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Ultrasound-guided fascia iliaca blocks in the emergency department

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ABSTRACT

Each year, over 300,000 individuals aged 65 and older are hospitalized for hip fractures in the United States.[1] Traditional pain management in the elderly population is difficult because of physiologic changes and comorbidities.[2] Peripheral nerve blocks are often placed by anesthesia professionals following hip surgery as part of a multi modal pain management program. Recently, the placement of fascia iliacal blocks has been successfully utilized in the emergency department for geriatric patients suffering from hip fractures. This technique can be easily mastered with proper training for use in the emergency department and pre-hospital environments reducing the pain of hip fracture and its associated risks of morbidity. This article provides a detailed review of anatomy and an ultrasound-guided technique for placement of the fascia iliaca block.

Introduction

Each year, over 300,000 individuals aged 65 and older are hospitalized for hip fractures in the United States.[1] As the population continues to age, this number will surely increase. Hip fractures are often very painful and management is difficult because of the patient's advanced age and frequent multiple comorbidities. Effective pain management is associated with improved functional outcomes.[2] Traditionally, opioids have been employed as a first-line treatment, however, patients with advanced age are susceptible to many of their side effects including respiratory depression, hypotension, altered mental status and nausea and constipation.[3] Non-steroidal anti-inflammatory drugs increase the risk of bleeding and can exacerbate existing renal and gastrointestinal issues, while acetaminophen alone is usually insufficient. The effects of certain analgesic medications can be exaggerated or prolonged because of delayed metabolism and excretion of active metabolites; this places the patient at risk for further injury.

Peripheral nerve blocks are commonly placed by anesthesia practitioners following hip surgery as part of a multimodal pain management program. When properly placed with ultrasound-guidance (USG), patients report less pain, require less opioids and achieve quicker recovery. Recently, studies have described the successful placement of fascia iliaca blocks (FIB) in the emergency department (ED) for patients suffering from hip fractures. This reduced the need for additional analgesics and decreased the incidence of adverse systemic events, while not posing significant risk to the patient.[4,5]

Advanced anatomy and physiology of hip innervation

Innervation of the lower extremity arises from the lumbar and lumbosacral plexi. Hip fractures commonly refer to a fracture occurring between the edge of the femoral head and 5 cm below the lesser trochanter,[6] which is primarily innervated by the lumbar plexus (see Fig. 1). The plexus is formed by the ventral rami of spinal roots L1–L3 and the superior portion of L4. The *femoral nerve* (FN), formed by the ventral rami of spinal roots L2–L4, is the largest nerve of the plexus originating near the lower third of the psoas major muscle, coursing distally in the groove created by psoas major and iliacus muscles within the pelvis. It runs deep to the inguinal ligament beneath the fascia iliaca and superior to the iliopsoas muscle just lateral to the femoral artery. The FN provides motor and sensory innervation to the femur, quadriceps, anterior thigh and knee, as well as sensory innervation to the medial aspect of the leg below the knee. In addition to the femoral nerve, the obturator nerve (ON) and lateral femoral cutaneous nerve (LFCN) also contribute motor and sensory innervation to the lower extremity. The ON arises from the ventral rami of spinal roots L2–L4 and emerges from the medial border of the psoas muscle at the sacroiliac joint underneath the external iliac artery and vein. It is primarily a motor nerve of the adductor muscles, but also provides sensory fibers to the hip and femur as well as to the soft tissue and skin along the medial aspect

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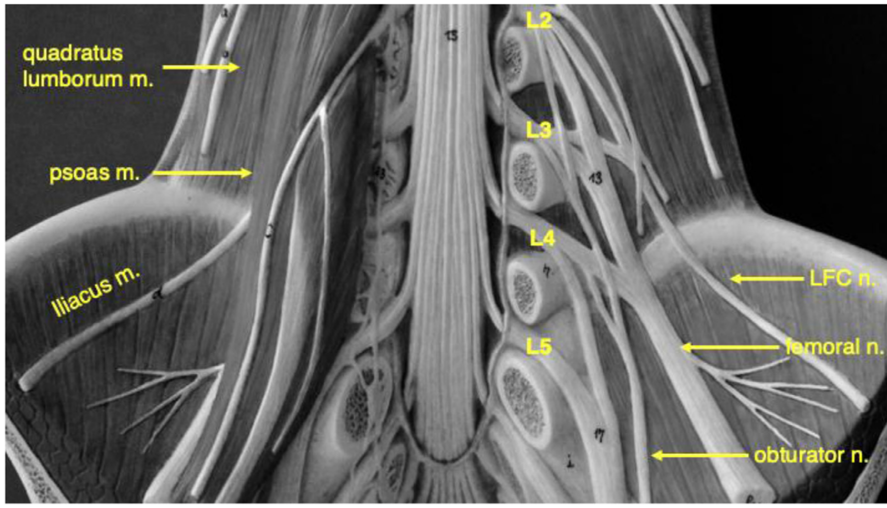

