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Research Article

A comparison of two approaches to brachial plexus anaesthesia

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ABSTRACT

Background: A prospective, double blind study was performed to compare the clinical effect of vertical infraclavicular and supraclavicular brachial plexus block using a nerve stimulation technique for upper limb surgery.
Methods: Eighty patients undergoing upper limb surgery under infraclavicular or supraclavicular brachial plexus block were enrolled into this study. The infraclavicular brachial plexus block was performed using the vertical technique (group I; N=40). The supraclavicular brachial plexus block was performed using the Kulenkampf technique (group S; N=40). In both the groups 30 ml of 0.5% ropivacaine was used as the local anaesthetic. The block performance time, the duration of onset of sensory and motor block was evaluated in both the groups S & I. The quality of the block & associated complications were also assessed.
Results: A significant difference in the block performance time with comparable duration of onset of sensory was noted between the two groups S & I. Greater incidence of Horner's syndrome was noted in group S.
Conclusions: Supraclavicular brachial plexus block may be easier to perform than infraclavicular brachial plexus block. The infraclavicular approach may be preferred to the supraclavicular approach when considering the complications.

Keywords: Brachial plexus block, Supraclavicular block, Infraclavicular block

INTRODUCTION

Brachial plexus block has evolved as a safe alternative to general anesthesia for upper limb surgery and for relief of perioperative pain.[1] Since the introduction of first brachial plexus block using cocaine by Halstead in 1884. The technique of brachial plexus block has evolved from classical blind technique to use of nerve stimulators and ultrasound guidance for brachial plexus blocks.[2] The availability of newer local anesthetic drugs, newer adjuvants, use of ultrasound for safe & successful conduct of block, avoidance of undesirable side-effects of general anaesthesia with reduced hospital stay has popularized the use of brachial plexus blocks.[1] There are essentially four approaches to a brachial plexus block: interscalene, supraclavicular, infraclavicular and axillary. Brachial plexus block at the level of the clavicle is said to anesthetize all four distal upper extremity nerve territories. The supraclavicular approach of brachial plexus blockade is anatomically advantageous for being at a level where the brachial plexus nerve trunks are tightly packed together, which facilitates a very rapid block onset following single point injection.[3] The administration of infraclavicular brachial plexus block is feasible in almost all patients & the close arrangement of the brachial plexus nerves at this level increases the success rate of this block. Both supraclavicular and infraclavicular approaches have nearly similar distribution of anesthesia.[4] However there has been no studies comparing both the above approaches of brachial plexus block using nerve stimulation in Indian

population, so we designed this randomized prospective observational study to compare supraclavicular and infraclavicular approaches of brachial plexus anaesthesia regarding the block performance time & time of onset of sensory and motor block, using neurostimulation in patients undergoing upper limb surgery.

