ULTRASONOGRAPHIC STUDY OF THE SPREAD OF LOCAL ANAESTHETIC DURING AXILLARY BRACHIAL PLEXUS BLOCK

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Methods used to demonstrate the spread of solutions in the axillary sheath include the use of radio-opaque dyes and x-rays [1] and cadaveric studies which involved dissection after injection of self-hardening solutions [2]. Ultrasonography has been used to measure the depth to the extradural space [3] and to locate the internal jugular vein [4]. In this study, ultrasonography was used to show sections of the axilla, to confirm the position of a cannula in the “axillary sheath” and to visualize the spread of an aqueous solution of local anaesthetic. The axilla was chosen because it allowed comparison of our observations with previous studies.

PATIENTS AND METHODS

We studied 10 patients (aged 17–70 yr, ASA I) who presented for surgery of the forearm and hand. A modification of the technique described by Sada, Kobayoshi and Marakami [5] was used, with the patient placed supine with the arm abducted 70°, the shoulder externally rotated and elbow flexed at 90°. The axillary artery was palpated high in the axilla and a 21-gauge polypropylene cannula with an inner metal needle was inserted under local anaesthesia. The cannula was directed towards and superior to the point of maximal pulsation until a click was felt. The cannula was then advanced over the metal needle until resistance was felt. No attempt was made to elicit paraesthesiae. Correct positioning of the cannula was confirmed by ultrasonography using a Toshiba SAL 38 B with a TP8300 thermal printer and a linear 64 element electronically-scanned probe operating at 3.5 MHz. The anatomy of the axilla was recorded 90° to the axis of the axillary vessels above, at and below the level of the pectoralis minor muscle before and after injection of 1.5% lignocaine 30 ml with adrenaline 1:200 000. The time to onset of block suitable for surgery was measured from the time of injection.

RESULTS

Paraesthesiae were not produced and the axillary vessels were not punctured in any patient. Successful block was achieved in all. All patients required a tourniquet for the surgery, but only two complained of mild discomfort from the tourniquet, which was relieved with fentanyl 50 μg and droperidol 2.5 mg i.v. Two patients had an incomplete sensory block over the deltoid. All the other patients had a complete block of the axillary nerves derived from C5 to T1. One patient required diazepam 5 mg for anxiety. Onset time was 18 min (mean; range 8–35 min). All patients were monitored after operation until total regression of motor block, which occurred within 2.5 h.

Figure 1 shows the anatomy of the axilla. The thick lines on the line drawing show the ultrasonic sections in relation to the anatomy of the axilla. The left upper picture shows the section

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**SUMMARY**

Ultrasonography has been used to demonstrate the anatomy of the axilla, to confirm the placement of a cannula and to visualize the spread of a local anaesthetic solution in the axillary sheath of 10 patients (aged 17–70 yr) for surgery of the forearm and hand. The block was successful in all subjects.
FIG. 1. Anatomy of the axilla. V = vein; A = artery; CH = chest wall; CLAV = clavicle; ACR = attachment to coracoid process; P.MAJ. = pectoralis major muscle; H = humerus.

FIG. 2. Section across the apex of the axilla showing the artery (A) and vein (V) before (upper ultrasound picture) and after (lower ultrasound picture) the injection of 30 ml of 1.5% lignocaine solution in water (LA). The artery and vein are better defined after LA injection, but are not separated. PECT.MAJ. = pectoralis major.
FIG. 3. Section of the mid-axilla before (upper ultrasound picture) and after (lower ultrasound picture) injection of 30 ml of 1.5% lignocaine in water. The thoraco-acromial branch of the axillary artery is clearly seen. The artery (A) and vein (V) appear separated after injection of local anaesthetic through the cannula (C).

FIG. 4. Section across the base of the axilla before (upper ultrasound picture) and after (lower ultrasound picture) injection of 30 ml of 1.5% lignocaine solution in water. The artery (A) and vein (V) appear separated after the injection of local anaesthetic solution (LA) and the plastic cannula is visible (→).
through the apex of the axilla, where the artery and vein lie close to the chest wall. The cephalic vein may be seen entering the axillary vein after piercing the clavipectoral fascia. The right upper picture shows the mid-axilla. The attachment of the pectoralis minor muscle to the coracoid process and the thoraco-acromial branch of the axillary artery are seen. The humeral head appears as a dark area at the right lower corner of the picture. The right lower picture shows the section through the base of the axilla. The coraco-brachialis and biceps muscles may be seen beneath the pectoralis muscle. The musculo-cutaneous nerve (between the small black arrows) may be seen running in the coraco-brachialis muscle.

Figures 2—4 show the apex, middle and base of the base of the axilla before (upper ultrasound picture) and after (lower ultrasound picture) injection of 1.5% lignocaine 30 ml (aqueous solution). Local anaesthetic solution may be seen in all three sections of the axilla. The artery and vein appear better defined and the separation of the vessels appears most marked in the mid-axilla after injection of local anaesthetic solution.

**DISCUSSION**

Traditionally, the methods used to study spread of local anaesthetic solutions have been based on radiography and cadaveric dissections. However, the ultrasound scan machine, available in many hospitals, may be an alternative technique. Correct positioning of the cannula may be visualized in relation to the axillary vessels. Radio-opaque dyes are unnecessary, as local anaesthetic solution may be “seen” with ultrasound. We found the distension of the “axillary sheath” was spindle shaped, and sections longitudinal to the axis of the axillary artery showed a curving of the axillary vessels around the head of the humerus.

The cross-sectional anatomy of the axilla was demonstrated clearly. In longitudinal section, the axillary vessels could be seen curving over the head of the humerus. The cannula and local anaesthetic solution were visualized better in real time scan, but photographs taken of “frozen” frames led to a loss in clarity of the boundaries. However, visible separation of the axillary vessels was caused by the local anaesthetic solution. The cords and nerves showed up as bright spots but were not visualized consistently in all patients. Perhaps the use of a probe frequency of 5 MHz may allow improved definition.

A limitation of this study was inability to quantify the volume of local anaesthetic on the ultrasound scan. The use of a computer interface with measurement of probe movements in the X, Y and X axes with graphic representation in three dimensions of sections taken close together might allow the volume of the distended tissues to be estimated and correlated with the volume of local anaesthetic injected.

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**REFERENCES**