Peripheral nerve block at the elbow and wrist

RA McCahon MBChB FRCA
NM Bedforth BMedSci BM BS FRCA

Key points

Success is dependent on a sound knowledge of the applied regional anatomy.

Peripheral nerve block at the elbow and wrist provides excellent postoperative analgesia.

The techniques can be used to provide anaesthesia for minor hand surgery.

Novel approaches are possible with ultrasound guidance.

Wrist and elbow blocks are used to provide anaesthesia and analgesia for hand and forearm surgery. They may be used to supplement a brachial plexus block or to provide perioperative analgesia after a regional or a general anaesthetic. Wrist or elbow blocks alone may be used to provide anaesthesia for minor hand procedures; thus, sparing the patient the complications of general anaesthesia and providing excellent postoperative analgesia with a reduced requirement for opioid analgesics.[1] Proximal brachial plexus block is associated with more motor block, but will provide partial or complete tourniquet anaesthesia. Therefore, sole reliance on peripheral arm blocks can only be advocated in procedures that do not require a tourniquet or last approximately <20 min.[2]

Anatomy

Successful blockade of the forearm and hand relies on a good understanding of the cutaneous nerve supply (Fig. 1). Knowledge of the anatomical landmarks enables rapid location of the underlying nerves.

Numerous variations exist in the neural anatomy of the forearm and hand. For example, there are six described combinations of sensory innervation of the dorsum of the hand. This variability and overlap of innervation mean that it is unwise to rely on the block of a single nerve supplying sensation to the operative field. A patient series of 825 patients by Klezl and colleagues[3] found that partial wrist blocks fail more frequently (i.e. cutaneous branches not blocked) compared with complete blocks (18 *vs* 2%). After this series, the authors advocated total wrist block involving block of the median, ulnar, and radial nerves at the wrist together with subcutaneous infiltration of the dorsum of the wrist in order to block any missed branches.

Three nerves and two branches thereof may be blocked at the wrist (Table 1). The key anatomical landmarks are flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), palmaris longus (PL), and the radial styloid[4] (Fig. 2). Suggested injection sites at the wrist and elbow are indicated by black dots in Figure 2.

Six nerves may be blocked at the elbow (Table 2). The key anatomical landmarks are the biceps tendon, brachial artery, and the elbow crease[4] (Fig. 2).

Techniques

The following points are important when performing these techniques:

- Informed patient consent.
- Trained assistance in an appropriate setting with rapid access to resuscitation equipment, and drugs.
- Patient monitoring as per the Association of Anaesthetists of Great Britain and Ireland recommendations.
- Intravenous access.
- A conscious patient can communicate pain or paraesthesia produced by intraneural injection.
- Infiltration of the skin at the injection site with local anaesthetic (LA).
- Aspiration before injection to check for intravascular placement. However, intravascular injection may still occur despite this manoeuvre.
- Motor stimulation should cease after an initial 1 ml of LA is injected. Continued motor stimulation after this initial injection may signify intravascular or intraneural injection.
- Stop injecting if there is resistance to injection or the patient complains of pain. Suspect intraneural needle placement and resite the needle.
- Deliver the injection slowly in 5 ml aliquots with repeated aspiration to allow the detection of intravenous injection of LA.

RA McCahon MBChB FRCA
Anaesthetic Research Fellow
Academic Department of Anaesthesia
Queen's Medical Centre
Nottingham University Hospitals
NHS Trust
Nottingham
UK

NM Bedforth BMedSci BM BS FRCA
Consultant Anaesthetist
Department of Anaesthesia
Queen's Medical Centre
Nottingham University Hospitals
NHS Trust
Nottingham NG7 2UH
UK
Tel: +44 0115 9249924
Fax: +44 0115 9783891
E-mail: nigel.bedforth@nuh.nhs. uk
(for correspondence)

