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A COMPARATIVE STUDY BETWEEN TWO DIFFERENT CURRENT STRENGTHS FOR SUPRACLAVICULAR BLOCK USING NERVE STIMULATOR IN ELECTIVE UPPER LIMB SURGERIES BELOW ELBOW

M. Kalasree Assistant Professor, Department of Anaesthesiology, Chengalpattu Medical College

M. Ravikumar Assistant Professor, Department of Anaesthesiology, Chengalpattu Medical College

G.Kanchana Senior Resident, Department of Anaesthesiology, Chengalpattu Medical College

ABSTRACT

BACKGROUND: Brachial plexus blockade provides excellent analgesia and anaesthesia for upper limb surgeries with reduced hospital stay and cost when compared with general anaesthesia. This study is designed to make nerve stimulator guided technique better by comparing the quality of blockade when performed at two different current strengths of 0.5 and 0.9 mA.

AIM : To study the quality of blockade while using two different current strengths for supraclavicular block with nerve stimulator in elective upper limb surgeries below elbow.

MATERIALS AND METHODS : After obtaining Institutional Ethical Committee approval, 60 patients of ASA I or II aged 16 to 60 years undergoing elective upper limb surgeries below elbow were selected and randomly divided into two groups. With informed consent, all patients received supraclavicular block by Winnie's approach with 15 ml of 2% Lignocaine with 1:2,00,000 adrenaline plus 15 ml of 0.5% bupivacaine. The nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, drug was injected in group B and current strength was gradually reduced till response was similarly obtained with 0.5 mA and the drug was injected in group A. A blinded observer recorded the duration of surgery, time of onset of sensory and motor blockade, total duration of sensory and motor blockade, time taken for rescue analgesia and complications.

STATISTICAL ANALYSIS : The data were analyzed using the SPSS (version 16) software. The parametric and non parametric data were analyzed with Student's 't' test and Chi-square test. A p value < 0.05 was considered statistically significant.

RESULTS : There was no statistically significant difference in both groups with respect to time taken to perform the block, onset of sensory and motor blockade and duration of motor and sensory blockade. There were no complications in both the groups.

CONCLUSION : We conclude that nerve stimulator guided blocks may be performed at the initial seeking current itself (< 1 mA) to avoid multiple attempts and unnecessary needle manipulations which may prove harmful to the patient.

KEYWORDS : Brachial plexus block, Supraclavicular block, Nerve stimulator, Subclavian perivascular approach, Current strengths.

INTRODUCTION

Regional anaesthetic technique like nerve blocks offer pain free surgical field during and after the intra operative period to patients with a lot of advantages over general anaesthesia like allowing the patient to stay awake maintaining their spontaneous breathing and protects against aspiration. Other complications of general anaesthesia like postoperative nausea and vomiting, allergic reactions, hemodynamic alterations, excess sedation, malignant hyperthermia and the remote possibility of failed intubation, etc., are easily circumvented by nerve blocks.

Early approach to nerve blocks followed the dictum of Moore which states *"No Paraesthesia; No anaesthesia"*[1]. The "art" of peripheral nerve blockade performed by gifted individuals has now turned into a "science" with the help of peripheral nerve stimulators and ultrasound imaging. Brachial plexus block was first performed by William Halstead and Alfred Hall[2] in 1884 by directly dissecting and exposing the nerves roots.

Brachial plexus blockade provides excellent analgesia and anaesthesia to patients for upper limb surgeries with reduced opioid analgesia thereby reducing hospital stay and cost when compared with general anaesthesia. It can be achieved by various approaches like Interscalene, Supraclavicular, Infraclavicular, Axillary and Posterior paravertebral. Techniques for brachial plexus blockade include landmark based paraesthesia elicitation, nerve stimulator guided, Ultrasound guided and Dual guided (USG and nerve stimulator).

This study is designed to make nerve stimulator guided technique better by comparing the quality of blockade when performed at two different current strengths of 0.5 and 0.9 mA.

MATERIALS AND METHODS

This study was a prospective randomized double blinded trial conducted during February to July 2016 in the Department of Anaesthesiology, Chengalpattu Medical College, Chengalpattu. After obtaining Institutional Ethical Committee approval, 60 patients of ASA I or II aged 16 to 60 years of either sex undergoing elective upper limb surgeries below elbow were selected and randomly divided into two groups.

