Fascia Iliaca Compartment Block: An Update

Jonathan Major[1†], Madankumar Narayanan[2]

[1]Clinical Fellow in Regional Anaesthesia, Frimley Park Hospital, Frimley, Camberley, UK
[2] Consultant in Anaesthesia and Intensive Care Medicine, Frimley Park Hospital, Frimley, Camberley, UK

Edited by: Su Cheen Ng, Beacon Hospital, Dublin, Ireland; Simeon West, University College Hospital, London, UK

† Correspong author e-mail: jonathan.major@nhs.net

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KEY POINTS

- The fascia iliaca compartment block remains a safe, simple and reliable technique for providing analgesia, particularly in the perioperative management of patients with hip fractures.
- Landmark and ultrasound-guided infrainguinal techniques are well described. There is anatomical logic to more proximal suprainguinal approaches that may be more effective.
- Identification of the correct fascial plane is essential for block success.
- Irrespective of the regional technique chosen, a multimodal analgesic strategy is advisable.

INTRODUCTION

In essence, the fascia iliaca compartment block (FICB) is an anterior lumbar plexus block in which local anaesthetic is injected deep to the fascia iliaca with the aim of blocking the femoral nerve (FN), lateral femoral cutaneous nerve (LFCN) and possibly obturator nerve (ON). Thus, its use is principally in providing analgesia for hip joint and femoral shaft surgery/pathology.

While efficacious, posterior lumbar plexus block (or psoas compartment block) remains a relatively advanced technique with a significant risk of adverse effects, including epidural and intrathecal spread, and intravascular injection; these complications have not been eliminated even with the use of ultrasound. Consequently, much focus over the years has been directed at anterior approaches to the lumbar plexus or its branches, descriptions of which have evolved over several decades. Published in 1973, Winnie's original '3-in-1' block[1] relied on eliciting paraesthesia. In 1989, Dalens et al described a landmark-based FICB[2] that has been subsequently revised with the widespread advent of ultrasound. Hebbard et al in 2011 described a more proximal ultrasound-guided suprainguinal approach,[3] and some modifications to this have since been advocated.

This article supplements ATOTW 193: 'Fascia Iliaca Compartment Block: Landmark and Ultrasound Approach'. It will revisit some key aspects of applied anatomy and explore the different approaches to performing the block. It will offer a detailed description of the suprainguinal FICB (S-FICB) and examine its applications and current evidence base.

ANATOMY

The lower limb is innervated by branches of the lumbosacral plexus, the principal nerves being the FN (posterior divisions of ventral rami of L2-4), ON (anterior divisions of ventral rami of L2-4), LFCN (posterior divisions of ventral rami of L2-3) and

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sciatic nerve (anterior and posterior divisions of ventral rami of L4-S3). The origin and course of these nerves as well as the anatomy of the fascia iliaca compartment and its boundaries are covered in some detail in the preceding article.

Hip joint innervation is complex and demonstrates significant interindividual variability. However, a recent systematic review of the literature has helped expose some important consistencies. The superior aspects of the anterior capsule are the areas of highest nociceptor density. Mechanoreceptors are also found in higher concentration anteriorly than posteriorly. Innervation of the hip joint consistently involves articular branches of FNs and ONs, which supply the anterior capsule. The posterior capsule consistently receives innervation from the nerve to the quadratus femoris (derived from anterior divisions of ventral rami of L4-S1).[4] While evidence also shows that other nerves including the superior and inferior gluteal nerves, accessory ON and sciatic nerve may also contribute, their involvement is less consistent. Figure 1 summarises the principal sensory innervation of the hip joint. Figure 2 illustrates consensus findings on the distribution of innervation patterns of the anterior and posterior joint capsule.[5]

Cadaveric dissection of the hip joint by Short et al[6] demonstrated that articular branches of the FN and ON were observed in all specimens, consistent with the findings of the systematic reviews above. FN branches were predominately responsible for innervation of the lateral and superomedial joint capsule, whereas ON branches were mainly found inferomedially. Importantly, 'high' articular branches of the FN, defined as originating proximal to the inguinal ligament, were observed in 92% of specimens. Similarly, 'high' ON branches, defined in relation to the bifurcation of the ON into its anterior and posterior divisions, were found in 62%.[6]

Together, these findings provide sound reasoning for targeting the nerves responsible for anterior hip joint innervation in providing perioperative analgesia for hip fracture. Furthermore, there is anatomical logic in favouring more proximal approaches, which are less likely to miss important articular branches. Indeed, this is the theoretical basis of the S-FICB.

