

Guideline

Ultrasound-Guided Femoral Nerve Block

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Applicable to	Medical and Nursing staff working in Children's Health Queensland				
Authorisation	Executive Director Clinical Services (QCH)				

Purpose

The purpose of this guideline is to assist clinicians in understanding the indications, utility, and process involved in performing an ultrasound-guided femoral nerve block (FNB), primarily in the Emergency Department (ED).

Scope

This guideline primarily applies to all staff involved in the care and management of children who have sustained femoral shaft fractures that need a FNB for analgesia.

A fascia iliaca compartment block (FICB) is often used as an alternative to the FNB when the lateral cutaneous nerve needs to be anaesthetised also. This may be a more suitable block for proximal femur fractures.¹ While this guideline primarily focuses on a femoral nerve block, more information regarding FICB can be found in [Appendix 1](#).

Related documents

Procedures, Guidelines, Protocols

- [CHQ-PROC-00302 Regional Analgesic Infusions](#)
- [CHQ-GDL-00731 Local Anaesthetic Systemic Toxicity](#)

Guideline

Introduction

An ultrasound-guided FNB is a safe and rapid method in attaining pain control for an injury to the lower extremity without having to administer large doses of intravenous opioids.²⁻⁵ Historically, femoral nerve blockade was performed using the landmark-based method. The ultrasound-guided technique is now the

standard of care and allows the visualisation of needle placement and spread of local anaesthetic which in turn decreases the risk of vascular puncture and increases the success rate of the femoral nerve blockade.⁶⁻¹⁰

Anatomy

The femoral nerve arises from L2-L4 and is the largest branch of the lumbar plexus. It travels under the inguinal ligament, to the femoral artery (see Figure 1). It innervates the hip joint, femur, anteromedial thigh, knee, and the medial aspect of the leg from the knee to the foot.⁷ It is important to note that unlike the FICB, the FNB does not include the lateral femoral cutaneous nerve.¹¹

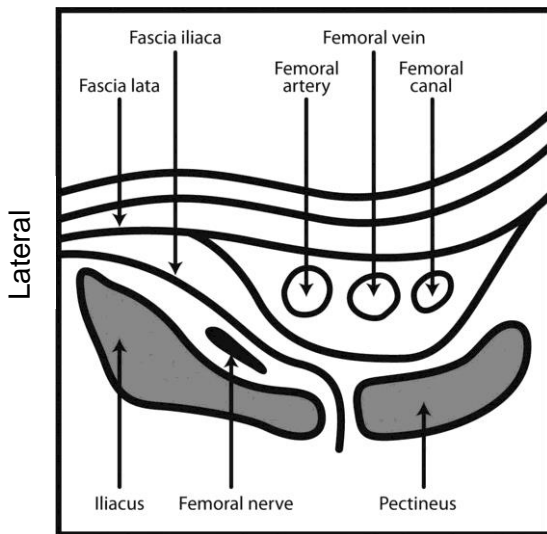


Figure 1. Femoral Nerve Anatomy¹²

Indications

Femoral nerve blockade is ideal for patients with femoral shaft fractures. It can also be used as an alternative to procedural sedation for patients who require a painful procedure (e.g. abscess drainage or laceration repair) along the area of femoral nerve innervation (anteromedial thigh and knee).

Contraindications

- Infection at the puncture site
- Femoral nerve injury
- High suspicion of compartment syndrome
- True allergy to local anaesthetic
- Previous femoral bypass surgery
- Relative contraindication— bleeding disorders or anticoagulant therapy^{1,7}

Preparation and Technique

a) Consent

- For nerve block procedure (verbal) and for procedural sedation (written).