Group A (0.5 mA), the nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, the current strength was gradually reduced till response was similarly obtained with 0.5 mA. Then the needle was fixed and the drug was injected through the extension catheter (de aired before the injection) by the assistant.

Group B (0.9 mA), the nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, the needle was fixed and the drug was injected through the extension catheter (de aired before the injection) by the assistant.

INCLUSION CRITERIA

- Age 16 to 60 years of either sex
- ASA class I and II patients
- Patients posted for elective upper limb surgeries below elbow.

EXCLUSION CRITERIA

- Age < 16 and > 60 years
- ASA class III & IV
- Infection at the puncture site
- Patients refusal
- Patients with hypersensitivity to lignocaine
- Coagulopathy
- Peripheral neuropathy
- Pregnancy
- Surgery in both upper limbs in same sitting.
- Anticipated difficult intubation.

PRE OPERATIVE PREPARATION

Patients underwent thorough preoperative evaluation which included detailed history, physical examination & investigations. Written informed consent was obtained.

INVESTIGATIONS

Haemoglobin, PCV, platelet count, bleeding time, clotting time, urine albumin & sugar, blood urea, serum creatinine/ electrolytes, random blood sugar, Chest X ray, ECG and echocardiography if necessary.

PROTOCOL

On the day of surgery, patients were wheeled into the theatre and then connected to a multipara monitor showing PR, SpO2, NIBP, continuous ECG and respiratory rate.

After obtaining basal vital parameters, the planned procedure was explained again to the patients in their own language. An 18G intravenous cannula was inserted into one of the hand or forearm veins of the patient's non operated upper limb and an infusion of 500 ml Ringer's lactate solution was started as per perioperative fluid requirement calculation. Intradermal sensitivity testing for lignocaine and bupivacaine were performed in all patients with 0.1 ml of each agent.

PREMEDICATION INTRAVENOUS

- Inj. Glycopyrrolate 0.2 mg,
- Inj. Midazolam 0.01 mg/kg
- Inj. Fentanyl 1µg/kg.

BLOCK PERFORMANCE – Winnie's subclavian perivascular approach[3]

Patient was placed supine with the head turned away from the side to be blocked. The arm to be blocked was adducted with forearm supinated and hand was kept as close to the ipsilateral knee as possible. A rolled towel was placed between the shoulders along the spine to increase exposure of the area.

Supraclavicular area was disinfected and draped. Subclavian artery was palpated 1 to 2 cm above the clavicle in the interscalene groove. After raising a skin wheal with 0.5 ml of 2% lignocaine using a 26G hypodermic needle, a 22G bevelled insulated needle of 5 cm length was inserted cephaloposterior to the artery perpendicular to the skin surface. If the rib was contacted, anteroposterior needle adjustment with careful medial and lateral probing was done to locate the plexus. Nerve response from the lower trunk, which is twitching of fingers or hand in flexion or extension was the desired response.

In Group A (0.5 mA), the nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, the current strength was gradually reduced till response was similarly obtained with 0.5 mA.

In Group B (0.9 mA), the nerve stimulator was set to deliver a current of 0.9 mA and twitch of hand or fingers in flexion or extension was obtained.

Following which, the needle was fixed and after negative aspiration for blood each time, the local anaesthetic mixture of 15 ml of 2% Lignocaine with 1: 2,00,000 adrenaline plus 15 ml of 0.5% bupivacaine was injected in 5 ml increments. Visual and verbal contact was maintained with the patient during and after injection. Patients were monitored closely for complications of the block and local anaesthetic systemic toxicity.

Following the block, the patients were taken over by an anaesthesiologist who was blinded to the grouping. Continuous vitals monitoring with regular assessment of the block was then performed by the blinded anaesthesiologist.

Surgery was allowed to commence after 20 minutes only on confirmation of adequate and complete blockade. Insufficient blockade was planned to be supplemented with general anaesthesia according to our institution protocol and such cases were to be excluded from the study.

The following parameters were noted by the blinded anaesthesiologist:

No. of attempts to perform the block
An attempt is defined as needle entry into the site for block till successful injection.

Time taken to perform the block
From the time of skin disinfection, till the end of local anaesthetic injection.