METHODS

After proper approval from the medical ethics committee and written informed consent from the subjects, 80 consecutive patients who were American society of anesthesiologists (ASA) physical status I to II, aged 18 to 65 years, scheduled to undergo surgery of the elbow, forearm, or hand under brachial plexus anesthesia were prospectively included into this randomized prospective blinded single hospital study. The exclusion criteria included patients having disorders of haemostasis, systemic infection or localised sepsis, major systemic illness, pregnancy, allergy to local anaesthetics, chest deformities, previous clavicle fractures, inability to understand the information provided, neurological disorders & patients having chronic pain. Written informed consent was obtained from each patient prior to inclusion in the study. Sample size calculation per group was based on a difference of 23% in success rate between the two approaches of brachial plexus block used in this study, obtained from previously published data.[5,6] Based on which, we calculated that a sample size of minimum 35 patients per group, would permit a type 1 error of alpha (α)=0.05 with a power of 80%. Patients were randomly allocated based on a computer generated table of random numbers to receive a supraclavicular brachial plexus block (group S, N=40) or infraclavicular brachial plexus block (group I, N=40). In both the groups 0.5% ropivacaine 30ml was used as the local anaesthetic. Standard ASA monitoring was commenced upon arrival to the preoperative holding area. A 22-gauge 50-mm insulated stimulation short bevel needle (Stimuplex[@], B/Braun medical, Germany) connected to a nerve stimulator (Stimuplex[@]-DIG, B/Braun, Germany) was used for all the blocks. The Infraclavicular brachial plexus block was performed in the operative arm with the patient in the supine position, the upper arm along the side, the elbow flexed and the hand resting on the lower chest or abdomen. The needle was introduced absolutely vertical to the horizontal plane half way between the jugular notch and the most ventral part of the acromion. The supraclavicular brachial plexus block (Kulenkampf technique) was performed with the patient in supine position, head turned toward the opposite side. The stimulation needle was inserted caudally parallel to the floor at the point of joining of the lateral border of the sternocleidomastoid muscle with the superior aspect of the clavicle. In both the group, the initial nerve stimulation current was set at 1.5 mA with impulse duration of 0.1 ms. The needle was advanced until a motor response was elicited. The needle position was considered to be adequate when the motor response in the hand or wrist was obtained which remained visible with a maximum current of 0.5 mA. At this point 30 ml of 0.5% ropivacaine was injected slowly (over 60s) with intermittent aspiration in both the groups S & I. All the blocks were performed by a single anesthesiologist. The block performance time i.e. time from the needle entry into the skin upto the completion of local anaesthetic injection, was noted. Block performance-related pain was evaluated immediately after removing the needle by asking the patient to verbally quantify the level of pain using a VAS pain score between 0 and 10 (0 meaning no pain and 10 meaning excruciating pain). A third anaesthesia resident blinded to the block technique evaluated the motor and sensory blockade in each nerve territory in the upper limbs at every 10 minutes interval upto 50 minutes after block performance. The sensory block for each nerve (radial, median, ulnar, musculocutanoeus, and media cutaneous of forearm) was assessed using alcohol-soaked gauze and further graded as: 0=no difference from an unblocked extremity; 1= less cold than unblocked extremity; 2= no sensation of cold. The motor block was evaluated using the following movements; forearm flexion, thumb abduction, thumb and second digit pinch and finger abduction and scored as follows: 0=no loss of force; 1=reduced force compared with the contralateral arm; and 2=incapacity to overcome gravity. A simultaneous comparison of the sensory and motor functions in the contralateral limb was used as a point of reference during comparison. The quality of the block graded as complete and incomplete. In a complete block the surgery was commenced without any discomfort to the patient or the need for block supplementation. An incomplete block was when a sensory or motor region involved in the surgery was not completely anesthetized and block supplementation by continuous infusion of propofol at 50 µg/kg/min and sufentanil 0.1-0.3 µg/kg IV was done. If the patient experienced pain despite supplementation, conversion to general anesthesia was done by the attending anaesthesiologist. Procedural complications like arterial puncture, intravascular injection, dyspnea, Horner's syndrome, pneumothorax etc. were noted. The data obtained from these patients was tabulated into Microsoft excel spread sheet and assessed. The values were expressed as the mean & standard deviation and median. Statistical analysis was performed using a Mann-Whitney rank sum test, two sided student's t-test, Fisher's Exact test wherever appropriate. A P value <0.05 was considered significant.

RESULTS

The demographic parameters were comparable between the two groups S and I (Table 1).

The comparison of block performance time between group S (3.2±0.92 min) and group I (5.9±0.8 min) was highly significant (p=0.0001) (Figure 1).

The mean onset time for sensory and motor block was 30 and 31 minutes in group S and 30.5 and 31.25 minutes in group I which were comparable (p>0.05) (Figure 2).

Higher incidence of Horner syndrome was noted in group S compared to group I, the incidence of other complications in both groups S & I were comparable (Table 2).

The median block performance related VAS score in both the group S and I was 3.

Table 1: Showing demographic and surgical characteristics in groups S and I.

	Group S (n=40)	Group I (n=40)
Age (years)	45±6	47±5
Sex (M/F)	26/14	28/12
Weight (kg)	61±12	63±9
Height (cm)	162±18	164±21
ASA (I/II)	30/10	28/12
Surgery (n)		
Hand	14	12
Wrist	8	9
Forearm	8	7
Elbow	10	12
Surgery duration (min)	68±35	65±23

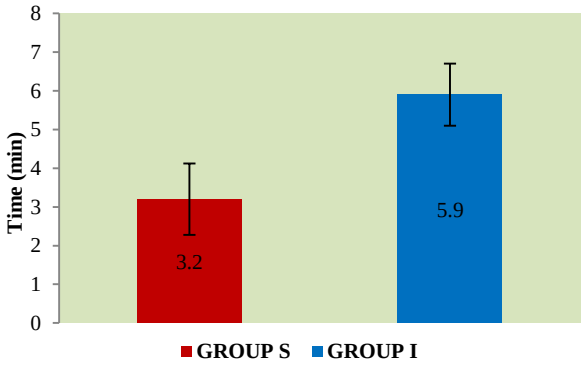

Figure 1: Block performance time comparison between group S and I.

