A Dissertation on

"RANDOMIZED PROSPECTIVE STUDY COMPARING THE EFFECTIVENESS OF POSTERIOR CORD STIMULATION WITH MEDIAL CORD STIMULATION IN INFRACLAVICULAR BLOCK FOR FOREARM AND HAND SURGERIES USING NERVE STIMULATOR "

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In partial fulfillment of the requirements for the award of degree of

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CHENNAI – 600 001

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DECLARATION BY THE CANDIDATE

I, Dr. KARTHICK RAJ A, solemnly declare that the dissertation, titled **" RANDOMIZED PROSPECTIVE STUDY COMPARING THE EFFECTIVENESS OF POSTERIOR CORD STIMULATION WITH MEDIAL CORD STIMULATION IN INFRACLAVICULAR BLOCK FOR FOREARM AND HAND SURGERIES USING NERVE STIMULATOR ",** is a bonafide work done by me during the period of March 2014 to August 2014 at Government Stanley Medical College and Hospital, under the expert supervision of **Dr. R. MATHANKUMAR, M.D, D.A,** Professor and Head of Department of Anaesthesiology, Government Stanley Medical College, Chennai.

This thesis is submitted to The Tamil Nadu Dr.M.G.R. Medical University in partial fulfillment of the rules and regulations for the M.D. degree examinations in Anaesthesiology to be held in April 2015.

Chennai – 600 001 **DR. KARTHICK RAJ.A**

CERTIFICATE BY THE DEAN

This is to certify that the dissertation presented herein by **Dr. KARTHICK RAJ.A, "RANDOMIZED PROSPECTIVE STUDY COMPARING THE EFFECTIVENESS OF POSTERIOR CORD STIMULATION WITH MEDIAL CORD STIMULATION IN INFRACLAVICULAR BLOCK FOR FOREARM AND HAND SURGERIES USING NERVE STIMULATOR"** is an original work done in the Department of Anaesthesiology, Government Stanley Medical College and Hospital, Chennai in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University for the award of degree of M.D. (Anaesthesiology) Branch X, under my supervision during the academic period 2012-2015.

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Title of the Work : A randomized prospective double blinded study comparing the effectiveness of posterior cord stimulation with Medical Cord Stimulation in infraclavicular block for forearm surgeries using nerve stimulator.

Principal Investigator : Dr. Karthick Raj.A

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The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 02.07.2014 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

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K Vasantha

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CONTENTS

ABSTRACT

Back ground : Infraclavicular approach to the brachial plexus sheath provides anesthesia for surgery on the distal arm, elbow, forearm, wrist, and hand. It has been found that evoked distal motor response or radial nerve type motor response has influenced the success rate of single injection infraclavicular brachial plexus block.

Aim of the study : To compare the effectiveness of block by stimulating posterior cord with medial cord in infraclavicular block for forearm and hand surgeries by using nerve stimulator.

Methods : After ethical committee approval, patients were randomly assigned to one of the two study groups of 31 patients each. In group P, posterior cord stimulation was used and in group M medial cord stimulation was used for infraclavicular brachial plexus block. The effectiveness of motor,sensory and surgical block were assessed

Results : Sensory block among radial nerve, ulnar, median, musculocutaneous nerve have been studied between two groups. In posterior cord group radial nerve was blocked completely in all patients and in medial cord group radial nerve

sparing was seen in some patients. There is insignificant difference in sensory block along ulnar, median nerve between two groups

Motor block was assessed in elbow, hand grip and wrist and there is a significant difference between two groups in elbow joint and insignificant difference in wrist and hand grip level

Complete motor block is the number patients of score 2 in all three joints. There is a significant difference between two groups. Complete motor blockade is seen in more number of patients in posterior cord group when compared to medial cord group.

Complete sensory block is compared between two groups. Posterior cord group has effective complete sensory blockade when compared to medial cord group.

Effectiveness of upper limb blockade (Complete motor and sensory)-Significant difference between two groups were seen. Posterior cord stimulation group has more effectiveness of block than medial cord group

Surgical block: In posterior cord group 5 patients required additional sedatives and analgesics. In medial cord group 18 patients required further dose of analgesics and

2 patients had inadequate block. Hence the effectiveness of surgical block is good with posterior cord group

Complications:The incidence of complications in the form of vascular puncture was not different between two groups.

CONCLUSION : Stimulating the posterior cord guided by a nerve stimulator before local anesthetic injection is associated with greater extent of block and effectiveness of block (in reporting no pain during the surgery) than stimulation of medial cord with similar rate of complications.

INTRODUCTION

Peripheral nerve blockade remains a well accepted component of comprehensive anaesthetic care due of their distinct advantages over neuraxial and general anaesthesia. Its role has expanded from the operating site into the arena of postoperative and chronic pain management. With appropriate selection and sedation, these techniques can be used in all age groups. Skill ful application of peripheral neural blockade broadens the anaesthesiologist's range of options in providing optimal anaesthetic care.

It is possible and desirable for the patient to remain ambulatory. Patient who arrive at surgery with full stomach face less danger of aspiration, if they vomit. Post anaesthetic nausea, vomiting and other side effects of general anaesthesia such as atelectasis, hypotension, ileus, dehydration and deep vein thrombosis are reduced.

In new trend of day care surgeries with minimal hospital stay and less financial burden on the patients, brachial plexus block seems to be a better alternative to general anaesthesia. A substantial savings on operating room turnover time can occur if peripheral nerve blockade are done outside operating rooms. Patient can position themselves on the operating table with little risk to the loss of airway and minimal personnel effort. High degree of patient and surgeon satisfaction results because of superior pain control with minimal side effects.

Peripheral nerve block of upper limb includes the various techniques of brachial plexus block. Among brachial plexus blocks, interscalene, supraclavicular and axillary blocks have been routinely used for many years in all over the world. Infraclavicular block has gained interest in recent times.

Infraclavicular brachial plexus block, first described by Bazy[1] in 1922, provides anaesthesia for surgery on the distal arm, elbow, forearm, wrist and hand. Numerous modifications of this technique have been developed to improve the success rate and risk of complications. With nerve stimulator the regional block has advantage of minimal discomfort to patient, lesser chance of nerve damage and improved success rate in contrast to paresthesia technique This block targets the musculocutaneous and axillary nerves at the level of the cords before these nerves leave the brachial plexus "sheath"[1,2]. This block carries no risk of accidental intrathecal, epidural, intravertebral injection, stellate ganglion block or paralysis of hemi diaphragm. Infraclavicular block is often performed by localizing one cord within the brachial plexus sheath and placing all the local anaesthetic solution at this location. However success rate of block depends upon the distal twitching of muscles rather than proximal stimulation also success rate depends on stimulating the type of cords of the brachial plexus. This has been observed in non randomized observational study that in infraclavicular block after localizing posterior cord would place the needle centrally within the infraclavicular portion of brachial plexus and allow an even spread of local anaesthetic comparing with medial cord. Hence this randomized study has been selected to compare the effectiveness of posterior cord stimulation with medial cord stimulation in infraclavicular block for forearm and hand surgeries.

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AIM OF THE STUDY

To compare the effectiveness of block by stimulating posterior cord with medial cord in infraclavicular block for forearm and hand surgeries by using nerve stimulator.

Primary Objective:

To assess the effectiveness of upper limb block based on

1. Number of patients reaching the sensory block in the areas distributed by radial, median, ulnar and musculocutaneous nerves.
2. Number of patients with the complete motor block at the level of elbow, hand grip, wrist
3. Number of patients with complete sensory block
4. Number of patients with effective upper limb blockade
5. Number of patients with effectiveness of surgical block

Secondary Objective:

Assess the complications

1. Subclavian vessel puncture
2. Local anaesthetic toxicity
3. Pneumothorax

HISTORY OF BRACHIAL PLEXUS BLOCK[3]

The first brachial plexus block was performed by William Stewart Halsted in 1885, less than a year after Karl Koller demonstrated the anaesthetic properties of cocaine on the eye of a patient.

Halsted exposed the nerve roots surgically under local infiltration and injected each of them with a small amount of dilute cocaine (0.1%) interneurally under direct vision. Only about 0.5 ml of local anaesthetic was required to produce complete anaesthesia.

In 1897 George Crile used a similar technique in which the plexus was exposed under local anaesthesia. Just behind the sternomastoid muscle, cocaine was injected into the nerve trunks under direct vision which was done as a therapeutic measure in a 12 year old boy who developed tetanic spasms following a compound fracture of the forearm; later the technique was used to provide anaesthesia for upper arm surgeries.

In 1911-1912 KULENKAMPFF described the first percutaneous supraclavicular approach. He pointed out that above the clavicle the plexus lies under the skin as it passes over the first rib and accessible to a percutaneous technique. The mid point of clavicle and the subclavian artery provided a constant landmark, most frequently at the point where external jugular vein intersects the clavicle. He performed his first attempt on himself and used 5 ml of Novocaine, later he increased it to 10 ml and was able to obtain complete anaesthesia. Direction of the needle was backwards, inwards and downwards. He emphasized that the purpose of the technique was not to hit the rib but to find the trunks by eliciting paresthesia. He said that the first rib just prevented pleural penetration. He used 4 cm needle.

Infraclavicular approach was originally suggested by BAZY and coworkers in 1917.-was included in LABAT's regional anesthesia in 1922.[1]

In 1977, RAJ and associates modified the infraclavicular technique by a lateral direction of the needle; and using the nerve stimulator to make the technique of locating the plexus more acceptable to the patients.[2]

In 1998 WILSON et al[13] described an infraclavicular coracoid technique –which was undertaken to evaluate the sensory distribution and its clinical efficacy.

ANATOMICAL CONSIDERATIONS[51]

Formation of the brachial plexus and its distribution is essential to the intelligent and effective use of the brachial plexus blockade for the surgeries of the upper limb. Close familiarity with the vascular, muscular and fascial relationship of the plexus throughout the formation and distribution is equally essential to the mastery of various techniques of Brachial plexus Blockade.

Derivation of plexus:

Brachial plexus is formed by the union of ventral rami of lower four cervical nerves (C5,6,7,8) and first thoracic nerve (T1) with frequent contributions from C4 or T2. When contribution from C4 is large and from T2 is lacking, the plexus appears to have a more cephalad position and is termed “prefixed”. When contribution form T2 is large and from C4 is lacking, the plexus appears to have a caudal position and is termed “post fixed”. Usually prefixed or post fixed positions are associated with the presence either of a cervical rib or of an anomalous first rib.

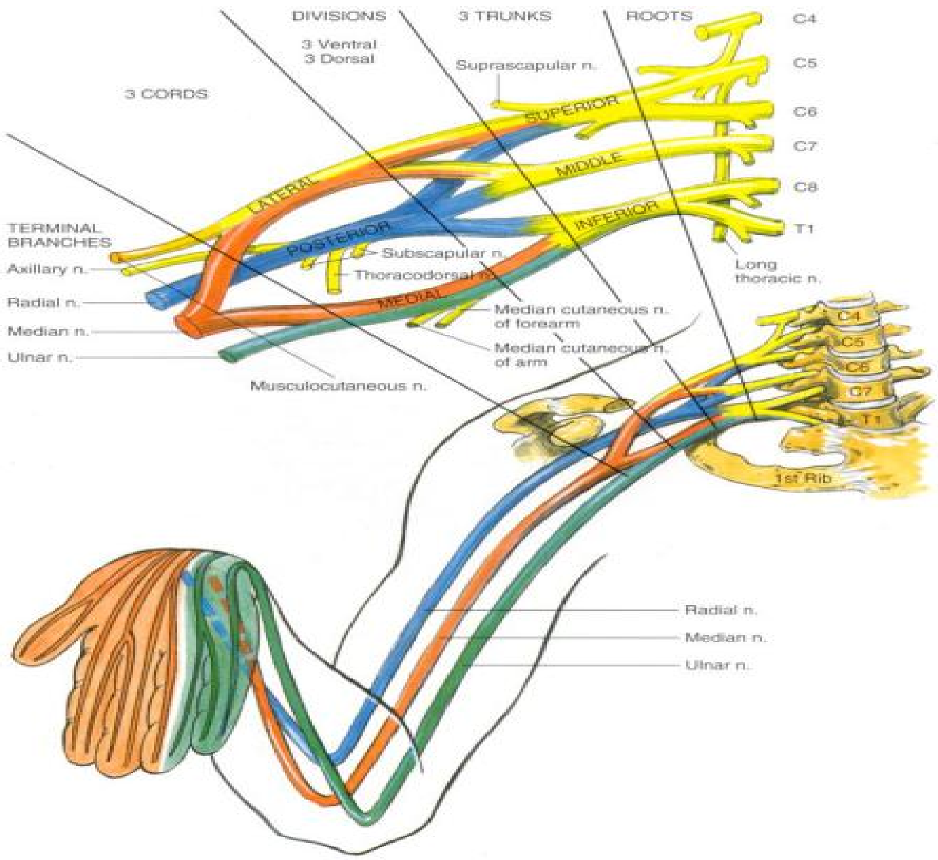
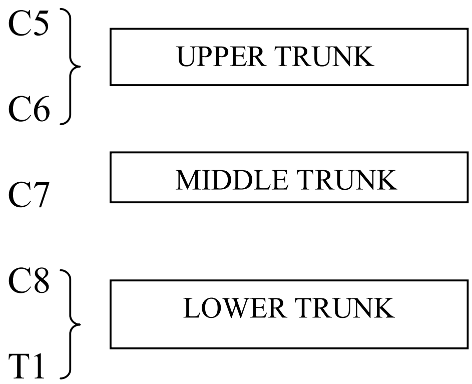


Figure 1 : Anatomy of Brachial Plexus

Course:

After leaving their intervertebral foramina, the roots course anterolaterally and inferiorly to lie between scalenus anterior and medius muscle, which arise from anterior and posterior tubercles of cervical vertebrae respectively. Here they unite to form the trunks.



The prevertebral fascia invests both the anterior and middle scalene muscles, fusing laterally to enclose the brachial plexus in a fascial sheath. Trunks emerge from the lower border of the muscle running inferiorly and anterolaterally converging towards the upper border of the first rib, where they lie cephaloposterior to the subclavian artery.

Lateral cord:

Lateral root of median nerve

Lateral pectoral nerve

Musculocutaneous nerve

Medial cord:

Medial root of median nerve

Medial cutaneous nerve of arm

Medial cutaneous nerve of forearm

Medial pectoral nerve

Ulnar nerve

Posterior cord:

Radial nerve

Axillary nerve

Upper and lower subscapular nerve

Nerve to lattismus dorsi

Branches from roots

Dorsal scapular nerve to Rhomboid muscles (C5)

Long thoracic nerve of Bell (C5, C6, and C7)

Branches from trunk:

Nerve to subclavius (C5-C6)

Suprascapular nerve (C5-C6)

RELATIONS

Brachial plexus has its roots in between the scalene muscles, trunks in the posterior triangle of the neck, divisions behind the clavicle and cords at the level of the Axilla and nerves beyond the axilla. In its course it lies superior and posterior to the subclavian artery. Dome of pleura is anteromedial to the lower trunk and posteromedial to the subclavian artery. The trunks emerge between the fascia covering the anterior and middle scalene muscles.

ANATOMY OF BRACHIAL PLEXUS ABOVE THE CLAVICLE:

The roots of the brachial plexus arises from the ventral divisions of C5 through T1 are clustured between the scalenus anterior and scalenus medius muscle. The five roots then converge toward each other to form three trunks -upper, middle and lower-, which are stacked one on top of the other as they traverse the triangular interscalene space formed between the scalenus anterior and medius muscle, which is known as interscalene groove. In the interscalene groove the subclavian artery accompanies the brachial plexus anterior to lower trunk.

BOUNDARIES OF INFRACLAVICULAR FOSSA:

Bounded anteriorily by pectoralis major and minor muscles, medially by ribs, superiorly by clavicle and coracoids process, and laterally by humerus. Brachial plexus is composed of cords at this location. The plexus at this level is surrounded by sheath at it is delicate. It contains the subclavian/axillary artery and vein. Axillary and musculocutaneous nerves leave the sheath at or before the corocoid process in 50-60% patients.

FUNCTIONAL ANATOMY AND TECHNIQUES

Common techniques of infraclavicular block

- Proximal vertical infraclavicular approaches
- Distal /lateral infraclavicular approaches

These approaches target the plexus either in the close proximity of the clavicle at its midpoint i.e Kilka's[5] point (VIB) or at the apex of the deltopectoral triangle medial to the coracoid process (VIP) approaches.

At this level the 3 cords of brachial plexus are posterior and lateral to the axillary artery, forming a groups of cords, the medial cord being in the most caudal position lying under the lateral cord. The most commonly elicited EMRs at this site are those of the:

Lateral cord-EMR elbow flexion (stimulation of musculocutaneous nerve) or EMR forearm pronation (stimulation of the neural elements of the lateral root of the median)

Posterior cord-EMR deltoid contraction (stimulation of the neural elements of the axillary nerve) or wrist/finger extension (stimulation of the neural elements of the radial nerve).Eliciting a medial cord/median response at the proximal infraclavicular site will require manipulation of the needle in a more distal direction aiming more medially or laterally

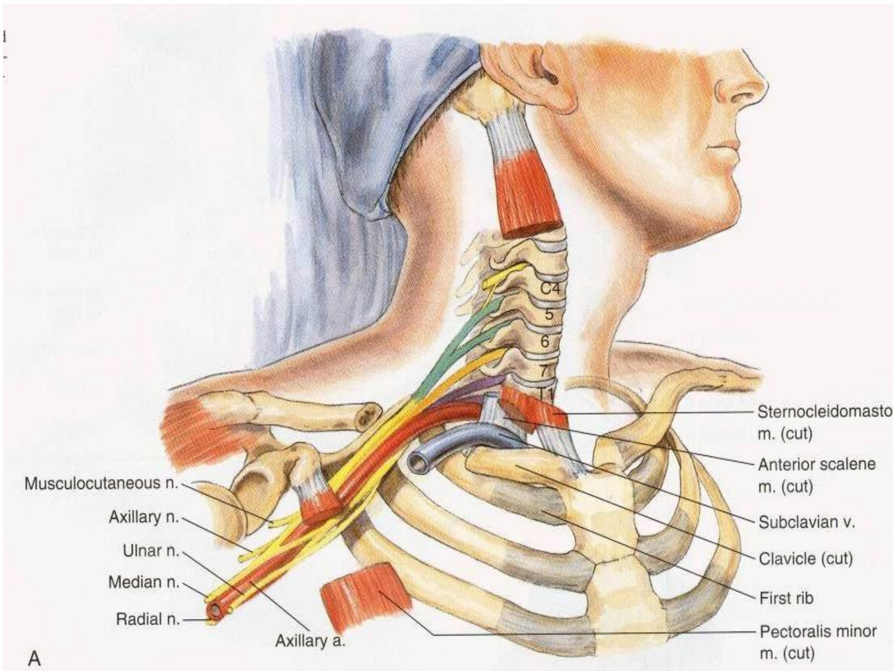


Figure 2 : Anatomy Important For Infraclavicular Block

1. **Proximal vertical infraclavicular approaches:**

Advantages:

- less painful-by passes pectoralis muscle
- plexus is superficial
- blocks musculocutaneous and axillary nerve consistently(may be missed in distal approach)

Disadvantage:

There may be difficulty in achieving medial cord response because the medial cord lies under the lateral cord. If there is difficulty then proceed to a more distal approach.

