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Original Research Article

A Randomized Comparative Study of Efficacy of Axillary and Infraclavicular Approaches for Brachial Plexus Block for Upper Limb Surgery Using Peripheral Nerve Stimulator

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Abstract:

Peripheral nerve block provides site specific, rapid onset, long lasting and effective anaesthesia and analgesia. Optimal pain relief and minimal side effects (e.g. nausea and vomiting) following surgery have a major impact on patient outcome. Peripheral nerve block for upper limb surgeries can be done by brachial plexus blockade. This can be done at the level of root, trunk, cord or terminal nerves. Nerve stimulator was invented for higher success rate and to decrease the complications. In our study, we compared injection of vertical infraclavicular technique with axillary technique, for brachial plexus block in patients undergoing distal forearm, wrist and hand surgery using a combination of 10 ml of 2% lignocaine and 10 ml of 0.5% bupivacaine and 10ml of 0.9% normal saline with the use of peripheral nerve stimulator (PNS). We compared the onset of sensory and motor block, time taken for complete sensory and motor block, duration of motor and sensory block, the success rate of nerve block and complications. All the data collected were entered into the Microsoft excel sheet and analyzed statistically. The p value of <0.05 was considered statistically significant. Results: In terms of efficacy the infraclavicular approach appears to be better than the axillary approach for brachial plexus block for surgeries done in distal forearm and hand.

Keywords: Infraclavicular Approach, Axillary Approach, Nerve Stimulator, Efficacy, Foream Surgery

Introduction

Brachial plexus block remains the only practical alternative to general anaesthesia for surgeries on the upper limb. It provides a superior quality of analgesia and avoids the common side-effects associated with general anaesthesia such as postoperative nausea and vomiting. It can be extremely useful in patients with significant co-morbidities such as severe respiratory and cardiovascular disease, morbid obesity and in those with potential airway difficulties. The axillary approach for blocking the brachial plexus has been used widely to provide anaesthesia for surgery of the

distal forearm and hand. It targets the branches of the brachial plexus. In 1995, Kilka[5,6] and colleagues found the vertical infraclavicular block. The advantages of this approach are less painful arm during positioning for patients with fractures, reliability of the technique on the identification of easily palpable landmarks and the block using single injection is time efficient. This technique is also helpful during catheter based techniques compared to axillary approach and supraclavicular approach.

Initially brachial plexus blockade was performed using paresthesia elicitation technique. It was a blind, landmark technique which was associated with high failure rates and nerve injuries and other complications. Electrical nerve stimulation is used not only to identify the location of nerves but also to prevent intraneural location of the needle. These stimulators provide a set direct current (DC) at the needle, when it is near the nerve, transmission of current to the nerve will take place. This is then followed by nerve stimulation which produces a motor response. Verifying the motor response of the required nerve to be blocked, increases chances of successful blockade.

In the infraclavicaular approach the nerves are blocked at the cord level mainly, while in axillary approach they are blocked at the level of branches.

Aim and Objectives of the Study

To compare the onset time, time to maximum block and success rate of infraclavicular and axillary approach of brachial plexus block using peripheral nerve stimulator in patients undergoing surgery in forearm, wrist and hand.

Materials and Methods

This is a prospective randomized single blinded study conducted in Govt Thanjavur medical college, Thanjavur, after approval of institutional ethical committee. An informed written consent was obtained from each patient after explaining the procedure before including in this study. Study design: Prospective single blinded control study. Study population: Age 18-75 years undergoing elective upper limb surgery. Sample size: 60 patients, 30 patients in group I (infraclavicular approach), and 30 patients in group A(axillary approach). Sampling technique: Randomized sampling. The single blinded approach was adopted for randomly assigning participants to each group.

Inclusion criteria:

1. Both gender.
2. ASA physical status 1and 2.
3. Age 18 to 75 years old.
4. Weighing 40 to 70 kilograms. 5. Surgeries of forearm, wrist or hand.

Exclusion criteria:

1. ASA grade 3&4.
2. Not satisfying inclusion criteria.
3. Pregnancy.
4. Psychiatric illness.
5. Coagulopathy.
6. Infection at the local site.
7. Allergy to amide local anaesthetics.8. Sensory neuropathy or motor defect in the arm in which the surgery is to be performed.