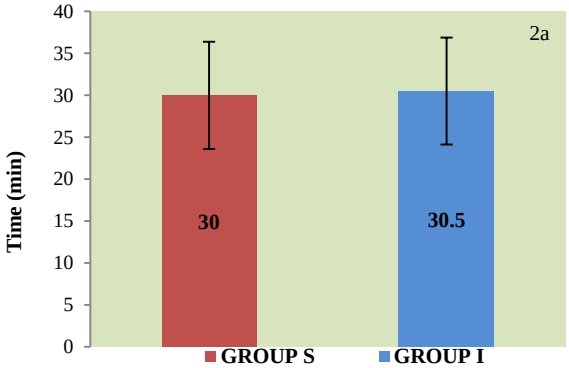

Figure 2a: Time of onset of sensory block.

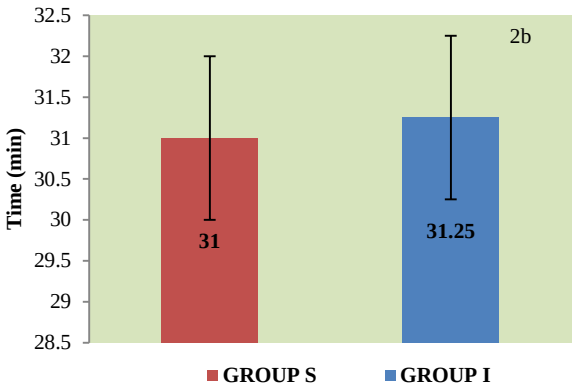

Figure 2b: Time of onset of motor block.

Table 2: Complications.

Complications	Group S (n=40)	Group I (n=40)
Horner syndrome	25 (62.5%)	2 (5%)
Dyspnea	0	0
Pneumothorax	0	0
Vascular puncture	2 (5%)	2 (5%)

DISCUSSION

In this study, the supraclavicular and infraclavicular approach to the brachial plexus block using neurostimulation showed a significant difference in the block performance time, with similar duration of onset of sensory and motor blockade. Higher incidence of Horner's syndrome with the supraclavicular approach was documented. We chose peripheral nerve stimulation technique for brachial plexus block in our study because there was very little data available on Indian population comparing neurostimulation guided supraclavicular with infraclavicular brachial plexus block. In comparison to the axillary approach, supraclavicular approach of brachial plexus block is known to provide excellent anaesthesia for upper-extremity surgeries, with the advantages of faster onset & denser block following a single injection of local anesthetic solution.[7.] The fear to cause an iatrogenic pneumothorax with the Kulenkampf technique of supraclavicular block, makes this technique less popular among anaesthesiologists. The reported incidence of pneumothorax following a supraclavicular block is 0.5% to 6.1%. However no incidence of introgenic pneumothorax was documented in our study population. the incidence of vascular puncture during supraclavicular or infraclavicular brachial plexus block was equal in our study population and didn't result in any intravascular injection or haematoma. This was probably because we used repeated aspiration and injection technique. The two approaches of brachial plexus anaesthesia yielded similar sensory and motor block onset time. We documented a 100% success rate for supraclavicular and infraclavicular brachial plexus block in our study population. Kilka et al reported a 95%

success rate for vertical infraclavicular approach using 40 ml of Prilocaine (1.5%) and 10 ml of Bupivacaine (0.5%); block assessed at 30 minutes.[8] Franco et al reported a 97.2% success rate with the supraclavicular brachial plexus block perivascular technique in 1,001 patients.[3] Possible reasons for the lower success rate observed in both the above studies include operator inexperience, different local anesthetic solution used than that of our study, the definition of a successful block and fewer number of patients observed in our study.[8,3] Limitations of our study include a single anesthesiologist performing all the brachial plexus blocks. Although this eliminated the interoperator variability, but it prevented generalizing the results. Our anaesthesiologist was more experienced with the supraclavicular approach than with the infraclavicular approach, which might be one of the reasons for a relatively longer block performance time observed in our study population for infraclavicular approach.

CONCLUSION

The supraclavicular brachial plexus block may be easier to perform in comparison to the infraclavicular brachial plexus block. The supraclavicular and infraclavicular approaches to the brachial plexus anaesthesia have nearly similar block onset time. But the infraclavicular approach may be preferred when considering the procedural complications. However large population based multicentric trials on Indian population are needed for further evaluation.

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