Femoral Nerve Block – A Guide for Medical Students and Junior Doctors

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ABSTRACT

A femoral fracture is a painful and distressing traumatic injury that is commonly encountered when working in an emergency department. The incidence of femoral shaft fracture has been estimated at 1.0-1.3 per 10,000 of population. The acute treatment of such an injury involves placement of the injured limb into a Thomas traction splint, which requires the provision of pain relief, commonly through use of a femoral nerve block. A femoral nerve block is a specific regional anaesthetic technique used by doctors in emergency medicine to provide anaesthesia and analgesia of the affected leg, to allow relief of pain from the fracture and facilitate movement of the injured limb into a splint. This article provides an educational overview of this practical procedure for junior doctors and medical students alike. We describe the technique as traditionally performed, as well as highlighting an increasingly favoured method using ultrasound as an adjunct to improve the accuracy and safety of the procedure.

Key Words: Femoral Fracture, Femoral Nerve Block, Emergency medicine; Clinical Procedures

Introduction

A femoral fracture is a painful and distressing traumatic injury that is commonly encountered when working in an emergency department (fig.1). The incidence of femoral shaft fracture has been estimated at 1.0-1.3 per 10,000 of population.1 Acute treatment of such an injury involves placement of the injured limb into a Thomas traction splint for distraction. Movement of the limb exacerbates the discomfort from the fracture site, which is often compounded by spasm of the quadriceps muscles that are inadequately supported by the fractured femoral bone.

Figure 1. Radiograph image of a midshaft right femoral fracture and Thomas splint. [Image: Emergency Department, Ninewells Hospital, Dundee]
A femoral nerve block is a specific regional anaesthetic technique used by doctors in emergency medicine to provide anaesthesia and analgesia of the affected leg, to allow relief of pain from the fracture and facilitate movement of the injured limb into a splint. Femoral nerve blocks are also used in pre-hospital care, as well as in theatre anaesthetic practice for operations involving the femoral bone, knee and anteriomedial thigh.

The superficial position of the femoral nerve in the proximal thigh and its proximity to easily identified anatomical landmarks makes the femoral nerve block a relatively straightforward technique that is easy to learn and provides a useful introduction to regional anaesthesia; a knowledge of which will be of interest to medical students and junior doctors considering careers in emergency medicine, anaesthetics or orthopaedics. Ultrasound imaging is increasingly seen as compulsory for elective central venous line placement and has become commonplace for regional anaesthesia in operating theatres. In this article we describe the technique for femoral nerve block as traditionally performed, as well as an increasingly favoured method using ultrasound as an adjunct to improve the accuracy of anaesthetic infiltration and aid the safety of the procedure.

**The Femoral Nerve**

The femoral nerve is derived from the lumbar plexus, arising from the ventral rami of the L2-L4 nerve roots. The femoral nerve descends through the pelvis, deep to the midpoint of the inguinal ligament and is found 1-2cm lateral to the femoral artery and vein (fig.2), before dividing into terminal branches that innervate the anterior thigh muscles, hip and knee joints as well as the skin of the anteriomedial thigh. The nerve lies deep to two fascial membranes, the fascia lata and the fascia iliaca. The relative orientation of the femoral neurovascular structures, from lateral to medial, can remembered by the acronym NAVY; Nerve, Artery, Vein, Y-fronts!

![Figure 2](image.png)

*Figure 2.* Right groin and thigh with surface anatomy representations of the inguinal ligament (grey) between the anterior superior iliac spine and the pubic tubercle, the femoral nerve (yellow), femoral artery (red) and femoral vein (blue). [Image: A.Bogacz]
Local Anaesthetic
There are many anaesthetic agents available for regional anaesthesia. Lignocaine and levo-bupivicaine (Chirocaine) are two of the most commonly used agents for femoral nerve block, either used alone or as a combined mixture. Lignocaine has a slightly shorter onset time and levo-bupivicaine has a longer duration of effect. The recommended maximum safe dose of lignocaine is 3mg/kg and for levo-bupivicaine is 2mg/kg. A volume of 10-20ml of 1% lignocaine or 0.25-0.5% levo-bupivicaine is usually sufficient for femoral nerve anaesthesia.

Traditional Femoral Block Technique
The patient should be lying supine, ideally with their leg extended. The pulsation of the femoral artery can be felt immediately distal to the mid-point of the inguinal ligament, between the anterior superior iliac spine of the pelvic ilium and the pubic tubercle at the pubic symphysis. The skin should be cleaned and an aseptic technique employed.

![Image: Injection of local anaesthetic lateral to the palpable femoral pulse.](A.Bogacz)

The injecting needle should be inserted through the skin approximately 1cm lateral to the femoral artery pulsation (fig.3), to a depth of around 2-3cm. Aspiration should be attempted with the syringe, to check for blood from accidental vascular puncture; if blood is aspirated the needle should be withdrawn and pressure applied over the injection site for a few minutes to prevent haematoma formation, then injection can be reattempted. Local anaesthetic can be slowly infiltrated as the needle position is adjusted laterally in a fanning motion to spread the distribution of local anaesthetic. Success of the block can be assessed by checking for loss of sensation over the anteriomedial thigh and most importantly by the patient reporting a reduction of pain. The patient should be observed for signs of local anaesthetic toxicity.

