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CORRESPONDENCE

Characteristics of a single versus multiple-injection axillary brachial plexus block

A single-blinded randomised, clinical trial

Sina Grape, Kyle Kirkham, Sébastien Bloc and Eric Albrecht

From the Department of Anaesthesia, Valais Hospital, University of Lausanne, Sion, Switzerland (SG), Department of Anaesthesia, Toronto Western Hospital & University of Toronto, Toronto, Ontario, Canada (KK), Department of Anaesthesia, Centre Médico-Chirurgical Ambroise Paré, Neuilly-sur-Seine, France (SB), and Department of Anaesthesia, University Hospital of Lausanne, University of Lausanne, Lausanne, Switzerland (EA)

Correspondence to Sina Grape, MD, MBA, Department of Anaesthesia and Intensive Care Medicine, Valais Hospital, Av Grand-Champsec 81, 1951 Sion, Switzerland
Tel: +41 26 603 87 59; e-mail: sina.grape@hopitalvs.ch

Editor,

When performing an axillary brachial plexus block under ultrasound-guidance, reducing the number of needle passes decreases needling time, is associated with less paraesthesia and provides an equivalent success rate, as demonstrated in a recent systematic review and meta-analysis.[1] In that report, all included trials compared a four-injection technique, also called perineural injection, with a two-injection technique or perivascular injection.[1] During the four-injection technique, the radial, ulnar, median and musculocutaneous nerves are blocked separately with an equivalent volume of local anaesthetic. In contrast, during the two-injection technique, a higher local anaesthetic volume is administered with the needle tip positioned below the axillary artery with the goal of spread to the radial, ulnar and median nerves. The musculocutaneous nerve is then blocked with a second injection to account for its location distant from the axillary artery.[1]

However, the location of this latter nerve is dynamic, and when patients perform extreme abduction of the arm, the musculocutaneous nerve comes in close proximity to the axillary artery, due partly to muscle reorganisation.[2] This dynamic repositioning offers the potential advantage of blocking four nerves with a single-injection, rather than the previously described two-injection technique.[2]

Given the importance of procedural efficiency in the majority of clinical settings, we undertook this randomised, controlled, single-blinded trial from July 2018 to April 2019 (trial registration: Clinicaltrials.gov - NCT03378323) and tested the hypothesis that a single-injection technique has a shorter procedure time and is as effective as a multiple-injection technique for ultrasound-guided axillary brachial plexus block. This study was reviewed and approved by Lausanne University's Institutional Review Board 101 (Commission cantonale d'éthique de la recherche sur l'être humain, protocol number 2017–102 02185; approval granted 16 April 2018).The primary outcome was procedure time. Secondary outcomes were onset time and success rate 30 min after completion of the block procedure. After informed consent, 50 patients undergoing elective forearm or hand surgery under axillary brachial plexus block were randomly allocated on the day of surgery to either the single or multiple-injection group, and all completed the study.

For patients in the multiple-injection group, the ipsilateral arm was abducted 90°, with the elbow bent (Fig. 1). A cross-sectional ultrasound image of the axillary artery lying superficial to the conjoint tendon, and the radial, ulnar, median and musculocutaneous nerves was obtained. The block needle was inserted from a lateral-to-medial, in-plane with the ultrasound beam, and each of the aforementioned nerves was blocked separately with 8 ml of a 1 : 1 mixture of mepivacaine 1% and ropivacaine 0.5% (total volume 32 ml). In the single-injection group, the arm was positioned in extreme abduction from the patient's side at an angle of 160°, with the elbow bent and the hand under the head (Fig. 1). An ultrasound image of the axillary artery in short view was obtained, and the block needle was positioned below the axillary artery. The total 32 ml of mepivacaine 1% and ropivacaine 0.5% were injected in slow increments at this location. An assessment of both motor and sensory blockade was performed every 5 min for a 30-min period according to previously published criteria.[3] Patients were followed through the procedure, in recovery and 24 h postoperatively.

We found that procedure time was significantly reduced in the single-injection group, with a mean (95% CI) of 4 (4 to 4) min, versus 6 (5 to 6) min in the multiple-injection group ($P < 0.001$). Block success rates 30 min after the block procedure were 84% (95% CI: 64 to 95) and 96% (95% CI: 80 to 100) in the single and multiple-injection groups, respectively ($P = 0.16$). The four patients in the single and the one patient in the multiple-injection groups with failed blocks all received an uneventful supplemental peripheral nerve block. In the multiple-injection failure, the spared distribution occurred with the radial nerve. Time to onset of action was significantly longer in the single-injection group with a mean (95% CI)

