



Comparing the Efficacy of Ultrasound-Guided Supraclavicular Brachial Plexus Block with or without Intercostobrachial Nerve Block for Forearm Surgeries – An Observational Study

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Background: Supraclavicular block is a commonly used block for regional anesthesia in forearm surgeries. The rationale behind this study is to prove that ultrasound (USG)-guided supraclavicular block is sufficient to provide adequate analgesia and eliminates the need for an intercostobrachial (ICB) block for forearm surgeries. **Aim:** We aimed to find whether there is any additional advantage in performing ICB block along with supraclavicular brachial plexus block in forearm surgeries. **Methods:** In this study, 110 patients undergoing elective forearm surgeries under USG-guided supraclavicular block were observed. A block solution of 30 ml was made and 20 ml was given as supraclavicular block. Group ICB, received an additional 10 ml ICB nerve block (ICBN) and group Non-ICB who did not receive an additional block. The outcomes assessed were intraoperative and postoperative tourniquet pain scores, hemodynamic changes, the onset of sensory and motor block, sensory and motor scoring, postoperative rescue analgesia time, and patient satisfaction. Data were analyzed using SPSS 25.0 version. **Results:** The mean intraoperative and postoperative pain scores in the group ICB was 0.76 ± 1.677 and in the non-ICB was 0.69 ± 1.439 and was no significant. Furthermore, there was no statistically significant difference between the immediate and late postoperative pain scores between the two groups. **Conclusion:** Our study has concluded that a sole USG-guided supraclavicular block provides adequate anesthesia of the operated forearm. Additional blocking of the ICBN does not affect the incidence or course of tourniquet pain.

Key words: Supraclavicular block, tourniquet pain, forearm, analgesia, patient satisfaction, peripheral neuropathy, local anesthetic, blood pressure

INTRODUCTION

The supraclavicular approach to brachial plexus block is used commonly in orthopedic upper limb surgeries and is associated with a quick onset of anesthesia and a high success rate.¹ Tourniquet is used commonly in these kinds of limb procedures to achieve a bloodless field.² Intercostobrachial (ICB) block is administered to reduce pain due to the application of tourniquet with the assumption that tourniquet pain is caused by compression of the T2 nerve fiber.³ ICB nerve arises from the second thoracic intercostal nerve and supplies the upper medial and posterior arm. The nerve is

not a component of the brachial plexus and an additional block of the nerve is recommended to reduce tourniquet pain.⁴

In common practice, ICBN is administered with a supraclavicular brachial plexus block; however, there is no concrete evidence comparing the efficacy of this practice and should encourage further research. Our primary objective was to assess whether the ICB block given subsequent to a supraclavicular brachial plexus block does in fact reduces tourniquet pain in forearm surgeries. Our secondary objectives included the onset of sensory block and motor blockade, sensory

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and motor scoring, hemodynamic changes, postoperative rescue analgesia, and patient satisfaction between the group which received ICB block and the group which did not receive the block.

MATERIALS AND METHODS

The study was initiated after approval by the Ethics and Scientific Committee (KMC MLR 08-19/336). It was designed to be a comparative, observational study and was conducted after registering with the clinical trial registry of India (CTRI/2020/03/024380). The study included 110 adult participants, scheduled to undergo forearm surgeries under regional anesthesia. The sample size of 110 was determined by the following calculation.

$$n = \frac{(Z_{\alpha} 2PQ + Z_{1-\beta} P_1q_1 + P_2q_2)}{(P_1 - P_2)}$$

where, $P_1 = 0.89$, $P_2 = 0.87$ and $n = 55$ in each group. Total $n = 55 \times 2 = 110$ at $Z_{1-\alpha} = 1.96$ at 5% level of significance. $Z_{1-\beta} = 0.84$ at 80% power with 95% confidence interval with respect to the study by Kubota *et al.* the minimum sample size required in each group was 55.⁵ The sampling method used was convenience nonprobability sampling.

