

Case Report

Ultrasound-Guided Supraclavicular Brachial Plexus Block in Hand and Forearm Surgery: Case Series

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Objective: Paresthesia technique or nerve stimulator-guided supraclavicular brachial plexus block can cause nerve injury, patient's discomfort, and dissatisfaction during the procedure. The present study aimed to retrospectively review the practice of ultrasound-guided supraclavicular brachial plexus block for orthopedic hand and forearm surgery.

Materials and Methods: Medical records of 175 patients receiving ultrasound-guided supraclavicular brachial plexus block for hand and forearm surgery, between January 2013 and December 2015, were retrospectively reviewed. The anatomical sonography of supraclavicular area was imaged by 2-D linear probe. The needle was advanced by in-plane technique and lateral to median direction. Multiple sites injection was needed depending on the visibility of spreading of local anesthetic agent. Complete block, block with intravenous opioids supplement, and block with additional ulnar nerve block were defined as successful block. Failed block was defined as the conversion to general anesthesia.

Results: Brachial plexus block in 170 patients (97.14%) were successful whereas five patients (2.86%) were converted to general anesthesia with laryngeal mask airway. There was no serious complication such as pneumothorax or intravascular injection.

Conclusion: Ultrasound-guided supraclavicular brachial plexus block with linear probe and in-plane needle advancement provided high success rate and low complication.

Keywords: Supraclavicular brachial block, Ultrasound guided regional block, Complication

J Med Assoc Thai 2018; 101 (10): 1457-61

Website: <http://www.jmatonline.com>

Brachial plexus block is a popular anesthesia technique for upper limb surgery because it provides anesthesia with minimal use of anesthetic agent. This technique involves injecting local anesthetics around the nerve plexus. Using ultrasound guidance, this nerve block provides anesthesiologists more confidence, better success rate, and fewer complications. The first brachial plexus block was performed by William Halsted with cocaine under surgical approach in the neck⁽¹⁾. In clinical practice, the located technique has been evolved from blind paresthesia technique to electrical nerve stimulation and ultrasound-guided in present day. Supraclavicular approach for brachial plexus block is the popular approach because the plexus is shallowest, and the local anesthetic injected will be around the trunks and divisions of the plexus. This results in anesthesia in all the areas of the upper extremity (Figure 1).

In clinical practice, there are three techniques

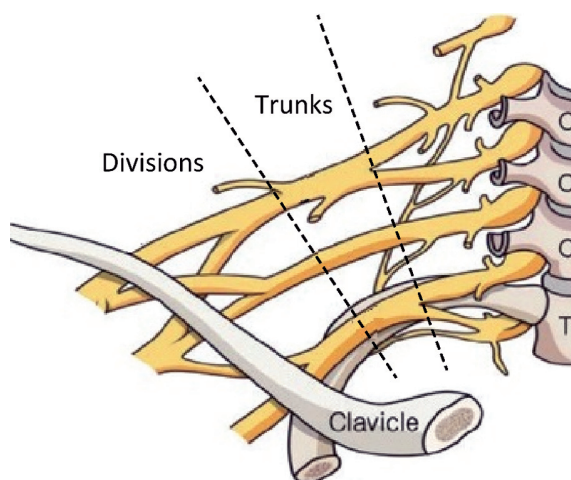


Figure 1. Anatomy of brachial plexus⁽²⁾.

to locate the brachial plexus. First, the paresthesia technique is simple and does not use any special equipment. The limitation of this technique is the need of the patient's cooperation; therefore, the success rate is low and has been lower than 80% in some previous studies^(3,4). It lessens patient's comfort and satisfaction

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How to cite this article: Sriramatr D, Chongarunnangsang W, Kusumaphanyo C, Promma J. Ultrasound-guided supraclavicular brachial plexus block in hand and forearm surgery: case series. J Med Assoc Thai 2018;101:1457-61.

from multiple injections⁽⁵⁾ and long duration of the procedure especially in obese patient. Second, the nerve stimulator-guided technique is a technique that uses electrical nerve stimulation to elicit muscle twitch. The disadvantages of this technique include patient anxiety and discomfort due to pain on muscle twitching. After 2 to 3 ml of the local anesthetic agent is injected, there is a decrease of muscle twitch resulting in a loss of confidence of anesthesiologist to inject all of the agent. This technique yields a better success rate than the paresthesia technique. However, intravascular injection or plural injury cannot be avoided⁽³⁾. Third, the ultrasound-guided technique uses sonographic anatomy in supraclavicular area as a guidance. Sonographic image reveals brachial plexus, subclavian artery, first rib, pleura, and the needle tip as well as real time spreading of local anesthetic agent. Technically, this technique yields even a higher success rate if the nerve plexus and related structure are accurately identified and the anesthesiologist is well-trained and practiced.

Ultrasound-guided brachial plexus block increased in popularity and will become a standard practice in the near future. Key success of the block includes successful block without complications, lower cost, and patient satisfaction.

The present study aimed to retrospectively explore the characteristics of ultrasound-guided brachial plexus block in patients admitted to HRH Princess Maha Chakri Sirindhorn Medical Center, Srinakharinwirot University.

