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Technical Note: The Humeral Canal Approach to the Brachial Plexus

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Many variations to the axillary approach to the brachial plexus have been described. However, the success rate varies depending on the approach used and on the definition of success. Recent work describes a new approach to regional anaesthesia of the upper limb at the humeral/brachial canal using selective stimulation of the major nerves. This report outlines initial experience with this block, describing the technique and results in 50 patients undergoing hand and forearm surgery. All patients were assessed for completeness of motor and sensory block. The overall success rate was 90 percent. Motor block was present in 80 percent of patients. Completion of the block was necessary in 5 patients. Two patients required general anaesthesia. The preponderance of ulnar deficiencies agrees with previously published data on this technique. No complications were described. Initial experience confirms the high success rate described using the Dupré technique. This technically straightforward approach with minimal complications can be recommended for regional anaesthesia of the upper limb.

INTRODUCTION

Brachial plexus block is a well recognized anesthesia technique for surgery to the upper limb. Many approaches have been described since Hirschel and Kulenkampff's first reports of percutaneous techniques in 1911 [1]. Of these, the axillary approach is one of the most popular, due both to its ease of performance and its relative safety. However, block success rate using the axillary approach does vary, depending on the technique used to locate the nerve plexus; detection of paresthesias, transarterial puncture or limb movement evoked using a nerve stimulator [2, 3]. Comparison between reported techniques is difficult, as definitions as to what constitutes a successful block vary.

In 1994, Louis-Jean Dupré reported a new approach to the brachial plexus, using what he described as the canal huméral [4]. This technique involves selective stimulation of the 4 major nerves supplying the upper limb — medial, ulnar, radial and musculocutaneous — via one skin puncture at the level of the arm (rather than the axilla). This paper will describe the technique in detail, and outline the results of my own experience using this approach to brachial plexus anesthesia.

MATERIALS AND METHODS

The brachial or humeral canal, as described by Dupré, lies on the medial aspect of the arm. It is bounded superiorly by the biceps muscle, inferiorly by the triceps, laterally by coracobrachialis and medially by skin and subcutaneous tissue (Figure 1). The brachial artery and veins pass through the canal serving as the principal anatomical landmark for this regional block. The median nerve lies anteromedial to the artery while the ulnar nerve is inferior to it. The musculocutaneous nerve passes through coracobrachialis and

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descends in the groove between biceps and brachialis. The radial nerve is located inferiorly to the artery, passing posteriorly to the body of the humerus. The intercostobrachial nerve leaves the humeral canal, passing subcutaneously accompanied by the basilic vein.

Usual monitoring is instituted and an intravenous cannula placed. With the patient in a supine position, the arm to be blocked is placed in abduction (80-90°) and external rotation. The brachial artery is palpated at the junction of the upper and middle thirds of the arm. A wheal of local anesthetic is introduced at this point, and a #22 gauge, 50 mm short beveled, insulated needle is passed through the skin. The needle is advanced tangentially toward the shoulder, superficial to the brachial artery and parallel to its course. The median nerve is located at 4-4.5 cm, with characteristic hand movement (pronation and flexion of the thumb and first two fingers). A volume of 8-10 ml of local anesthetic is injected slowly. The needle is withdrawn to the subcutaneous tissue and is then reoriented medially and slightly more perpendicularly to locate and anesthetize the ulnar nerve (characteristic hand movement - flexion of the 3rd and 4th fingers and the wrist). The needle is once again withdrawn to the subcutaneous tissue, and is redirected beneath the body of biceps in the direction of the coracoid process to locate the musculocutaneous nerve (flexion at the elbow). To anesthetize the radial nerve, the needle is withdrawn and advanced perpendicularly to the skin to contact the body of the humerus. By walking the needle posteriorly off the humerus, the radial nerve can be stimulated (extension at the wrist and fingers, supination). As the needle is finally withdrawn, two to four millilitres of epinephrine free local anesthetic is injected anteriorly and posteriorly subcutaneously on either side of the skin puncture to block the intercostobrachial nerve and the medial cutaneous nerve of arm.

This technique depends on the use of a nerve stimulator and consequently certain end points should be emphasized. The stimulator is used to produce evoked activity in each of four specific nerve distributions, being set at 2-3 mA and 1-2 Hz initially. To ensure that the needle tip is in sufficiently close proximity to the nerve to be anesthetized, evoked activity should be present at stimulating current of 0.5 mA or less, prior to local anesthetic injection. The local anesthetic of choice for this block is lidocaine 1.5 percent with 1:200000 epinephrine. A volume of 8-10 ml is recommended for the medial, ulnar and radial nerves, with the greater volume being chosen to anesthetize that nerve supplying the site of the surgical procedure. Anesthesia of the musculocutaneous nerve is achieved with a volume of 6-8 ml of the above solution.

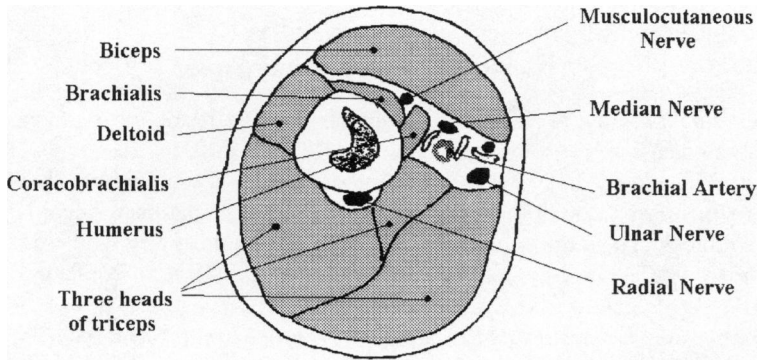

Figure 1.