Patients observed in this study were those scheduled for upper limb surgeries with the planned use of a tourniquet and who desired regional anesthesia as the primary anesthetic technique. The inclusion criteria were, bodyweight between 50 kg to 70 kg, patients between 18 and 70 years of age and an ASA physical status I and II. The exclusion criteria were history of allergy to local anesthetics, coagulopathy or bleeding diathesis, history of peripheral neuropathy, local skin infection, baseline systolic blood pressure ≥ 150 mmHg, baseline diastolic blood pressure ≥ 85 mmHg, history of chronic pain syndromes, and history of regular drug use.

A written informed consent was procured from those willing to participate. The patients underwent a thorough preanesthetic evaluation and preoperative orders were issued.

In the preoperative room, the monitors connected were pulse oximeter, electrocardiogram, and noninvasive blood pressure. An appropriate sized cannula was secured for intravenous drug and fluid administration. An alternate oxygen source and emergency drugs were kept ready. Baseline hemodynamic readings and preoperative VAS pain score of the operating limb were noted.

A total of 110 patients were observed in this study. Patients who received both supraclavicular brachial plexus block and ICB block were called ICB group and the patients who received only supraclavicular brachial plexus block were named as Non-ICB group.

They were given the supraclavicular brachial plexus block under ultrasound (USG) guidance by an anesthesiologist with more than 3 years of experience (expert in giving regional blocks) and who was not a part of the study. Data were recorded by an investigator from the study team.

A block solution was prepared with 15 ml of 0.5% bupivacaine (Anawin, Neon pharmaceuticals) and 15 ml of 2% lignocaine with adrenaline (1: 200,000, Neon pharmaceuticals). The total block solution was 30 ml. All the patients, who were observed in the study, received 20 ml of the block solution for the supraclavicular block. Fifty-five patients who received additional ICB block were observed as ICB group and 55 patients who did not receive the block were observed as Non-ICB group.

The patients were positioned supine for the supraclavicular block with arms in an adducted position. Under aseptic conditions, a preliminary USG scan (Venue 50, GE Medical Systems USA) was conducted over the supraclavicular region. Using a linear transducer 8-13 MHz, the brachial plexus was identified as small oval hypoechoic structures. A 21G, 5 cm insulated needle (Stimuplex A, B Braun, Japan) was inserted from lateral to medial direction by an in-plane short-axis technique. The objective was to place the needle in the brachial plexus sheath. The tip of the needle then penetrated the fascial sheath and was advanced gradually and the drug was injected to visualize the spread within the brachial plexus and displacement of trunks and divisions.

For ICB block, patients were positioned supine with arms in an abducted position. Under aseptic conditions, 10 ml of block solution was infiltrated subcutaneously along the axillary crease superiorly and inferiorly using a 25 G 1.5-inch needle.

Sensory block was assessed by the pin-prick method with a 23G hypodermic needle over the dermatomal distribution of the upper limb nerves and was compared with the contralateral arm. The patients were given a score of 0 if there was complete sensory block, 1 if there was reduced sensation and 2 if the patient had normal sensation. For assessing motor blockade, they were given a score of 0 for total paralysis of the limb, 1 for decreased motor strength with the ability to move fingers and 2 for complete motor function.⁶ These parameters were measured every 5 min till 20 min after dispensing the nerve block. The absence of sensation to pinprick along the dermatomal distribution was considered as successful block performance. Onset time for sensory and motor blockade was also noted.

Tourniquet management

After the supraclavicular block performance, the patient remained in the supine position. Exsanguination of the operating limb was done elevating the limb and a pneumatic

tourniquet (8 cm × 46 cm fabric cuff; MDE GmbH and Co. KG, Germany) was placed on the arm with proper padding. The tourniquet was inflated to 100 mmHg above the baseline systolic blood pressure. It remained inflated for the duration of the surgery while the patient was observed for any signs of tourniquet-related distress. The patients were assessed for any intraoperative tourniquet pain or discomfort above the elbow and the values were documented using 10-point VAS pain scores at 5, 10, and 15 min and then every 10 min until the surgery was over. Postoperatively, the patients were assessed for postoperative tourniquet pain using VAS pain score. The time frame for tourniquet pain assessment was done from intraoperative pre tourniquet insufflation period to 4 h postoperatively.

Failure to achieve surgical anesthesia after 30 min of performing the block was considered as block failure. For a failed block with a VAS score >3, an intervention was done by conversion to general anesthesia. The number of patients requesting postoperative analgesia also were recorded.