Time of onset of sensory blockade
From the time of completion of local anaesthetic injection (time zero), sensory blockade was assessed by pin prick in radial, median and ulnar nerve territories (dorsal surface of thumb, palmar surfaces of index and little fingers respectively) for every 2 minutes till 20 minutes.

Onset time was calculated when patients experienced no response to pin prick in all three territories irrespective of whichever nerve was blocked first.

Total duration of sensory blockade
Time interval between onset of sensory blockade to the time when patient first experienced touch sensation in any of the three territories in the hand blocked.

Time of onset of motor blockade
From the time of completion of local anaesthetic injection (time zero), motor blockade was assessed for every 2 minutes in the hand using Hollmen scale[4]:

Grade 1 – normal motor function.
Grade 2 – weak motor function.
Grade 3 – very weak motor function.
Grade 4 – complete loss of motor function.

Attaining Grade 2 was considered as onset of motor blockade.

Total duration of motor blockade
Time interval between onset of motor blockade to the time when patient was able to move any finger in the hand blocked.

Time taken for Rescue analgesia
Time interval between onset of sensory blockade to the time when patient experienced pain sensation in the surgical site. Analgesia was provided with Inj. Diclofenac 75 mg intramuscularly.

Complications (if any).

OBSERVATION AND RESULTS
The study comprised of two groups. The patients were selected by computer generated random numbers.

GROUP A: 30 patients received supraclavicular block at current strength of 0.5 mA.

GROUP B: 30 patients received supraclavicular block at current strength of 0.9 mA. The patient characteristics like age, weight and sex were noted. The outcomes measured were duration of surgery, number of attempts to perform the block and time taken to perform the block, onset time for sensory and motor blockade, duration of sensory and motor blockade, time taken for rescue analgesia and complications if any.

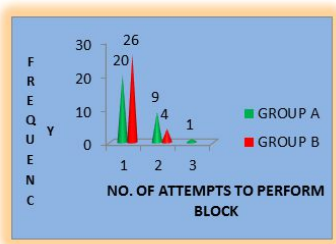
With regard to parameters like age, sex, weight and duration of surgery, the two groups were similar with a p value of >0.05.

OBSERVATION	GROUP A	GROUP B	p value
AGE (years)	33.57 ± 11.717	39.03 ± 11.924	0.078
SEX	25 males	23 males	0.5
	5 females	7 females	
WEIGHT (kg)	56.93 6.908	56.03 6.189	0.597
DURATION OF SURGERY (mins)	70.67 26.351	72.5 26.677	0.79

Results for the other observed parameters also showed no statistically significant difference as shown by the tables and graphs below.

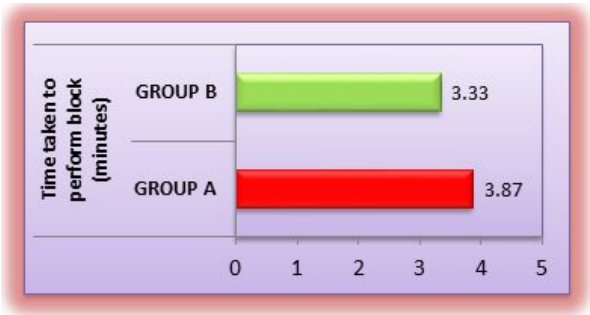
NO. OF ATTEMPTS TO PERFORM BLOCK

GROUP	N	MEAN	STD DEVIATION	t	p
A	30	1.37	0.556	1.952	0.056
B	30	1.13	0.346		



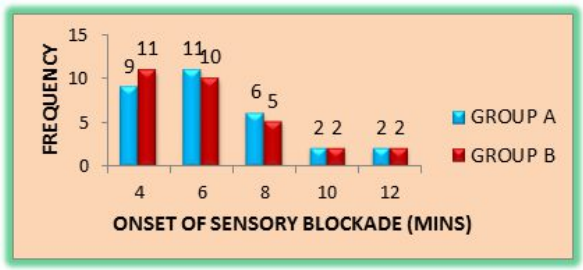
TIME TAKEN TO PERFORM THE BLOCK

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	3.87	1.224	1.964	0.054
B	30	3.33	0.844		



