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Comparison of Supraclavicular Brachial Plexus Block Para-Vascular Approach and Infraclavicular Brachial Plexus Block in providing Surgical Anesthesia for Below Elbow Operation

Wafaa N. Saker, R.K. K.Khalil, M.A. Elhadad and A.M. Abosakaya
Anesthesia and Intensive Care Department, Faculty of Medicine, Benha University, Benha, Egypt
E-mail: wafaasaker69@gmail.com

Abstract

Background: Regional anesthesia presents considerable advantages over general anesthesia, such as enhanced hemodynamic stability, superior postoperative pain relief, and expedited postoperative recovery.

Aim: This research aims to evaluate the effectiveness of supraclavicular versus infraclavicular brachial plexus blocks in patients undergoing surgeries below the elbow.

Patients and Methods: The study was conducted with 70 patients who were scheduled for below-elbow surgeries. They were divided into two groups: Group A (35 patients receiving supraclavicular block) and Group B (35 patients receiving infraclavicular block). Data collected included block performance time, onset times for sensory and motor blocks, block duration, complication rates, block success rate, and the need for intraoperative analgesia.

Results: Group A experienced significantly quicker onset times for sensory (7 ± 2 minutes) and motor blocks (8 ± 2 minutes) compared to Group B (sensory: 12 ± 2 minutes, motor: 13 ± 2 minutes), with p-values less than 0.001. The block performance times were similar between the groups (Group A: 9 ± 3 minutes, Group B: 9 ± 2 minutes, p = 0.544). There were no significant differences in the duration of sensory and motor blocks between the two groups. However, complications were more prevalent in Group A, including issues such as breathing difficulty, Horner's syndrome, and vascular puncture.

Conclusion: While the supraclavicular block achieves quicker onset times compared to the infraclavicular block, it also carries a higher risk of complications. Nevertheless, both methods are effective for providing anesthesia in below-elbow surgical procedures.

Keywords: Regional anesthesia; Brachial plexus block; Supraclavicular block; Infraclavicular block; Below-elbow surgeries.

1.Introduction

Brachial plexus blockade is a cornerstone technique in regional anesthesia, particularly for surgeries of the upper limb [1]. By providing effective sensory and motor blockade, it offers significant advantages over general anesthesia, including reduced postoperative pain and quicker recovery times [2]. The choice of approach for brachial plexus block—whether supraclavicular or infraclavicular—depends on various factors including the site of surgery, patient anatomy, and clinician expertise. Each approach has distinct anatomical targets and potential complication profiles, influencing their suitability for specific surgical procedures [3, 4].

The supraclavicular block, often referred to as the 'classic' approach, targets the brachial plexus at the level of the subclavian artery. This approach is favored for its rapid onset and comprehensive anesthesia of the arm and forearm. However, it carries a risk of pneumothorax due to the proximity of the pleura [5]. Conversely, the infraclavicular block targets the plexus more distally and is preferred for surgeries at or below the elbow due to its lower risk of pleural puncture. Though considered safer in terms of respiratory complications, it may be technically more challenging and potentially less effective in terms of onset time and block duration [6, 7].

Comparative studies evaluating these two techniques are crucial in determining optimal anesthesia practice, especially for surgeries confined to the lower parts of the upper limb, such as below the elbow operations [1, 5, 8, 9]. These studies not only help in understanding the efficacy and safety profiles of each block but also assist in refining technique selection based on surgical and patient-specific needs.

Therefore, this study aimed to compare the supraclavicular brachial plexus block using the para-vascular approach with the infraclavicular block in terms of block performance time, sensory and motor block onset, block duration, complication incidence, block success rate, and the proportion of patients requiring additional analgesia for intraoperative comfort in below-elbow surgeries.

2. Patients & Methods

Study Design

This study was a prospective, randomized controlled trial conducted at Benha University Hospital.

Participants

The study included 70 patients, aged 18 to 65, scheduled for below-elbow surgeries. They were randomly assigned into two groups: Group A (supraclavicular block, 35 patients) and Group B (infraclavicular block, 35 patients). Eligible participants included males and females within the

specified age range, all with an ASA grade of 1 or 2. Exclusion criteria were applied to patients who declined participation, those outside the age range, individuals with neck burns, allergies to local anesthetics, infections at the procedure site, coagulation disorders, mental health issues, or an ASA grade of 3 or 4.