Under strict aseptic precautions, infraclavicular block was performed with the patient in supine position and head turned towards opposite side. The needle is connected to the nerve stimulator and current of 2mA, frequency 2HZ, pulse of 0.1ms is set. E.C.G. lead is placed in the arm. When the elbow flexion and digits flexion obtained local anaesthetics were administered after negative aspiration.

Axillary block is performed with the arm in abducted position. When wrist flexion with pronation or flexion of the fingers

were obtained local anaesthetics were administered after negative aspiration

Observation and Results

Demographic profiles age, height and weight were analysed and the distribution was comparable between the two groups with p value more than 0.05.

The mean values of onset of sensory blockade for Group – I and Group – A were 3.26 min and 3.74 min respectively. The p-value of 0.3067 suggests that the approaches doesn't differ significantly in achieving the onset of sensory blockade.

Mean time for the onset of motor blockade for group I approach was 5.29min while the group A approach needed a mean of 6.24 min. The p-value of 0.0362 while being at the higher end of the significance spectrum still under the significance level suggesting that infraclavicular approach fairs well in comparison with axillary approach.

Group I had a mean of 5.64 min and group A had a mean of 7.40 min for achieving complete sensory blockade. A p-value of 0.0001 at 5% significance shows that the time to achieve complete sensory blockade is much shorter for infra-clavicular approach.

Onset of maximum motor blockade averaged at 7.76min for group I and group A mean had a value of 9.85 min. The p-value for this parameter is 0.0 up to fourth decimal digit values demonstrating the superior performance of infraclavicular over axillary approach.

Total duration of sensory blockade for group I averaged at 154.17 min while group A averaged at 110.67 with a significant p-value of 0.0019 suggesting that infraclavicular approach yields a longer duration of sensory blockade.

Qualitatively the central parameter for defining the performance of any particular (regional anesthetic approach) for group I had a mean of 123.27 min while group A had a mean of 106.67min. The p-value of zero up to fourth decimal values suggests the better duration of motor blockade with infraclavicular approach over axillary approach.

There was statistically significant difference in relation to success rate of block between group I and group A. p value of 0.04 of infraclavicular approach showing the better performance.

The occurrence of vascular complications is statistically insignificant when it is compared to infraclavicular approach.

Diagrams and Tables

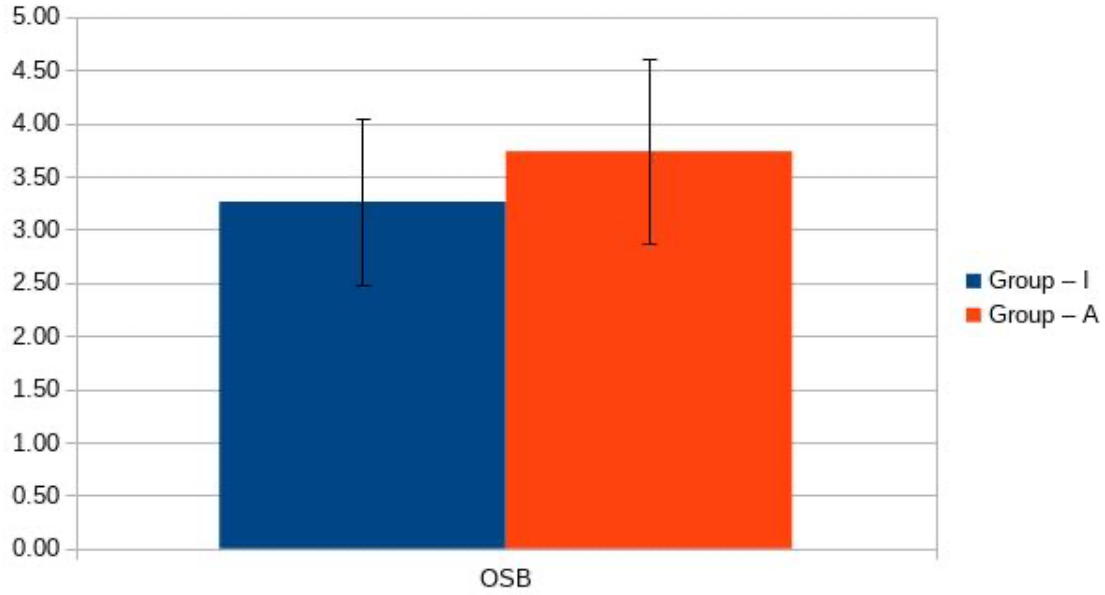

Figure 1: Comparison of onset of sensory blockade between the two groups

Table: 1: Comparison of onset of sensory blockade between the two groups.

