Vertical Infraclavicular Block with Local Anesthetic Injections at Different Currents

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Abstract- Injecting local anesthetic at the seeking current would be appealing.It would save time and avoid potentially dangerous manipulations of the needle. This study aimed to test the hypotheses that in vertical infraclavicular block, injecting local anesthetic at a seeking current of 0.8 mA would produce the same quality of block as injecting at ≤0.5mA. A total of sixty ASA I –III adult patients scheduled for elective surgery on the hand, wrist and forearm in two equal groups of 30 patients, were enrolled in this study. The technique described by Kilka & Geiger used in both groups. After eliciting a clear and visible motor response of all fingers in either extension or flexion, injection was performed at a current of 0.8 mA and ≤0.5 mA in study and control groups respectively. Duration of time to analgesia and to anesthesia was evaluated. The mean duration of onset of analgesia in radial, median and ulnar nerves in both groups, were similar. The onset of anesthesia took a mean of 13.5 minutes in the control group and 15.6 minutes in study group (P=0.064). The onset of analgesia was 4.2 minutes in the control group and 4.3 minutes in study group. (P=0.508). The success rate in both groups was 100%. We had patients in both groups who developed complete anesthesia of the hand within 25 minutes. We conclude that the injection at 0.8 mA would result in a similar quality of block to one injected at ≤0.5 mA. The difference between two groups was not statistically significant.

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Introduction

Successful brachial plexus block depends on correct needle placement and injection of a local anesthetic solution near the neurovascular compartment. The peripheral nerve stimulation provides a method to facilitate the approximation of needle and nerve and thus increasing success rate (1).

The proximity of the needle to nerve is important because the closer the needle to the nerve, the more efficient the block. However, in clinical practice what distance is close enough, has not been clearly defined (2). During nerve stimulation technique, the intensity of plexus seeking current is set according to the depth from the skin to the plexus. After eliciting a motor response, both the needle and current output are manipulated to the extent that the desired motor response could be observed at ≤0.5mA. A motor response at ≤0.5mA is considered the standard for injecting the local anesthetic solution (3,4). Producing the response at a lower current means manipulating the needle position. This manipulation could have dangerous consequences for the patient and increase the complications of the technique.

The aim of this study was to test the hypotheses that in vertical infraclavicular brachial plexus block, injecting local anesthetic solution at a seeking current of 0.8 mA (our seeking current in orthopedic operation room) after producing a clear motor response of the fingers in either flexion or extension, would produce the same quality of block as the one injected at ≤0.5mA.

Materials and Methods

After institutional ethical committee approval and obtaining informed consent, 60 successive, ASA I –III adult patients scheduled for elective surgery on the hand, wrist or forearm included in this study. Patients were

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excluded if they refused to have regional anesthesia, clinically significant coagulopathy, and infection at the injection site, pregnancy, and deformity in the block area, neurological deficit in the operative limb and a previous allergic reaction to local anesthetics. Patients were randomly allocated into two equal groups of 30 patients.

Before starting the technique all of the patients were informed that, they would receive a regional anesthesia called vertical infraclavicular block as their anesthetic and details of the procedure and sensory and motor block assessment after the block were explained to them. An intravenous catheter was placed in the contralateral arm and standard monitors (Electrocardiogram, Noninvasive arterial blood pressure and Pulse oximetry) were applied. With the patient in the supine position, midazolam 0.03 mg/kg and fentanyl 1µg/kg were administered to achieve a mild sedation. Our standard vertical infraclavicular technique in both groups was the technique described by Kilka & Geiger. With the patient in supine position and the hand of the side to be blocked positioned on the abdomen, the puncture site was located according to anatomical landmarks described for the technique , i.e. at the halfway point between the ventral apophysis of the acromion and the jugular notch. Following cutaneous local anesthesia with 1 ml of lidocaine 2%, a 22 gauge, 50-mm short bevel insulated needle (UniPlex NanoLine, Pajunk, Germany) attached to a nerve stimulator (MultiStim SWITCH pajunk Germany) that was advanced in strictly vertical direction perpendicular to the operation table. We started the technique in both groups with a seeking current of 0.8mA at 2 HZ and 0.1 ms. The desired and accepted motor response was visible twitch of all fingers in either flexion or extension.

In control group, we followed the usual way of performing block, starting with a seeking current of 0.8mA and manipulating the needle in a way that the desired motor response could still be observed at lower current of ≤0.5mA and injected local anesthetic incrementally. In study group, we aimed to elicit the same motor response at 0.8mA and injected a local anesthetic without decreasing the output. We used a combination of 1.5% lidocaine (25 ml), 0.5% bupivacaine (10ml) and 1:200000 epinephrines in every block.

After injection, the sensory spread of the block was evaluated by pinprick testing with a 23-gauge hypodermic needle in the sensory territories of radial, ulnar and median nerve in the hand. The palmar surfaces of the index and little fingers were used to test the median and ulnar nerves, respectively. To test the radial nerve we used the dorsal surface of the thumb. The end of injection was considered time zero the sensory assessment was conducted at 2, 4, 6, 8, 10, 15, 20 and 25 min. We defined a successful block as one that allowed the surgery to proceed within 30 minutes after injection.