INDICATIONS

There is consistent evidence that regional nerve blocks reduce pain associated with hip fracture, with a consequent reduction in opioid use and associated side effects including delirium and reduced length of hospital stay.[7] The UK Association of

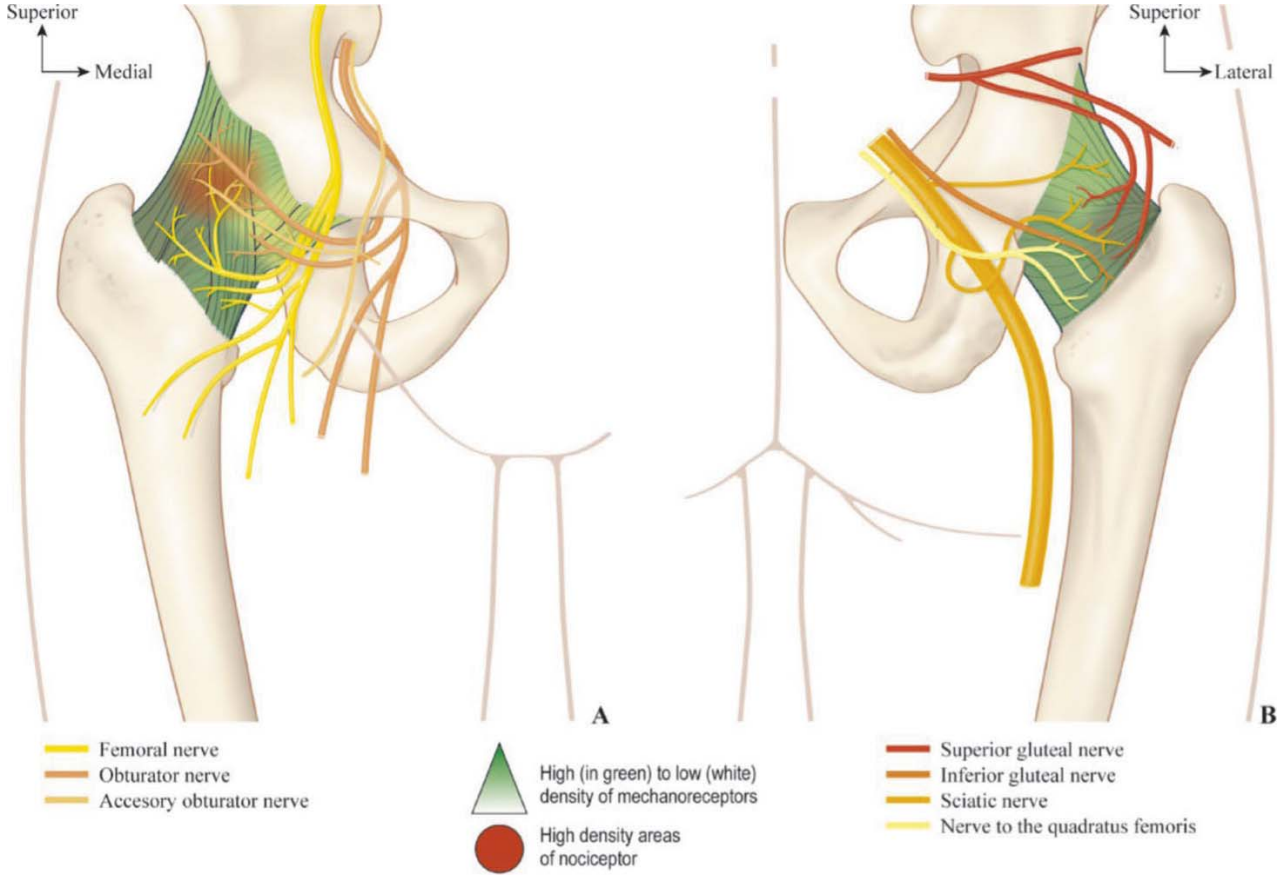

Figure 1. Sensory innervation of the hip joint based on a review of the literature. (A) anterior, (B) posterior. Reproduced from ref 4 with permission from Oxford University Press.