Preoperative Assessment

All patients underwent a thorough preoperative assessment, which included a clinical history review, a general clinical examination, and a routine preoperative workup. The workup included a complete blood count, liver and kidney function tests, a coagulation profile, and, if indicated, ECG and echocardiography. Viral markers for hepatitis B, hepatitis C, and HIV were tested following the university hospital protocol. Sedation was provided with 25-50 micrograms of fentanyl and 1-2 mg of midazolam.

Group A: Supraclavicular Block

For the supraclavicular block, patients were positioned supine with their heads tilted to the opposite side. The skin was disinfected, and a 6–13 Hz ultrasound probe was placed transversely above the midclavicular point to identify the subclavian artery and brachial plexus. The procedure involved anesthetizing the skin with 2% lidocaine, inserting the needle laterally, and injecting local anesthetic (LA) to lift and hydro-dissect the plexus from the artery. A 30 mL mixture of 2% lidocaine and 0.5% bupivacaine was used. Frequent aspiration and fractionated injections minimized the risk of intravascular injection [10].

Group B: Infraclavicular Block

For the infraclavicular block, patients were positioned supine with the head turned away from the block side, and the arm abducted to 90 degrees with the elbow flexed. The ultrasound probe was placed medial to the coracoid process to identify the axillary artery and surrounding brachial plexus cords. The skin was cleansed, anesthetized with 2% lidocaine, and the needle was advanced to deposit LA around the posterior cord. A total of 30 mL of LA, consisting of 2% lidocaine and 0.5% bupivacaine, was used to achieve adequate spread around the artery [10].

Statistical methods:

The data management and statistical analysis were conducted using SPSS version 28 (IBM, Armonk, New York, United States). The normality of the quantitative data was evaluated by employing the Shapiro-Wilk test and direct data visualization tools. The idea of normality was applied to summarize the quantitative data using means and standard deviations. The categorical data were simplified by representing them using numerical values and proportions. The independent t-test was used to compare quantitative data between the research groups. The Chi-square or Fisher's exact test was used to compare categorical data. Multiple linear regression analyses were conducted to forecast the initiation of sensory and motor analgesia. The regression coefficient was obtained along with its 95% confidence intervals. All statistical tests conducted were bilateral. Significance was attributed to P values < 0.05.

3.Results

❖ **Demographics**

The studied groups were comparable regarding age (P = 0.496), sex (P = 0.788), BMI (P = 0.845), co-morbidities (P = 0.192), and ASA (P = 1.0). **Table 1, Figures 1, 2**

Table (1) Demographic data between the studied groups.

		Group A (n = 35)	Group B (n = 35)	P-value
Age (years)	Mean ±SD	36 ±13	33 ±13	0.496
Sex				
Males	n (%)	26 (74.3)	25 (71.4)	0.788
Females	n (%)	9 (25.7)	10 (28.6)	
BMI	Mean ±SD	27.76 ±4.2	27.58 ±3.62	0.845
Co-morbidity	n (%)	13 (37.1)	8 (22.9)	0.192
ASA				
ASA I	n (%)	22 (62.9)	22 (62.9)	1.0
ASA II	n (%)	13 (37.1)	13 (37.1)	

SD: Standard deviation; BMI: Body mass index; ASA: American Society of Anesthesiologists.

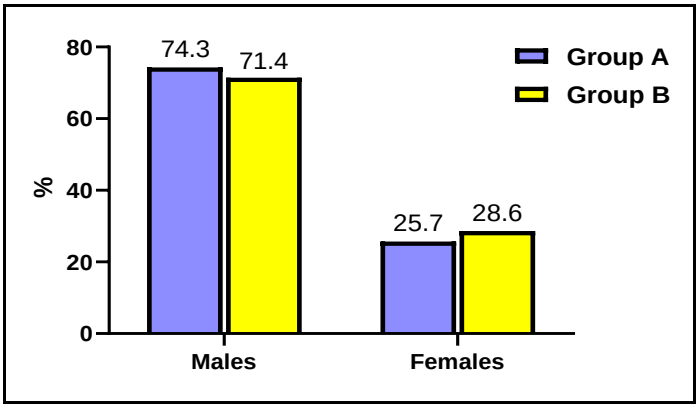

Fig. (1) Gender distribution in the studied groups.

