Upper limb nerve blocks

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Abstract

Brachial plexus blockade is commonly used for a variety of upper limb surgical procedures and the introduction of ultrasound guidance has led to re-evaluation of many of the approaches. Large-scale studies examining both efficacy and complications of ultrasound-guided techniques compared with nerve stimulation are lacking, but there is a growing body of research to support the routine use of ultrasound. Interscalene block remains the approach of choice for shoulder surgery but phrenic nerve blockade remains common, even using low volumes of local anaesthetic. Of the currently available studies comparing the other approaches, there seems to be little difference in efficacy between axillary, supraclavicular and infraclavicular approaches for elbow, forearm and hand surgery when equivalent levels of expertise are used. Recently, the growth of ambulatory surgery has influenced the increased use of peripheral nerve blocks for analgesia. The major features influencing block choice and performance are discussed here.

Keywords Brachial plexus block; regional anaesthesia; technique; ultrasound

Royal College of Anaesthetists CPD Matrix: 1D02, 2E01, 2G01, 3A09.

Learning objectives

After reading this article, you should be able to:

- select the appropriate brachial plexus block for upper limb surgery
- appreciate potential advantages of ultrasound-guided approaches
- outline four major techniques of brachial plexus block
- appreciate potential advantages of peripheral nerve blocks

Upper limb nerve blocks

Upper limb blockade remains central to the practice of peripheral regional anaesthesia for both operative surgery and postoperative analgesia. Brachial plexus blockade can greatly simplify management of patients with significant medical comorbidity, particularly those with respiratory disease, cardiovascular disease, obesity, diabetes, altered conscious level and those with a compromised or difficult airway. In addition, prolonged infusion analgesia for more major surgery may facilitate earlier limb mobilization and have the potential to reduce hospital stay and improve functional outcome. The development of ultrasound-guided approaches has stimulated widespread interest in many of these techniques. Although well-controlled large-scale studies examining both block efficacy and complications compared with peripheral nerve stimulation are lacking, there is a growing volume of work in the literature to support routine ultrasound use. To perform these techniques safely it is vitally important for the anaesthetist to obtain adequate supervised training and then maintain experience by continuing to use a few techniques frequently rather than attempting to master all approaches or reserving them only for the most medically compromised patients. Equally, careful patient selection plays a crucial role in achieving maximum benefit.

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Choice of technique

Choice of technique (Table 1) is important to optimize success for any given procedure. The interscalene approach will reliably block the more proximal plexus nerves (axillary, suprascapular) as well as the cervical plexus, necessary for successful awake shoulder surgery. The infraclavicular and supraclavicular approaches are useful when arm abduction is limited, with the former excellent for catheter placement and fixation for infusion use and the latter useful for humeral surgery. The axillary approach can be used for most hand, forearm and elbow surgery with the lowest potential for complications. The blockade of more peripheral nerves in the distal arm and forearm is useful for block rescue or for postoperative analgesia with reduced motor blockade.

The potential advantages of ultrasound-guided block performance are listed in Box 1, but are not necessarily equally applicable to all approaches. Tran et al.[1] prospectively compared ultrasound-guided axillary, supraclavicular and infraclavicular blocks for surgery on the elbow, forearm, wrist and hand, and found no difference in anaesthesia-related time, success rate (95–97.5%), block-related pain scores, vascular puncture or paraesthesia.

Axillary block

This is a useful block for hand, forearm and elbow surgery as well as proximal vascular access procedures on the medial aspect of the upper arm such as brachio-basilic fistula formation. The completeness of brachial plexus blockade has already been substantially improved by the introduction of triple injection nerve-stimulation techniques, which provide reliable blockade of the radial and musculocutaneous nerves, often missed with single-injection approaches. Even with ultrasonic location, this is likely to remain a multiple-injection technique as circumferential spread of injectate around the artery is often limited. It is an ideal block for the relative novice as there is a lower potential for significant complications when compared with the more proximal blocks, and the location and injection around a number of nerve structures during each block, help develop ultrasound-related skills. The presence of the easily visualized axillary

Techniques of upper limb block

Technique	Sensory block	Advantages	Disadvantages
Interscalene	Shoulder, humerus, elbow, lateral aspect forearm and hand	Blocks deep structures of shoulder and upper arm	C8, T1 often missed, phrenic nerve palsy inevitable, occasional serious complications
Supraclavicular	Whole limb except shoulder	Widest area of block	Risk of pneumothorax, phrenic nerve palsy
Infraclavicular	Hand, forearm, elbow	Ease of arm positioning, secure site for catheter fixation	Risk of pneumothorax, landmarks not always obvious
Axillary	Hand, forearm, elbow	Easy technique, low risk of complications	Difficult to position painful limb, need for multiple-injection technique
Peripheral nerves	Individual nerve territories	Easy techniques, long duration	Limited area of block, may need multiple injections, tourniquet pain