Successful block was defined separately for motor and sensory components. A successful sensory block was defined as absence of light touch in each of the 4 nerves stimulated (median, ulnar, radial and musculocutaneous). Successful motor blockade required absence of movement against gravity in the muscle group supplied by a particular nerve. In cases of incomplete blockade, anesthesia was completed at the elbow or wrist.

RESULTS

A total of 50 patients (M/F 28/22) were studied in detail for the purposes of this report. All patients underwent upper limb surgery, including tendon repairs, wound explorations and wiring of wrist (Colles) fractures.

Overall sensory success rate was 90 percent. Complete motor block existed in 80 percent of patients, but this did not prevent surgery proceeding. Of the unsuccessful blocks, one was medial, one radial and three ulnar. All musculocutaneous blocks were successful, Following supplementation, the radial failure and one ulnar failure were still insufficient for surgery and it was necessary to proceed to general anesthesia. The mean time for establishing a sensory block was 17 ± 10 minutes. No complications were described, although one patient complained of bruising at the site of needle puncture.

DISCUSSION

This work confirms the previous studies describing the use of this block to anesthetize the upper limb [4, 5]. The 4 principal nerves to the upper limb are all easily located using a nerve stimulator with the brachial artery as the primary anatomical landmark. The success rate of the technique compares well with other approaches to the brachial plexus, with a range of success from 90-96 percent [4, 5] as compared with 70-80 percent using conventional axillary approaches [2, 3]. Bouaziz et al. [5] compared conventional axillary blockade with the humeral canal approach in 60 patients undergoing upper limb surgerv of less than 2 hr duration. The conventional technique chosen was that described by Lavoie [6], involving stimulation of the musculocutaneous nerve and one of the other 3 major nerves to the surgical site. Lavoie illustrated that this approach had a similar success rate as stimulation of each of the 4 major nerves (94 percent). Bouaziz and colleagues had an 88 percent success rate with the humeral canal technique. However, their results with the Lavoie approach were considerably poorer than the original 94 percent, with only 54 percent of blocks being considered successful. The principal difference was in the success rate for anesthetizing the radial nerve. Comparison of the humeral canal technique with a 4 nerve stimulation technique may be more valid. Results from the present series are illustrated alongside those of Bouaziz in Figure 2.

As the humeral canal is anatomically different from the perivascular sheath in the axilla, it has been argued that the uptake of local anesthetic from this site may have a different profile. The mean doses of lidocaine are approximately 35 ml of 1.5 percent with 1:200000 epinephrine, i.e., 525 mg. This dose borders on the conventionally accepted dose of lidocaine for a 70 kg subject. However, Bouaziz also looked at plasma lidocaine levels over 90 min and found a Cmax of 3.4 ± 0.5 g/ml and a Tmax of 40 ± 17 min. This is significantly less than the accepted toxic thresholds of 6-10 g/ml [7].

The humeral canal approach targets the 4 principal nerves to the upper limb. It does not take specific account of the other 3 nerves supplying sensation to the arm; the intercostobrachial and the medial cutaneous nerves of the arm and forearm. The injection of 2-4 ml of lidocaine subcutaneously at needle withdrawal anesthetizes the intercostobrachial nerve and may have some effect on the medial cutaneous nerves. However, none of these

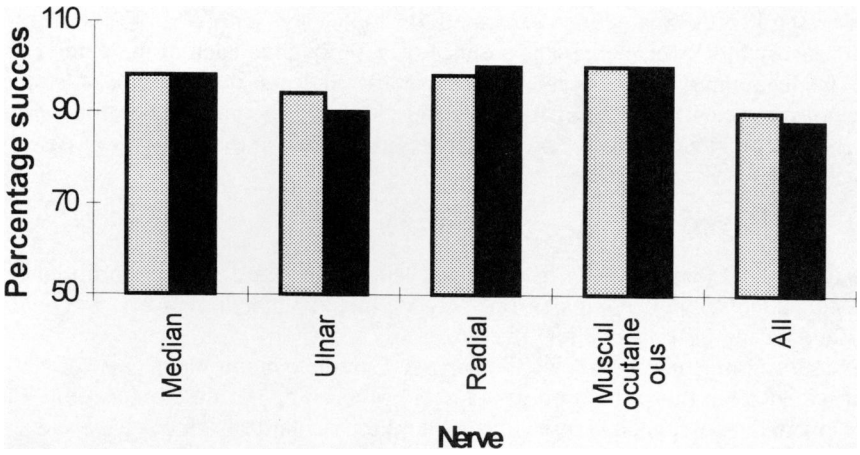

Figure 2.

nerves were formally tested in the present series. Neither Bouaziz nor Dupré comment on block deficiencies due to these nerves.

As with any regional technique, there are certain technical points which may increase the success rate of the humeral canal approach. Palpation of the brachial artery, while necessary in aiding location of the median nerve, must be performed with care. The palpating finger may approximate the needle tip to the nerve while it is in fact further away. Thus evoked motor activity at 0.5 mA may be present until the palpating finger is removed. Injection without removing this finger may well result in a failed block. As regards the radial nerve, it is crucial that the needle insertion point is at the junction of the upper and middle thirds of the arm [8]. An insertion below this point will produce difficulty in radial nerve location, as this nerve passes posteriorly in the groove of the humerus at this point.

In summary, the humeral canal approach is a useful addition to the anesthesiologist's repertoire of regional anesthesia techniques for the upper limb. It has a high success rate, is well tolerated by patients and is a relatively easy technique to learn. While it may prove difficult in muscular young males, it has few complications. As well as being a pnmary method of anesthetizing the upper limb, it may also be used to supplement anesthesia in individual nerves not blocked by more conventional approaches. These advantages will ensure this technique finds a place in the management of patients undergoing upper limb surgery.

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