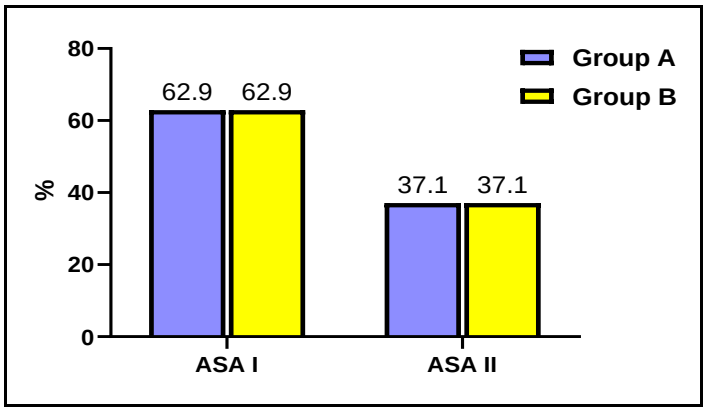

Fig. (2) ASA grade in the studied groups

Block performance time

No significant difference was reported between the studied groups regarding block performance time (P = 0.501). Table 2, Figure 3.

Table (2) Block performance time in the studied groups

		Group A (n = 35)	Group B (n = 35)	P-value
Block performance time (min)	Mean ±SD	6.7 ±2.1	7 ±2.1	0.501

SD: Standard deviation

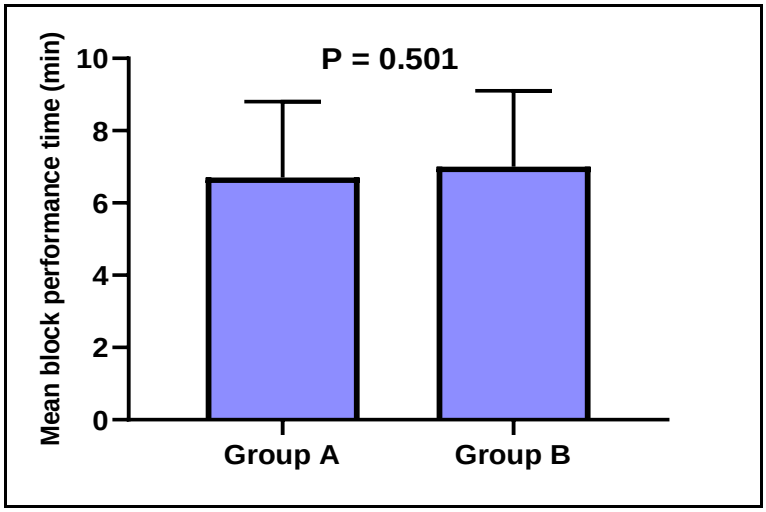

Fig. (3) Block performance time in the studied groups

❖ **Block onset**

Group A exhibited significantly lower onset of sensory block (7 ±2 vs. 12 ±2, P < 0.001) and motor block (8 ±2 vs. 13 ±2, P < 0.001) compared to group B. **Table 3, Figure 4.**

Table (3) Block onset in the studied groups.

		Group A (n = 35)	Group B (n = 35)	P-value
Onset of sensory block (minutes)	Mean ±SD	7 ±2	12 ±2	**<0.001***
Onset of motor block (minutes)	Mean ±SD	8 ±2	13 ±2	**<0.001***

