Regional infraclavicular blocks via the coracoid approach for below-elbow surgery: a comparison between ultrasound guidance with, or without, nerve stimulation

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Abstract

This randomised, observer-blinded study compared brachial plexus infraclavicular block under ultrasound guidance with, or without, nerve stimulation, for patients undergoing below-elbow surgery.

Sixty-six patients, aged 18-70 years, with American Society Anesthesiologists' status I, II or III, were randomised into two groups. Brachial plexus infraclavicular block achieved success rates of 76% in the ultrasound guidance without nerve stimulation group and 82% in the ultrasound guidance with nerve stimulation group, but was not significantly different (p-value 0.55). Block supplementation rates were 18.2% in the ultrasound guidance without nerve stimulation group vs. 12.2% in the ultrasound guidance with nerve stimulation group (p-value 0.55), resulting in 100% of the ultrasound guidance without nerve stimulation group reaching complete successful block, compared to 97% of the ultrasound guidance with nerve stimulation group. The mean performance time was significantly shorter in the ultrasound guidance without nerve stimulation group compared to the ultrasound guidance with nerve stimulation group (8.9 ± 3.9 minutes and 14.7 ± 3.3 minutes, respectively, p-value 0.001). Block onset time was 24.39 ± 4.3 minutes and 21.51 ± 2.4 minutes for the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively. The block onset time was significantly different between the groups (mean difference of 2.88, p-value 0.023). However, there was no difference in the time to readiness for surgery or surgical analgesia between the groups: ultrasound guidance without nerve stimulation (33.3 ± 8 minutes), and ultrasound guidance with nerve stimulation (36 ± 6 minutes) (p-value 0.09). Patients' satisfaction was 93.9% vs. 87.9% in the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively (p-value 0.39). In this study, the use of ultrasound guidance alone for brachial plexus infraclavicular block provided rapid performance and yielded a high success rate without the aid of a nerve stimulator.

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Introduction

Brachial plexus infraclavicular block is a safer technique than the supraclavicular approach for below-elbow surgery, but appears to be less popular because of the difficulty in palpating the surface landmarks, thereby hindering an accurate approach to the brachial plexus. Numerous modification of the technique, based on various factors, such as anatomical landmarks, single or multiple injections, and eliciting paraesthesia by nerve stimulation, have been attempted to improve the success of this block. MacLennan, in a review article, and more recently, a meta-analysis by Abrahams, Aziz, Fu and Horn showed that the ultrasound guidance without nerve stimulation technique has become the new gold standard for improved success.[1-4]

Peripheral nerve block, performed under ultrasound guidance, has many advantages. It enables the anaesthetist to localise the nerve bundle and its adjacent structures in real-time visualisation. More importantly, it secures an accurate needle position and provides visual confirmation of the distribution of the injected local anaesthetic. This results in improved quality of nerve block, shortens the latency of block performance, and reduces the required local anaesthetic volume and the risks of intraneural and intravascular injection, as well as those pertaining to pleural puncture.[5] Soeding et al reported that ultrasound guidance had significantly improved the onset and completeness of sensory and motor blocks, when compared to the immobile needle, single-injection technique with nerve stimulation.[6]

Many studies have shown that ultrasound guidance without nerve stimulation-guided infraclavicular block via the coracoid process is an attractive approach, providing an excellent block.[5,7-11] The anatomical location of the nerve cords, namely the medial, lateral and posterior cords, are arranged in relation to the axillary artery, thus making this approach easy and effective. Furthermore, when compared to the mid-clavicular approach (Raj approach), the coracoid approach is associated with a lower risk of respiratory complications.[5,9,11]

Factors which make this block more difficult include poorly defined surface landmarks in an obese patient, palpating for arterial pulsation, elicitation of an appropriate motor response and the patient's inability to tolerate discomfort from muscle twitches induced by the electrical current. A successful nerve stimulation-guided infraclavicular block is dependent on obtaining a distal motor response from the nerve stimulation, which may be difficult in 5-21% of patients.[5,12] This study compared ultrasound-guided brachial plexus infraclavicular block with the combined technique of ultrasound guidance with nerve stimulation for the brachial plexus infraclavicular block in terms of performance time, success rate and occurrence of complications.

