

## A COMPARISON OF AXILLARY AND HUMERAL APPROACHES FOR BRACHIAL PLEXUS BLOCK USING PERIPHERAL NERVE STIMULATOR FOR BELOW ELBOW SURGERIES

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Received : 07/06/2023  
Received in revised form : 18/07/2023  
Accepted : 30/07/2023

**Keywords:**

Brachial plexus block, Axillary approach, Humeral approach, elbow surgeries.

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DOI: 10.47009/jamp.2023.5.4.267

Source of Support: Nil,  
Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2023; 5 (4); 1329-1334



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### Abstract

**Background:** The axillary block is one of the most prevalent ways of brachial plexus block. This block's accessible landmarks and simplicity suit various surgical procedures. The study aimed to assess the onset time and success rate of brachial plexus block utilizing the axillary method versus the humeral technique in patients having surgery on the forearm, wrist, and hand. **Materials and Methods:** A prospective, randomized study was conducted among 100 patients undergoing forearm or wrist surgery to compare the success rate, performance time, and onset of surgical anaesthesia using four-injection brachial plexus. Patients were stratified into Group A (axillary method, n = 50) and Group H (humeral method, n = 50) using a peripheral nerve stimulator. **Result:** An equal number of patients (n = 50) were included in both the group, A and H, which reported an incidence of a complete block (90% vs. 92%), followed by onset (9.44+/-3.72 min vs. 10.87+/-4.12 min) with no significant difference between both the groups. Similar performance times were recorded in groups A and H (6.71+/- 1.70 min versus 7.39+/- 1.80 min). Patients in both groups did not report a significant difference between the ulnar and radial nerve blocks. A significant difference was reported in group A with lower block performance pain and discomfort using a visual analogue scale (5.44 +/-1.42 versus 6.7+/-1.658; P < 0.005). **Conclusion:** Both axillary and humeral approaches provide a higher success rate and rapid onset of sensory anaesthesia for using a brachial plexus block.

## INTRODUCTION

One of the most used regional anaesthetic methods for hand, forearm, and elbow surgeries is the brachial plexus block at the axilla. Nevertheless, based on the strategy employed and the definition of success, the success rate of this block may change.<sup>[1]</sup> Brachial plexus blocks are frequently utilized during upper limb surgery to provide anaesthetic. Different failure and complication rates exist for inter scalene, supraclavicular, axillary, and humeral canal approaches, whether or not a neurostimulator is used.<sup>[2]</sup> Research has demonstrated that peripheral nerve blocks are typically better tolerated than alternative modalities like oral painkillers or general anaesthesia and produce greater regional analgesia. Peripheral nerve blocks should never be used if the patient is allergic to local anaesthetics, cannot

comply, or refuses. A nerve injection should be delayed or reconsidered if an active infection occurs at the injection site. These pre-existing neurological impairments are present along with the block's distribution, a patient's coagulopathy, or if they are on antithrombotic medication.<sup>[3]</sup>

The humeral method offered a higher success rate than the axillary approach, according to research that compared it to a traditional axillary block. It contrasted a four-injection approach at the humeral level with a two-injection axillary block in which the nerves innervating the operative site were found and injected—the musculocutaneous and another nerve.<sup>[1]</sup> The brachial plexus is the neural supply to the upper limb, composed of cords, divisions, trunks, and roots. It is located between the anterior and medius muscles of the scalenus. A nerve stimulator for peripheral nerve blocking has been the most

popular method since the invention of ultrasound guidance.<sup>[4]</sup>

A nerve stimulator finds the four distal nerves of the plexus. They are each independently injected in the multiple-injection axillary block approach, which has been demonstrated to have a quick start and a high success rate. However, this approach could be more challenging and time-consuming than other axillary block procedures. This double-blind trial compared a simpler multiple-nerve stimulation method without the ulnar nerve to the 4-injection method.<sup>[5]</sup> One of the methods employed is the well-described use of a peripheral nerve stimulator (PNS) to help accomplish the axillary approach to the brachial plexus block. Its usage has been encouraged because of the potential danger of paraesthesia-related neurological damage. Nevertheless, there was no difference in the success rates of the various approaches in two trials that compared peripheral nerve stimulation with either paraesthesia and transarterial fixation technique or with paraesthesia and insertion of a catheter into the brachial plexus sheath technique.<sup>[6]</sup>

