A COMPARISON OF TWO APPROACHES OF ULTRASOUND GUIDED INFRACLAVICULAR BLOCK FOR UPPERLIMB SURGERIES

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BRANCH X (ANAESTHESIOLOGY)

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DR.M.G.R MEDICAL UNIVERSITY CHENNAI,

TAMIL NADU

CERTIFICATE BY GUIDE

INSTITUTE OF ANAESTHESIOLOGY AND CRITICAL CARE

This is to certify that this dissertation entitled "**A COMPARISON OF TWO APPROACHES OF ULTRASOUND GUIDED INFRACLAVICULAR BLOCK FOR UPPERLIMB SURGERIES**" is a bonafide and genuine research work done by **Dr.C.B.MANOJ KUMAR,** in partial fulfilment of the requirement for the degree of **MD in Anaesthesiology and Critical care**.

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DECLARATION

I, **Dr.C.B.MANOJ KUMAR,** solemnly declare that, this dissertation titled "**A COMPARISON OF TWO APPROACHES OF ULTRASOUND GUIDED INFRACLAVICULAR BLOCK FOR UPPERLIMB SURGERIES"** has been done by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree or diploma to any other University or board either in India or abroad.

This is submitted to The Tamilnadu DR.M.G.R Medical University, Chennai in partial fulfilment of the rules and regulations for the award of Doctor of Medicine degree branch X (Anaesthesiology) to be held in MAY 2020.

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CONTENTS

INTRODUCTION

BRACHIAL PLEXUS NERVE BLOCK:

Regional block of the brachial plexus is one of the commonest and easier way of providing anaesthetia and analgesia for the upper limb procedures. Well-designed outcome studies have confirmed the benefits of regional anesthesia in patients undergoing upper extremity surgery. The approach to the brachial plexus differs according to the dermatomes involved and ease of approach to block the required dermatomes. The brachial plexus can be blocked at various level right from trunks in the neck to individual nerves in the hand. As a flourishing advancement, ultrasound is used in nerve blocks.

The brachial plexus can be blocked at various levels namely interscalene, supraclavicular, infraclavicular, axillary, individual nerves at various levels of arm and forearm, wrist block and digital blocks.

The interscalene is more helpful in proximal upperlimb and shoulder analgesia whereas supraclavicular block is used in and out for upperlimb surgeries upto digits. Axillary block is more preferred when surgery is more distal in forearm or hand. Wrist block is performed for procedures in hand while individual nerve blocks are preferred for short procedures where the dermatomes involved in surgery are clearly defined. This will decrease the dose of local anaesthetics needed for procedures.

Infraclavicular nerve block is preferred when the approach or positioning to a supraclavicular block or interscalene is not possible, also with a demand of covering arm for tourniquet pain.

Here, two different approach for infraclavicular plexus is chosen for comparison to find an optimum approach for the plexus with minimal sparing of nerves, with inclusion of musculo-cutaneous nerve and also which can also be performed easily. This study also compares two different positioning of arm for comparison of optimum visualisation of cords with ease.

All these approaches can be used not only for perioperative mode of anaesthesia for the patients, but also can be used as a post-operative pain relief modality. Even continuous catheters can be introduced into plexus and can be used to provide local anaesthetics in aliquots. This will reduce the use of opioids and their side effects.

A REVIEW OF ANATOMY:

Brachial plexus is formed by the ventral primary rami of the cervical segments C5, C6, C7, C8 and the thoracic segment T1. With rare contributions from C4 and T2, which are termed prefixation and post fixation respectively. These provide the motor and sensory supply of the upperlimb.

The nerve roots emerging out from intervertebral foramen, lies in the gutter between tubercles of transverse processes. All the five roots get sandwiched

between scaleni medius and anterior. The roots of C5 and C6 join to form upper trunk, C7 continues as middle trunk and C8 and T1 joins to form lower trunk. All these lie inside a fibro-fatty sheath which extends upto axilla. It is this sheath, where the anaesthesiologist performing the block is supposed to deposit the drug, to produce the block. These trunks descends downwards laterally and cross the 1st rib. At the lateral border of the first rib, trunks divide into anterior and posterior divisions. These six divisions further descends toward the axilla and form three cords, namely medial, lateral and posterior cords. They are named according to their relation with axillary artery.

The lateral cord is formed by union of anterior divisions of upper and middle trunks. Then it divides into lateral pectoral, medial pectoral and lateral head of median nerve.

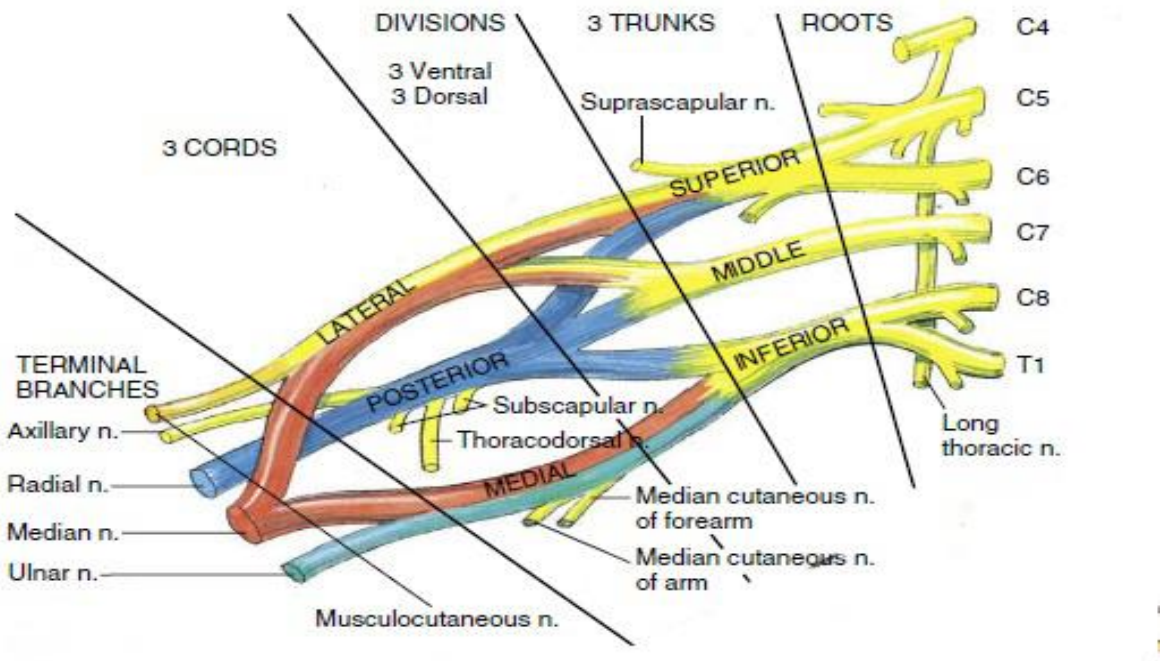


Fig.1: The Brachial Plexus (Diagramatic representation)

The medial cord is the continuation of anterior division of lower trunk. It then divides into medial pectoral, medial cutaneous nerve of arm, medial cutaneous nerve of forearm, medial head of median nerve and ulnar nerve.

The posterior cord is made by posterior divisions of all three trunks. It divides into upper subscapular, lower subscapular, nerve to lattissmus dorsi, axillary and radial nerve.

Apart from these, the roots give branches to longus cervicis, to scalene muscles, to rhomboids, to serratus anterior and contributes to phrenic nerve.

The trunks give a nerve to subclavius and suprascapular nerve.

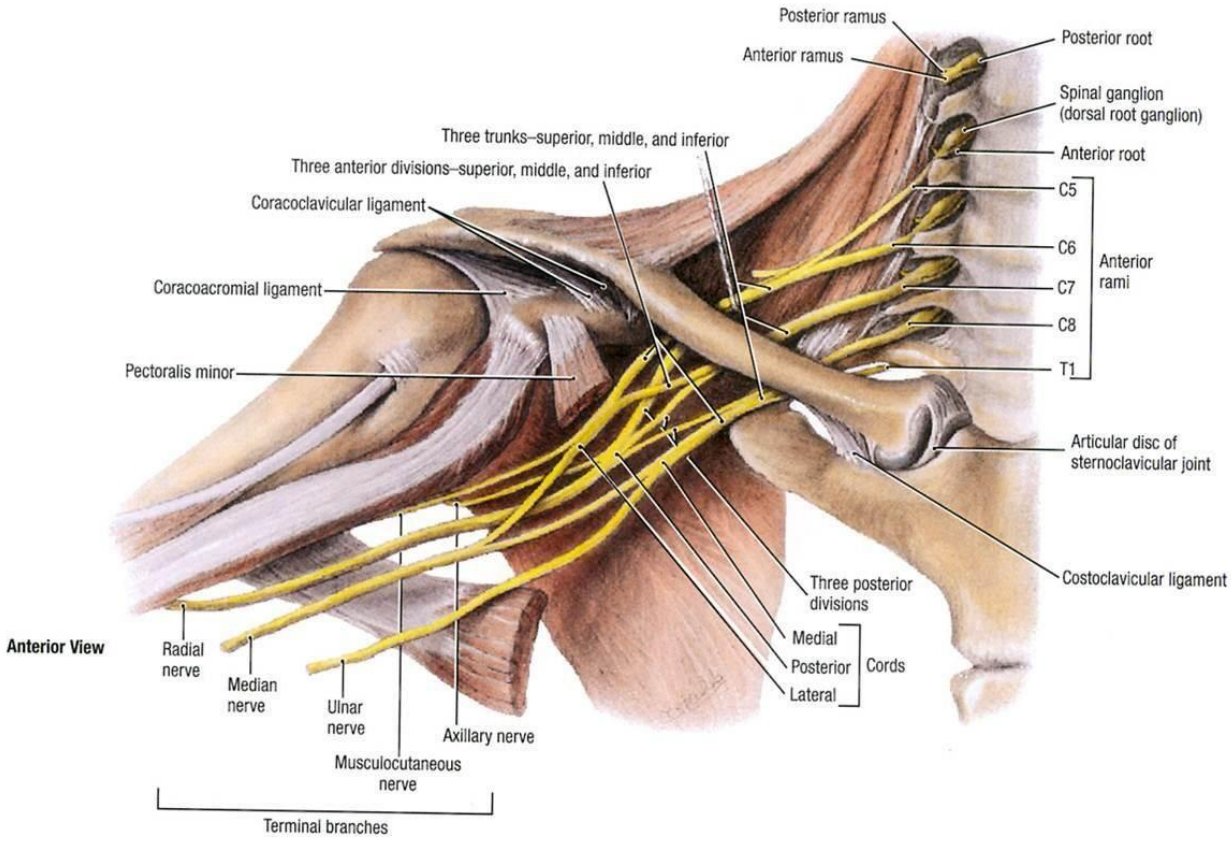


Fig.2 : The Brachial Plexus after removal of Pectoralis Minor

The cutaneous innervations of the upper extremity are not distinct. They are widely overlapped.

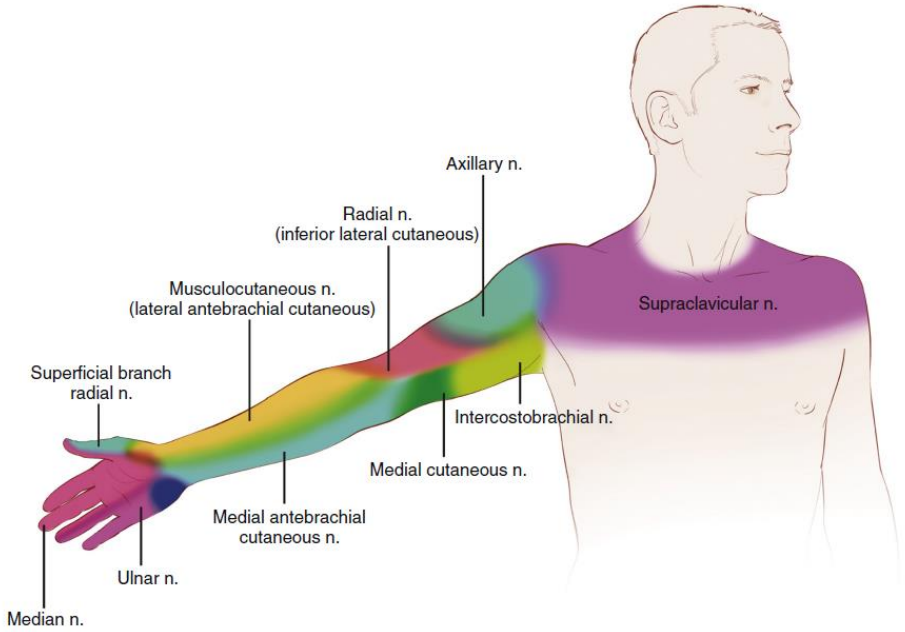


Fig.3: Dermatomal representation – Anterior view

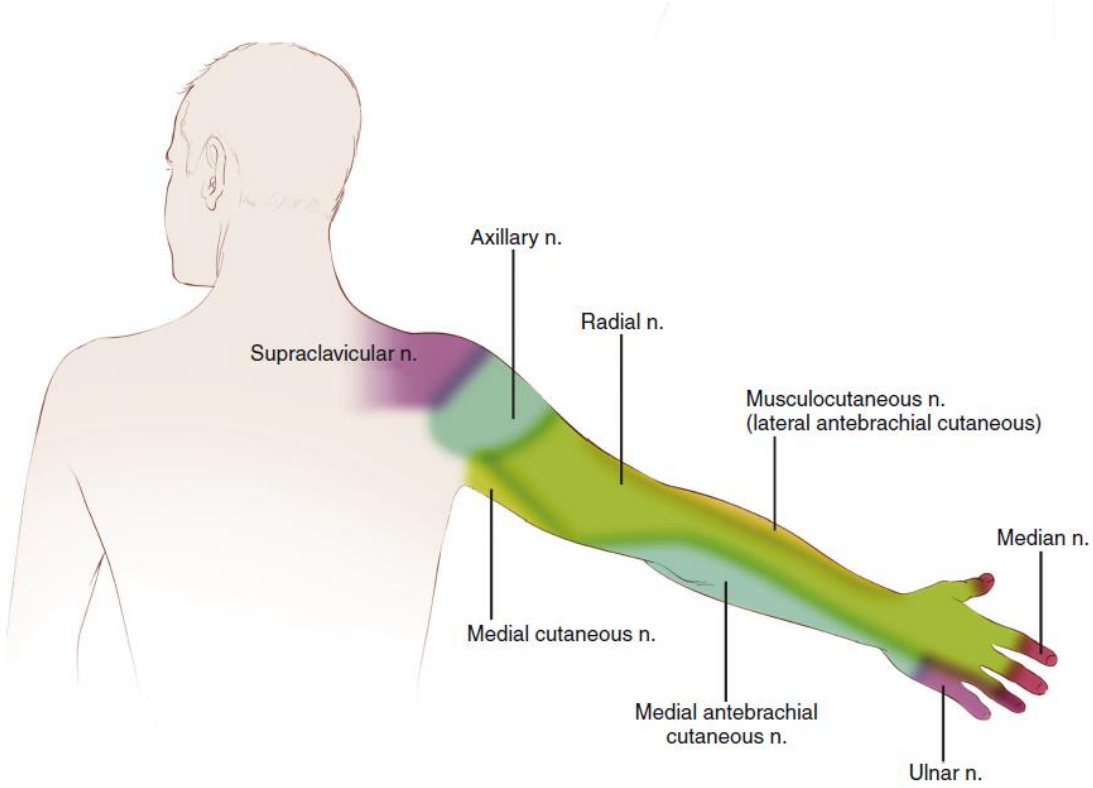


Fig.4: Dermatomal representation – Posterior view

Levels of Blockade:

The brachial plexus can be blocked at various levels. Of the major approaches, The interscalene approach Blocks brachial plexus at the level of Distal roots/ proximal trunks, supraclavicular approach aims at the distal trunks and divisions, infraclavicular blocks at the level of cords. Distal to these approaches mostly targeted at the individual nerves. Targeted nerves are chosen according to the dermatomes and myotomes involved in the surgery.

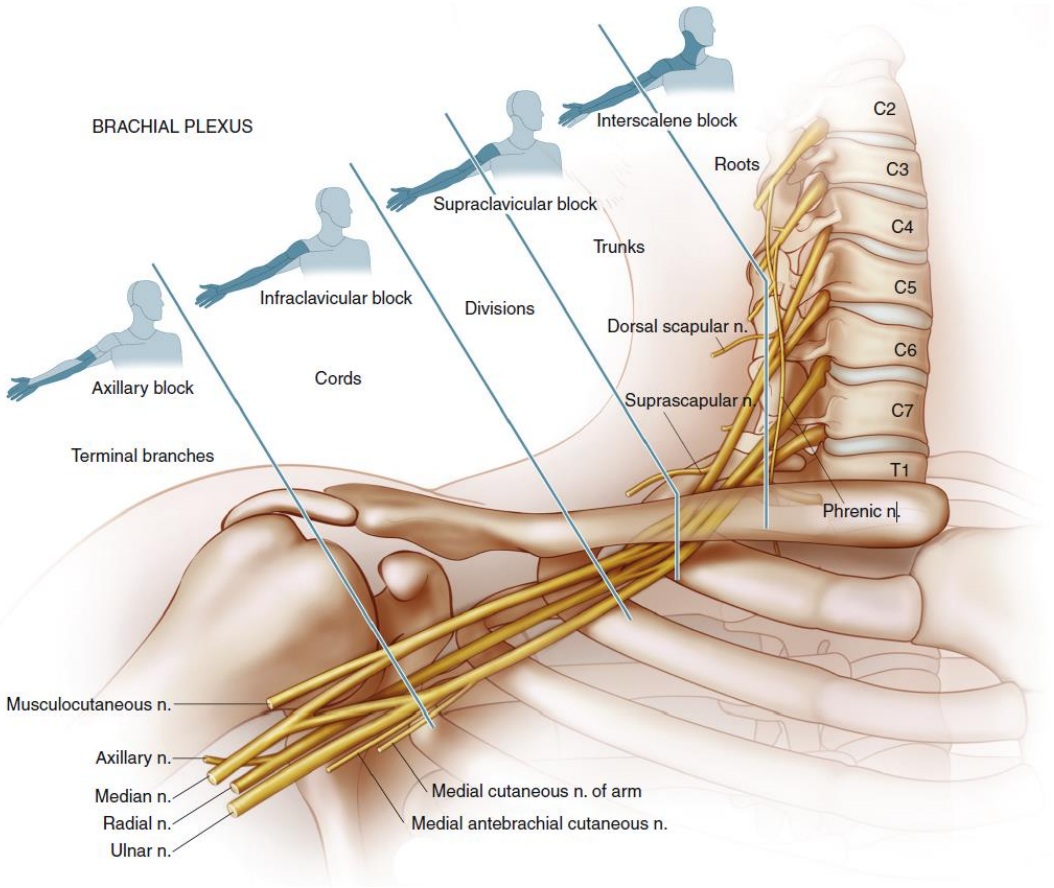


Fig.5: The Brachial Plexus and Levels of Blockade

This study is a comparative study of infraclavicular block at two levels of cords.