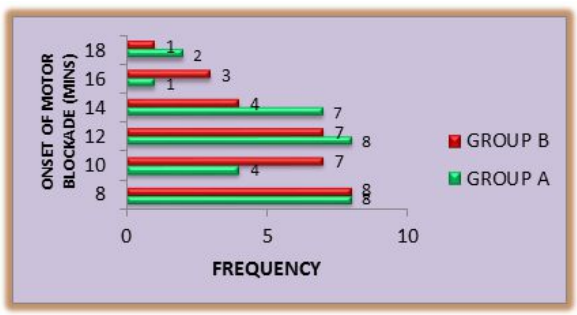
ONSET OF SENSORY BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	6.47	2.33	1.762	0.083
B	30	6.27	2.33		



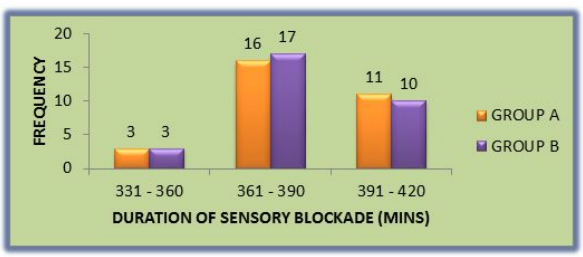
ONSET OF MOTOR BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	P
A	30	11.67	2.975	1.940	0.057
B	30	11.33	2.893		



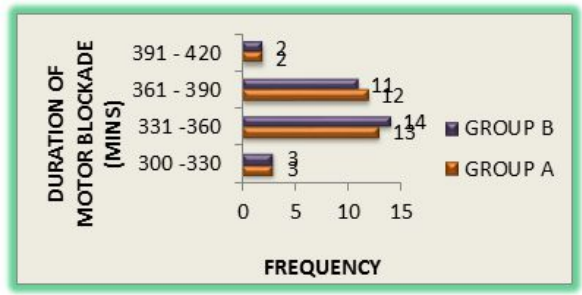
DURATION OF SENSORY BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	390.33	18.659	0.370	0.712
B	30	390	19.493		



DURATION OF MOTOR BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	363.33	19.357	0.644	0.522
B	30	364.33	23.589		



TIME FOR RESCUE ANALGESIA

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	412.67	18.742	1.622	0.110
B	30	410.67	22.118		

DISCUSSION

Kulenkampff[5] in 1911 introduced the classical supraclavicular approach after successful self injection with procaine. Subclavian perivascular technique was described by Winnie and Collins in 1964.

Electrical nerve stimulator was first described by Von Perthes[6] in 1912. Insulated needles were introduced by Pearson[7]. Use of nerve stimulators became common only in the mid to late 1990s.

Supraclavicular block is aimed at the trunks and divisions of the brachial plexus. It is popularly termed as "spinal of the upper extremity"[8] owing to the dense blockade produced with a smaller volume of anaesthetic injected at a compact location of the plexus. Advantages include rapid onset with reliable and complete anaesthesia of upper extremity including arm, elbow, forearm and hand.

Nerve stimulators deliver a low current electrical impulse to peripheral nerves in order to stimulate the motor fibres and thereby identify the proximity to nerves without actually stimulating sensory nerves which causes pain and discomfort to the patient. They identify nerves without making real contact with them. During initial needle placement, the nerve stimulator delivers a current of 1 to 2 mA and after obtaining desired muscle twitch, the current strength is reduced to 0.3 to 0.5 mA. Then, the local anaesthetic is injected in divided doses. Response obtained at very low current strength of <0.3 mA indicates intraneural / intrafascicular injection.

Carlo D. Franco et al[9] prospectively gathered data from 1001 subclavian perivascular blocks performed at the Cook County Hospital over 2.5 years. All blocks were performed by Winnie's technique using nerve stimulator instead of paraesthesia with a volume of 35 to 40 ml of local anaesthetic solution. 97.2% blocks (973) were completely successful, 1.6% (16 blocks) were incomplete and required supplementation and only 1.2% (12 blocks) failed completely and required general anaesthesia. They concluded that nerve stimulator guided technique was successful and safe for surgery on the upper extremity. There was no occurrence of pneumothorax or any other major complications.