Patient satisfaction was assessed and recorded using a two-point assessment scale where, 0 stood for unsatisfied and 1 for satisfied. They were asked to mark satisfied only if they would be compliant to accept the same block in future. Certain adverse effects such as diaphragmatic paresis, accidental vascular puncture, pneumothorax, and Horner's syndrome, if present, were recorded.

Once all the observations were recorded, the data collected were analyzed. It was analyzed using the median and interquartile ranges for all parameters. Nonparametric (Mann–Whitney test) was performed to compare the VAS score between the two blockades. A Statistical Package for the Social Science software (International Business management, version 25.0. Armonk, United States of America) was used to do the analysis. $P < 0.05$ was considered statistically significant.

RESULTS

All the USG-guided supraclavicular blocks were successful. There was no statistically significant variation in the demographic data between the two groups [Table 1].

Similarly, the mean heart rate, systolic, and diastolic blood pressure between the two groups were not statistically significant.

There was no statistically significant variation in the preoperative, intraoperative, and postoperative VAS scores for tourniquet pain between the two groups [Table 2].

The mean sensory block onset time achieved in group ICB post block was 6.04 ± 1.905 min and in non-ICB group was 6.00 ± 2.301 min with a $P = 0.928$ and was nil significant [Figure 1].

Similarly, the motor block onset time in group ICB was 9.33 ± 2.742 min and in non-ICB group was 8.78 ± 2.982 min with a $P = 0.321$ and was no statistically significant [Figure 2]. Sensory and motor scores between the two groups were statistically insignificant.

In the postoperative period, 16.4% of patients in Group ICB requested analgesics after the procedures, while in the non-ICB group 9.1% of patients requested postoperative analgesia which was not significant, as shown in Figure 3.

In the postoperative period, in Group ICB 90.9% of patients were satisfied with the pain relief and procedure done. Similarly, in Group Non-ICB 90.9% of patients were satisfied with the outcome [Figure 4].

There were no adverse events observed during the surgery.

DISCUSSION

In our study, the primary outcome measured included intra-operative and post-operative tourniquet pain scores. The secondary outcome measured included the onset of sensory block and motor blockade, sensory and motor scoring, hemodynamic changes, postoperative rescue analgesia, and patient satisfaction.

In our study, we observed that there was no statistically significant variation in the tourniquet pain scores between the group which received ICB block and the group which did not receive the block, after a supraclavicular brachial plexus block.

It is a common practice to supplement supraclavicular brachial plexus block with ICB block.⁴ We aimed to find

Table 1: Demographic data

	ICB	NICB	<i>P</i>
Gender			
Male	30	29	0.848 (NS)
Female	25	26	
Age (mean)	40.18	42.62	0.390 (NS)

ICB=Intercostobrachial; NS=Non significance; NICB=Non intercostobrachial

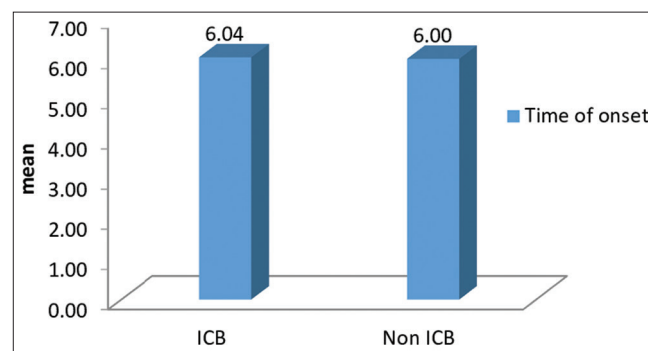


Figure 1: Mean onset time of sensory block

Table 2: Pain scores

Group	<i>n</i>	Mean±SD	Median (IQR)	Mann–Whitney test (<i>P</i>)
Preoperative VAS score [#]				
ICB	55	4.02±2.273	53-6	0.178 (NS)
Non-ICB	55	3.56±2.062	42-5	
IO tourniquet pain score [§]				
ICB	55	0.76±1.677	0 (0-0)	1.000 (NS)
Non-ICB	55	0.69±1.439	0 (0-0)	
Tourniquet pain score-immediate postoperative*				
ICB	55	0.93±1.773	0 (0-0)	0.943 (NS)
Non-ICB	55	0.80±1.471	0 (0-2)	
Pain score-late postoperative [†]				
ICB	55	0.64±1.470	0 (0-0)	0.955 (NS)
Non-ICB	55	0.55±1.184	0 (0-0)	

