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Appendix A. Supplementary data

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Ultrasound-guided axillary brachial plexus block *versus* distal peripheral forearm nerve block for hand and wrist surgery: a randomised controlled trial

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Editor—Regional anaesthesia and local anaesthesia are increasingly recognised as the best options to provide anaesthesia for ambulatory hand and wrist surgery.[1] Ultrasound (US)-guided axillary brachial plexus block is one of the preferred techniques of most anaesthesiologists for distal upper extremity surgery.[2] Disadvantages of this technique include the risk of arterial puncture and slower onset compared with i.v. regional anaesthesia.[1] In recent years, a growing body of literature has investigated the potential of US-guided distal nerve blocks as a primary anaesthetic technique.[3,4] The main advantage of distal peripheral forearm nerve blocks is the preservation of motor function of the digits and the more proximal muscles.[5] Because of the large number of short procedures performed within the field of hand surgery, rapid turnover with reliable regional anaesthesia is required for optimal efficiency. However, block performance time and total anaesthesia-related time, focused on regional anaesthesia for hand surgery, have not been studied in an RCT. This observer-blinded, randomised controlled superiority trial was designed to compare US-guided axillary brachial plexus block and distal peripheral forearm nerve block in patients undergoing hand surgery and carpal tunnel release.

The detailed methods are included in the Supplementary material. Briefly, ethical approval (Ethics Committee of the Jessa Hospital, Hasselt, Belgium; B2432020000027), registration (ClinicalTrials.gov, December 16, 2020, NCT04678765), and written informed consent were obtained. The first subject was enrolled after approval of an amendment by the ethical committee of the Jessa Hospital on January 13, 2021. In total, 80 adult patients undergoing unilateral hand surgery (i.e. foreign body removal and abscess incision/drainage of the hand; trigger finger release; tendon repair; and Dupuytren's contracture release surgery, with exclusion of surgery on Digit I, finger amputation, and manipulation of Digits III, IV, and V) or carpal tunnel release with an ASA physical status of 1–3 were enrolled over 10 months from January to October 2021. Exclusion criteria included BMI $\geq$40 kg m^{-2}, puncture site infection, pre-existing peripheral neuropathy, chronic pain syndrome, diabetes mellitus, allergy to study medications, or coagulopathy. Participants were randomly assigned in a 1:1 ratio to US-guided axillary brachial plexus block or US-guided distal peripheral forearm nerve block using sealed envelopes. Nerve blocks were performed in a regional anaesthesia block room by a highly experienced anaesthesiologist.

Distal peripheral forearm nerve blocks were performed, as described by Jalil and colleagues,[3] and included a US-guided mid-forearm median and ulnar nerve block with a circumferential subcutaneous infiltration on the radial side of the wrist. Axillary brachial plexus blocks were performed similar to the method described by Tran and colleagues.[6] The primary superiority outcome was total anaesthesia-related time, defined as the sum of block performance time and block onset time.[6] Block performance time was defined as the time between the start and end of the block procedure, including imaging and needling time. Block performance time was recorded with two stopwatches by the attending block room nurse. Block onset time was defined as the time required to achieve a level of anaesthesia deemed adequate for the surgery (not necessarily a complete block). After block performance, a blinded study assistant entered the block room and performed sensory block measurements every 2 min to assess onset time. Sensory block of median and ulnar nerves was graded according to a 3-point scale using a cold test: 0=no block, 1=analgesia (feeling touch, not cold), and 2=anaesthesia (feeling no touch or cold).[6,7] Subjects were considered ready for surgery when overall sensory block score (the sum of the median score and ulnar score) of 3 out of 4 points was achieved.[7] The key secondary outcome was surgical block success rate (I=complete sensory block, II=incomplete surgical block with need of extra local anaesthetic, and III=unsuccessful block with conversion to general anaesthesia).[8] Patient satisfaction was evaluated using the Evaluation du Vécu de l'Anesthésie LocoRegionale (EVAN-LR) questionnaire.[9] Other secondary endpoints are described in the Supplementary material. Sample size was determined for the primary outcome. A time difference of 20% between groups was considered clinically significant.[6] The anaesthesia-related time of axillary brachial plexus block was estimated to be 25.5 (7.7) min. Assuming α=0.05 and power=0.80, the calculated sample size for each group is 36. To account for a possible 10% dropout rate, the sample size was increased to 80 subjects. Categorical group comparisons were performed using a χ^2 test or Fisher's exact test, as appropriate. For continuous data, normality was checked using the Shapiro–Wilk test. The Student *t*-test was used for group comparisons of normally distributed continuous data. Non-normally distributed data were analysed using the Mann–Whitney *U*-test.