ULTRASOUND GUIDED NERVE BLOCKS

It is definite for an anaesthesiologist to know the ultrasound machine and the physics behind its operation.

What is an ultrasound?

The human ear can hear any sound wave whose frequency is from 20 to 20,000 Hz. Beyond or below that we cannot hear the sound. The sound waves, whose frequency is more than 20,000Hz are termed as Ultrasound waves. Some animals and Bats are inherently equipped to hear ultrasound waves. Bats, which don't have eyes, uses ultrasound waves to locate the prey and other hindrances in their path. Commonly used Ultrasound frequencies in medical diagnostics are between 1-15MHz.

Ultrasound usage allows non-invasive visualisation of tissues. Real-time ultrasound images are obtained by reflection of the ultrasound waves from tissues and organs.

History of ultrasound:

1880: Pierre and Jacques Curie discovered about the piezoelectric effect in crystals.

1942: Karl and Dussik described ultrasound used as diagnostic tool.

1978: P. La Grange published ultrasound application, especially doppler, for placement of needles for nerve blocks.

1989: P. Ting and V. Sivagnanaratnam used USG to demonstrate the anatomy of the axilla and observe the spread of local anaesthetics during axillary block.

1994: Steven Kapral and colleagues explored brachial plexus blockade using B-mode ultrasound.

Basic operation of ultrasound:

The transducers/probes used in the ultrasound machines are fitted with piezoelectric crystals. They are made of lead zirconate/titanate. These crystals vibrate and convert the electrical energy provided to them into sound energy whose frequency are in ultrasonic range. They are streamlined into the tissues. The tissues may absorb, scatter, refract or reflect the sound waves depending on their content. The reflected waves return to the probes, where the crystals detect them and convert them to electrical energy. These reflected and converted energies are processed by the ultrasound machines to a heterogenous real-time images.

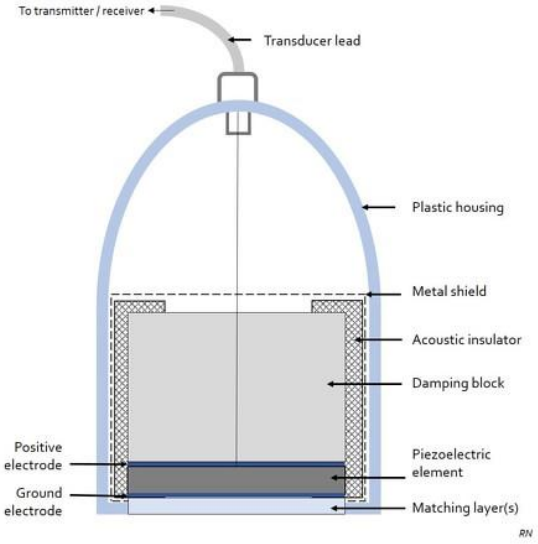


Fig.6: An Ultrasound Probe

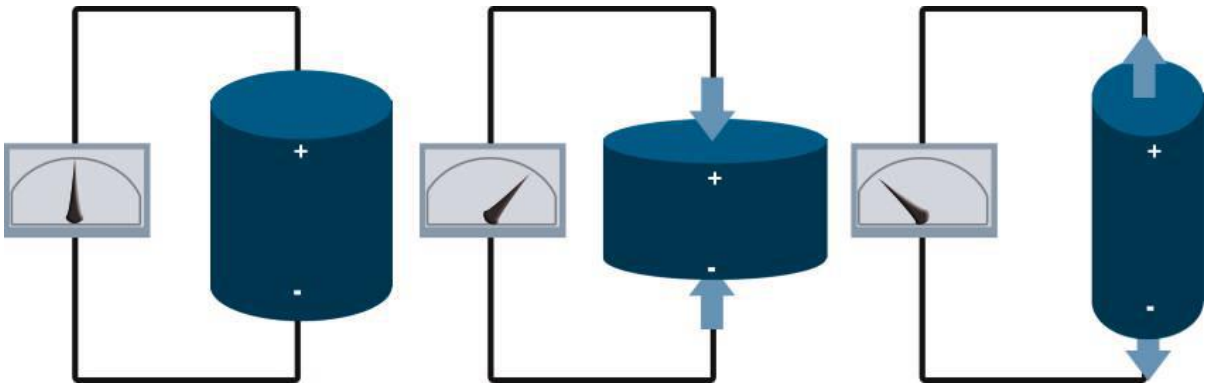


Fig.7: Piezoelectric effect

Ultrasound image modes:

A-Mode: It is older mode of imaging. The transducer sends a single pulse of ultrasound wave and waits for returned signal. The image is a single dimension image. It does not give any spatial relationship of imaged structures.

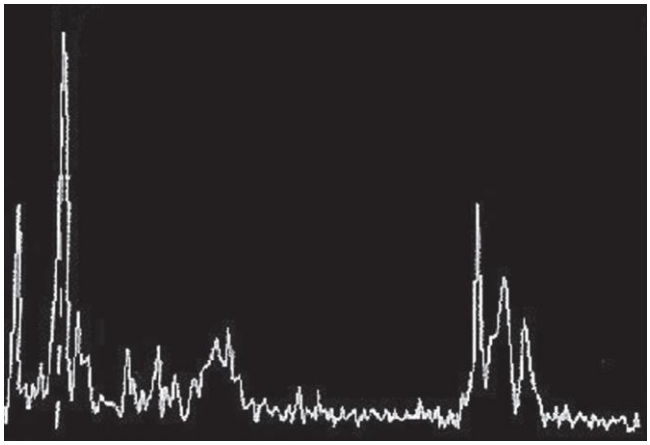


Fig.8: The A-mode of ultrasound consists of a one-dimensional ultrasound image displayed as a series of vertical peaks corresponding to the depth of structures at which the ultrasound encounters different tissues.

B-Mode: This is the widely used mode. B-Mode gives a two-dimensional image area. It provides a cross-sectional image through the area of interest.

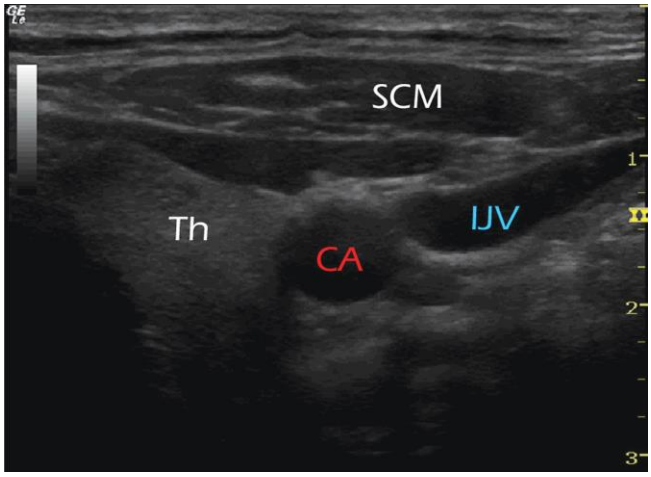


Fig.9: An example of B-mode imaging. The horizontal and vertical directions represent distances and tissues, whereas the intensity of the grayscale indicates echo strength.

Doppler mode: this uses doppler effect as the principle. It is defined as the change in frequency or wavelength of the sound wave resulting from relative motion between source and receiver. Colour doppler produces a colour-coded map of doppler shifts, superimposed on a B-Mode image. Red colour is for the sound waves coming towards the probe while blue is for waves going away from probe.

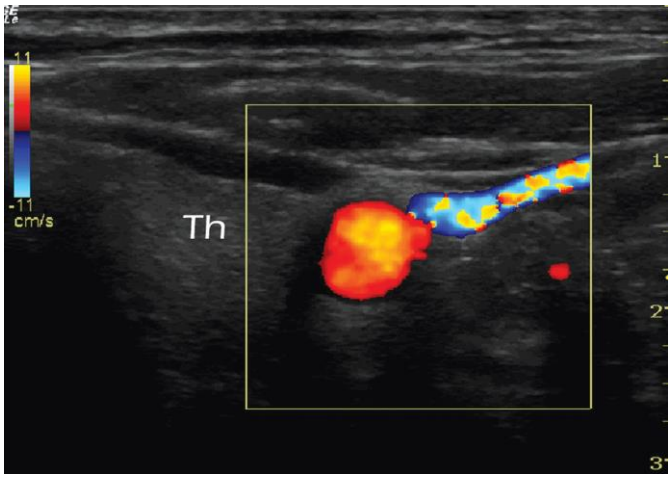


Fig.10: Colour Doppler produces a color-coded map of Doppler shapes superimposed onto a B-mode ultrasound image

M-Mode: A single beam is used to produce a image of a moving structure. The image is produces in a wave-like manner. Mostly used in cardiac imaging.

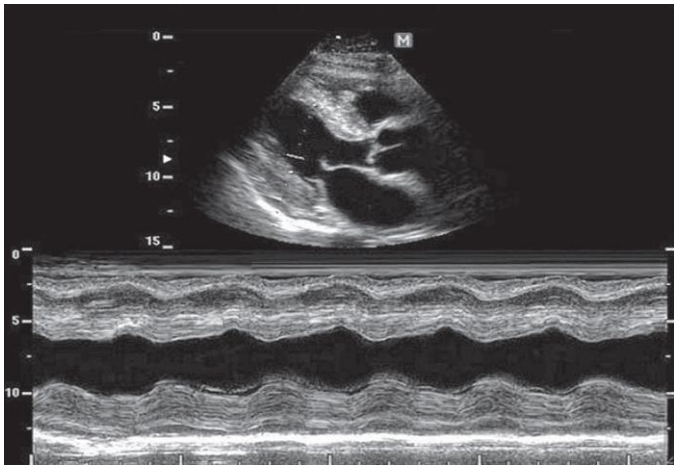


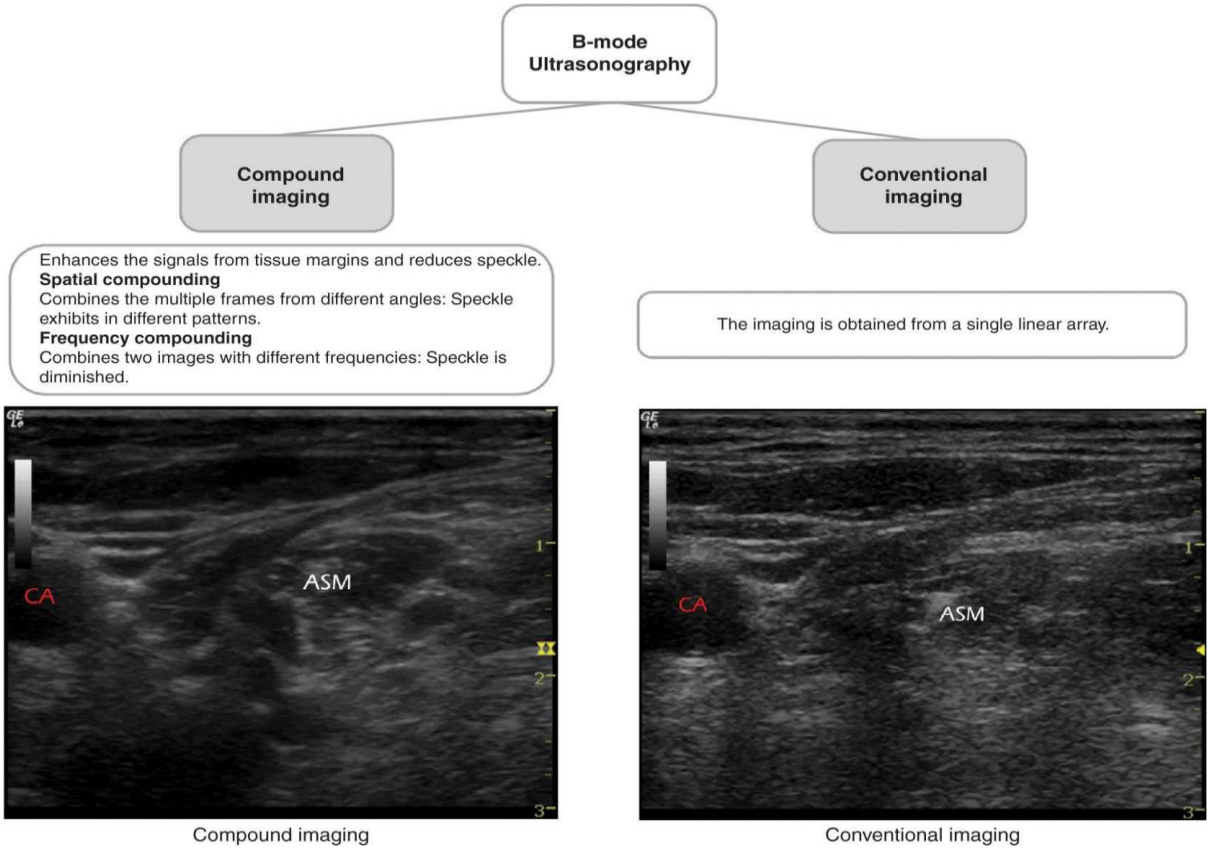
Fig.11: M-mode consists of a single beam used to produce an image with a motion signal. Movement of a structure can be depicted in a wavelike matter

Resolutions:

AXIAL: Minimum separation of above-below planes along the beam axis.

LATERAL: Side by side distance between the two objects is seen.

TEMPORAL: To observe the moving objects mainly.



Compound imaging

Conventional imaging

Probes:

Ultrasound machines convert the reflected waves received by the transducers into visible dots. This provides an anatomic image on the screen. Three types of transducers are used commonly. One is the linear, second one is the curved or curvilinear and third type is called a phased array probe. Linear probe produce parallel lines and a rectangular image, whereas the curved probe produce an arc shaped curvilinear image. Phased array probes are used in echocardiography.

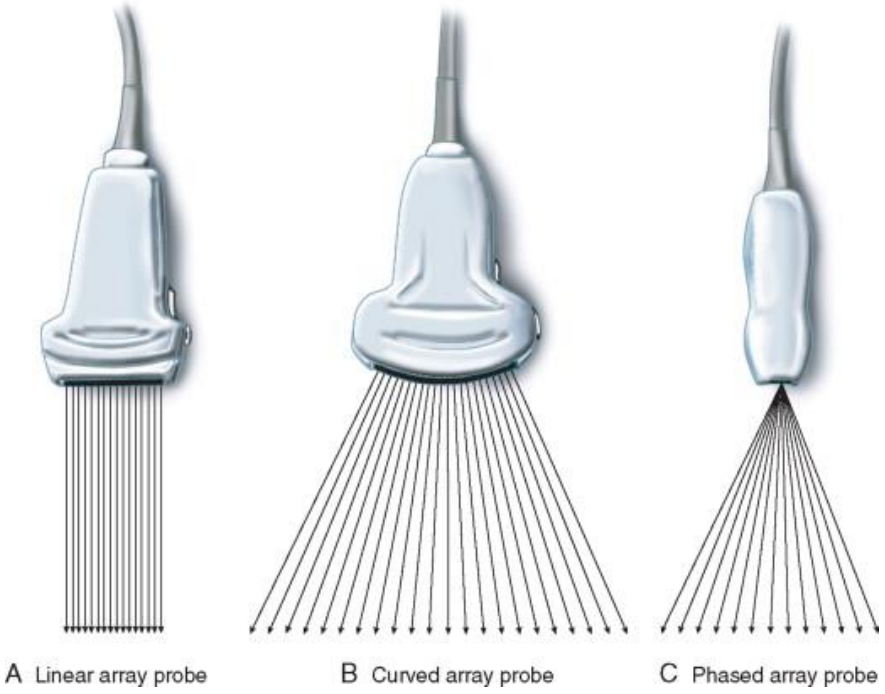


Fig.12: Commonly used probes

An aqueous gel is used to reduce the impedance and for eliminating the air medium between the transducer and skin, so that there will be minimal loss of reflected waves.

Interaction of ultrasound waves with tissues:

REFLECTION:

Reflection of a sound wave is similar to an optical reflection. Here energy is sent back into the starting or the originating medium. True reflection means, reflection angle must be equal to the incidence angle. The strength of the reflection depends on the difference of impedance between the two media and the incident angle. If the impedances is equal, there is no reflection. If there is a significant difference between the media impedances, there will be far greater or complete reflection. This reflection intensity is highly angle dependent, which means that the ultrasound transducer must be placed perpendicularly to the target to be visualized.