The aim of this study was to compare ultrasound-guidance, with, or without, nerve stimulation, in terms of ability to alleviate fear of complications and discomfort due to neurostimulation, as well as compare success rates with minimal performance times and greater patient satisfaction.

Method

This study was a prospective, randomised, single-blinded study, carried out in the operation theatre of the University Kebangsaan Malaysia Medical Centre (UKMMC) from May 2010 until August 2011. After obtaining approval of protocol from the Dissertation Committee, the Department of Anaesthesia and Intensive Care and the Medical Research and Ethics Committee, UKMMC (Approval code: FF-167-2010), 66 patients, aged 18-70 years with American Society of Anesthesiologists' status I, II or III, scheduled for below-elbow surgery (either elective or semi-emergency cases), were recruited. Patients who had clinically significant coagulopathy, a local skin infection, an allergy to local anaesthetic, a body mass index greater than 35 kg/m^2 and with known neuropathies, were excluded. Block randomisation was performed by using a list of random numbers, with varying block sizes for six patients. Sealed envelopes that revealed group allocation were opened immediately before the block was performed. Patients were randomised into two groups. The ultrasound guidance without nerve stimulation group received brachial plexus infraclavicular block using ultrasound guidance alone, and the ultrasound guidance with nerve stimulation group comprised patients who received a brachial plexus infraclavicular block using ultrasound guidance with nerve stimulation.

After written informed consent was obtained, both groups of patients proceeded to undergo brachial plexus infraclavicular block. Information on the study was explained. The block was performed using the SonoSite® ultrasound machine (SonoSite, Washington, USA) and a 7.5-MHz fixed frequency linear ultrasonic scanning probe. In order to reduce operator bias, a single operator performed the procedure, while other independent medical personnel assessed the progress of the block. This operator was a postgraduate trainee who had been taught to perform this block under supervision by a staff regional anaesthetist prior to this study.

Preoperative assessment included a full medical history, a physical examination, and investigations as indicated. The patient was placed in the supine position, with the head turned away from the hand that was to be blocked. Standard monitoring was applied. An intravenous cannula was secured on the non-operated hand and connected to normal saline drip. The hand to be blocked was placed by the side of the body with the wrist resting on the abdomen and the elbow flexed. Prior to this block, the patient received intravenous midazolam 1-2 mg and intravenous fentanyl 25-50µg, titrated to the appropriate level of sedation. In this study, a standardisation of a premixed local anaesthetic cocktail consisting of 30 ml of levobupivacaine 0.5% and 10 ml of lignocaine 2% was made. Each patient received up to 0.5 ml/kg of this cocktail for the initial and additional blocks, not exceeding a maximum of 30 ml. An insulated stimulating needle (22 G Stimuplex® needle) was used to perform the block.

A pre-scan was performed in both groups prior to aseptic preparation. The time taken for this was not included in the procedure time. The depth of axillary artery perpendicular to the skin surface was measured. The Stimuplex® needle, either A100 (100 mm) or A50 (50 mm) in length, was selected based on this depth (A50 is a depth equal to, or less than, 3 cm. A100 is a depth of more than 3 cm). Subsequently, aseptic technique, including a skin scrub with chlorhexidine 0.5% solution, a sterile transducer cover (Opsite®) and a sterile ultrasonic gel (Cathejell™) were prepared, and then the infraclavicular area was draped. Skin infiltration using lignocaine 2% approximately 2-3 ml was given prior to the introduction of the Stimuplex® needle.

