a new way of depositing Local Anesthetics (LAs) within the myofascial plane of the psoas tendon anteriorly and the pubic ramus posteriorly. This is the plane where the branch

of femoral, obturator and accessory obturator nerves that supply sensory innervation to the anterior hip capsule run, which dominates the majority of hip-related pain [4,5]. Evidence suggests that the PENG block is effective in decreasing pain scores and opioid consumption in different hip-related procedures in adults [5,6]. Pediatric-related evidence is limited to case reports [7,8].

The successful implementation of day-case open reduction for children with DDH has increased in some centers [9]. Pain management plays an important role in perioperative care and recovery. Optimal perioperative analgesic options for this population are vital to minimize the need for opioids and related adverse effects. Regional anesthesia techniques, such as epidural analgesia and lumbar plexus block, may be associated with complications such as epidural hematoma, postoperative headache or prolonged motor block. Thus, the PENG technique seems to be a promising, safe method for unilateral hip procedures. In addition, this approach also helped to save time in a busy operating theater by reducing the time for postural changes. It may offer a more cost-efficient and satisfying method for surgeons.

In 2021, Morrison et al. [32] published a systematic review of studies describing the use of the PENG blockade in adults and pediatrics to treat hip pain caused by either fracture or surgery. They found 20 studies that met the inclusion criteria for both the PENG blockade alone and the PENG blockade in combination with other topical analgesic techniques. They concluded that the PENG blockade is a promising regional analgesic technique. We achieved similar results regarding analgesic efficacy and avoidance of rescue opioids.

### Informed Consent

An informed written consent was obtained from the patient to publish this work.

### Conclusion

This case series showed that the PENG block assured opioid-free pain management and provided adequate postoperative analgesia. However, we are convinced that future randomized, controlled trials are needed in this field.

### Author Statements

#### Funding

This research received no external funding.

#### Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

#### Data Availability Statement

The data presented in this study are available on request from the corresponding author.

#### Conflicts of Interest

The authors declare no conflict of interest.

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