*Significant P-value; SD: Standard deviation

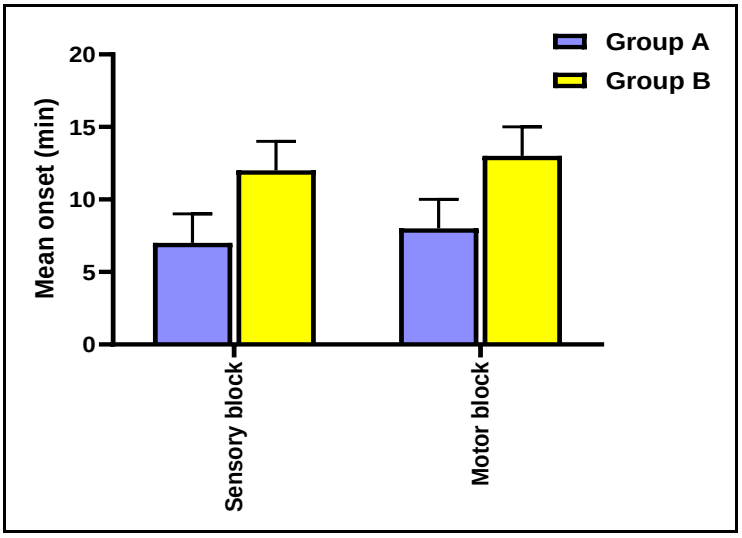

Fig. (4) Block onset in the studied groups.

❖ **Block duration**

The duration of sensory and motor blocks were insignificantly different between the studied groups (P = 0.197 for each). **Table 4, Figure 5**

Table (4) Block duration in the studied groups.

		Group A (n = 35)	Group B (n = 35)	P-value
Duration of sensory block (minutes)	Mean ±SD	620.3 ±158.9	665.3 ±36.5	0.107
Duration of motor block (minutes)	Mean ±SD	620.3 ±158.9	665.3 ±36.5	0.107

*Significant P-value; SD: Standard deviation.

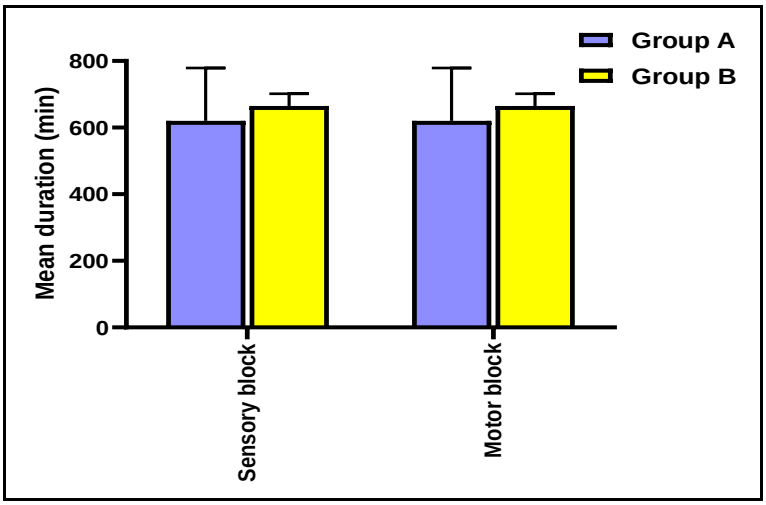

Fig. (5) Block duration in the studied groups.

❖ **Need for rescue analgesia**

No significant difference was reported between the studied groups regarding the need for rescue analgesia (P = 0.71). **Table 5, Figure 6.**

Table (5) Need for rescue analgesia in the studied groups

		Group A (n = 35)	Group B (n = 35)	P-value
Need for rescue analgesia	n (%)	5 (14.3)	3 (8.6)	0.71

n: Number; %: Percentage

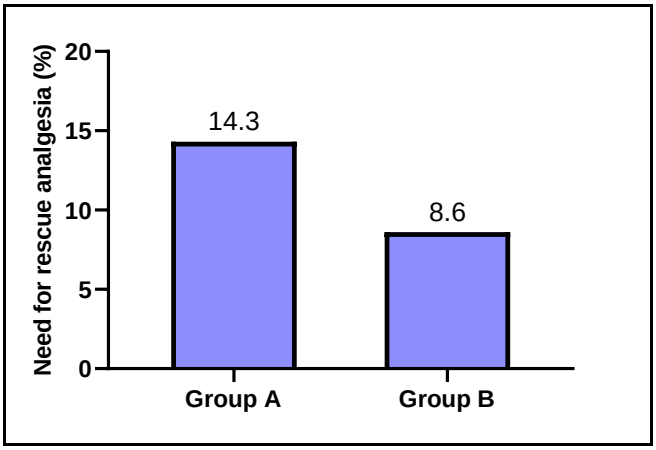

Fig. (6) Need for rescue analgesia in the studied groups.