Based on these findings, we believe comparing the axillary approach with the humeral method would be more reliable. Therefore, the axillary technique versus the humeral approach to the brachial plexus block was compared in this prospective, randomized trial. The study aimed to assess the onset time and success rate of brachial plexus block utilizing the axillary method versus the humeral technique in patients having surgery on the forearm, wrist, and hand. Intravenous access was achieved using a venous cannula of adequate size. Intravenous fluid administration was initiated. Pulse oximetry, noninvasive blood pressure (NIBP), and an electrocardiogram (ECG) were all coupled. The baseline numbers were taken down. All patients received intravenous injections of midazolam (20 micrograms/kg) and fentanyl (1 microgram/kilogram) 15 minutes before the block. The four injections of brachial plexus block were conducted utilizing the peripheral nerve stimulator by axillary approach in Group A, and humeral approach in Group H. By adjusting the needle through the same entry point, the median nerve, radial nerve, musculocutaneous nerve, and ulnar nerve were detected in both ways.

## MATERIALS AND METHODS

A randomized single, blinded clinical study was conducted on 100 patients at the government Rajaji hospital, Madurai. After approval from the Madurai Medical College's Institutional Ethics Committee, pilot research was conducted to identify the study population and decide on the inclusion and exclusion criteria. The day before surgery, participants were told of the study's goal, the operation, and the anticipated research procedures after being properly screened for the abovementioned criteria. An aware consent was obtained.

### Inclusion Criteria

Both male and female patients, patients between the age of 20-50 years were considered in the study, ASA 1 and ASA 2, and patients undergoing surgery at the forearm and wrist were included.

### Exclusion Criteria

Patients who did not provide proper written consent, pregnant women, patients with Psychiatric illness, neuropathy, coagulopathy, infection at the puncture site, allergy to local anaesthetics, and surgeries using tourniquets were excluded.

The parameters observed in this study were the time taken to perform the block, the complete block after 30 minutes, the onset time for the sensory block, the onset time for the median nerve block, the musculocutaneous nerve block, the radial nerve block, and the ulnar nerve block, the VAS score after the block procedure, the motor block after 30 minutes, and the duration of postoperative analgesia. The selected patients were randomly assigned to two groups designated A and H. Each group received 50 patients. The alphabets A and H were chosen at random to provide randomization. A lot of patients were allocated to group A. Individuals with low H have been assigned to the group.

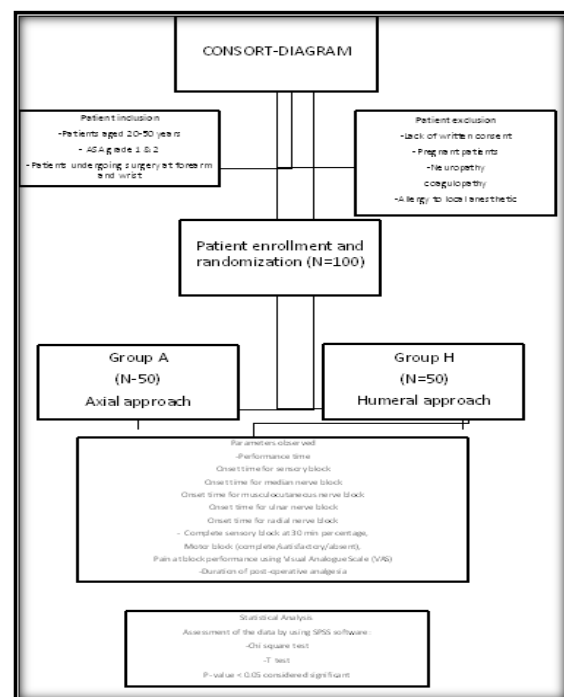


Figure 1: Consort diagram of the study

All patients fasted for 6 hours before surgery for meals and 2 hours for clear fluids. All patients received preoperative night sedation with a 5 mg diazepam pill. Intravenous access was achieved using a venous cannula of adequate size. Intravenous fluid administration was initiated. Pulse oximetry, noninvasive blood pressure (NIBP), and an electrocardiogram (ECG) were all coupled. The baseline numbers were taken down. All patients received intravenous injections of midazolam (20 micrograms/kg) and fentanyl (1

microgram/kilogram) 15 minutes before the block. The four injections of brachial plexus block were conducted utilizing the peripheral nerve stimulator by axillary approach in Group A, and humeral approach in Group H. By adjusting the needle through the same entry point, the median nerve, radial nerve, musculocutaneous nerve, and ulnar nerve were detected in both ways. The techniques for an axillary and humeral block of median, ulnar, musculocutaneous, and radial nerve were provided in the supplementary data. When the block was completed, the pain and suffering associated with the injections were measured using a visual analogue scale (VAS).