Increased risk of pneumothorax when compared to distal approach.

Patient position:

Supine, head turned contralateral side. Roll under the interscapular and neck area, operated arm abducted, forearm supported for clear view of the hand.

Needle entry site:

It is preferable to mark the deltopectoral triangle of the clavicle(kilka's point-VIB-vertical infraclavicular approach).[5]

i. The midpoint of the line between suprasternal notch and acromian process.To identify acromian process, move the upper arm, the immobile acromian can be distinguished from mobile humeral head. Mark the needle entry site immediately distal to the clavicle the midpoint of the line joining the sternal notch and the anterior acromian (kilka's point for VIB approach)

ii. If the external jugular vein is visible, trace its trajectory down over the clavicle, this point should be in alignment with the above marked needle entry site.

iii. Feel the interscalene groove above the clavicle and trace it down the clavicle, this point should also align with the marked needle entry site.

iv. To mark the distal needle entry site for the more distal VIP(vertical infraclavicular brachial plexus block) approach, identify the deltopectoral triangle (infraclavicular fossa).Feel the coracoid process by asking the patient to shrug the shoulder, resulting in the anterior movement of the coracoid while the head of humerus is in upward direction. Mark the medial border of the coracoid process, the needle insertion site is at the distal angle of the deltopectoral triangle (infraclavicular fossa) 1cm medial to the coracoid process.

Procedure:

The operator stands near head of the patient on the ipsilateral side. One can start with the proximal puncture site (kilka's point), moving to a distal site if no response is obtained or start at the distal paracorocoid site in the deltopectoral triangle. After disinfection and local anaesthetic infiltration, advance the insulated 22G, 5cm block needle in strictly perpendicular direction in the saggital plane. Set the stimulating current set at 1.0mA, 2Hz, 0.1ms.The most common initial response at the depth of 2-3cm is lateral cord response (flexion of the elbow from biceps contraction or forearm pronation). Advance the needle 1-2cm for a posterior or medial cord response. If a EMR of medial/posterior cord is not elicited, withdraw the needle drop the angle by 15-20^{o} so as to advance the needle in a more caudad direction to seek the medial cord response. If no response is elicited on the initial needle insertion site more the needle to a lateral location for 1-2cm.If lateral search fails to elicit a motor response move the needle site 1cm medially. Keep in mind that a more medial needle insertion site from kilka's point increases the risk of pneumothorax.

Gauging the depth of brachial plexus for infraclavicular block:

CORNISH et al[14] in a recent MRI study showed the infraclavicular region anatomy and assessed the possibility of estimating brachial plexus depth before performing an infraclavicular block by using identifiable anatomical landmarks such as coracoid process and clavicle. The depth of the plexus can be most reliably gauged when the needle is inserted in the parasagittal plane,1cm medial to the corocoid process directly below the clavicle.

Depth of the plexus from the needle insertion point in the parasagittal plane is equivalent to the vertical distance between the horizontal plane of the needle insertion point and the middle of the clavicle.

2. **Wilson etal[13] Distal/Lateral infraclavicular approaches(distal coracoid approaches)**This approach blocks the brachial plexus below the pectoralis minor tendon around the second part of axillary artery.

Advantages:

Carries a relatively **lower risk** of pneumothorax compared to proximal VIP approach especially that performed in the close proximity of the clavicle. It is technically easier to elicit the desired EMR responses.

Disadvantages:

i. Patient discomfort-requires the needle to traverse the pectoralis major so it is more painful than the proximal VIP approaches.
ii. Due to the variable take off of the axillary and musculocutaneous nerves, there is a possibility of them getting spared.

Technique

Patient position- same as proximal VIP approaches

Needle entry site

Kapral et al[6] (Lateral infraclavicular) : the operator stands on the ipsilateral side to be blocked. The coracoids process is identified by asking the patient to shrug the shoulder, the coracoid process is felt when the head of humerus is positioned in the upward direction. The needle is inserted directly posteriorly in the sagittal plane until it contacts the coracoids process. The needle is then withdrawn 2-3 mm and reinserted under the coracoid process till it contacts the brachial plexus. Kapral et al has reported that in a lateral infraclavicular approach, a pronounce sensory and motor blockade of musculocutanoeus nerve was observed and an addition spectrum of nerves (thoracodorsal, axillary and medial brachial cutaneous nerve) were also involved

WILSON et al[13](distal coracoid) : the coracoid process is identified as described above. The needle entry site is 2cm medial and 2cm inferior to the tip of the coracoid process. The needle is inserted directly posteriorly in the sagittal plane. The distance of plexus from skin ranges from 3-6cm.

PERIPHERAL NERVE STIMULATORS

Peripheral nerve stimulators (PNSs) have become indispensable in the practice of modern regional anesthesia. A more in-depth understanding of how they function is required so that their full potential can be realized in a clinical setting. Although the use of PNSs for regional anesthesia was first suggested by Von Perthes in 1912, it has gained wide acceptance concurrent only with the resurgence of interest in regional anesthesia during the last two decades. The manufacturing industry has met the demand for devices that are more accurate in determining nerve location prior to the injection of local anesthetic, and several makes and models are commercially available. Though the newer models are inherently more accurate, they often include a plethora of functions with controls that are intuitive.

PHYSIOLOGICAL BASIS OF PERIPHERAL NERVE STIMULATOR TECHNOLOGY [46,47,48]

The ability of a nerve stimulator to evoke a motor response depends on the intensity, duration, and polarity of the stimulating current used and the needle (stimulus)-nerve distance. To propagate a nerve impulse, a threshold current must be applied to the nerve fibre. Peripheral nerve stimulation is typically performed using a rectangular pulse of current. When a square pulse of the current is used to stimulate a nerve, the total charge delivered is the product of the current strength and the duration of pulse.

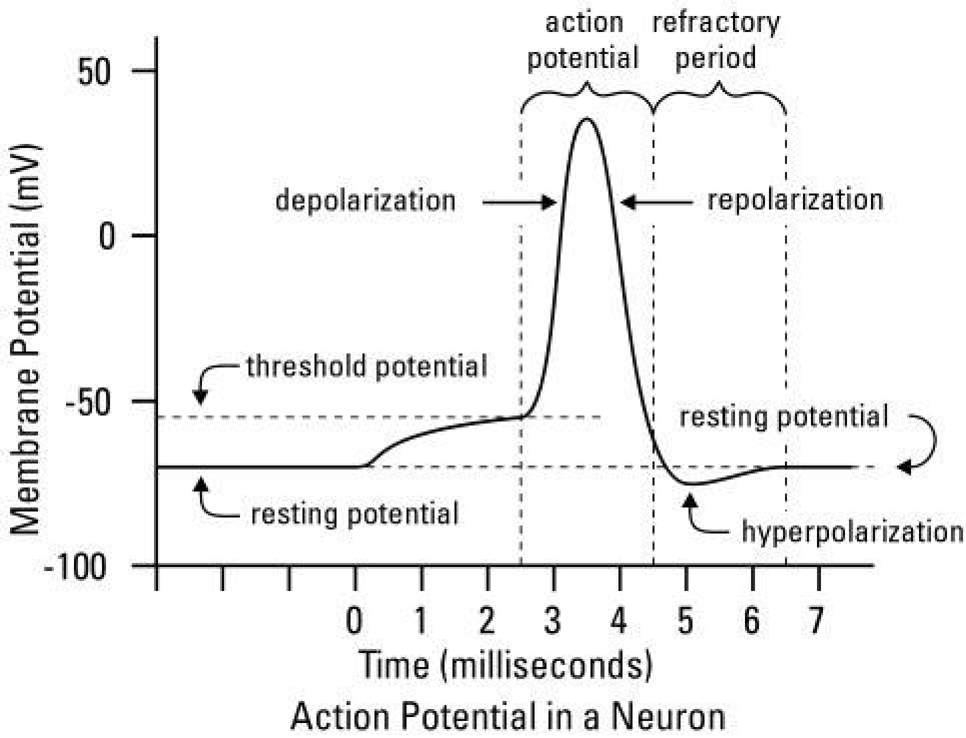


Figure 3 : Action Potential in a Neuron

As like other tissues in the body, The functional unit of the nervous system maintains the intracellular negativity with respect to outside extracellular. This is known as resting membrane potential and is about -70mV.When the nerve is stimulated a transient change in the ion permeability of the membrane, an increase in transmembrane conductance of sodium channel occurs. When applying a strong stimulus it depolarizes the membrane and creates an action potential which then propagates along the nerve to stimulate the muscle and causes a contraction as shown in fig 1.

The actual current output by the stimulator is calculated as voltage output

{V}/ impedance = output {mA} (Ohm's law).

The importance of the stimulation of the particular nerve is the relationship between duration and strength of the current and the stimulus polarity. To conduct a nerve impulse, a particular threshold level of stimulus must be applied to the nerve. Below this threshold, none of the impulse should be propagated. Any increase in the stimulus above this threshold results in a corresponding increase in the intensity of the impulse.

Assuming that a square pulse of current is used to stimulate the nerve the total energy (charge) applied to the nerve is a product of current intensity and pulse duration.

The following two terms are of importance for nerve stimulation.

Rheobase: The minimal current required to stimulate the nerve with a long pulse.

Chronaxie : The duration of current required to achieve twice the stimulation that the rheobase produces.

The current intensity (I) to stimulate the nerve depends on the rheobase (Ir), chronaxie (C) and duration of the stimulus (t).

$$I = Ir (1 + C/t)$$

The chronaxie can be used to measure the stimulation threshold of any particular nerve and is useful when comparing different nerves or types of nerve fibers. The chronaxies of peripheral nerves are shown in Table No. 1,

CHRONAXIES OF PERIPHERAL NERVES TABLE NO. 1

TYPE OF FIBRE	CHRONAXIE
Alpha Fibres	50 to 100
Delta Fibres	170
C Fibres	400

When compared to small delta fibres the large α motor nerve fibres are very much stimulated for sensation of pain. This makes it possible to elicit a motor response without significant patient discomfort. However, when a higher intensity current is used (e.g. greater than 1.0 mA), preferential stimulation of the motor fibers may be lost, and uncomfortable paresthesia – like stimulation is often elicited. Hence significantly less current should be applied for elicitation of motor response to prevent uncomfortable stimulus to the patient.

Electrodes Orientation

The principle concept of electrode orientation in peripheral nerve stimulator is the preferential cathode stimulation, which states that when the cathode is positioned closer to the nerve that the anode , significantly less current is needed to obtain a response to stimulation than if the positions are reversed . If the stimulating electrode is negative, the resting membrane potential alters with current flow current flow near to the needle, produces a membrane depolarization across the nerve which spreads all around the nerve and initiates a motor response . If the nerve around the electrode is positive, results in the formation of hyperpolarisation due to current near the needle and a ring of depolarization formed below the needle tip . This forms of arrangement of electrode has least efficiency in initiating the stimulus and has clinical importance. Significantly more current is required to stimulate the nerve. The site of placement of the positive electrode is irrelevant with modern stimulators as long as quality electrodes are used and good electrical contact is achieved. The electrocardiographic electrodes for location of nerve should be avoided because it has poor quality.

Relationship between Intensity of current and Needle nerve density

The commonest malconceptions about stimulation of the nerve is that nerve stimulators are considered (nerve finders). It is often understood that a large current should be used to locate the nerve initially and then the needle should be manipulated closer towards the nerve by simultaneously decreasing the intensity of the current and slowly advancing it. However, the nature of the current-nerve distance is not that simplistic, as will be seen from the following discussion.

The relationship between the intensity of the stimulus and the distance from the nerve is governed by Coulomb's law

$$I = K(Q/r2)$$

where I is the current needed to stimulate the nerve, K is a constant, Q is the minimal current required for stimulation, and r is the distance from the stimulus to the nerve.

The presence of the inverse square means that a current of very high intensity is required as the needle moves away from the nerve. In addition, although stimulation with a current of high intensity (e.g., 4 to

8 mA) may result in nerve stimulation even though the needle is some distance away; from the nerve, it does not offer information about the plane in which the needle must be advanced to get closer to the nerve. Besides such high-current stimulation inevitably results in patient discomfort. Thus, nerve stimulators cannot be used as a substitute for a sound knowledge of regional anesthesia anatomy.

In contrast, when stimulation is accomplished using a current of low intensity, much more information can be obtained, For instance, a clear motor response achieved at 0.2 to 0.5 mA indicates an intimate needle-nerve relationship, which is associated with a higher success rate of achieving neuronal blockade. However, nerve stimulation using a stimulating current of less than 0.2 mA (0.1 – 0.3 m sec) may be associated with intramural placement of the needle and should be avoided. In our experience, stimulation at such a low-intensity current often results in pain and, occasionally, resistance on injection. In this case, the needle should be slightly withdrawn so that stimulation is achieved with a current between 0.20 and 0.50 mA and the injection carried out.

Salient features of peripheral nerve stimulators

In their pioneering work about two decades ago, Galindo and colleagues made recommendations about desirable features of Peripheral nerve stimulators. Although their suggestions are still valid today, current nerve stimulators have become much more specialized and advanced and incorporate rather, complex, sophisticated electronics. Advances in technology have largely served the purpose of manufacturing more reliable, precise units. However, the plethora of functions and features on some models can make their use confusing. Base on our interactions with many anesthesiologists who attended our workshops on peripheral nerve blocks and participated in our recent survey on the use of nerve stimulators, it is clear that keeping pace with the technological advances in this field has become a challenge for many clinicians. For this and other practical reasons, we believe that nerve stimulators for regional anesthesia should be engineered specifically for the purpose of nerve stimulation, and be simple to operate, highly reliable, and ergonomic.

1. **Constant-current output:**

The impedance of tissues, needles, connecting wires and grounding electrodes may vary. A constant- current design incorporates automatic compensation in voltage output for changes in tissue or connection impedance during nerve stimulation, ensuring accurate delivery of the specified current within a clinically relevant range of impedance loads.

2. **Accurate Current Display:**

The ability to read the current being delivered is of utmost importance for both the success and safety of nerve blocks.

3. **Convenient Means of Current Intensity Control:**

Current can be controlled using either digital means or an analog dial. Alternatively, current intensity can be controlled using a remote controller, such as a foot pedal or hand- held controller, allowing a single operator to perform the procedure and control the current output. The stimulator design should allow for changes in the current intensity in increments of 0.01 mA in the range of 0.00 to 0.50 mA and 0.1 mA thereafter.

4. **Pulse Width:**

A short pulse width (e.g., 100 to 200 ohms) corresponding to the chronaxies of A fibers appear to be the most suitable for nerve localization. Although some units allow the user to change the duration, the clinical utility of such a feature is still not well defined.

5. Stimulating Frequency:

A 2 to 2.5 Hz stimulating frequency appears optimal for nerve localization. When using older units with 1-Hz stimulation (one stimulus per second), the needle must be advanced very slowly to avoid missing the nerve between stimuli.

6. Disconnect and malfunction Indicator:

This is an essential feature because the anesthesiologist should know when the stimulus is not being delivered due to a malfunction (e.g. disconnected, poor electrical connection, battery failure). The future needle designs may also incorporate an indicator of current intensity and disconnect on the hub of the needle.

PHARMACOLOGY

BUPIVACAINE

It is an amide local anaesthetic which is structural analogue of mepivacaine. Structure is similar to lignocaine except that the amine containing group is butylpiperidine. Levobupivacaine the s-enantiomer of bupivacaine is also available with less cardio toxicity

MECHANISM OF ACTION

Bupivacaine is a sodium channel blocker. It binds to the specific sites located on the inner portion of the sodium channels as well as obstructing sodium channels near their external openings to maintain these channels in inactivated or closed gate.

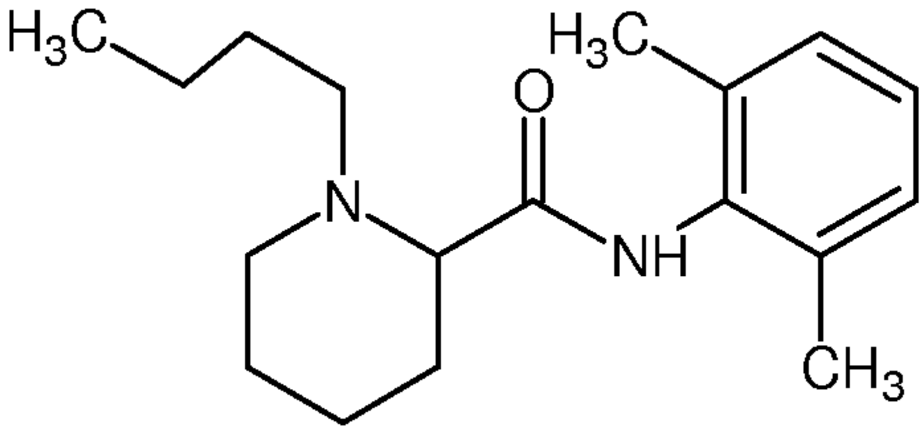


Figure 4 : Bupivacaine Molecular Structure

PHARMACOKINETICS:

- It has Pka 8.1
- 95 percent protein bound mainly with α1 acid glycoprotein
- Volume of distribution is about 73 litres
- Clearance rate is 0.47 litres/min
- Elimination half life is 1.2 to 2.4 hrs
- It has slow onset with peak effect occurs at 0.17 to 0.5 hrs
- Toxic plasma concentration is >5μg/ml

METABOLISM

Possible pathways for metabolism includes aromatic hydroxylation, N-dealkylation, amide hydrolysis and conjugation. The N-dealkyl metabolite has been measured in blood or urine

- Therapeutic uses:
- DOSE 3mg/kg
- Used in epidural and spinal anaesthesia
- For peripheral nerve blocks
- For infiltration analgesia

The mean total urinary excretion of bupivacaine and its dealkylation and hydroxylation metabolites account for >40% of the total anaesthetic dose

CLINICAL CHARACTERISTICS OF BUPIVACAINE

Clinical uses	Concentration	Onset	Duration(min)
Infiltration	0.25%	Fast	120-480
Nerve block	0.25-0.5%	Slow	240-960
Epidural	0.5-0.75%	Moderate	120-300
spinal	0.5-0.75%	Fast	60-240

ADVERSE EFFECT AND COMPLICATIONS

Systemic toxicity

This is due to an increased plasma concentration of the drug. Plasma concentrations are determined by the rate of drug entrance into the systemic circulation relative to their redistribution to inactive tissue sites and clearance by metabolism. The magnitude of toxicity depends on dose administered, vascularity of the area, presence of adrenaline in the solution and protein binding of the drug

Central nervous system

Circumoral numbness is often an early symptom with restlessness, tinnitus, vertigo and difficulty in focusing develops later. Furthur increases in CNS concentrations result in slurred speech and skeletal muscle twitching which signals the imminence of tonic-clonic seizures. Seizures are usually followed by CNS depression, which may be accompanied by hypotension and apnea. The typical plasma concentration of bupivacaine associated with seizures is 4.5-5.5mic/ml. Hypoxia, Hypocarbia, hyperkalemia and acidosis can decrease the seizure threshold and increase CNS toxicity. The treatment includes oxygenation, ventilation and benzodiazepine or barbiturates helps in termination of seizures.