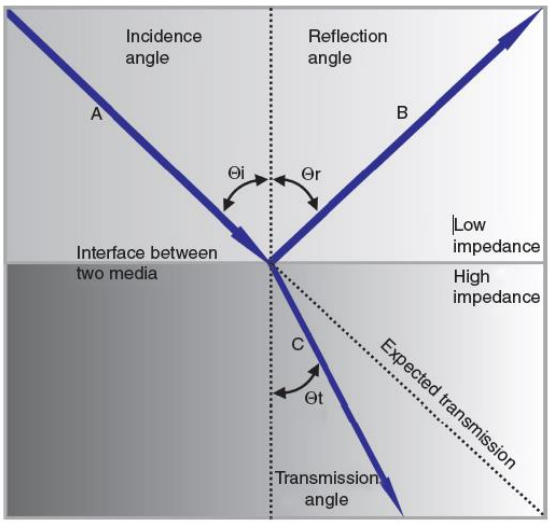


Fig.13: The interaction of ultrasound waves through the media in which they travel is complex. When ultrasound encounters boundaries between different media, part of the ultrasound is reflected, and part transmitted. The reflected and transmitted directions depend on the respective angles of reflection and transmission.

SCATTERING:

It is the redirection of sound in different directions through rough surfaces or heterogeneous media . Reflection intensities are relatively independent of the

direction of the incident sound wave. Therefore, the visualization of the target nerve is not significantly influenced by scattering.

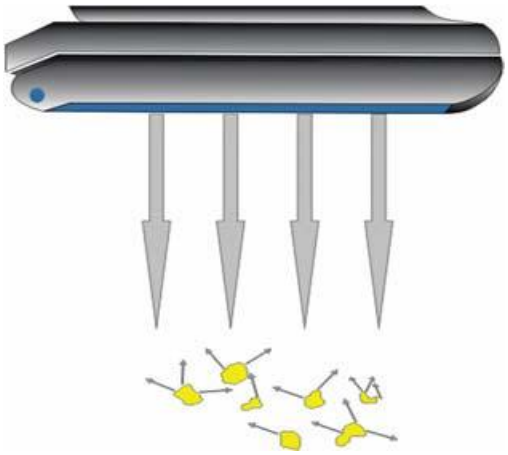


Fig.14: Scattering effect

ABSORPTION:

Absorption is defined as the direct conversion of sound energy into heat energy and thus the ultrasound scanning generates heat in the tissue. Higher scanning frequency gives better axial resolution and visualization of superficial structures. Lower frequency is selected to increase the penetration for visualization of deeper structures. Use of longer wavelengths produce lower resolution hence the resolution of ultrasound imaging is proportional to wavelength of the imaging wave. The frequencies between 6 and 12 MHz used for imaging of the peripheral nerves. Lower frequencies between 2 and 5 MHz, are used for imaging of neuraxial structures.

Functional keys in the machine:

1. Depth: this key allows to have an optimal depth setting for common nerves. The target nerve should be in centre of the image, to visualise other structures in the vicinity.
2. Frequency: optimal frequency range should be selected before performing the block, on a desired nerve. Higher the frequency, lower is the wavelength. This is because of the rapid absorption of the sound energy by tissues. So, for deeper structures, low frequency probes are used.
3. Focusing: Resolution can be improved by choosing a higher frequency and by focusing the beam at the desired place.
4. Gain: screen brightness is a common term used for gain. Excessive or inadequate gain can cause both blurring of tissues and loss of information. Optimal gain is gain at which the best contrast is obtained between the muscles and adjacent connective tissues. Nerves are comparable to connective tissues in their texture.
5. Doppler: it is used to detect vascular structures or the spread of local anaesthetics.

Needle insertion:

Two techniques are used regarding needle-transducer relationship. They are in-plane and out-of-plane techniques.

In-plane: needle is placed in plane of the transducer beam, such that the needle is visualised longitudinally, so both the shaft and tip are visible. Realtime visualisation of the structures pierced are visible.

Out-of-plane: needle insertion is perpendicular to the ultrasound beam. The shaft of needle is visible in cross section, as just a bright dot. Shaft is not visible. But this technique is difficult. Tip of the needle is visualised either by shaking the needle or by tilting the probe towards the direction of the needle, until it disappears.

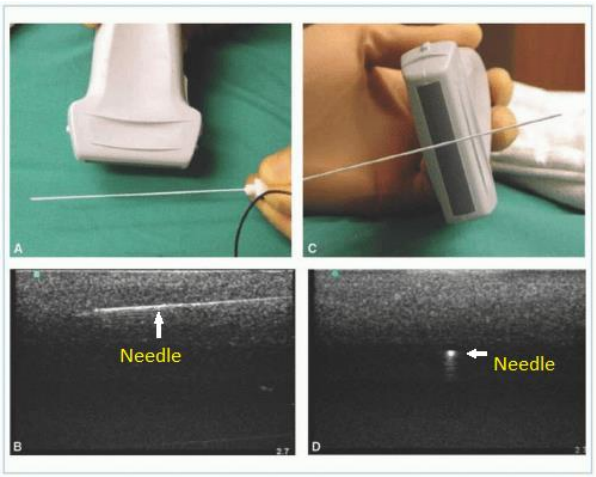


Fig.15: A is In-Plane technique of needle insertion and B is the ultrasound picture of that technique.

C is out-of-plane technique with its needle view in ultrasound as D.

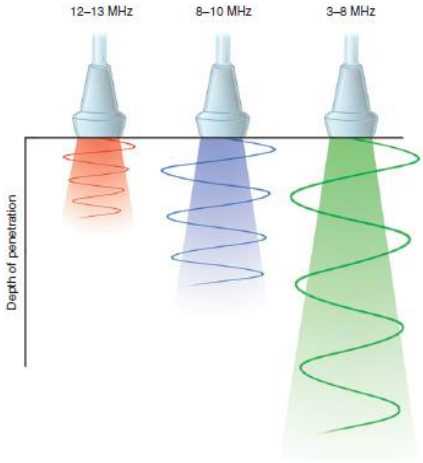


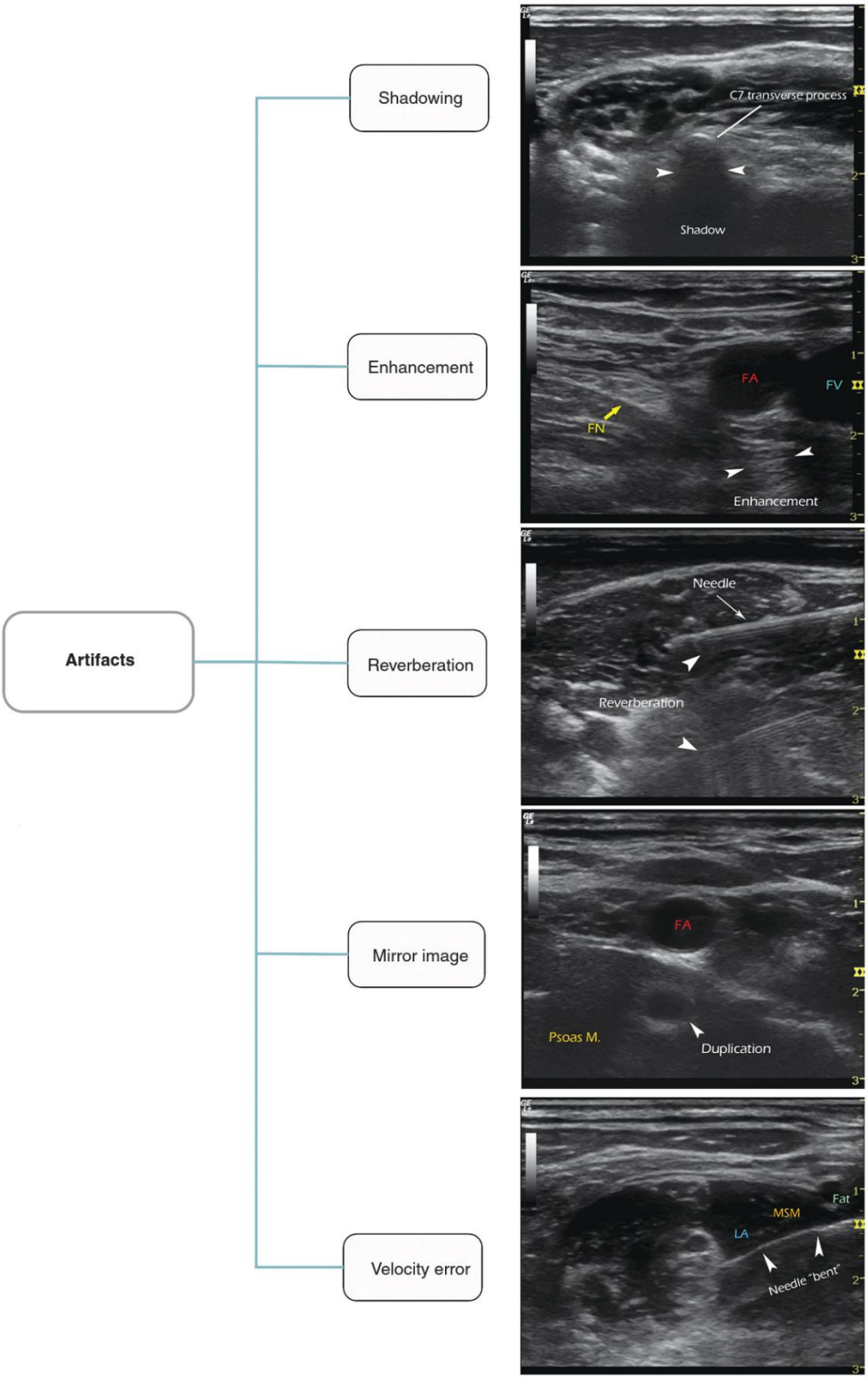
Fig.16: Frequency and depth covered in various probes

Depth of tissues from skin and appropriate probes:

FIELD DEPTH (CMS)	FREQUENCY (MHZ)	PERIPHERAL BLOCKADES
< 2	12-15	Wrist, ankle block
2-3	10-12	Interscalene and axillary
3-4	10-12	Femoral, Supraclavicular and TAP
4-7	5-10	Infraclavicular, Popliteal and sub gluteal sciatic nerve block
7-10	5-10	Pudendal, gluteal sciatic and lumbar plexus block
>10	3-5	Anterior approach to sciatic nerve

Artefacts:

Artefacts is used to describe any part of an image that does not accurately represent the anatomic structures present within the subject being evaluated. artefacts may cause structures to appear in an image that are not present anatomically or a structure that is present anatomically may be missing from the image. artefacts may also show structures as present but incorrect in location, size, or brightness. Artefacts have the potential to interfere with image interpretation. These artefacts cannot be fully eliminated. But, essential knowledge about them may help the anaesthesiologist from misinterpretation of images. Common artefacts are given the following picture.



Common artifacts during ultrasound imaging.

Preparation for ultrasound scanning:

Before performing an ultrasound guided block, a good preparation is mandatory. They are compiled as an abbreviation SCAN.

S: supplies – gather all equipments necessary, like, Ultrasound machine with powercords, transducers with covers, nerve block kits, nerve stimulators if necessary, sterile trolley, local anaesthetics, etc.

C: comfortable positioning – patient, ultrasound machine, sterile trolley, monitors are to be positioned ergonomically.

A: ambiance – the lighting of the procedure room should be ambient facilitating good visualisation of the screen and the patient.

N: name and procedure – check the name of the patient and side of surgery. Also the procedure planned to be noted.

INFRACLAVICULAR BLOCK:

This study is a comparative study of two approaches of infraclavicular block. Infraclavicular block aims at anaesthetising the cords of brachial plexus. Also, this blocks axillary and musculocutaneous nerves. The indications being the surgeries in upperlimb, reliably beneath the shoulder. Infraclavicular cords of brachial plexus are blocked at various levels and approaches. But the commonest and classical method is the sub-coracoid approach. Usually, this approach does not need any special positioning of the limb.

Anatomy: At the level of proximal axilla, where infraclavicular block is done, the axilla is a pyramid shaped space with an apex, a base, and four sides. The base is the armpit which is concave, and the anterior wall is composed of the pectoralis major and pectoralis minor muscles and their fasciae. The posterior wall of the axilla is formed by the scapula and the muscles of scapula, the subscapularis and the teres major. The latissimus dorsi adjoins the teres major muscle to form the inferior aspect of the posterior wall of the axilla. The medial wall of the axilla is composed of the serratus anterior muscle and fascia, and the lateral wall is formed by the muscle and tendons of the anterior and posterior walls while insertion into the humerus. The apex of the axilla is triangular and is formed by the of the clavicle, the scapula, and the first rib. The neurovascular bundle of the upperlimb pass into the pyramid-shaped axilla through its apex.

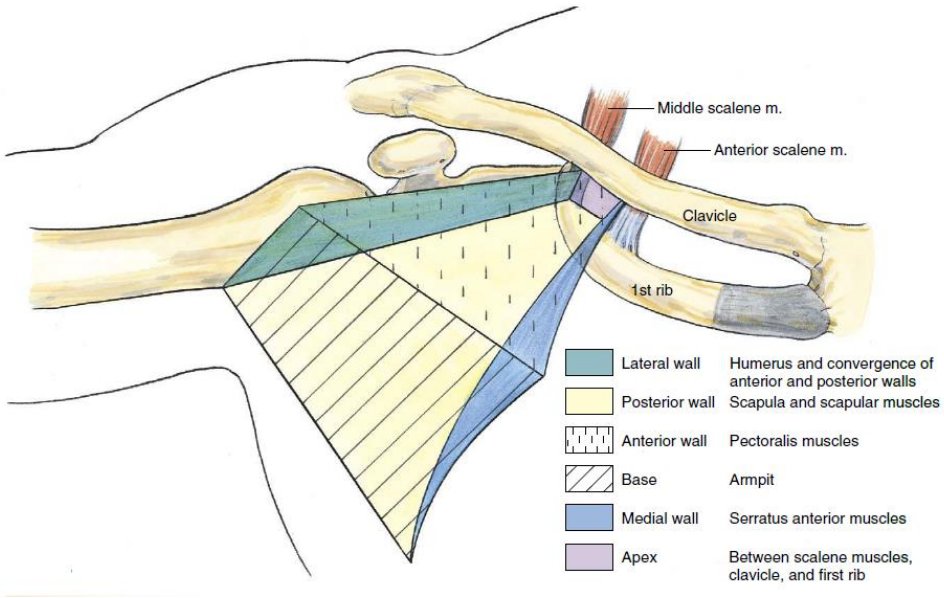


Fig.18: Diagramatic representation of infraclavicular area

The contents of the axilla are blood vessels and nerves— the axillary artery and vein and the brachial plexus, lymph nodes and loose areolar tissue. The neurovascular elements are enclosed within the axillary sheath, a fascial extension of the prevertebral layer of cervical fascia. The axillary sheath adheres to the clavipectoral fascia behind the pectoralis minor muscle and continues along the neurovascular structures until it enters the arm.

The brachial plexus divisions become cords in the axilla. The posterior divisions of all three trunks bind to form the posterior cord; the anterior divisions of the superior and middle trunks form the lateral cord; and the free anterior division of the inferior trunk forms the medial cord. These cords are named according to their relationship to the second part of the axillary artery. Here, nerves to the subscapularis, pectoralis major and minor, and latissimus dorsi muscles arise from the brachial plexus. The medial brachial cutaneous, medial antebrachial

cutaneous, and axillary nerves also leave the brachial plexus from the level of the cords.

At the lateral border of the pectoralis minor, the cords rearrange to give rise to the peripheral nerves of the upper limb. The branches of the lateral and medial cords are all “ventral” nerves to the upper extremity. The posterior cord provides all “dorsal” innervation to the upper extremity. Thus, the radial nerve supplies all the dorsal muscles in the upper extremity below the shoulder. The musculocutaneous nerve supplies muscles in the arm and provides cutaneous innervation to the forearm. In contrast, the median and ulnar nerves passes through the arm, but in the forearm and hand they provide the innervation of flexor muscles. The median nerve innervates more in the forearm, whereas the ulnar nerve innervates more in the hand.

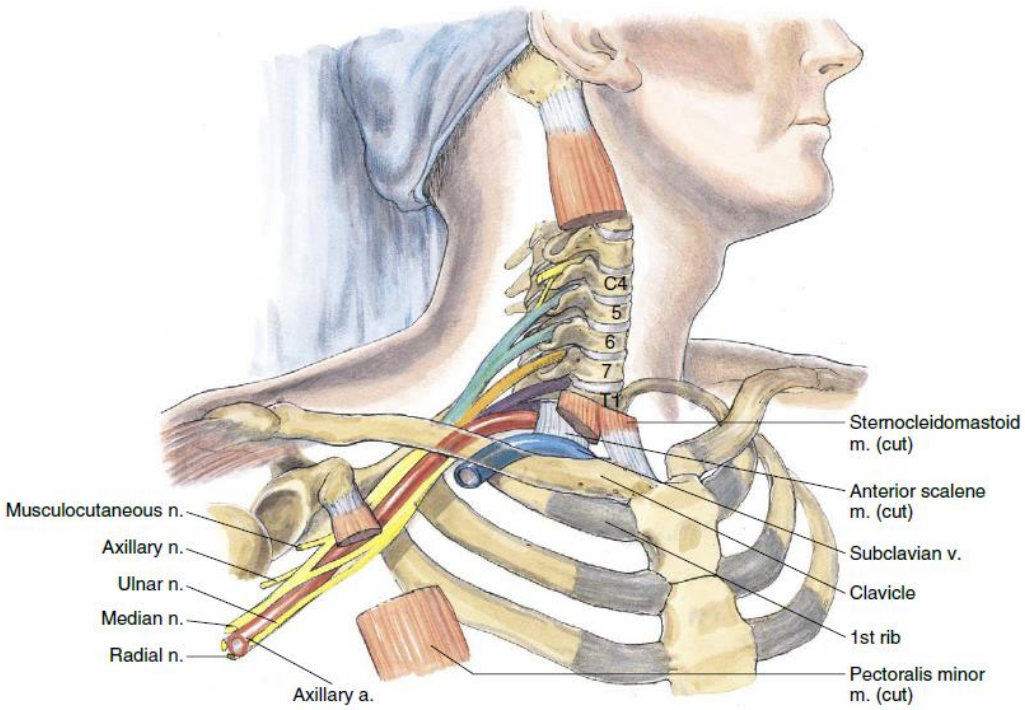


Fig.19: Relation between axillary artery and brachial plexus

Position: The patient is placed supine, with the arm to be left at the patient's side and adjustments can be made with skin markings. The anesthesiologist can stand on the ipsilateral or the contralateral side of the patient, depending on his or her preference and the patient's body habitus.

