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Fascia iliaca block, history, technique, and efficacy in clinical practice

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The facsia iliaca block (FIB) is a relatively new regional technique where local anesthetic is delivered within the fascia iliaca region.

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Indications for a FIB include surgical anesthesia to the lower extremity after knee, femoral shaft, hip surgery, management of cancer pain or pain secondary to inflammatory conditions of the lumbar plexus, as well as treatment of acute pain in the setting of trauma, fracture, or burns. The FIB may be performed using either a loss of resistance technique or an ultrasound (US)-guided technique; however, the use of US has become commonplace and resulted in improved femoral nerve and obturator nerve motor blocks. The main targets of the FIB are the predominant nerves contained in the fascia iliaca compartment (FIC), namely the femoral nerve and the lateral femoral cutaneous nerve. The FIB US guided technique is beneficial to patients and the possibility to perform FIB should be discussed and coordinated with surgical staff appropriately, considering its superiority to general or epidural anesthesia.

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Introduction

The fascia iliaca compartment block (FIB) was first described by Dalens et al. in 1989 as a means of blocking the three principal lumbar plexus nerves of the thigh with a single injection of local anesthetic delivered immediately dorsal to the fascia iliaca [1,2]. Dalen wrote that this technique is easy, reliable, requires no unusual skills or expensive devices, and threatens no vital organ. The FIB is considered an alternative to the "3-in-1" technique for lumbar plexus nerve block described by Winnie et al. in 1973.

A lumbar plexus nerve block may be performed after surgery to the knee, femoral shaft, or hip to provide high-quality anesthesia to the region supplied by the lumbar plexus. Its anesthetic effect is considered superior to that of systemic morphine administration, and is associated with fewer side effects than epidural anesthesia [3]. Several approaches to the lumbar plexus have been described, including the FIB and the 3-in-1 technique [4]. The rationale behind these approaches is to anesthetize the three main nerves of the lumbar plexus (the femoral nerve, the lateral femoral cutaneous nerve, and the obturator nerve) by using a single injection of local anesthetic [3,4]. Some patients also experience an anesthetic effect on the genitofemoral nerve [3,5].

In 1989, Dalens et al. compared the FIB with the 3-in-1 technique in a study involving 120 children. They reported that while both techniques resulted in similar rates of complete sensory block to the femoral nerve (100%), the FIB provided improved blockade of the lateral femoral cutaneous nerve (92% vs 15%; $p < 0.05$). However, it was noted that in patients receiving the FIB, the duration of postoperative pain relief was reduced by an average of one hour. This may be attributable to vascular uptake of local anesthetic. A comparable study of 100 adults reported similar rates of sensory block in the femoral nerve (88–90%) and improved sensory blockade of the lateral femoral cutaneous nerve in the fascia iliaca group compared to the 3-in-1 group (90% vs 62%; $p < 0.05$)[3]. Rates of motor blockade of the obturator nerve and sensory blockade of the genitofemoral nerve were not significantly different between the groups [3].

The FIB may be performed using either a loss of resistance (LOR) technique or an ultrasound (US)-guided technique. A 2008 trial [6] reported a similar rate of sensory block in the anterior and lateral thigh in both groups, but improved sensory block of the medial thigh in the US group. Additionally, US guidance resulted in improved femoral nerve and obturator nerve motor blocks.

General indications

A lumbar plexus nerve block is most commonly used for surgical anesthesia to the lower extremity after knee, femoral shaft, and hip surgery [3,4]. Additional indications include the management of cancer pain or pain secondary to inflammatory conditions of the lumbar plexus, as well as amelioration of acute pain in the setting of trauma, fracture, or burns [3–5].

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Relatively few contraindications exist for a FIB. These include patients with coagulopathy or who are taking antithrombotic medication, infection at the site of injection, history of femoral bypass surgery, or pre-existing neural deficits in the block's distribution [5,7]. If there is concern for development of compartment syndrome, nerve blocks should be avoided due to symptom masking [7]. Absolute contraindications include allergies to the anesthetic agents and crush injury at or near the site of injection [5,7].