b) Equipment

- Monitoring – continuous cardiac monitoring and SpO₂.
- Ultrasound machine with a linear transducer (5-15 MHz).
- EMLA (topical anaesthetic cream) on site prior to procedure (although this should not delay procedure).
- Local anaesthetic by injection of the skin prior to the nerve block (unlikely to be necessary if EMLA and procedural sedation are utilised).
- Sterile dressing or suture pack.
- Chlorhexidine solution.
- Sterile drapes, sterile gloves.
- Clean ultrasound probe then cover with sterile ultrasound probe cover.
- Sterile gel (standard ultrasound gel is a potential source of infection).
- 10 mL syringe and blunt 18 Gauge needle.
- Levobupivacaine (for femoral block).
 - Dosage of levobupivacaine (children > 12 months):
 - 0.4 - 0.6 mL/kg of 0.25% (25 mg/10mL) (equivalent to 1 - 1.5 mg/kg); **or**
 - 0.2 - 0.3 mL/kg 0.5% (50 mg/10mL) (equivalent to 1 - 1.5 mg/kg).^{13,14}



Ultrasound probe

Maximum dose

- Maximum dose is 1.5 mg/kg, based on ideal body weight (IBW).
 - IBW if 1 – 5 years: Weight (kg) = 2 x (age (years) + 5);
 - IBW if 5 – 14 years: Weight (kg) = 4 x age (years).¹⁵

Do not give more than a total of 75mg.
- Aim not to use more than 15 mL, therefore in older kids we recommend smaller volumes of higher concentration. For example: in patients > 50 kg, use 0.5% levobupivacaine at 0.3 mL/kg to a maximum volume of 15 mL = 75 mg.^{2,13-15}
- Don't forget that if you use local anaesthetic for this and other procedures, the total amount of anaesthetic used and should not exceed the mg/kg maximum dose for the patient (or 75 mg).
- In ages 3 - 12 months, you may need lower doses. These patients should be discussed with anaesthetists - refer to Acute Pain Guide (*currently in development*).
- Draw up levobupivacaine in a 10 mL syringe (you may need more than one 10 mL syringe) and attach it to the nerve block needle extension tube.

- Levobupivacaine is the local anaesthetic of choice at Queensland Children's Hospital due to its lower risk of toxicity.¹⁶ A safe alternative is ropivacaine (maximum dosage 2 - 2.5 mg/kg).¹⁷
 - Ropivacaine 0.2%, 2 mg/mL, 1mL / kg, (equivalent to 2 mg/kg) max dose 140 mg (70 mL max).
 - Ropivacaine 0.75%, 7.5 mg/mL, 0.25 mL/kg, (equivalent to 1.875 mg/kg) max dose 140 mg (18.5 mL max).
- Nerve block needle or spinal needle (22 Gauge, with low pressure extension tubing)
 - 50 mm long is usually enough. In older patients, you may need it to be 90 mm long.
- Band-aid.
- Splint and traction equipment ready to apply.

c) Patient preparation

Positioning

Place the patient in a supine position with slight external rotation of the hip if tolerated. The ultrasound machine should be placed opposite the operator, across the bed.

Establish intravenous (IV) access^{1,7}

Procedural sedation

Most patients will require procedural sedation, such as ketamine, to tolerate the nerve block, splinting and traction process. This can be decided if it is needed on a case by case basis.

Splint and traction equipment

If procedural sedation has been utilised, every effort should be made to apply splinting and traction while the patient is still sedated, with the FNB in place. Ensure this equipment is at the bedside before starting this procedure.

d) Documentation

1. Document procedure on FNB Procedure Details Form in FNB box (see [Appendix 3](#)).
2. Prior to starting the procedure, **ensure you have checked for femoral nerve injury and for signs suggestive of compartment syndrome**, and document this **before** starting procedure.¹ If there are any signs of nerve injury or compartment syndrome, do not start the procedure without speaking to the Emergency Consultant and the Orthopaedic team.

e) "STOP BEFORE YOU BLOCK"

- Confirm patient identity.
- Confirm side and site to be blocked.¹⁸

f) Step-by-Step scanning and injection technique

1. Ensure cardiac and SpO₂ monitoring is applied.^{1,10}

2. On the ultrasound machine, select the linear transducer with the nerve preset. To enhance your images, select 'needle profiling' from the right-hand column options (if you are using the SonoSite X-Porte).
3. Wash hands.
4. Wear sterile gloves.
5. Clean skin then drape the area.
6. Place gel on the ultrasound probe then place a sterile cover over it, then place sterile gel on the inguinal crease of the patient.
7. Place the ultrasound probe in the transverse orientation at the inguinal crease with the probe indicator pointing to the patient's right.
8. Locate the femoral vein and artery. Move the probe slightly lateral to locate the femoral nerve. See [Figure 2](#) and [Figure 3](#).