In the ultrasound guidance without nerve stimulation group, under direct visualisation and using the in-plane technique, the neurovascular bundle was visualised in the parasagittal plane, just medial to the coracoid process in the lateral infraclavicular region. The probe was further adjusted to obtain a good cross-sectional view of the axillary artery as it

passed under the pectoralis muscles, with the possibility of viewing all of the cords in relation to the artery, including the medial, lateral and posterior sides. The Stimuplex® needle was advanced in a caudal direction, and posteriorly towards the neurovascular structures. As a safety precaution, the whole needle length was viewed throughout the procedure and the bevel was pointed superiorly. A definite attempt to identify the brachial plexus was not considered to be necessary. After having confirmed the target site with the needle positioned posterior to the axillary artery, the local anaesthetic was slowly administered in 5 ml aliquots, with frequent aspiration to ensure safety. This technique of local anaesthetic deposition, limited to a maximum of three redirections of the needle, produced an appropriate spread of the local anaesthetic in a U-shaped distribution around the axillary artery.[7]

In the ultrasound guidance with nerve stimulation group, a nerve stimulator (Stimuplex® HNS 11, B Braun Melsungen, Bethlehem, Germany) was used. Ultrasound image visualisation was only used to target the location of the axillary artery. Subsequently, the Stimuplex® needle was connected to the nerve stimulator that was programmed with a frequency of 1 Hz and 0.1 ms stimulation. The needle was advanced superiorly to the axillary artery, and then redirected inferiorly if a response was obtained with nerve stimulation. When a distal motor response was obtained, as described by Borgeat, Ekatodramis and Dumont,[12] the intensity of the current was then progressively reduced from the initial 1 mA to 0.4 mA. Subsequently, the entire dose of the local anaesthetic was deposited in fractionated amounts with multiple aspirations. The procedure was abandoned if the time to obtain the distal motor response exceeded more than 20 minutes, and the case was then considered to be a failure. The performance time, which was defined as the duration between the time to localise the neurovascular bundle under ultrasound guidance and the time to complete administration of the local anaesthetic, was recorded.

An independent observer assessed the blocks for both sensory and motor components at five-minute intervals for 30 minutes. The progress of sensory and motor block specific to each of the terminal nerves (median, radial, ulnar and musculocutaneous) was recorded. Sensory block was assessed as loss of cold sensation to ice cube application at the region of sensory supply of each nerve, with the same stimulus delivered to the contralateral side.[7,15] The following scale was used to assess the sensory block: 1 = a sensation in response to the cold, 2 = a lesser degree of cold compared to that on the contralateral side, 3 = no recorded cold sensation. Motor block was evaluated using forearm flexion, wrist extension, thumb and index finger opposition, thumb and little finger opposition (for the musculocutaneous, radial, medial and ulnar nerves, respectively), and scored as the following scale: 1 = normal muscle power, 2 = reduced power compared to that on the contralateral side, 3 = loss of muscle power. Complete block was defined as the presence of complete sensory block in all four nerve distributions and complete motor block in the distribution of at least three of the four nerves.

The onset time, defined as the duration between the time to complete administration of the local anaesthetic to the point of onset of a complete block, was recorded. Readiness for surgery was defined as the performance time plus onset time. Thirty minutes after completion of administration of the initial local anaesthetic, any patient with inadequate block was managed with additional or supplemental regional anaesthesia, such as skin infiltration with a local anaesthetic, individual nerve block and mid-forearm block, with the same local anaesthetic mixture for the brachial plexus block (5 ml for each nerve). If block failure was confined to a single nerve distribution, supplemental nerve block, with the same local anaesthetic mixture used for the brachial plexus block (5 ml for each nerve) was performed. If successful, operation was allowed. However, if more than two nerves were inadequately blocked, general anaesthesia with spontaneous breathing was then given.

Postoperatively, the patient was monitored routinely in the recovery room and assessment for pain was carried out using a simple scale of either: 1 = no pain or 2 = tolerable pain or intolerable pain. Intravenous analgesia (morphine 0.1 mg/kg) was given if the patient had intolerable pain, in which case reginonal anaesthesia was considered to have been a failure. Any local swelling, haematoma at the injection site or the presence of a urticarial rash were also recorded. The patient was discharged to the ward after 30 minutes observation in the recovery room. Twenty-four hours post-block, the patient was reassessed for any residual numbness or weakness, as well as the above mentioned complications. The patient's satisfaction was assessed and choice of anaesthesia for future surgery recorded as "yes", "no" or "uncertainty".