Safety profile

Although the FIB is considered relatively easy to perform, mastering the technique requires experience. While many conditions may be managed with an epidural or subarachnoid block, the FIB is associated with less side effects when compared with these techniques [3,4]. Related to the proximity of the femoral artery and vein to the site of injection, complications include the possibility of local anesthetic toxicity. Groin and back pain, ecchymosis, and hematomas of the groin are further possible complications.

Anatomy

The main targets of the FIB are the predominant nerves contained in the fascia iliaca compartment (FIC), namely the femoral nerve and the lateral femoral cutaneous nerve. The FIC is a potential space located just above the inguinal region of the upper thigh, which can be infiltrated with local anesthetic upon injection. This facial plane separating the femoral nerve from the femoral artery is situated just lateral to the femoral artery and lies atop (anterior to) the iliacus muscle. It courses anteriorly in relation to the psoas and pectineus muscles also [5]. It is superolaterally bound by the iliac crest and merges medially with the fascia overlying the psoas muscle. The Sartorius muscle, as well as the femoral artery and vein, are located between the fascia lata and the fascia iliaca [5]. The thigh femoral and lateral cutaneous nerves are located under the fascia iliaca [8].

The ultrasound should begin by identifying the femoral artery at the level of the inguinal crease. If not immediately visible, the transducer should be moved medially and laterally to visualize the vessel. This vessel can often be identified via direct US visualization by its arterial pulsation. The iliopsoas muscle is immediately lateral and deep to the femoral artery and vein and is covered by a hyperechoic fascia, which separates the muscle from the superficial subcutaneous tissue [8].

The femoral nerve is the largest of the four nerves in the group and is commonly identified via US by direct visualization of the femoral artery, with the nerve coursing immediately lateral to the artery.

The hyperechoic femoral nerve should be visualized as wedged between the iliopsoas muscle and the fascia iliaca and lateral to the femoral artery. The fascia lata (seen superficially in the subcutaneous layer) is oriented more superficial and may have more than one layer.

The Lateral femoral cutaneous nerve can be visualized running behind the lateral aspect of the inguinal ligament [5]. The obturator nerve can be seen running through the psoas muscle, although it only contributes a minimal amount of nociception to a small portion of the medial leg and is variably blocked by the FIB.

Moving the transducer several centimeters lateral can visualize the Sartorius muscle covered by its own fascia as well as the fascia iliaca. Additional lateral movement of the transducer shows the anterior superior iliac spine [8].

Sensory innervation of the lower extremity is supplied predominately through 4 major nerves and their branches: the sciatic nerve, femoral nerve, obturator nerve, and the lateral femoral cutaneous nerve [5]. These originate from the lumbar plexus, except for the sciatic, which receives some of its contribution from the sacral plexus [9].

The incision for most hip fracture surgeries is typically located over the lateral part of hip, and this area is innervated by the lateral femoral cutaneous nerve running rather superficially [9]. The femoral nerve is responsible for most of the innervation of the deeper structures, and to some degree, co-innervates some lateral superficial structures along with the lateral femoral cutaneous nerve. These areas, which are located predominately over the anterior (some lateral) portions of the thigh, include most of the skin in the anterior region, as well as the muscle and periosteum overlying the femoral head, neck, and proximal femur. For this reason, the target of the FIB is the cutaneous lateral femoral cutaneous nerve and the deeper femoral nerve, and the blocking of nociceptive input from these nerves [9].

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Related to the widespread distribution of sensory innervation contributed by these two nerves in relation to the lower extremity, FIB has also been found useful in perioperative pain control of total knee arthroplasty as well as hip procedures [9]. However, the sciatic nerve, which innervates the posterior portion of the thigh, is not blocked by the FIB. For this reason, traction during surgery or hematomas formed at the surgical site may generate nociceptive stimulation to the posterior periosteum femur receptors, facilitating nociception (and subsequent pain perception) transduced by the unblocked sciatic nerve [9]. For this reason, additional analgesia may be required post operatively to address posterior thigh and/or knee pain.