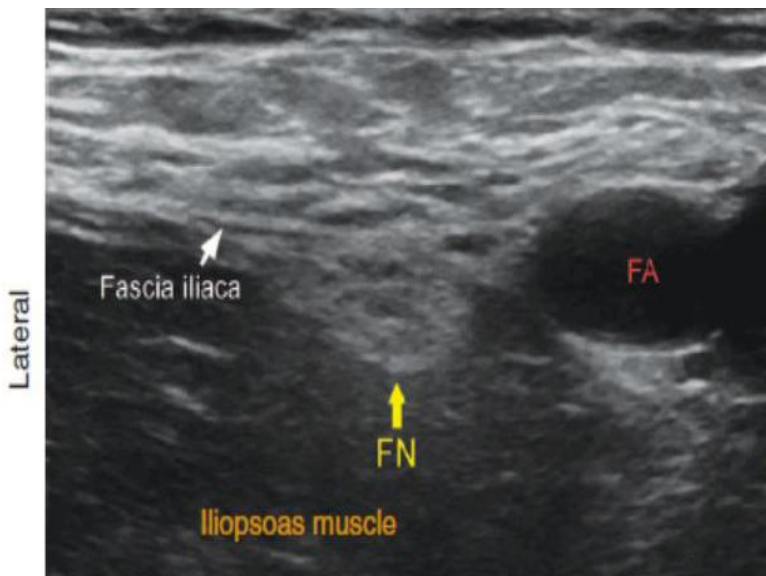


Figure 2. Ultrasound representation of femoral nerve. FN femoral nerve, FA femoral artery^{19,20}

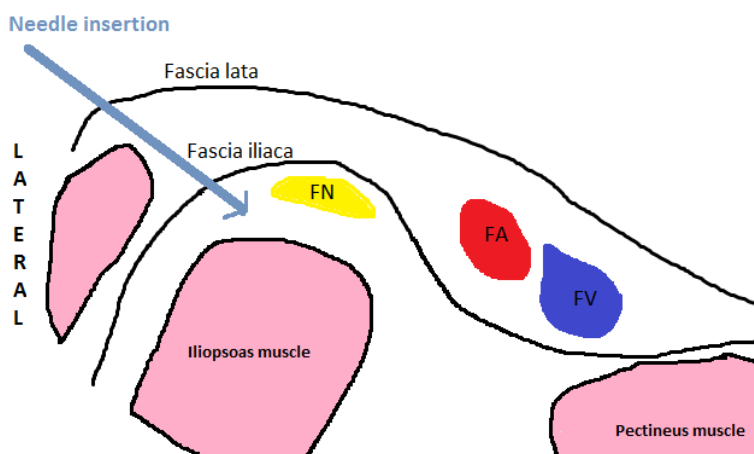


Figure 3. Anatomy around the femoral nerve. FN femoral nerve, FA femoral artery, FV femoral vein.

9. Other important landmarks to identify are the fascia iliaca (superior to the femoral neurovascular bundle) and the iliopsoas muscle (deep to the femoral nerve). See [Figure 2](#) and [Figure 3](#).
10. Insert the needle at an approximately 30-degree angle with a lateral to medial in-plane technique so that the needle can be visualised during the **entire** procedure. Direct the needle tip to the lateral aspect of the femoral nerve with the goal of injecting the anaesthetic at the lateral aspect of the femoral nerve, under the fascia iliaca and above the iliopsoas muscle. This would enable the anaesthetic to spread and bathe the femoral nerve. See [Figure 4](#) and [Figure 5](#).

