International Journal of Medical Anesthesiology

E-ISSN: 2664-3774
P-ISSN: 2664-3766
www.anesthesiologypaper.com
IJMA 2020; 3(2): 11-15
Received: 12-02-2020
Accepted: 14-03-2020

Dr. Aditi Bhatnagar
Department of Anaesthesiology
NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Digdoh hills, Nagpur, Maharashtra, India

Dr. Megha Tajne
Department of Anaesthesiology
NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Digdoh Hills, Nagpur, Maharashtra, India

Dr. Anjali Bhure
Department of Anaesthesiology
NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Digdoh hills, Nagpur, Maharashtra, India

Corresponding Author:
Dr. Aditi Bhatnagar
Department of Anaesthesiology
NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Digdoh hills, Nagpur, Maharashtra, India

Comparative study between nerve stimulator guided technique and ultrasound guided technique for supraclavicular nerve block in upper limb surgery- A randomized controlled trial

Dr. Aditi Bhatnagar, Dr. Megha Tajne and Dr. Anjali Bhure

DOI: https://doi.org/10.33545/26643766.2020.v3.i2a.116

Abstract
Background and Aims– Ultrasonography guided supraclavicular block is presumed to have faster onset time and increased the success rates with a reduction of the local anaesthetic dose, and also low down the complication rates. Whether or not the use of USG can improve practitioner's ability to successfully perform a faster supraclavicular nerve block remains needs to be studied. Hence study proposes to compare nerve stimulator guided technique and ultrasound guided technique for supraclavicular nerve block in upper limb surgery.
Methods- 60 adult patients, who were ASA physical status I–II and scheduled for elective upper limb surgery, were studied prospectively. 30 patients in each group to receive a supraclavicular block using either Ultrasound guidance (group U) or Nerve stimulation guidance (group P). Both the groups were injected with inj. Bupivacaine 0.5% 15ml and 2% lignocaine- with epinephrine 1:200000 15ml (total volume, 30 mL). The groups were compared in terms of Onset of sensory and motor block, Block performance time, Block success rate; hemodynamic parameters, and complications. Paired t-test and two-independent samples t-test were used for analysis. A p-value <0.05 was considered statistically significant for all comparisons.
Result- The mean block performance time for P group was 4.65 $\pm$ 1.11 seconds while that of the U group was 3.41 $\pm$ 0.88 seconds (p = 0.0001). The mean time of onset of sensory block was 9.45 $\pm$ 3.21 minutes in P group versus 8.75 $\pm$ 2.98 minutes in the U group (P = 0.4007). The mean time of onset of motor block was 10.65 $\pm$ 2.62 minutes in P group versus 10.14 $\pm$ 2.44 minutes in U group (p=0.4405). Block success was achieved in 25 patients in P group out of 30 (83.3%), while in U group, out of 30 only 2 patient did not achieve block success (93.3%) P = 0.68. The hemodynamic changes in the form of systolic and diastolic blood pressure, mean blood pressure, heart rate and oxygen saturation recorded every 5 min up to 30 minutes showed no significant difference.
Conclusion- Ultrasonography is a faster to perform, more accurate modality to perform the supraclavicular block.

Keywords: supraclavicular block, ultrasonography, peripheral nerve stimulator

Introduction
A well-conducted regional anaesthetic technique has very much to offer to an anaesthesiologist, surgeon, as well as patients owing to its advantages over general anaesthesia such as remaining conscious, avoiding polypharmacy, better haemodynamic stability and excellent post-operative analgesia. The world of regional anesthesia has changed considerably over the past decade, with a newfound interest in peripheral nerve blocks. Upper extremity regional anaesthesia has been a mainstay of the anesthesiologist's armamentarium, the brachial plexus being the target of blockade. The brachial plexus is a complex network of nerves, extending from the neck to the axilla, which supplies motor and sensory fibers to the upper extremity. On the level of the supraclavicular fossa, the plexus is most compactly arranged. Supraclavicular brachial plexus block provides consistently effective regional anaesthesia to the upper extremity. Different technical modalities are being used for identifying and locating the brachial plexus in the supraclavicular area [1].
Peripheral nerve stimulation method includes electric stimulation and patient-reported paraesthesia which rely on surface landmark identification in a semi-blind manner.