Using power and sample size calculator, PS2®,[13] and based on the α value of 0.05 and β value of 0.2, a sample size of 33 patients in each arm was required from the study by Dingemans et al.[7] The IBM® Statistical Package for Social Sciences® version 20 was used for statistical analysis. Continuous data were presented as mean (± standard deviation) and median (range) for not normally distributed variables. Categorical variables were presented as number and percentage. Continuous variables were analysed using Student's t-test. Categorical variables were scrutinised using the Mann-Whitney U test or the chi-square test, χ^2. A p-value of less than 0.05 was considered to be statistically significant (p-value < 0.05).

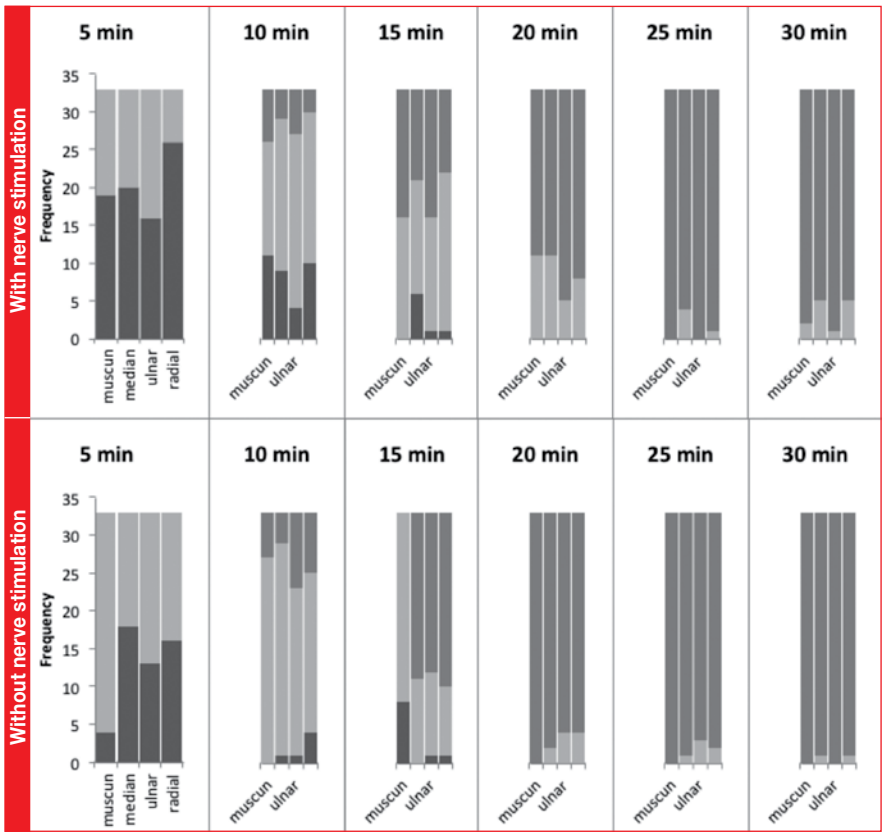
Results

A total of 66 patients were analysed, with 33 patients in each group. One patient who underwent two different surgeries at different times was recruited twice. Eleven patients were categorised as obese (body mass index > 30 kg/m^2). These comprised 12.1% and 21.2% from the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively. The two group's demographic data and surgical procedures were compared (Table I).

Continuous values expressed as mean ± standard deviation and number with percentage in parentheses

Figure 1 shows the progression of sensory test scores for all four nerves dermatome, including the musculocutaneous, median, ulnar and radial in both groups over 30 minutes. Almost 50% of patients had sensory block in all territories within 15 minutes, but the onset time was slower in median and radial nerve distribution for the ultrasound guidance without nerve stimulation group. Sensory block was almost complete in both groups for all territories at 30 minutes, with the exception of one patient in each respective group where there was failure of sensory block in the median nerve distribution. In addition, another four patients in the ultrasound guidance without nerve stimulation group, and one patient in the ultrasound guidance with nerve stimulation group, had inadequate or partial block in the radial nerve distribution. The progression of motor block paralleled that of the sensory block.

