Lower limb nerve blocks

Calum RK Grant
Pavan Kumar BC Raju

Abstract

Peripheral nerve blocks are increasingly used for a wide range of surgical procedures involving the lower limb. A number of techniques can be used to provide anaesthesia and highly effective postoperative analgesia, offering an alternative to general anaesthesia in some cases, minimizing the requirement for strong opiates and improving the quality of recovery following surgery. Ultrasound-guided nerve localization offers several potential advantages when performing femoral, sciatic and ankle blocks; however, neurostimulation remains a useful and widely used aid to lower limb regional anaesthesia practice.

Keywords Ankle block; femoral; lower limb; popliteal; regional anaesthesia; sciatic; ultrasound

Royal College of Anaesthetists CPD Matrix: 1D02, 2G01, 2G02, 2G03 and 3A09

Learning objectives

After reading this article, you should understand the:

- indications and potential benefits of lower limb blocks
- indications and potential advantages of ultrasound-guided nerve localization
- principles of specific lower limb nerve block techniques

There has been a resurgence of interest in regional anaesthesia over the past decade, largely as a result of improved nerve localization provided by modern ultrasound technology. The use of peripheral nerve blocks in anaesthesia for surgery of the lower limb and subsequently continuous nerve block infusions have superseded epidurals as the analgesic gold standard following lower limb arthroplasty. Peripheral nerve blocks that provide effective pain relief with a low incidence of systemic side-effects can facilitate improved functional recovery and shortened rehabilitation times after major orthopaedic surgery.[1] The use of continuous peripheral nerve catheter infusions can extend analgesia for 48–72 hours postoperatively, avoiding problems associated with block regression and inadequate analgesia that may occur after single injection techniques. As a general rule, proximal sciatic, femoral and lumbar plexus blocks are most suitable for use in an in-patient setting. Nerve localization in the lower limb is currently achieved using either ultrasound guidance or peripheral nerve stimulation.

Ultrasound-guided lower limb blocks

B-mode ultrasound allows visualization of peripheral nerves and surrounding structures of interest such as blood vessels, muscles and fascia. It also allows the anaesthetist to visualize, in real-time, the needle trajectory or needle tip and the spread of local anaesthetic when performing a nerve block. Unlike blind percutaneous approaches that rely upon specific anatomical landmarks, ultrasound allows the practitioner to visualize and block peripheral nerves in the lower limb at almost any point along their course. There is growing evidence that ultrasound guidance results in greater efficacy, faster block onset and shorter procedural times when used for specific lower limb blocks.[2] The femoral, popliteal and sciatic nerves (distal to the infra-glutaeal fold) are relatively superficial and can be accurately identified using high-frequency (8–15 MHz) ultrasound probes. Deeper structures, such as the lumbar plexus and proximal sciatic nerve, can be imaged using low-frequency probes that allow greater tissue penetration; however, image resolution is lost at lower frequencies and, as a result, these blocks are technically more difficult to perform under ultrasound guidance.

Indications

Lower limb arthroplasty

The role of peripheral nerve blockade following lower limb arthroplasty has been called into question recently with a move in many centres towards the use of local infiltration analgesia (LIA). Current evidence, however, still supports the use of peripheral nerve blocks as the most effective method of providing analgesia after lower limb arthroplasty.[3] There were 165,459 hip, knee and ankle arthroplasty procedures performed in England and Wales in 2011.[4] The use of peripheral nerve blockade, and in particular continuous catheter techniques, as part of a multimodal analgesic strategy can facilitate rapid functional recovery. Blocks are established using intermediate concentrations of local anaesthetic (that is 0.25–0.375% levobupivacaine) followed by low-dose infusions to minimize motor block. Infusate concentrations as low as 0.024% levobupivacaine have been shown to provide effective analgesia from continuous femoral nerve block whilst minimizing quadriceps weakness.[5] Persisting motor block is a recognized side-effect of continuous nerve block and some surgeons have concerns because it may delay patient mobilization. When planning pain relief following lower limb arthroplasty, however, consideration must be given to the frequent side-effects associated with alternative forms of analgesia such as systemic opioids (postoperative nausea and vomiting, sedation and constipation) and the observation that inadequate analgesia can leave patients unable to comply with initial physiotherapy due to painful restriction of limb movement.

Hip surgery

Primary hip arthroplasty or fractured neck of femur surgery can be usefully supplemented by lumbar plexus block or to a lesser

Calum RK Grant *FRCA is a Consultant Anaesthetist at Ninewells Hospital and Medical School, Dundee, UK. Conflicts of interest: none declared.*

Pavan Kumar BC Raju *MD FRCA is a Fellow in Regional Anaesthesia at Ninewells Hospital and Medical School, Dundee, UK. Conflicts of interest: none declared.*

extent by femoral or fascia iliaca block. Revision hip arthroplasty is an indication for continuous lumbar plexus block. Complete anaesthesia of the hip joint requires a proximal sciatic nerve block (e.g. Labat's approach) in addition to lumbar plexus block to anaesthetize the posterior aspect of the joint.

Knee surgery

Primary knee arthroplasty is typically associated with severe acute post-surgical pain. Current opinion is that the optimal combination of nerve blocks required to provide effective post-operative analgesia is a continuous femoral nerve block and a single-shot sciatic nerve block. Continuous lumbar plexus block may be used in place of a femoral nerve block, although it is associated with a higher incidence of side-effects, in particular epidural spread of local anaesthetic.

