

## Original Article

# The technique comparison of brachial plexus blocks by ultrasound guided with blocks by nerve stimulator guided

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**Abstract:** Objective: Brachial plexus perineural blocks provide specific analgesia for upper limb surgery. We present our experience with ultrasound-guided supraclavicular brachial plexus perineural blocks for distal upper limb surgery. Although single-injection ultrasound-guided supraclavicular blocks have been reported, little is known about the advantages using this approach compared with nerve stimulator guided. Methods: There were 60 patients who underwent upper limb surgery for orthopedic trauma and received a supraclavicular brachial plexus anesthesia. 30 patients (U-group) were injected by an ultrasound-guided technique with the needle tip remaining under direct vision. 30 patients (NS-group) were inserted by nerve stimulator guided. Recorded the onset time, puncture times, pains cases with tourniquet in each group. Compared the difference between two groups. Results: In U-group, all cases had successful perineural injection. Most of them, effect of anesthesia was fast onset and needed insert only once. No pains were reported under using tourniquet. There were no vessel punctures or other direct procedure-related complications. In NS-group, most injections were successful, but slow onset and needed multiply insert needle. 5 patients said pains under using tourniquet when surgery started and had to add opioid by vein. One patients' lung were puncture and result in pneumothorax. One patient's was intravascular injection. Conclusions: Supraclavicular brachial plexus perineural insertion using ultrasound guidance is feasible and almost have no complications, deserves further study with a randomized controlled trial comparing this relatively new technique with only using nerve stimulator.

**Keywords:** Peripheral nerve block, perineural infusion, ultrasound-guided supraclavicular block, nerve stimulator guided, supraclavicular block

## Introduction

Supraclavicular brachial plexus block is considered to be one of the most effective anesthetic procedures for upper extremity surgeries. Brachial plexus blocks can offers potential advantages over other locations. The compactness of the brachial plexus in this location facilitates a rapid onset and complete block of the brachial plexus for procedures distal to the shoulder. Its major drawback is placement of the needle, with inaccurate placement, being a risk factor for pneumothorax and vascular puncture and failure of the procedure [1].

The use of ultrasound has several benefits including faster onset and reduction in the dose of local anesthetic [2]. Ultrasound guided

needle placement may reduce the risk of complications and increase the accuracy of the block.

Although the benefits of infraclavicular perineural catheters placed with and without ultrasound guidance have been well described [3-5], evidence regarding ultrasound guidance for insertion of supraclavicular perineural catheters is extremely limited [18].

More recently, ultrasound guided technique has been used in single-injection supraclavicular brachial plexus blocks in our work. With the advent of ultrasound-guided techniques, avoid complications. In our study, we had compared brachial plexus punctured by ultrasound guided with nerve stimulator guided. Little has been

**Table 1.** General informations (values are  $\bar{x} \pm s$ , n=30)

	Gender (M/F)	Age (average, y)	Weight (average)
U-group	19/11	41.2 $\pm$ 2.35	66.7 $\pm$ 9.18
NS-group	21/9	40.9 $\pm$ 4.05	69.3 $\pm$ 6.24
X <sup>2</sup> or t	0.785	0.855	2.027
P	0.392	0.397	0.079

Two group comparison, gender, age and weight of *p* value bigger than 0.05, (*P*>0.05), it is no significant difference between two groups.

published on the efficacy and safety of ultrasound-guided supraclavicular block in patients based on practical experience, and there has been no published report on its usage.

We present our experience with a novel ultrasound-guided supraclavicular perineural insertion technique and other advantages in this procures.

### Materials and methods

This study was approved by the Institutional Review Board of the hospital, and monitoring for this retrospective case series. The purpose and method were explained to the patient and guardian prior to surgery to obtain informed consent.

Sixty patients with multiple injuries of upper extremity were scheduled for operation. The supraclavicular brachial plexus blocks approach with ultrasound guidance was selected for the U-group patients. The NS-group patients choose the nerve stimulator technique to block the supraclavicular brachial plexus. All patients were supine with the wounded arm at the side and the back slightly elevated. A small and thin sponge cushion was placed under the ipsilateral scapula, and the head was turned to the opposite side. Monitors and oxygen via a face mask were applied, and the skin was prepared with iodophor before application of a sterile fenestrated drape. Intravenous midazolam and fentanyl were titrated as necessary for patient comfort, while ensuring that patients remained responsive to oral cues.