Figure 2 shows the comparison of performance time, onset time and time of readiness for surgery of the two groups. The mean performance time was 8.9 ± 3.9 minutes and



Min: minutes, Muscul: Musculocutaneous

Figure 1: Evaluation of sensory block after administration of the local anaesthetic. *Top:* Ultrasound guidance with nerve stimulation group. *Bottom:* Ultrasound guidance without nerve stimulation group

Table I: Demographic data and type of surgery

Description	Ultrasound guidance without nerve stimulation group n = 33, (%)	Ultrasound guidance with nerve stimulation group n = 33, (%)
Ethnicity		
Malay	13 (39.4)	20 (60.6)
Chinese	10 (30.3)	4 (12.1)
Indian	3 (9.1)	5 (15.2)
Others	7 (21.2)	4 (12.1)
Age (year)	38.8 ± 12.5	34 ± 13.8
Sex		
Male	28 (84.8)	25 (75.8)
Female	5 (15.2)	8 (24.2)
ASA status		
I	25 (75.8)	26 (78.8)
II	8 (24.2)	5 (15.1)
> II	0	2 (6.1)
Body mass index	24.5 ± 4.5	25.9 ± 7.1
Type of surgery		
Superficial surgery or tendon repair	13 (39.4)	9 (27.3)
Metacarpal or finger	6 (18.2)	5 (15.2)
Wrist, distal radius or ulnar	11 (33.3)	16 (48.5)
Elbow, proximal and midshaft radius or ulnar	3 (9.1)	3 (9.1)

ASA: American Society of Anesthesiologists

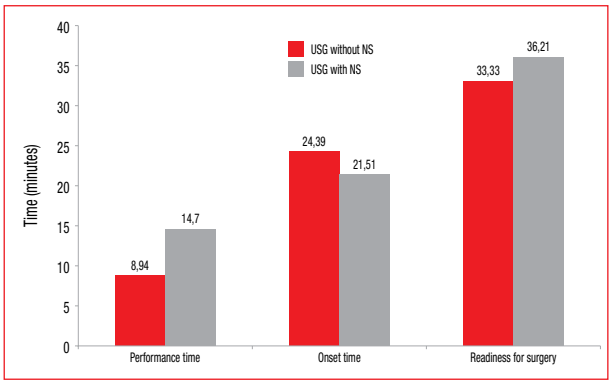


Figure 2: Performance time, onset time and time of readiness for surgery

14.7 ± 3.3 minutes for the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively (p-value 0.001). Block onset time was 24.39 ± 4.3 minutes and 21.51 ± 2.4 minutes for the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively. The block onset time was significantly different between the groups (mean difference of 2.88, p-value 0.023). There was no significant difference in time to readiness for surgery for the ultrasound guidance without nerve stimulation group (33.3 ± 8 minutes) and the ultrasound guidance with nerve stimulation group (36 ± 6 minutes) (p-value 0.09). Stimuplex® needles used were A50 in 40 patients and A100 in 26 patients.

During insertion, the needles were observed to be angled posterior to the frontal plane, with inclination ranging from 30-60 degrees from the skin plane. The depth from the skin to the axillary artery ranged from 2-5 cm, with the median being 3 cm.

Block success, block failures, need for supplementary analgesia and general anaesthesia are shown in Table II. Overall success, including supplemental analgesia, was achieved within 30 minutes in 100% of the ultrasound guidance without nerve stimulation group, compared to 97% in the ultrasound guidance with nerve stimulation group, without a statistically significant difference. The success rate of the brachial plexus infraclavicular block alone using ultrasound guidance without nerve stimulation was 76%, compared to 82% in the group that was aided by nerve stimulation (the ultrasound guidance with nerve stimulation group). In the ultrasound guidance without nerve stimulation group, six patients (18.2%) required supplementation (three local anaesthetic infiltration and three peripheral nerves blocks). None of the patients had total block failure. Conversely, in the ultrasound guidance with nerve stimulation group, four patients (12.2%) required supplementation (two local anaesthetic infiltration and two peripheral nerves blocks). One patient had total block failure, where no response was obtained with distal stimulation over a period of 20 minutes, and needed general anaesthesia. Of the patients who required supplementation or needed a general anaesthetic, the causes included a patchy block or failure to block one of the nerve dermatome, namely the radial (four), ulnar (four) and median (two) nerves.