Time needed for complete sensory block

The studied groups exhibited comparable rates of achieving complete sensory block at 10 min (P = 0.794), 15 min (P = 0.808), 20 min, 25 min (P = 1.0), and 30 min (P = 1.0). **Table 6, Figure 7.**

Table (6) Time needed for complete sensory block in the studied groups

Complete sensory block		Group A (n = 35)	Group B (n = 35)	P-value
At 0 min	n (%)	0 (0)	0 (0)	-
At 10 min	n (%)	10 (28.6)	11 (31.4)	0.794
At 15 min	n (%)	20 (57.1)	21 (60)	0.808
At 20 min	n (%)	0 (0)	0 (0)	-
At 25 min	n (%)	1 (2.9)	1 (2.9)	1.0
At 30 min	n (%)	2 (5.7)	2 (5.7)	1.0

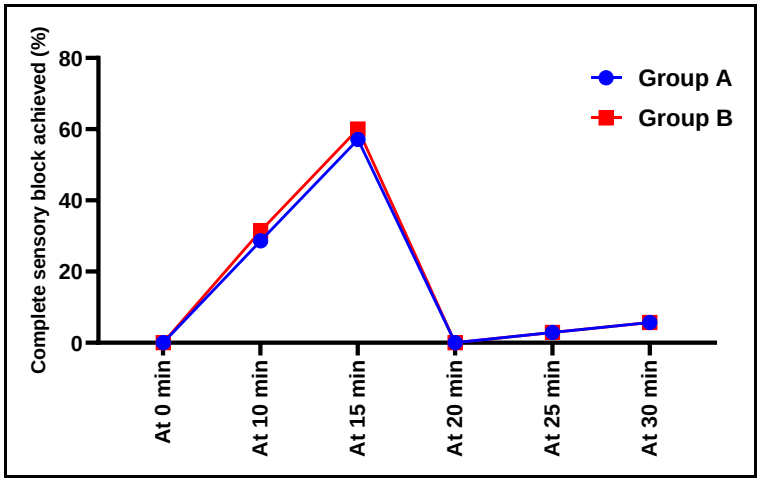

Fig. (7) Time needed for complete sensory block in the studied groups

❖ **Time needed for complete motor block**

The studied groups exhibited comparable rates of achieving complete motor block at 10 min (P = 0.794), 15 min (P = 0.808), 20 min, 25 min (P = 1.0), and 30 min (P = 1.0). **Table 7, Figure 8.**

Table (7) Time needed for complete motor block in the studied groups

Complete sensory block		Group A (n = 35)	Group B (n = 35)	P-value
At 0 min	n (%)	0 (0)	0 (0)	-
At 10 min	n (%)	10 (28.6)	11 (31.4)	0.794
At 15 min	n (%)	20 (57.1)	21 (60)	0.808
At 20 min	n (%)	0 (0)	0 (0)	-
At 25 min	n (%)	1 (2.9)	1 (2.9)	1.0
At 30 min	n (%)	2 (5.7)	2 (5.7)	1.0