Needle Puncture: With the arm by the side or abducted to 90 degrees, the coracoid process is identified by palpation and a skin mark placed. The skin entry mark is then made at a point 2 cm medial and 2 cm caudad to the previously marked coracoid process. Deeper infiltration is then performed with a 25-gauge, 5-cm needle while the needle is directed from the insertion site in a vertical parasagittal plane. Then a 6- to 9.5-cm, 20- to 22-gauge needle is inserted in a direction similar to that taken by the infiltration needle. If a paresthesia technique is used, a distal upper extremity paresthesia is sought; if a nerve stimulator technique is used, a distal upper extremity motor response is sought. If needle redirection is needed to achieve either a paresthesia or a motor response, the needle should be redirected in a cephalo-caudad arc. The depth of contact with the brachial plexus depends on body stature and needle angulation; it ranges from 2.5 to 3 cm in lean patients and from 8 to 10 cm in obese individuals. Once adequate needle position has been achieved, either the single-injection dose of local anesthetic is administered incrementally or hydro-dissection is done before threading the continuous brachial plexus catheter. For a single-injection technique the block can be administered in a manner similar to that used in other

blocks. Continuous catheter placement is possible with infraclavicular approach since the displacements of catheters are rare in this approach.

Though the cords can be blocked by anatomical landmark techniques, because of the accuracy, direct visualisation of cords and decreased damage to surrounding tissues, usage of ultrasound is in increasing trend.

Ultrasound guided infra-clavicular block:

The brachial plexus is farthest from the patient's skin at the subcoracoid site of infraclavicular block. The ultrasonographic implications will be: (1) the ultrasound depth will have to be adjusted accordingly, and (2) transducer frequency may need to be reduced to improve penetration.

This approach is useful for single-injection blocks for surgery distal to the elbow when a supraclavicular approach is not possible or not needed. This approach is useful for catheter placement for prolonged analgesia in upper extremity surgeries such as elbow replacements and surgeries or serial debridement; this may also be useful to patients with chronic pain requiring analgesia.

To start, the transducer is placed inferior to the clavicle, such that a sagittal image slice of the patient is created on the screen. The subclavian/first part of axillary artery and vein should appear in short axis and as circular hypoechoic structures posterior to the pectoralis major and minor muscles. If there is difficulty locating the vessels, the transducer is slide laterally and depth is increased. Next, the

medial edge of the transducer should be rotated caudad to optimize the short-axis view of the vessels. The three cords of the brachial plexus should be identified around the subclavian/first part of axillary artery as hyperechoic circles or ovals with hypoechoic fascicles. The anaesthesiologist should be aware that amount of pressure being applied to the transducer because it is possible to compress the subclavian vein unintentionally despite the transducer's distance from the vessel. Preferably, needle is inserted in the in-plane technique and from the cephalad side of the transducer. However, the needle can be inserted from the caudad side also. The target is to place the needle near the brachial plexus, posterior to the subclavian artery (i.e., the 6 o'clock position). For single-injection techniques, a circumferential spread of local anesthetic around the subclavian artery is the end point of the block with adequate volume of local anaesthetic. Such a spread of local anesthetic should also incorporate the three cords of the brachial plexus.

The mnemonic to check brachial plexus block before initiation of the surgical procedure is the "four Ps." "push, pull, pinch, pinch" can help an anesthesiologist to check the four peripheral nerves of interest in the brachial plexus block. By having the patient resist the anesthesiologist's pulling the forearm away from the upper arm, motor innervation to the biceps muscle is assessed. If this muscle (pull) has weakened, it is a sign, that local anesthetic has reached the musculocutaneous nerve. Likewise, by asking the patient to attempt to extend the forearm by contracting the triceps muscle, the radial nerve can be tested. Pinching

the fingers in the distribution of the ulnar or median nerve— that is, at the base of the fifth or second digit, respectively— helps the anesthesiologist develop a sense of the adequacy of block of both the ulnar and median nerves.

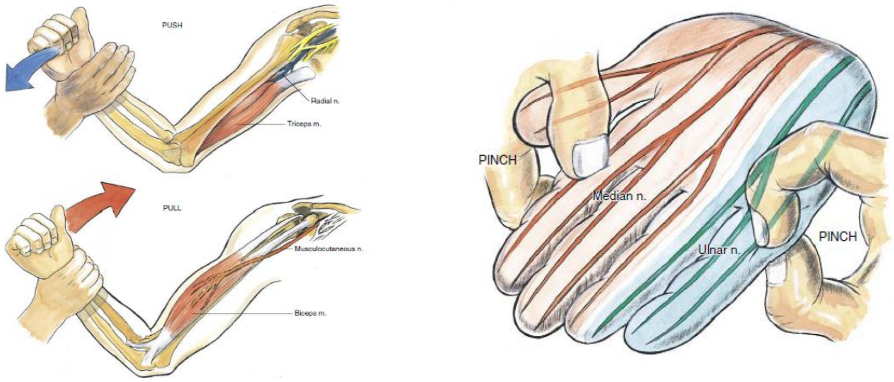


Fig:20: Common Pull, Push and two Pinch tests

In this study, the common approach, sub-coracoid approach is compared with a proximal, costoclavicular approach of the brachial plexus block at the infraclavicular level.

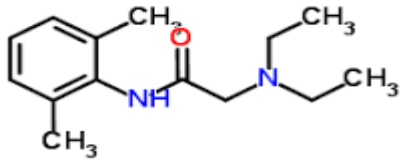
Relevant Pharmacology:

In single-injection techniques, appropriate drugs are lidocaine (1% to 1.5%), bupivacaine (0.5%), or ropivacaine (0.5% to 0.75%). Lidocaine produce 2 to 3 hours of surgical anesthesia without adrenaline and 3 to 5 hours with the addition of adrenaline. These drugs are useful for small procedures or day-care procedures. For more extensive surgical procedures requiring hospital admission, longer-acting agents such as bupivacaine or Ropivacaine are appropriate. Plain bupivacaine and Ropivacaine produce surgical anesthesia lasting 4 to 6 hours; the addition of adrenaline in 1:200000 dilution may prolong this period to 8 to 12

hours. The local anesthetic timeline must be considered when prescribing a drug for outpatient infraclavicular block because blocks lasting as long as 18 to 24 hours are also reported, and it will hinder the post-operative period of a day-care procedure. So, higher concentrations of bupivacaine with added adrenaline are better avoided.

LIGNOCAINE

Lignocaine an aminoethyl amide an amide group local anaesthetic.



- Introduced in 1948
- Most widely used local anaesthetic and also an antiarrhythmic agent.
- Lidocaine produces faster, more intense, longer-lasting, and more extensive anesthesia than does an equal concentration of procaine.
- It blocks the nerve conduction by decreasing the entry of sodium ions during the upstroke of action potential.
- Once the concentration of local anesthetics increases the rate of rise of action potential and the maximum depolarization decreases causing slowing of conduction. Hence local depolarization doesn't reach the threshold potential and conduction block ensues.

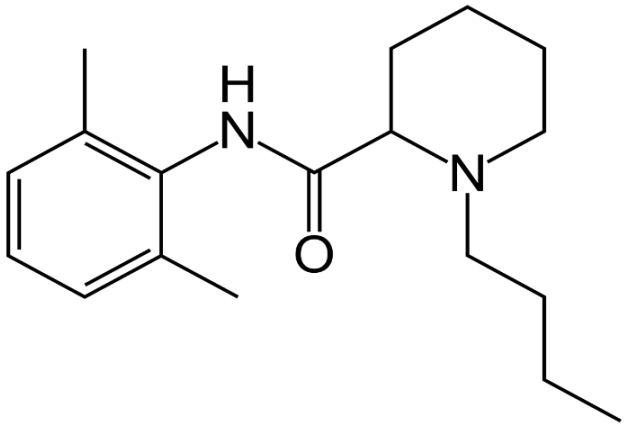
- Lidocaine is absorbed rapidly after parenteral administration and from the GI and respiratory tracts.
- Lidocaine is dealkylated in the liver by CYPs to monoethylglycine xylidide and glycine xylidide, which can be metabolized further to monoethylglycine and xylidide.
- Both monoethylglycine xylidide and glycine xylidide retain local anesthetic activity.
- About 75% of the xylidide is excreted in the urine as the further metabolite 4-hydroxy-2,6-dimethylaniline.
- Duration of action after infiltration- 60-120 minutes
- Maximum single dose for infiltration – 300mg
- pKa- 7.9
- Protein binding – 70%
- Nonionized fraction at pH 7.4- 25%
- Nonionized fraction at pH 7.6- 33%
- Lipid solubility- 2.9, Volume of distribution- 91 liters (L)
- Clearance – 0.95 L/min.
- Elimination half time – 96 minutes

BUPIVACAINE

- Bupivacaine is a widely used amide local anesthetic.
- Similar to that of lidocaine except that the amine-containing group is a

butyl piperidine.

- Potent anaesthesia producing long lasting effect.



- First synthesized in 1957 by Ekenstam
- More sensory than motor blockade has made it popular drug for prolonged postoperative pain and labour analgesia.
- Recently liposomal derived bupivacaine was approved by FDA
- More slowly absorbed than lignocaine.
- Bupivacaine is primarily metabolized in the liver by CYP3A4 to pipecolylxylidine, which is then glucuronidated and excreted.
- Alpha 1 acid glycoprotein important plasma protein site of bupivacaine.

- Duration of action after infiltration- 240-480 minutes
- Maximum single dose for infiltration – 175mg
- pKa- 8.1
- Protein binding – 95%
- Nonionized fraction at pH 7.4- 17%
- Nonionized fraction at pH 7.6- 24%
- Lipid solubility- 28
- Volume of distribution- 73 liters (L)
- Clearance – 0.47 L/min.
- Elimination half time – 210 minutes
- IV injection of bupivacaine result in precipitous hypotension, cardiac dysrhythmias, and atrioventricular heart block.
- QT prolongation, ventricular tachycardia most common side effect.
- Cardio toxic dose occurs at plasma concentration 8-10 mcg/ml
- Cardio toxicity sensitivity is more in pregnancy
- Drowsiness occurs at plasma concentration 1.5 mcg/ml
- Peripheral paresthesia occurs at plasma concentration 2 mcg/ml

- Convulsions occur at plasma concentration 4 mcg/ml.
- Available hyperbaric forms include concentrations of 0.5% and 0.75%, with dextrose 8.25%.
- Isobaric formulations are available in concentrations of 0.5% and 0.75%.

AIM OF THE STUDY

In the various approaches of brachial plexus block, this study is performed to compare two approaches of infraclavicular brachial plexus block, regarding their ease and efficiency in lower arm and forearm surgeries.

BACKGROUND OF THE STUDY:

Infraclavicular block has expanded in brachial plexus blocks because of its ease of performance and the ability to anaesthetize the axillary, musculocutaneous, median, radial and ulnar nerves in single needle prick. The block can be done with minimal risk of pneumothorax, block of the phrenic nerve or stellate ganglion. Ultrasound can be a significant aid to infraclavicular block, increasing the success rate and lowering the incidence of arterial puncture.

In the classical sub-coracoid technique, the arm is adducted to the side and the puncture is made inferior to the coracoid process. Few anaesthesiologists prefer the arm to be abducted to 90° and then perform the block. This positioning is of little use, since it partially anaesthetize the axillary and musculocutaneous nerves. So, in this study, we position the arm furthermore abducted to 110°, externally rotated and the elbow is flexed 90°. Needle insertion is more proximal, at the apex of delto-pectoral groove.

We use this proximal approach because the cords are clustered together tightly, postero-superior to the axillary artery, at this location and expected to lie closer

to the skin. As one moves distally along the plexus, the medial cord comes to lie between the axillary artery and vein where it may be more difficult to block. In addition, abducting and externally rotating the arm may bring the plexus closer to the surface of the skin and further away from the ribs and pleura.

REVIEW OF LITERATURE:

1. P. Bigeleisen1 and M. Wilson, published an article in British Journal of Anaesthesia 96 (4): 502–7 (2006); Advance Access publication February 24, 2006, "***A comparison of two techniques for ultrasound guided infraclavicular block***"

This study addressed on the debate about the proper site and arm position and the direction of the needle for the performance of ultrasound guided infraclavicular block. Using ultrasound, the authors compared the ease and success rate of a medial or a lateral approach to the brachial plexus for performing infraclavicular block in two groups of patients (n=202). The proximity of the needle to the lung in each group was also measured with and without the arm abducted from the side. RESULTS: The medial approach was quicker to perform compared with the lateral approach (9 min vs 13 min). The medial approach also had a faster onset. On average, the three cords were more readily imaged with the medial technique (92%) compared with the lateral technique (82%) and the medial technique prevented tourniquet pain more reliably (97%) vs the lateral technique (83%). In the medial technique, the plexus was also closer to the skin (3.7 cm) compared

with the lateral technique (4.5 cm). The lateral approach more frequently avoided the chest wall (49%) compared with the medial technique (35%) but resulted in more frequent vascular puncture. Both approaches provided good anesthesia at the surgical site. Also, Abducting the arm 110 degrees and externally rotating the shoulder moves the plexus away from the thorax and closer to the surface of the skin. As a conclusion, For infraclavicular block using ultrasound guidance the medial approach is faster and easier to perform, has lower incidence of tourniquet pain and vascular puncture, and brings the plexus closer to the skin. The recommendation was abducting the arm 110 degrees to minimize the risk of pneumothorax. Externally rotating the shoulder also brings the plexus closer to the skin.

2. "***Evaluation of brachial plexus fascicles involvement on infraclavicular block: unfixed cadaver study***" of Luiz Carlos Buarque de Gusmãoa, Jacqueline Silva Brito Limaa, Jeane da Rosa Oiticica Ramalhoa, Amanda Lira dos Santos Leitea, Alberson Maylson Ramos da Silva; REVISTA BRASILEIRA DE ANESTESIOLOGIA, Official Publication of the Brazilian Society of Anesthesiology, Received 24 March 2014; accepted 2 June 2014

This study shows how the diffusion of the anesthetic into the sheath occurs through the axillary infraclavicular space and hence proves the efficacy of the anesthetic block of the brachial plexus, and may thereby allow a consolidation of

this pathway, with fewer complications. 33 armpits of adult cadavers were analysed and unfixed. The authors injected a solution of neoprene with latex dye in the infraclavicular space, based on the technique advocated by Gusmão et al., and put the corpses in refrigerators for three weeks. Subsequently, the specimens were thawed and dissected, exposing the axillary sheath along its entire length. Results and discussion: they demonstrated spread of dye involvement of all fasciculus of the plexus in 51.46%. In partial involvement was 30.30%, 18.24% of cases the acrylic was located outside the auxiliary sheath involving no issue. Conclusions: The results allow us to establish the infraclavicular as an effective and easy way to access plexus brachial, because the solution involved the fascicles in 81.76% partially or totally, when it was injected inside the axillary sheath. We believe that only the use of this pathway access in practice it may demonstrate the efficiency.

3. D. Nieuwvelda, V. Mojicaa, A.E. Herreraa, J. Pomésb, A. Pratsc, X. Sala-Blanchd; published "***Medial approach of ultrasound-guided costoclavicular plexus block and its effects on regional perfusion***" in Revista Española de Anestesiología y Reanimación;

This study was about an Ultrasound-guided infraclavicular block in the costoclavicular space located between the clavicle and the first rib, reaches the secondary trunks when they are clustered together and lateral to the axillary artery. This block is most often performed through a lateral approach, the

difficulty being finding the coracoid process an obstacle and guiding the needle towards the vessels and pleura. A medial approach will avoid these structures. Traditionally the assessment of a successful block is through motor or sensitive responses, but a sympathetic fibre block can also be evaluated measuring the changes in humeral artery blood flow, skin temperature and/or perfusion index. The Objective was to describe the medial approach of the ultrasound-guided costoclavicular block evaluating its development by motor and sensitive response and measurement of sympathetic changes. Description of the technique and administration of 20 ml of contrast in a fresh cadaver model, evaluating the distribution with CT-scan and sagittal sections of the anatomic piece. Subsequently in a clinical phase, including 11 patients, the authors evaluated the establishment of motor, sensitive and sympathetic blocks. They evaluated the sympathetic changes reflected by humeral artery blood flow, skin temperature and distal perfusion index. Results: In the anatomical model the block was conducted without difficulties, showing an adequate periclavicular distribution of the contrast in the CT-scan and in sagittal sections, reaching the interscalenic space as far as the secondary trunks. Successful blocks were observed in 91%of patients after 25 min. All the parameters reflecting sympathetic block increased significantly. The humeral artery blood flow showed an increase from 108 ± 86 to 188 ± 141 ml/min ($p = 0.05$),skin temperature from 32.1 ± 2 to 32.8 ± 9◦C ($p = 0.03$) and perfusion index from 4 ± 3 to 9 ± 5($p = 0.003$).Conclusions: The medial

approach of the ultrasound-guided costoclavicular block is anatomically feasible, with high clinical effectiveness using 20 ml of 1.5% mepivacaine. The sympathetic block can be evaluated with all three parameters studied.