Upon needle placement, blood was aspirated in two patients (6.1%) from the ultrasound guidance with nerve stimulation group. Subsequently, only one patient (3%) from the ultrasound guidance with nerve stimulation group had local swelling at the puncture site, but no haematoma was observed. At 24 hours post-block in the ultrasound guidance without nerve stimulation group, two patients (6.1%) experienced paraesthesia, of whom one patient (3%) had persistent numbness, compared to four patients (12.1%) who experienced paraesthesia in the ultrasound guidance with nerve stimulation group. None had Horner's syndrome, phrenic nerve block or pneumothorax.

Patient satisfaction with the brachial plexus infraclavicular block was 93.9% and 87.9% in the ultrasound guidance without nerve stimulation group and the ultrasound guidance with nerve stimulation group, respectively. There was no significant difference (p-value 0.64) between the two groups. Only 66.7% in the ultrasound guidance with nerve stimulation group, as compared to 72.7% in the ultrasound guidance without nerve stimulation group, would choose regional anaesthesia or the peripheral nerve block again in the future.

Table II: Block success, failure and supplemental block

Type of anaesthesia		Ultrasound guidance without nerve stimulation group (n = 33)	Ultrasound guidance with nerve stimulation group (n = 33)
Successful regional anaesthesia	Yes	33 (100)	32 (97)
	No	0	1 (3)
Supplemental analgesia	No supplement	25(75.8)	27(81.8)
	Local infiltration	3 (9.1)	2 (6.1)
	Other form of block	3 (9.1)	2 (6.1)
	General anaesthetic without additional analgesia	2 (6.1)	1 (3.1)
	General anaesthetic with additional analgesia	0	1 (3)

Discussion

In this study, both groups depended on ultrasound to guide needle placement with, or without, additional nerve stimulation. Block success was achieved if there was visualisation of the U-shaped spread of local anaesthetic around the axillary artery (the ultrasound guidance without nerve stimulation group), or the presence of a distal motor response to the nerve stimulation (the ultrasound guidance with nerve stimulation group).[1,7] With 66 patients studied, we found that brachial plexus infraclavicular block via the coracoid approach, obtained by ultrasound-guidance alone could provide an effective and successful block, similar to that achieved using combined ultrasound guidance with nerve stimulation for below-elbow surgery.

The infraclavicular block that was performed under ultrasound guidance alone took a significantly shorter time than that taken using nerve stimulation. This is consistent with the findings of previous studies.[14-16] In the present study, the success rate of brachial plexus infraclavicular block aided by nerve stimulation (the ultrasound guidance with nerve stimulation group) without supplemental analgesia was 82%. This was relatively lower than that in previously published studies on peripheral nerve block.[7,17] The success rate in the ultrasound guidance without nerve stimulation group was only 76%, lower than that in previous studies.[6,7,14] These differences are the result of variations in the technique of local anaesthetic deposition, operator experience, bias and varying definitions of a successful block. They might also have been the effect of several factors relating to the operator, ultrasound machine and patient characteristics. In the beginning, the operator was inexperienced and starting to learn the skill of handling the ultrasound machine, and the block was performed cautiously in order to avoid complications. Consequently, the performance time was longer, compared to that in previous studies in which the operators were either staff anaesthesiologists or subspecialists in the field of regional anaesthesia. A different type of ultrasound guidance without a nerve stimulation machine and a smaller probe may have contributed to technical difficulties, thus also being a factor in prolonged performance time, as well as delayed readiness for surgery. In order to reduce the confounding bias, a single operator was involved in performing the block, whose experience was controlled and equal in both groups. Our evaluation of sensory and motor block was achieved using independent, blinded observers. This may also have introduced inter-observer variation. It would appear that adequate training and experience in ultrasound scanning is very important in achieving desired results.