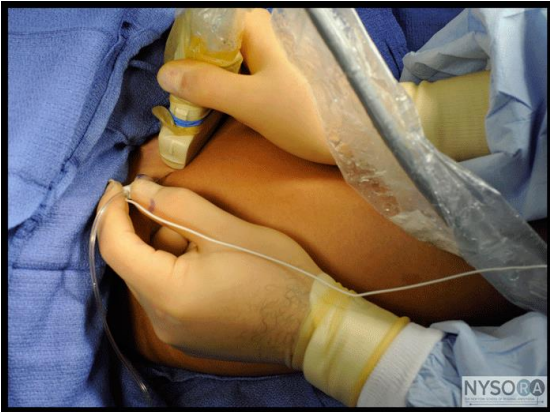


Figure 4. In plane technique²⁰

- a. Remember to **aspirate prior to injecting** to ensure lack of vascular puncture.^{2,7,21}
- b. Try injecting a small amount (1 mL) of anaesthetic first to ensure that the anechoic fluid is located under the fascia iliaca and above the iliopsoas muscle. If so, continue to inject local anaesthetic to bathe the femoral nerve. It is important to visualise the entire needle **including the tip** during the procedure.

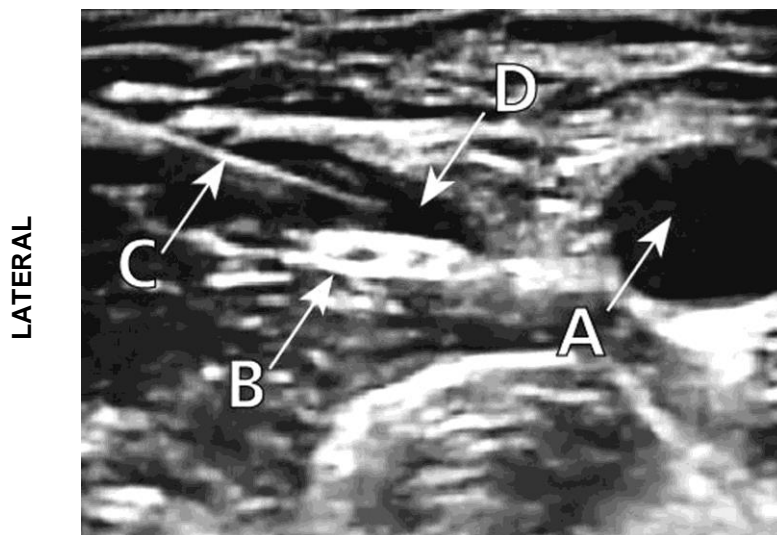


Figure 5. A femoral artery, B femoral nerve, C needle, and D local anaesthetic around the femoral nerve.¹²



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It is important to visualise the entire needle including the tip during the procedure.

Post procedure cares

- Apply Thomas splint and traction.
- Monitor hourly for signs of compartment syndrome.¹
- Keep on cardiac monitor for one (1) hour post procedure.

Complications

- Nerve injury is rare, particularly when this procedure is performed under ultrasound guidance. Ensure documentation of neurological status before the procedure is performed.
- Local anaesthetic systemic toxicity is rare especially when the nerve block is performed under ultrasound guidance. It is important to visualise the needle tip to ensure that the anaesthetic is injected away from the femoral vessels. Toxicity can lead to cardiovascular collapse and seizures. See [Appendix 2](#) for details.²¹
- Compartment syndrome possibility should always be considered especially when the patient presents with a significant crush injury or burns. It is important to discuss with the orthopaedic surgeon prior to performing the femoral nerve blockade due to the theoretical possibility that a femoral nerve block may delay the diagnosis of compartment syndrome.
- Infection.
- Allergy.

Conclusion

Ultrasound-guided FNB is an important skillset for emergency physicians to attain to provide adequate pain control to patients with femoral shaft fractures. The usage of ultrasound to perform a femoral nerve block decreases the rate of complications and increases the likelihood of a successful block.