Cardiovascular system

The cardiovascular system is the more resistant to the toxic effects of high plasma concentrations than in the central nervous system. Part of the cardiotoxicity that results from high plasma concentrations occurs because it also blocks Na+ channels in the heart and this block of the inactivated state of the cardiac Na+ and k+ channels is stereospecific. R-Bupivacaine is more potent than S-Bupivacaine. The primary cardiac electrophysiological effect of local anaesthetics is decrease of the rate of depolarization in the fast conducting tissues of purkinje fibres and ventricular muscle. It also decreases the action potential and the effective refractory period.

Accidental intravenous injection of bupivacaine may result in precipitous hypotension, cardiac dysrhythmias like premature ventricular contractions, Supraventricular tachycardia, Atrioventricular heart block and ventricular tachycardia that may be resistant to conventional resuscitative measures. Cardiotoxic plasma concentrations are 8-10µg/ml.

Moreover bupivacaine depress the maximal rate of depolarization in the cardiac action potential(Vmax) by inhibiting the sodium ion influx. This Vmax depression by bupivacaine is considerably more than lidocaine and ropivacaine .In addition, the rate of recovery from a dose dependent block is slower in bupivacaine-treated papillary muscles. Moreover, high blood levels of bupivacaine will prolong conduction time through various parts of the heart indicated by prolongation of PR interval and QRS complex. It also exerts dose dependent negative inotropic action on cardiac muscle.

LIGNOCAINE HYDROCHLORIDE

Lidocaine, the first amino amide–type local anesthetic, was first synthesized under the name 'xylocaine' by Swedish chemist Nils Lofgren in 1943. It is chemically a tertiary amide, diethyl aminoacetyl, 2,6 xylidine hydrochloride monohydrate. It is a local anaesthetic of moderate potency and duration but of good penetrative powers and rapid onset of action.

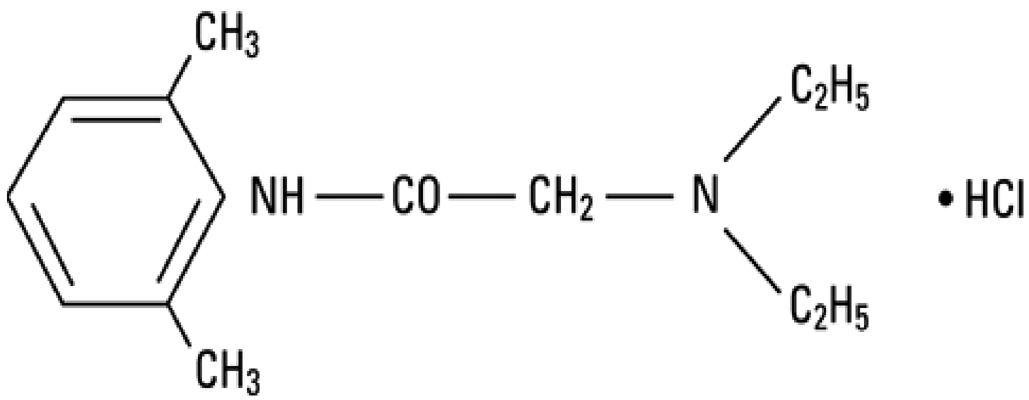


Figure 5 : LIGNOCAINE MOLECULAR STRUCTURE

MECHANISM OF ACTION

Lignocaine blocks the fast voltage gated sodium channels and hence altering the conduction of nerve impulse in the cell membrane of neurons which is responsible for signal propagation . With further blockage, the postsynaptic neuronal membrane will not depolarize and fail to generate an action potential.

PHARMACOKINETICS

- Lignocaine is 64% protein
- Onset of action is 45 to 90 sec
- Pka 7.9
- Lipid solubility 2.9
- Volume of distribution 91 litres
- Clearance rate 0.95 lit/min
- Elimination half life 96 mins
- Toxic plasma concentration > 5μg/ml

METABOLISM

The principal metabolic pathway of lidocaine is oxidative dealkylation in the liver to monoethylglycinexylidide followed by hydrolysis of this metabolite to xylidide. Hepatic disease or decreases in hepatic blood flow which may occur during anaesthesia can decrease the rate of metabolism of lignocaine. Elimination half life is increased more than fivefold in patients with liver dysfunction.

DOSE

- For Intravenous route-1 to 1.5 mg/kg preservative free solution as an anti arrhythmic.

- Safe dose 3mg/kg without adrenaline
- With adrenaline 7mg/kg

Purpose of adding adrenaline:

Epinephrine 1:200000 or 5µg/ml may be added to lignocaine to produce vasoconstriction which limits systemic absorption and maintains the drug concentration in the vicinity of nerve fibres to be anaesthetized.

TOXICITY

Central nervous system:

Low plasma concentrations are likely to produce numbness of the tongue and circumoral tissues. As the plasma concentration continues to increase local anaesthetic readily crosses the blood brain barrier and produces Restlessness, vertigo, tinnitus and difficulty in focusing occurs initially. Furthur increases in concentration result in slurred speech, skeletal muscle twitching, tonic clonic seizures, CNS depression, hypotension, apnea.

i. Transient neurologic symptoms
ii. Cauda equina syndrome

ALLERGIC REACTIONS

Due to the methyl paraben or similar preservatives are structurally similar to paraaminobenzoic and allergic reactions are due to antibody stimulation by the preservative.

Cardiovascular system:

Lignocaine in plasma concentrations of <5µg/ml is devoid of adverse cardiac effects producing only a decrease in the rate of spontaneous phase 4 depolarisation. plasma concentrations of 5 to 10µg/ml may produce profound hypotension due to relaxation of arteriolar vascular smooth muscles and direct myocardial depression.

THERAPEUTIC USES

- Topical anaesthesic (2-4%)
- EMLA cream (lignocaine 2.5% prilocaine 2.5%)
- Local infiltration and peripheral nerve block
- Intravenous regional anaesthetic (Biers block)
- Regional anaesthetic (spinal / epidural)
- Stress attenuation and prevention of rise in intra cranial tension
- Suppression of the ventricular cardiac dysryhthmias

REVIEW OF LITERATURE

1. Wilson et al[13] used a coracoid approach to this block to create an easily understood technique with the help of magnetic resonance images of the brachial plexus from 40 patients. About 2cm medial to coracoid process was identified in a parasagital section. The description of infraclavicular brachial plexus block through coracoids approach may provide advantages over Raj et al[2] described a lateral needle orientation of infraclavicular block to prevent the risk of pneumothorax inherent with blocks performed under the clavicle with the needle directed medially. Some other techniques by lateral needle angulation or different landmarks for infraclavicular blocks have been described. Sims [4] described a more medial and cephalad needle entry site with an inferior and lateral needle angulation. Whiffler's technique [7] uses a needle entry site that is most often inferior and medial to the coracoid process determined by abduction of affected arm with shoulder depressed and bypalpation of vascular landmarks . The needle direction, such as that we describe, is directly posterior. The depth of needle insertion required to reach the brachial plexus often requires the entire length of the needle (51 mm). The risk of penetrating the thoracic cavity was zero as noted in preliminary cadaveric study with this method. Kilka et al.[5] through previous anatomical studies selected 170 patients

and gave anaesthesia for upper limb surgeries through coracoids approach of infraclavicular block . They divided the distance between the ventral process of acromian and jugularis fossa into equal parts and inserted the needle under the midpoint of the clavicle and the needle was manipulated in posterior direction. By using nerve stimulator muscle contractions in the area to be operated with a current 0.3 mA was obtained. 94.8% of patients had adequate surgical block. The remaining patients with an inadequate block was offered general anaesthesia . Complications such as venous puncture occurred in 17 patients (10.3%), and Horner's syndrome was noted in 11 patients (6.8%). Arterial puncture and pneumothorax [41] was not seen. Infraclavicular block with coracoids approach can be easily performed with a consistent palpable bony mark and the arm can be placed in either abduction or placed along the side of the body is the main advantage than other routes. Additionally, it is an easily understandable technique because the needle insertion is directly posterior from the skin entry site. Other advantages common to other infraclavicular blocks include the ability to block the musculocutaneous nerve of the brachial plexus using a single injection, minimization of the risk of pneumothorax, and avoidance of neurovascular structures of the neck. This study concludes that using the infraclavicular/coracoid brachial plexus technique provides effective surgical anaesthesia for forearm and hand surgeries. The required depth of insertion varies with body habitus. This infraclavicular, coracoid block technique has become more comfortable for anaesthesiologist when compared to medial approach

2. LecamwasamH etal[15] success of infraclavicular block with stimulation of posterior cord of brachial plexus. This was a prospective nonrandomized controlled trial done in 350 patients. The main description of the study is stimulating the posterior cord and single injection Infraclavicular block after placing the needle centrally within the infraclavicular portion of brachial plexus and allow an even spread of local anaesthetic. This study therefore hypothesized that stimulation of posterior cord is associated with more block success, rapid onset of block when compared to medial or lateral cord stimulation. This study confirms the clinical impression that posterior cord stimulation before local anaesthetic injection is associated with greatest likelihood of Infraclavicular block success compared with medial or lateral cord stimulation. The posterior cord appears to be lie central to both lateral and medial cord while viewing from the angle taken from the needle in infraclavicular portion of brachial plexus. The location of posterior cord remains important because, the relative position of cords twisting around the axillary artery. Deposition of local anaesthetic at or

around the posterior cord appeared more likely to reach all the cords because of peripheral spread. Similarly multiple cord stimulation has also a good spread of local anaesthetic and has a good success of block. This study did not address the relative merit of stimulating and injecting the cords separately. The concept of placing a needle centrally to increase the success rate of infraclavicular block is not new. Borgeat et al[16] in his study reported 96% rate of Infraclavicular block success when eliciting distal or radial nerve response with central placement of needle. Porter et al[21] in his study by ultrasound guided infraclavicular block for three cases, he deposited the local anaesthetic posterior to axillary artery(also a central placement) and predicts the block success for the same reason. Eventhough ultrasound guided block is a most reliable method for confirming central placement it was not popular as like nerve stimulator because it needs additional training. Given the 88.5% rate of successful block we achieved overall, it is unclear how much improvement we could achieve with ultrasound. This study concludes that posterior cord stimulation before injection of local anaethetic is associated with more frequent rate of block success when compared to stimulation of either lateral or medial cord. However, this study was limited by the fact it was a non-randomized observational study and specific cord identification was not attempted which is the contrast to this study.

3. Bloc etal[18] studied evoked distal motor response on single stimulation less volume infraclavicular plexus block. This was a randomized clinical trial of 500 patients included. This study compares the single injection infraclavicular block success rate by utilizing electrically evoked radial, median, ulnar nerve type distal motor responses to inection of local anaesthetic solution. The first evoked distal motor response was radial, median, and ulnar nerve type in 46%,41% and 13% respectively. In radial nerve type response the success rate was significantly higher 90% when compared to median 75% or ulnar 67% type motor response. For those patients with radial nerve type response no sedation or general anaesthesia was supplemented intraoperatively. None of the patients had specific complications. Hence this study concludes that highest success rate of infraclavicular block is with radial nerve type motor response when compared to median or ulnar type i.e evoked distal motor type of single injection has high success of infraclavicular block.

4. Bowens C *etal*[19] Selective local anesthetic placement with combined use of ultrasound and nerve stimulator guidance for

infraclavicular brachial plexus block. This was a prospective randomized controlled trial done in 60 patients. This study compares the success rate of local anaesthetic injection after central placement or peripheral placement with the combined procedure of ultrasound with nerve stimulator. On statistical analysis the results were comparable between two groups and the success rate was significantly higher with central placement over peripheral placement (95% versus 86%, P = 0.004). Individual cord success rates were as follows: lateral 93%, posterior 99%, and medial 82% (P = 0.001). The central group required attending physician intervention more frequently (26% vs 6%, P < 0.001). Postoperative pain scores of < or =4 were more with central placement (100% versus 93%, P = 0.012).Hence this study concludes that single injection with central placement targeting posterior cord has high degree of infraclavicular block success.

5. Li *etal*[20] Efficacy of infraclavicular block based on stimulating different cords of brachial plexus. This was a prospective randomized study of 60 patients. The aim of this prospective study was to obtain efficacy of infraclavicular brachial plexus blockade based on stimulating different cords of brachial plexus. The cords of the brachial plexus are located in relation of axillary artery. Based on this special location the extent and efficacy of motor and sensory blockade differs while

stimulating different cords of the brachial plexus. A successful blockade was defined as analgesia or anaesthesia in all dermatomes of the five nerves (median nerve, musculocutaneous nerve, radial nerve, ulnar nerve, and medial antebrachial cutaneous nerve).The result shows that posterior cord stimulation provides complete blockade in 30 patients (80%) and stimulating the lateral cord provided complete blockade in 18 patients (54.1%).Hence this study concludes that local anaesthetic injection before posterior cord stimulation has greatest extent and effectiveness of blockade when compared to medial or lateral cord stimulation.

6. Bloc *etal*[26] Ultrasound evaluation of spread of local anaesthetic injection associated with median or radial nerve type motor response in infraclavicular brachial plexus block. This was a prospective randomized study of 32 patients. With radial-nerve or posterior cord type motor response, the success rate of infraclavicular plexus block was 100%, but 3 supplemental axillary blocks were requested with median-nerve–type motor response. Significantly high quality diffusion scores were seen in posterior cord type response when compared to medial cord response (***P*** = .03).Local anaesthetic injection after posterior cord type response resulted in reproducible feature of posterior spread of local anaesthetic in ultrasound guidance due to this spread the

axillary artery displaces upwards and medially . Superficial spread of local anaesthetic has been seen most frequenty with median nerve type response causes axillary artery to be displaced posteriorly and results in minimal success of block. This study concludes that radial nerve type motor response has more frequent block success due to spread of local anaesthetics which was seen in ultrasound and associated with complete motor and sensory block at the level of three cords when compared to medial cord stimulation.

6. Steven borne *et al*[31] interpretation of distal muscle response with stimulation of the cords of the brachial plexus. Interpretation of the muscle twitches during performance of infraclavicular block with specific cord stimulation is difficult and often confusing but it is theoretically important for block success. An end point of easily defined motor responses with nerve stimulation is very essential and it is also necessary to block the appropriate cords of brachial plexus. In addition to an extensive reviews and methods of the motor and sensory neuroanatomy of the upper extremity, They have demonstrated an easy and comfortable method to learn and remember the motor response with respect to stimulating each of the cords of the brachial plexus. If the arm is positioned in the anatomical position, when lateral cord is stimulated the 5th digit (pinkie) moves laterally (pronation of the

forearm), When posterior cord is stimulated, (extension) response is seen at the level of wrist, hands and contraction of triceps ,When medial cord is stimulated (flexion) response is seen at wrist, fingers . The pinkie thus moves "toward" the cord that is stimulated.

7. Desroches *etal*[30] infraclavicular brachial plexus block through coracoid approach is clinically effective. This was a prospective descriptive study and evaluated the motor block, sensory distribution and the effectiveness of infraclavicular block through coracoid approach. This prospective study of 150 patients received an infraclavicular block by the coracoid approach performed by a single anesthesiologist. With the help of nerve stimulator infraclavicular brachial plexus block was performed with a local anaesthetic mixture of 40 ml 1.5% mepivacaine with adrenaline. The parameters observed were complete motor and sensory block, time to perform the block. The results showed the block performance time was S ± 2 min (mean ± SD). 136 patients, 91.3% had a complete sensory block, defined as anaesthesia or analgesia in five nerve below the elbow (musculocutaneous, ulnar, median, radial and medial cutaneous nerve of the forearm) . The axillary nerve block was seen in 98.7% of the patients and of the medial cutaneous nerve of the arm in 62%. An arm tourniquet (260 mmHg of pressure) was applied to 115 of the 137

patients with a successful block and all patients had successful tourniquet tolerence for a duration of 37 ± 20 min (mean ± SD). Hence this prospective study concludes that coracoid approach of an Infraclavicular block provides greater sensory block with a good tourniquet tolerence . This approach provides highly consistent brachial plexus anesthesia for upper limb surgery.

8. Porter *et al*[21] studied about the infraclavicular block success with placement of needle and injection of local anaesthetic posterior to axillary artery.In this study they have used combined ultrasound and nerve stimulator technique for elicitation of motor response and injection of local anaesthetics. This combined technique of infraclavicular brachial plexus block has not been evaluated before. He demonstrated and described the infraclavicular brachial plexus block with ultrasound to place the needle and catheter and observed the type of muscle twitch obtained and spread of local anaesthetic after injection.

In case 1 he observed that injection of local anaesthetics after proximal muscle stimulation i.e the contraction of pectoral group of muscles or biceps. This results in failure of nerve block due to spread of local anaesthetic between pectoral muscle and axillary artery.

In 2^{nd} case, he observed after test local anaesthetic injection that stimulation of proximal group of muscles was associated with spread of local anaesthetic anteriorily. He repositioned the needle followed by catheter posterior to axillary artery until the distal group of muscle contraction obtained. This made a successful block after injection of local anaesthetic through the catheter because the drug spreads posterior to axillary artery.

In case number 3, he observed based on the previous response in case 2 eventhough there was no distal response seen he placed the catheter posterior to axillary artery. This results in block success due to the local anaesthetic spread below the axillary artery.

Hence this study concludes that infraclavicular brachial plexus block with the help of ultrasound guided nerve stimulator results in confirmation of the spread of local anaesthetic injection because of direction visualization of the needle tip of the catheter location enables direct visualization of needle/catheter. This suggests that local anaesthetic spread below the second part of axillary artery results in successful block.

9. Vincent,minville *et al*[25] infraclavicular brachial plexus block with double stimulation motor response. This was a prospective study of 50

patients. This study has compared the infraclavicular block success with dual stimulation in response to second nerve stimulation or response with the aid of nerve stimulation. The results shows that in radial or posterior cord response group the block success rate was 96.6%,In medial cord group success rate was 88.7% and 90% for ulnar nerve response group. The P value shows less than 0.05 . Block performance time and time of onset of block were not significant between the two groups and no serious complications were reported. This study showed that using dual stimulation method having initially located and blocked the musculocutaneous nerve, furthur injection from a posterior cord response resulted in a greater infraclavicular block success rate success than injection from a median or ulnar response. The second response was posterior cord or radial in 55% of patients . This is explained by after musculocutaneous nerve has been blocked the needle should redirected posterior and medially. This corresponds, anatomically, to the radial nerve position compared with the musculocutaneous. The ulnar nerve was less easily identified (10%) as it is more medial location to the artery. Hence this study concludes that local anaesthetic injection on radial , ulnar and median nerve response results in great block success rate with similar block performance time and onset between the two groups however the second motor nerve respone or radial provides a great block success rate than ulnar or median response under dual stimulation technique.

10. Alan Macfarlane et al [38] has used the mixture of local anaesthetic agents 50:50 concentrations of 2%lidocaine and 0.5 % bupivacaine and adrenaline 1:400000 for ultrasound guided supraclavicular block.