Koscielniak-Nielsen reviewed 20 studies relating to peripheral nerve block under ultrasound guidance.[3] He concluded that ultrasonographic visualisation of nerves and the adjacent anatomical structure was affected by the abovementioned factors. Similarly, direct visualisation of the needle advancement in real time and assessment of the local anaesthetic spread around the nerve bundle were also affected by similar factors.[5]

When compared to a study carried out by Dingemans, Williams and Arcand,[7] and Sauter et al,[8] our study reported a longer onset time, time to complete block and also time to readiness for surgery. Previously, Sandhu and Capan suggested six redirections of the needle surrounding the artery in order to cover the cords to yield a good block.[10] Our study was designed to avoid multiple injections in patients from the ultrasound guidance without nerve stimulation group, in order to reduce the performance time. Dingemans, Williams and Arcand described a U-shaped distribution of local anaesthetic deposition around the posterior, medial and lateral aspects of the axillary artery, which reliably produced a good quality brachial plexus block.[7] Bloc et al demonstrated a consistent success rate associated with local anaesthetic spread posterior to the axillary artery and the presence of radial nerve type stimulation, while inconsistent block was associated with local anaesthetic deposition anterior to the axillary artery and median nerve type stimulation.[15] In the ultrasound guidance with nerve stimulation group, only a distal motor response by nerve stimulation was accepted before the local anaesthetic was administered, although this was occasionally difficult to achieve. This difficulty was also reported by Borgeat, Ekatodramis and Dumont,[12] where the majority of elicited distal motor responses were of the median and/or ulnar type. The radial nerve was stimulated in only in 15% of patients.

In the present study, supplemental analgesia was considered at the end of 30 minutes post-block, as was carried out in most of the older studies. Recently, the authors of two studies offered their own solutions in order to improve success rates and reduce the time to readiness for surgery. It was possible to identify patients who required supplemental local anaesthesia at an early stage. Given the low rate of failure in achieving adequate surgical anaesthesia because of insufficient sensory blockade at 15 minutes, Jones et al recommended early consideration of “top-up” blocks in patients with large cutaneous areas of a “missed” block or patchy block.[18] As a result, all of his patients were ready for surgery under regional anaesthesia in a significant shorter time. Fredrickson et al used 42 ml infraclavicular lidocaine 1.5% with epinephrine 1/200 000 (infraclavicular only), or 30 ml lidocaine 1.5% with epinephrine 1/200 000, followed by a distal median, radial, and ulnar nerve block, using a total of 12 ml 50:50 lidocaine 2% plus ropivacaine 0.75%. They were able to show an accelerated anaesthesia onset time and improvement in block consistency in the group where distal blocks were performed in addition to the infraclavicular block.[16]

Two of our patients who presented with lacerated wounds over the dorsum of the hand with nerve damage experienced specific areas of paraesthesia preoperatively, as well as postoperatively. Only one patient experienced numbness over the median nerve distribution, which was noted at 24 hours post-block. However, none had persistent paraesthesia at early follow-up, either during our visit to the ward, or by telephone call 72 hours post-block. The swelling that occurred in two patients in the ultrasound guidance with nerve stimulation group did not develop into any significant haematoma. Patients' satisfaction was acceptable in both groups. The discomfort experienced on electrical stimulation is an additional reason for non-preferential use of a nerve stimulator.

Based on currently available literature, it remains controversial whether or not nerve stimulation or ultrasound guidance is superior in ensuring high success rates and the avoidance of complications. While one by itself may be the better modality for a certain technique or in a certain clinical scenario, the other may be equal to, or even superior, for another. A multimodal approach for nerve location was published by B Braun Medical Incorporated. This dual guidance, also known as a combined method (ultrasound guidance with nerve stimulation), might be the appropriate practice for the peripheral nerve block, particularly for a brachial plexus infraclavicular block. This may be useful in patients who are obese and have poor landmarks, and for trainees who have insufficient experience using ultrasound during the early part of their learning.[17]

Conclusion

In this study, using ultrasound guidance alone for brachial plexus infraclavicular block provided rapid performance and yielded a high success rate without the aid of a nerve stimulator.

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