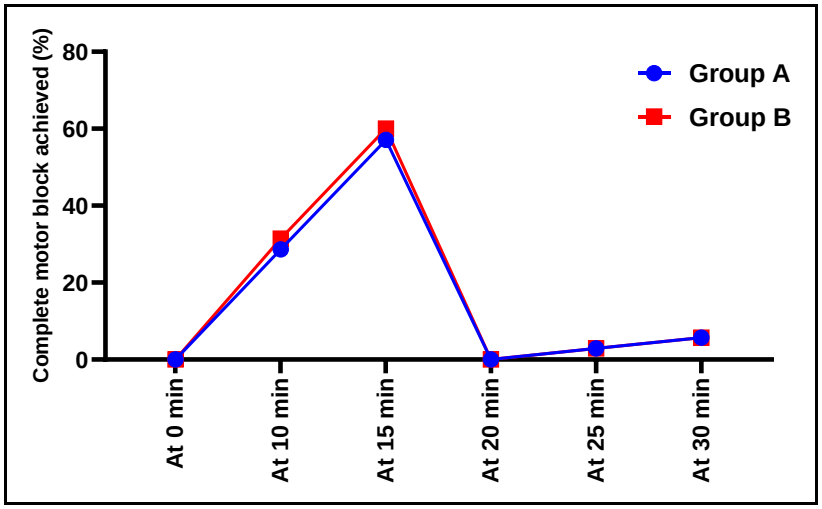

Fig. (8) Time needed for complete motor block in the studied groups

❖ **Complications**

Group A showed higher phrenic nerve affection (11.4% vs. 0%) but without statistical significance (P = 0.114). Other complications significantly differed between the studied groups (P = 0.005), with breathing difficulty, Horner's syndrome, pain and discomfort, and vascular puncture being all higher in group A than in group B (11.4%, 2.9%, 5.7%, and 2.9% vs. 0%). **Table 8**

Table (8) Complications in the studied groups

		Group A (n = 35)	Group B (n = 35)	P-value
Phrenic nerve affection	n (%)	4 (11.4)	0 (0)	0.114
Other complications				
Breathing difficulty	n (%)	4 (11.4)	0 (0)	**0.005***
Horner's syndrome	n (%)	1 (2.9)	0 (0)	
Pain and Discomfort	n (%)	2 (5.7)	0 (0)	
Vascular Puncture	n (%)	1 (2.9)	0 (0)	
No complications	n (%)	27 (77.1)	35 (100)	

*Significant P-value

Success rate

The success rate did not significantly differ between the studied groups (P = 0.493), with Groups A and B showing rates of 94.3% and 100%, respectively. **Table 9, Figure 9.**

Table (9) Success rate in the studied groups

		Group A (n = 35)	Group B (n = 35)	P-value
Success rate	n (%)	33 (94.3)	35 (100)	0.493

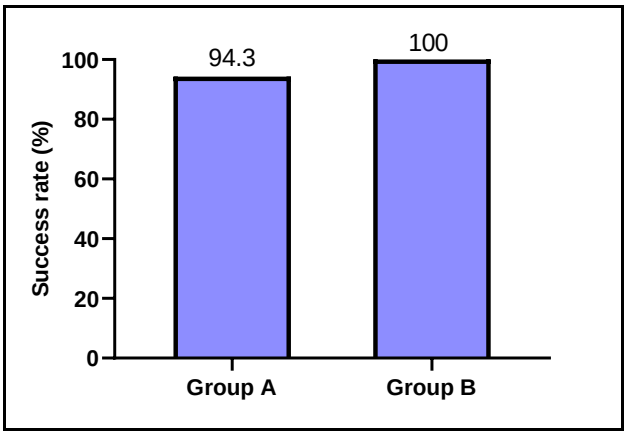

Fig. (9) Success rate in the studied groups.

4. Discussion

In our current study, we meticulously compared the ultrasound-guided supraclavicular and infraclavicular approaches to the brachial plexus in patients undergoing below-elbow surgeries. Our findings reveal that the block performance time was nearly identical between the two groups, echoing the results of several previous studies.

Arcand et al. [11] found that block performance times for infraclavicular and supraclavicular blocks were similar, with times of 4.0 ± 3.3 minutes and 4.7 ± 4.0 minutes, respectively, despite faster ultrasonic visualization in the infraclavicular region. Koscielniak-Nielsen et al. [12] confirmed these findings, reporting averages of 5.0 ± 1.6 minutes for infraclavicular blocks and 5.7 ± 1.6 minutes for supraclavicular blocks. Waindeskar et al. [13] also observed similar performance times of 7.6 ± 1.44 minutes for infraclavicular and 8.1 ± 1.39 minutes for supraclavicular blocks, with a P value of 0.1. Abhinaya et al. [8] reported performance times of 9.57 ± 3.19 minutes for the infraclavicular group and 11.53 ± 2.90 minutes for the supraclavicular group. El-Sawy et al. [14] noted that the mean block performance time was under 10 minutes in both groups. Dhir et al. [15] found mean times of 285 ± 128 seconds for infraclavicular blocks and 307 ± 138 seconds for supraclavicular blocks. Similarly, Vazin et al. [16] observed no significant difference in performance times. Conversely, Guru et al. [17] found that the supraclavicular block was significantly quicker, with an average time of 10.31 ± 1.52 minutes, compared to 14.83 ± 1.45 minutes for the infraclavicular block.