Using a 6- to 13-MHz linear ultrasound probe (ACUSON, Siemens, Germany), the brachial plexus was verified in a cross section medial to the clavicle and posterolateral to the subclavi-

an artery. Using local anesthetic infiltration the relative district, to anesthetize (with 1% lidocaine) the skin and subcutaneous tissue, a 17-gauge uninsulated Tuohy-tip epidural needle was inserted through the skin wheal and directed in plane toward the target nerves. Under continuous in-plane ultrasound guidance, the needle tip was advanced through the middle scalene muscle, passing below the brachial plexus to lie between the first rib and subclavian artery. An initial 40-mL bolus of mepivacaine, 1.5%, with epinephrine, 2.5  $\mu$ g/mL, was injected through the placement needle under continuous ultrasound visualization to confirm circumferential spread around the brachial plexus.

Finding the muscle gap between the anterior and middle muscle and puncturing with a 5 cm insulate needle connected to the nerve stimulator (Stimuplex HNS 12, B. Braun Melsungen AG, Germany). Stimulus intensity was 1 mA, pushing needle toward to downward, inward and backward, stimulated brachial plexus and had produced motor reaction at shoulder, biceps brachii, anterior arm and hand. Adjusting the nerve stimulator small to 0.3-0.5 mA, at this time still could see the motor reaction at above locations, identified the needle tip was right site. Repeatedly pumpback through the needle and found no blood, other liquid and gases. An initial 40-mL bolus of mepivacaine, 1.5%, with epinephrine, 2.5  $\mu$ g/mL, was injected through the placement needle. During puncture, it was testified the insert needle adjacent inside or back too if diaphragm or trapezius contracted, needed to adjust the way and depth. Otherwise, you should choose the location and try again.

When beginning operation, complete upper limb anesthesia was testified using cold and light touches. However, patients who underwent uncomplicated surgical procedures felt acute pain and were management by vein titrating opioid and sedative. If pain couldn't control, altering general anesthesia.

Record the puncture times, onset time, pain cases during operation and complications.

### Statistical analysis

Differences among the groups for puncture times and onset time of the nerve blocks were assessed with a two sided t-test for indepen-

**Table 2.** Basic clinic information of two groups

	U-group		Ns-group	
	Open reduction	External fixation	Open reduction	External fixation
Supracondylar fracture of humerus	2		2	1
Ulnar fracture	3	1	3	1
Radial fracture	5		5	1
Olecranal fracture	3		4	
Forearm fracture	6		5	
Radial head fracture	2		2	
Colles fracture	4	4	2	4
	30		30	
$\chi^2$			0.748	
P			0.374	

Surgery site, every figure expresses patients numbe. two group comparison, *P* value is bigger than 0.05 ( $P > 0.05$ ), they are no significan difference in each group.

**Table 3.** Puncture times and onset time ( $\bar{x} \pm s$ )

	Puncture times	Onset time
U-group	1.13 (34/30) $\pm$ 0.35	5.67 $\pm$ 2.58
NS-group	2.40 (72/30) $\pm$ 1.10	16.97 $\pm$ 7.87
t	2.622	7.473
P	0.0127	0.00021

In the table, 34/30 express that there are all 34 puncture times in 30 patients; as well as 72/30 express that there are all 72 puncture times in 30 patients. Each *P* value of puncture times and onset time is less than 0.05 ( $P < 0.05$ ), there are significant difference between groups.

**Table 4.** Pain with tourniquet and complications

	Pain with tourniquet	complications
U-group	0	0
NS-group	5	2

5 cases feel pain with tourniquet and two cases appears complications in NS-group, it is no pain or complications in U-group.

dent samples. Statistical significance was considered for  $P < 0.05$ . Count data were checked out by  $\chi^2$ , it had statistical significant if  $P < 0.05$ . Results are expressed as  $\bar{x} \pm s$  as indicated.

## Results

Patient characteristics and surgical information are presented in **Tables 1, 2**. No differences existed between groups in terms of gender, body weight, age.