4. "***Ultrasound-Guided Infraclavicular Brachial Plexus Block Prospective Randomized Comparison of the Lateral Sagittal and Costoclavicular Approach***" published by Banchobporn, Songthamwat, MD, Manoj Kumar Karmakar, MD, Jia Wei Li, PhD, Winnie Samy, MSc, and Louis Y.H. Mok, FANZCA in Regional Anesthesia and Pain Medicine • Volume 43, Number 8, November 2018

It proposed that an infraclavicular brachial plexus block (BPB) at the costoclavicular (CC) space may overcome some of the limitations of the lateral sagittal (LS) approach. In this study, authors hypothesized that the CC approach will produce faster onset of sensory blockade of the 4 major terminal nerves of the brachial plexus than the LS approach. In this study, Forty patients undergoing elective upper extremity surgery under a BPB were randomized to receive either the LS (Gp-LS, n = 20) or CC approach (Gp-CC, n = 20) for infraclavicular BPB. Twenty-five millilitres of 0.5% ropivacaine was used for the BPB in both study groups. Sensory motor blockade of the ipsilateral median, radial, ulnar, and musculocutaneous nerves was assessed by a blinded observer at regular intervals for 45 minutes after the block. Sensory block was assessed using a verbal rating scale (0–100) and motor block using a 3-point qualitative scale (0–2). Onset of

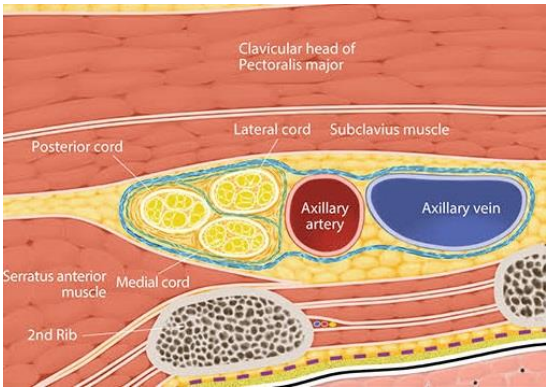
sensory (primary outcome variable) and motor blockade was defined as the time it took to achieve a sensory verbal rating scale of 30 or less and motor grade of 1 or less, respectively. Time to readiness for surgery was defined as the time it took to achieve a sensory score of 30 or less and motor grade of 1 or less in all the 4 nerves tested. Results: The overall sensory onset time (median [interquartile range]) was significantly faster (P = 0.004) in Gp-CC (10 [10–26.25]minutes) than in Gp-LS (20 [15–30]minutes). The overall sensory score was significantly lower in Gp-CC than in Gp-LS at 5 (P < 0.001), 10 (P=001), 15 (P = 0.001), and 20 (P = 0.04) minutes after the BPB. The overall motor score was significantly lower (P = 0.009) in Gp-CC than in Gp-LS at 10minutes after the BPB. There were more (P = 0.04) patients with complete sensory-motor blockade at 20 minutes after the BPB in Gp-CC (25%) than in Gp-LS (0%). Time to readiness for surgery was also significantly faster (P = 0.002) in Gp-CC (10 [10–26.5] minutes) than in Gp-LS (20 [15–30] minutes). Authors concluded that The CC approach for infraclavicular BPB produces faster onset of sensory blockade and earlier readiness for surgery than the LS approach.

5. "***Ultrasound-Guided Costoclavicular Brachial Plexus Block Sonoanatomy, Technique, and Block Dynamics***" Published by Jia Wei Li, PhD, Banchobporn Songthamwat, MD, Winnie Samy, MSc, BN, Xavier Sala-Blanch, MD, and Manoj Kumar Karmakar, MD, FRCA,

FHKCA, FHKAM; in Regional Anesthesia and Pain Medicine • Volume 42, Number 2, March-April 2017

This study aimed to describe in detail the relevant sonoanatomy, technique, and block dynamics of an ultrasound guided costoclavicular brachial plexus block (BPB). Thirty patients scheduled for hand or forearm surgery under a BPB underwent transverse ultrasound imaging of the medial infraclavicular fossa to identify the cords of the brachial plexus at the costoclavicular space (CCS). An ultrasound-guided BPB was then performed at the CCS with 20 mL of 0.5% ropivacaine. Sensory-motor blockade of the ipsilateral median, radial, ulnar, and musculocutaneous nerves were assessed at regular intervals for 30 minutes after the injection. Successful block was defined as being able to complete surgery under the BPB. Results were, the CCS was visualized as a well-defined intermuscular space lying deep and posterior to the mid-point of the clavicle. The cords of the brachial plexus were clustered together lateral to the axillary artery within the CCS. The costoclavicular BPB was successfully performed in all patients, and the median onset time for sensory and motor blockade of all the 4 nerves was 5 [5–15] and 5 [5–10] minutes, respectively. Complete sensory blockade of all the 4 nerves was achieved in 30 [20– 30] minutes, and the BPB was successful in 29 (97%) of 30 patients. There were no complications directly related to the technique or the local anesthetic injection. Conclusions: This report describes a novel technique of infraclavicular BPB at the costoclavicular space

that produces rapid onset of BPB. Future research should compare the safety and efficacy of this new technique with the traditional lateral sagittal infraclavicular BPB.



6. "***Ultrasound-guided costoclavicular approach infraclavicular brachial plexus block for vascular access surgery***" done by Zhi Yuen Beh1, Mohd Shahnaz Hasan2; in J Vasc Access 2017; 18 (5): e57-e61

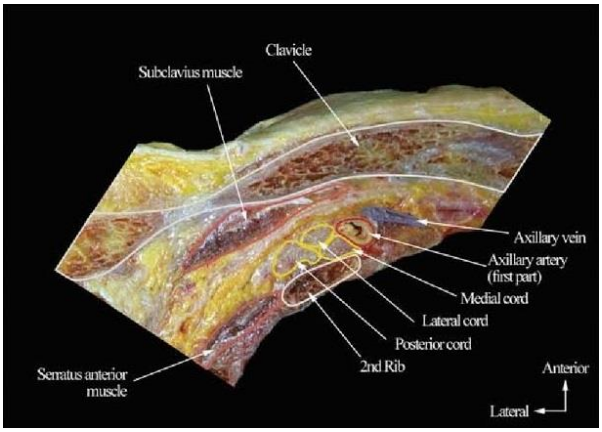
This was a case series, to report the use of a newly described regional technique, ultrasound-guided costoclavicular approach infraclavicular brachial plexus block for surgical anesthesia in two high-risk patients undergoing 2nd stage transposition of basilic vein fistula. Methods: Both patients had features of difficult airway, American Society of Anesthesiologists (ASA) physical status class III and central venous occlusive disease. The common approach, i.e., ultrasound-guided supraclavicular brachial plexus block was technically difficult with inherent risk of vascular puncture due to dilated venous collaterals at the supraclavicular area possibly compromising block quality. The risk of general anesthesia (GA) was significant as patients were morbidly obese with possible

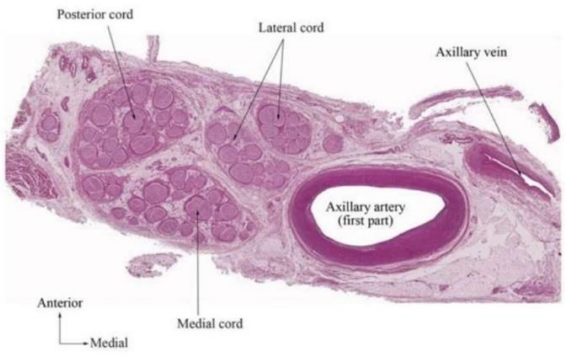
risk of obstructive sleep apnea postoperatively. As an alternative, authors performed the ultrasound-guided costoclavicular approach infraclavicular brachial plexus block with 20 mL local anesthetic (LA) ropivacaine 0.5% delivered at the identified costoclavicular space using in-plane needling technique. Another 10 mL of LA was infiltrated along the subcutaneous fascia of the proximal medial aspect of arm. Results: Both surgeries of >2 hours' duration were successful, without the need of further local infiltration at surgical site or conversion to GA. Conclusions: Ultrasound-guided costoclavicular approach can be an alternative way of providing effective analgesia and safe anesthesia for vascular access surgery of the upper limb.

7. ***"Anatomic Basis for Brachial Plexus Block at the Costoclavicular Space - A Cadaver Anatomic Study"*** Xavier Sala-Blanch, MD, Miguel Angel Reina, MD, PhD, Pawinee Pangthipampai, MD, and Manoj Kumar Karmakar, MD, FRCA, FHKCA, FHKAM; Regional Anesthesia and Pain Medicine • Volume 41, Number 3, May-June 2016

The costoclavicular space (CCS), which is located deep and posterior to the midpoint of the clavicle, may be a better site for infraclavicular brachial plexus block than the traditional lateral paracoracoid site. However, currently, there is paucity of data on the anatomy of the brachial plexus at the CCS. This cadaver anatomic study was done to define the anatomy of the cords of the brachial plexus at the CCS and thereby establishing the anatomic basis for ultrasound-guided

infraclavicular brachial plexus block at this proximal site. The anatomy and topography of the cords of the brachial plexus at the CCS was evaluated in 8 unembalmed (cryopreserved), thawed, fresh adult human cadavers using anatomic dissection, and transverse anatomic and histological sections, of the CCS. Results: The cords of the brachial plexus were located lateral and parallel to the axillary artery at the CCS. The topography of the cords, relative to the axillary artery and to one another, in the transverse (axial) plane was also consistent at the CCS. The lateral cord was the most superficial of the 3 cords and it was always anterior to both the medial and posterior cords. The medial cord was directly posterior to the lateral cord but medial to the posterior cord. The posterior cord was the lateral most of the 3 cords at the CCS and it was immediately lateral to the medial cord but posterolateral to the lateral cord. Conclusions: The cords of the brachial plexus are clustered together lateral to the axillary artery and share a consistent relation relative to one another and to the axillary artery, at the CCS.





MATERIALS AND METHODS

The study was done in Government Rajaji Hospital, Madurai under Institute of Anaesthesiology for the period of one year. A Sample size of 26 pts in each group was calculated to be sufficient to achieve power 80% and a type 1 error of 0.05. We recruited 35 patients per group to account for random errors, patient drop out, and additional comparisons.

After obtaining approval from Institute ethical committee and getting written informed consent, 70 patients who underwent various surgeries below mid-humerus were enrolled for the study. They were randomly divided into two groups. This study is a randomised prospective study. Randomisation is done with SPSS ver26.0 trial version and patients are assorted into two groups.

Group 1: the arm is abducted to 110°, externally rotated and elbow flexed to 90°. The ultrasound probe is kept at the apex of delto-pectoral group, that is more

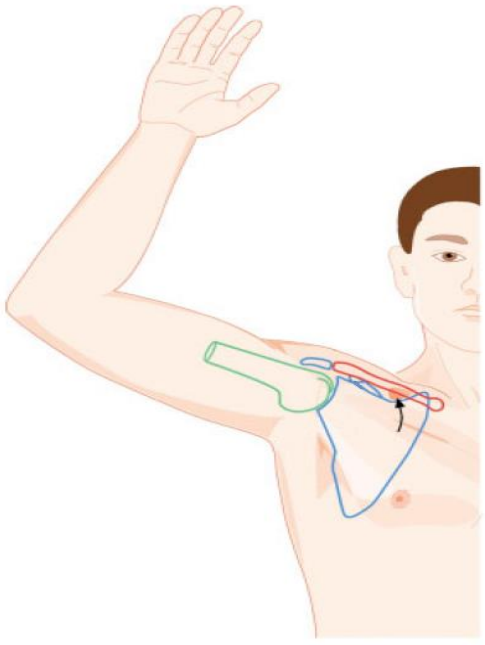


Fig.21: Group 1 arm positioning; arm abducted to 110°, externally rotated and elbow flexed to 90°

proximally than the classical approach and the block is performed in in-plane technique.

Group 2: this is the classical sub-coracoid approach where the arm is kept by the side of the patient in neutral position and block is performed in in-plane technique.

In both the groups, block was performed with 0.5% of injection Bupivacaine 15cc and 2% of injection Lignocaine 10cc. Total volume of 25cc is injected into the nerve sheath.

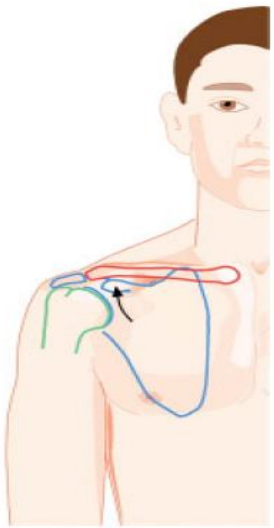


Fig.22: Group 2 arm positioning; neutral position – arm by the side of the patient, adducted.

Inclusion criteria:

Patients from 18 to 60 years of age, of both sexes, who were assessed under ASA 1 & 2, of Weight more than 50kgs and who are undergoing lower arm, elbow, forearm, wrist and hand surgeries are included.

Exclusion criteria:

Patients who were assessed under ASA 3 and above, of Weight less than 50kgs, on antiplatelets and anti-coagulants, with severe respiratory diseases, neurological problems, local infections, who has allergy to Local anaesthetics, pregnant women and who refuses to have a nerve block and who does not want to take part in study are excluded from the study.

Procedure:

Preoperative evaluation of the patient was done prior to surgery, with usual protocols.

Patients were allocated to the group, randomly and procedure was explained to the patient. After receiving the patient in the operating table, a peripheral venous line was established. Standard monitors like pulse probe with oxygen saturation (SpO2), blood pressure monitors and 5 lead Electrocardiogram are attached. Pre-operative values noted.

A Sonosite M-Turbo machine with a linear probe of frequency 5-16Hz is used for ultrasound examination and performing the block.

After preparing a sterile field, the linear probe was placed over the brachial plexus was imaged at both the sites, i.e., the proximal and distal part of delto-pectoral groove. Then the arm was abducted to 110° at the shoulder and flexed 90° at the elbow for group 1 patients. The axillary artery and vein were imaged, and the

medial, lateral and posterior cords were identified. The distance from the skin to the artery in the anterior – posterior direction was measured and the locations of the cords relative to the artery and vein. An attempt was also made to image the rib, pleura or lung. Distance to the rib, pleura or lung from the artery is also measured. This approach is called as the costo-clavicular approach of Infraclavicular brachial plexus block.

Fig.23: Patient arm positioning in Group 1

*Picture was taken for representation only. Block was performed under strict aseptic precautions. Face was draped to hide the identity

In the group 2 patients, the arm is kept in neutral position, by the side of the patient. After preparing the sterile field, the ultrasound probe is kept in a parasagittal orientation, in the distal end of delto-pectoral groove and coracoid process is identified. The probe slightly moved caudally, so that the cross section of axillary artery and vein are visualised. All the three cords are identified. The position of cords in respect to the artery and vein was noted. Same measurements were noted.

Fig.24: Patient arm positioning in Group 2

*Picture was taken for representation only. Block was performed under strict aseptic precautions.

Infiltration of the skin and pectoral muscles along the needle path is done with 23G needle and a 18G needle is used to perform the block. This needle was introduced superior to the probe at an angle of 45° to the skin in caudal direction, in in-plane technique. The needle was visualised entirely throughout the trajectory and after negative aspiration for blood and air, the plexus was infiltrated with 25cc of local anaesthetic which was already prepared as above. Realtime spread of drug in the plexus is visualised, such that all the three cords are bathed in the local anaesthetic mixture. Time taken for performing the block, time taken for sensory blockade, motor blockade and their quality are noted. Tourniquet pain in terms of VAS was noted. Any sparing or untoward events are also noted.

Fig.25: Group 1 ultrasound view of brachial plexus. LC-Lateral cord; PC-Posterior cord; MC-Medial cord; AA-Axillary artery; AV-Axillary vein; PM- pectoralis major; SCL-Subclavius

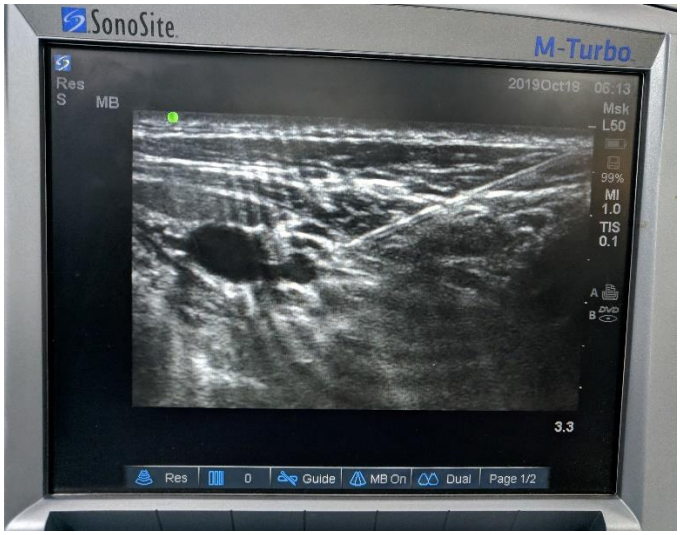


Fig.26: Group 1 ultrasound view with needle tracing.