S.No	Parameter	Group I Mean ±SD	Group A Mean ±SD	p value	Statistical test
1	Onset of sensory blockade (min)	3.26±0.87	3.74±0.78	0.3067 (NS)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired 't' test was used to compare the means. NS = not significant.

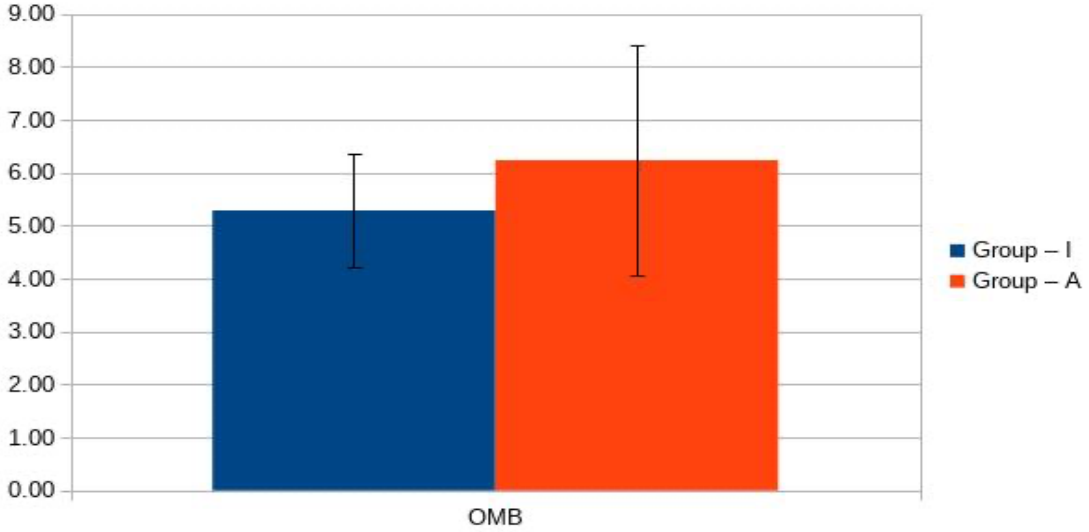

Figure 2: Comparison of onset of motor blockade between the two groups

Table 2: Comparison of onset of motor blockade between the two groups

S.No	Parameter	Group I Mean ±SD	Group A Mean ±SD	p value	Statistical test
1	Onset of motor blockade (min)	5.29±02.17	6.24±01.08	0.0362 (S)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired 't' test was used to compare the means. S = significant.

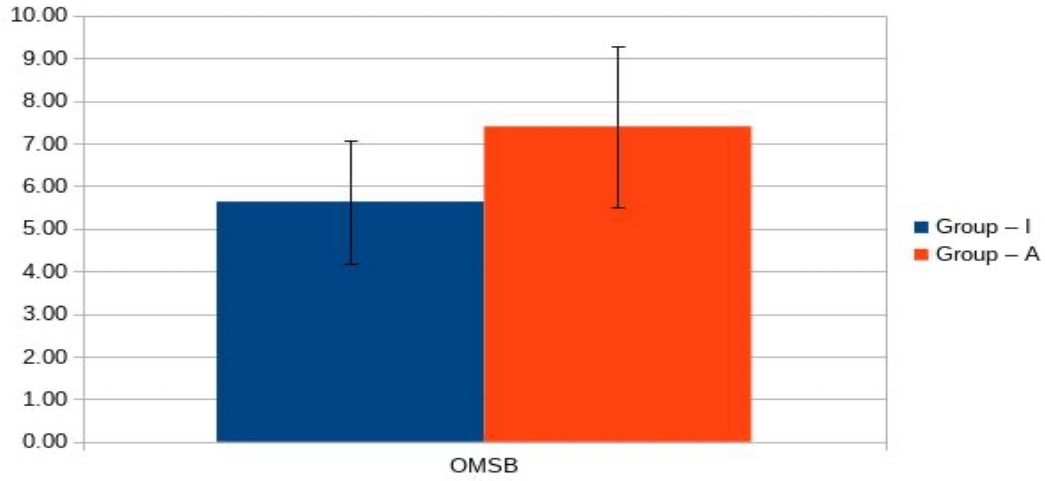

Figure 3: Comparison of onset of complete sensory block between groups

Table 3: Comparison of onset of complete sensory block between groups.