Peripheral nerve stimulator has been in use, but not without the risk of complications, for supraclavicular block since a very long time.

Ultrasonography is a relatively new guidance technique for supraclavicular block. It provides real-time view of the block needle, the brachial plexus and its spatial relationship to the surrounding vital structures. It allows the faster onset time and increased the success rates with a reduction of the local anaesthetic dose, and also brought down the complication rates [2, 3].

Whether or not the use of USG can improve practitioner's ability to successfully perform supraclavicular nerve block remains controversial. Hence our study proposes to compare nerve stimulator guided technique and ultrasound guided technique for supraclavicular nerve block in upper limb surgery.

Inclusion Criteria-

1. Patients of the American Society of Anesthesiologists' (ASA) Physical status I or II,
2. Age group 18–60 years.
3. Electively posted adult patients of general and orthopaedic surgery with upper limb surgeries
4. BMI <35kg/m2
5. Patients with no pre-existing motor or sensory deficit in the operative limb

Exclusion Criteria

1. Patient refusal
2. Bleeding disorders,
3. Infection at the injection site,
4. Mental incapacity or language barrier precluding informed consent,
5. Those who were allergic to the amide local anaesthetics.
6. Patients with chest deformity, clavicle fracture, any pulmonary pathology and pregnancy.

Methodology

After obtaining institutional research ethics board approval of the study protocol and written informed consent from all subjects, 60 adult patients, who were American Society of Anaesthesiology physical status I–II and scheduled for elective elbow, forearm, wrist, or hand surgery, were studied prospectively. The study was conducted in 2 years from January 2018 to December 2019.

The primary objective was to compare the two techniques of supraclavicular block in terms of Onset of sensory and motor block, Block performance time, Block success rate; while the secondary objectives included comparision of hemodynamic parameters: Heart-rate, systolic and diastolic blood pressure, oxygen saturation and complications like vascular punctures, pneumothorax, nerve palsies, hematoma formation and infection at injection site.

Randomization was done by computer generated software RALLOC by minitab corporate version 3.5.2 updated from version STB-54 (2011), Allocation concealment by group allocation was shared with the anaesthetist who performed the block in a sealed opaque envelope. The research fellow evaluating the supraclavicular block was blinded to group allocation. Patients were allocated in two equal groups, 30 patients in each group to receive a supraclavicular block using either

-Ultrasound guidance (group U).

-Nerve stimulation guidance (group P).

After taking the patient inside the operation theatre, standard monitors were attached ECG, NIBP, pulse oximeter, IV accesses with wide bore cannula was secured, patients were pre medicated with injection Midazolam 0.03mg/kg, given 5 minutes before procedure.

No analgesic drugs were given during pre-medication

Both the groups were injected with inj. Bupivacaine 0.5% 15ml and 2% lignocaine- with epinephrine 1:200000 15ml (total volume, 30 mL).

In Peripheral nerve stimulator (P) group, the patient was kept in the recumbent position without a pillow, arms at his/her sides and head turned to the opposite side to be blocked. Small roll pad was placed below shoulder. The patient was then asked to lower the shoulder and flex the elbow, so that the forearm rested on his/her lap.The wrist was then supinated so that the palm faced the patient's face.

The point of needle entrance was about 1inch (2.5 cm) lateral to the insertion of the sternocleidomastoid (SCM) in the clavicle or one thumb breath lateral to SCM. Palpation of the subclavian artery at this site confirmed the landmark. The palpating index finger is then placed at this site. Local infiltration of 1ml of 2% lignocaine is done at the proposed puncture site. We used an insulated needle to perform this technique. The needle was then connected to nerve locator by the electrodes and is properly grounded with the help of ECG leads.