Materials and Methods

The present study was funded by the Strategic Wisdom and Research Institute, Srinakharinwirot University and approved by the Institutional Review

Board. Medical records of 175 cases of ultrasound-guided supraclavicular brachial plexus block during first three years of our practice between January 2013 and December 2015 were retrospectively reviewed. All cases were orthopedic hand and forearm surgery. Anesthetic solution was either lidocaine or lidocaine plus bupivacaine with total volume of 20 to 30 ml. Informed consents were obtained in all cases. Non-invasive blood pressure, heart rate, EKG, and oxygen saturation were monitored before block. The block procedure was done with aseptic technique. Linear probe was placed on the supraclavicular area to identify subclavian artery, brachial plexus, first rib, and pleura (Figure 2). Color Doppler was used to detect normal variation of vessels in all cases. The procedure was done with 22 G-gauge needle in-plane technique, lateral to medial needle advancement (Figure 3). Tip of needle was identified in all cases before injecting the anesthetic solution. Syringe aspiration was done before and every 5 ml of anesthetic solution injection to prevent intravascular injection or pleural injury (Figure 4).

Anesthetic solution was injected at one or more sites depending on the spreading of anesthetic solution. Pinprick and/or cold sensation and motor power were tested every three minutes before the operation (Figure 5). Demographic data, degree of block success, and complications were recorded.

Successful block included complete block, block with opioids supplement as needed, and block with additional ulnar nerve block. Unsuccessful block with proceeding to general anesthesia was considered failed block.

Results

The overall success rate of ultrasound-guided

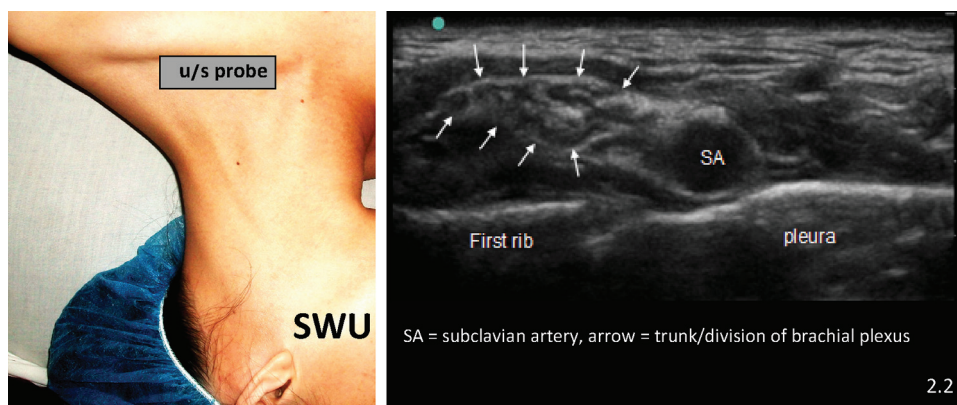


Figure 2. Sonographic image of anatomy from placing the linear probe on supraclavicular area.

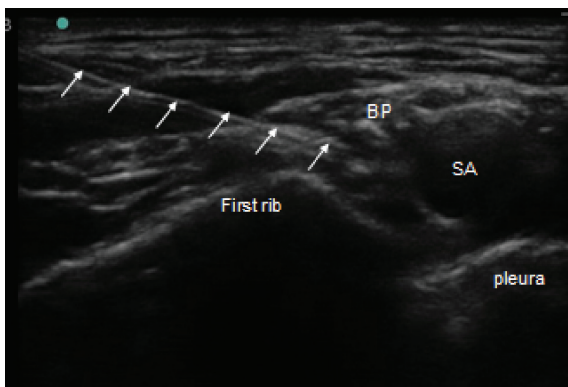


Figure 3. Sonographic image of needle advanced to the brachial plexus (arrow: needle, BP: brachial plexus, SA: subclavian artery).

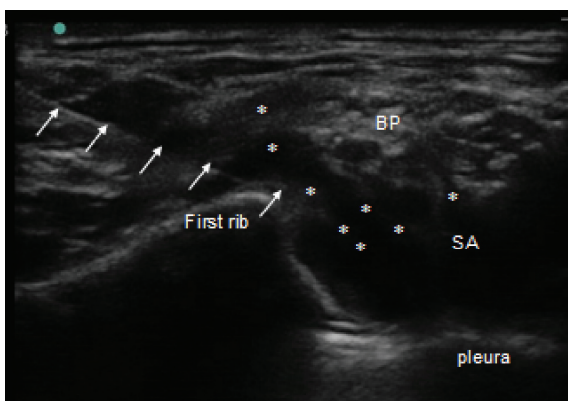


Figure 4. Sonographic image of spreading of local anesthetic solution around the brachial plexus (arrow: needle, BP: brachial plexus, SA: subclavian artery, *: local anesthetic solution).