11. Neilsen et al[36] comparison of ultrasound guided supraclavicular and infraclavicular block published in Acta Anaesthesiologica scandinavica, In this study effective surgical anaesthesia was considered after blocking five terminal nerves radial, median, ulnar, musculocutaneous with a sensory score of anaesthesia, score 2 or analgesia, score 1 i.e patients were declared ready for surgery when they attain score 2 or score 1.

12. In 1990 Zaharai DT et al described the use of nerve stimulator which allows accurate nerve blocks without causing paraesthesia and decreasing the possibility of nerve injury.

13. In 1985 Smith DC et al described an inexpensive portable nerve stimulator which is used to enhance the ease and effectiveness of peripheral nerve locator.

14. In 1984 Bashein G et al and Ford et al in their independent studies concluded that in nerve stimulator assisted nerve blocks, insulated needles more precisely located the peripheral nerves than uninsulated ones.

15. In 1980 Yasuda I et al described the use of nerve stimulator with insulated needle in Supraclavicular brachial plexus block. They identified the plexus at the mean depth of 27 mm below the skin and the block was successful in 98% of patients when the stimulation of index, middle or ring finger was obtained.

METHODOLOGY (Materials And Methods)

This was a prospective randomized comparitive study conducted at Government Stanley Hospital, attached to Stanley Medical College, Chennai .Sixty two patients of ASA grade I or II of either sex undergoing surgery on the elbow, forearm or hand (mostly orthopedic and plastic surgeries) were randomly allocated into two groups P and M. Each group comprises of 31 patients. Surgery was done under infraclavicular block with posterior cord stimulation, Group P and medial cord stimulation, Group M

Primary Objective:

To compare the extent and effectiveness of infraclavicular brachial plexus block achieved by injecting local anaesthetic drug using nerve stimulator guided posterior cord stimulation and medial cord stimulation.

To assess the effectiveness of upper limb block based on

1. Number of patients reaching the sensory block in the areas distributed by radial, median, ulnar and musculocutaneous nerves.
2. Number of patients with the complete motor block at the level of elbow, Wrist and hand grip

3. Number of patients with complete sensory block
4. Number of patients with effective upper limb blockade
5. Number of patients with effectiveness of surgical block

Secondary Objective:

Assess the complications

1. Subclavian vessel puncture
2. Local anaesthetic toxicity
3. Pneumothorax

INCLUSION CRITERIA

- Age 18 to 60 years
- Both sex
- PS I & II undergoing surgery for both elective/emergency
- Hand , wrist , Fore arm and elbow

EXCLUSION CRITERIA

- Hypersensitivity to local anaesthetics
- Skin infection at the site of puncture
- Coagulopathy
- Severe cardiac diseases
- Neuromuscular disorders

- Neurological disorders or deficits
- Pregnancy
- Any other conditions that requires General Anaesthesia

DRUGS AND EQUIPMENT

1. Nerve stimulator, PLEXYGON
2. Monitors:

   NIBP, Pulse oximeter, ECG
3. Drugs:
   a. Tablet Diazepam
   b. 0.5%Bupivacaine
   c. 2%Lignocaine with adrenaline
   d. Injection Midazolam and Fentanyl
4. 18 G IV cannula
5. All emergency drugs.
6. 20ml syringe, Surface electrodes
7. One 25G needle for skin infiltration
8. A 10cm long, short bevel, insulated nerve stimulating needle.

Sample size:

Based on previous literature, the four motor nerves blocked is 77% for posterior cord stimulation and for lateral or medial cord stimulation is 50%.Based on these proportions for these two groups the significance level of 5% with power of 90% the required sample for the study is 62 i.e for each group 31 cases is needed

$$\text{Sample size} = \frac{2(Za+Zb)^2\ (P1Q1+P2Q2)}{(P1-P2)^2}$$

$$\text{Sample size} = \frac{2(1.960+1.282)^2\ (77 \times 23+50 \times 50)}{(77-50)^2}$$

$$= 62$$

PROCEDURE:

Written informed consent will be obtained on the day of surgery. Patients with an average age of 18 -60 years undergoing forearm and hand surgeries were randomized into either posterior cord (P group) and medial cord group (M group) using computer generated random number method into two groups of 31 each.

Patient was premedicated with tablet Diazepam 0.03mg/kg 30 min prior to block procedure. The patient was shifted to operation theatre. Using computer generated random numbers patient was allocated to either P group or M group.

18 G IV cannula started on non surgical limb .Monitors such as pulse oximeter, NIBP and ECG were connected.

Patient was placed in a supine position with head slightly turned to an opposite side and the arm abducted .The coracoid process was palpated and a point 2cm medial and 2cm inferior to the process identified and marked. The skin was prepared with chlorhexidine in alcohol solution and the skin overlying this point was infiltrated with 1ml of 2%lignocaine.A 10cm long short beveled insulated needle connected to nerve stimulator is then inserted perpendicular to the skin. The stimulator was set to deliver a rectangular current impulses with a frequency of 2Hz and a pulse width of 100ms.The initial stimulating current was set at 1mA.Once the proximity to cord is identified by visible contractions of an appropriate muscle group the current was incrementally reduced to 0.3mA until muscle activity is resumed. If the stimulation persist even with current less than to 0.2mA it indicates the needle touches the nerve and there would be more chance for nerve injury so needle withdrawn a little. The cord is identified with specific muscle response[31]

Medial cord: Flexion of fingers, wrist and ulnar deviation of the wrist

Posterior cord :

Extension of the fingers, wrist, contraction of triceps.

Figure 6 : An X Ray Demonstrating The Relevant Anatomy For Infraclavicular Block

1. **Coracoid Process**
2. **Clavicle**
3. **Humerus**
4. **Scapula**
5. **Rib Cage**

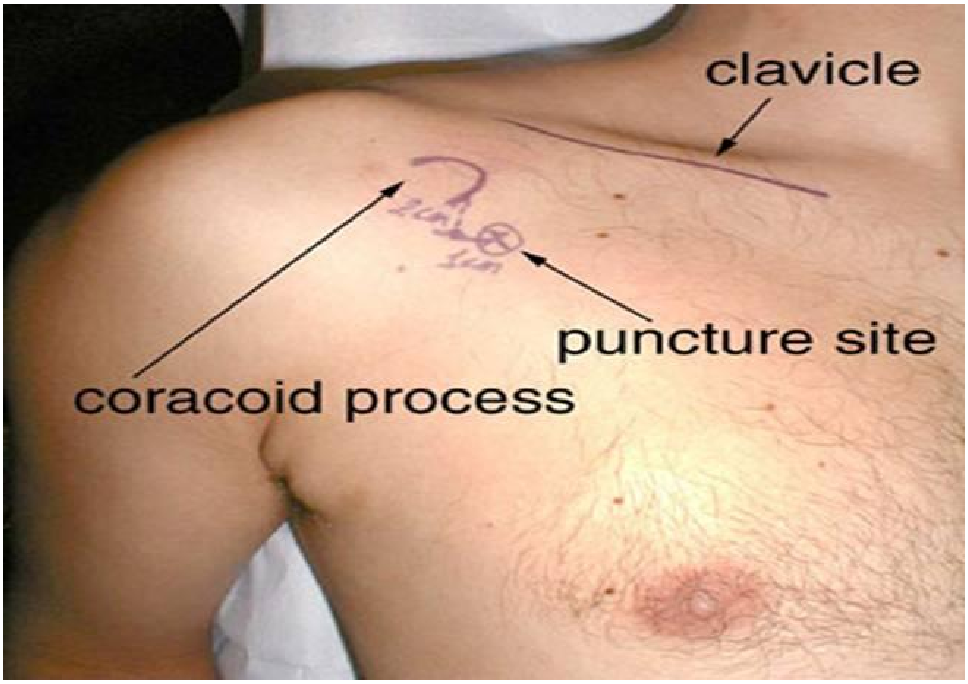


Figure 7 : Surface Markings For Infraclavicular Block

Figure 8 : Peripheral Nerve Stimulator

0.5ml/kg of local anaesthethetic mixture [38] containing 0.25% bupivacaine and 2% lignocaine with adrenaline is injected (not exceeding 30 ml)after negative aspiration of blood at the site after electrical stimulation of cord with respect to specific muscle contraction. The block was evaluated for motor and sensory functions serially at 5,10,15,20,25 and 30min.For motor block evaluation the motor activity was observed in elbow, wrist and hand grip. Motor block grading was performed using the following scale[36]

Grade 0	-	normal contraction
Grade 1	-	Reduced contraction or paresis
Grade2	-	Complete paralysis

For sensory block evaluation patient's skin in the sensory areas of radial, ulnar nerve, median nerve and musculocutaneous nerve was tested with pinprick stimulation. The sensory score[36] for effectiveness of block is documented as

Score 2	-	anaesthesia
Score 1	-	analgesia
Score 0	-	unbearable pain

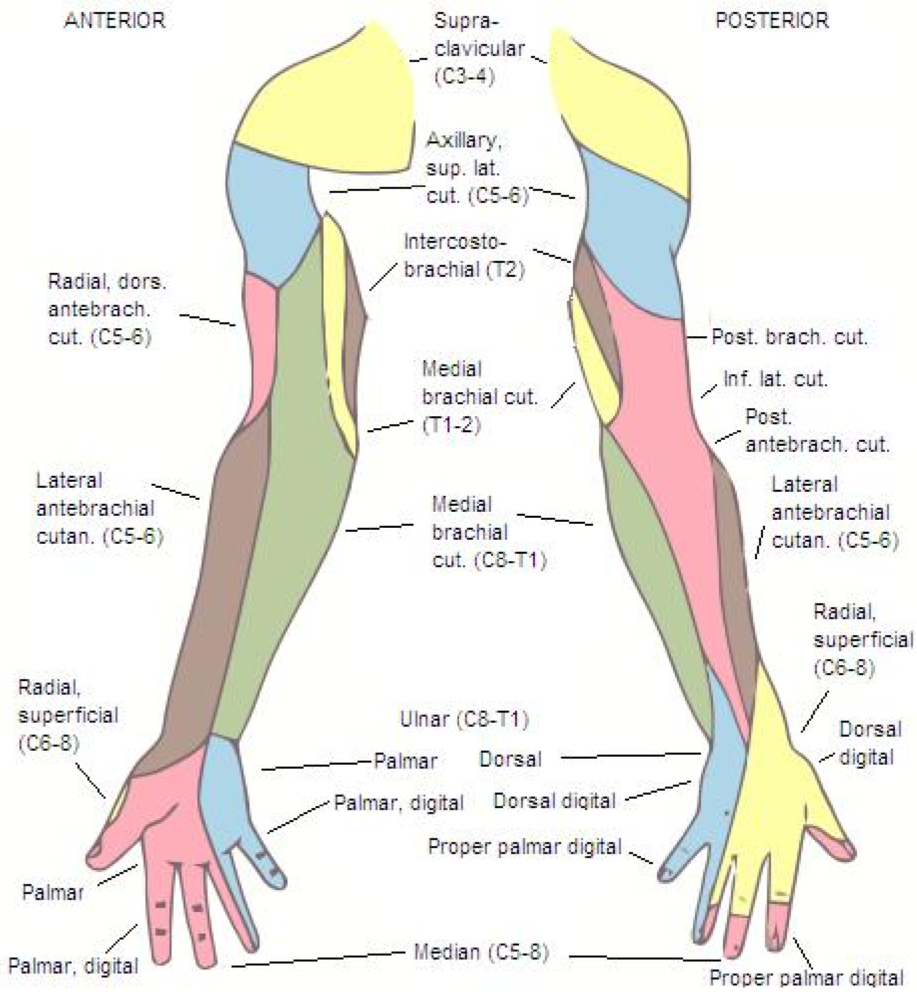


Figure 9 : Dermatomes of upper limb

Any complication including bleeding from subclavian vessel puncture, pneumothorax, local anaesthetic toxicity was recorded. At 30 min after block placement any patient with block that was inadequate for surgery was offered general anaesthesia.

Intra op hemodynamic monitoring such as Heart rate, BP, SPO2 should be measured every 10min.At the end of the procedure patient will be transferred to Post anaesthesia care unit for observation.

OUTCOME MEASURES

1. Sensory block-assessed every 10 minutes after the needle removal for 30 minutes Sensory block was checked by pin prick stimulation at the areas supplied by

a. Radial nerve-dorsum of hand over the second metacarpophalangeal joint

b. Median nerve- Thenar eminence

c. Ulnar nerve-Little finger

d. Musculocutaneous nerves-Lateral side of the forearm

The assessment of sensory block for each nerve was documented as

a. Anaesthesia or no pain-Score 2

b. Analgesia- score 1

c. Unbearable pain-Score 0

2. Motor block-Assessed at 30 minutes after needle removal in elbow,wrist and hand grip

    a. Elbow: by flexion and extension at elbow joint against resistance

b. Wrist: Flexion and extension at wrist joint against resistance

c. Hand grip: by flexion of the fingers at the metacarpophalangeal and interphalangeal joints. Flexion and adduction of fingers and thumb.

Motor block was evaluated as

Score 2	-	complete paralysis
Score1	-	Reduced contraction or paresis
Score0	-	normal contraction

3. Complete sensory block-defined as a sensory block of score 2 in all four nerve territories

4. Complete motor block-defined as a motor block of score 2 in all the three joints

5. Effectiveness of block-defined as complete sensory block (score 2 in all four nerve territories) and complete motor block (score 2 in all above mentioned three joints)

6. Surgical block-defined as a sensory score of 1(analgesia) or score 2 (anaesthesia) in all four nerve territories after 30minutes of block irrespective of motor block

7. Complications: The following complications has been observed

a. Subclavian vascular puncture-identified by aspiration of blood before injecting local anaesthetic solution

b. Local anaesthetic toxicity-numbness over tongue, circumoral region, seizures, bradycardia, hypotension and arrhythmias

c. Pneumothorax-identified clinically by persistent cough, breathlessness, chest pain intraoperatively. Postoperatively patient has been observed for signs and symptoms, periodic auscultation and confirmed with chest X ray for the clinically suspected patients.

Patients were declared ready for surgery when they had an effective surgical block Intraoperatively patients with score 1 of sensory block was given additional dose of 0.25mg/kg of inj midazolam and 2μg/kg of inj fentanyl.

All patients were supplemented with nasal oxygen 3-4lit/min through face mask intraoperatively.

Patient has been monitored through out the procedure. At the end of the procedure, patient was transferred to post anaesthesia care unit for observation for 24 hrs.

All the blocks in both the groups were performed by the principal investigator. Outcome measures were assessed by anaesthesia resident.

OBSERVATION AND RESULTS

A prospective randomized comparitive study conducted at Government Stanley Hospital, attached to Stanley Medical College, Chennai .Sixty two patients of ASA grade I or II of either sex undergoing surgery on the elbow, forearm or hand (mostly orthopedic and plastic surgeries). This study comprised of two groups. The patients were randomly selected

Group P : 31 patients were received infraclavicular block with posterior cord stimulation.

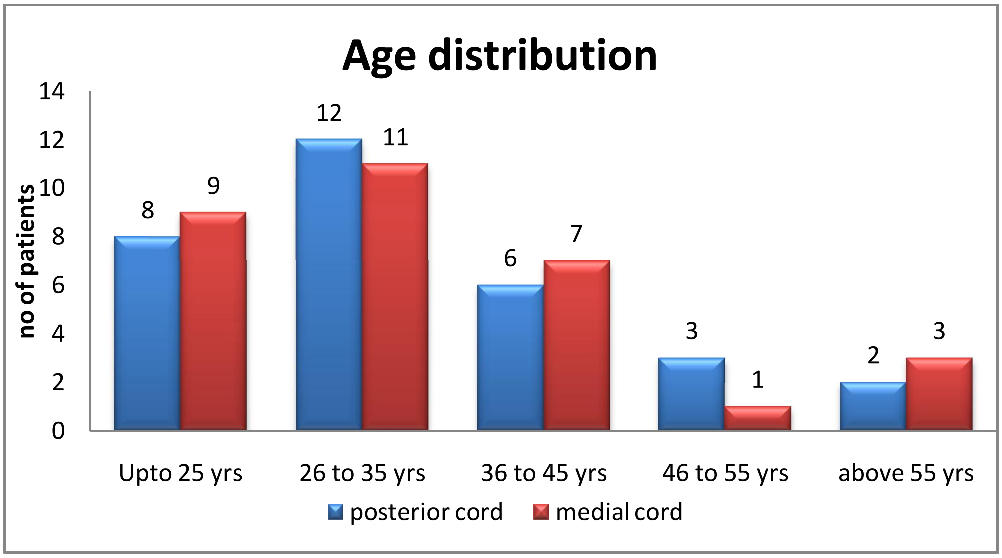
Group M: 31 patients were received infraclavicular block with medial cord stimulation.

Table 1: Age distribution

Age distribution in Posterior cord group varies from 18 years to maximum of 60 years with a mean value of 33.45 years and standard deviation of 12.2.Distribution in medial cord varies from 18 years to maximum of 60 years with the mean value of 33.19 years and standard deviation of 12.5.On analyzing the data statistically the p value is 0.935, hence the difference is statistically insignificant between the two groups.

TABLE 1 (Age distribution)

Age in years	Group P		Group M		TOTAL	
	No	%	No	%	No	%
18- 25 yrs	8	25.8	9	29	17	27.4
26 to 35 yrs	12	38.7	11	35.5	23	37.1
36 to 45 yrs	6	19.4	7	22.6	13	21
46 to 55 yrs	3	9.7	1	3.2	4	6.5
>55 yrs	2	6.5	3	9.7	5	8.1
Mean		33.45				
S.D		12.55				
P value		0.935 not significant				



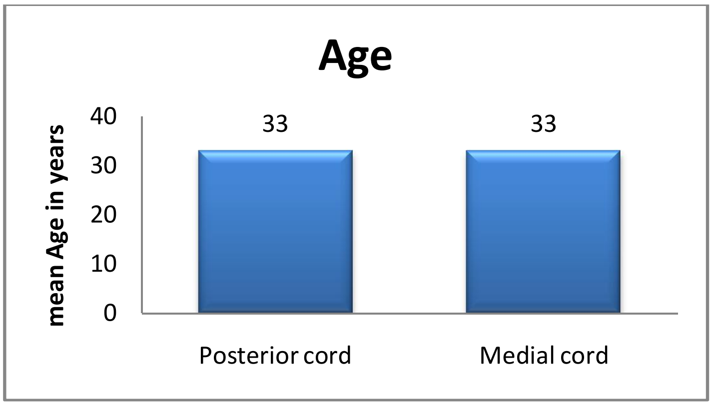
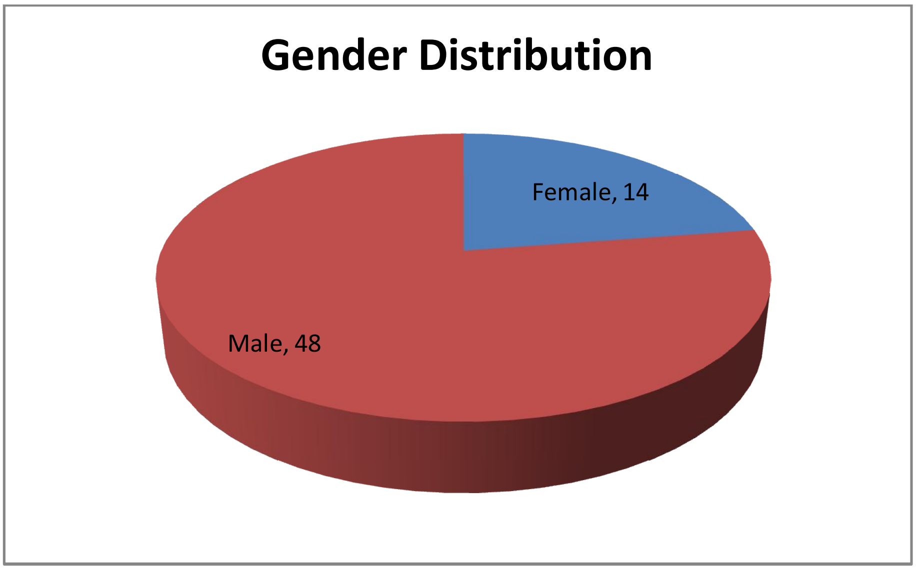


Table 2: SEX DISTRIBUTION

Sex distribution in posterior cord group-males were 23, and the rest were females and in medial cord group-males were 25, and the rest were females. On analyzing the data the P value shows 0.544, statistically insignificant between two groups.