Consultation

Key stakeholders who reviewed this version:

- Consultant Paediatric Emergency Department, CHQ
- Fellow Paediatric Emergency Department, CHQ
- Consultant Paediatric Emergency Department, CHQ
- Consultant Paediatric Emergency Department, CHQ
- PAH Emergency Department and Clinical Toxicology Unit
- Pharmacist Lead Critical Care, CHQ
- Consultant Paediatric Anaesthetics Department, CHQ
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Guideline revision and approval history

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1.0 (30/01/2019)	Deputy Director, Emergency, Critical Care	Divisional Director, Critical Care	Executive Director Clinical Services (QCH)

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Accreditation references	NSQHS Standards (1-8): <ul style="list-style-type: none"> • Standard 1: Clinical Governance • Standard 5: Comprehensive Care

Appendix 1. Fascia Iliaca Compartment Block

The FICB blocks the femoral nerve and more reliably blocks the lateral cutaneous nerve, so has the added benefit of blocking sensory innervation to the lateral thigh. Blockade of the obturator nerve is possible but unreliable with this method.¹ It is useful in patients with hip pain and proximal femur fractures (fractured neck or shaft of femur). Local anaesthetic is spread along the fascial plane rather than around the individual nerve.²² This block should be performed under ultrasound guidance.¹¹

The proceduralist must adhere to a sterile technique. The consent, patient preparation, equipment list, dose and post procedure cares are the same as the FNB guideline above.

Procedure

Place the linear ultrasound probe in a transverse position, distal to the inguinal ligament. Identify the femoral artery. Then move the probe laterally to identify the femoral nerve. Move the probe more laterally to identify the fascia lata, iliacus muscle and fascia iliaca (see [Figure 6](#)).

Introduce the needle (under ultrasound guidance using the in-plane approach, from the lateral side) inferior to the inguinal ligament, then advance through the fascia lata and then beneath the fascia iliaca. Aspirate. There should be no blood and no resistance to aspiration. Inject local anaesthetic (gentle aspiration after each few mL of injection). Spread the local anaesthetic in medial and lateral directions under the fascia iliaca (see [Figure 6](#)). Watch for separation of the fascia iliaca away from the iliopsoas muscle.

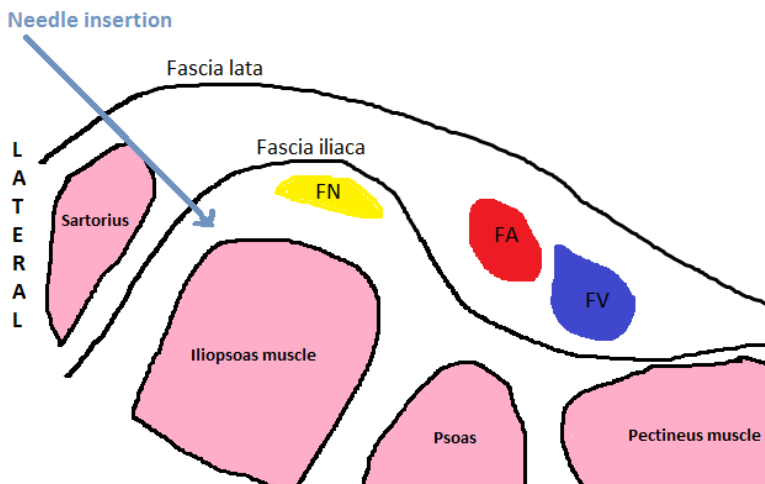


Figure 6. Injection site for FICB (FN femoral nerve, FA femoral artery, FV femoral vein).

Appendix 2. Treatment of local anaesthetic systemic toxicity

Local anaesthetic systemic toxicity can develop in a patient after local anaesthetic is administered via any route. It usually occurs from inadvertent intravascular administration. A more comprehensive guideline regarding this toxicity is available through Children's Health Queensland (CHQ).

This appendix includes a brief summary of the initial assessment and management of a patient with suspected local anaesthetic toxicity, but does not aim to replace phone consultation with a toxicologist.



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It is important to discuss all suspected local anaesthetic toxicity cases with a Toxicologist for individual case management advice.

Signs and symptoms of Local Anaesthetic Toxicity

Suspect toxicity if there is any physiological derangement after LA administration.

