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Original Contribution

Shoulder position influences the location of the musculocutaneous nerve in the axillary fossa☆,☆☆

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Abstract In the axillary fossa, the musculocutaneous nerve (MC) is generally distant from the axillary artery and from the other brachial plexus nerves. In that way, MC requires a specific block.

We observed that the location of MC is influenced by the position of the patient's arm and shoulder. Abduction of the shoulder significantly reduced the distance between the MC and the axillary artery. This change in the location of the MC is probably due to the moving of the nerve because of muscle rearrangements and the ability to achieve better proximity of the probe in the axillary fossae.

1. Introduction

In the axillary fossa, the distribution of the terminal branches of the brachial plexus is well described. Median, ulnar, and radial nerves are located near the axillary artery (AA) in their specific quadrant [1–3]. The musculocutaneous (MC) nerve is usually located apart from the AA in between the biceps brachii muscle and the coracobrachialis muscle, at a mean distance of approximately 10 mm from the AA [1]. This spatial distribution of the 4 nerves relative to the AA results in the need for both multiple needle mobilizations and injections of local anesthetic when performing an axillary block (BAX). In that way, whatever the technique used for BAX (perineural or perivascular), a specific infiltration of MC nerve is required [4–6]. In an attempt to reduce the number of injections and needle mobilization during BAX placement, we have analyzed using ultrasound anatomy view the impact of forearm and arm positions over the shoulder on the relative position of the 4 nerves within the axillary fossa. We have observed that arm

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positions influenced the location of MC. We identified upper limb movements responsible for bringing the position of the 4 nerves of the brachial plexus closer in the axillary fossa.

The purpose of this study was to evaluate the impact of the relative position of the arm over the shoulder on MC location in the axillary fossa.

2. Materials and methods

The local ethics committee of our institution approved this study. All patients received an explanation of the procedures of the study and gave informed consent. Fifty consecutive adults patients (American Society of Anesthesiologists I-III), scheduled for an elective day-case surgery of the forearm under axillary block, were prospectively included in this observational evaluation.

Ultrasound location of nerves in the axillary fossa was achieved using a multifrequency linear matrix probe (ML 6-15 MHz; LOGIQ E9, GE Healthcare, Piscataway, NJ). Ultrasound sequences were performed for all patients lying supine in 3 successive positions (A, B, C: Fig. 1). In position A, the arm was abducted at 90°, and the forearm was in extension and the hand in supination. In position B, the arm was abducted at 90°, and the forearm was flexed over the arm with the hand touching the shoulder. In position C, the arm was abducted between 160° and 180°, and the forearm was flexed on the arm with the hand touching the occipital scalp.

In each position, the 4 nerves were identified dynamically by an up and down slide of the ultrasound probe from the axillary fossa to the elbow [7]. They were then located in the axillary fossa, with the ultrasound probe always maintained in the same predefined position: leaning against the major pectoralis muscle, perpendicularly to the arm, in the position used for axillary block placement.

In each position (A-B and C), a single image was recorded according to a number that only the anesthesiologists who performed the scan knew. For each image, the practitioner aimed at a good visualization of the MC nerve, the artery, and the median nerve.

After the images had been recorded by the anesthesiologist caring for the patient on the hard disk of the ultrasound device, 2 experts independent from the clinical case and unaware of the relative position of the arm and shoulder retrospectively analyzed each image for each position. MC-AA distance was calculated as the distance elapsing between MC and AA borders. Spatial MC position relative to the AA was identified within a 12-section pie chart (numbered from 1 to 12, starting at 12 o'clock) divided into 4 quadrants, with the AA as the central axis (Fig. 2). In order to analyze the impact of arm position upon MC-AA distance, a Student *t* test was used to compare the mean MC-AA distance ($P < .05$ significant). Values were expressed as mean ± SD and percentages.

3. Results

Twenty-five men and 25 women were included in this evaluation. The mean age was 45 years. Mean weight and mean height were 71 kg and 165 cm, respectively.

The 4 terminal nerves of the brachial plexus (median-ulnar-radial-MC) were identified and localized in 100% of patients by the anesthesiologist who scanned the patients.

AA, median, and MC nerves were easily located on the images by the 2 experts independent from the clinical case.

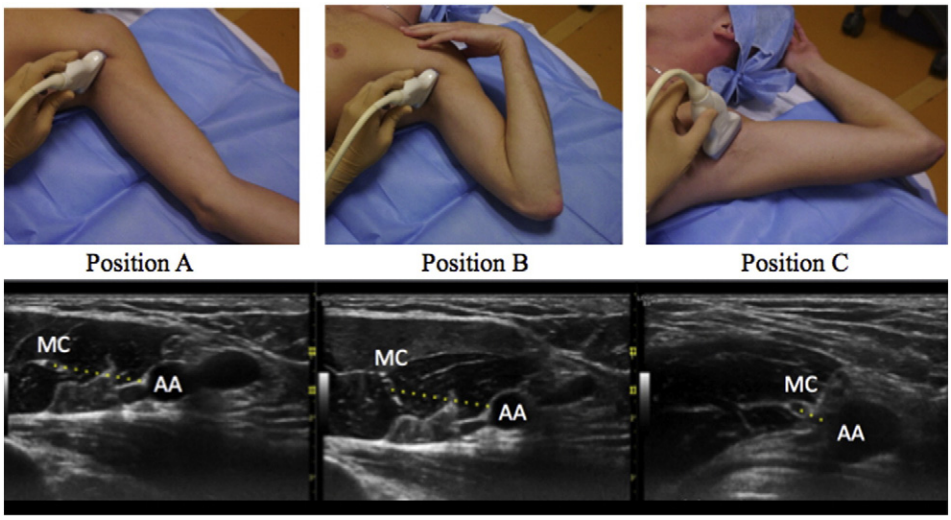

Fig. 1 Location of the MC in the 3 successive positions. Position A: the arm is abducted at 90°, and the forearm is in extension and the hand in supination; position B: the arm is abducted at 90°, and the forearm is flexed over the arm with the hand touching the shoulder; position C: the arm is abducted between 160° and 180°, and the forearm is flexed on the arm with the hand touching the occipital scalp. MC = musculocutaneous nerve; AA = axillary artery.