Quality of the sensory and motor block was determined using the following scale. A value of 1 was given for the patient's baseline function and a value of 2 represented a diminished response from baseline.

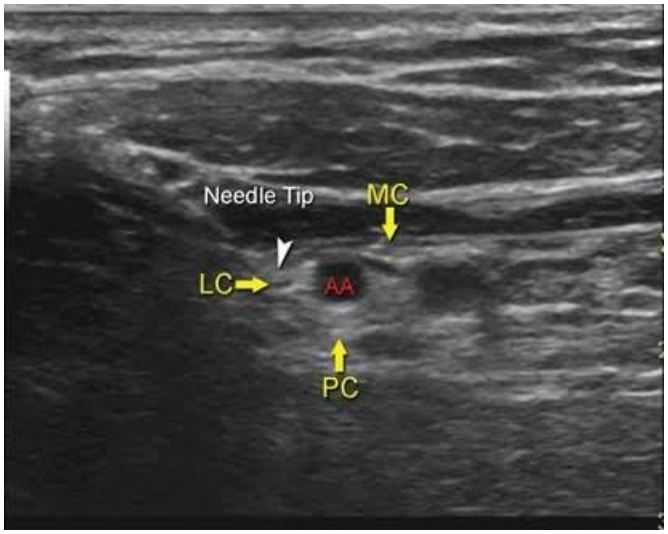


Fig.27: Group 2 ultrasound view of brachial plexus. LC-Lateral cord; PC-Posterior cord; MC-Medial cord; AA-Axillary artery; Note the Medial cord lying between Axillary artery and vein.

For the sensory test, a value of 3 represented a response which would allow surgical incision without pain. This was accomplished by pinching the patient in the following distributions: axillary nerve (skin over distal deltoid muscle), musculocutaneous nerve (lateral side of forearm), median nerve (nail bed of third finger), radial nerve (skin over anatomical snuff box), ulnar nerve (medial border of fifth finger), intercosto-brachial nerve (skin distal to the axillary hair).

For the motor test, a value of 3 represented the inability to flex or extend the following joints: axillary nerve (abduct arm more than 10°), musculocutaneous nerve (flex elbow), median nerve (flex distal interphalangeal joint of second finger) radial nerve (extend wrist), ulnar nerve (abduct third and fourth fingers). Measurements of these parameters were made before the block and at 5 and 20 min after the block. Also the usual “four Ps” (Pull, Push, Pinch and Pinch) are tested.

Any complaints of pain in the surgical field during or after the surgery were also noted.

ONSET OF SENSORY BLOCKADE:

The time of onset of sensory block was defined as the interval between the injection of drug to sensory value of 3.

DURATION OF SENSORY BLOCKADE:

The duration of the sensory block was defined as the time interval between the complete sensory block and the return of normal sensation in the corresponding dermatomal area of Axillary, Radial, Median, Ulnar, Musculo-cutaneous and intercosto-brachial nerves.

ONSET OF MOTOR BLOCKADE:

The onset time of motor block was defined as the time between the completion of the local anesthetic injection and complete paralysis of Axillary, Radial, Median, Ulnar and Musculo-cutaneous nerves.

DURATION OF MOTOR BLOCKADE:

The duration of motor block was defined as the time interval between the complete paralysis and complete recovery of motor function.

Tourniquet pain is noted from time of inflation till its removal. Maximum time of tourniquet allowed was 90minutes. If the procedure warranted extension,

tourniquet was released for 10minutes and re-applied. But none of the patients had extension of tourniquets. Any pain on application of tourniquet is noted as o for absence of pain and 1 for presence of pain. If the patient develops pain, 5ml of 1% lignocaine is infiltrated subcutaneously, just below the axillary hairline.

Post operatively, the time of recovery of motor blockade and sensory blockade are noted by following up the patient. Once complete recovery is documented, the study is completed on that patient.

STATISTICAL ANALYSIS

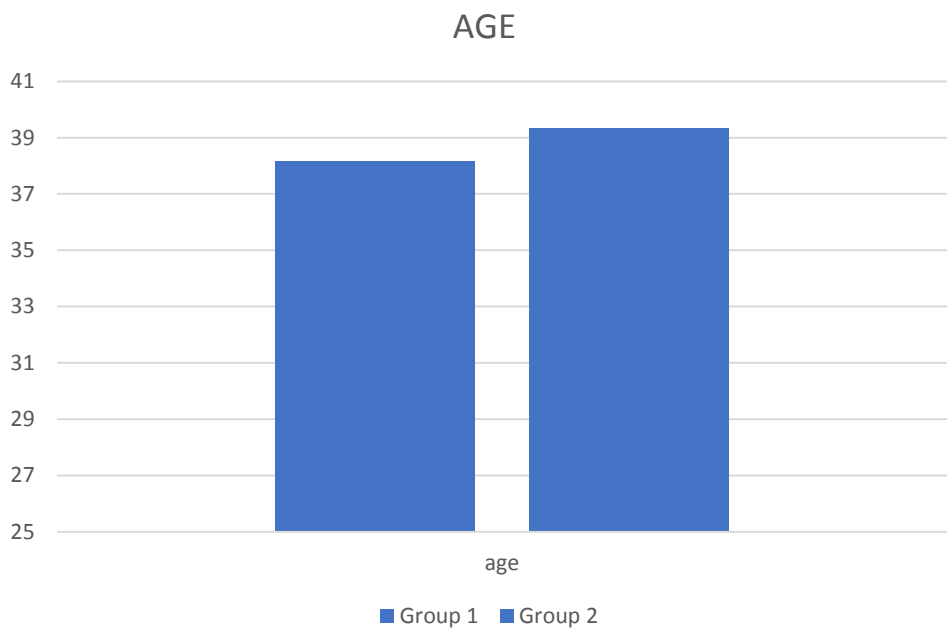
The sample size was arrived at a value of minimum of 26 patients. So after accounting for exclusion from study, other causes of drop outs, a minimum of 30 patients were needed for the study to be with a power of 80% and an alpha error of 0.05. in this study we enrolled 35 patients in each group and there was no drop outs.

- Analysis of vitals was done using student T test.
- Analysis of the quality of sensory and motor block, and the incidence of tourniquet pain to be done using a Chi square test
- Analysis of the time to perform the block to be done by Student's T-test.
- Analysis of the incidence of vascular puncture to be done using Fisher's exact test.
- Analysis of the distance from the skin to the artery and from the artery to the rib, lung or pleura to be done using student's T test

The data collection is done with MS Excel and data was analysed with SPSS v26.0 software, trial version. A P-value of 0.05 is considered to be significant.

RESULTS

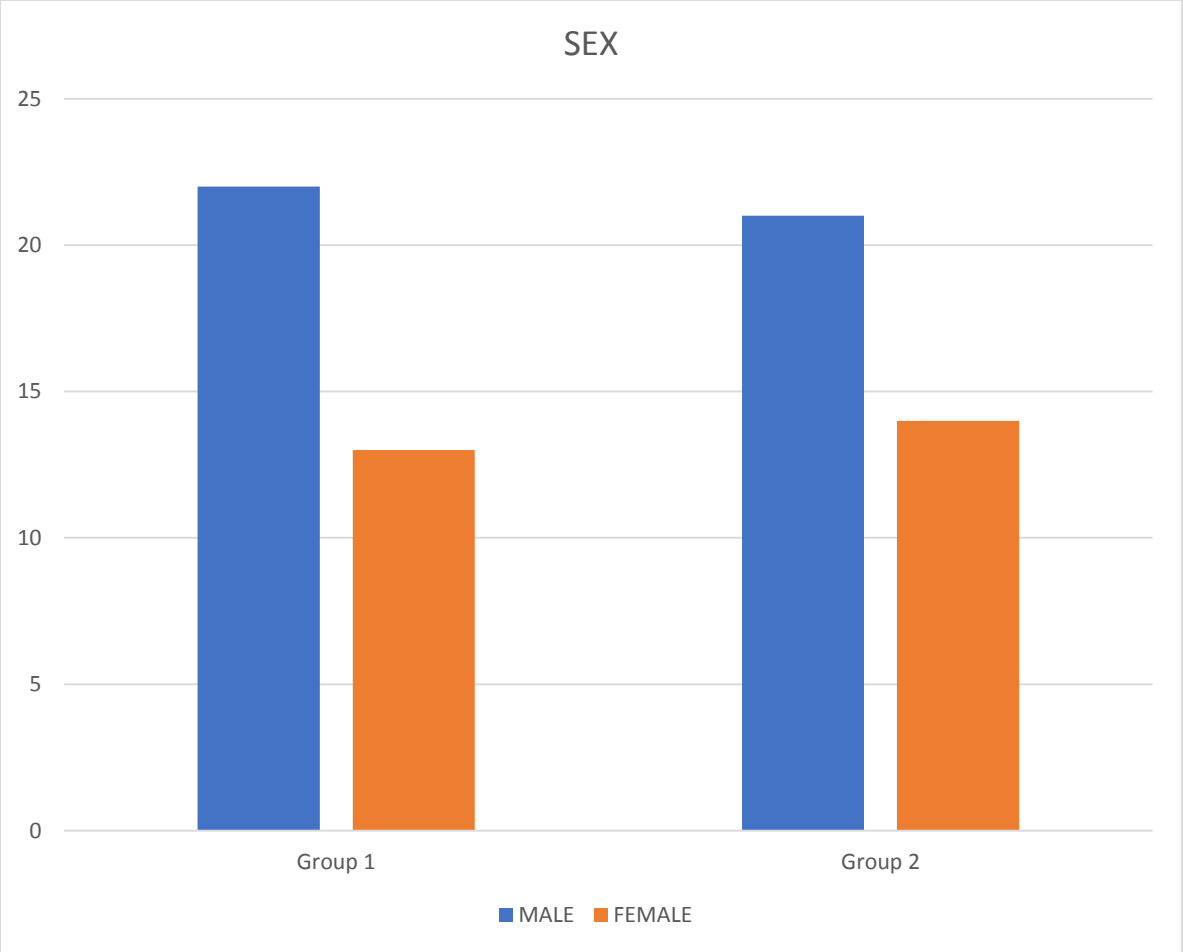
Age distribution:



The mean age in Group-1 was rounded off to 38 years and in Group-2 was 39 years. P-value is 0.33, which is not significant. Age group among the groups are comparable.

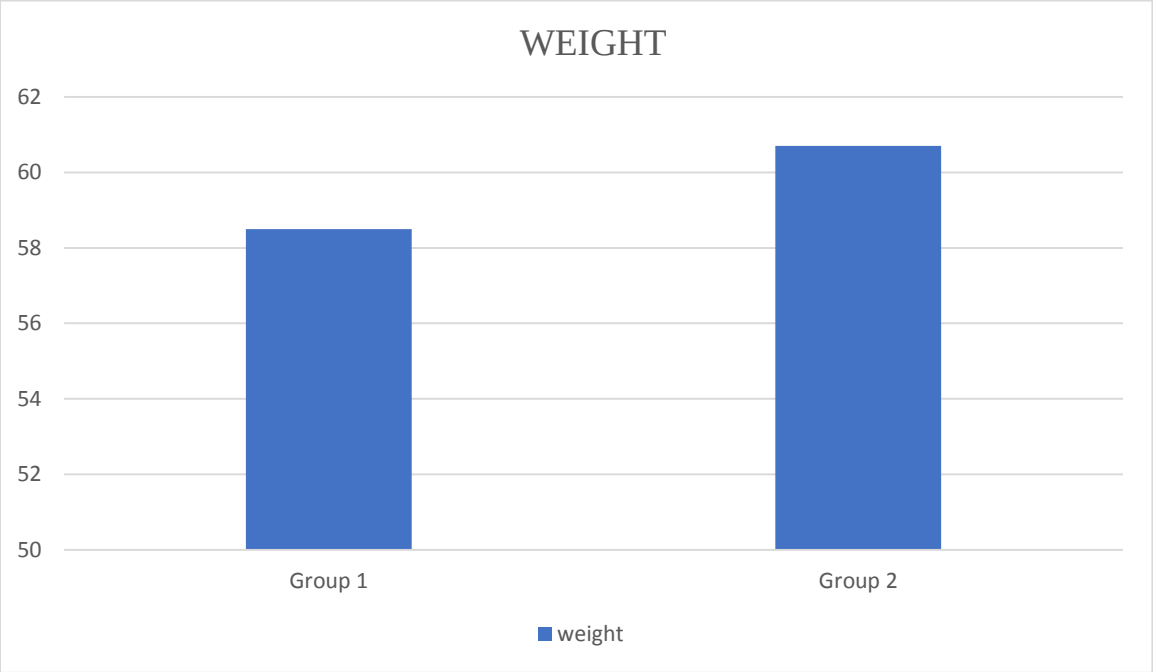
Sex distribution:

	MALE	FEMALE
GROUP 1	22	13
GROUP 2	21	14



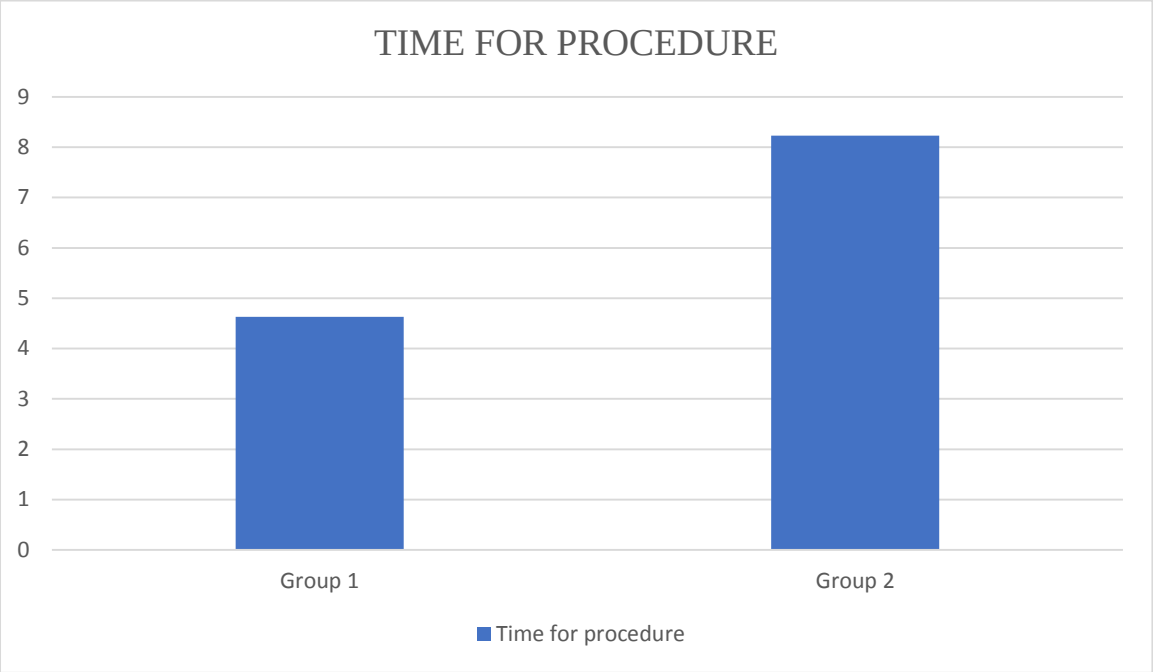
Sex distribution is also comparable.

Weight distribution



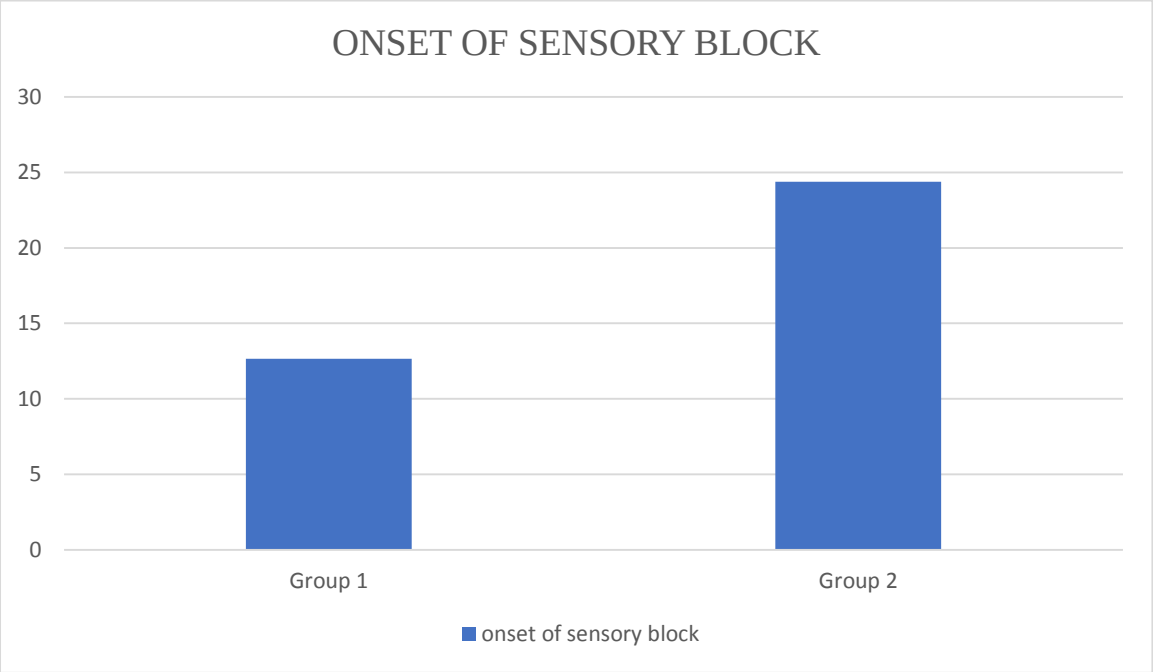
Average weight of group-1 patients was 58.5±6.523133 kgs and of group-2 is 60.7±5.562177. P-value is 0.67. Not significant. So, the weight of the patients is comparable.

