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Postoperative Pain Management in Patients Undergoing Hip Surgeries with Spinal Anesthesia: Review Article

Mustafa Kamal Mohamed

Anesthesia, Intensive Care and Pain Management Department, Faculty of Medicine, Sohag University, Sohag, Egypt

Corresponding author: Mustafa Kamal Mohamed**, Mobile: (+20)** 01065674322**, E-mail:** mostafakamal69@yahoo.com

ABSTRACT

Background: There are several pre-, intra-, and post-operative therapies and management options available for minimizing and controlling postoperative pain. Postoperative pain following total hip arthroplasty (THA) is frequently categorized as moderate to severe. This can have an impact on the recovery process after surgery, leading to a delay in the ability to move and an extended stay in the hospital. A very efficient approach for pain relief is required. Historically, the management of this has been accomplished by the utilization of epidural analgesia, peripheral nerve blocks, and the administration of opioids through injection or directly into the spinal cord. Combining multimodal analgesia with nerve block methods is frequently employed to alleviate pain throughout the surgical phase of hip fractures. This approach has been demonstrated to effectively prevent complications and enhance postoperative function by ensuring proper pain control.

Objective: This review aimed to assess spinal anesthesia in management of postoperative pain.

Methods: We searched PubMed and Google Scholar for information on Postoperative pain management, Hip surgeries and Spinal anesthesia. Although only the most current or comprehensive study from October 2009 to November 2023 was included, the writers additionally assessed references from pertinent literature. Papers written in languages other than English have been disqualified due to lack of translation sources.

Conclusion: Peripheral nerve blocks offer efficient pain relief, but to adequately manage pain, it may be required to block the femoral nerve (FN), obturator nerve (ON), and lateral cutaneous nerves (LCN). However, this procedure can be challenging, time-consuming, and may lead to lingering motor impairment. Spinal and parenteral opioids have a connection with modest but unpleasant adverse effects.

Keywords: Postoperative pain management, Hip surgeries, Spinal anesthesia.

INTRODUCTION

Fractures occurring in and around the hip are prevalent among both young and old individuals and are accompanied by severe pain. A hip fracture is a severe injury that can have life-threatening implications and is a frequent orthopedic emergency in older individuals [1].

Performing surgery within 48 hours following a fracture has been demonstrated to reduce the occurrence of complications and fatality rates [2].

Annually, almost 1.6 million individuals globally get a hip fracture, and this figure is rising by 25% per decade due to population growth. Owing to the progressive aging of the people globally, it is projected that by 2050, there would be around 6.3 million individuals suffering from hip fractures. Hip fractures should be promptly treated with surgery. Hip surgery may result in varying degrees of pain, ranging from moderate to severe [3].Postoperative pain has many harmful side effects on different body systems if not adequately managed during the perioperative period. These side effects may lead to significant morbidities and even mortality in high-risk surgical patients [4]. The most common reaction to acute pain is anxiety. Sleep disturbance, depression, and hostile actions will be evident when the duration of pain becomes prolonged [5].

During the recovery process, the limitation of physical activity as a result of pain leads to negative outcomes. Combining multimodal analgesia with nerve block methods are frequently employed to manage pain throughout the surgical phase of hip fracture. This approach has been demonstrated to effectively prevent complications and enhance postoperative activities by ensuring proper pain control. The Pericapsular Nerve Group (PENG) block is a novel technique that involves injecting a local anesthesia around the anterior hip capsule to block the nerves that supply the anterior hip capsule. This is primarily achieved by blocking the FN' hip branch and para-occlusive nerve, which run between anterior inferior iliac spine and the iliopubic ramus [6].

Efficient pain control is essential not only for the well-being of the patient, but also for the overall functioning of the healthcare system and the physician's practice.

A work done by **Mistry *et al.*** [7] showed that the participant's subjective experience of pain has a key role in determining their level of satisfaction with the orthopedic surgeon and the surgical facility. Consequently, the pain experienced by patients might directly influence the results of patient satisfaction surveys and the reimbursement received by hospitals and physicians in some nations [8].

Peripheral nerve blocks:

1. Peri-capsular nerve group block (PENG)

The PENG block is a technique that uses ultrasonic guidance. Initially, it was reported by **Giron-Arango *et al.*** [9]. The PENG block specifically affects the ON articular branches, the accessory nerve, the ON, and the FN. This results in sensory innervation to the front part of the hip's capsule [10].