TABLE 2 (Sex distribution)

Genders	Group P		Group M	
	No	%	No	%
Males	23	74.2	25	80.6
Females	8	25.8	6	19.4
'P' value	0.544 not significant			



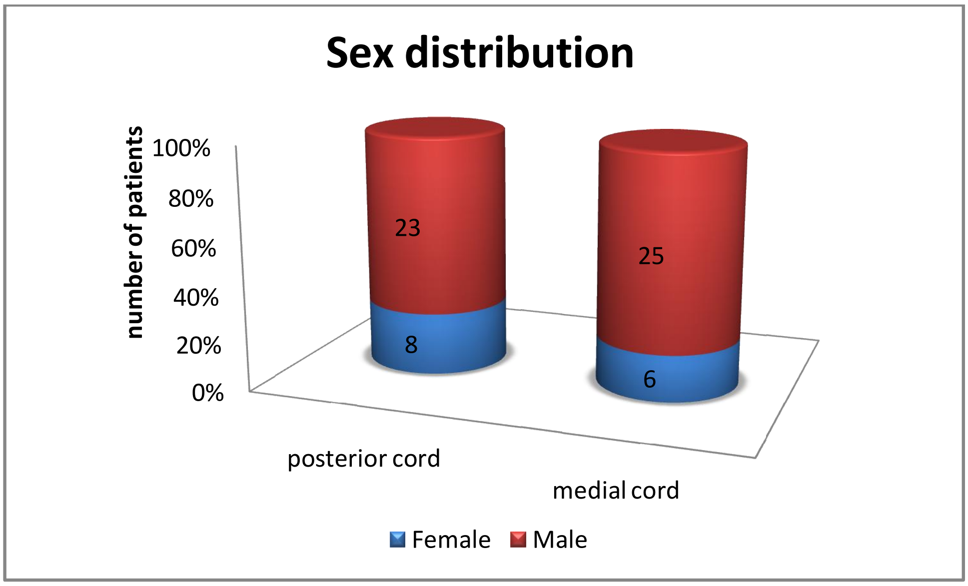
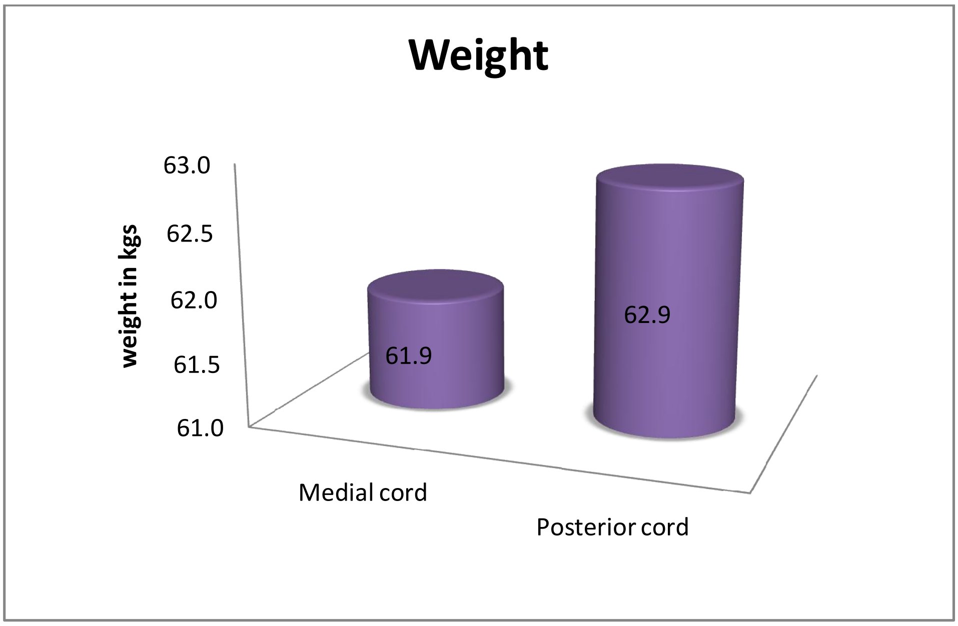


TABLE 3 WEIGHT DISTRIBUTION

	Group P	**Group M**
Mean	62.87	61.87
Standard deviation	7.86	6.52
‘P’ value	0.588 not significant	

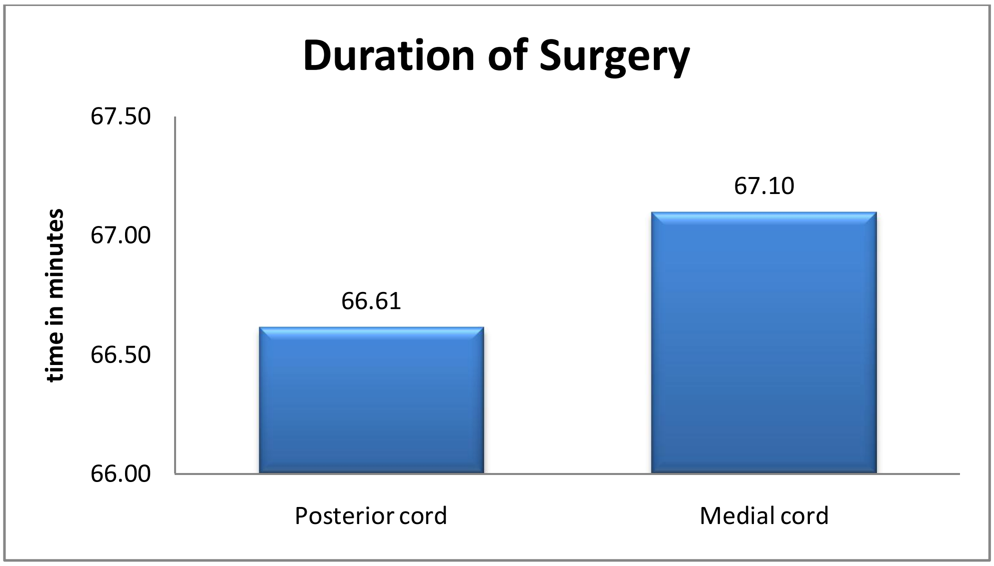
In group P weight of patients ranges from minimum of 50kgs to maximum of 72 kgs, with a mean of 62.87kg and a standard deviation of 7.86.In Group M weight of patients ranges from minimum of 45kgs to maximum of 75kgs, with a mean of 61.87 and a standard deviation of 6.52.On analysis the P value shows 0.588 which is statistically insignificant between two groups



Duration of surgery between two groups: Duration of surgery ranges from minimum of 25 minutes to a maximum of 150minutes with a mean of 66.21 and a standard deviation of 36.22 in group P. The duration of surgery in Group M ranges from minimum of 20 minutes to a maximum of 150min with mean of 67.10 and a standard deviation of 36.66.On analyzing the data the P value shows 0.958 which is statistically insignificant between two groups.

TABLE 4 (Duration of surgery)

Group	Mean	Standard deviation
Posterior cord	66.21	36.22
Medial cord	67.10	36.66
P value	0.958 insignificant	

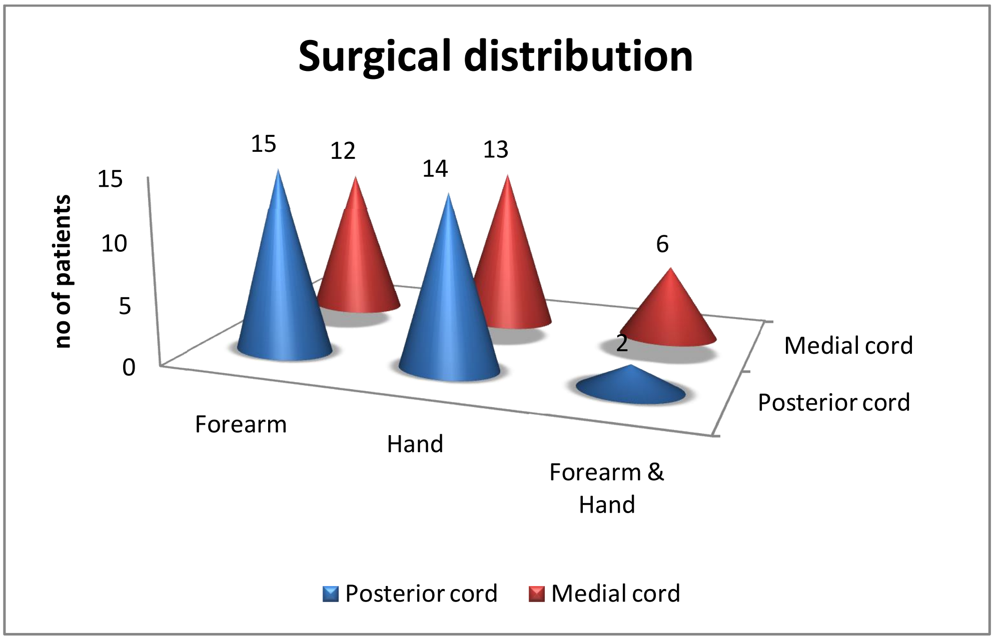


Surgical distribution between two groups:

In Group P,15 patients had surgical procedures over the area of forearm which is 48.4%.14 patients had surgical procedures over the area of hand which is 45.2% and 2 patients had surgical procedures over both forearm and hand which is 6.5%.In Group M,12 patients had surgical distribution over forearm which is 38.7%,13 patients had surgical procedures over hand which is 41.9% and 6 patients had surgical distribution over both forearm and hand which is 19.4%.On analysis P value shows 0.306 which is statistically insignificant

TABLE-5 (Surgical distribution)

Surgical distribution	Group P		Group M	
	No	%	No	%
Forearm	15	48.4	12	38.7
Hand	14	45.2	13	41.9
Forearm and hand	2	6.5	6	19.4
'P' value	0.306 not significant			

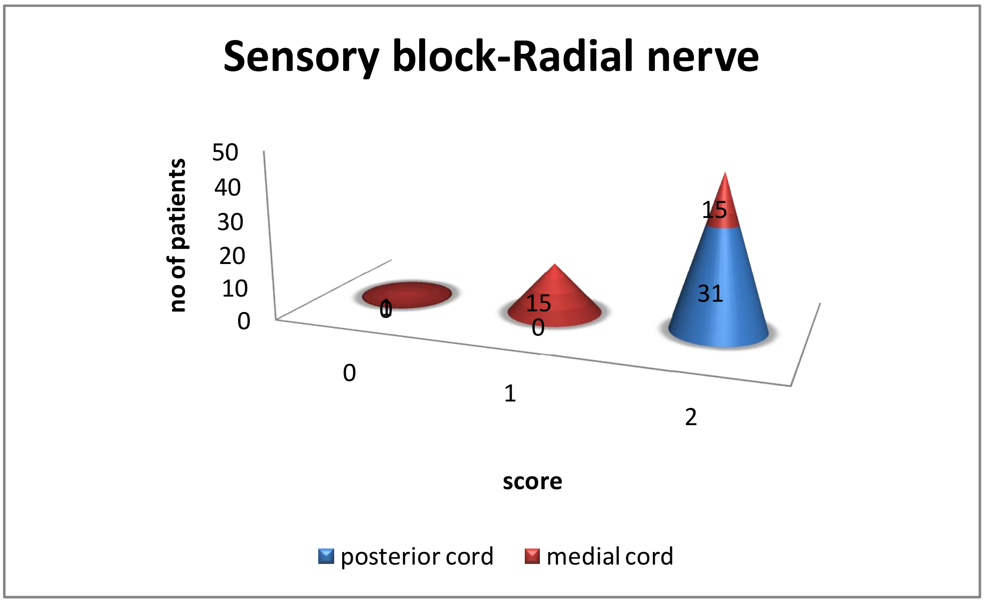


SENSORY BLOCK – RADIAL NERVE :

At radial nerve distribution,sensory score of score 2 is found in 31 patients which is 100% in group P.In Group M 15 patients had score 2 which is 48.4%.Sensory score of 1 is found in 16 patients from Group M.Incomplete block of sensory score 0 is found in one patient from Group M.On analysis the P value shows .001 which is statistically significant between two groups.

TABLE - 6(Sensory block-Radial nerve)

Sensory block-Radial nerve	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	1	3.2
Score 1	0	0	15	48.4
Score 2	31	100	15	48.4
Chi square value	21.56			
'P' value	0.001 significant			

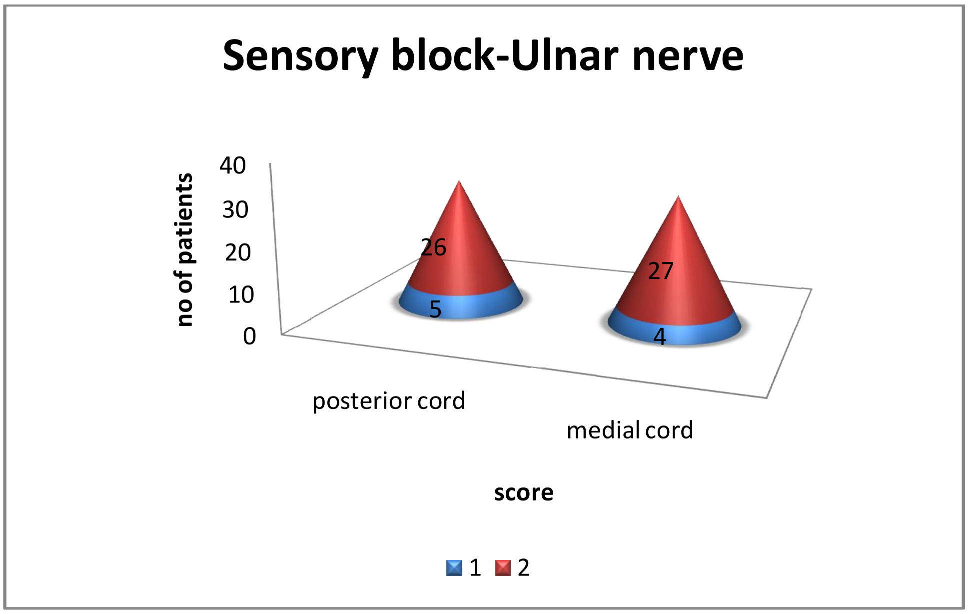


SENSORY BLOCK- ULNAR NERVE:

Sensory block in ulnar nerve with score 2 in posterior cord group has 83.9% and in medial cord group has 87.1%.Sensory block with score 1 in posterior cord group has 16.1% and in medial cord group has 12.9%. On analysis the p value shows 0.718,hence it is statistically insignificant between two groups

TABLE- 7 (Sensory block – Ulnar nerve)

Sensory block- Ulnar nerve	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	0	0
Score 1	5	16.1	4	12.9
Score 2	26	83.9	27	87.1
Chi square value	0.130			
'P' value	0.718 not significant			

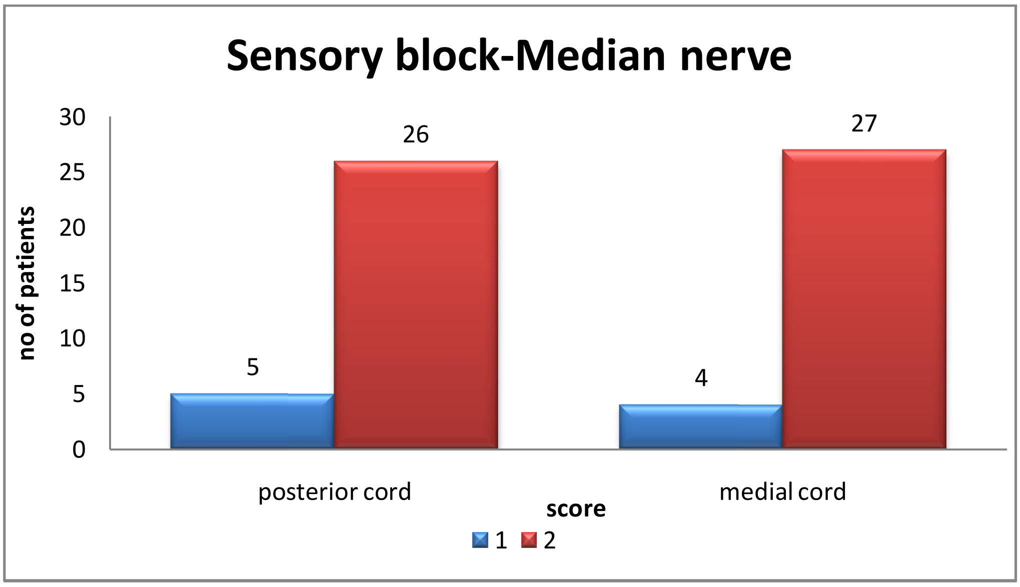


SENSORY BLOCK – MEDIAN NERVE:

Sensory block in median nerve distribution with score 2 in posterior cord stimulation has 83.9% and in medial cord stimulation has 87.1%.Sensory block with score 1 in posterior cord stimulation has 16.1% and medial cord stimulation has 12.9%.On analysis the p value shows 0.718,hence it is statistically insignificant between two groups.

