A METHOD TO FACILITATE REGIONAL ANAESTHESIA BY DETECTION OF MIXED NERVE ACTION POTENTIALS

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SUMMARY

We have studied conduction anaesthesia of the median and ulnar nerves at the axilla using mixed nerve action potentials (MNAP) as a guide to needle position in three volunteers. The median and ulnar nerves were stimulated distally at the wrist using surface electrodes and MNAP were detected proximally in the axilla using an insulated needle electrode. The increase in amplitude of MNAP to maximum as the insulated needle electrode approached the nerve trunk was taken as an indication that the tip of the needle was in close proximity to the nerve trunk. Instillation of 1% lignocaine plain 4 ml decreased the amplitude of the MNAP with the onset of nerve block. We conclude that this method may be of potential use as an aid to peripheral regional anaesthesia by allowing accurate localization of needle position close to specific nerve trunks.

KEY WORDS

Anaesthetic techniques: regional. Measurement techniques: mixed nerve action potentials

There are several factors which may discourage the anaesthetist from using regional anaesthesia, not least the uncertainty of success. Several methods have been described to increase the success of regional anaesthesia, including eliciting paraesthesiae, the use of a peripheral nerve stimulator [1-3] and, most recently, ultrasound [4]. However, they all have some disadvantages. The detection of mixed nerve action potentials (MNAP) has been established by neurophysiologists [5, 6], but to our knowledge has not been applied to the clinical use of regional anaesthesia. The aim of this study was to determine if the detection of MNAP may be a useful aid to regional anaesthesia.

METHODS AND RESULTS

Local Ethics Committee approval was obtained for the study. Anaesthetists in training and an ambulance paramedic were used as volunteers. Full informed consent was obtained from each volunteer and they allowed one of their upper limbs to be studied each session.

A Dantac 1500 EMG apparatus was used to provide both stimulation and detection of MNAP. The peripheral median or ulnar nerve was stimulated distally at the wrist using a bipolar surface stimulator (DISA) delivering a 0.2-ms square wave pulse at a frequency of 1 Hz. This elicited a tingling sensation of mild to moderate nature at the wrist, with a stimulation intensity of 8-15 V. MNAP were recorded proximally using a disposable, 23-gauge, 50-mm length Teflon-sheathed Pole needle. The Pole needle acted as the recording electrode (cathode), whilst the reference electrode (anode) was a silver disc smeared with electrolyte jelly attached to the skin close to the point of insertion. An earth strip (ground electrode) soaked in saline was wrapped around the arm between the stimulator and the recording electrode. The axillary artery was used as the anatomical landmark for the approach to the brachial plexus in the axilla.

After s.c. infiltration of the skin with 1% lignocaine, the Pole needle was inserted so that the uninsulated tip was positioned subcutaneously. The intensity of the stimulus delivered by the distal stimulating electrode was reduced until the smallest amplitude MNAP was recorded by the Pole needle. The Pole needle was then advanced towards the neurovascular bundle until a maximum MNAP was obtained. This was taken as the point of closest approximation to the nerve trunk. The Pole needle was fixed in position and 1% lignocaine plain 4 ml injected via the side port of the needle. The neurovascular sheath was occluded distal to the needle insertion using digital pressure for a period of approximately 5 min. Sensory block was confirmed by testing pinprick sensation and demonstrating an increase in sensory threshold to electrical stimulus.

The MNAP were recorded in stages: s.c., at the point of closest proximity to the nerve trunk and after instillation of local anaesthetic at 0, 3, 5, 10 and 15 min.

There were four successful median and ulnar nerve blocks and no failures. The decrease in amplitude of the MNAP immediately after instillation of local anaesthetic at time 0 was probably the result of a spatial conduction barrier caused by the...
Volume of local anaesthetic between the needle and the nerve (fig. 1). At 2 min, the amplitude of the MNAP had increased in size, possibly signifying dispersion of local anaesthetic within the sheath and approximation of the needle to the nerve as a consequence. At 5 min, the amplitude of the MNAP had reduced in size as a result of the action of local anaesthetic on the nerve. A progressive reduction in the amplitude of the MNAP was noted at 10 and 15 min, by which time clinical block was obvious to the volunteer. Sensory block was confirmed by demonstrating the increase in sensory threshold to electrical stimulus by approximately 90%. The rapid onset of anaesthesia (mean 5.2 min, range 3–7 min), despite the small dose of local anaesthetic used, confirmed indirectly the proximity of the Pole needle to the nerve trunk. The mean (range) duration of anaesthesia was 78.6 (64–94) min for the median nerve and 82.5 (70–98) min for the ulnar nerve.

**COMMENT**

This study has demonstrated that MNAP generated by distal stimulation may be used as a guide to accurate needle placement on specific nerve trunks. The results were consistent and reproducible. The "pop" felt when the needle enters the neurovascular axillary sheath has often been described as a good indicator of correct needle placement. It was interesting to note that, on several occasions when a pop was felt, there were no discernible increases in MNAP. This probably indicated that the Pole needle may have been in the sheath but not necessarily close to the nerve trunk.

The accuracy of the placement of the block needle may potentially allow a reduction in the dose of local anaesthetic used without sacrificing the success of the block. We have demonstrated that an effective conduction block could be achieved by using a low dose of local anaesthetic. The reason for this was probably accurate needle placement. The sensory block obtained with 1% lignocaine 4 ml seemed to have been complete. The advantage of this method over a peripheral nerve stimulator is that it avoids direct stimulation of muscle, which may give false positive results [2], and avoids pain experienced by some patients either when the nerve trunk is stimulated directly [3] or if direct motor nerve stimulation causes muscle contraction at the site of injury. Development of simple apparatus to allow distal nerve or dermatomal stimulation and the detection of proximal MNAP should facilitate introduction of the technique into clinical practice.

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REFERENCES