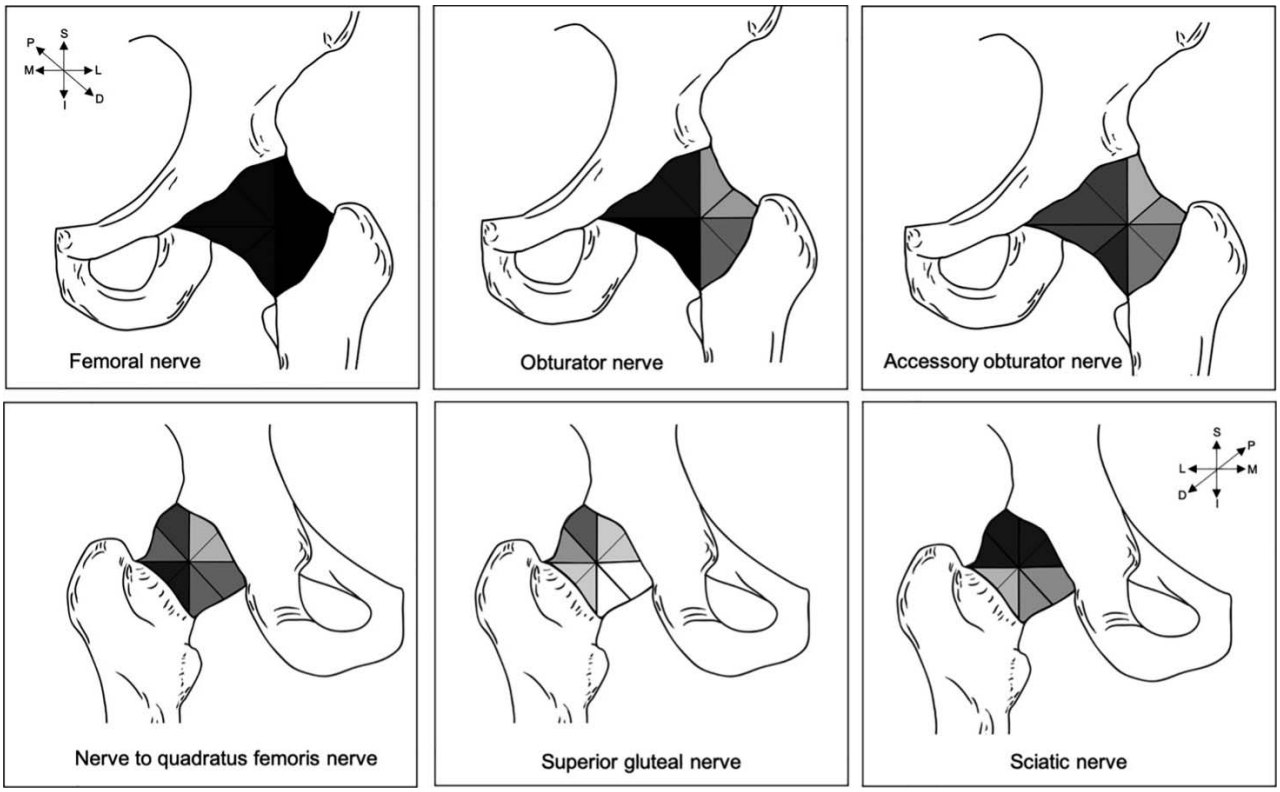

Figure 2. Consensus findings on hip joint innervation patterns by the main nerves responsible for joint capsule innervation. Anterior hip capsule (top row), posterior capsule (bottom row). The intensity of the shading relates to the percentage of studies that agree that a particular region of the hip capsule receives innervation from a certain nerve. Reproduced from ref 5 with permission under Creative Commons License CC BY 4.0.

Anaesthetists of Great Britain and Ireland (AAGBI) guidelines explicitly recommend that 'single shot nerve blocks should be provided in the Emergency Department and at the time of surgery (provided 6 hours has passed between blocks)', advising that 'femoral or fascia iliaca blocks should be used, the latter possibly providing better incisional analgesia after surgery'.