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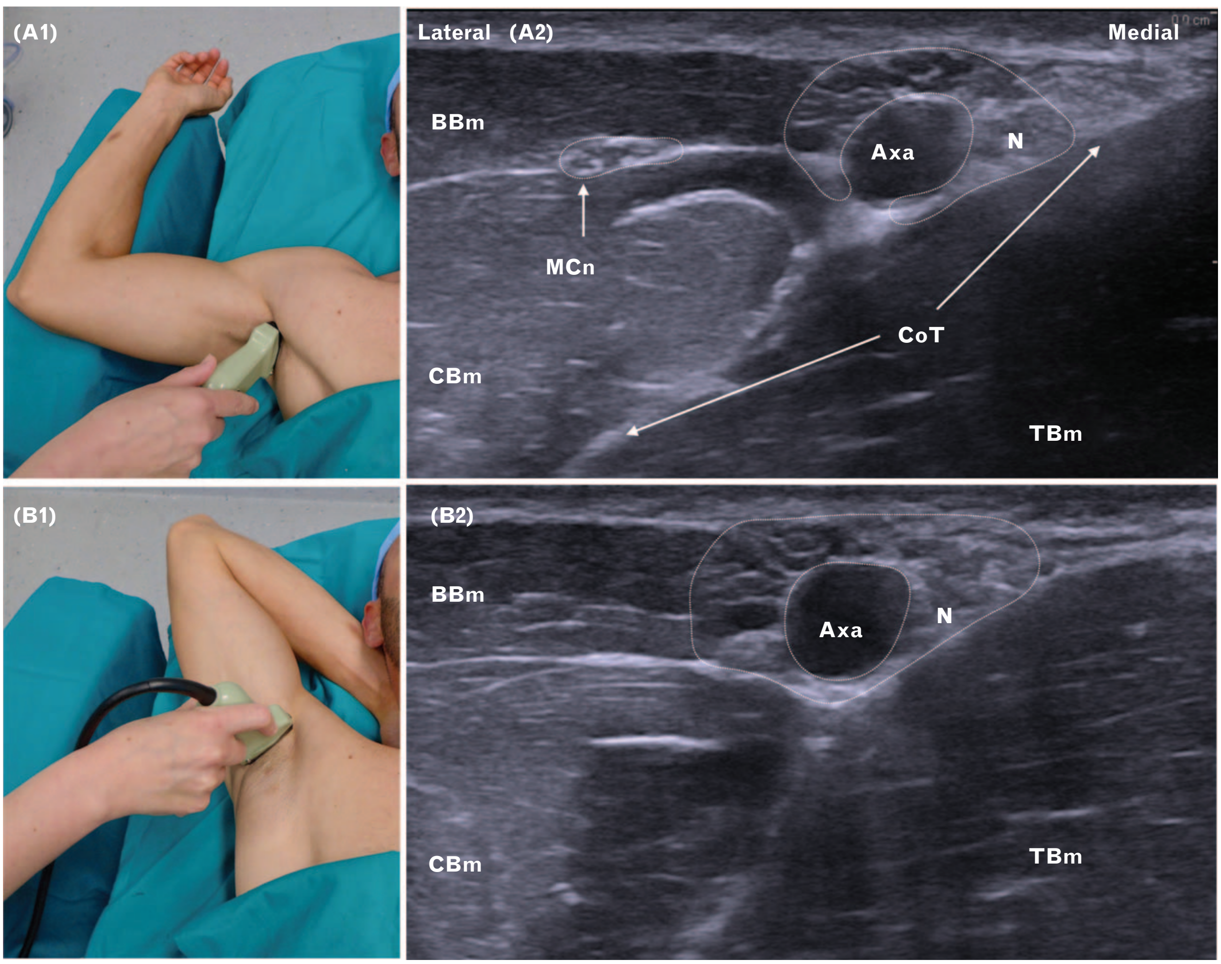
Fig. 1 Abduction of the arm with an angle of 90° (A1) and 160° (B1), along with the ultrasound-images of the axillary brachial plexus (A2, B2). The median, medial antebrachial cutaneous, ulnar, and radial nerves (N) surround the axillary artery (Axa). When the arm is abducted to 160°, the musculocutaneous nerves is part of this conglomerate of nerves. BBm, biceps brachii muscle; CBm, coracobrachialis muscle; CoT, conglomerate of conjoint tendon of the teres major and latissimus dorsi muscles; MCn, musculocutaneous nerve; TBm, triceps brachii muscle.



of 23 (19 to 27) min versus 17 (15 to 19) min in the multiple-injection group ($P = 0.01$).

These results suggest that a single-injection technique for the axillary brachial plexus block requires less needling time, but at the expense of a prolonged time to onset of action. However, we consider the practical implications and ease of the single-injection approach more clinically relevant than this small time difference. In situations wherein nerve imaging and identification is difficult, positioning the needle tip just below the axillary artery is easily achievable. Furthermore, reducing the number of needle passes has been shown to reduce the risk of needle contact with the target nerves,[4] and therefore may result in less paraesthesia or potential for neural injury.