S.No	Parameter	Group I Mean ±SD	Group A Mean ±SD	p value	Statistical test
1	Onset of complete sensory blockade (min)	5.64 ± 01.89	7.40 ± 01.45	0.0001 (S)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired 't' test was used to compare the means. S = significant.

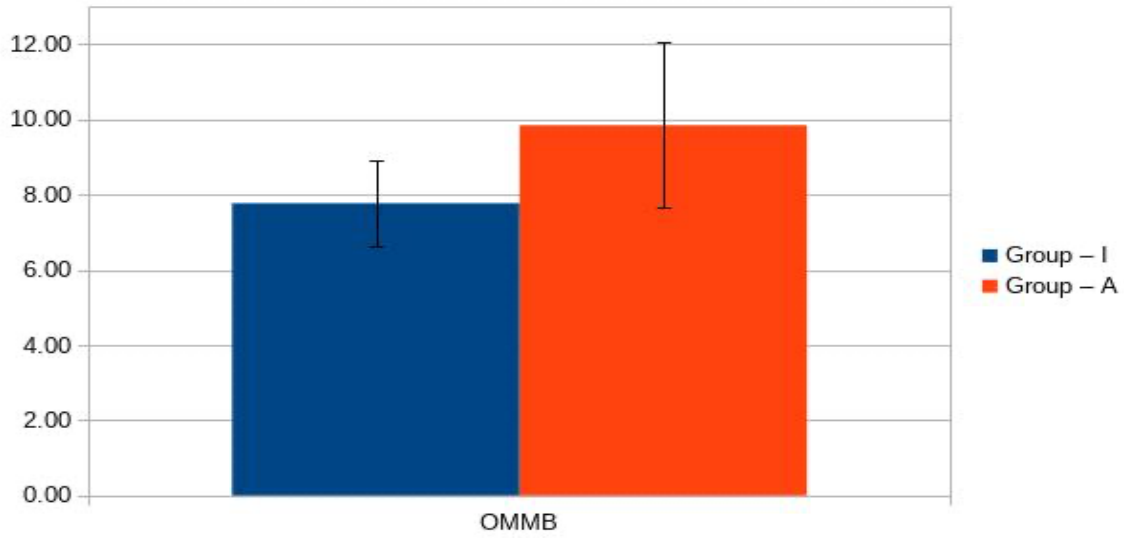

Figure 4: Comparison of onset of maximum motor blockade between the two groups

Table 4: Comparison of onset of maximum motor blockade between the two groups

S.No	Parameter	Group I Mean± SD	Group A Mean ±SD	p value	Statistical test
1	Onset of maximum motor blockade (min)	7.76 ± 02.20	9.85 ± 01.15	0.0000 (S)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired 't 'test was used to compare the means. S = significant

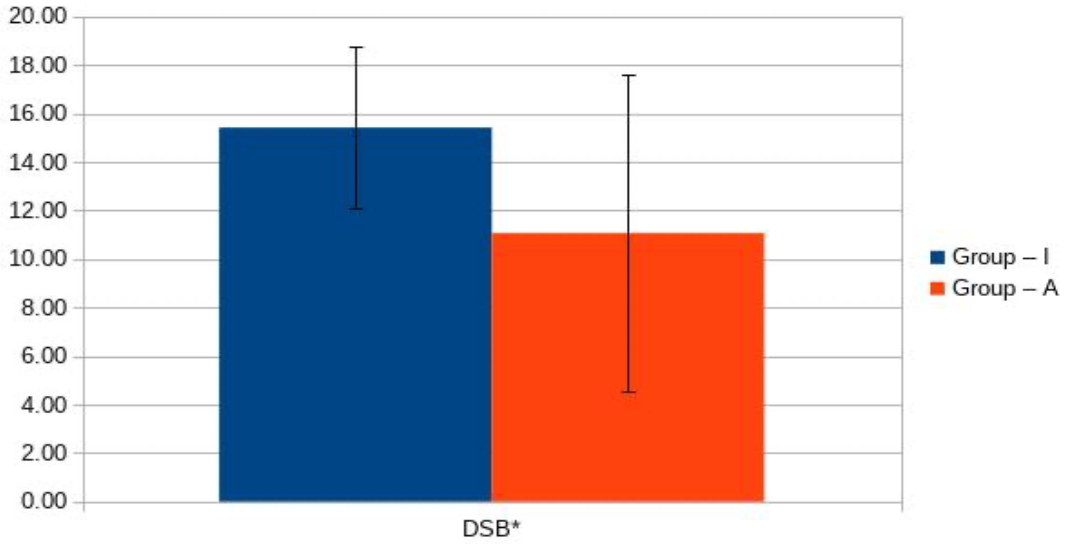

Figure 5: Comparison of duration of sensory blockade between the two groups

Table 5: Comparison of duration of sensory blockade between the two groups.