- Perioperative analgesia for hip fracture
- Analgesia for hip or femoral shaft surgery (including total hip arthroplasty)
- Analgesia for knee surgery (including above-knee amputation)
- Analgesia for lower-limb tourniquet

CONTRAINDICATIONS

Patient refusal, local anaesthetic allergy and infection at the injection site all represent absolute contraindications. Previous femoral bypass surgery is also generally considered a contraindication. Anticoagulation or coagulopathy are important relative contraindications. There is no consensus on recommended thresholds; instead, the risks and benefits should be considered on an individual basis.

General preparation and safety considerations relevant to performing regional anaesthesia are covered in ATOTW 134: 'Peripheral Nerve Blocks—Getting Started'.

LANDMARK-BASED FICB

With the more widespread availability of ultrasound and its increasing embedment from an earlier stage within medical training, the use of landmark-based FICB appears to have decreased. However, there remains a role for this technique, especially for those practitioners not trained in the use of ultrasound and/or in settings outside the operating theatre environment. The UK Royal College of Emergency Medicine Best Practice Guideline from 2020 still describes a landmark-based procedure.

With the patient supine, a line connecting the anterior superior iliac spine (ASIS) and ipsilateral pubic tubercle, beneath which the inguinal ligament lies, is marked. The injection point is 1 cm caudal to the junction of the lateral and middle thirds of this line,

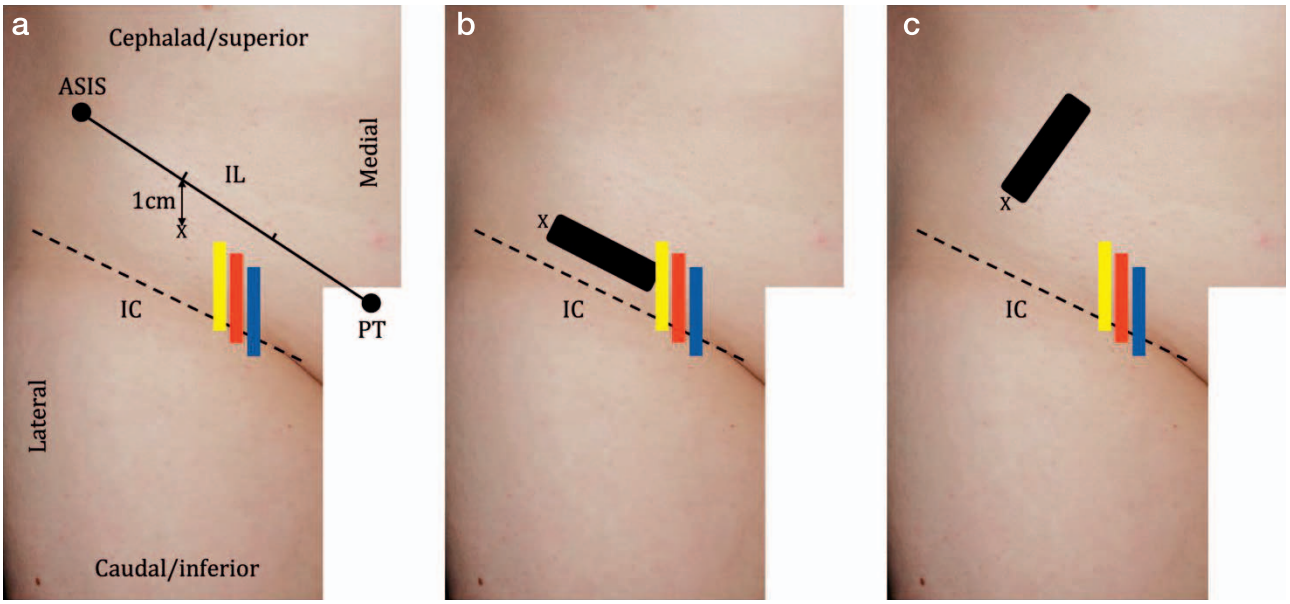

Figure 3. Important surface landmarks and suggested probe positions and needle insertion points for (a) landmark FICB, (b) ultrasound-guided I-FICB and (c) ultrasound-guided S-FICB. The 'X' indicates the suggested point of needle insertion. Yellow, red and blue rectangles represent approximate locations of the femoral nerve, artery and vein, respectively. The black rectangle (b, c) indicates the suggested probe position/orientation. ASIS, anterior superior iliac spine; IC, inguinal crease; IL, inguinal ligament, divided into thirds; PT, pubic tubercle.