Ankle and foot surgery

Again, these procedures are associated with significant post-operative analgesic requirements which can be met, effectively, using peripheral nerve blocks. A combination of popliteal and saphenous nerve blocks are required to provide analgesia for ankle/hind-foot surgeries whereas an ankle block, which is possible to perform using ultrasound guidance, is ideal for most forefoot procedures. Unlike popliteal sciatic nerve block, ankle block does not result in transient foot-drop therefore, most patients can mobilize heel-walking allowing early postoperative discharge.

Other procedures

Peripheral lower limb blocks are frequently used for traumatic lower limb injuries. It is worth noting that nerve blocks should probably be avoided in cases where there is a risk of compartment syndrome developing, specifically following tibial shaft and some femoral fractures. There is concern that the block will mask pain associated with an evolving compartment syndrome, resulting in delayed diagnosis. Careful patient selection and discussion with surgical colleagues are recommended if there is any uncertainty regarding this risk.

Peripheral nerve blocks are also indicated for anaesthesia and analgesia in lower limb vascular surgical procedures or amputations. There are often multiple benefits (for example cardiovascular stability, decreased opioid requirements) in this high-risk group of patients who may also be at risk of significant chronic post-surgical pain.

Nerve block techniques

There are many nerve blocks and approaches for the lower limb. An exhaustive list is outside the scope of this article.[6] The following techniques are well established and provide the anaesthetist with a range of options that will effectively cover the vast majority of lower limb surgical procedures.

Lumbar plexus block – posterior approach

This technique provides reliable block of the femoral, obturator and lateral cutaneous nerve of thigh components of the lumbar plexus, by deposition of local anaesthetic within the psoas muscle compartment in the retroperitoneal space. It is technically more difficult than other lower limb blocks and the deep nature of the plexus and its proximity to several important anatomical structures (for example kidney, major blood vessels, epidural space) mean that this is not a block for the novice regional anaesthetist. The potential for complications and side-effects is higher than for other lower limb blocks; nevertheless, it provides very effective analgesia for hip and knee surgery. The psoas muscle is highly vascular and resultant systemic uptake of local anaesthetic means that single-shot blocks typically provide only 4–6 hours of analgesia. A continuous catheter technique is therefore more appropriate to prolong postoperative analgesia.

Capdevila et al.,[7] best describe the approach, based upon CT anatomical studies (Figure 1). Using a nerve stimulator, the block needle (100 mm in length is adequate for most adult patients) is inserted perpendicular to skin and carefully advanced. It should encounter the transverse process of the lumbar vertebrae at a depth of approximately 5–7 cm, which is an important landmark as the plexus is reliably located at a depth of no more than 2 cm deep to this. Quadriceps contraction in the 0.3–0.5 mA range is the accepted endpoint. Correct interpretation of neurostimulation is important and will assist in block performance. An adductor response (obturator nerve) indicates that the needle tip is too medial, hamstring contraction (lumbosacral trunk) indicates needle tip too caudad, and hip flexion is produced by direct psoas stimulation, indicating that the needle tip is too deep. Strict asepsis should be observed when performing this block especially when a catheter is introduced. This block is contra-indicated in patients at an increased risk of bleeding (for example those on clopidogrel or with a coagulopathy) because of the risk of psoas haematoma formation. The most frequently observed side effect, in up to 20% of cases, is spread of local anaesthetic to the epidural space that may produce a bilateral block and hypotension; however, this does not usually represent a significant problem in day-to-day clinical practice.

Femoral nerve block

Femoral nerve block is the most frequently used analgesic block for lower limb surgery. It is relatively simple to perform as the

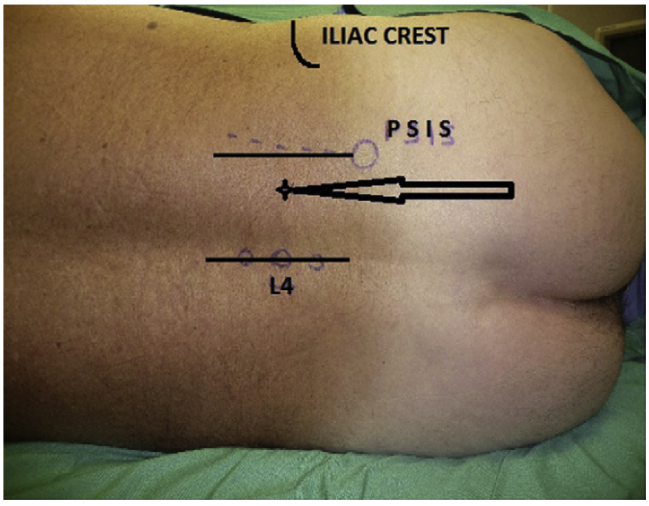

Figure 1 Landmarks for posterior approach to lumbar plexus. A line is drawn between the spinous processes of the lower lumbar vertebrae. A parallel line is then drawn from the posterior superior iliac spine (PSIS). The spinous process of L4 is identified. The needle insertion point (black arrow) lies two-thirds of the way from the spinous process of L4 to the line drawn from PSIS.