S.No	Parameter	Group I Mean ±SD	Group A Mean ±SD	p value	Statistical test
1	Duration sensory blockade (min)	154.17 ± 65.48	110.67 ± 33.52	0.0019 (S)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired 't' test was used to compare the means. S = significant.

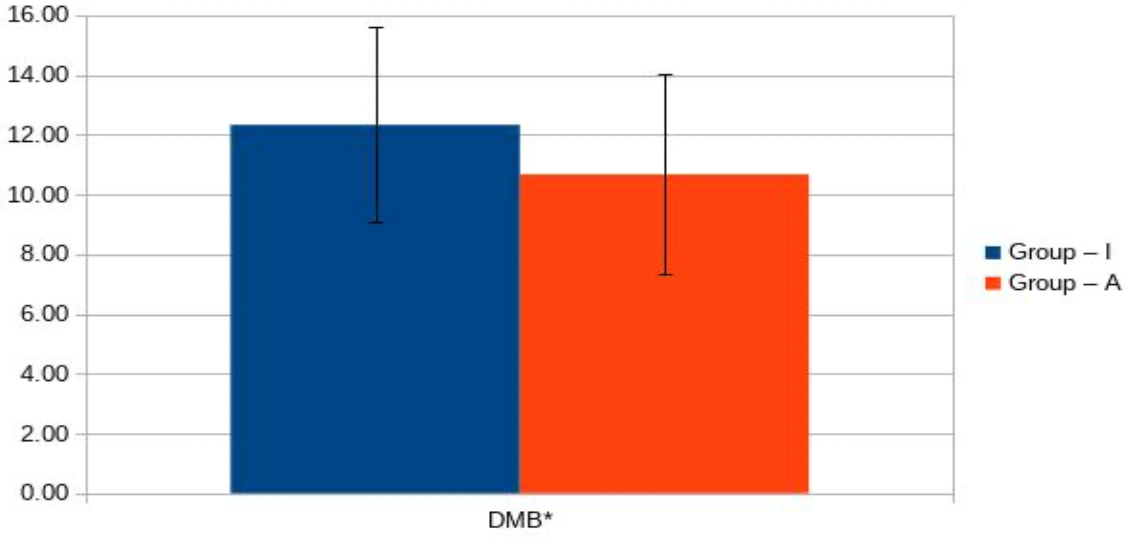

Figure 6: Comparison of duration of motor blockade between the two groups

Table 6: Comparison of duration of motor blockade between the two groups

S.No	Parameter	Group I Mean ±SD	Group A Mean ±SD	p value	Statistical test
1	Duration of motor blockade (min)	123.27 ± 33.41	106.67 ± 32.57	0.0000 (S)	Unpaired 't' test

Footnote: Data are expressed as mean with SD. Unpaired‘t’ test was used to compare the means. S = significant.