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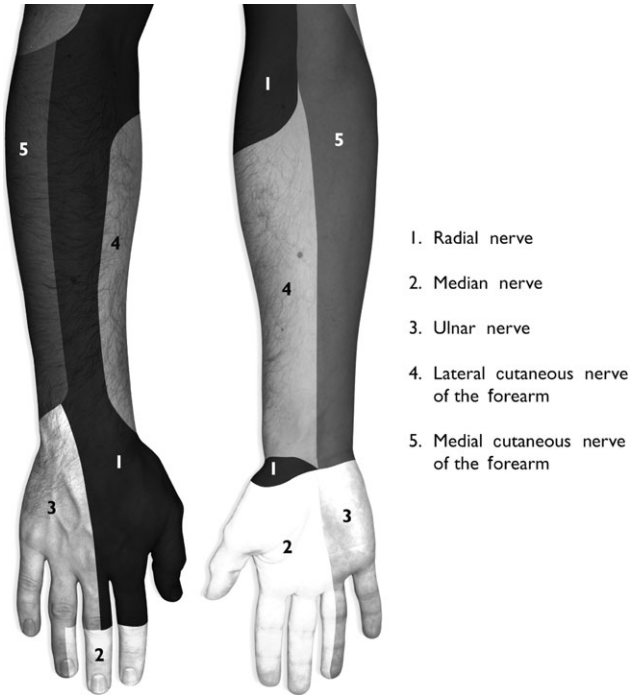

Fig. 1 Cutaneous nerve supply of the forearm and hand.

Elbow and forearm

A 22G insulated, short-bevelled stimulating needle is used. The needle is attached to a peripheral nerve stimulator (PNS), which delivers a small current to the nerve in order to stimulate its motor fibres. A suitable starting current is 1 mA with a frequency of 2 Hz and a pulse width of 0.1 ms. The needle is redirected to achieve motor stimulation of the chosen nerve without paraesthesia and with a stimulating current of 0.3–0.5 mA. It is advisable to reposition the needle if motor stimulation occurs at $\leq$0.2 mA as this may indicate intraneural placement of the needle tip. The motor responses elicited from the various nerves are summarized in Table 2. The arm should be abducted and externally rotated with the hand held in supination, so that the key anatomical landmarks at the elbow may be identified (see Table 2).

Table 1 Anatomical landmarks at the wrist

Superficial radial	Subcutaneous; styloid process of radius to mid-point of dorsum of wrist
Median	3–5 cm proximal to distal palmar crease between PL and FCR or 1 cm medial to FCR if PL absent
Palmar cutaneous branch (median nerve)	Superficial from above insertion point distally and laterally across flexor retinaculum
Ulnar	2 cm proximal to distal palmar crease deep to medial border of FCU; medial to ulnar artery
Dorsal cutaneous branch (ulnar nerve)	Superficial from above point over ulnar aspect of wrist

Radial nerve

The needle is inserted in the groove between brachioradialis and biceps, 2 cm proximal to the elbow crease, and advanced towards the lateral epicondyle of the humerus. Motor stimulation of the radial nerve is achieved at a depth of 2–4 cm. The needle is positioned to achieve optimal motor stimulation, and 5–10 ml of LA is injected. As the needle is withdrawn, it is redirected subcutaneously along the lateral border of the biceps tendon where a further 5–10 ml is deposited to block the lateral cutaneous nerve of the forearm (terminal branch of the musculocutaneous nerve).

Median nerve

The median nerve is found approximately 1 cm medial to the brachial artery on the elbow crease, lying at a depth of 1–2 cm. The needle is advanced at 45° cephalad to the skin, and a click may be felt as it passes through the bicipital aponeurosis. When optimal

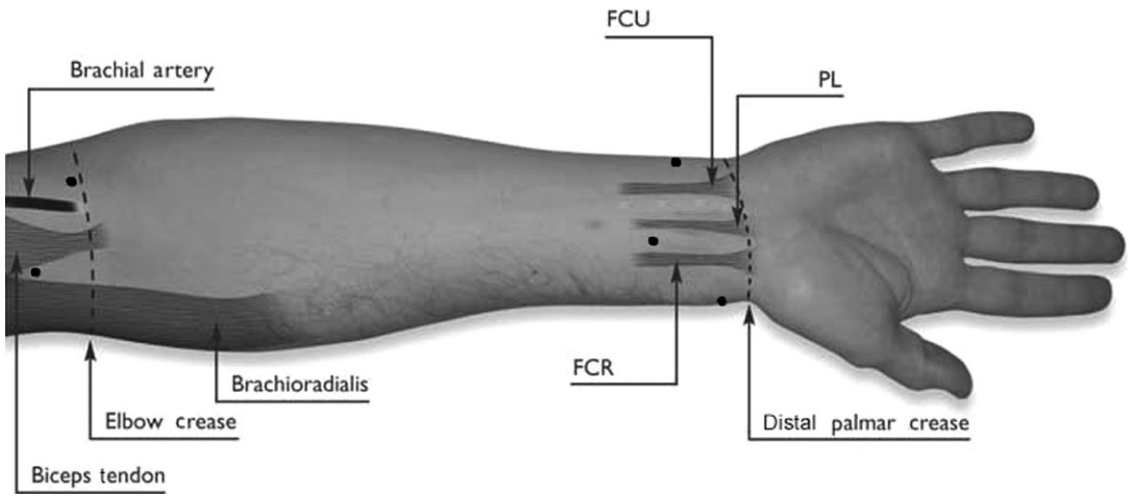

Fig. 2 Anatomical landmarks and injection sites (•) of the anterior forearm and wrist.