Fascia illiaca block ultrasound guided technique

Although traditionally, the FIB was known as a quick and relatively simple block to perform via "blind" technique using anatomical landmarks, the recent advances made in US technology have greatly improved portability, resolution, and ease of operation, making regional anesthesia blocks, such as the FIB, even simpler, more beneficial, and most importantly safer.

Before US was readily available, a technique using anatomical landmarks was used, and can still be employed today if US is unavailable or the acuity of the patient's condition warrants an emergent or expedited block. The femoral artery is palpated and marked to ensure avoidance throughout the procedure and to roughly estimate the position of the femoral nerve bundle (immediately lateral to the artery). By drawing a line on the skin from the pubic tubercle to the anterior superior iliac spine, and dividing that line into three equal sections, the needle can be placed at the lateral third of the distance from the anterior superior iliac spine to the pubic tubercle. The puncture site is usually located 2–3 cm caudal to the medial one-third point of the line [9]. In this "blind" approach, a characteristic "2 pops" are felt when penetrating the fascia lata and fascia iliaca facial layers, and is indicative of entrance into the target compartment [5]. Local anesthetic can then be administered in a "single-shot" or bolus fashion (usually 20–30 mL) or a catheter can be inserted (via a cannulated US needle) and fed into the space (moving cranially approximately 5 cm). The catheter is then secured to the skin (usually with a retaining device or tape), and connected to a pump for continuous infusion [9].

Most sources suggest using sterile, or at least semi-sterile, technique (sterile gloves, mask, cap) when inserting an indwelling catheter for infusion. However, block success with this "feel" technique proved too sporadic as false "pops" were common. In contrast, the US-guided technique allows for monitoring of the needle placement, avoidance of critical structures, and precise local anesthetic delivery, which helps to ensure appropriate local anesthetic spread into the correct plane and thus, adequate sensory-neural blockade [8].

The FIB is performed with the patient in the supine position. The bed or table should be flat to maximize access to the inguinal area (see Fig. 1). Palpation of the femoral pulse may serve as a landmark, however, it is not required as the artery is quickly visualized by transverse placement of the transducer on the inguinal crease, followed by slow lateral or medial movement. For US guided technique, a linear transducer (6–14 MHz) is generally used. Initial transducer position should be transverse, just caudal to the femoral crease, and just lateral to the femoral artery (see Fig. 1) [8]. Identify the hyperechoic fascia iliaca superficial to the hypoechoic iliopsoas muscle (Fig. 2). The fascia iliaca is the second fascial plane encountered when viewing the proximal lower extremity via US and runs just below the facia lata [5]. Laterally, the Sartorius muscle (SM) is identified by its typical triangular shape when compressed by the transducer, and medially, the femoral nerve (FN) is visualized deep to the fascia and lateral to the artery (Fig. 2) [8].

The patient should be in the proper position and the skin disinfected with chlorhexidine. The transducer is positioned to identify the femoral artery, the iliopsoas muscle, and fascia iliaca (just below the iliopsoas). Move the transducer laterally until the Sartorius muscle is identified. After a skin wheal is made with local anesthetic to anesthetize the skin, the US-guided needle (usually an 80–100 mm, 22-gauge short-beveled needle) is inserted in-plane with the US probe, so as to adequately visualized [8]. The sensation of a "pop" may be felt as the needle eventually pierces the fascia, and the fascia may be perceived to "snap" back on the US image. After negative aspiration to rule out any possibility of intravascular infiltration, 1–2 mL of local anesthetic should be injected to confirm the proper injection plane between the fascia and the iliopsoas muscle [8].