TABLE – 8 (sensory block – Median nerve)

Sensory block-Median nerve	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	1	3.2
Score 1	5	16.1	4	12.9
Score 2	26	83.9	27	87.1
'P' value	0.718 not significant			

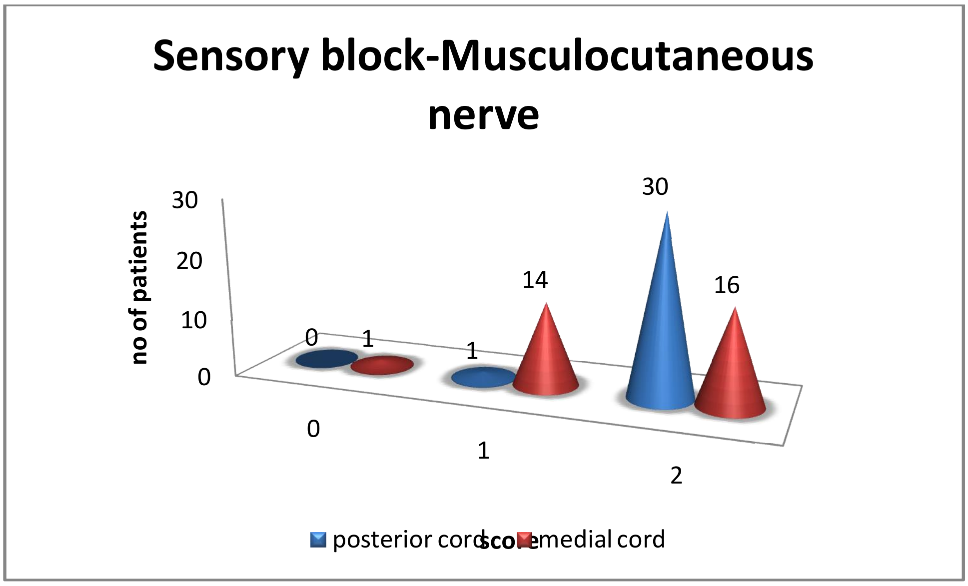


SENSORY BLOCK – MUSCULOCUTANEOUS NERVE

Sensory block with score 2 in posterior cord stimulation has 96.8% and in medial cord stimulation has 51.6%.Sensory block with score 1 in posterior cord stimulation has 3.2% and in medial cord stimulation has 45.2%.On analysis the p value shows .001,hence it is statistically significant between two groups.

TABLE – 9 (Sensory Block – Musculocutaneous nerve)

Sensory block-Musculocut nerve	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	1	3.2
Score 1	1	3.2	14	45.2
Score 2	30	96.8	16	51.6
P value	.00 significant			

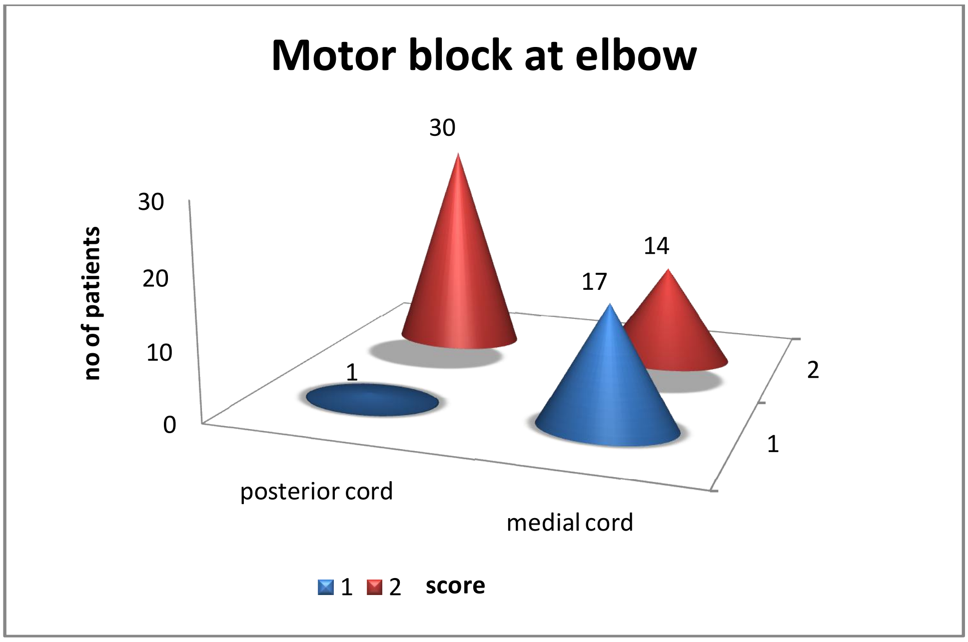


MOTOR BLOCK –AT ELBOW

Motor block at elbow with score 2 in posterior cord group is 96.8% and in medial cord group is 45.2%.Motor block with score 1 in posterior cord group is 3.2% and medial group has 54.8%.On analysis the P value shows .000,hence statistically significant between two groups.

TABLE – 10(Motor block – Elbow)

Motor block at elbow	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	0	0
Score 1	1	3.2	17	54.8
Score 2	30	96.8	14	45.2
‘P’ value	.001 significant			

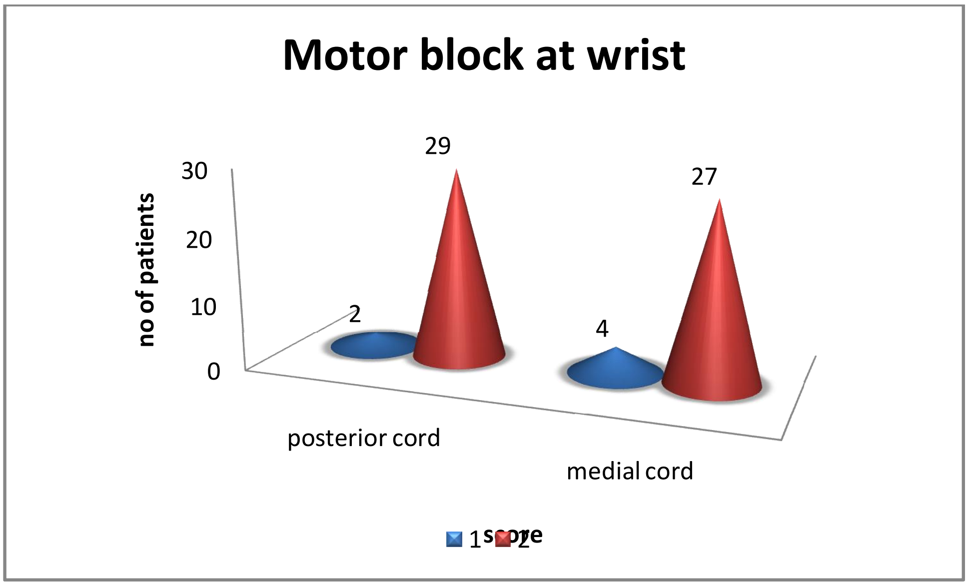


MOTOR BLOCK-AT WRIST

Motor block at wrist in posterior cord group with score 2i.e complete paralysis is 93.5% and in medial cord group is 87.1%.Motor block with score 1 in posterior cord group is 6.5% and in medial cord group has 12.9%.On analysis the p value shows 0.390,statistically insignificant between two groups.

TABLE – 11(Motor block-Wrist)

Motor block at wrist	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	0	0
Score 1	2	6.5	4	12.9
Score 2	29	93.5	27	87.1
'P' value	0.390 not significant			

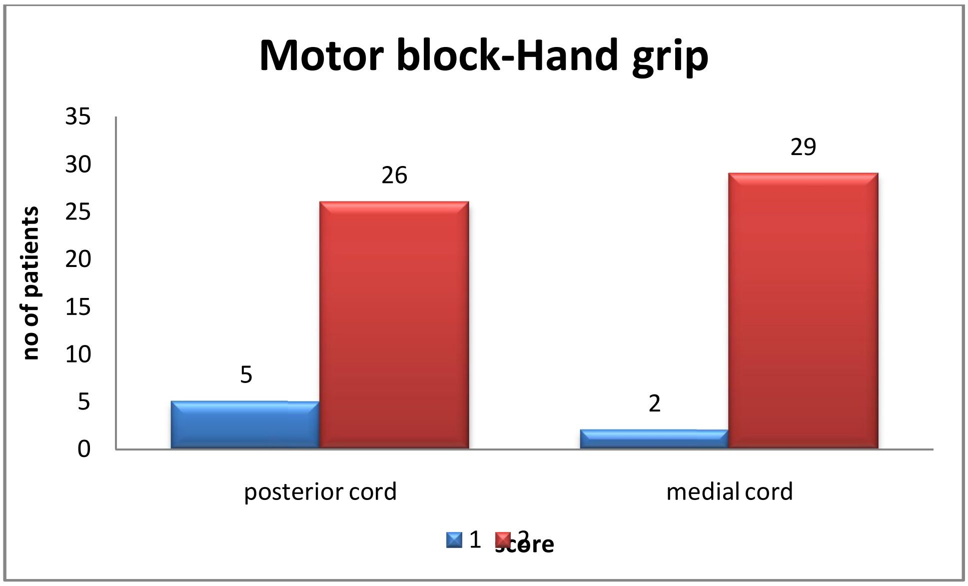


MOTOR BLOCK-HAND GRIP

Motor block at hand grip with score 2 in posterior cord group has 83.9 and in medial cord group has 93.5%.Motor block with score 1 in posterior cord group has 16.1% and in medial cord group has 6.5%.On analysis p value shows 0.229,hence statistically insignificant between two groups.

TABLE – 12 (Motor block – Hand grip)

Motor block at hand grip	Group P		Group M	
	Number	%	Number	%
Score 0	0	0	0	0
Score 1	5	16.1	2	6.5
Score 2	26	83.9	29	93.5
'P' value	0.229 not significant			

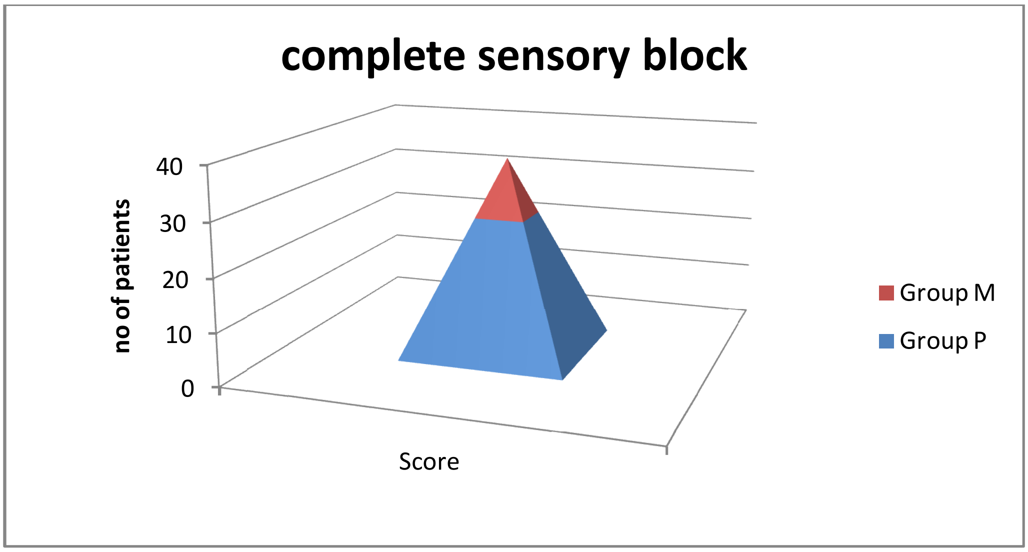


COMPLETE SENSORY BLOCK – SENSORY BLOCK IN ALL FOUR NERVES

In all four nerve distribution, 26 patients in group P and 11 patients in group M is having sensory block of score 2.On analysis the P value shows 0.00 which is statistically significant between two groups

TABLE – 13 (Complete sensory block)

Complete sensory block	Group P		Group M	
	Number	%	Number	%
Score 2	26	83.9	11	35.5
'P' value	.001 significant			

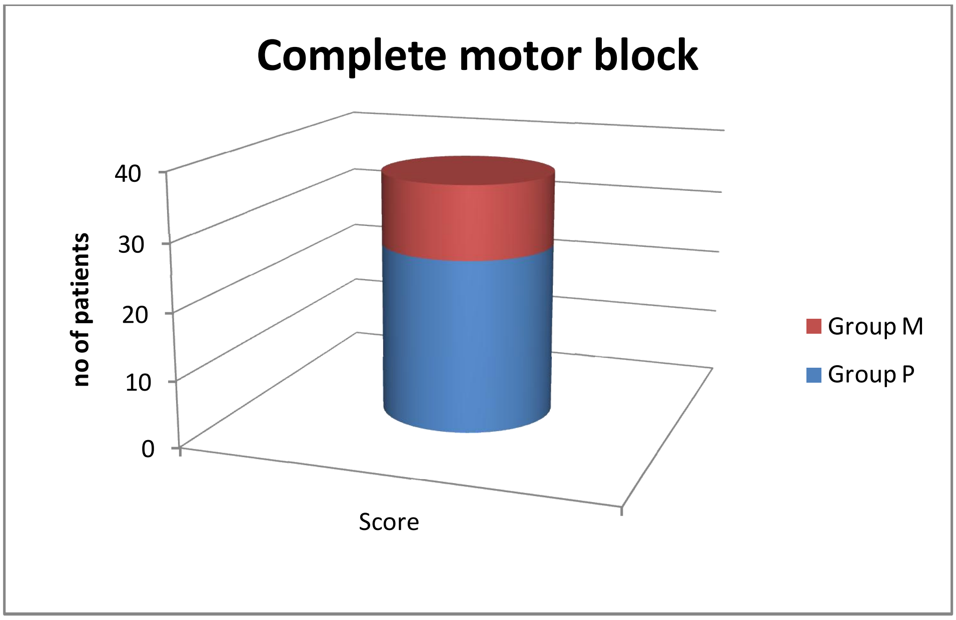


COMPLETE MOTOR BLOCK-IN ALL THREE JOINTS

In all three joints complete motor block score of 2 is found in 26 patients of posterior cord group, and 11 patients in medial cord group. On analysis the P value shows .001 which is statistically significant between two groups

TABLE – 14 (Complete Motor block)

Complete motor block	Group P		Group M	
	Number	%	Number	%
Score 2	26	83.9	11	35.5
'P' value	0.001	significant		

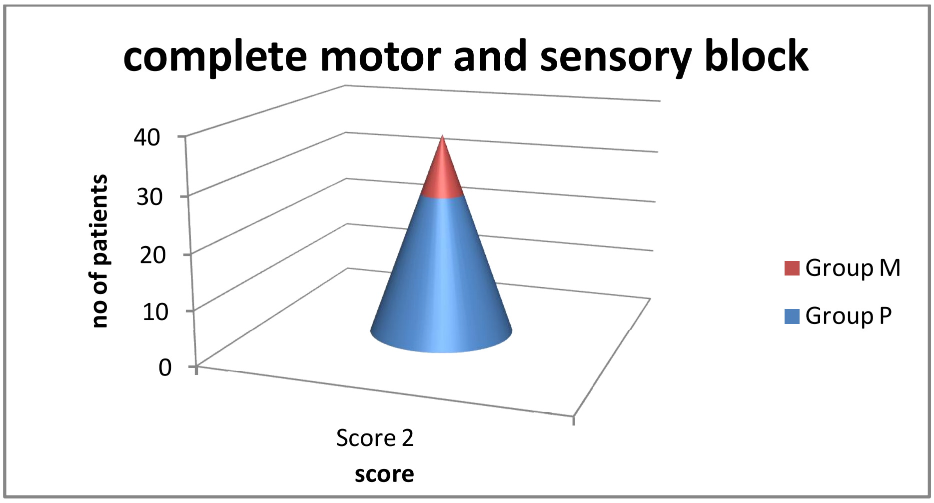


EFFECTIVENESS OF BLOCK: COMPLETE MOTOR AND SENSORY

Effectiveness of block is defined as a complete sensory and complete motor block. The effective upper limb block is found in 26 patients of posterior cord group which is 83.9% and 11 patients of medial cord group which is 35.5%.Effective upper limb block is seen better with posterior cord group when compared to medial cord group. On analysis the P value shows 0.001 which is statistically significant between two groups.

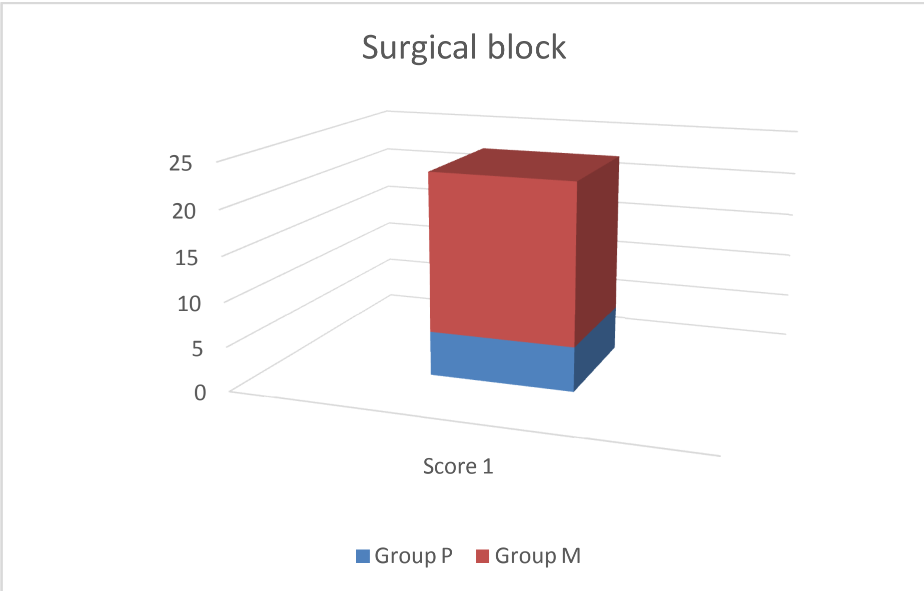
TABLE – 15(Complete Motor and sensory)

Complete motor andsensory block	Group P		Group M	
	Number	%	Number	%
Score 2	26	83.9	11	35.5
'P' value	0.001 significant			



Effectiveness of surgical block: Defined as sensory score of 1 or score 2 in all four nerve territories after 30 minutes of block, irrespective of motor block.

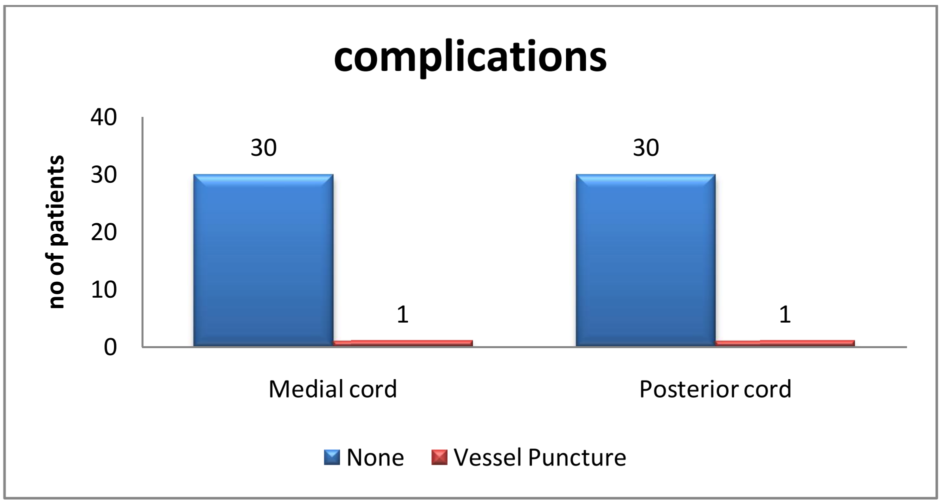
Surgical block	Group P		Group M	
	Number	%	Number	%
Score 1	5	16.9	18	58.06
'P' value	0.002 significant			



COMPLICATIONS BETWEEN TWO GROUPS

subclavian vessel puncture has been reported in 2 patients,one patient in each group. No other complications like pneumothorax,local anaesthetic toxicity has been reported. On analysis the p value is 1.000statistically insignificant.