The observations were collated, and the results were reported as mean and standard deviation. The quantitative analysis was compared to the student's t-test for independent samples. The chi-square test was used to compare qualitative analysis. When applying these tests to compare mean values between two groups, a p-value of less than 0.05 was considered significant. SPSS version 11.5 statistical software was used for all analyses. All values were rounded to the nearest two decimals.

## RESULTS

Group A had a range of ages from 18 to 50, with an average age of 30.58 and a standard deviation of 10.5. Group H had a range of ages from 20 to 50, with an average age of 30.33 and a standard deviation of 9.05. Both groups were comparable in terms of age and gender distribution. Group A had 16 female patients and 29 male patients. Group H had 30 male patients and 16 female patients. The age distribution for both groups was similar. There were 25 patients in Group A between 20 and 30 years old, 12 between 31 and 40, and 8 between 41 and 50. There were 28 patients in Group H between 20 and 30 years old, ten between 31 and 40, and 8 between 41 and 50 [Figure 2].

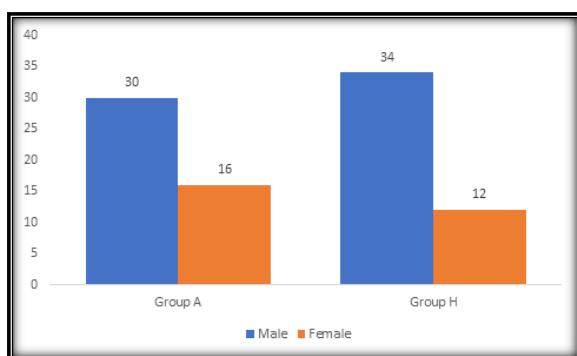


Figure 2: Gender distribution

Patients in Group A had a minimum weight of 40 kg and a maximum weight of 65 kg. The average weight was 51.14 kg, with a standard deviation of 6.42. Patients in Group H had a minimum weight of 45 kg and a maximum weight of 62 kg. The mean weight was 51.66 kg, with a standard deviation of 2.57. There was no significant difference in weight

between the two groups, and they were comparable in weight distribution. Group A had 43 hand surgeries and two forearm surgeries. Group H had 41 hand surgeries and five forearm surgeries.

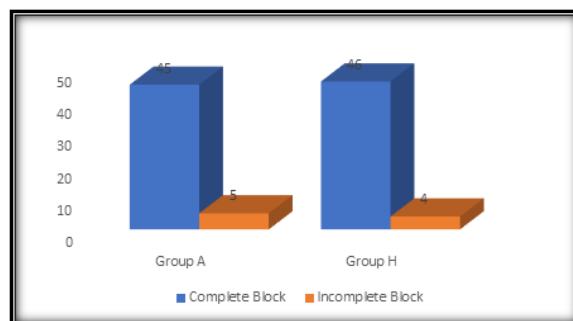


Figure 3: Surgical site distribution

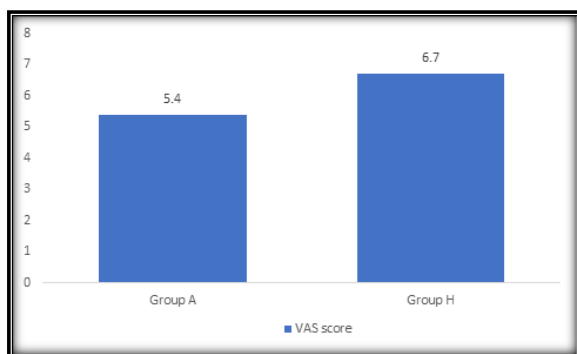
The lowest time required to complete the block in both groups was 4 minutes, while the maximum time required was 10 minutes. The average time to complete the block was 6.76 minutes in Group A and 7.35 minutes in Group H, with standard deviations of 1.65 and 1.86, respectively. There was no significant difference between the two groups.

The onset time for sensory block, median nerve block, musculocutaneous nerve block, ulnar nerve block, and radial nerve block varied in both groups. There was no significant difference in the onset times between the two groups. The mean onset time for the sensory block was 9.44 minutes in Group A and 10.87 minutes in Group H, while the mean onset times for median nerve block, musculocutaneous nerve block, ulnar nerve block, and radial nerve block ranged from 6.222 to 6.739 minutes in Group A and 7.065 to 7.28 minutes in Group H [Table 2].