Time taken to perform the block:



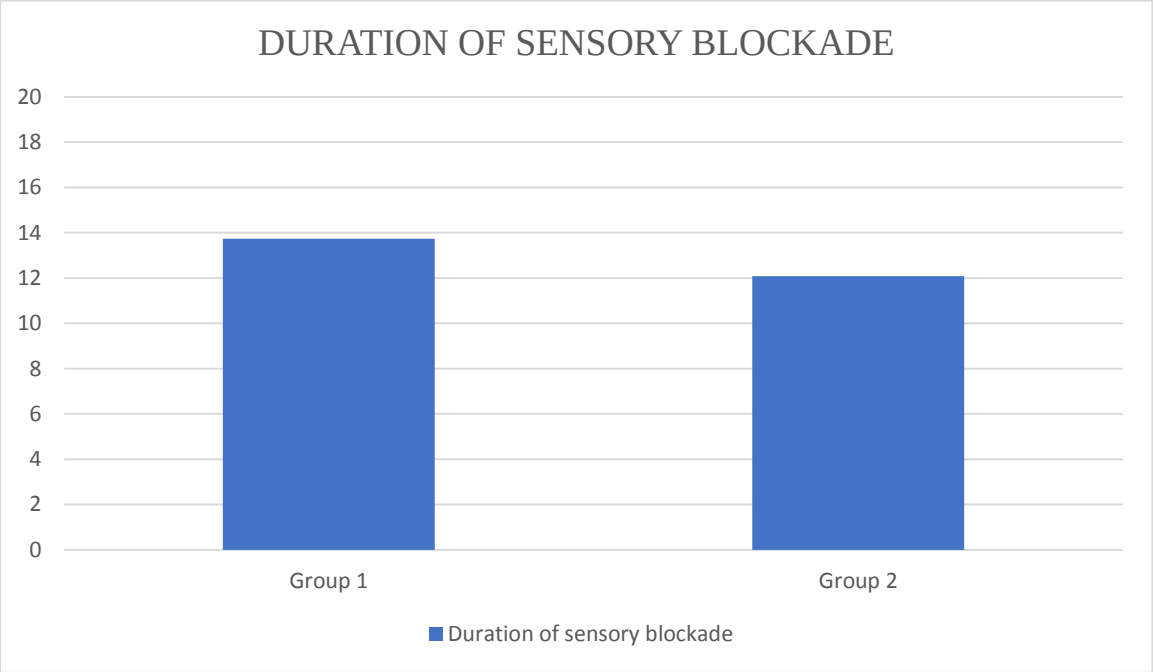
The mean time taken for the procedure was 4.63 minutes with a standard deviation of 2.143 in group 1, while its almost double the time in group 2 with 8.23 ±2.14 minutes. P-value is <0.001. it denotes that the value is extremely significant.

Onset of sensory blockade



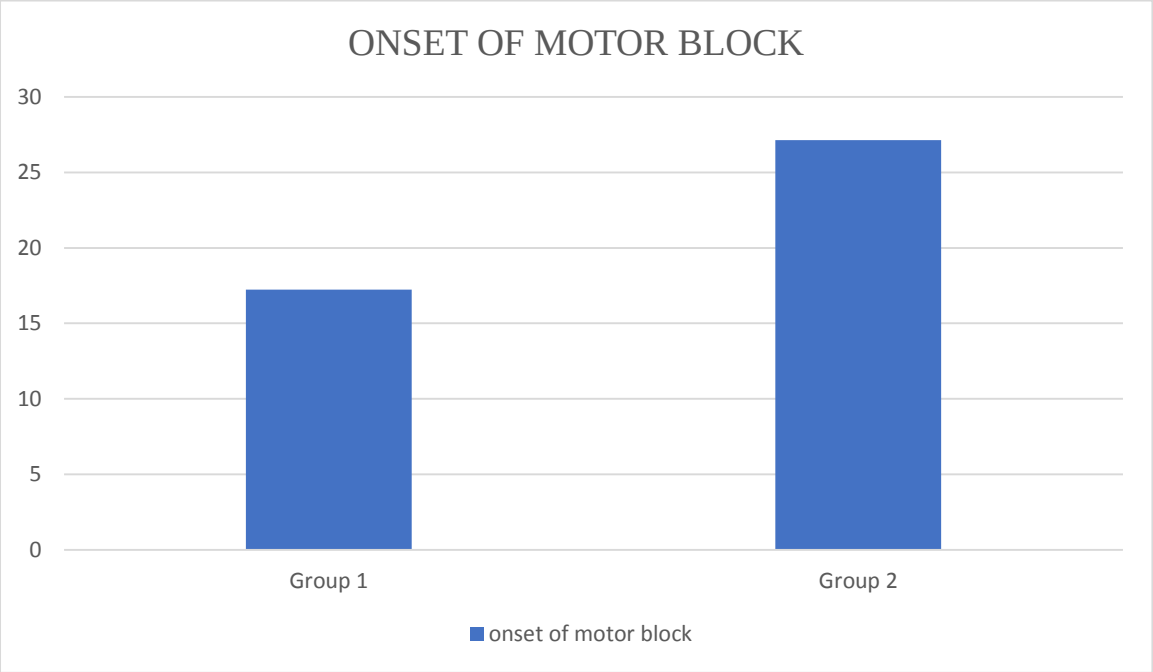
The mean time taken for onset of sensory blockade is 12.66±4.15 minutes in Group1 and 24.37±2.89 minutes in Group 2. Its very significant with a P-value of <0.001.

Duration of sensory blockade



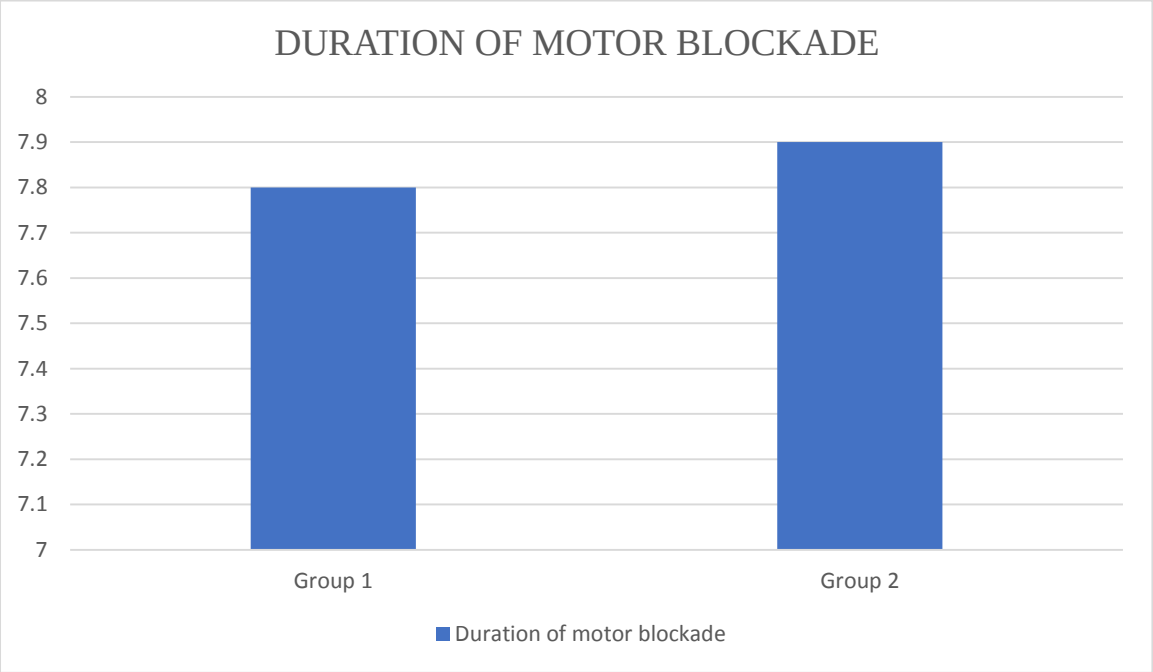
The duration of sensory blockade for complete recovery was 13.72±1.16 hours in Group 1 and 12.08±0.87 hours in Group 2. The P-value is <0.001 and its very significant.

Onset of motor blockade



The mean time of onset of motor blockade was 17.23±4.53 minutes in Group 1 and 27.14±2.86 minutes in Group 2. That's an extremely significant data with a P-value of <0.001

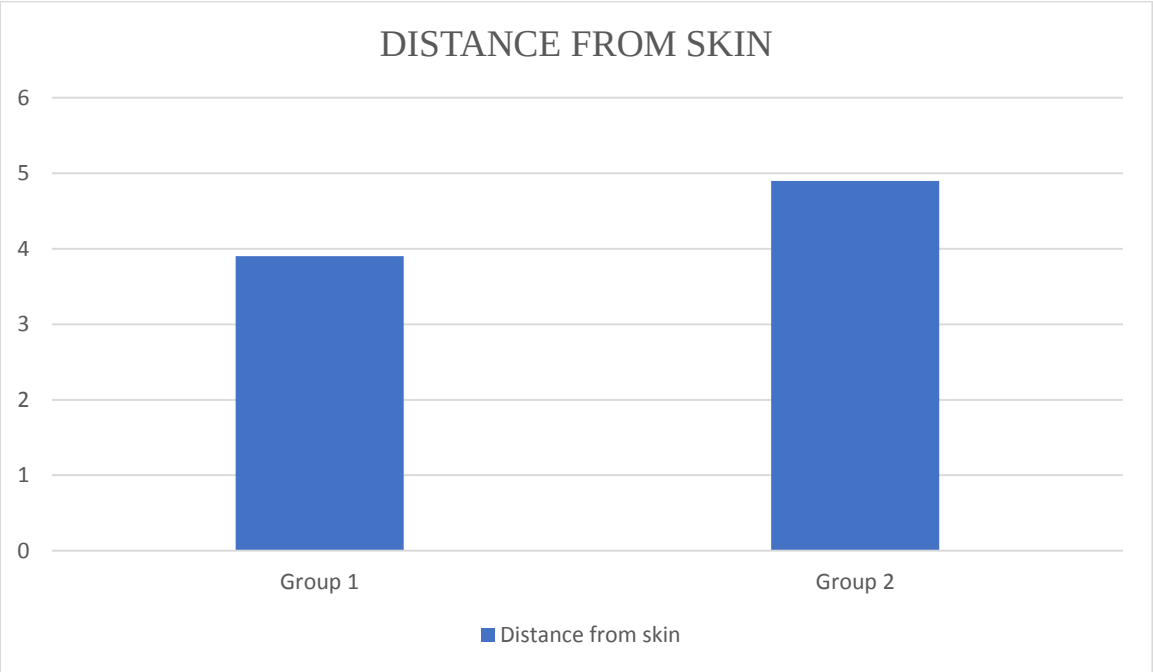
Duration of motor blockade



Here, the duration of motor blockade, for complete recovery of motor blockade is comparable. The mean duration is 7.8±0.8 hours in Group 1 and 7.9±0.5 hours in Group 2. P-value is 0.203. This is not a significant value.

Distance of plexus from skin

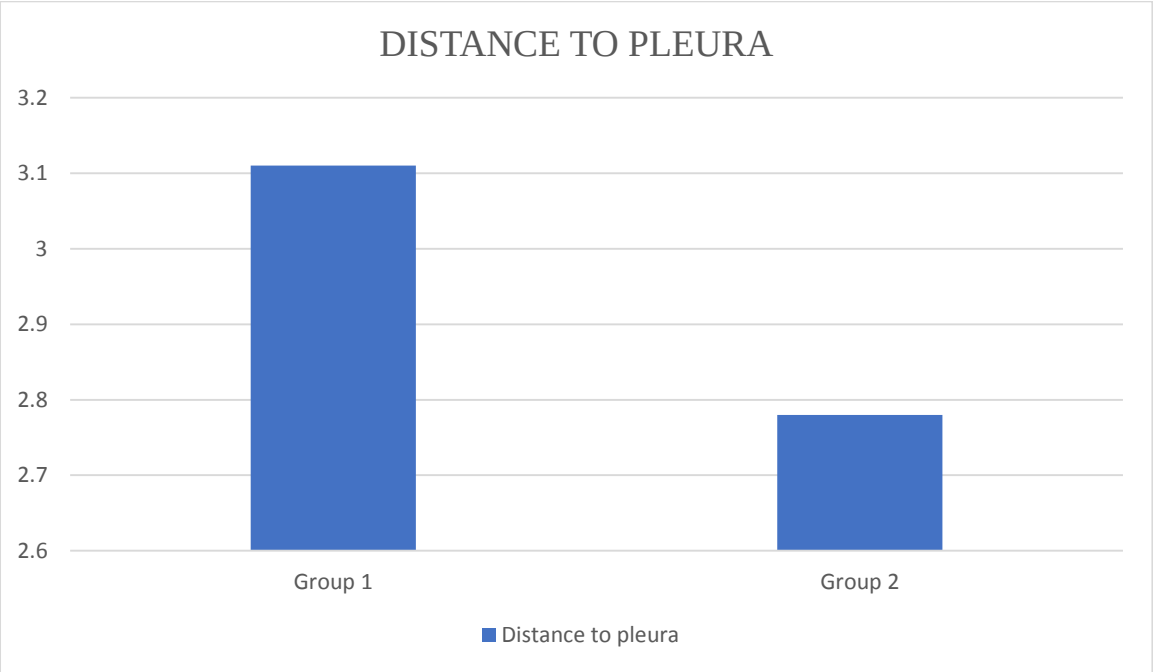
The vertical distance from skin to the outermost part of plexus is measure in ultrasound.



The mean distance of plexus/artery from the skin is found to be 3.9±0.55 cms in Group 1 and 4.99±0.60 cms in Group 2. These values are extremely significant having a P-value of <0.001.

Distance to pleura

The vertical distance from the lower most part of the plexus to the pleura is measured.



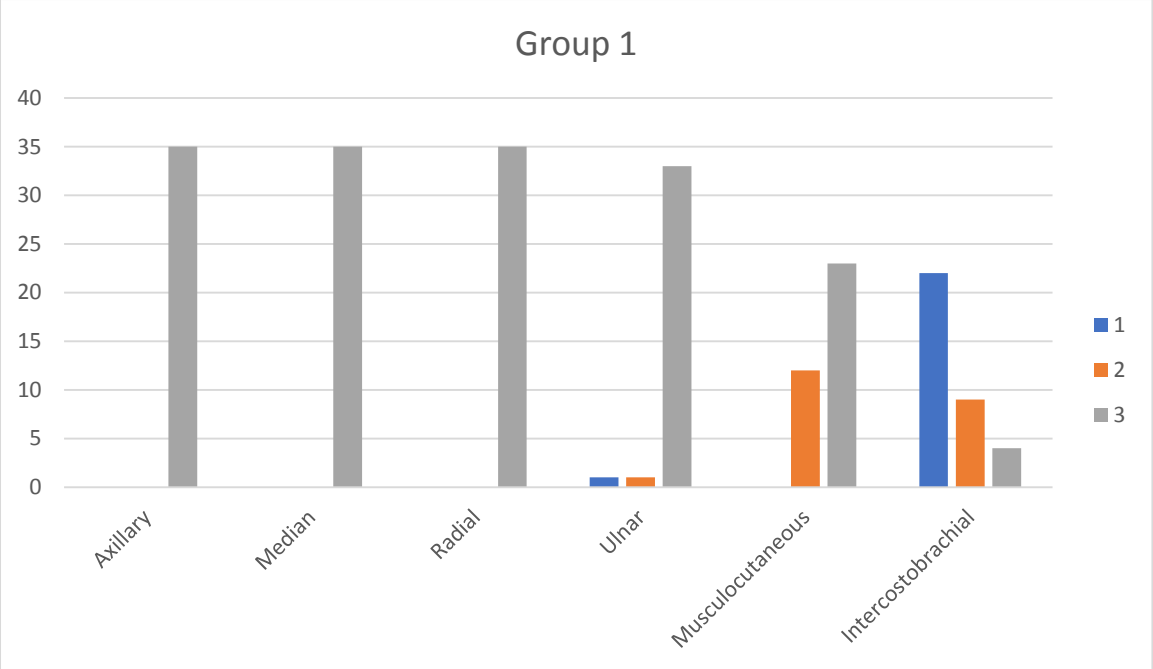
The mean distance of pleura from the plexus is 3.11±0.62 cms. in Group 1 and 2.78±0.64 cms in Group 2. This is statistically significant with P-value of 0.01.