We started the stimulation with an intensity of 2.0 mA and a pulse width of 100 µs. Once the desired response was obtained (i.e. a muscle twitch of the fingers that is clearly visible), we start decreasing the current gradually to 0.5mA. If still, we get the desired response the drug 30 ml solution will be injected. If the response is obtained at 0.4mA also, then the needle is repositioned again so as to get response at 0.5mA but not at 0.4mA.

In the presence of inadequate response repositioning of the needle will have to be done in the anteroposterior plane, either slightly more posterior or slightly more anterior, but always parallel to the midline.

If the twitches instead disappear before reaching the lower trunk, the needle is withdrawn to the point of the previous twitch and advanced with a slight change in the anteroposterior angle of insertion. The risk of intraneural injection is minimized by using low injection pressures and meticulous technique. If pain or abnormal pressure is felt at any point during injection, the needle should be withdrawn 1–2 mm, after which a new assessment is made.

In Ultrasound (U) group, the patient is placed in the supine position with the the head turned the opposite side. This is a superficial block for which a linear high frequency US probe covered with sterile cover will be used. The probe is moved laterally to visualize the plexus as it passes over the 1st rib.

After taking all aseptic precautions the needle is advanced in-plane, from lateral to medial, the entrance point is located at about 1 cm away from the probe to decrease the angle of insertion and improve needle visualization. We have used the in-plane approach of needle insertion with respect to the ultrasound probe.

The needle is then slowly advanced under direct visualization, towards the angle formed by the first rib and the subclavian artery. The local anaesthetic spread should be seen reaching the angle formed by the 1st rib (vertical

arrows pointing up) and the subclavian artery (SA). The local anaesthetic will be seen as a hypoechoic (dark) shadow projecting from the tip of the needle.

All patients will be followed up for 24hrs for any respiratory, vascular, hemodynamic or local post-operative complications

The occurrences of any adverse events or potential block-related complications were recorded, including motor deficits, pain, and bruising.

In cases where ‘‘block success’’ was not achieved after 20 min a standardized algorithm was followed:

- First, the surgeon had to infiltrate the surgical skin site with 1–2% lidocaine or 0.25–0.5% bupivacaine without epinephrine.
- Next, fentanyl 25 mcg iv was administered every 5 min as needed, to maximum 100 mcg in hr; and finally,
- A supplemental (‘‘rescue’’) nerve block was administered if one nerve is spared.
- If more than one nerve was spared, general anaesthesia is given.

Data was entered in MS Excel, coded and analysed in statistical software STATA, version 10.1, 2011. Significance of within-the-group differences in means between before treatment and after treatment were assessed by paired t-test. Between-the-group differences in mean change from baseline in two groups were tested with two-independent samples t-test. A p-value <0.05 was considered statistically significant for all comparisons.

Results

There were no significant difference in between both the groups with respect to the demographic parameters. (table1)

Table 1: Demographic Parameters

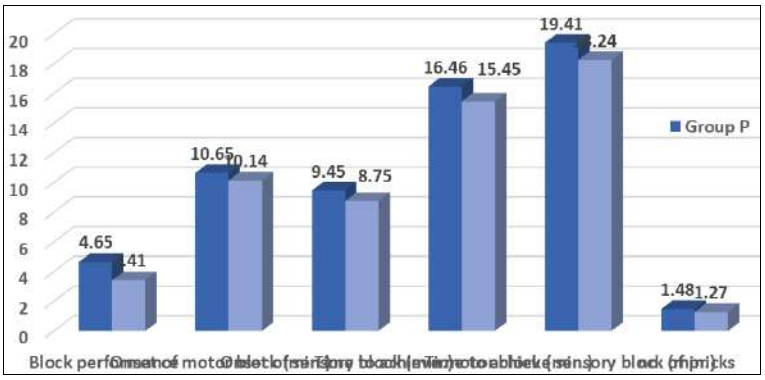
Variable	Group P	Group U
	Mean	Mean
Age (years)	35.24 ± 15.02	37.93 ± 13.29
Weight	45 ± 9.69	57.13 ± 9.47
Height (mt)	1.56 ± 0.06	1.57 ± 0.06
BMI (Kgm^2)	22.89 ± 3.49	23.16 ± 4.11
Gender male/ female	13/16	11/18
ASA PS I/II	23/6	22/7