Fig. 1. The lumbar plexus is formed by the ventral rami of the spinal nerve roots L1–L4. Fascial iliaca blocks target three nerves of the plexus; the femoral nerve, lateral femoral cutaneous (LFC) and obturator nerves. Under ultrasound-guidance, a needle is passed lateral to the femoral nerve, beneath the fascia iliacus and superior to the iliacus and psoas muscles. A large volume of local anesthetic (30–40 mL) is injected, resulting in cephalad, lateral and medial spread anesthetizing the nerves.

of thigh. The LFCN is formed by the ventral rami of spinal nerve roots L2–L3 and takes a lateral course, exiting the psoas muscle at its midpoint. It follows an oblique path to the anterior iliac spine where it passes underneath the inguinal ligament, providing sensory innervation to the lateral thigh.

Fascia iliaca block

Since hip fractures involve nerve innervation from the lumbar plexus, advanced practitioners can focus on specific regional techniques to treat pain. The FIB is a peripheral nerve block commonly placed by anesthesia professionals as part of a multimodal pain management plan for postoperative pain following hip surgery. With proper training, emergency room physicians, physician assistants and nurse practitioners can perform this advanced skill. First described by Dahlens as a landmark technique,[7] ultrasound-guidance (USG) has recently been incorporated into the performance of this block. USG allows providers to (1) identify anatomic landmarks, (2) view needle insertion real-time and (3) observe the spread of local anesthetic.[8] Studies demonstrate USG results in improved pain control, faster onset of analgesia, more efficacious blocks, and the reduced use of opioid analgesics, which minimizes sedation, as well as the rate, severity and duration of delirium.[9,10]

The USG FIB has been described as a “low tech” alternative to the femoral nerve or lumbar plexus block.[11] The proposed mechanism of this block follows that since the FN, ON and LFCN lie deep to the fascia iliaca, injecting a large volume of local anesthetic beneath the fascia will result in sufficient spread cephalad, medially and laterally anesthetizing the nerves. The patient is positioned supine, with slight external rotation of the extremity (if tolerated). This provides optimal access to the inguinal region and visualization of key anatomic structures. The skin is cleaned and prepped, and the ultrasound transducer is placed in a transverse orientation at the inguinal crease. It is slid medially or laterally until a single hypoechoic femoral artery and vein are identified (see Fig. 2). The FN lies just lateral to the artery and superior to the large dark, hypoechoic iliopsoas muscle. The nerve should appear as a bright, hyperechoic oval structure. If the nerve is not readily seen, tilting the transducer slightly cephalad or caudad will help distinguish it from the muscle and more superficial subcutaneous tissue. The thin bright fascia iliaca covers the iliopsoas muscle, separating it from the subcutaneous tissue above it. The fascia lata rests superiorly within this tissue. Sliding the transducer laterally several centimeters brings the sartorius muscle into view, which is covered by its own fascia and the fascia iliaca (see Fig. 3).

Once all pertinent structures are identified, a small skin wheal is placed lateral to the edge of the transducer. A 2–4 cm B-bevel needle is inserted through the skin wheal and advanced under USG beneath the fascia lata and iliaca, lateral (near but not adjacent) to the femoral nerve. In order to achieve the optimal spread of local anesthetic, the needle must pass through both fascial planes. Following negative aspiration for blood to ensure an inadvertent vascular injection does not occur, 1–2 mL of local anesthetic is injected, observing for separation of the fascia iliaca from the iliopsoas muscle. If local anesthetic is observed above the fascia or in the muscle itself, the needle is repositioned.

When correct needle placement is verified, incremental injections of 5 mL are achieved following each negative aspiration. Local anesthetic spread should be noted medially and laterally from the injection point. Additional needle repositions may be required. A total of 30–40 mL of low-concentration local anesthetic (bupivacaine or ropivacaine 0.2-0.25%)[7] is usually required to achieve the spread medially toward the femoral nerve and laterally toward the sartorius muscle. When accomplished using proper technique, the femoral nerve is reliably blocked 100% of the time and the lateral femoral cutaneous nerve greater than 80% of the time.[11] The obturator nerve is not reliable blocked. Ultrasound guided FIBs have an efficacy of up to 48 h.[12]

