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CORRESPONDENCE

Brachial plexus block at the level of the humeral head: a proof-of-concept observational cadaver and clinical study

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To the Editor,

Brachial plexus blockade below the clavicle for hand and forearm surgery can be performed between the costoclavicular area and the axilla.[1] In a proof-of-concept study, we sought to examine the feasibility of blocking the brachial plexus at the level of the humeral head. We aimed to determine whether the branches of the plexus are clustered around the axillary artery in this area, and whether a block at this level could be effective. This approach may limit the number of needle redirections required[2] and reduce the risk of pleural puncture.[3]

Following study registration (ClinicalTrials.gov; NCT03653000) and approval from local ethics committees (Comité d'Ethique Hospitalo-Facultaire Universitaire de Liege, Liege, Belgium, number 707, reference 2017/139, 2017/140; Centre hospitalier inter-régional Edith Cavell Research Ethics Board, Brussels, Belgium, number: code EC 332, OM 157, 25-10-2017, reference B707201732660), we first conducted 3 cadaver dissections in the area anterior to the humeral head. Subsequently, we performed ultrasound-guided perivascular injections at this level in 20 patients undergoing hand or forearm surgery.

We placed two fresh cadavers supine with the arm in 90° of abduction and external rotation, and with the forearm flexed to 90°. We conducted two dissections after ultrasound scanning of the area and a third after ultrasound-guided injection of 20 mL of methylene blue, posterior to the axillary artery.

We performed ultrasound scanning with the probe placed on the pectoralis major muscle anterior to the humeral head in a sagittal orientation (Electronic Supplementary Material [ESM] eFig. 1a). The resulting

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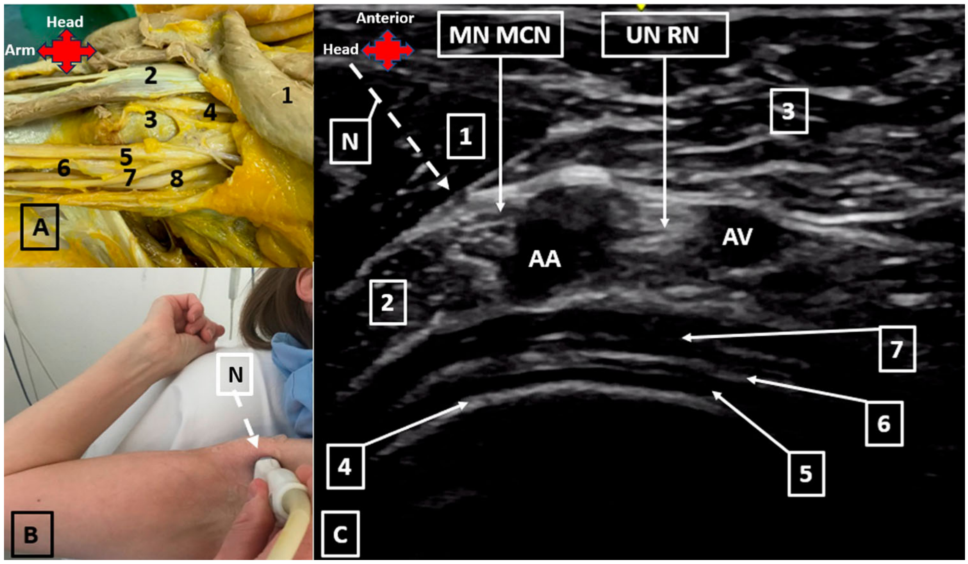

Figure (A) Complete dissection of the shoulder: 1) pectoralis major muscle, 2) coracobrachialis muscle, 3) the head of the humerus, 4) musculocutaneous nerve, 5) median nerve, 6) axillary artery, 7) ulnar nerve, and 8) radial nerve. (B) Position of the ultrasound probe on the head of the humerus and part of the pectoralis major muscle. (C) Ultrasound image of the brachial plexus at the level of the humeral head: 1) pectoralis major muscle, 2) coracobrachialis muscle, 3) fat, 4) cortical bone, 5) cartilage, 6) surface of the cartilage, and 7) the subscapularis muscle.

AA = axillary artery; AV = axillary vein; MCN = musculocutaneous nerve; MN = median nerve; N = needle; RN = radial nerve; UN = ulnar nerve

image showed three layers: the cortical bone, the cartilage layers of the humeral head, and the fascia of the subscapularis muscle. The neurovascular structures lay superficial to the fascia of the subscapularis muscle (ESM eFigs 1b and 1c).

Dissection confirmed that the neurovascular structures anterior to the humeral head were grouped together and surrounded by fibro-fatty connective tissue. These structures were bound anteriorly by the fascia and by the aponeurosis of the pectoralis major muscle, and posteriorly by the fascia of the subscapularis and coracobrachialis muscles (Figure A and ESM eFig. 2a).

The third dissection showed that adipose and connective tissues were stained with methylene blue, together with all four main terminal branches of the brachial plexus; the ulnar nerve showed less staining than the other three. Interestingly, we did not observe any spread inside the muscles (ESM eFig. 2b).

After obtaining informed consent, we subsequently enrolled 20 patients scheduled for hand, forearm, and elbow surgery (ESM eTable) in an observational study. We positioned the ultrasound probe as we did in the cadaver study (Figure B). Using ultrasound guidance, we inserted an 80-mm 22G needle in a cephalocaudal direction until it penetrated the posterior fascia of the pectoralis major muscle (Figure C). We injected 1.5% lidocaine with 1:400,000 epinephrine around the artery until the nerves were visibly surrounded. The mean (standard deviation [SD]) volume of local anesthetic to achieve this was 20 (3) mL. The approach produced surgical blockade in 17/20 (85%) patients. Ulnar nerve blockade was incomplete in 3/20 (15%) patients who needed supplementary sedation. The mean (SD) time required to perform the block was 7 (2) min. The mean (SD) onset times of sensory and motor blockade were, respectively, 8 (5) and 10 (6) min for the musculocutaneous nerve, 8 (5) and 11 (5) min for the median nerve, 9 (6) and 12 (7) min for the ulnar nerve, and 9 (5) and 10 (6) min for the radial nerve. We noticed one vascular puncture and three episodes of radial paresthesia during the procedures without any significant sequelae.

In summary, in this proof-of-concept observational cadaver and clinical study, we describe an ultrasound-guided brachial plexus block approach anterior to the humeral head. We cannot guarantee the safety of this approach given the small sample size. Our experience suggest this approach as a potentially suitable site for continuous nerve blockade. Nevertheless, further studies are required to compare this approach with other ultrasound-guided brachial plexus block techniques, including the other infraclavicular approaches and axillary brachial plexus blockade.

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