Our study revealed that the supraclavicular group experienced a quicker onset of sensory and motor blocks compared to the infraclavicular group. Specifically, the sensory block took an average of 7 ± 2 minutes in the supraclavicular group, while it took 12 ± 2 minutes in the infraclavicular group. Similarly, the motor block occurred in 8 ± 2 minutes in the supraclavicular group, compared to 13 ± 2 minutes in the infraclavicular group. These differences were statistically significant. According to Waindeskar et al. [13], the supraclavicular group experienced a considerably faster onset of surgical anesthesia compared to the infraclavicular group (14.48 ± 1.78 vs. 17.05 ± 2.28 minutes). Yazer et al. also found that the supraclavicular group had a faster onset of anesthesia, with an average time of 8.9 ± 5.6 minutes, compared to the infraclavicular group's 17.6 ± 5.3 minutes. Additionally, the overall time linked to anesthesia was shorter for the supraclavicular method [18]. Dhir et al. [15] observed similar initiation times in both groups. Vazin et al. [16] reported that the supraclavicular approach resulted in quicker block onset times and shorter overall anesthesia-related periods. However, Abhinaya et al. [8] found that the infraclavicular group achieved sensory blockage faster (6.43 ± 2.61 minutes) compared to the supraclavicular group (8.45 ± 2.87 minutes, P = 0.006), while the onset of motor blockade was similar. Guru et al. [17] also observed that sensory blocking began earlier in the infraclavicular group compared to the supraclavicular group, and this difference was statistically significant.

There were no notable variations in the duration of sensory and motor blocks between the groups. Arcand et al. [11] found that the durations of postoperative analgesia were similar, with an average of 434 ± 167 minutes in one group and 471 ± 215 minutes in the other (P = 0.39). El-Sawy et al. [14] also found that the duration of motor block, sensory block, and the time until the first request for pain relief were comparable in both groups. Guru et al. [17] reported no statistically significant difference in the duration of sensory block. Additionally, there was no significant difference in the requirement for rescue analgesia between the groups.

The supraclavicular group experienced a higher frequency of complications, including more cases of phrenic nerve involvement, respiratory difficulties, Horner's syndrome, pain, discomfort, and vascular puncture. Koscielniak-Nielsen et al. [12] observed a higher number of temporary negative occurrences in the supraclavicular group. Abhinaya et al. [8] documented instances of pneumothorax, Horner's syndrome, and diaphragmatic paresis in the supraclavicular group. Kohan et al. [19] reported that supraclavicular blocks have higher rates of temporary complications such as Horner's syndrome and phrenic nerve palsy, whereas infraclavicular, interscalene, and axillary blocks have a lower frequency of issues.

The success rates of the supraclavicular and infraclavicular groups in our study were 94.3% and 100%, respectively, with no significant difference between the two groups. Arcand et al. [11] found that both techniques had similar success rates, although radial territory anesthesia was less reliable with the infraclavicular block. Koscielniak-Nielsen et al. [12] discovered that the infraclavicular group had a higher success rate. Abhinaya and colleagues [8] documented comparable success rates. According to Waindeskar et al. [13], the infraclavicular group had a 100% success rate, whereas the supraclavicular group had a success rate of 92.5%. In cases where the supraclavicular block failed, the ulnar nerve region was typically spared.

Overall, our study reinforces that both approaches offer comparable performance times and block quality, with subtle differences in sensory and motor block onset, complications, and success rates that can guide clinical decisions based on specific patient needs and surgical contexts.

5. Conclusion

Both supraclavicular and infraclavicular blocks are effective anesthetic techniques for below-elbow surgery, demonstrating comparable performance times and post-operative analgesia duration. While the supraclavicular block offers a faster onset of surgical anesthesia, it is associated with a higher incidence of complications. Given these findings, the infraclavicular block emerges as a compelling alternative, meriting increased utilization for below-elbow surgeries due to its favorable safety profile and efficacy.

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