Nitin Sathyan et al[10] compared nerve locator and paraesthesia

technique for supraclavicular block in 50 patients using 20 ml of 0.5% ropivacaine solution. They found that the onset of sensory block was lesser in nerve locator group (10 to 15 minutes) than in paraesthesia group(11 to 15 minutes). The onset time for motor block was similar in both groups at 19.44 minutes and 17.72 minutes in paraesthesia and nerve locator groups respectively. Paraesthesia group had the higher incidence of multiple punctures with five cases of block failure requiring general anaesthesia. They concluded that nerve locator technique is safe and better compared to paraesthesia technique.

In our study, supraclavicular block performed at two different current strengths 0f 0.5 and 0.9 mA using nerve stimulator were compared. The idea was that, if blocks performed at the seeking current of 0.9 mA after obtaining definite motor response were similar to those performed after reducing the current strength to 0.5 mA, then there would be no need for unnecessary needle manipulations. The rate of complications due to needle manipulations and needle passes can also be significantly reduced. The time taken to complete the block will also reduce if blocks are performed at the seeking current. In our study, it was found that the two groups showed no statistically significant difference.

Statistical analysis was done using SPSS version 16 for windows. Quantitative analysis was compared using Student's't' test. A 'p' value of < 0.05 obtained by two tailed analysis was considered statistically significant.

The number of attempts to perform block was 1.37±0.556 in Group A and 1.13±0.346 minutes in Group B with a 'p' value of 0.056 which was statistically insignificant. The time taken to perform block was 3.87±1.224 minutes in Group A and 3.33±0.844 minutes in Group B with a 'p' value of 0.054 which was statistically insignificant.

The onset of sensory blockade was 6.47±2.33 minutes in Group A and 6.36±2.438 minutes in Group B with a 'p' value of 0.862 which was statistically insignificant comparable to the study by **Carlo Franco et al**[11] in which they compared the characteristics of supraclavicular block performed at 0.5mA (Group 1) and 0.9mA (Group 2) after observing motor twitch of fingers in 60 patients. The authors tried to "compare 0.5 and 0.9 mA not as minimum stimulating currents but rather as currents which elicited an unmistakable motor twitch." One patient was excluded from the study. The success rate for the block in the remaining 59 patients of both the groups was 100%. They concluded that eliciting a "clearly visible twitch of fingers at 0.9 mA can be followed by injection of local anaesthetic solution." Also, decreasing the current strength to 0.5mA produced no improvement in the overall quality of the block as shown by the similar onset and duration of analgesia / anaesthesia and satisfaction score of patients.

Aghdashi et al[12] conducted a similar study regarding the quality of vertical infraclavicular block performed using nerve stimulator at 0.8 mA (study group) and 0.5 mA (control group). The onset of analgesia occurred in 4.3 minutes and 4.6 minutes in study and control group. The onset of anaesthesia occurred in a mean duration of 15.6 and 13.5 minutes in study and control groups (p = 0.064). They concluded that injection at seeking current (0.8 mA) produces a similar quality of block when compared with injection at 0.5 mA.

Gurnaney H et al[13] retrospectively compared the relationship between current strengths to elicit motor response before performing nerve blocks in pediatric patients under general anaesthesia. 666 patients had received peripheral nerve blocks during the period studied. All blocks were performed at current strengths ranging from 0.2 to 1 mA. The overall success rate was 96% and there was no difference in success rate between blocks performed at <0.5 mA or =0.5 mA or >0.5 mA (p value of 0.793).

The onset time was comparable to the study by **Mithun Duncan et al**[14] which compared nerve stimulator with ultrasound guided block and found the sensory onset time to be 5.90 ± 1.85 minutes in nerve stimulator group. The onset time was also comparable to the study by **Pathak et al**[15] in which sensory block onset was in 6.7 ± 2.9 minutes.

The onset of motor blockade was 11.67±2.975 minutes in Group A and 11±2.694 minutes in Group B with a 'p' value of 0.376 which was statistically insignificant. The onset of motor blockade followed the onset of sensory blockade which was comparable to the study by **Chan et al**.[16]

The duration of sensory blockade was 390.33±18.659 minutes in Group A and 390.36±20.454 minutes in Group B with a 'p' value of 0.996 which was statistically insignificant. The duration of motor blockade was 363.33±19.357 minutes in Group A and 364.64±24.416 minutes in Group B with a 'p' value of 0.821 which was statistically insignificant.