Signs are often initially neurological (these can be subjective and difficult for infants/young children to report).

- Tinnitus, drowsiness, dizziness, anxiety, confusion, perioral numbness, blurred vision, dysarthria, limb twitching, tremor, and metallic taste.²³

More severe local anaesthetic toxicity involves two (2) main systems:

- Cranial nervous system – manifesting as seizure activity, apnoea and coma.²
- Cardiovascular - tachycardia and hypertension or bradycardia and hypotension. This can progress to ventricular dysrhythmias and asystole.^{21,24}

Investigations

- Blood gas – methaemoglobin concentration and electrolytes.
- Electrocardiogram (ECG) – looking for Sodium channel blockade signs (e.g. prolonged PR, QRS and QT intervals, large terminal R wave in aVR).²⁵

Management

1. Stop local anaesthetic administration.
2. Call for help – Resus team and Toxicologist support (131 126).
3. Maintain airway and oxygenation.
 - a. Avoid hypoxia, hypercarbia and acidosis (as they potentiate LAST).¹⁰
 - b. Hyperventilate to pH 7.5.
4. Manage ventricular dysrhythmias and provide cardiovascular support as per standard advanced life support guidelines being mindful of the following:
 - a. Adrenaline may potentiate dysrhythmias, consider lower dose adrenaline boluses (<1 mcg/kg).
 - b. Hypotension - treat with 20 mL/kg fluid bolus +/- inotropes.

- c. Consider ECMO in consultation with PICU.¹⁰
 - d. Administer sodium bicarbonate 2 mEq/kg, repeated every 1 - 2 minutes until a perfusing rhythm is seen.²⁵
5. Manage seizures with benzodiazepines (e.g. midazolam 0.05 - 0.2mg/kg IV bolus)
- a. Phenytoin is contraindicated.
6. The antidote of IV lipid emulsion can be considered for life-threatening cardiovascular toxicity which is not responding to resuscitative methods outlined above. Its efficacy is unproven.²⁶⁻²⁸
- a. 1.5 mL/kg of 20% IVLE ('clinoleic') over 1 minute followed immediately by infusion (0.25 mL/kg/min). Further boluses (to a maximum of 3 (three), q5mins) can be considered if no response.^{2,21,24}
 - i. IVLE ('clinoleic') is stored in the green clean utility room at CHQ ED.

Methaemoglobinaemia

Methaemoglobinaemia can also occur after local anaesthetic administration. It is not dose related. Neonates are more at risk. Methaemoglobinaemia is more common after benzocaine, lignocaine or prilocaine administration.

Clinical signs include blue discolouration of mucous membranes. Cellular hypoxia evolves. Do not rely on pulse oximetry.²⁸

If clinical signs appear, please collect a blood gas to check MetHb level.

Management

- Oxygen therapy.
- Methylene blue (1 mg/kg) in consultation with a Toxicologist.
 - Often given if MetHb > 30% or if >2 0% and symptomatic.
 - Contraindicated in Glucose-6-Phosphate-Dehydrogenase deficiency, methaemoglobinaemia reductase deficiency, nitrite-induced methaemoglobinaemia, and hypersensitivity. Renal impairment needs dose adjustment.²⁵

Appendix 3. Documentation form

Femoral nerve block checklist

(to be scanned in to ieMR)

Pt sticker here

Indication for femoral nerve block _____

Prior to block commencement,

- is there any suspicion of nerve injury or are high risk factors for compartment syndrome present?

- No Yes (If yes, do not proceed with block and discuss with orthopaedics and ED consultant)

Consent obtained (verbal) No Yes

Procedural sedation used Ketamine Other Nil

Type of block FNB FICB Other

Ultrasound utilised No Yes

Sterile technique utilised No Yes

Time of procedure _____

Local anaesthetic _____ and dose _____

Traction and splint applied No Yes

Complications seen No Yes (If yes, document details in ieMR)

Clinical evidence that nerve block improved symptoms No Yes

Proceduralist name _____

Supervisor/Consultant involved _____

Sign _____

Print name _____