as indicated in Figure 3a. The ipsilateral femoral pulse should be palpated to ensure it is medial to this point. A short-bevelled needle is inserted perpendicular to the skin, and the angle is then adjusted to approximately 60° and directed cranially. Two 'pops' should be felt as the needle is advanced, representing passage through the fascia lata and fascia iliaca, respectively. The angle should be reduced to 30°, the needle advanced a further 1 to 2 mm and, after negative aspiration, the local anaesthetic should be injected with minimal resistance.

ULTRASOUND-GUIDED INFRAINGUINAL FICB

While clear evidence of a safety benefit is lacking, an ultrasound-guided technique facilitates more accurate placement of local anaesthetic and therefore improves efficacy, as evidenced by higher rates of FN and ON block.[8] Given the possibility of false 'pops', identification of the correct fascial plane on ultrasound must aid block performance and is logically a superior technique.

Using a high-frequency ultrasound probe, start scanning at the level of the inguinal crease in a transverse plane and first identify the femoral artery medially. The hypoechoic iliopsoas muscle with its overlying fascia iliaca should be seen, with the hyperechoic, oval-shaped FN lying between these structures and lateral to the femoral artery, as illustrated in Figure 4. The more superficial fascia lata is not always easy to identify. The triangular-shaped sartorius muscle should be identified further laterally. The inguinal crease is usually distal to the point at which the profunda femoris artery branches off the posterolateral aspect of the common femoral artery, especially in obese individuals; thus, from this starting point (which is too low), the probe needs to be moved in a cephalad direction. The block should be performed proximal to the arterial bifurcation.

Using an in-plane approach, a short-bevelled needle is inserted from lateral to medial, aiming to penetrate the fascia iliaca at the junction between the medial border of sartorius and iliopsoas muscles, lateral to the FN. The approximate probe position is indicated in Figure 3b, although in practice this varies significantly according to the individual patient's anatomy. The spread both medially and laterally beneath the fascia should be visualised, and local anaesthetic should be seen to reach the FN medially.

For further information regarding the infrainguinal approach, refer to ATOTW 193: 'Fascia Iliaca Compartment Block: Landmark and Ultrasound Approach'.

ULTRASOUND-GUIDED SUPRAINGUINAL FICB

A variety of in-plane and out-of-plane approaches with different needle entry points have been described. Here we present the method advocated by our institution, based on modifications to Hebbard's original technique,[3] as developed by Desmet et al[9] and Vermeylen et al[10].

Figure 4. Typical sonoanatomy of the I-FICB. (a) The white circle indicates the needle entry point at the medial border of the SM, with the 'X' indicating the desired plane of hydrodissection/local anaesthetic spread. Note that this figure is stitched from 2 separate ultrasound images. (b) Suggested block ergonomics for performing I-FICB. FA, femoral artery; FI, fascia iliaca; FL, fascia lata; FN, femoral nerve; IPM, iliopsoas muscle; SM, sartorius muscle.

Preparation: General

- Obtain informed consent.
- Establish intravenous access, appropriate monitoring (electrocardiogram, noninvasive blood pressure, SpO_2), presence of trained assistant and availability of resuscitation facilities.
- Place the patient in the supine position.
- Ensure correct-side block (follow the World Health Organisation's Surgical Safety Checklist[11] and 'Prep, Stop, Block' initiative).
- Position operator on the ipsilateral side, with the ultrasound machine on the contralateral side.
- Follow appropriate aseptic precautions: 0.5% chlorhexidine in 70% isopropyl alcohol skin disinfectant, sterile gloves, sterile probe cover; full aseptic technique for catheter insertion.
- Administer lidocaine for skin infiltration.