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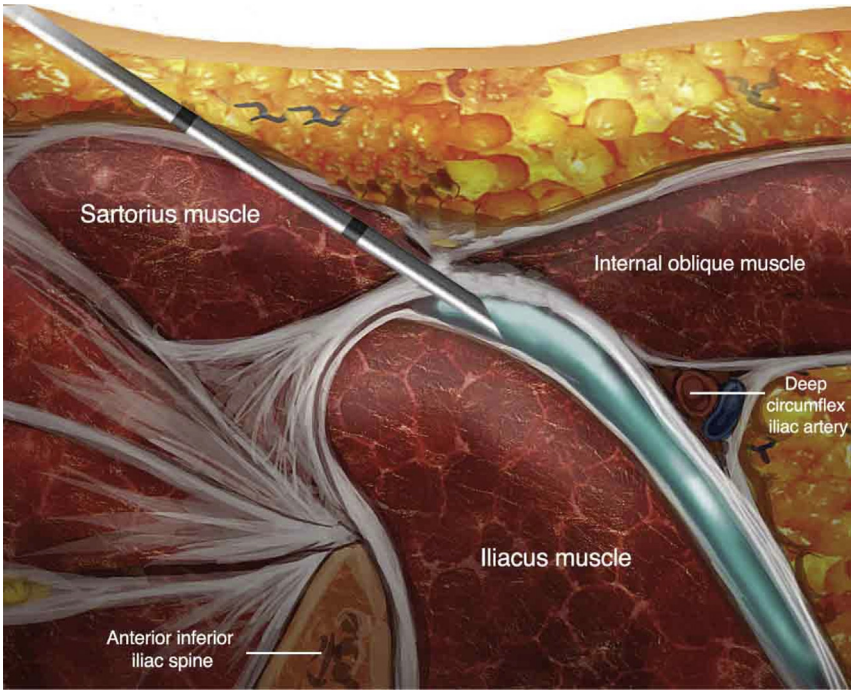

Fig. 1. Schematic of the fascia illiaca compartment in a parasagittal view. Image is reused with permission from NYSORA.

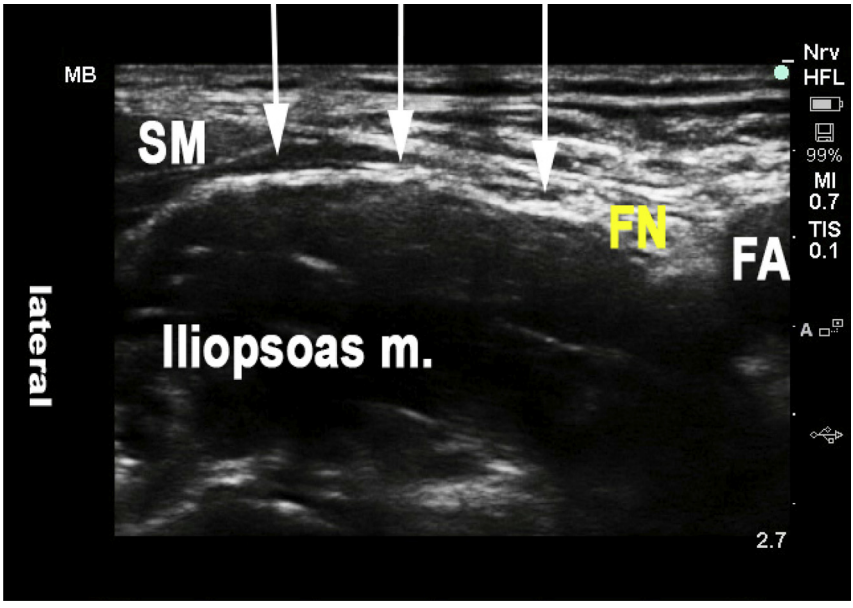

Fig. 2. Ultrasound imaging showing landmarks for the fascia illiaca block. The sartorius muscle (SM) is typically triangular shaped and medially the femoral nerve (FN) is visualized deep to the fascia and lateral to the femoral artery (FA).