Complications of Femoral Nerve Block
The proximity of the femoral artery and vein to the femoral nerve makes vascular puncture a complication associated with femoral nerve block. As with all local anaesthetic infiltration procedures it is important that the operator attempts to aspirate with the syringe to check for blood, which would highlight vascular puncture and should prevent inadvertent intravascular injection and subsequent local anaesthetic toxicity. Systemic local anaesthetic toxicity from intravascular injection or overdose can affect the cardiovascular and
neurological systems resulting in bradycardia, tachyarrhythmia or asystole, hypotension, seizures, agitation or decreased conscious level and may be preceded by symptoms of dizziness, perioral paraesthesia or dysarthria.¹⁴

Inadequate or ineffective block is another complication of the technique. The fascia lata and iliaca can act as barriers to local anaesthetic infiltration; should the injecting needle not penetrate these fascias then the local anaesthetic solution will be prevented from reaching the nerve and result in ineffective block. Specific needles for regional anaesthetic use that are used in theatre anaesthetic practice will often transmit a popping sensation as each fascia is crossed. This is less easy to detect with the standard, sharp injection needles used in emergency departments or hospital wards.

Ultrasound Guided Femoral Nerve Block

A simple ultrasound scanner can be used for a femoral nerve block. A mobile ultrasound scanner is often used, which is primarily designed to visualise blood vessels beneath the skin, amongst muscle, fat and connective tissue to facilitate needle guidance for vascular access procedures. Using the same visual image information, ultrasound scanners can be used to direct a needle away from vascular structures and towards a nerve for infiltration of local anaesthetic for peripheral nerve blockade. Use of an ultrasound scanner can improve the precision of the femoral nerve block technique and reduce the likelihood of the aforementioned complications by improving the accuracy of local anaesthetic infiltration around the nerve, reducing the volume of local anaesthetic agent necessary for effective block as well as providing visual confirmation of infiltration away from adjacent vascular structures.⁵

Figure 4. Confirming correct orientation of the ultrasound probe. There are corresponding orientation markers on the probe and monitor screen (green arrows) as well as mid-point marker dots on the monitor image to represent the middle of the scanning surface of the probe (red arrows). [Image: A.Bogacz]

The location of the femoral nerve is identified by a method similar to the traditional technique. The patient should be lying supine with their leg extended. The femoral artery can be palpated to ensure accurate positioning of the ultrasound probe. Before attempting to visualise the nerve, the skin should be cleaned using an aseptic technique. The ultrasound probe should be covered with a protective sheath to prevent contamination of the probe and aid the sterility of the procedure. The correct orientation of the probe can be checked by tapping the end of the scanning surface of the probe beside the orientation marker and
observing a movement artefact next to the corresponding dot on the image on the monitor (fig. 4).

Figure 5. Placement of ultrasound probe over the palpable femoral pulse. [Image: A.Bogacz]

The ultrasound probe is placed over the femoral artery pulsation (fig. 5) and moved medially or laterally to visualise and identify the femoral vessels by their individual characteristics. Blood vessels appear as dark, circular areas in cross section on an ultrasound image. An artery is pulsatile and non-compressible on an ultrasound image, whereas a vein is non-pulsatile and compresses/collapses when the ultrasound probe is used to apply downward pressure to the skin overlying the vessel. The compartment containing the femoral nerve appears as a speckled triangular structure lateral to the femoral artery (fig 6.).

Figure 6. Ultrasound image of femoral artery (red), femoral vein (blue), femoral nerve compartment (yellow), fascia lata (green) and fascia iliaca (orange). [Image: A.Bogacz]

The midpoint marker of the ultrasound probe/monitor can be positioned directly above the femoral nerve compartment and the injection needle inserted through the skin directly under the probe (fig.7).
The needle can often be visualised on the ultrasound monitor, particularly with angles of insertion greater than 45 degrees. Advancement of the needle causes visible movement of the subcutaneous tissues on screen and correlates with the position of the tip of the needle. When the needle tip has crossed the fascia lata and fascia iliaca and into the femoral nerve compartment, aspiration should be attempted with the syringe to check for blood to ensure against accidental vascular puncture.

A 1ml ‘test dose’ of local anaesthetic can be slowly infiltrated and a corresponding small spread of local anaesthetic should be seen on the monitor to further confirm correct needle position (fig 8). Continued infiltration of local anaesthetic can proceed with visualised widening of the soft tissue space within the femoral nerve compartment and around the nerve as observed on the monitor7 (fig 8). Downward compression/movement of the nerve compartment and/or blood vessels, usually combined with spread of tissue and local anaesthetic above the nerve compartment, is suggestive of infiltration of anaesthetic above the fascial membranes and will likely result in ineffective block. Effectiveness of the block
should be assessed. Although ultrasound-guidance should reduce the risk of complication, intravascular injection and local anaesthetic toxicity are still possible and patients should still be observed afterwards as a matter of good medical practice.

**Conclusion**

The femoral nerve block is likely to be the most widely performed lower limb regional anaesthetic procedure and its common use and the relative simplicity of the procedure makes the femoral nerve block a useful means to inform medical students and junior doctors of the principles, practice and complications of regional anaesthetic techniques. We hope this article has been an interesting and educational overview of a commonly used procedure for the treatment of an emergency injury, as well as an informative insight into the increasing use of ultrasound beyond the radiology department and as an adjunct for regional anaesthesia outside of theatre anaesthetic practice. The use of ultrasound is a skill that requires practice, and experience is vital to achieve competence. Interpreting ultrasound images can be bewildering at first; however, this improves with experience and becomes clearer with increasing familiarity. An experienced clinician should always supervise inexperienced operators when performing a procedure with local anaesthetic, with the availability of resuscitations facilities a prerequisite.

**References**


The SUMJ Website :- [http://sumj.dundee.ac.uk](http://sumj.dundee.ac.uk)