Complications	Group P		Group M	
	Number	%	Number	%
Vessel puncture	1	3.2	1	3.2
pneumothorax	0	0	0	0
Cardiac toxic/CNS toxic	0	0	0	0
Chi square value	0.000			
'P' value	1.000 not significant			



DISCUSSION

Brachial plexus block, like other regional anesthetics, offers specific advantage to the patient, surgeon, anesthesiologist, and surgical facility, which may not be true for use of general anesthesia[1]. The anesthesia is limited to a restricted portion of the body on which the surgery will be performed, leaving the other vital centers unaffected. It is possible and desirable for the patient to remain ambulatory.

The use of brachial plexus block may minimize development of central nervous system hyper excitability during a surgical procedure carried out during general anesthesia.[2]

Among the various approaches to brachial plexus blockade, infraclavicular block has become wide popular now. It is ideal for the operations distal to elbow and it is performed at the cords of the brachial plexus. The major benefit of this approach, when compared to brachial plexus blocks above the clavicle, is the unlikely risk of encroaching upon the pleural space or lung parenchyma and causing a pneumothorax[7], while maintaining the high success rate of blocking the axillary and musculocutaneous nerves prior to their departure from the sheath of the brachial plexus. The other major advantages of the ICB approach include a lower likelihood of tourniquet pain during surgery, and a more reliable blockade of the musculocutaneous and axillary nerves when compared to a single-injection axillary block. While the risk of pneumothorax should be insignificant with coracoid-based ICB[41], the vertical infraclavicular block technique, as studied in volunteers using MRI anatomic evaluation, is associated with a potential risk of pneumothorax, particularly in women or with needle advancement of more than 6 cm. The negligible risk of clinically relevant hemidiaphragmatic paralysis[28] from the paracoracoid approach is another advantage for selecting this block, as compared with supraclavicular techniques.

The two most commonly used conventional techniques for nerve localization during peripheral nerve blockade are peripheral nerve stimulation and mechanical elicitation of paraesthesia[8,9]. The introduction of peripheral nerve stimulators into clinical practice was a major advance in regional anaesthesia. Peripheral nerve stimulator uses an insulated needle through which an electrical current is applied using a nerve stimulator. Anatomical landmarks identify the point of insertion through the skin, and the needle is advanced until an appropriate motor response is obtained. The location of needle tip is carefully adjusted in order to achieve the desired motor response at an electric current below 0.5mA,which conventionally designated close approximation of the needle tip to the nerve[46,47] .The mechanical pararsthesia technique involves inserting a short beveled needle at the appropriate anatomic landmark and advancing it until a paraesthesia is elicited in the distribution of the desired nerve,suggesting close proximity of the needle the nerve. Despite the time-tested record of safety of these blind techniques an inherent rate of block failure exists. Nerve stimulator is also no help in avoiding puncture of blood vessels, the pleura, and other vulnerable structures, the anatomical relations of which to the target nerves show considerable variability, and complications including local anaesthetic toxicity due to intravascular injection and nerve damage from the mechanical trauma and/or intraneural injection have been reported, Enneking et al[52]

Materials selection[48]:

The insulated needle was selected to deliver the current precisely around the tip so that the nerve is stimulated if the needle tip is closer to it. The uninsulated needle do not stimulate better the nerve when the tip is closer to it but it does that when the tip is past 0.8-1cms the nerve i.e tip is away from the nerve. Therefore the needle needs to be insulated to create a better proximity to the nerve.

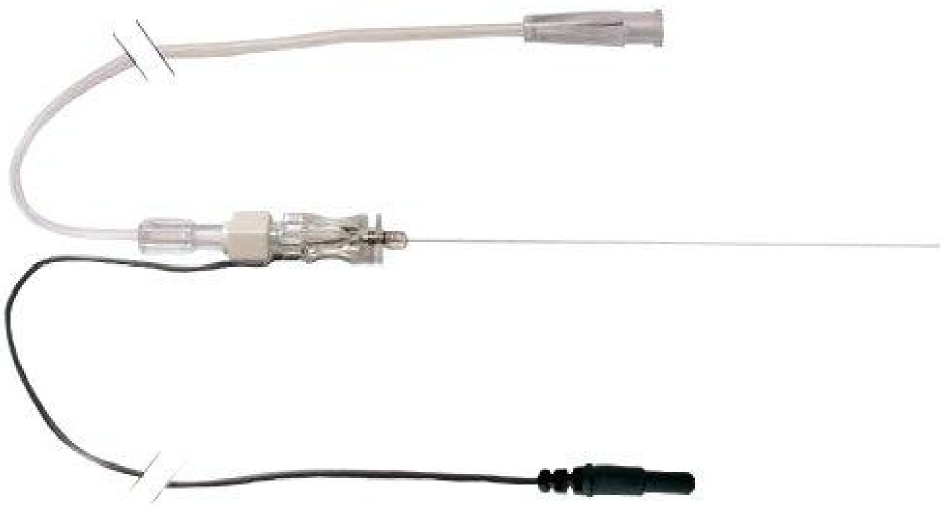


Figure 10 : Insulated Needle

Several modifications of the original infraclavicular approach to the brachial plexus –Raj et al[2], Sims[4] , and whiffler[7] suggest that the perivascular sheath may be injected in this area as an alternative to other approaches.

The infraclavicular approach was developed in the hope to overcome these limitations, but widespread use of Raj's[2] infraclavicular brachial approach has not gained popularity, since most believe it requires the use of a nerve stimulator and a long needle able to penetrate both the pectoralis major and minor muscles, which can cause greater patient discomfort. This approach to infraclavicular block used lateral needle orientation to overcome the risk of pneumothorax inherent with blocks performed under the clavicle with the needle directed medially.

Wilson etal[13] described in 1998,a coracoid approach to an infraclavicular block that is adopted in this study which was undertaken to evaluate the effectiveness of motor and sensory blockade between two groups medial cord stimulation with posterior cord stimulation. When compared to raj approach, distal coracoid approach is clinically effective. A study has done to evaluate the effective sensory distribution, motor block and clinical efficacy by le bloc, and showed great outcome with this approach. Borgeat[16], using a different infraclavicular approach, reported a success rate of 44% when a proximal motor response was accepted for local anaesthetic injection, compared to 97% when they looked specifically for a distal motor response.

Eventhough the infraclavicular block has many advantages over supraclavicular and axillary nerve blocks, success rate and maximum extent and effectiveness of block depends upon the distal stimulation particularly the radial nerve response when compared to ulnar, medial cord or lateral cord stimulation. This has been studied by various authors and also published in different journals. . Lecamwasam et al [15]Study showed that stimulation of posterior cord predicts success of infraclavicular block. This study confirms the clinical impression that stimulation of the posterior cord before local anaesthetic injection is associated with increased likelihood of Infraclavicular block success compared with stimulation of either lateral or medial cord. This is because of anatomical location of cords in relation to axillary artery.). With either the peripheral nerve stimulator technique, and especially with the US-guided technique, it is helpful to visualize the axillary artery in the center of clockface and the brachial plexus cords arranged around the axillary artery in a parasagittal topographic arrangement . The brachial plexus cords should appear as hyperechoic polyfasicular (honeycomb appearance) structures arranged around the centrally located anechoic, pulsatile axillary artery. Most commonly, the lateral cord is located cephalad (9 to 11 o'clock position) to the axillary artery, the posterior cord is located immediatley deep to the lateral cord and axillary artery (6 to 8 o'clock position), and the medial cord is located caudal (3 to 5 o'clock) to the axillary artery. However, the exact position of the cords relative to the axillary artery is variable, but the posterior cord is always located in between the lateral and medial cords. Since the posterior cord is located in central between the medial and lateral cords. Instillation of local anaesthetic at the posterior cord appeared more likely than a more peripheral injection to reach all the three cords.

Bloc etal[26] compared an ultrasound evaluation of spread of local anaesthetic associated with Radial or median type response during infraclavicular brachial plexus block. This prospective randomized study of 60 patients compared the performance time and quality of blockade. Sensory block, motor block and supplementation rates were evaluated for musculocutaneous, ulnar, median and radial nerves were evaluated. Volume of anaesthetic mixture used was 0.5 ml/ kg. Our study was similar to this study but using nerve stimulator guided comparision of posterior cord with medial cord stimulation through coracoids approach of an infraclavicular block.

Li etal[20] influence of stimulating different cords in efficacy of block, This study has done to compare the efficacy of block between medial and lateral cord stimulation in infraclavicular block. This study is also similar to our study comparing the effectiveness of block between two stimulations. This study concludes that stimulation of posterior cord before local anaesthetic injection had greater efficacy of blockade in infraclavicular block for forearm and hand surgeries.

Discussion of demographic variable:

We included patients in the age group of 18 to 60 years in our study. It is done for two reasons. The paediatric patients have immature nerves and the coverings around the nerve is not well developed so very small quantity of the drug if deposited nearer to the nerve is more than enough to cause complete blockade which is not the situation in normal adults..Hence for these reasons we avoided paediatric age groups. In geriatric age groups problems of age related nerve degeneration and altered sensations may pose problems in arriving at the results.

By statistical analysis of two groups the age distribution between the two groups were statistically not significant with P value of 0.935, (P>.05)

Sex as a variable:

As like age there were no predilection towards sex between two groups.By statistical analysis of two groups the age distribution between two groups were statistically insignificant with P value of 0.544, (>.05)

Weight:

When comparing the weight of the patients in two groups it was statistically not significant with a p value of 0.588, (>.05)

Surgical distribution between two groups:

On statistical analysis the surgical distribution between two groups were statistically insignificant with P value of .306, (>.05)

Duration of surgery between two groups:

When comparing the duration of surgery between the two groups it is found be statistically insignificant with the P value of 0.958, (>.05)

Outcome Measures

Various criteria have been used by different authors to determine the success rate of block. A block is considered successful by most authors when analgesia is present in all areas subjected to clinical intervention. This definition is sufficient from a clinical point of view, but implies a falsely high success rate and makes comparision between two groups are difficult. Therefore, to standardize the criteria of success, we considered our block successful when analgesia was present in all areas supplied by the four major nerves.

Sensory block in all four nerve regions:

The sensory block in four nerve territories radial, ulnar, median and musculocutaneous nerves were compared between the two groups. On analysis the sensory block is statistically significant between two groups for radial P value .00,musculocutaneous .001 and statistically insignificant for median nerve P .718 and ulnar nerve P .708

Lecamwasam etal[15] supports our study showing significant difference between two groups P<.05 in radial nerve distribution. The reason is radial nerve arises from the posterior cord of brachial plexus and another reason is the anatomical location of plexus in relation to axillary artery, ,the posterior cord appears to lie central to both the lateral and medial cords and instillation of local anaesthetic at this level will more likely to reach all three cords. Medial cord stimulation has more radial nerve sparing because of its location in relation to artery and proximal spread of local anaesthetic less likely to reach all cords.

complete motor blockade:

In our study motor block was evaluated at elbow, handgrip and wrist. On analysis between two groups it is found to be statistically significant with P value .001 which is similar to bowens et al[19] study with a significant P value of .002

Complete sensory block:

Complete sensory block is the sensory score 2 in all four nerve regions radial, ulnar, median and musculocutaneous. In our study on statistical analysis there is found to be significant between two groups with a P value .00

Lecamwasam etal[15], borgeat etal[16], Li etal[20] supports our study with a greater efficacy of sensory blockade with a significant P value of .001,.002 and .03 respectively

Effectiveness of upper limb blockade i.e complete motor and sensory:

Complete motor and sensory block of score 2 in posterior cord group is 83.5% and in medial cord group is 35.8%.On statistical analysis there is significant difference between two groups with P value .001.Again lecamwasam etal, bowens et al, Li et al, porter et al supports our study. According to bowens et al based on the location of plexus in relation to axillary artery, In median nerve type response, instillation of local anaesthetic cause superficial spread associated with specific posterior displacement of axillary artery so less likely to reach all the three cords of the brachial plexus. Injection after radial nerve type or posterior cord stimulation results in more posterior local anaesthetic spread associated with medial and upper movement of axillary artery hence there will be dense blockade in posterior cord stimulation.

Surgical block:

Defined as sensory score of 1 or score 2 in all four nerve territories after 30 minutes of block, irrespective of motor block. In posterior cord group 5 patients had score 1 and hence posterior cord group patients required supplemental sedation for five patients intraoperatively. In medial cord group 18 patients required additional sedatives and analgesics intraoperatively. In Nielsen et al[36] ultrasound guided comparison of supraclavicular and infraclavicular block sensory score of 1 or 2 was considered as surgical block. In our study similar parameters are used for effectiveness of surgical block. On statistical analysis the P value shows .002 which is statistically significant between two groups.

Patients with score 1 was given additional sedatives 0.25mg/kg of midazolam and 1mic/kg fentanyl intraoperatively depends upon the surgical area of distribution. In medial cord group more number of patients required intraoperative sedation and analgesics.Two patients from medial cord group had inadequate blockade, score 0 along radial nerve distribution.

Complications:

In both groups subclavian vascular puncture was noted in 2 patients while performing the block procedure. No other complications such as pneumothorax, local anaesthetic toxicity has been noted. On analysis there is statistical insignificant between the two groups with a P value 1.000.In Wilsons et al coracoids approach of infraclavicular block subclavian venous puncture has been report

SUMMARY

62 patients of ASA grade I and II undergoing upper limb surgeries were randomly assigned into two groups, Group P and Group M.

In this randomized prospective study, 31 patients received an infraclavicular block by coracoid approach, posterior cord stimulation in group P, and other 31 patients with medial cord stimulation in group M. Surgeries below the level of elbow were selected for this study. Parameters observed were sensory block, motor block, complete sensory block, complete motor block, effectiveness of upper limb blockade, surgical block.

The study shows that Sensory block among radial nerve, ulnar, median, musculocutaneous nerve have been studied between two groups. In posterior cord group radial nerve was blocked completely in all patients and in medial cord group radial nerve sparing was seen in some patients. There is insignificant difference in sensory block along ulnar, median nerve between two groups

Motor block was assessed in elbow, hand grip and wrist and there is a significant difference between two groups in elbow joint and insignificant difference in wrist and hand grip level. Complete motor

block is the number patients of score 2 in all three joints. There is a significant difference between two groups. Complete motor blockade is seen in more number of patients in posterior cord group when compared to medial cord group.

Complete sensory block is compared between two groups. Posterior cord group has effective complete sensory blockade when compared to medial cord group.

Effectiveness of upper limb blockade (Complete motor and sensory)-Significant difference between two groups were seen. Posterior cord stimulation group has more effectiveness of block than medial cord group

Surgical block: In posterior cord group 5 patients required additional sedatives and analgesics. In medial cord group 18 patients required further dose of analgesics and 2 patients had inadequate block. Hence the effectiveness of surgical block is good with posterior cord group

Complications:

The incidence of complications in the form of vascular puncture was not different between two groups.

CONCLUSION

From our study it is inferred that nerve stimulator guided Posterior cord stimulation in infraclavicular block through coracoid approach has greatest extent and effectiveness of motor and sensory block when compared to medial cord stimulation with similar rate of complications.

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PROFORMA

Name of the patient

Age/sex: **Height:** **Weight:**

IP no: **Assessment number:**

Pre anaesthetic assessment:

Diagnosis:

Planned procedure:

Anaesthetist:

Surgeon:

Informed consent in Tamil:

Randomisation-Tick the following

1)Medial cord group

2)Posterior cord group

IV line

Premedication:

Monitors

Base line vital parameters

Heart rate	
NIBP	
SPO2	

Motor block score after 30min

Motor block score after 30 min	P group	M group
Elbow-0		
-1		
-2		
Wrist -0		
-1		
-2		
Hand grip - 0		
-1		
-2		

Evaluation of sensory response

Sensory block of the nerves-block score	Group P	Group M
Musculocutaneous nerve		
Radial nerve		
Ulnar nerve		
Median nerve		

Intra operative vital parameters-HR,BP,SPO2,

Additional rescue analgesics given,if any

Complications-Tick if present

1. CVS-Bradycardia/tachycardia/Arrhythmias
2. CNS-circumoral numbness or tingling/confusion/convulsions/coma
3. Subclavian vessel puncture
4. pneumothorax
5. none

சுய ஒப்புதல் படிவம்

கை மற்றும் முழங்கையில் அறுவை சிகிச்சை செய்து கொள்ளும் போது, அறுவை சிகிச்சையின் போது ஏற்படும் வலியை குறைப்பதற்கு நரம்பை தூண்டும் கருவியை கொண்டு கழுத்து எலும்பிற்கு (கிளாவிக்கிள்) கீழ் பகுதியில் உள்ள நரம்புதிட்டுகளை தூண்டி மயக்க மருந்தை செலுத்தி செயலிழக்க செய்வதன் மூலம் ஏற்படும் விளைவுகள் பற்றிய ஆய்வு

ஆய்வாளர் : மரு. A. கார்த்திக் ராஜ்
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ஸ்டான்லி மருத்துவ கல்லூரி - சென்னை

வழிகாட்டி : பேராசிரியர் மரு. R. மதன் குமார் M.D.D.A
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பெயர் : வயது: உள்ளிருப்பு எண்:

இந்த மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது என்னுடைய சந்தேகங்களை தீர்க்கவும் அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது.

நான் இவ்வாய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்த காரணத்தினாலும் எந்த கட்டத்திலும் எந்த சட்டசிக்கலும்

இன்றி இந்த ஆய்விலிருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன்

நான் ஆய்விலிருந்து விலகிக்கொண்டாலும் ஆய்வாளர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கோ அல்லது உபயோகிக்கவோ என் அனுமதி தேவையில்லை எனவும் அறிந்து கொண்டேன். என்னை பற்றிய தகவல்கள் ரகசியாமாக பாதுகாக்கப்படும் என்பதையும் அறிவேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும் பரிசோதனை முடிவுகளையும் ஆய்வாளர் அவர் விருப்பத்திற்கேற்ப பயன்படுத்திக் கொள்ளவும் அதனை பிரசுரிக்கவும் முழுமனதுடன் சம்மதிக்கிறேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன் எனக்கு கொடுக்கப்பட்டுள்ள அறிவுரைகளின்படி நடந்து கொள்வதுடன் ஆய்வாளருக்கு உண்மையுடன் இருப்பேன். என்றும் உறுதி அளிக்கிறேன்.

உடல்நலம் பாதிக்கப்பட்டாலோ வழக்கத்திற்கு மாறான ஏதேனும் நோய்குறி தென்பட்டாலோ அதனை தெரிவிப்பேன் என்றும் உறுதி கூறுகிறேன்.

இந்த ஆய்வில் எனக்கு எவ்விதமான பரிசோதனைகளையும் சிகிச்சை களையும் மேற்கொள்ள நான் முழுமனதுடன் சம்மதிக்கிறேன்.