The motor block was complete in 37 individuals in Group A and satisfactory in 8 cases. The motor block was complete in 36 individuals in Group H and satisfactory in 15 patients. The p-value was not significant in comparison [Table 1].

In Group A, 45 patients had a complete Sensory Block at the end of the 30-minute block treatment, whereas five patients had an incomplete block. In Group H, 46 patients had a complete Sensory Block at the end of the 30-minute block treatment, whereas four patients had an incomplete block. The p-value was not significant when compared [Table 3].

The VAS score after Block performance in Group A varies from 4 to 9, with a mean of  $5.4 \pm 1.42$ . The VAS score after Block performance in Group H varies from 4 to 9, with a mean of  $6.7 \pm 1.66$ . In contrast, the p-value was significant [Figure 3].

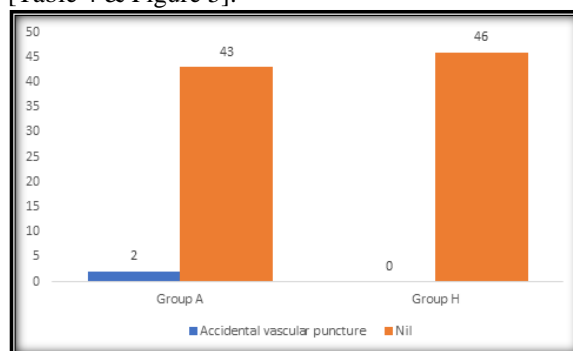


**Figure 4: VAS at Block Performance**

The total time required for postoperative analgesia in Group A ranged from 4 hours at the lowest to 9 hours at the maximum, with a mean of 5.31 hours and a standard deviation of 1.379. Group H ranged from 4 hours at the lowest to 9 hours at the highest, with a mean of 5.13 hours and a standard deviation of 1.641.

The P-value was not significant when compared [Table 4].

There were two vessel punctures in Group A. In Group H, there were no punctures. The results showed a p-value of 0.242, which was not significant. In neither group were any additional issues noted [Table 4 & Figure 5].



**Figure 5: Complications in Patients**

**Table 1: Demographic data of the study**

		GROUP - A	GROUP - H	P-value
Age	< 25	12	14	0.624
	26 – 50	21	21	
	> 50	12	11	
	Mean	39.333	37.696	
	SD	14.689	16.951	
Weight	< 50	9	11	0.538
	51 - 70	33	31	
	> 70	3	4	
	Mean	57.289	55.957	
	SD	8.877	11.505	
Motor block	Complete	37	36	0.833
	Satisfactory	8	10	

**Table 2: different evaluation parameters included in the study**

Parameters observed	Group A		Group H		P-Value
	Mean	SD	Mean	SD	
Performance time	6.71	1.701	7.28	1.807	0.228
OT	6.88	2.96	7.91	3.45	0.146
MT	6.33	2.9	6.52	3.475	0.78
MCT	6.44	2.743	7.28	3.757	0.228
UT	6.222	2.852	7.065	3.738	0.23
RT	6.333	2.697	6.739	2.832	0.486

**Table 3: Complete sensory block at the end of 30 minutes**

Complete the block at the end of 30 minutes	Group A		Group H	
	N	%	N	%
Complete Block	45	90	46	92
Incomplete Block	5	10	4	8
Total	50	100	50	100

**Table 4: Duration of postoperative analgesia and complications among groups**

		GROUP - A	GROUP - H	P-value
Duration of Post OP Analgesia	Mean	5.31	5.13	0.571
	SD	1.379	1.641	
Complications	Accidental vascular puncture	2	0	0.242
	Nil	43	46	

## DISCUSSION

The brachial plexus block can be used for surgical procedures on the hand, forearm, and elbow. The brachial plexus block's success rate varies depending on the method employed. The axillary approach is

one of the most often used brachial plexus block techniques at the axilla level. Evoking paresthesia, transfixing the axillary artery, employing a peripheral nerve stimulator, or using ultrasonography are all methods that can be used to do this treatment. According to research, utilizing a peripheral nerve

stimulator (PNS) to accomplish an axillary block gave identical results to stimulating all four main nerves at the axillary crease. This is because the musculocutaneous nerve and another nerve that innervates the surgery site were stimulated.<sup>[6]</sup> The method of numerous nerve blocks at the humeral canal using a neurostimulator is called the humeral approach. The brachial plexus's principal nerves are all selectively blocked using this method, which has a high success rate.<sup>[7]</sup>