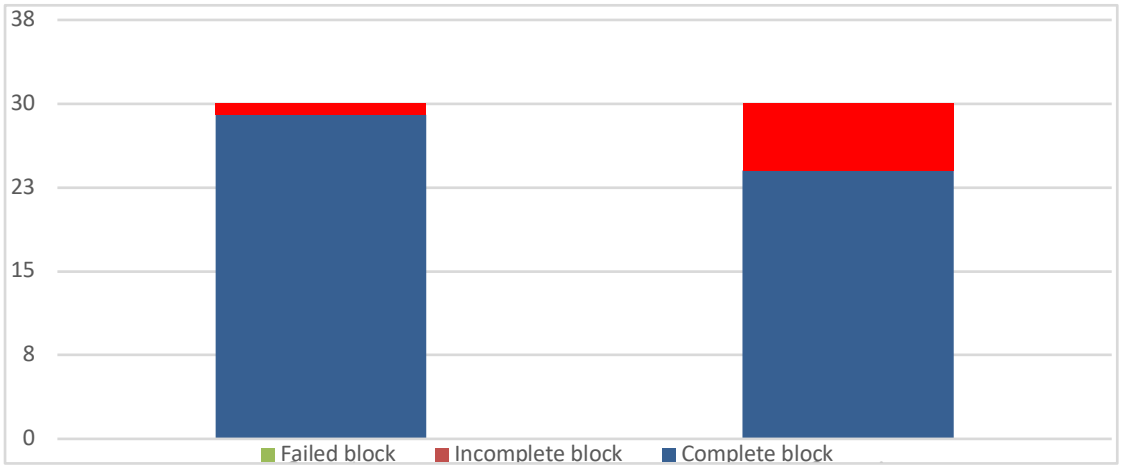

Figure 7: Comparison of success rate of blockade between the two groups

Table 7: Comparison of success rate of blockade between the two groups

S.no	Quality of block	Group I	Group A	p value	Statistical test
1	Complete block	29	24	0.04(S)	Chi-square test
2	Incomplete block	1	6		
3	Failed block	0	0		

Footnote: Data are expressed as frequency (n) Total n=30/group. Chi-square test was used to compare the frequencies between the groups. S=significant.

Discussion

The purpose of our study was to compare the efficacy of axillary and infraclavicular approaches of brachial plexus block as in patients undergoing forearm and hand surgeries.

In our study, mean age in years in group – I (41.03) and group – A (40.93) had a p-value of 0.9716 which was statistically insignificant. Age distribution between the two groups are comparable. The gender distribution was comparable in both groups with a p value of 0.7866 which was statistically insignificant.

Mean weight in kg in group –I (54.13) and group A-(53.83) had a p value of 0.8326 which was statistically insignificant. Mean weight between the groups are comparable. ASA grade between the two groups had a p value of 0.7906 which was statistically insignificant. ASA grade between the two groups are comparable.

Mean duration of surgery in group I-(100.3 min) and group A-(100.67min) had a p value of 0.9640 which was statistically insignificant. Mean duration of surgeries for group I and group A are comparable. Site of surgery between the two groups had a p value of 0.9501 which was statistically insignificant. Site of surgeries between the two groups are comparable.

In our study, onset of sensory blockade was 3.26± 00.87 in infraclavicular group compared with 3.74 ± 00.78 in axillary group. Difference in the onset of sensory blockade is insignificant with a p-value of 0.3067.

Onset of maximum sensory blockade was 5.64±01.89 in group I compared to 7.40±01.45 in group A. Onset of maximum sensory blockade showed highly significant difference at 0.5% error with a p-value being 0.0001.

In our study the duration of sensory blockade in the infraclavicuar approach was significantly better than the axillary approach and thus indicating the suitability of infraclavicular block over axillary approach. Duration of sensory blockade was 154.17 ±65.48 (minutes) in group I compared with 110.67±33.52 (minutes) in group A which is statistically significant with p value of 0.0019.

Motor parameters showed remarkably better performance with ICB approach overall. Onset of motor blockade was 5.29 ± 02.17 (minutes) in infraclavicular group compared with 6.24 ±01.08 (minutes) in axillary group. The onset of motor blockade with infraclavicular block is superior than the axillary blockade approach with a p-value of 0.0362. It is statistically significant.

In our study the two parameters being onset of complete motor blockade and duration of motor blockade showed remarkable superiority for infraclavicular block than axillary blockade approach with the p-value remaining zero up to fourth decimal values. Onset of complete motor blockade in infraclavicular group was 7.76 ±02.20 (minutes) and 9.85 ±01.15 (minutes) in axillary group. Duration of motor blockade was 123.27 ±33.41 (minutes) in infraclavicular group and 106.67 ±32.57 (minutes) in axillary group.

Significant statistical difference was found between the success rates of infraclavicular and axillary approaches with a p value of 0.04. The incidence of vessel puncture in axillary group is statistically insignificant when compared with infraclavicular group.

The occurrence of vessel puncture is more in axillary group A. No other complications were seen in our study.

Conclusion

We have demonstrated that both infraclavicular and axillary provide adequate surgical anaesthesia for upper limb surgeries. The infraclavicular approach is efficacious as far as onset of motor block, onset of complete sensory and maximum motor block success rate, duration of block (analgesia) are concerned. The onset of sensory block and occurrence of vascular complications are comparable. Regarding the ease of block performance, the infraclavicular block is superior due to its easily identifiable landmarks and comfortable patient position while performing the block. So from our study results, in terms of efficacy the infraclavicular approach appears to be better than the axillary approach for brachial plexus block for surgeries done in distal forearm and hand.

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