இப்படிக்கு,

ஆய்வாளரின் கையொப்பம் நோயாளியின் கையொப்பம்

நோயாளியின் தகவல் தாள்

கை மற்றும் முழங்கையில் அறுவை சிகிச்சை செய்துகொள்ளும்போது, அறுவை சிகிச்சையின்போது ஏற்படும் வலியை குறைப்பதற்கு நரம்பை தூண்டம் கருவியை கொண்டு கழுத்து எலும்பிற்கு (கிளாவிக்கிள்) கீழ் பகுதியில் உள்ள நரம்புதிட்டுகளை தூண்டி மயக்க மருந்தை செலுத்தி செயலிழக்க செய்வதன் மூலம் ஏற்படும் விளைவுகள் பற்றிய ஆய்வு

ஆராய்ச்சியின் நோக்கமும் ஆராரங்களும்

அறுவை சிகிச்சை செய்வதற்கு மயக்க மருந்து மிகவும் அவசியமானது அவ்வாறான மயக்க மருந்துகளும் மயக்க முறைகளும் பலவகை உண்டு கை மற்றம் முழங்கையில் அறுவை சிகிச்சை செய்வதற்காக கழுத்து எலும்புக்கு கீழ் பகுதியில் உள்ள நரம்புதிட்டுகளை (பிரேக்கியல் பிகள்ஸஸ்) நரம்பு தூண்டும் கருவியை கொண்டு தூண்டப்படமுழ் பொழுது ஏற்படும் கை அசைவுகளை கவனித்து மயக்க மருந்து கொடுக்கப்பட்டால் மயக்க மருந்தின் பயன்பாடு நன்றாக இருக்கும் மற்றும் பக்கவிளைவுகளும் குறைவாக இருக்கும் இதன் முக்கியத்துவத்தை உணர்த்தவே இந்த ஆய்வு மேற்கொள்ளப்படுகிறது.

ஆய்வுமுறை

நீங்கள் இரு குழுக்களாகப் பிரிக்கப்படுவீர்கள் ஒரு குழுவிற்கு கை மற்றும் முழங்கையில் அறுவை சிகிச்சை செய்வதற்காக கழுத்து எலும்புக்கு கீழ் உள்ள போஸ்டீரியர் நரம்புத்திட்டையும்

இன்னொரு குழுவிற்கு கழுத்து எலும்புக்கு கீழ் உள்ள மீடியல் நரம்புதிட்டையும் தூண்டுவதின் மூலம் ஏற்படும் உணர்வுகள்.

கை மற்றும் முழங்கையில் அறுவை கிசிச்சை செய்வதற்காக கழுத்து எலும்புக்கு கீழ் உள்ள நரம்புதிட்டுகள் தூண்டப்பட்டு கைகளின் அசைவு என்னவென்று குறிக்கப்படும். பின்னர் புபிவகைகன் மற்றும் அட்ரினலின் கலந்த லிக்னோகைன் மயக்க மருந்து கலவை கொடுக்கப்படும். அத்தருணத்திலிருந்து 10, 15,020, 25, 30 வது நிமிடங்களில் தொடு உணர்வு கை, மற்றம் முழங்கை அசைவை கண்காணிக்கப்பட்டு அறுவை சிகிச்சை மேற்கொள்ளப்படும்.

மேலும் மயக்க மருந்து செலுத்தப்பட்டதிலிருந்து 24 மணி நேரத்திற்கு ஏதேனும் பக்கவிளைவுகள் ஏற்பட்டதா என்றும் கண்காணிக்கப்படும்.

<u>உண்டாகக்கூடிய இடர்கள்</u>

இந்த ஆய்வின் பொழுது பயன்படுத்தப்படும் புபிவகைன் மற்றும் லிக்னோகைன் அருந்தினால் இதயதுடிப்பு மற்றும் இரத்த அழுத்தத்தில் மாற்றங்கள் ஏற்படவோ மற்றும் காக்கா வலிப்பு ஏற்படவோ வாய்ப்புகள் உண்டு.

மேலும் நுரையீரலை சுற்றியுள்ள சவ்வில் ஓட்டைவிழுந்து நீமோதொராக்ஸ் ஏற்படும் வாய்ப்பும் உண்டு.

<u>ஆய்வில் உள்ள உரிமைகள்</u>

உங்கள் மருத்துவ பதிவேடுகள் அந்தரங்கமாக வைத்துக்கொள்ளபடும். இந்த ஆய்வின் முடிவுகள் மருத்துவ இதழ்களில் வெளியிடப்படலாம் ஆனால் உங்கள் பெயர் அடையாளம் காட்டப்படமாட்டாது இந்த ஆய்வில் பங்கேற்பது தன்னிச்சையானது மற்றும் வேறு காரணங்களால் நீங்கள் எதுவும் கூறாமலேயே எப்பொழுது வேண்டுமென்றாலும் விலகிக்கொள்ளலாம் ஏதேனும் பக்கவிளைவுக்ள ஏற்பட்டால் முழு சிகிச்சையும் மருத்துவ குழுவினரால் உடனடியாக வழங்கப்படும்

நோயாளியின் கையொப்பம்
(இடது பெருவிரல் ரேகை)

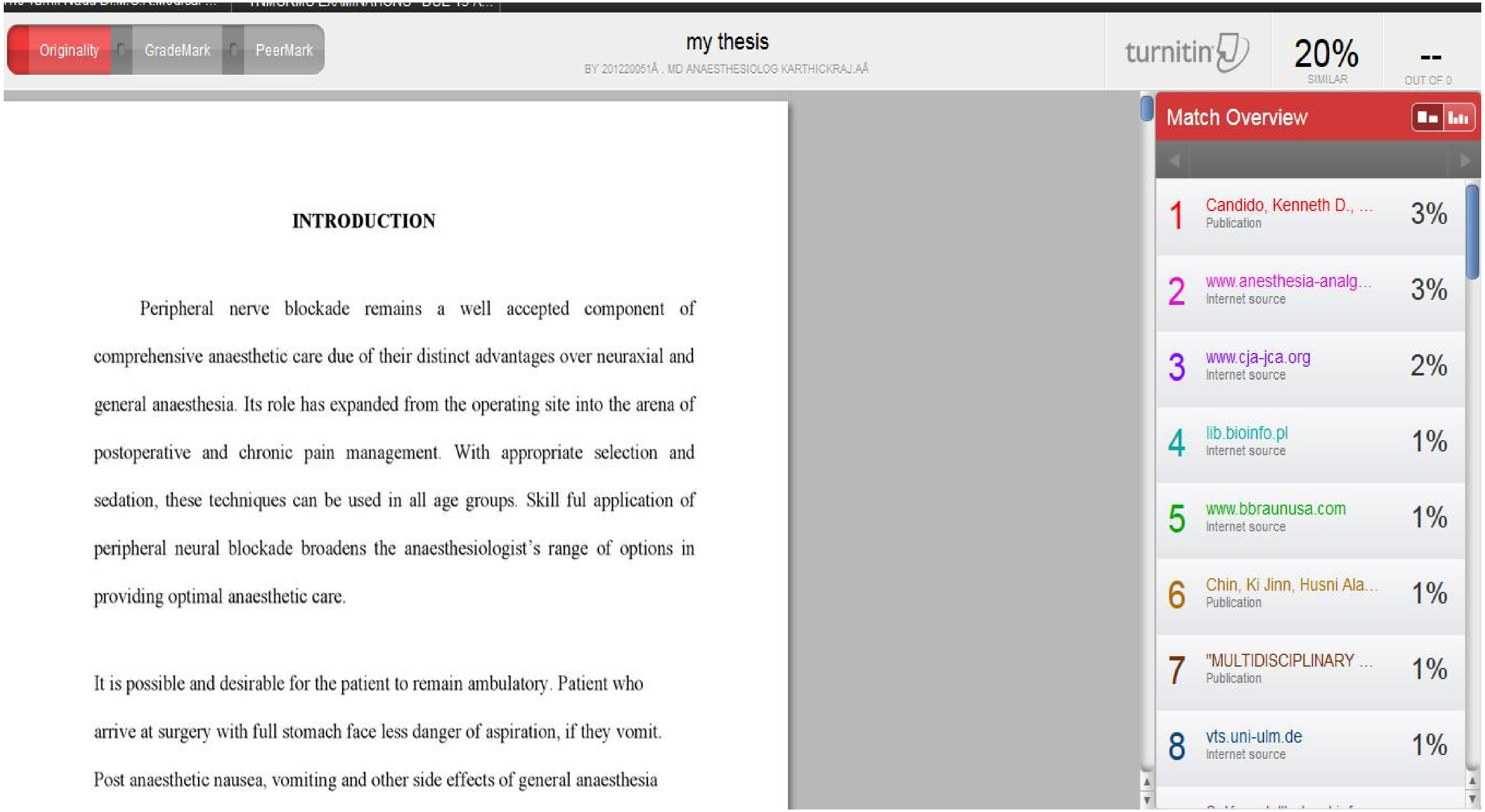
தேதி

மருத்துவரால் தெளிவாக
படித்துக் காட்டப்பட்டது

S.no	Group	Name	age	sex	IP no	weight	Diagnosis	procedure	motor block score after 30 min			sensory block score after 30 min				complicatio	Duration of surgery
									Elbow	wrist	Hand grip	Radial	Median	Ulnar	musculocutaneous		
1	M	karnan	21	M	27888	65	Distal radius left	ORIF	2	2	2	2	2	2	2	None	120min
2	M	Parvathi	43	F	32568	58	Distal 3rd humeru	ORIF	1	2	2	1	2	2	1	None	90min
3	M	Venugopal	30	M	342877	67	PTS Rt hand	FDP tagging	1	2	2	1	2	2	0	none	90min
4	M	kanakaraj	20	M	31939	55	frac head of radiu:	Radial head excisi	1	1	2	1	1	2	1	None	60min
5	M	Ramachandran	34	M	29356	62	Galleazi fract Rt	ORIF	1	2	2	1	2	2	1	None	45min
6	M	Ajay	18	M	25345	48	Frac distal 3rd humerus	ORiF	2	1	2	2	1	2	2	None	120min
7	M	Subramani	60	M	337999	57	Rt ulnar nerve pal:	Exploration and re	1	2	2	1	2	2	1	None	150min
8	M	chitra	40	F	344797	60	PTS Lt hand	Ext Repair	1	2	2	1	2	2	1	None	90min
9	M	Sarath kumar	22	M	27243	85	frac dist3rd radius	ORIF	1	2	2	1	2	2	1	none	90min
10	M	chandran	55	M	31587	65	frac bothbone forearm L	ORiF	2	2	2	2	2	2	2	None	120min
11	M	Judisartha	29	M	345562	60	PTRAmid ring fingerRt	Debrider	2	1	2	1	2	2	2	None	25min
12	M	shanmugam	30	M	345719	62	Rawarea index fingerLt	CFF mic	1	2	2	1	2	2	2	None	60min
13	M	Kumar	25	M	344730	60	Rt traumaticamputation inc	shorteni	2	2	2	2	2	2	2	None	30min
								and closure									
14	M	Nandhini	19	F	344735	45	Frac Rt ring finger	Moulding	2	2	2	2	2	2	2	None	30min
15	M	vijayan	40	M	344736	70	fracture lt both bo	ORIF with plating	1	2	2	0	2	2	1	None	120min
16	M	Robert	21	M	344781	65	Lt extensor injury	primary ext repair	2	2	2	2	2	2	2	none	60min
17	M	pindu	20	M	344523	58	Lt crush injury	debridement	1	2	2	1	2	1	2	none	30min
18	M	sathya	26	F	344569	55	PBC wrist Lt	contracture releas	1	2	2	2	1	2	1	vessel punc	45min
19	M	Moorthy	28	M	345865	68	PTRA rt forearm	debridement	2	2	2	2	2	2	2	none	30min
20	M	mani	30	M	345858	75	PEBRA rt hand	debridement	1	2	2	1	2	2	1	None	25min
21	M	valli	43	F	345437	60	frac lt prox phalan	ORIF	2	2	2	2	2	2	2	None	40min
22	M	kannan	28	M	345677	72	groin flap lt palm	flap thinning	1	2	2	2	2	2	1	None	60min
23	M	bavani	34	F	32554	68	PTRA rt thumb	groin flap	2	1	1	1	1	1	2	none	90min
24	M	balan	36	M	32547	75	crush inj lt	debridement	2	2	2	2	2	2	2	none	30min
							forearm										
25	M	mohammed	27	M	34562	60	PTRA rt forearm	sec SSG	1	2	2	1	2	2	1	none	60min
26	M	senthil	28	M	34558	60	PTRA lt forearm	sec SSG	2	2	2	2	2	2	2	none	50min
27	M	perumal	60	M	12564	62	PTS rt arm	radial nerve	1	2	2	2	2	1	1	none	120min
								exploration									
28	M	palani	20	M	35288	59	PTRA rt hand	SSG	2	2	2	2	2	2	2	none	60min
29	M	munusamy	60	M	344964	60	PBC it forearm,h:	contracture releas	1	2	1	1	2	1	1	none	90min
30	M	umapathy	44	M	344814	68	Rt midfinger	shortening and	1	2	2	1	2	2	1	none	30min
							amputation	closure									
31	M	selvam	38	M	344757	65	Lt crush injury	debridement	2	2	2	2	2	2	2	none	20min
							index finger										

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
S.no	Group	Name	Age	sex	IP no	weig	diagnosis		procedur	Motor block score after 30min				sensory block score after 30min					Complicati		Duration of surgery	
										Elbow	wrist	Hand grip		Radial	Ulnar	Median	Musculocutaneous					
1	P	rajneesh	29	M	32546	72	PTRA rt forear		debriden	2	2	2		2	2	2	2		none		30 min	
2	P	Ajeesh	46	M	35489	59	PTRA rt thumb		flap cove	2	2	2		2	2	2	2		none		60 min	
3	P	munisha	23	F	344807	50	rt midfinger		shortenii	2	2	2		2	2	2	2		none		40min	
							amputation		closure													
4	P	Rani	60	F	2589	65	frac distal 3rc		ORIF	2	2	2		2	2	2	2		vessel pun		120min	
							humerus															
5	P	Guhan	30	M	2789	62	frac lt distal		ORIF	2	2	2		2	2	2	2		none		90min	
							radius															
6	P	Alagar ra	22	M	22465	58	frac rt radial l		radial he	2	2	2		2	2	2	2		none		45 min	
7	P	Ibrahim	53	M	21456	64	frac distal rac		ORIF	2	2	2		2	2	2	2		none		90min	
8	P	Rajan	44	M	344876	60	Rt mid and lit		shortening and													
							finger amput		closure	2	2	2		2	2	2	2		none		45 min	
9	P	Arun	18	M	344944	52	Lt indexmid fi		shortenii	2	2	2		2	2	2	2		none		40 min	
							amputation		and closure													
10	P	Ram	30	M	25896	65	frac lower3rd		ORIF	2	2	2		2	2	2	2		NONE		150min	
							humerus															
11	P	Geetha	20	F	25897	50	frac bothbone		ORIF	2	2	1		2	1	1	2		none		120min	
							forearm															
12	P	Srinivasa	39	M	24569	62	chronic arthri		excision	2	2	2		2	2	2	2		none		30min	
							elbow															
13	P	john brit	29	M	344720	65	PTS rt hand		debriden	2	2	2		2	2	2	2		none		25min	
14	P	dhana ba	45	F	344483	58	PTRA lt hand		debriden	2	2	2		2	2	2	2		none		40min	
									SSG													
15	P	jeyanthi	27	F	336307	52	PBC lt hand		SSG	2	2	2		2	2	2	2		none		60min	
16	P	chandra	40	F	344211	60	frac rt prox ph		ORIF	2	2	2		2	2	2	2		none		30min	
17	P	manikan	19	M	343037	54	frac lt little fi		ORIF	2	2	2		2	2	2	2		none		40min	
18	P	kavya	30	F	345827	60	PTRA rt hand		groin fla	1	2	1		2	1	1	1		none		90min	
19	P	senthil	28	M	34569	70	PTRA rt forear		sec SSG	2	2	2		2	2	2	2		NONE		45min	
20	P	rajan	33	M	32547	72	PTRA rt thumb		groin fla	2	1	1		2	1	1	2		none		50min	

21	P	meenam	60	M	325416	68	PTRA RT hand	Abdomin	2	2	2		2	2	2	2		none		120min	
22	P	Vignesh	18	M	15362	55	frac rt sh ft	K wire fix	2	2	2		2	2	2	2		none		45min	
							of radius														
23	P	Nataraja	55	M	14362	63	Right distal	Excision	2	2	2		2	2	2	2		none		120min	
							radius GCT	bone grafting													
24	P	Vijay	24	M	21456	58	frac bothbone	ORIF with	2	2	2		2	2	2	2		none		90min	
							forearm	plating													
25	P	baskar	40	M	345197	68	rt midfinger	shortenii	2	2	2		2	2	2	2		none		30min	
							amputation	closure													
26	P	rupesh	35	M	343222	67	Lt ring,little	shortenii	2	1	1		2	1	1	2		none		30min	
							finger amput	closure													
27	P	megala	18	F	344930	56	PTS RT HAND	SSG	2	2	2		2	2	2	2		none		60min	
28	P	sivachan	29	M	45632	70	fracture rt	DCP	2	2	1		2	1	1	2		none		90min	
							distal radius														
29	P	Kamalak	38	M	13562	67	fracture lt	ORIF	2	2	2		2	2	2	2		none		90min	
							distal humerus														
30	P	Rajesh	26	M	21444	65	fracture shaft	ORIF	2	2	2		2	2	2	2		none		120min	
							humerus dist	with plating													
31	P	thirukum	29	M	344962	71	lt midringer f	shortenii	2	2	2		2	2	2	2		none		30min	
							amputation	and closure													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Peripheral nerve blockade remains a well accepted component of comprehensive anaesthetic care due of their distinct advantages over neuraxial and general anaesthesia. Its role has expanded from the operating site into the arena of postoperative and chronic pain management. With appropriate selection and sedation, these techniques can be used in all age groups. Skill ful application of peripheral neural blockade broadens the anaesthesiologist's range of options in providing optimal anaesthetic care.
It is possible and desirable for the patient to remain ambulatory. Patient who arrive at surgery with full stomach face less danger of aspiration, if they vomit. Post anaesthetic nausea, vomiting and other side effects of general anaesthesia
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INTRODUCTION

Peripheral nerve blockade remains a well accepted component of comprehensive anaesthetic care due of their distinct advantages over neuraxial and general anaesthesia. Its role has expanded from the operating site into the arena of postoperative and chronic pain management. With appropriate selection and sedation, these techniques can be used in all age groups. Skill ful application of peripheral neural blockade broadens the anaesthesiologist's range of options in providing optimal anaesthetic care.

It is possible and desirable for the patient to remain ambulatory. Patient who arrive at surgery with full stomach face less danger of aspiration, if they vomit. Post anaesthetic nausea, vomiting and other side effects of general anaesthesia such as atelectasis, hypotension, ileus, dehydration and deep vein thrombosis are reduced.

In new trend of day care surgeries with minimal hospital stay and less financial burden on the patients, brachial plexus block seems to be a better alternative to general anaesthesia. A substantial savings on operating room turnover time can occur if peripheral nerve blockade are done outside operating rooms. Patient can position themselves on the operating table with little risk to the