Discussion

The average age of a hip fracture patient is approximately 80 years-old.[2] Twenty-four hours after hip fracture, 50% of patients who are greater than 50 years-old, report their pain as “severe or very severe”.[13] It is estimated that approximately 20% of hip fractures present with some level of dementia,[13] making the assessment of pain even more difficult. Ineffective pain management increases the risk of atelectasis, pneumonia, deep vein thrombosis, increased incidence of delirium and overall decreased function during hospitalization.[10,14]

Multiple studies have demonstrated the efficacy of FIB in the ED for the treatment of hip fracture pain.[4,5,9] Kassam et al. compared oral morphine usage in patients suffering proximal femur fractures who received a FIB compared to patients who took oral morphine alone. The authors found a significant reduction in pain scores in the

Fig. 2. Initial transducer placement for a fascia iliaca block. The transducer is placed in a transverse orientation at the level of the inguinal crease and slid medially or laterally until a single femoral artery (FA) and vein (FV) are identified. The femoral nerve (FN) lies lateral to the artery, superior to the iliopsoas muscle and beneath the fascia iliaca. The transducer is slid several centimeters laterally to bring the sartorius muscle into view (see Fig. 3a and b).

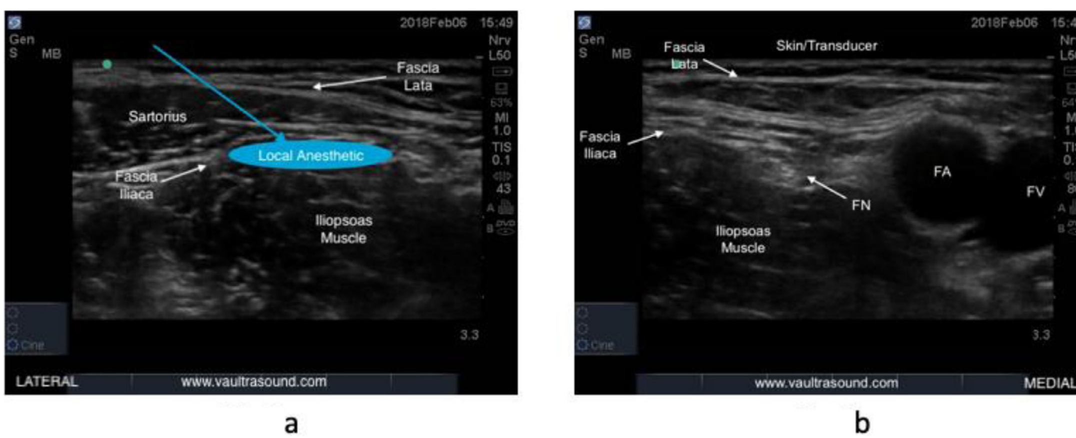

Fig. 3. (a) Desired location of local anesthetic placement for an ultrasound-guided fascia iliaca block. (b) The optimal image for initial transducer placement for determining key anatomic structures. Once the femoral artery (FA), vein (FV), nerve (FN) and iliopsoas muscle are identified, the transducer is slid several centimeters laterally until the sartorius muscle is located. Following placement of subcutaneous lidocaine lateral to the transducer, a needle is passed lateral, but not adjacent to the femoral artery and beneath the fascia lata and iliaca. Following negative aspiration, 1–2 mL of local anesthetic is injected to confirm separation of the fascia from the muscle.

FIB group and they required an average of 50 mg less of oral morphine.[4] Chesters and Atkinson conducted a literature review of two randomized controlled trials evaluating the FIB for pain relief in patients with proximal femur fracture. The studies demonstrated with statistical significance that analgesia provided by FIB was superior to or equal when compared to other forms of acute pain management.[5] The authors noted additional opioid analgesia was not required in either intervention group.[5]

The FIB can be easily mastered with training. Both emergency physicians and non-physician healthcare providers can safely place FIB with proper and brief instruction.[9, 15] Hards et al. concluded "The FIB is suitable for use in the prehospital environment for the management of femoral fractures. It has few adverse effects and can be performed with a high success rate by practitioners of any background", even when performed without USG.[16]

Summary

The use of USG FIB in the prehospital and emergency environments is a proven modality for treating acute proximal femur fractures in patients with advanced age. In addition to better analgesia, these procedures are safe and result in less side effects associated with traditional opioid medications. Studies demonstrate that USG FIB may be useful in the pre-hospital care of hip fracture injuries, and with proper training, can be easily placed by advanced practice providers. This training can be sought by Emergency Department providers as a means to improve patient care. Alternatively, collaboration with the in-house anesthesia team, including Certified Registered Nurse Anesthetists, can be pursued to utilize advanced techniques for pain control.

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