The first dull response to pinprick in any of the three sensory territories in the hand was considered time to analgesia.When the patient reported no sensation to pinprick in above-mentioned nerve territories, it was time to anesthesia.

All patients were postoperatively monitored in the post-anesthesia care unit (PACU) for one hour and then discharged to an orthopedic ward. A post-anesthesia visit 24 hours later ensured that there were no complications related to block.

Results

No difference was between the two groups regarding age, gender, duration of surgery or ASA grade. Table 1 shows the mean duration of onset of analgesia in radial, median and ulnar nerves in both groups.The difference between the two groups was not statistically significant except for the radial nerve (p = 0.031). Table 2 shows the mean duration of complete anesthesia to pinprick and onset of analgesia in one of the nerve territories of the hand. The onset of anesthesia took a mean of 13.5 minutes in group 1 and 15.6 minutes in group 2. The difference was not statistically significant (*P*=0.064). The onset of analgesia or first reported dull sensation in the hand was 4.2 minutes in group 1 and 4.3 minutes in group 2. The difference again was not statistically significant (*P*=0.508).

One patient in study group was excluded from the study. He developed a burst of coughing while we were injecting local anesthetic, and we had to withdraw the needle. A second attempt was not tried in this patient. The success rate in the remaining patients was 100%. We had patients in both groups who developed complete anesthesia of the hand in 25 minutes. No supplementation needed during the surgery. There was not any nerve damage in both groups.

Table 1. Onset time of analgesia in individual nerves in both groups

Nerves	Mean duration ± SD (in min)		*P*-value
	Group I (≤0.5 mA)	Group II (0.8 mA)	
Radial	4.96 ± 2.59	6.23 ± 2.19	0.031
Ulnar	5.13 ± 3.06	5.86 ± 3.22	0.343
Median	5.96 ± 3.83	6.60 ± 2.91	0.189
Total	30	29	

Table 2. Onset time of complete anesthesia and analgesia in both groups

	Group 1 (≤0.5 mA)	Group II (0.8 mA)	*P*-value
Analgesia onset (min)	4.27 ± 2.31	4.30 ±1.60	0.508
Anesthesia onset (min)	13.58 ± 5. 34	15.66 ± 3.88	0.064

Values are expressed as mean ± SD

Discussion

Vertical infraclavicular block (VICB) provides a complete block of the upper extremity and is quick to perform. In contrast to other techniques of brachial plexus block, it has clear landmarks that could be identified in almost every patient. No especial positioning of the arm is necessary, and patient's hand could lie comfortably on her or his abdomen. This makes the block appealing in orthopedic patients who suffer from fractures of the arm (5).

We mostly use VICB in our orthopedic operation room. Literature is inconclusive regarding the intensity of seeking current in this technique, and it ranges between 1 and 2 mA in different textbooks of regional anesthesia (6,7). It is generally accepted that while using a peripheral nerve stimulator to perform a block, the intensity of seeking current is set based on the expected depth of the nerve or plexus and their structure.

We noticed that using high seeking current (>1 mA) and manipulating the needle to get the desired motor response causes patient discomfort, and pain in the fractured limb especially when lateral cord is stimulated which leads to biceps contractions. We lowered the seeking current to 0.8 mA in an attempt to lessen the patient discomfort. To our best knowledge, there are two nerve blocks in which injection at a current higher than 0.5 mA has been recommended (8) (i.e. supraclavicular block and lumbar plexus block). Keeping in mind the anatomy of the brachial plexus at infraclavicular area , the fibers of the divisions combine to form the three cords which are packed tightly together (medial, lateral, and posterior) under the midpoint of the clavicle (9). It could be assumed that in VICB, desired response to stimulation indicates a relatively central positioning of the stimulating needle in the plexus (10).

We wondered if 0.8 mA (our seeking current) could be used as both seeking and injecting current in performing VICB according to kilka & Geiger. We believe that findings presented here, that in the presence of visible twitch of fingers in either extension or flexion local anesthetic could be injected at a seeking current of 0.8 mA and there is no need to manipulate the needle in order to have the desired motor response at currents below 0.5 mA.

In 2004, Franco *et al.,* 11 reported that during the performance of a supraclavicular block eliciting clear visible response of the fingers at 0.9 mA and injecting of local anesthetic results in similar quality of the block as measured by the onset time and duration of anesthesia.

The difference in onset of analgesia for radial nerve between two groups was statistically significant but in clinical practice, it had no effect on time to anesthesia in two groups. At the time of patients discharge to an orthopedic ward, the block had not started to wear off. We believe that a major reason for the success of this technique is that the local anesthetic is injected at a point where the plexus is reduced to it is least components and size.

Injecting the local anesthetic at the seeking current would be appealing. It saves time and avoids potentially dangerous manipulations of the needle and complications of the block including vascular puncture and pneumothorax (12).

The results presented here indicate that injecting local anesthetic in 0.8 mA provides adequate surgical anesthesia for upper limb surgeries. Both current intensities are equally efficacious as far as the onset of analgesia and anesthesia are concerned. Injection of local anesthetic at 0.8 mA may provide advantages over injection at ≤0.5 mA. It eliminates the need to manipulate the needle and thus allows for patient comfort during block performance and may decrease possible complications related to the block.

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