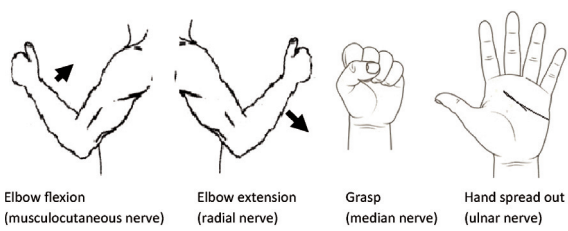


Figure 5. Motor power test after brachial block^(6,7).

supraclavicular brachial plexus block was 97.14% (170/175 patient). Among this, 14.28% (25 patients) needed opioid supplement (fentanyl or morphine), and 4.57% (eight patients) needed additional ulnar nerve block. Failed block with conversion to general anesthesia was found 2.86% (five patients). There was no serious complication. The demographic data and block characteristics were shown in Table 1 and 2, respectively.

Table 1. Demographic data of patients

Data	
Male:female	101:74
Age (year), mean (range)	41.3 (13 to 91)
BMI (kg/m ²), mean (range)	23.74 (12.46 to 43.77)
ASA (I:II:III)	109:44:22
Elective:emergency	123:52
Site of operation (right:left)	89:86
Operation time (minute), mean (range)	101 (35 to 260)

BMI = body mass index; ASA = American Society of Anesthesiologists physical status

Discussion

The present case series showed the high success rate of ultrasound-guided supraclavicular brachial plexus block for orthopedic hand and forearm surgery. The present series success rate was 97.14% (170/175 patients). The success rate of ultrasound-guided technique reported elsewhere varied between 78% to 95%⁽⁸⁻¹⁰⁾. Paresthesia technique, which is a blind technique, provided success rate of 80% or lower⁽³⁾. The technique is even more difficult if anatomical landmarks are not well identified, for example, in obese patient. Misinterpreted paresthesia by the patient is probably contributing to unsuccessful block⁽⁵⁾. Vermeylen et al reported 53.5% of normal variation of brachial plexus anatomy⁽¹¹⁾, which could explain the low success rate of the paresthesia technique.

The paresthesia nerve stimulator-guide, a blind technique, motor twitch is elicited by a presumption that the needle tip is inside the nerve plexus. However, this technique can give false negative^(8,9,12) with success rate of 78% to 85%. Many studies concluded that nerve stimulator did not increase the success rate of the block^(8,12).

The ultrasound guided brachial plexus block gives a sonographic image of the plexus anatomy as well as the surrounding structures. With the image, the block can be achieved by injecting local anesthetics to the appropriate site where nerve trunks and divisions are bathed in the injected anesthetic solution. Combining ultrasound with nerve stimulator yields only a 94.2% success rate⁽¹⁰⁾. Perlas et al reported 94.6% success rate⁽¹³⁾, whereas Gamo et al⁽¹⁴⁾ reported as high as 99.5%. Increasing the local anesthetics volume up to 40 ml could increase the success rate to 97.1%⁽⁵⁾.

In the present study, our success rate of ultrasound-guided supraclavicular block was 97.14%, which was comparable to the previous studies. Ulnar nerve sparing is common in supraclavicular approach. The

Table 2. Characteristic of block

	Successful brachial block (n = 170, 97.14%)			Failed block (n = 5, 2.86%)
	Complete block (n = 137, 78.29%)	Opioid supplement (n = 25, 14.28%)	Additional ulnar nerve block n = 8 (4.57%)	Conversion to general anesthesia
Sex: male/female	77/60	16/9	6/2	2/3
Age (year)	40.2 (13 to 91)	47.44 (15 to 91)	36.6 (18 to 52)	55.2 (20 to 77)
Time of surgery (minute)	100 (35 to 260)	110 (45 to 205)	101 (55 to 240)	114 (85 to 145)
Site of operation				
Hand	59	8	8	3
Wrist	35	5	0	1
Forearm	43	12	0	1

present study had 4.57% additional ulnar nerve block. All cases were ring finger and/or little finger surgery. Opioids supplement was given in patients reporting tourniquet pain.

Onset time of block is another factor determining successful block. While it is preferred to allow 13 to 30 minutes of onset^(5,16), Kapral et al suggested as long as 40 minutes⁽¹⁶⁾. There was no serious complication in the present study.

Conclusion

Ultrasound-guided supraclavicular brachial plexus block is safe and provides success rate as high as 97.14% with minimal complications. It has superior results as compared to paresthesia and nerve stimulator-guide techniques.

What is already known on this topic?

Previous studies showed the success rate of ultrasound-guided technique at between 78% to 95%. The success rate of combining ultrasound and nerve stimulator guide technique was higher at 94%. However, the disadvantage of this technique was patient discomfort due to pain on muscle twitch.

What this study adds?

In this study, our success rate of ultrasound-guided supraclavicular block was 97.14%. The patients were comfortable due to high success rate without pain on muscle twitch from nerve stimulator.

Acknowledgement

The present study was supported by, the HRH Princess Maha Chakri Sirindhorn Medical Center, Ongkharak, Nakhon Nayok, Thailand.

Potential conflicts of interest

The authors declare no conflict of interest.

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