In U-group, all cases had successful perineural injection. Most of them, effect of anesthesia was fast onset and needed insert only once. The average puncture times were  $1.13 \pm 0.35$ , the average onset time was  $5.67 \pm 2.58$  m, No pains were said under using tourniquet. There were no vessel punctures or other direct procedure-related complications. In NS-group, most injections were successful, but slow onset and needed multiply insert needle. The average puncture times were  $2.4 \pm 1.10$ , the

average onset time was  $16.97 \pm 7.87$  m, 5 patients said pains under using tourniquet when surgery started and had to add opioid by vein. One patients' lung were puncture and result in pneumothorax. One patient's was intravascular injection. (**Tables 3, 4**).

## Discussion

The success rate of a supraclavicular block with a U-group was higher than that of a supraclavicular block with NS-group in our study. Understanding why the advantages were significant in real-time procedures by ultrasound guiding.

Although single-injection ultrasound-guided supraclavicular blocks have been reported [6], little is known about the advantages using this approach compared with nerve stimulator guided. In our study, we compared with two approaches in blocks brachial plexus. We have got the conclusion that supraclavicular brachial plexus perineural insertion using ultrasound guidance is feasible and almost haven't complications.

The brachial plexus is derived from the fifth, sixth, seventh, and eighth cervical nerves and the first thoracic nerve. The nerves form trunks between the anterior and middle scalene muscles, and descend down to the clavicle and first rib. As the trunks pass between the clavicle and first rib, each trunk divides into anterior and posterior divisions. A supraclavicular block is performed at the first rib level in this region

[7, 8]. Two techniques used in our study are all asked for mastering the anatomy of the site.

Nerve stimulators may be potential devices to assess nerve blocks [9]. Traditionally, the elicitation of paresthesia or a muscle twitch with a nerve stimulator allows for a precise needle location [10]. It is impossible to know the precise needle location without a real time image, such as ultrasound. Therefore, this may explain why the average onset times and the average puncture times are all longer in the NS-group than the U-group.

Ultrasound guidance for peripheral nerve blocks reduces the number of complications and improves the quality of regional blockade in adults, compared with blind techniques or nerve stimulator guidance [11, 12].

Pneumothorax and vascular puncture are the most potentially life-threatening complications in the use of the supraclavicular brachial plexus block. Another main complication of blind approaches results from the spread of high volumes of local anesthetic [13].

Ultrasound facilitates the identification and avoidance of important structures, and direct visualization of local anaesthetic spread may reduce dosages and result in selective blocks with higher accuracy and fewer complications [14].

Although the potential risk of a pneumothorax is ever present [15] when placing a supraclavicular block with or without ultrasound guidance, direct visualization of the needle using proper in plane ultrasound guidance should reduce the probability of this complication compared to blind techniques [13, 16]. Furthermore, ultrasound guidance allows visual confirmation of the spread of the local anesthetic solution around the brachial plexus, possibly increasing the reliability of the initial surgical block [3, 17, 18].

It was also observed that the onset time were different between the two groups. The average onset time of the U-group was faster than the NS-group. These results suggest that the reason for the difference was the needle location. In U-group, the needle was placed adjacent to brachial plexus, even placed in middle of plexus, so, drugs began work at once. In contrast,

the needle was only near the brachial plexus in NS-group, there were a few tissues between needle and plexus, drugs must pass the tissues until to the plexus, while its need times.

We acknowledge that this study has several limitations. The most important limitation to this study is that we were unable to exclude several other factors that could affect treatment effects since this study was a retrospective study. Therefore, the results of this study are not fully reliable, since the complicated rates of U-group are low in both approaches used in the study. Prospective randomized long-term studies should be performed in the future to supplement such limitations.

Supraclavicular brachial plexus perineural blocks using ultrasound guidance alone is feasible. By using ultrasound imaging for real-time injection of local anesthetics and placement of nerve catheters, the reliability of this block should be comparable to those in other locations [19]. On the basis of single-injection studies, the supraclavicular location for perineural infusion has the theoretical advantage of providing a more reliable block of the distal branches compared to nerve stimulator guided. Peripheral nerve blocks by ultrasound guided were not associated with any complications, whereas blocks by nerve stimulator had two cases. So, there are potential benefits of peripheral nerve blocks compared with NS-group. Therefore, the ultrasound guided approach is recommended.

### Disclosure of conflict of interest

None.

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