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If local anesthetic coverage occurs over the fascia or in the muscle itself, additional needle repositioning and injections may be necessary to properly position the tip of the needle below the fascial plane. A correct injection will result in the separation of the fascia iliaca facilitated by the local anesthetic spread in the medial–lateral direction from the point of injection [8]. The objective is to insert the needle tip under the fascia iliaca at an approximate lateral third of the line which connects the anterior superior iliac spine to the pubic tubercle (the injection is made several centimeters lateral to the femoral artery) and to deposit a large volume (20–40 mL) of local anesthetic until its coverage is lateral toward the iliac spine and medial toward the femoral nerve; observed with US visualization [8]. Spread of local anesthetic is visualized and confirmed via real-time confirmation of hypoechoic fluid (LA) expanding the potential space and spreading along the facial plane. A release of the pressure of the transducer may reduce resistance to the injection and improve the dispersion of local anesthetic. If the coverage is inadequate, additional injections lateral or medial to the original needle insertion or injection site can be made to facilitate medial–lateral coverage [8].

The distribution of anesthesia and analgesia is dependent upon on the extent of the local anesthetic spread and the nerves that are blocked. Femoral nerve blockade results in anesthesia of the anterior portion of the medial thigh (down to and including the knee) and anesthesia of the variable strip of skin on the medial leg and foot (saphenous nerve). The lateral femoral cutaneous nerve innervates the anterolateral thigh [8].

Choice of anesthetic and anesthetic concentration also plays a critical role in appropriate blockade of sensation, and, depending on desired effect, degree of motor blockade. A dose of 20–40 mL of local anesthetic is usually required for successful blockade in an adult patient. Other sources suggest weight based dosing (i.e. 20 mL for <50 kg, 25 mL 50–70 kg, 30 mL > 70 kg) for bolus dosing of local anesthetic [9]. A dose of 0.7 mL/kg is commonly used in children.

Typically a solution of 0.5% or 0.25% Ropivacaine, Bupivacaine is used for bolus injection, and 0.25% Ropivacaine used for catheter infusion [10]. When choosing the concentration of local anesthetic, consideration should be given to the duration and density of neural blockade one is trying to achieve. The block should be adequate for sustained and complete sensory blockade, but degree of motor blockade to the lower extremity should be determined by the post-operative ambulatory status of the patient. Accidental motor-blockade or weakness secondary to an over-dense block can lead to increased time to ambulation after surgery.

As blockade of the anterior branch of the obturator nerve may not occur with the fascia iliaca block, this nerve should be blocked to ensure appropriate analgesia of the superomedial thigh when required. Another suprainguinal technique may result in a more proximal spread and perhaps more effective analgesia after hip surgery [8].

Conclusion

In the current review, we have discussed the anatomy, technique, efficacy, and in-practice concerns for fascia iliaca compartment block, which is an effective and relatively safe supplement in the pre-operative pain management of several surgical modalities. As the number of orthopedic surgeries to the knee, femoral region, and hip increase rapidly, FIB provides high-quality anesthesia to the region of the lumbar plexus and is superior to that of systemic morphine administration, with fewer side effects than epidural anesthesia. It is relatively easy to perform with several choices of anesthetic and technique, yielding the ability to be personalized in a day-today setting. These positive attributes make this anesthetic technique beneficial to the patient and the possibility to perform FIB should be discussed and coordinated with surgical staff appropriately, considering its superiority to general or epidural anesthesia.

Practice points

- Although the FIB is considered relatively easy to perform, mastering the technique requires experience.
- While many conditions may be managed with an epidural or subarachnoid block, the FIB is associated with less side effects when compared with these techniques.

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- As the number of orthopedic surgeries to the knee, femoral region, and hip increase rapidly, FIB provides high-quality anesthesia to the region of the lumbar plexus and is superior to that of systemic morphine administration, with fewer side effects than epidural anesthesia.

Research agenda

- The FIB US guided technique is beneficial to patients and the possibility to perform FIB should be discussed and coordinated with surgical staff appropriately, considering its superiority to general or epidural anesthesia.
- Although traditionally, the FIB was known as a quick and relatively simple block to perform via "blind" technique using anatomical landmarks, the recent advances made in US technology have greatly improved portability, resolution, and ease of operation, making regional anesthesia blocks, such as the FIB, even simpler, more beneficial, and most importantly safer.

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