The similar block success rate between groups at 30 min deserves consideration. Although our results suggest a trend to favour the multiple-injection group, the absence of statistical significant differences may represent a type II error. A posthoc analysis indicates that a total of 194 patients would be required to detect a difference with this outcome, with alpha and beta values of 0.05 and 0.2.

In conclusion, an axillary brachial plexus block performed with a subarterial single-injection technique is associated with a shorter procedure time, but increased time to onset of action. This technique allows adoption of a conservative approach to needle-nerve proximity. A trial with success rate as the primary outcome is warranted before reaching a final conclusion regarding the value of the single injection technique.

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Effect of working four night shifts on driving performance and risk behaviour in traffic of anaesthesiology residents

A cross-over study

Clemens Barends, Marleen Wever, Jaap Domburg, Götz Wietasch and Rients Huitema

From the Department of Anaesthesiology (CB, MW, JD) and Department of Neurology, University Medical Center Groningen, Groningen, The Netherlands (GW, RH)

Correspondence to Clemens Barends, Department of Anaesthesiology, University Medical Centre Groningen, Hanzeplein 1, PO Box 30.001, 9700RB Groningen, The Netherlands
E-mail: c.r.m.barends@umcg.nl

Editor,

Residents training to become medical specialists work night shifts on a regular basis. The accompanying sleep–wake pattern has detrimental effects on cognitive functions and task performance.[1,2] These effects extend beyond the performance of clinical tasks and also influence daily activities after working hours, such as traffic participation.

A recent study of Huffmyer *et al.*[1] has shown evidence of decreased driving performance after working six consecutive night shifts. In the University Medical Center Groningen, the Netherlands, however, anaesthesiology residents work no more than four consecutive, 10-h night shifts. This roster is compliant with the 2003 European Working Time Directive[3] which aims to protect employees against the detrimental effects of extended and irregular working hours. Our residents nevertheless frequently express feeling less alert and unsafe to drive home after these four night shifts. These reports, coupled with Huffmyer's results prompted us to investigate whether our four night shift roster also decreases cognitive function and driving performance.

We investigated whether driving a motor vehicle after four consecutive night shifts was less safe compared with driving after a normal week without night shifts. The study was approved by the Institutional review Board (METc- 2017/261, Prof W.A. Kamps, 6 June 2017). Twenty residents participated in a cross-over study of two sessions with identical tests. One session was scheduled before their normal day shift (day shift condition, DSC), the other session after four consecutive night shifts (night shift condition, NSC). The sessions consisted of three tests: first, a validated test of perceptual speed (the Adaptiver Tachistoskopischer Verkehrsauffassungstest)[4]; second, a 25-min monotonous test drive investigating vigilance by measuring swerving from the midline of the road [the SD from the lateral position (SDLP)]; and third, a risk behaviour test measuring the driving speed (mean ± SD in km h^{-1}) after participants had been given an incentive to increase their speed. All driving tests were taken in a driving simulator used normally to assess medical fitness to drive. Participants were asked to fill in a questionnaire measuring subjective sleepiness and alertness using a visual analogue scale-scale, both before and after the tests to minimise bias. We analysed the results using repeated measures Analysis of Variances. In total, 17 residents completed all study procedures, mean age ± SD of participants was 31 ± 3,4; six of the participants were male.

Participants reported higher alertness before (7.25 ± 0.96) and after the DSC-session (7.57 ± 1.0) compared with before (4.93 ± 1.4) and after (4.6 ± 1.5) the NSC-session [F(1, 14) = 75.72; P < 0.001]. Reported sleepiness before (3.4 ± 1.7) and after (3.3 ± 2.1) the DSC-session was lower compared with before (6.1 ± 1.9) and after (6.9 ± 1.7) the NSC-sessions [F(1, 14) = 16.10; P = 0.001]. Conversely, and surprisingly, there was no difference in perceptual speed between DSC and NSC (55.95 ± 7.51 vs. 55.71 ± 7.01, respectively; P = 0.91).

Although vigilance decreased as the test drive progressed (SDLP increased from 19.4 ± 3.7 to 21.8 ± 6.9 for DSC and from 19.3 ± 4.2 to 21.8 ± 5.5 for NSC, with a significant linear trend [F(1, 16) = 5.91; P = 0.027)] we found no effect of whether participants drove in the DSC or the NSC [F(1, 16) = 0.07; P = 0.98]. In addition, the slopes of the linear trend lines of SDLP in DSC and NSC did not differ: (0.46 ± 1.27 vs. 0.73 ± 1.04, respectively; P = 0.35, Fig. 1). In other words, participants swerved more as the monotonous test drive progressed but this increase was not larger after night shifts. Furthermore, mean driving speed in the risk behaviour drive did not differ between both sessions: (101.31 ± 7.51 vs. 100.32 ± 13.07, respectively; P = 0.72).

From these results we conclude that after four consecutive night shifts our residents did not suffer from decreased perceptual speed or vigilance even though they reported being more sleepy and less alert. This