Preparation: Equipment

- 50- to 100-mm 22G short-bevelled echogenic needle
- 30 to 40 mL of local anaesthetic agent (eg, 0.25% bupivacaine, ensuring toxic dose [2 mg/kg] not exceeded)
- High-frequency, linear array ultrasound probe

Scanning Protocol and Sonoanatomy

- Palpate the ASIS and place the probe in a parasagittal orientation just medial to this point.
- Slide the probe inferomedially along the course of the inguinal ligament. As the probe is moved back and forth, the bony prominence of the ilium, the anterior inferior iliac spine (AIIS), should be identified. The AIIS forms the attachment of the rectus femoris muscle and can be identified by a sudden rising of bony shadow toward the transducer as the probe is moved laterally, as in Figure 5a.
- At this level, the 'bow tie' or 'horizontal hourglass' sign is sought, as illustrated in Figure 5b. This is formed by the sartorius muscle caudally and the transverse abdominus and internal oblique muscles cranially. The external oblique muscle is an aponeurosis at this point and is not identifiable. Optimising this view generally requires rotation of the transducer such that the cranial end points toward the umbilicus and the probe orientation is therefore approximately perpendicular to that of the inguinal ligament, as shown in Figure 3c. Deep to the 'bow tie' lies the iliopsoas muscle and its immediately overlying, hyperechoic fascia iliaca.
- Identify the deep circumflex iliac artery (DCIA), which is an important vascular landmark. The DCIA arises from the external iliac artery and runs approximately 1 cm cranial to the inguinal ligament in a fibrous sheath formed by the transversalis fascia and fascia iliaca.

Block Performance

- With the ultrasound probe orientated as in Figure 3c, introduce the needle in plane just below (or just above) the inguinal ligament, in a caudal to cranial direction.
- The fascia iliaca is penetrated, and after negative aspiration, injection results in its separation from the underlying iliacus muscle as this tissue plane is carefully hydrodissected.
- Local anaesthetic should pass freely over the iliacus muscle and down into the iliac fossa.

Practical Tips

- A slightly more cranial entry point, and therefore steeper needle trajectory, aids with the tactile feedback gained from traversing fascial layers but may be less feasible in obese patients. In general, though, this block requires a relatively shallow needle trajectory to avoid intramuscular injection (in the iliopsoas), which can create false fascial layers and will lead to an ineffective block.
- The needle tip must be cephalad to the pelvic brim at the point of injection to help ensure that the pinch point of the 'bow tie' promotes local anaesthetic spread proximally within the pelvis toward the lumbar plexus (and does not 'spill' down the thigh).
- Upward movement of the DCIA, which is superficial to the fascia iliaca, indicates injection in the correct plane.

DISCUSSION

Safety

A systematic review from 2018 on the effects of FICB for hip fracture patients demonstrated very few adverse effects. Local haematoma at the injection site, the most frequently reported complication, was described in 1.7% of cases.[12] More serious