The time for first rescue analgesia was 412.67±18.742 minutes in Group A and 410.36±22.849 minutes in Group B with a 'p' value of 0.675 which was statistically insignificant. The duration of analgesia was comparable to the study by **Mithun Duncan et al**[14] in which the duration of analgesia in nerve stimulator group was 401.13±105.65 minutes. There were no complications in both the groups. The success rate in both groups at 0.5 and 0.9 mA was 100% comparable to the study by **Carlo Franco et al**[11].

LIMITATIONS OF THE STUDY

- All patients belonged to ASA I and II.
- Smaller sample size.

CONCLUSION

From our study, it is inferred that supraclavicular block performed at 0.5 and 0.9 mA using nerve stimulator for upper limb surgeries below elbow is comparable in terms of attempts at block performance, time taken to perform block, onset and duration of block. The success rate was 100 % with no complications in both groups. Hence, nerve stimulator guided blocks may be performed at the initial seeking current itself (< 1 mA) to avoid multiple attempts and unnecessary needle manipulations which may prove harmful to the patient.

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REFERENCES:

1) Moore DC. Regional Anaesthesia. Springfield, IL: Charles C. Thomas, 1953;241.
2) Halsted WS: Practical comments on the use and abuse of cocaine; suggested by its invariably successful employment in more than a thousand minor surgical operations. N Y Med J 42:294, 1885.
3) Winnie AP, Collins VJ: The subclavian perivascular technique of brachial plexus anesthesia. Anesthesiology 24:353–363, 1964
4) Hollmen scale to assess motor and sensory blockage by peripheral nerve block. C Caponga, D cell no chal, Alkalization of local anaesthetic which block which anaesthetics? Reg. Anaesth. 1995 Sept; 20(5) 369-77.
5) Kulenkampff D. Anesthesia of the brachial plexus [German]. Zentralbl Chir 1911;38:1337-1350.
6) Perthes G. Conduction anesthesia with the help of electrical stimulation [German]. Mu¨nchen Med Wochenschr 1912; 59:2545-2548.
7) Pearson RB. Nerve block in rehabilitation: a technique of needle localization. Arch Phys Med Rehabil. 1955;26:631-633.
8) Hadzic's peripheral nerve blocks and anatomy for ultrasound guided regional anaesthesia 2nd edition; Chapter 13: Page 362.
9) 1,001 Subclavian Perivascular Brachial Plexus Blocks: Success With a Nerve Stimulator. Carlo D. Franco, M.D., and Zairo E.G. Vieira, M.D. Regional Anesthesia and Pain Medicine, Vol 25, No 1 (January–February), 2000: pp 41–46.
10) Brachial Plexus Block, a Comparison of Nerve Locator versus Paraesthesia Technique. Dr Nithin Sathyan , Dr Harish Hegde , Dr Sampathila Padmanabha, Dr Anish K. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). Volume 13, Issue 1 Ver. X. (Feb. 2014), PP 06-10
11) Franco CD, Domashevich V, Voronov G, Rafizad AB, Jelev TJ. The supraclavicular block with a nerve stimulator: To decrease or not to decrease that is the question. Anesth Analg. 2004; 98(4):1167–71
12) Vertical infraclavicular block with local anesthetic injections at different currents. Aghdashi MM, Mosaffa F, Shokohi S, Abbasivash R, Hassani E. Acta Med Iran. 2014;52(12):927-30.
13) The relationship between current intensity for nerve stimulation and success of peripheral nerve blocks performed in pediatric patients under general anesthesia. Gurnaney H1, Ganesh A, Cucchiaro G. Anesth Analg. 2007 Dec;105(6):1605-9.
14) A comparative study of nerve stimulator versus ultrasound-guided supraclavicular brachial plexus block. Mithun Duncan, Akshaya N. Shetti, Debendra Kumar Tripathy, D. Roshansingh, and N. Krishnaveni. Anesth Essays Res. 2013 Sep-Dec; 7(3): 359–364.
15) Supraclavicular brachial plexus block with and without Dexamethasone – A Comparative Study Dr R. G. Pathak, Dr Anand P. Satkar, Dr Rajendra N. Khade, International Journal of Scientific and Research Publications, Volume 2, Issue 12, December 2012
16) Chan VW, Perlas A, Rawson R, Odukoy O. Ultrasound guided supraclavicular brachial plexus block. Anesth Analg. 2003;97:1514–7.