Table 1

Potential advantages of ultrasound-guided blockade

- Accuracy of needle placement
- Visualization of local anaesthetic spread in real time
- Allows additional local anaesthetic deposition
- Compensation for anatomical variation
- Avoidance of intraneural/intravascular injection
- Reduced complications, e.g. pleural puncture
- Wide variety of approaches (not landmark dependent)
- Rapid block onset
- Reduced local anaesthetic dosage
- Avoids nerve-stimulation-related fracture-site pain

Box 1

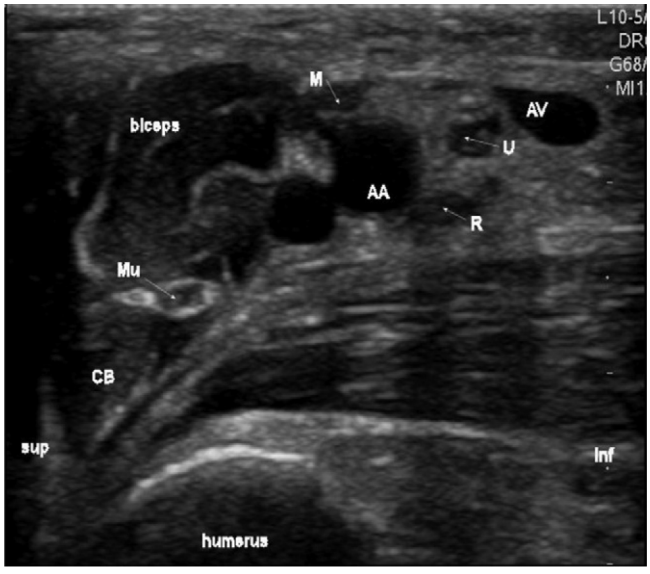

Figure 1 Ultrasound image of the distal axilla showing the relationship of the terminal nerves of the brachial plexus to the axillary artery (AA) and axillary vein (AV). The musculocutaneous nerve (mu) lies in a plane between biceps and coracobrachialis (CB) muscles and frequently has a partially hypoechoic core which is often also a feature of the ulnar nerve (U). The median nerve (M) lies in typical position with the radial (R) located below the ulnar nerve in the 5 o'clock position.

artery and its relationship to the terminal nerves, although variable, also facilitates performance (Figure 1). The artery is usually visualized as proximal as possible, allowing the probe to be supported against the chest wall in a transverse orientation. The structures are relatively superficial allowing a high-frequency (10 MHz) probe to be used with the depth set at approximately 3 cm for best clarity and appreciation of the surrounding structures. The nerve appearances are variable but usually more hyperechoic in this region, with the musculocutaneous nerve seen lying in the fascial plane between short head of biceps and coracobrachialis muscles (Figure 1). The median nerve is usually visualized in the superolateral 9–12 o'clock position relative to the artery. The ulnar nerve may lie in the corresponding inferomedial (1–3 o'clock) position but more commonly lies at a discrete distance from the artery beneath the axillary vein at a similar level. The radial nerve is the most difficult to visualize and is generally located below the ulnar nerve (5 o'clock position). To help with identification, the nerves can be traced from their more distal positions to their final locations relative to the artery. Needle insertion can be either in plane (needle visualized) or out of plane (ideally needle tip alone visualized). A word of caution; with an out-of-plane approach, the needle tip and its shaft, both appear as a hyperechoic dot. Hence, the needle tip position is best confirmed by the incremental spread of local anaesthetic. Visualization of the entire needle with the in-plane approach is the most demanding ultrasound skill to acquire and becomes crucial with the more proximal plexus blocks, to avoid needle-related complications such as pleural puncture. There is evidence to suggest echogenic needles can improve visibility of both the shaft and the tip independent of angle of insertion, which may have implications for patient safety.[2] Complete blockade of all seven nerves is usually rapid (often within 10 minutes) using lidocaine 1.5% with epinephrine 5 μg/ml, 20–30 ml depending on spread, although volumes as low as 1 ml/nerve have been successfully employed.[3] Lidocaine will generally provide a block of 2–3 hours' duration. Longer acting agents such as levobupivacaine or ropivacaine in similar volumes can be used for more major procedures such as total elbow arthroplasty or complex fracture fixation and will provide around