Indication: The PENG block is an innovative method of regional analgesia that effectively alleviates pain

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following hip surgeries and fractures. It has been demonstrated to offer superior pain relief contrasted to other peripheral blocks frequently employed for this type of surgeries [11].

Clinical Significance: The PENG block is a novel and alternative method of regional pain relief for hip surgeries. It can be utilised alongside other regional anaesthesia methods to specifically target the front part of the hip joint as it blocks the articular branches of the FN and accessory ON. This technique can be used instead of a FN block or lumbar plexus block to avoid weakening the quadriceps muscle and enable early postoperative rehabilitation [12].

The present literature strongly supports the utilization of multimodal analgesia in conjunction with regional analgesia, such as nerve blocks and periarticular infiltration methods. This approach has been shown to reduce the need for opioids after surgery and enhance patient outcomes by decreasing morbidity and shortening hospital stays [13].

Technical performance of PENG block:

The PENG block is conducted with the subject lying in supine posture and the operator positioned on the same side of the afflicted limb.

The ultrasonography machine ought to be positioned in a way that allows for a clear and unobstructed view of the screen. An ultrasonic probe with a low-frequency (curvilinear) of 2-5MHz is first positioned in a transverse plane above the anterior inferior iliac spine. It is then adjusted to align with the pubic ramus by turning the probe 45 degrees counterclockwise (Figure 1 A).

In this approach, it ought to be feasible to visually examine the iliopubic eminence, the tendon of the iliopsoas muscle, the femoral artery, and the pectineus muscle. Before needle inserting, it is important to determine the FN via scanning.

To achieve the desired placement, a sonographic needle measuring 80 mm ought to be placed in a direction from the side to the center, using an approach that aligns with the imaging plane. The goal is to place the needle tip in the musculofascial plane, which is located between the psoas tendon at the front and the pubic ramus at the back (Figures 1 B). Prior to injecting the LA into the intended area, it is important to check for the absence of any negative aspiration. Additionally, the distribution of fluid in the target area ought to be carefully observed [14].