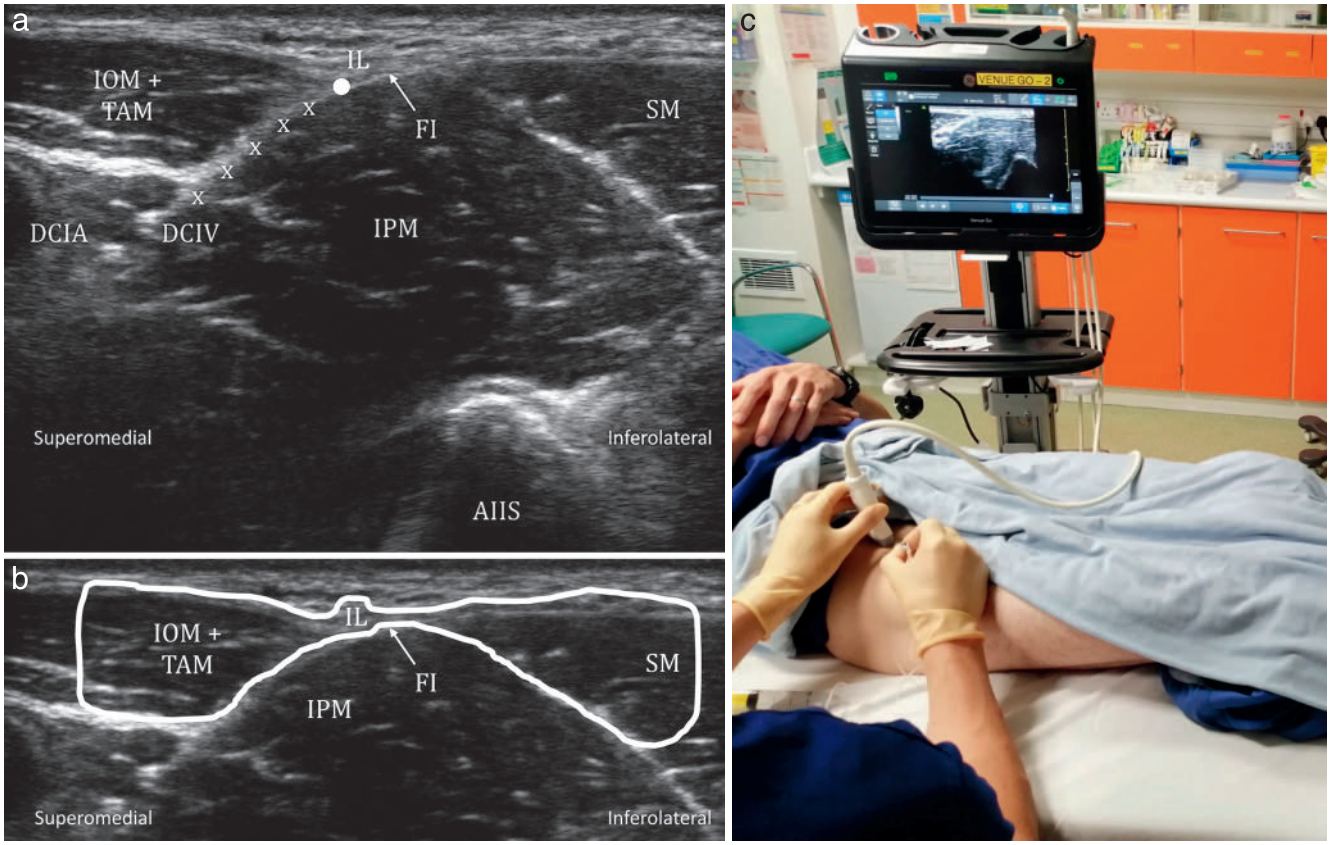

Figure 5. Typical sonoanatomy of the S-FICB. (a) The white circle indicates the needle entry point, with the 'X' indicating the desired plane of hydrodissection/local anaesthetic spread. (b) The 'bow tie' sign. (c) Suggested block ergonomics for performing S-FICB. AIIS, anterior inferior iliac spine; DCIA, deep circumflex iliac artery; DCIV, deep circumflex iliac vein; IL, inguinal ligament; IOM, internal oblique muscle; IPM, iliopsoas muscle with its overlying fascia iliaca (FI); SM, sartorius muscle; TAM, transverse abdominus muscle.

complications including bladder injury have been described in individual case reports, but such reports are extremely rare. Little exists in the literature regarding complication rates specifically related to the S-FICB.

Landmark or Ultrasound?

A higher incidence of sensory loss in the medial, anterior and lateral aspects of the thigh, as well as a significantly higher rate of FN and ON motor block, has been demonstrated with an ultrasound-guided infrainguinal FICB (I-FICB) compared with a landmark technique.[8] Therefore, if appropriate skill and equipment are available, the use of ultrasound is recommended. The S-FICB is a more advanced fascial plane block that carries with it a risk, albeit very small, of breaching the peritoneal cavity and causing visceral injury. On this basis, the S-FICB should be performed only under ultrasound guidance.

What Volume?