There was significant difference noted in the block performance time in between the two groups. The mean block performance time for P group was 4.65 ± 1.11 seconds while that of the U group was 3.41 ± 0.88 seconds (p = 0.0001) (table2)

Table 2: Mean difference in variables between two groups

Variable	Group P		Group U		P value
	Mean	SD	Mean	SD	
Block performance	4.65	1.11	3.41	0.88	0.0001
Onset of motor block (min.)	10.65	2.62	10.14	2.44	0.4405
Onset of sensory block (min.)	9.45	3.21	8.75	2.98	0.4007
Time to achieve motor block (min.)	16.46	3.26	15.45	5.81	0.4213
Time to achieve sensory block (min.)	19.41	4.15	18.24	3.34	0.2415
No. of pricks	1.48	0.69	1.27	0.70	0.2617

There was no statistically significant difference amongst the onset of sensory block, onset of motor block amongst the two groups. The mean time of onset of sensory block was 9.45 ± 3.21 minutes in P group versus 8.75 ± 2.98 minutes in the U group (P = 0.4007). The mean time of onset of motor block was 10.65 ± 2.62 minutes in P group versus 10.14 ± 2.44 minutes in U group (p=0.4405) (table 2) (Graph1)



Graph 1: Bar diagram showing mean difference in variables between two groups

In U group, one patient required Inj Fentanyl and 1 patient was given general anaesthesia. In P group 1 patient conversion into general anaesthesia and 4 patients required other forms of analgesia.

The time to achieve motor block and time to achieve sensory block was also comparable with no statistically significant difference amongst the two groups. The time to achieve motor block was 16.46 ± 3.26 minutes in P group versus 15.45 ± 5.81 minutes in U group (p=0.4213). The time to achieve sensory block was 19.41 ± 4.15 minutes in P group versus 18.24 ± 3.34 minutes in U group (p=0.2415). (Table 2). The hemodynamic changes in the form of systolic and diastolic blood pressure, mean blood pressure, heart rate and oxygen saturation were recorded every 5 min up to 30 minutes from the removal of the needle, and showed no significant differences in between the two groups.

Discussion

Though the invention of the nerve stimulator provided the advantage of localizing nerves, regional anesthesia still remained a blind procedure, until the advent of Ultrasonography which helps in real time visualisation of the brachial plexus and to guide the needle thereby minimizing the risk of injury to the nearby structures.

In our study both groups were comparable with respect to age, gender, BMI and ASA grade of the patients. No significant difference was found in between two groups. Therefore, clinically insignificant variations in age simply

helped us to alleviate confounding factors like distribution, metabolism, excretion and action of drug.

In our study, in the P group 41.38% cases required 4 min, and 1 case required 8 min (maximum) for block performance while in the U group, in 51.72% cases it was 3 min, and 6 min (maximum) for 1 case. The mean block performance time for group U and group P was 3.41min±0.88 and 4.65±1.11 min respectively. P value was 0.0001.Thus the difference of block performance time between the two groups was statistically significant.

In our study a trained and the same anaesthetist performed all the blocks. The procedure time was greater in the nerve stimulator group because of the variability in the relationship between the surface anatomy and nerve location whereas use of USG may minimize this variation.