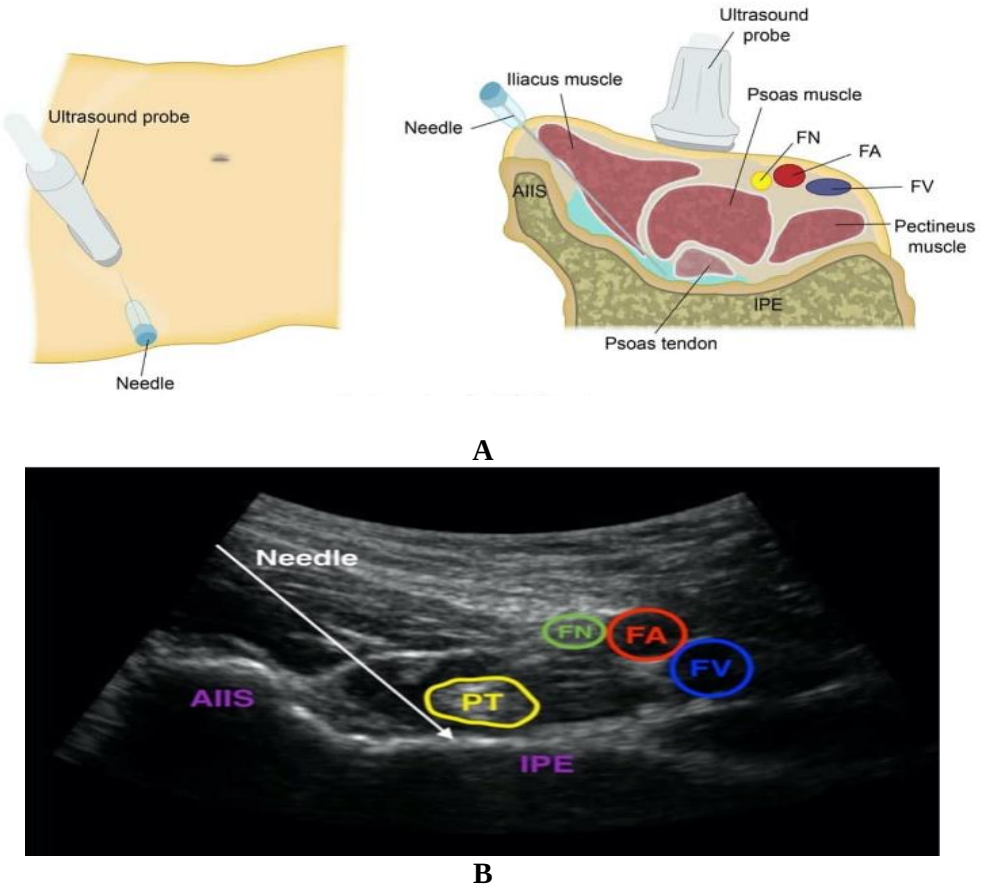

Figure (1): A) Performing of PENG block, B) Labelled and with intended needle course [14]: AIIS = Anterior inferior iliac spine, IPE = iliopectineal eminence, PT = psoas tendon. FN = femoral nerve, FV = femoral vein, FA = femoral artery.

Complications: Proficiency in regional anesthetic procedures necessitates a comprehensive understanding of the potential risks linked to a certain surgery. Possible risks of peripheral nerve blocks comprise bleeding, infection, nerve injury, and toxicity from local anesthesia. The systemic toxicity from local anesthetics occurs when they are either injected into the blood vessels or administered at a dose that exceeds the hazardous limit. The management strategy for this emergency involves promptly administering intravenous intralipid and implementing hemodynamic supportive therapies [15].
The Second American Society of Regional Anesthesia and Pain Medicine Practice Advisory focuses on the neurologic complications related to regional anaesthesia and pain medicine. It specifically highlights complications caused by ischemic, mechanical, or neurotoxic damage to the peripheral nervous system [15].

The contraindications for PENG block include [16]:

- Patient refusing.
- Injection site infections.
- Allergies to local anesthesia.
- Systemic anticoagulation (INR >1.5 or inadequate time since stopping anticoagulant based on ASRA recommendations).

2. Fascia Iliaca Compartment block:

FICB refers to a procedure known as anterior lumbar plexus block, when a local anesthesia is administered below the fascia Iliac to specifically block the lateral femoral cutaneous nerve (LFCN), FN, and maybe the ON. Therefore, its primary purpose is to provide pain relief for surgery or conditions affecting the femoral shaft and hip joint [13].

Indications:

- Management of pain before, during, and after surgery for hip fracture.
- Pain relief for surgery involving the hip or femoral shaft, such as THA.
- Analgesia for knee surgeries (comprising above-knee amputation).
- Pain relief for tourniquet of the lower limb [16].

Complications:
blocking failure, neuropraxia, hematoma, quadriceps weakness, local anesthetic systemic toxicity (LAST), perforation of peritoneal cavity contents, and puncture of the bladder [17].

Block technique: While lying on their back, a high-frequency (6-14 MHz) linear probe is used to locate the femoral artery at the inguinal crease. The iliopsoas muscle, along with the fascia iliac that covers it, is located. The hyperechoic FN is usually observed between the iliopsoas muscle and the fascia iliac, at a depth of 2-4 cm, to the side of the femoral artery [17]. Aspiration is conducted prior to the administration of 1–2 ml of LA. The accuracy of needle placement is verified by the distinct separation of the fascia iliac from the iliopsoas muscle, with the local anesthetic moving towards the FN in a medial direction and the iliac crest in a lateral direction [18]. Routinely, volumes ranging from 30 to 40 ml are utilized to ensure that the LA is administered within acceptable dosage limits and to achieve the best possible distribution **(Figure 2)** [17].

