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Post-operative analgesia in penile surgeries in pediatrics with focus on sacral erector spinae plane block and caudal block

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Abstract

Surgical postoperative pain commonly occurs in pediatrics. Inadequate treatment of such problem might lead to behavioral disturbance, disordered sleeping patterns, parental dissatisfaction, chronic postoperative pain, and might negatively affect the follow-up as well as future approaches. Multimodal analgesia which involves using > one method of pain controlling to achieve synergistic beneficial analgesia influences with decreasing opioid- related adverse events (opioids, non-opioid drugs, regional and local analgesia). The ESPB is a relatively novel interfascial plane block that is utilized for postoperative analgesia in penile surgeries in pediatrics. Caudal epidural block in children is a commonly used technique of regional anesthesia; it's an effective method that provide perioperative analgesia for any painful sub-umbilical intervention.

Keywords: Penile surgeries, spinae plane, caudal block

Introduction

Surgical postoperative pain commonly occurs in pediatrics. Inadequate treatment of such problem might lead to behavioral disturbance, disordered sleeping patterns, parental dissatisfaction, chronic postoperative pain, and might negatively affect the follow-up as well as future approaches^[4].

Preoperative assessment

Preoperative evaluation of children have to consider the emotional upset often happens to parents as well as the child. Consent of the parents to approaches on behalf of their children; thus, good communication play an essential role in allaying their anxiety. According to the developmental age, the child might be included in the discussion. Urological problems are distressing and embarrassing for the child thus management should be carried out cautiously. Preanesthetic evaluation clinics can help providing required data^[5].

Anesthetic evaluation for major urological surgeries have to confirm that hematological and biochemical parameters are within normal limit. Analgesic methods frequently involve central neuraxial blockade for urologic approaches. Contraindications that include the presence of congenital spinal abnormality, local or systemic infection, bleeding diathesis, and absent consent should be ruled out^[5].

Penile surgeries in pediatrics

Hypospadias

- It's a relatively frequent congenital problem. The external urethral meatus might be present anywhere across the anterior aspect of the penis. It might be accompanied by abnormal penile curvature ventrally (chordee) in addition to altered distribution of the foreskin (hood), that's deficient ventrally. General anesthetic along with a regional anesthesia approach is the common procedure of choice. In infants, it's better to use endotracheal tube with controlled ventilation^[6]. A caudal extradural block is considered an efficient analgesia procedure for management of hypospadias and decreases opioid analgesic requirement postoperatively^[7].

Circumcision, preputioplasty, and meatotomy

- Religious circumcision is usually carried out in the neonate in Muslim as well as Jewish communities. Historically, there is contradiction concerning analgesia requirement. It has been evidenced that analgesics prevent the side effects of gagging, choking, and emesis. Thus, efforts have to be done to decrease pain [8].

Cystoscopy and urolithiasis

Cystoscopy is carried out for diagnosing as well as treating pediatric urological problems. It might be a part of the investigations conducted for recurrent UTI, urinary incontinence, hematuria, in addition to the evaluation of urological anomalies. Treatment approaches might be done to correct urethral strictures, posterior urethral valves, and urolithiasis [9].

Postoperative analgesia

Knowledge about the sensory innervation of the genitourinary system is pivotal when planning for regional anesthetic modalities. The sympathetic nerves arising from the hypogastric plexus to integrate the pelvis causes inhibition of the detrusor muscle of the urinary bladder and carry motor nerve supply to the internal sphincter. Thus, the usage of clonidine, one of the α -2 agonists, as a local anesthesia additive in the epidural or caudal block is of great benefits if bladder spasm is expected due to of operative approach [10].

Multimodal analgesia that involves the usage of >1 approach of pain control to achieve synergistic beneficial analgesia effect in conjunction with reduction of the opioid-related adverse influences [13].

- Opioids.
- Non-opioid drugs.
- Regional and local analgesia.

Transversus abdominis plane (TAP) block

This procedure aims at depositing the local anesthesia in the fascial planes between the internal oblique and transversus abdominis muscles. The ventral branches of the intercostal nerves, T7 - L1, supply the AAW and traverse this plane [12].

Ilioinguinal/ilio-hypogastric nerve block

- Both nerves are formed by branches of the primary anterior rami of L1 & T12. They give sensory innervation to skin that cover the AAW, upper medial area of the thigh, and anterior 1/3 of scrotum in addition to the root of penis in men and labia majora in women. This nerve block can help for analgesia after groin operation [13].

Dorsal penile nerve block

This method is well described to produce analgesic effect after circumcision or minor hypospadias operation with less failure and complication rates. Landmark approach is usually done that includes the injection superior to the root of the penis below the symphysis pubis in posteriorly, medially, and slightly caudally directions with lost resistance on penetrating the Buck's fascia [14].

Sacral erector spinae block

Technique of sacral erector spinae block

After induction of anesthesia the patient was placed in the prone position. Aseptic circumstances are provided for the block, and a linear US probe is positioned on the 5th lumbar vertebra spinous process in the sagittal plane to detect the beginning portion of the sacrum. The probe is mobilized caudally, and visualizing the sacral medial crest become possible. Here again, the probe is mobilized laterally till the sacral intermediate crest can be seen [11].

Following reaching the appropriate image at the level of 2nd sacral segment using the US, the block needle is advanced cranio-caudally till become in contact with the bone. Before LA injection, the needle is aspirated to rule out accidental intravascular placing of the needle tip [14].