Table 3 shows comparison of block performance time In between the two groups in various studies, where all except Duncan *et al*. [4] had results similar to our study.

Table 3: Block Performance time (minutes) by different authors

Studies	Ultrasonography Group		PNS Group		P value
	MEAN	SD	MEAN	SD	
Present Study	3.41	0.88	4.65	1.11	0.0001
Williams *et al*. [5]	5.0	2.4	9.8	7.5	0.0001
Ratnawat *et al*. [1]	6.27	1.1	8.0	1.53	<0.0001
Alfred *et al*. [6]	11.57	2.75	21.23	4.84	<0.0001
Mani K *et al*. [7]	2.58	0.65	5.82	0.84	<0.0001
Rupera *et al*. [8]	4.55	0.74	5.71	0.92	<0.0001
S Ramkrishna [9]	6.34	1.02	8.2	1.32	<0.0001
Duncan *et al*. [4]	7.27	3.88	8.8	1.73	0.05

The mean onset time for sensory block was found to be less in ultrasonography group than the nerve stimulator group in our study, but the difference was not statistically significant. P value was 0.4007. It was 8.75 ± 2.98 min in the U group and 9.45 ± 3.21 min in the P group.

Table 4. Shows comparison of time of onset of sensory block In between the two groups by different authors. Difference was statistically significant in all studies except that of Duncan *et al*. [4] and the present study.

Table 4: Onset of Sensory Block (minutes) by different authors

Studies	Ultrasonography Group		PNS Group		P value
	Mean	SD	Mean	SD	
Present Study	8.75	2.98	9.45	3.21	0.4007
Ratnawat *et al*. [1]	6.46	1.02	7.68	1.33	<0.0001
Alfred *et al*. [6]	12.83	3.64	16	3.57	0.001
Rupera *et al*. [8]	2.97	0.72	3.63	0.76	0.002
S Ramkrishna. [9]	6.53	1.13	7.79	1.21	<0.0001
Duncan *et al*. [4]	5.47	1.25	5.90	1.18	0.174

The time taken for onset of motor block was less in the U group(9.45 ± 3.2 min) than in the P group (10.14±2.4 min), this difference was not statistically significant (p = 0.4405).

Table 5 shows comparison of time of onset of motor block In between the two groups by different authors. Difference was statistically significant in all studies except that of Duncan *et al*. [4] Rupera *et al*. [8] and the present study.

Table 5: Onset of Motor Block (minutes) by different authors

Studies	Ultrasonography Group		Pns Group		P Value
	Mean	Sd	Mean	Sd	
Present Study	10.14	2.44	10.65	2.62	0.4405
Ratnawat *Et al*. [1]	8.10	1.02	9.94	1.28	<0.0001
Alfred *Et al*. [6]	23	4.27	27	3.85	<0.0001
Rupera *Et al*. [8]	4.55	0.78	5.13	0.71	0.007
S Ramkrishna. [9]	8.01	1.18	9.63	1.41	<0.0001
Duncan *Et al*. [4]	7.53	1.92	8.07	1.26	0.20

The sonographic imaging-guided supraclavicular block helps in assessing the size, depth, and exact location along with the anatomy of the adjacent structures. USG assists in exact placement of the needle and helps in depositing the local anaesthetic in the accurate site and also helps in visualizing the spread of the drug. This, in turn, hastens the onset of the block.

We have used a fixed volume of 30ml of local anaesthetic for all the patients in both the groups; however, in some studies the amount of local anaesthetic was calculated according to the body weight. There is also a difference in the type, concentration and additives used in the local anaesthetic chosen for the study hence the vast difference in parameters like onset of sensory block, onset of motor block, time to achieve complete sensory and motor block and the duration of the block. However, these pharmacological differences do not have any impact on the procedure of performing the block, hence does not create any bias in the block performance time.