In total, 111 patients were assessed for eligibility, of which 31 were excluded (Consolidated Standards of Reporting Trials [CONSORT] diagram and baseline characteristics in the Supplementary material). Total anaesthesia-related time (min:s) of the US-guided distal peripheral

Table 1 Primary and secondary outcomes. Data are expressed as mean (standard deviation) or as median [inter-quartile range]. A *P*-value <0.05 is considered statistically significant. EVAN-LR, Evaluation du Vécu de l'Anesthésie LocoRegionale; OR, operating room.

	Ultrasound-guided axillary nerve block (n=40)	Ultrasound-guided forearm nerve block (n=40)	P-value
Total anaesthesia-related time (min:s)	11:46 (04:17)	07:29 (03:24)	<0.001
Needling time (min:s)	03:02 (00:41)	02:21 (00:37)	<0.001
Performance time (min:s)	03:28 (00:46)	02:44 (00:37)	<0.001
Onset time (min:s)	08:18 (04:08)	05:57 (05:38)	0.03
Surgical block success, *n* (%)			0.17
I	29 (72.5)	34 (85.0)	
II	11 (27.5)	6 (15.0)	
III	0 (0.00)	0 (0.00)	
Total OR time (min)	26 (6)	27 (4)	0.70
Tourniquet time (min)	11 (4)	13 (7)	0.53
Surgical time (min)	8 (4)	10 (6)	0.24
Patient satisfaction (EVAN-LR)			
*Information	55.0 [28.8]	50.0 [15.0]	0.12
*Attention	62.5 [37.5]	56.2 [25.0]	0.30
*Discomfort	100.0 [12.5]	93.8 [23.4]	0.12
*Pain	100.0 [6.2]	93.8 [12.5]	0.08
*Waiting	100.0 [25.0]	100.0 [25.0]	0.97
*Global	80.0 [13.5]	77.50 [14.6]	0.11
Surgeon satisfaction	6.0 [1.0]	6.0 [1.50]	0.16
Postoperative medication	25 (62.5%)	28 (70.0%)	0.64

forearm nerve block was significantly shorter compared with US-guided axillary brachial plexus block (07:29 [03:24] *vs* 11:46 [04:17]; $P<0.001$) (Table 1). Surgical block success rate was not significantly different between groups (Table 1). Incomplete block with need of additional local anaesthesia during surgery was observed in 11 subjects (27.5%) after US-guided axillary brachial plexus block *vs* six subjects (15.0%) after US-guided distal peripheral forearm nerve block ($P=0.17$). Conversion to general anaesthesia was not observed in either treatment group. Secondary outcomes are presented in Table 1. The US-guided axillary brachial plexus block was associated with less regional anaesthesia procedural pain (3.0 [3.0] *vs* 4.0 [3.8]; $P=0.03$) but more pain during surgical incision (2.0 [5.0] *vs* 0.0 [2.5]; $P<0.01$) compared with US-guided distal peripheral forearm nerve block. No differences in pain experience were observed between groups at other time points (Supplementary Fig. 3).

In line with our results, Soberón and colleagues[10] reported a faster onset time of sensory block in the distal peripheral forearm nerve block group compared with different types of proximal brachial plexus nerve blocks, including US-guided supraclavicular, infraclavicular, or axillary block. No unequivocal explanation can be found for the faster onset times after US-guided forearm block compared with axillary block. It can be hypothesised that it is attributable to the alternating thickness of the epineurium and the nerves themselves along their course because the thickness of both epineurium and nerve decreases from proximal to distal, which could facilitate the penetration and diffusion of the local anaesthetic into the nerve more distally.

In conclusion, our data suggest that US-guided distal peripheral forearm nerve block is superior compared with US-guided axillary brachial plexus block in reducing total anaesthesia-related time.

Declaration of interest

The authors have no conflicts of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bja.2023.03.020.

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Use of hand sanitiser as a potential substitution for nonsterile gloves in reducing carbon emissions

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