The half dose is injected into the region between the multifidus muscle and the intermediate sacral crest and S4 level, the other half is injected into the other aspect, during the block technique, the carino-caudal extension of the LA and the superior movement of the erector spinae muscle and multifidus muscle was determined in real time using the US [15]. (Fig. 2).



Fig 1: Sacral erector spinae plane. Blue arrow indicates the erector spinae plane (ESP) Yellow arrow indicates the sacrum [15]

Advantages of ESP

ESP block is a technique that has great advantages over traditional neuroaxis-near techniques. Firstly, it is an easily applicable technique as the visualization of the erector spinae muscle by ultrasound is easy and it is not difficult to aim the needle at it. Second, the low risk of complication as serious structures (such as main vessels, pleura, or dura) whose injury can cause severe complications are away from the target of blockage. It is also part of the multimodal analgesia that enhance recovery after surgery [16]. Bilateral ESPB provides successful post-operative analgesic effect for gastric operations and incisional & ventral hernia, with decreasing in rescue-analgesia requirements and total opioid consumption [17].

Complication of ESP

In addition to known complications of regional anesthesia (which includes local structures injury and hematoma formation) and complications related to local anesthetic toxicity, only 2 complications were documented [14]. The first was pneumothorax and the 2nd was motor involvement if ESPB was carried out at reduced thoracic level. Pneumothorax that occurs after ESPB isn't common when it's carried out with US guidance; but might be due to lost hand-eye coordination or miscalculation of the depth. Motor weakness could happen if the local anesthetic spreads to the lumbar plexus on carrying out the procedure from the lower thoracic or lumbar regions [18].

Caudal block

Techniques

- 1) **Blind technique:** The patient is position could be lateral or ventral, with the hips flexed to 90°. Careful disinfection of the skin is carried out, since it is very close to the anus. Aseptic methods should be kept [19]. Following determining the bony landmarks of the sacral triangle, the 2 sacral cornuae are determined via movement of the physician fingertips from side to side. The gluteal cleft isn't a reliable mark of the midline. The puncture is carried out between the 2 sacral cornuae. Orientation of the needle is at an angle of sixty in relation to the back plane, ninety in relation to the skin surface. The needle bevel is oriented ventrally, or parallel to the sacro-coccygeal ligament's fibers. The distance from present between the skin and sacro-coccygeal ligament is 5-15 mm, according to the size of the child [21]. The sacro-coccygeal ligament produces a perceptible 'pop' on crossing it, resembling the ligamentum flavum during lumbar epidural anesthesia. Following crossing the sacro-coccygeal ligament, redirection of the needle thus become at an angle of thirty in relation to the skin surface, and then advanced a few millimeters into sacral canal. If the needle becomes in contact with the bony wall of sacral canal ventrally, it must be positioned back lightly [22]. Following confirming absent spontaneous reflux of blood or CSF (more sensitive when compared to the aspiration test), injection of local anesthesia can be done with no resistance and slow over about 1 min. Subcutaneous bulging at the injection area suggests needle misplacement. Thus, the aspiration tests is preferred to be repeated many times during injecting LA [23].
- 2) **Ultrasound-guided caudal block technique:** Ultrasound imaging is carried out via the use a high

frequency linear array probe. Placing of the US probe is carried out between the sacral cornua in sagittal plane and the needle is advanced under real-time guidance into the sacral canal via the sacro-coccygeal ligament. The block needle is used with in-plane or out-of-plane technique [24].

The in-plane approach

The needle is advanced at the angle of about 20 °, thus it's parallel to the posterior sacral aspect and the risk of insertion into deeper structures is low. Once feeling a "pop" and/or visualizing the needle on the sonogram, the right placing of the needle in the caudal epidural space has to be ensured. This is done via injecting a test bolus of saline (0.1–0.2 mL/kg) and determining the real-time the anterior displacement of posterior dura. After confirming the right site of the needle, injection of the needed dosage of local anesthetics in aliquots is carried out. Visualizing the cephalad spread of the local anesthetics within the epidural space is possible via the use of color Doppler [25].

The out-of-plane approach

Scanning of the sacral hiatus is first done at the sacral cornua in a transverse plane. Using the US image of hiatus in the middle of US screen, positioning of the puncture site is carried out caudally close to the midpoint of the transducer. Once feeling a "pop" and/or visualizing the needle in the hiatus a test dose saline is injected. The optimal position of the needle in the caudal epidural space is ensured via a localized turbulence or a dilated hiatus (superior displacement of the sacro-coccygeal ligament) during injection. The local anesthetics are injected slowly under ultrasound visualization. With transverse US scanning, the spread determined from the needle is rather wide and it may be troublesome to ensure accurate location of the tip [26].

Complications

1. Dural tap. This is more possible with excessive advancing of the needle in the sacral canal when subarachnoid injection of local anesthetic agents might lead to marked spinal anesthesia. Under GA this might be suggested if non-reactive mydriasis (dilated pupil) was detected [34].
2. Vascular or bone puncture may result in intravascular injection and in turn local anesthetic systemic toxicity. Prevention of such complication can be achieved via using a test dose, stopping injection if resistance was felt and slowly injection while monitoring the hemodynamics & ECG of the patient. Sacral perforation may result in damage of the pelvic organs (for example rectal puncture) [35].
3. Injection of a large dose that exceeds the maximal allowed local anesthetic dose with risks of overdose that might cause CVS or neurological complications [35].
4. Delayed respiratory depression caused by caudal injection of opioids [35].
5. Urine retention: it's mandatory to observe spontaneous micturition before hospital discharge [35].
6. Sacral osteomyelitis rarely occurs [36].

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