Table 2 Anatomical landmarks and motor responses at the elbow

Nerve	Anatomical landmarks and injection site	Motor response to stimulation by PNS
Radial	Groove between lateral border of biceps tendon and brachioradialis, 1.5–2 cm proximal to elbow crease.	Thumb extension; wrist extension.
Lateral cutaneous nerve of forearm (musculocutaneous)	Subcutaneous; lateral border of biceps tendon.	Not applicable
Median	1 cm medial to brachial artery at the elbow crease.	Finger flexion; wrist pronation alone inadequate.
Medial cutaneous nerve of forearm	Subcutaneous; medial border of biceps tendon.	Not applicable
Ulnar	2 cm proximal to ulnar sulcus (medial epicondyle).	Ring finger flexion; thumb adduction; ulnar deviation at the wrist.
Posterior cutaneous nerve of forearm (branch of radial nerve)	Subcutaneous; between olecranon and lateral epicondyle of humerus.	Not applicable

motor stimulation is achieved, 5–10 ml of LA is injected. The needle is then redirected subcutaneously along the medial border of the biceps tendon where the medial cutaneous nerve of the forearm is blocked by injecting a further 5–10 ml of LA.

Ulnar nerve

Block of the ulnar nerve is achieved by abducting the arm and flexing the elbow to 90°. The needle is inserted 1–2 cm proximal to the ulnar sulcus and directed 45° cephalad. When optimal needle position has been achieved, 5–10 ml of LA should be injected. Injection into the tight ulnar sulcus should be avoided as this can cause pressure-induced neuropraxia. Within the ulnar sulcus, the nerve is relatively immobile and is at risk of needle trauma.

Wrist

It may be safer to use a short-bevelled needle in conjunction with a nerve stimulator, but many anaesthetists commonly use a standard 23G–25G needle. The arm is abducted with the hand in supination. The key anatomical landmarks at the wrist are identified (see Table 1).

Median nerve

Advance the needle at 45° to the skin towards the wrist. The median nerve runs 1–1.5 cm deep; 3–5 ml of LA is injected. Paraesthesia of the thumb or index finger warrants withdrawal of the needle by 1–2 mm. In order to block the palmar cutaneous branch of the median nerve, the needle is advanced subcutaneously towards the flexor retinaculum and a further 3–5 ml of LA is injected as the needle is withdrawn. Note that in patients with carpal tunnel syndrome, block of the median nerve at the wrist could cause pressure-induced neuropraxia in the tight carpal tunnel.

Ulnar nerve

To block the ulnar nerve, the same needle can be advanced beneath the tendon of FCU towards the radial border of the forearm, to a depth of 1–1.5 cm. The needle is redirected subcutaneously around the ulnar aspect of the wrist in order to block the dorsal cutaneous branch of the ulnar nerve. This medial approach to the ulnar nerve reduces the risk of intra-arterial needle placement. The alternative is to make an anterior approach, medial to the ulnar artery and lateral to the tendon of FCU. This approach may require a second injection around the ulnar border of the wrist. Using either method, 3–5 ml of LA is injected at each site.

Radial nerve

At the wrist, the radial nerve is separated into numerous terminal branches. LA is injected subcutaneously between the radial styloid and the midpoint of the dorsum of the wrist. This should be confluent with the LA infiltration of the dorsal cutaneous branch of the ulnar nerve.

Ultrasound guidance

Ultrasound-guided regional anaesthesia can be utilized in elbow and forearm blocks, facilitating both traditional and novel approaches to the nerves. The nerves can easily be blocked more proximally in the forearm to avoid the need for blocking their distal branches subcutaneously. Ultrasound guidance may reduce the time taken for block placement, the dose of LA required, and the need for high stimulation currents, improving patient comfort. The safety profile of regional anaesthesia may improve with ultrasound-guided techniques. Under direct vision, the incidence of direct needle trauma to nerves and vessels may be reduced and therefore injection of LA into these structures may be avoided.

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Please see multiple choice questions 10–12