Given the course of the ON and its separation from the fascia iliaca compartment by the psoas muscle, the ability of any FICB approach to achieve ON blockade has been called into question.[13] At the very least, the mechanism of blockade is debated although proximal spread via the lumbar plexus is frequently hypothesised in the literature. A cadaveric dye study of single-injection S-FICB used computed tomography (CT) imaging and dissection findings to demonstrate that a volume of 40 mL was able to achieve staining of FN, LFCN and ON, with lower volumes tending to miss ON.[14] Clinically successful blockade of all 3 nerves was demonstrated in 69% of patients receiving a 40-mL S-FICB in a study of patients undergoing total hip arthroplasty.[9] Reassuringly, 40 mL of 0.5% ropivacaine did not exceed maximum tolerated plasma levels in any patients, although care needs to be taken not to exceed commonly accepted dosing thresholds. A case series of 28 patients who received 30 mL S-FICB prior to undergoing total hip arthroplasty demonstrated efficacy of the technique in providing analgesia, measured both by low pain scores and opioid consumption postoperatively. Magnetic resonance imaging (MRI) demonstrated effective spread to the FN and LFCN in 28 of 28 patients, whereas only 12 of 28 showed spread to the ON.[15] While the optimum volume is not definitively established, this is a fascial plane block in which significant spread away from the point of injection is desirable, and therefore a large volume, the current literature supporting 30 to 40 mL, is recommended.

Which Approach?

The S-FICB has demonstrated efficacy in elective and emergency situations. After total hip arthroplasty, lower morphine consumption and reduced pain scores were observed in the block group versus the control group who did not receive a block.[9] In 22 patients who presented with acute hip fracture and received an S-FICB in the emergency department, there was a significant reduction in pain scores at 60 minutes from baseline, although 7 of 22 patients (32%) required additional opioid analgesia.[16] A randomised trial evaluating S-FICB versus lumbar plexus block in 60 patients undergoing total hip arthroplasty used a 40-mL injection performed postoperatively and found equivalence between the techniques, as evaluated by breakthrough morphine requirement and pain control. The S-FICB, however, resulted in a longer duration of analgesia and shorter hospital stay.[17]

But is the S-FICB superior to the I-FICB? A volunteer study demonstrated successful sensory blockade of the medial, anterior and lateral thigh in 80% of subjects receiving a 40-mL S-FICB compared with 30% of those receiving a 40-mL I-FICB.[10] The cranial spread of local anaesthetic, as evaluated by MRI, was also greater in the S-FICB group. There are no meaningful patient studies comparing the 2 approaches, but given the potential of a more proximal approach to provide greater coverage of the relevant branches of the lumbar plexus, as discussed above, the S-FICB should be considered if appropriate expertise is available.

Catheter Techniques

A single injection should provide effective analgesia for several hours, and in some cases, the duration may exceed 24 hours. The provision of continuous regional analgesia may be appropriate for hip fracture patients in certain situations:

- Delay in surgical fixation is anticipated
- Higher degree of postoperative pain is expected, for example, due to more complex surgery
- Surgical fixation is deemed futile (ie, palliative indications)

Either I-FICB or S-FICB approaches are amenable to catheter-based techniques. The superiority of a continuous infusion or intermittent bolus regimen is unclear, and the regimen should therefore be chosen according to the individual patient and/or local protocol.

FICB and Nonphysicians

To ensure the timely provision of regional anaesthesia for hip fracture patients on arrival to hospital, Regional Anaesthesia UK and the AAGBI endorse the performance of ultrasound-guided I-FICB by trained nonphysician practitioners. Indeed, a systematic review of 7 studies involving 699 patients receiving prehospital FICB demonstrated a success rate of greater than 90% and concluded that the technique can be performed safely by practitioners of any background with appropriate training.[18] In contrast, the S-FICB should not be performed by nonphysician practitioners due to the higher potential for harmful complications.

CONCLUSION

While proof that regional anaesthesia improves outcomes remains elusive, there is good evidence that peripheral nerve blocks provide effective, opioid-sparing analgesia in the hip fracture population. That said, there is insufficient evidence to make firm recommendations regarding the optimal approach. The FICB is a relatively easy block to perform, and given the potential for greater coverage of the relevant nerve branches with a superior approach, the S-FICB is worthy of consideration.

SUMMARY

An ultrasound-guided I-FICB is recommended if appropriate equipment and expertise are available, although a landmark-based technique remains acceptable. The S-FICB should always be performed under ultrasound guidance. Given the greater cranial spread of anaesthetic agent and therefore potential for superior blockade of the relevant articular branches, the S-FICB approach should be considered for hip fracture patients, although a high volume (up to 40 mL) may be necessary to achieve adequate coverage.

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