Block success in our study was defined as diminished sensation to pinprick in each of the radial, ulnar, median, and musculocutaneous nerve distributions when measured 20 min after block performance. Block success was achieved in 25 patients in P group out of 30 (83.3%), while in U group, out of 30 only 2 patient did not achieve block success (93.3%) P = 0.68. This difference was not statistically significant.

The haemodynamic parameters were observed every 5 minutes after execution of the block and were comparable in both the groups throughout the study.

There were no incidences of complications such as vascular punctures, pneumothorax or nerve injuries during the procedure in our study; and no respiratory discomfort in the patients followed up 24 hrs post operatively in both the groups. Our limitation was that study was conducted on ASA I and II patients with Body Mass Index ≤35 kg/m^2, hence the results are not applicable on patients having BMI more than 35 kg/m^2. And patients with higher ASA grading.

All the blocks were performed by a single anaesthetist who, had no prior experience of both the techniques and had been trained with both the modalities before starting the study. Thus, the learning curve which may have affected the procedure times for new learners or seasoned anaesthetists who are already comfortable with the Nerve Stimulation or Ultrasonography, will be different.

Conclusion

From the summary of the results, it can be concluded that ultrasonography is a faster to perform, more accurate

modality to perform the supraclavicular block.

However Ultrasonography has slight advantage over Nerve Stimulation technique in terms of onset of the sensory block, onset of motor block, the number of successful blocks; with no difference in the haemodynamic changes in both the groups. Both the techniques were safe to perform without any complications.

At the end, it is worth mentioning that ultimately the technique to be used depends upon the availability of the instruments, choice of the anaesthetist and the understanding of the patient.

References

1. Ratnawat A, Bhati FS, Khatri C, Srinivasan B, Sangwan P, Chouhan DP. Comparative study between nerve stimulator guided technique and ultrasound guided technique of supraclavicular nerve block for upper limb surgery. Int. J Res Med Sci. 2016; 4:2101-6.
2. Horlocker Terese T, Marhofer Peter MD, Chan Vincent WS. Ultrasound-Guided Regional Anesthesia: Current Concepts and Future Trends. Regional Anesthesia. 2007; 104(5):1265-1269. doi: 10.16..1213/01.ane.0000260614.32794.7b
3. Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, McCartney CJ, Franco CD *et al*. Upper extremity regional anaesthesia: essentials of our current understanding, 2008. Reg Anesth Pain Med. 2009; 34:134-70.
4. Duncan M, Shetti AN, Tripathy DK, Roshansingh D, Krishnaveni N. A comparative study of nerve stimulator versus ultrasound-guided supraclavicular brachial plexus block. Anesth Essays Res. 2013; 7(3):359-364. doi:10.4103/0259-1162.123235.
5. Williams SR, Chouinard P, Arcand G, Harris P, Ruel M, Boudreault D *et al*. Ultrasound guidance speeds execution and improves the quality of supraclavicular block. Anesthesia & Analgesia. 2003; 97(5):1518-23.
6. Alfred VM, Srinivasan G, Zachariah M. Comparison of ultrasound with peripheral nerve stimulator guided technique for supraclavicular block in upper limb surgeries: A randomized controlled trial. Anesth Essays Res. 2018; 12:50-4.
7. Mani KV, Arunpandiyan V, Shankar R. A study on comparison between ultrasound guided technique and peripheral nerve stimulator guided technique in performing brachial plexus block (supraclavicular approach) for upper limb surgeries. International Journal of Medical and Health Research. 2017; 3(7):61-64.
8. Rupera KB, Khara BN, Shah VR, Parikh BK. Supra-clavicular brachial plexus block: ultrasonography guided technique offer advantage over peripheral nerve stimulator guided technique. National journal of medical research. 2013; 3:3.
9. Ramakrishna S. Ultrasound Versus Nerve Stimulator-guided Technique of supraclavicular nerve block for upper limb surgery: A prospective randomized comparative study. Asian Pac. J Health Sci. 2018; 5(3):103-108.