[‡]Preoperative VAS; [§]Intraoperative tourniquet pain score; *Tourniquet pain score-immediate postoperative; [†]Tourniquet pain score late postoperative. VAS=Visual analog score; IQR=Interquartile range; ICB=Intercostobrachial; SD=Standard deviation; NS=Non significance; IO=Intraoperative

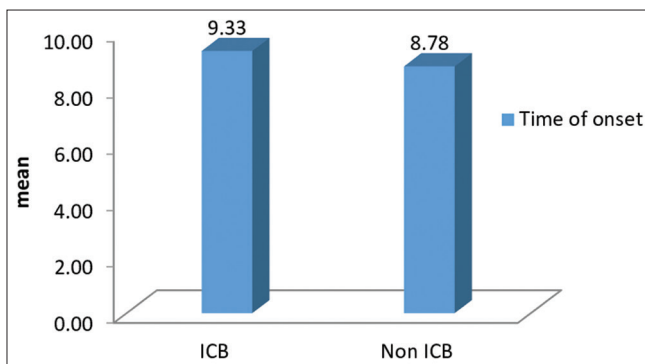


Figure 2: Mean onset time of motor block

whether there was any additional advantage in giving ICB block along with supraclavicular brachial plexus block in forearm surgeries, which we failed to prove.

Tourniquet pain is defined as a dull aching pain along the area of its application.⁷ Few studies show that the pain can be attributed to the stimulation of the slowly conducting C fibers which are not blocked by compression.⁸ The constant pressure from the tourniquet along with the activation of the dorsal horn accentuates the dull aching pain.⁹ It has also been observed that ICB nerve block will not alleviate the ischemic and compressive pain caused by tourniquet and additional analgesics have to be supplemented for the pain.⁴ These observations prove that blockade of ICB nerve may not alleviate pain due to tourniquet.

In a retrospective study conducted on 57 patients, the need for supplementary anesthesia for tourniquet pain was observed as the primary outcome in procedures done under axillary brachial plexus block. The requirement for supplementary anesthesia for tourniquet pain was higher in the group that did not receive subcutaneous ring injection than in the group in

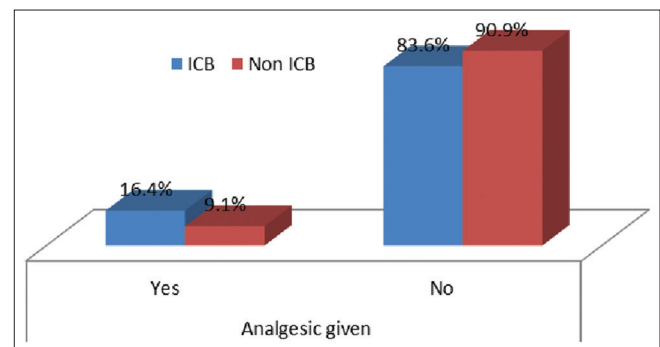


Figure 3: Percentage of patients requesting analgesia

which it was administered.⁵ This finding negates our results, but the primary block given by us was the supraclavicular block, which can be a source of difference.

In another single-blinded randomized study conducted on 82 patients who underwent forearm surgeries, the patients were divided into two groups. One group received USG-guided axillary block and the other group received infraclavicular block, both were done without an ICB block. The primary outcome measured was tourniquet pain. The authors concluded that in surgeries of moderate duration, both blocks had similar incidences of tourniquet pain. The onset time and severity of tourniquet pain were similar in both groups. Four patients in the axillary brachial plexus block group and one in the infraclavicular group had tourniquet pain and the rest of the patients were free of pain and no additional interventions were required.¹⁰ This study observed that even without an ICB block, the patients in both groups tolerated tourniquet pain well. In our study as well, we found that the incidence of tourniquet pain was negligible in both groups, even though our