Several axillary investigations showed that a four-injection strategy resulted in early onset and frequent success. The research compared the four injections of brachial plexus block utilizing a peripheral nerve stimulator using the axillary method with the humeral technique. They concluded that the differences between the two techniques were not clinically significant and that the axillary and the humeral routes offer a high success rate and a quick onset of sensory anaesthesia.<sup>[5]</sup> To determine the sample size for our investigation, we assumed that a 20% difference in success rate would be regarded as clinically significant. The needed sample size for the two groups was 45 patients, with a power of 80% to detect a 20% difference in success rate at a significance level of 0.05. Fifty patients were included in each group to account for dropouts, and the research involved 100 patients. The study population was created using examples from earlier research.<sup>[1,8]</sup>

The research comprised individuals of both sexes between the ages of 20 and 50 who weighed between 40 and 70 kg. Our investigation used the four-injection approach at the humeral and axillary levels. The research involved finding and injecting the musculocutaneous nerve and another nerve that innervates the surgery site.<sup>[1]</sup> Another investigation involved finding and injecting the median nerve and radial nerve.<sup>[9]</sup> Compared to conventional techniques, it employed a peripheral nerve stimulator to treat axillary block and had better results with targeted stimulation of the four principal nerves. Multiple paresthesias increased the likelihood of a successful block, according to research.<sup>[10]</sup> We decided to modify four injection techniques for blocking the brachial plexus using a peripheral nerve stimulator based on the findings of the investigations, as mentioned earlier.

Our investigation evaluated the motor block 30 minutes after the block technique was finished. Depending on the variety of motions present after the 30 minutes, the motor block was rated as complete, adequate, or absent. This was in line with the findings of Sia et al. During 30 minutes, the research evaluated the motor block every 5 minutes. Scores ranged from 0 for no motor block, 1 for little movements, and 2 for no movement.<sup>[9]</sup>

In our study, the pain and discomfort at the end of the block were measured using the Visual Analog Scale (VAS). A verbal rating scale from 1 for pleasant to 4 for excruciating discomfort was used by Fuzier et al.<sup>[9]</sup> The Visual Analog Scale (VAS) was employed

by Sia et al. to quantify the discomfort felt during the block technique.<sup>[5]</sup> In our investigation, the intercostobrachial and medial cutaneous nerve of the arm and forearm were blocked by infiltrating the skin with 5 ml of the local anaesthetic mixture on either side of the axillary artery Group A and the brachial artery in Group H. The median, musculocutaneous, ulnar, and radial nerves were blocked with a 5 ml dose of a local anaesthetic combination. The local anaesthetic combination was utilized in this trial for a total amount of 25 ml. Compared to the coracoid route, which only requires two injections of ropivacaine, the axillary approach to the brachial plexus causes a quicker start of the block and better dissemination of analgesia.<sup>[11]</sup>

90% of Group A's entire blocks were successful, compared to 92% of Group H's. With a p-value of 0.43 ( $p > 0.05$ ), the differences were statistically not significant when compared. In contrast, the research found that the humeral technique had a higher success rate (88%) than the traditional axillary method (54%).<sup>[1]</sup> Group A and Group H had the same onset time, so they did not differ. According to one research, following three injections of 1.5% lidocaine with epinephrine, blocks were complete in 47% of patients after 10 minutes and 90% at 20 minutes. The differences in local anaesthetic solutions employed in various investigations made comparing the onset time challenging.<sup>[12]</sup>

The median nerve block onset time in Group A was 6.33+/-2.98 minutes. The median nerve block onset time in Group H was 6.52+/-3.60 minutes. The findings agreed with those of Sia et al.<sup>[8]</sup> The research did not discover a delay at the beginning of a sensory block of the median nerve.<sup>[13]</sup> In conclusion, the humeral group's pain score was much greater. Our findings contradicted another study, which found that individuals sedated with midazolam and sufentanil had low pain levels in the humeral approach.<sup>[14]</sup> In group A, there were two vessel punctures (4%). In group H (0%), there were no vascular punctures. In both research groups, Sia et al. observed vascular puncture, hematoma development, and symptoms of intravascular injection. Sia et al. reported no neurological problems, consistent with our findings.<sup>[8]</sup>

## CONCLUSION

Based on the results of our investigation, it was concluded that the differences between the four injections of brachial plexus block employing a peripheral nerve stimulator performed via the axillary route and the humeral technique were clinically less significant. With identical success and complication rates, both techniques can be employed for procedures below the elbow when employing a peripheral nerve stimulator.

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