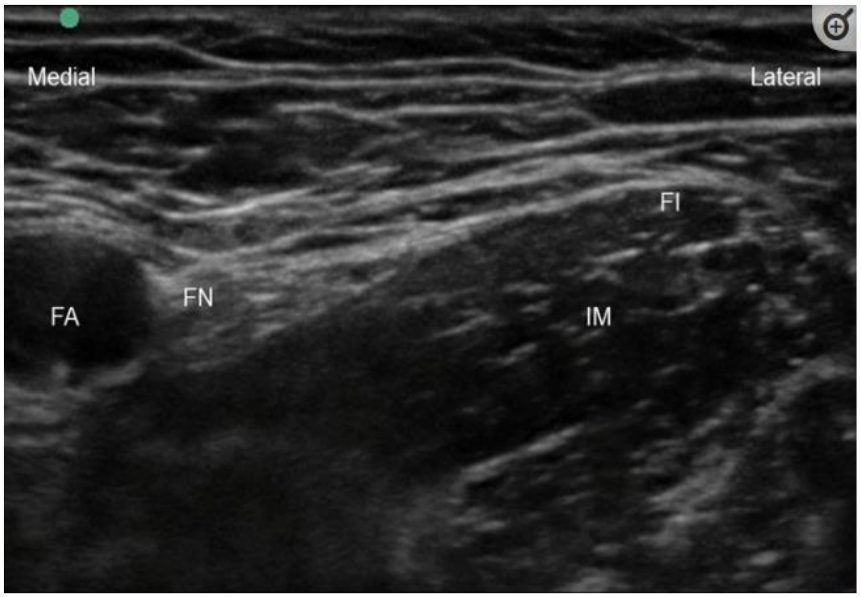

Figure (2): Sonoanatomy of Infra-inguinal approach to fascia iliac compartment block. FN, femoral nerve; FA, femoral artery; FI, fascia iliac; IM, iliacus muscle; IPM, iliopsoas muscle [17].

Pharmacological management

1) Bupivacaine

Bupivacaine is commonly used for several purposes, such as infiltration (0.25%), blocking peripheral nerves (0.375–0.5%), spinal anaesthesia (0.5 and 0.75%), and epidural anaesthesia (0.5 and 0.75%). Due to its systemic toxicity, IV regional anesthesia is contraindicated [19].

Concentrations: Bupivacaine is administered at different concentrations for various clinical purposes. For labor analgesia and managing of acute pain, it is frequently utilized at a dosage of 0.05%. On the other hand, for spinal anaesthesia and peripheral nerve blocks, a concentration of 0.5% is commonly employed [19].

Metabolism and Excretion: Bupivacaine is one of the Amides which are bio transformed in the liver followed by renal excretion [20].

2) Morphine

The maximum effect of an intravenous bolus is achieved within 15 minutes. The duration of the activity spans from 2 to 3 hours. The clearance of morphine is dependent on both the kidneys and the liver. The liver mostly metabolizes it. Morphine 6-glucuronide, a significant byproduct, is a powerful opioid agonist that might accumulate up in cases of kidney failure [21].

Mechanism of action: Morphine predominantly functions as an agonist of μ opioid receptors by binding to these brain receptors and to the terminal axons of primary afferents in the spinal cord. Morphine acts as an indirect antagonist of N-type calcium channels by interacting with G-proteins, so blocking the release of neurotransmitters from peripheral nociceptive neurons to the CNS. Morphine further attaches to postsynaptic receptors and induces hyperpolarization in postsynaptic neurons [22].

3) Ketorolac:

It is an FDA-approved medicine specifically indicated for the management of acute onset pain that ranges from moderate to severe. It belongs to the family of NSAIDs. Ketorolac is a flexible medication that may be used in several ways, including oral, nasal spray, IM, or IV. It is frequently employed following surgeries to alleviate pain. The addition of ketorolac to opioids results in a substantial decrease in the amount of opioids required and reduces the frequency of adverse effects, which include vomiting and reduced movement in the gastrointestinal tract. Ketorolac is equally efficacious as strong opioid analgesics in children [23].

Mechanism of Action: Ketorolac, similar to other NSAIDs, inhibits cyclooxygenases, which are enzymes responsible for converting arachidonic acid into prostacyclin, prostaglandins, and thromboxane. Suppressing these chemicals reduces fever, pain, and inflammation. Ketorolac achieves this by suppressing the activity of both cyclooxygenase-1 and cyclooxygenase-2. It exhibits more documented effectiveness compared to the majority of other NSAIDs [24].

Adult Dosing: It is advised to provide a single dosage of 30 mg IV or IM, or 30 mg every 6 hours. The total dose should not exceed 120 mg during a 24-hour period. In adults, it is recommended to take a single oral dosage of 20 mg after receiving IV or IM treatment. After that, a dose of 10 mg can be taken every 4 to 6 hours, with a maximum of 40 mg during a 24-hour period [25].

Half-life: of a single 30 mg IM or single 10 mg oral dosage is 5.6 hours. Ketorolac is not approved for usage in those under the age of 17, although it can be used off-label in pediatric patients to treat acute moderate to severe pain [25].

CONCLUSION

Peripheral nerve blocks offer efficient pain relief, but to adequately manage pain, it may be required to block the FN, ON, and LCN. However, this procedure can be challenging, time-consuming, and may lead to lingering motor impairment. Spinal and parenteral opioids have a connection with modest but unpleasant adverse effects.

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