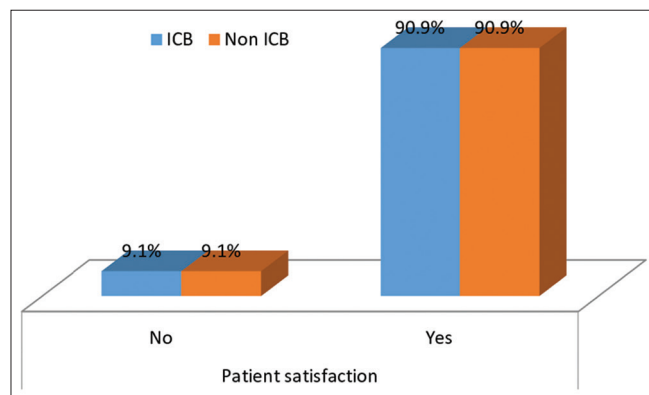


Figure 4: Patient satisfaction with pain relief

primary block technique was supraclavicular brachial plexus block.

A 2013 updated meta-analysis and review concluded that in contrast to other brachial plexus blocks, the infraclavicular block had a reduced risk of tourniquet pain but did not specify a precise definition or any method to measure this result.¹¹ Conversely in our study, we opted for supraclavicular brachial plexus block as our primary block instead of infraclavicular block and concluded that it is effectual enough to decrease the risk of tourniquet pain in upper arm surgery.

There was also documented proof that in the infraclavicular pyramidal space, infraclavicular brachial nerve lies adjacent to the other nerves that supply the skin of the upper arm, which could get blocked with local anesthetic spread and reduce tourniquet pain.¹² The above study proves that localized spread of the anesthetic drugs to the concerned nerves causing tourniquet pain can reduce the discomfort due to tourniquet application.

This assumption should open up a query regarding the absence of tourniquet pain in patients receiving supraclavicular block as revealed in our study. The main observations noted in our study, i.e., the incidence of intraoperative tourniquet pain, postoperative tourniquet pain, first analgesic request time, and patient satisfaction were found to be similar in the two groups. Thus, the practice of administering an additional ICB block in patients receiving supraclavicular block is debatable.

There have not been many published research papers, which have studied tourniquet pain after administering supraclavicular brachial plexus block as a primary observation. Hence, our study proves that the requirement of additional ICB block after supraclavicular block is not mandatory. This study provides evidence that can help decrease the number of injections administered to the patient, allow lower volumes of local anesthetics to be injected and increase patient compliance in future practices.

The study population in our study had similar baseline characteristics and was comparable. Furthermore, the use of convenience nonprobability sampling decreased the risk of bias in the study. It was carried out in more than one center which improves its external validity and reliable test were performed to assess the secondary outcomes including motor and sensory blockade.

About 9.1% of patients in the ICB and non-ICB group were unsatisfied with the supraclavicular brachial plexus block technique even though the postoperative pain score were less. This can be attributed to discomfort during the procedure, residual sedation, and patient's expectations and preferences.

There are a few limitations to the study. We did not include the duration of the surgery and the duration of tourniquet inflation time that would have some influence on the outcome. However, all our surgeries finished within 90 min of commencement. Furthermore, we did not include the type of postoperative analgesia that was used as supplementary analgesia. The involvement of multiple operators performing the block added to the confounding factors. Another limitation was that the inter-individual pain perception threshold was not taken into account for this study.

These observations can be scrutinized in succeeding studies that researchers can undertake. Randomized controlled trials can be carried out which will provide results with better accuracy. The use of intraoperative sedation can be incorporated as an outcome to observe better tolerance to tourniquet pain. The use of a similar brachial plexus block with combinations of local anesthetics, use of additives and its action on the intraoperative and postoperative incidence of tourniquet pain can also be studied.

In spite of these limitations, we aspire that our study can open up the wide possibility of further research on this subject. Future endeavors should also focus on improving the learning curve of USG-guided upper limb blocks and on decreasing the incidence of adverse effects while increasing the efficacy of the block performed.

CONCLUSION

Our study has concluded that a sole USG-guided supraclavicular block is sufficient to provide adequate anesthesia of the operated forearm and additional blockade of the ICBN does not affect the incidence or course of tourniquet pain.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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