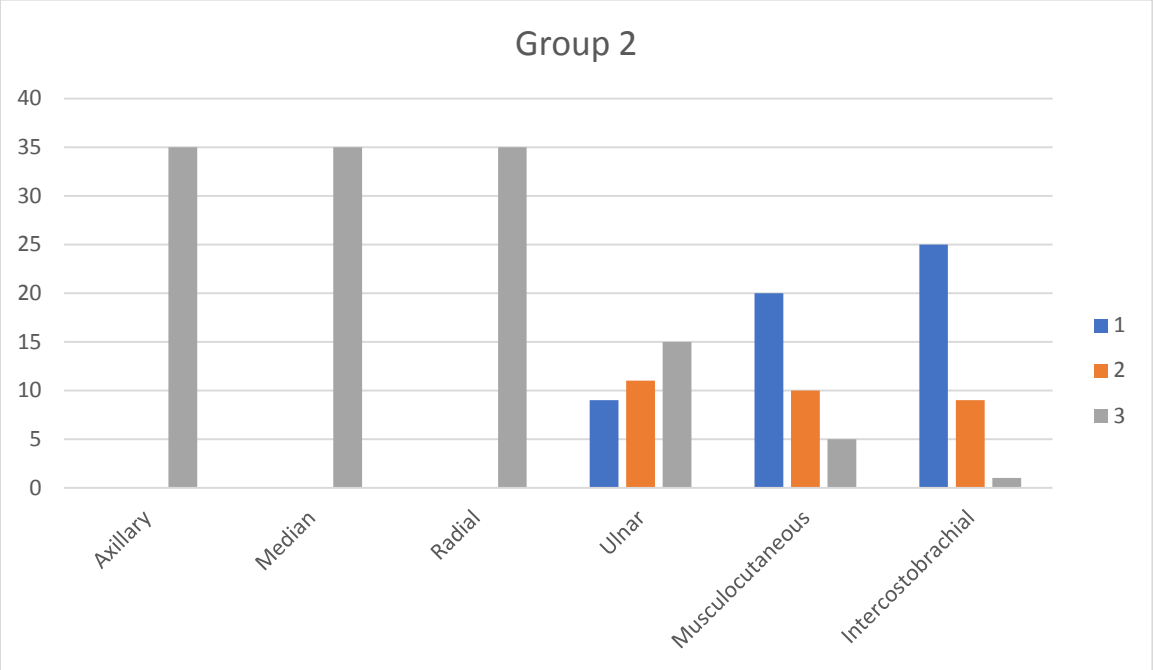
Quality of sensory block

The axillary, median, radial, ulnar, musculo-cutaneous and intercostobrachial dermatomal areas are checked for sensory loss. The procedure of checking for loss of sensation and grading was already discussed in the methodology. The following results were observed in terms of number of patients in the grading of sensory loss.

Group 1	axillary	median	radial	ulnar	Musculo-cutaneous	Intercosto-brachial
1	0	0	0	1	0	22
2	0	0	0	1	12	9
3	35	35	35	33	23	4

Group 2	axillary	median	radial	ulnar	Musculo-cutaneous	Intercosto-brachial
1	0	0	0	9	20	25
2	0	0	0	11	10	9
3	35	35	35	15	5	1





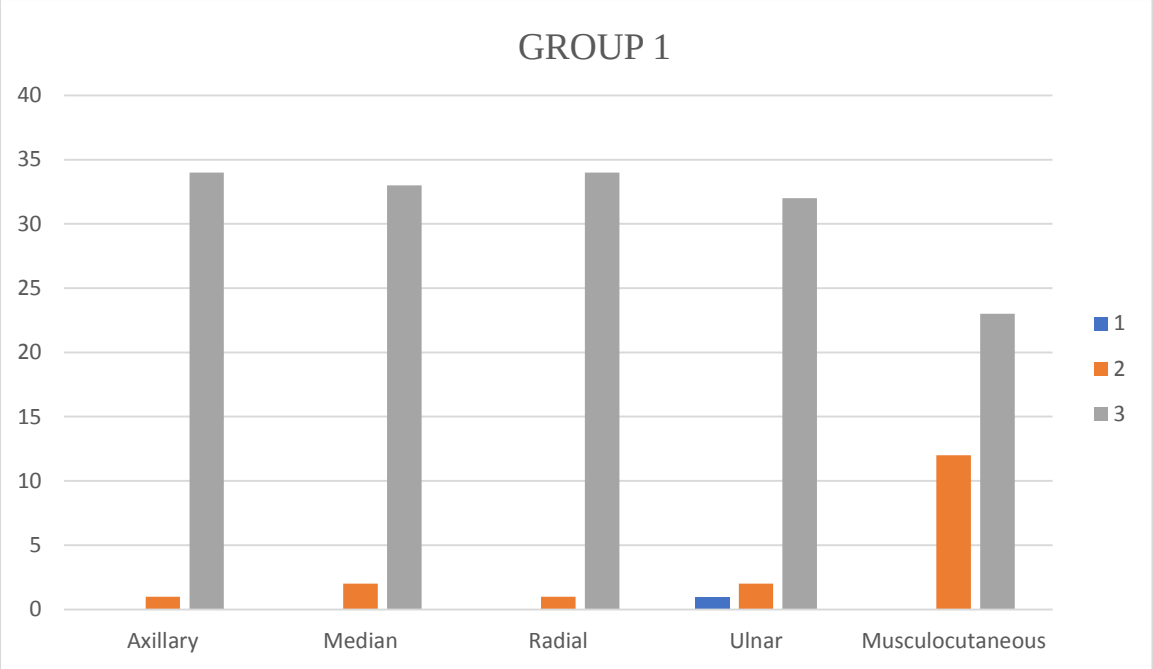
There was no difference in involvement of Axillary, Median and Radial nerve. But there was statistically significant difference in ulnar nerve sparing. It is more often present in Group 2 than Group 1. The musculo-cutaneous nerve is also spared in Group 2 when compared to Group 1. Involvement of inter-costobrachial nerve is not compromising in both of the groups.

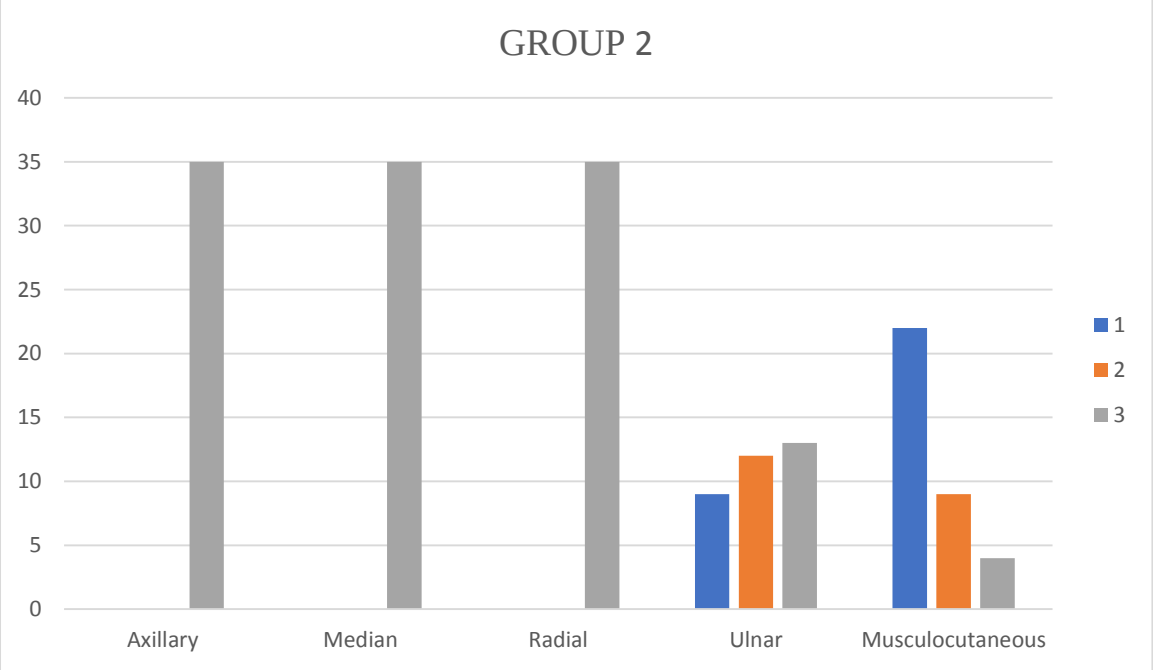
Quality of motor block

The motor involvement of Axillary, Median, Radial, ulnar and Musculo-cutaneous nerve are checked, as explained previously, in methodology. Following observations are obtained in terms of number of patients falling under the grading of motor blockade.

Group 1	axillary	median	radial	ulnar	musculocutaneous
1	0	0	0	1	0
2	1	2	1	2	12
3	34	33	34	32	23

Group 2	axillary	median	radial	ulnar	musculocutaneous
1	0	0	0	9	22
2	0	0	0	12	9
3	35	35	35	13	4

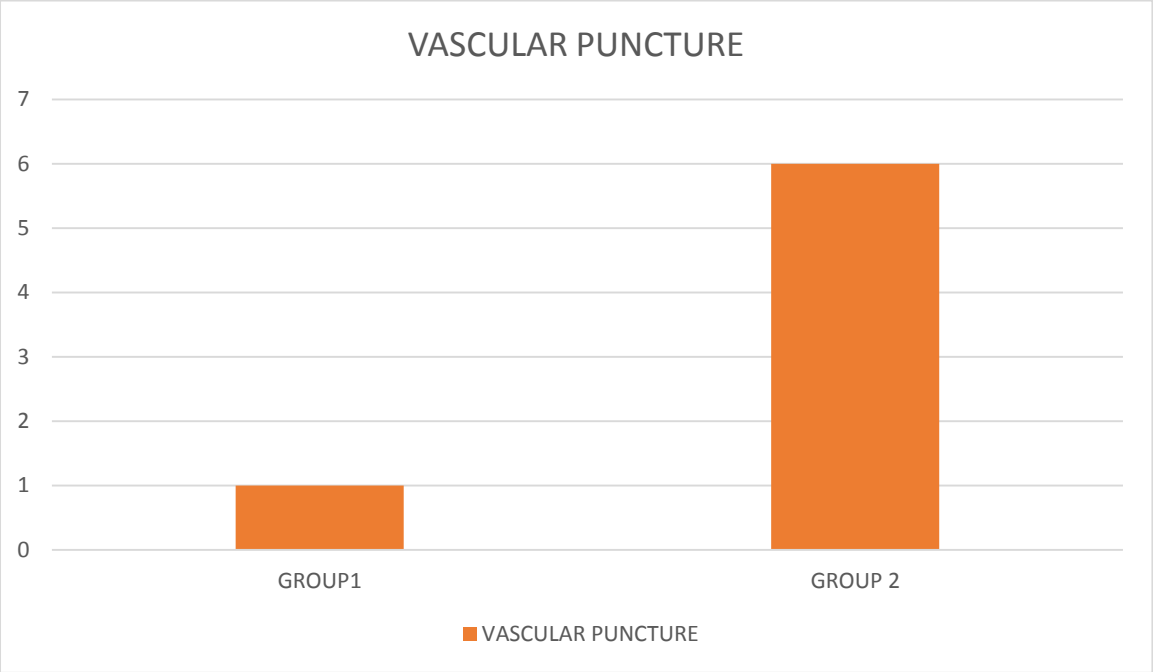




There was no sparing of Axillary, Median and Radial nerve while ulnar is spared significantly in Group 2 than Group 1. Also musculocutaneous nerve was spared more in Group 2 than Group 1.

Vascular puncture

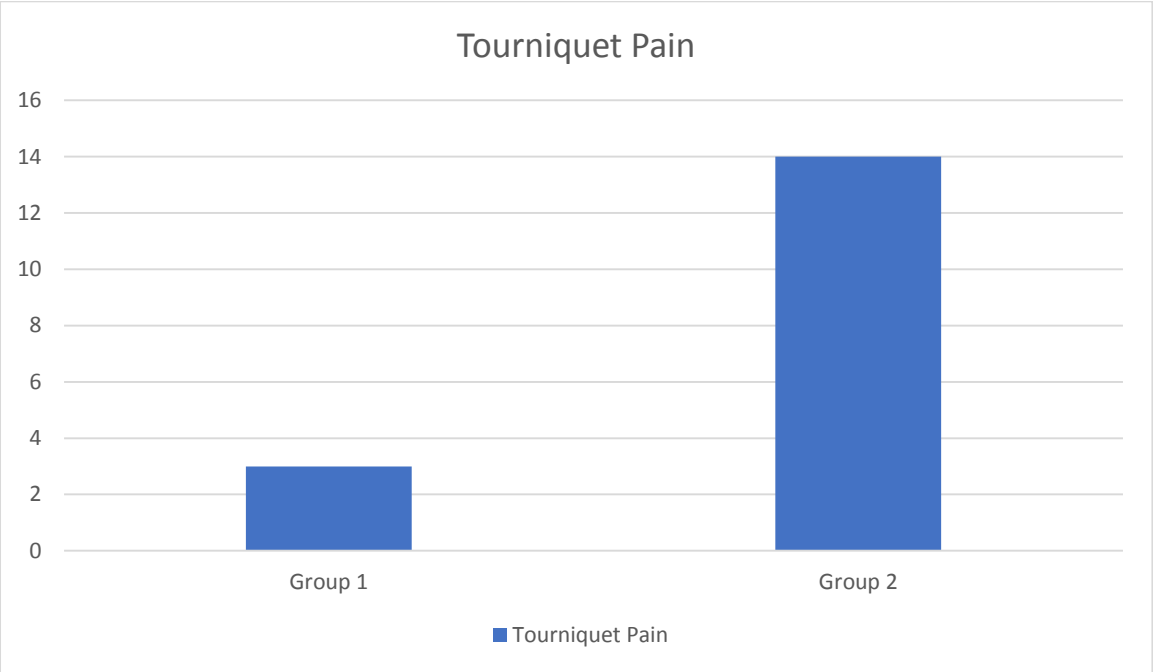
Incidence of injuring the axillary or subclavian artery is compared.



In the first group, only one patient suffered an axillary artery injury. In Group 2, six patients had injury to axillary artery. P-value of 0.006. This is statistically significant. All the vascular punctures occurred during initial periods of study.

Tourniquet Pain

After 30 minutes of performing the block, tourniquet was applied to the patients and they were observed for any pain.



After applying tourniquet, a total of 3 patients had minimal pain in Group 1 and 14 patients had pain in Group 2. This is statistically significant with P-value of <0.001. This may be due to increased incidence of sparing of musculocutaneous nerve in Group 2 combined with intercosto-brachial nerve, which is spared in almost both groups.

SUMMARY

Though five patients in Group 1 found the positioning of the limb bit uncomfortable, they co-operated for the procedure politely.

In Group 1, the mean age was 38 ± 8 years (values rounded off to nearby whole number) and in Group 2, it is 39 ± 8 years. These values are not statistically significant, denoting that the age in between groups is comparable. The sex distribution is also similar among the groups. In respect to weight of the patients, mean weight is 58.5kgs in Group 1 with a standard deviation of 6.62 and in Group 2 is 60.7 ± 5.56 kgs. This is also not significant statistically.

When the infraclavicular block is approached proximally, in the apex of delto pectoral groove, as in Group 1 here, the time taken to perform the block is very much reduced with a mean time of 4.63 minutes with a standard deviation of 2.14 minutes. This is extremely significant when compared to Group 2, that is when approached in sub-coracoid area, which is 8.23 ± 2.14 minutes.

Onset of Sensory blockade was 12.66 ± 4.15 minutes in Group 1, compared to 24.37 ± 2.89 minutes in Group 2. The onset of sensory blockade was calculated with grading of 1 which defines the baseline sensory level, 2 as partial blockade and 3 as complete analgesia with no sensation. This was checked for Axillary, Median, Radial, Ulnar, musculo-cutaneous and the intercosto-brachial nerves in their respective dermatomes. Time taken for onset is calculated for all the nerves

to block to their maximum level. The duration of the sensory blockade is calculated by following up the patient in post-operative ward till the sensory levels comes to baseline level, 1 in the grading. This was found to be 13.72 ± 4.15 hours in Group 1 compared to 12.08 ± 0.87 hours in Group 2.

Regarding the quality of the sensory blockade, the number of patients are observed for each nerve in each grade of sensory blockade as discussed above. Sensory involvement of the individual nerves were found to have no difference in Axillary, Median and Radial nerves. But the ulnar sparing was more common in Group 2 (9/11/15 patients in grades 1/2/3 respectively) compared to Group 1 (1/1/33 for 1/2/3 respectively). Also, a significant difference was observed in involvement of musculocutaneous nerve in Group 1 (0/12/23 in grades 1/2/3 respectively) compared to Group 2 (20/10/5 in 1/2/3 respectively). This denotes the musculocutaneous sparing in Group 2 is common than Group 1. There was not a significant difference, when intercosto brachial nerve was considered. It was 22/9/4 for grades 1/2/3 respectively, compared to 25/9/1 patients for grades 1/2/3 respectively in Group 2.

When its motor involvement, the onset was 17.23 ± 4.53 minutes in Group 1 compared to 27.14 ± 2.86 minutes in Group 2. The onset is calculated by observing the motor blockage as per the grading 1 for baseline muscle power, 2 for partial blockade and 3 for complete paralysis of the muscles of the corresponding nerves like Axillary, Median, Radial, Ulnar and Musculo-

cutaneous nerves. The patients were followed up for recovery of muscle power to the baseline level. Time taken for complete recovery was taken as duration of motor blockade. It was 7.8 ± 0.8 hours compared to 7.9 ± 0.5 hours in Group 1 and Group 2, respectively. The P-Value is 0.203, which is not significant statistically. That means the motor blockage duration is comparable in both the groups.

The motor blockade quality was measured with the grading discussed for every muscle. (Axillary, Median, Radial, Ulnar and Musculo-cutaneous). It was found to be similar for Axillary, Median and Radial nerve involvement. But Ulnar nerve is spared in many occasions in Group 2 when compared to Group 1.

The vertical distance, that is the antero-posterior distance of the plexus from skin was found to be 3.9 ± 0.55 centimeters in Group 1, compared to 4.99 ± 0.60 cms in Group 2. These values are statistically significant, explaining that the plexus is closer to skin in Group 1 than Group 2.

The incidence of pleural puncture is a dependent of the distance of pleura from the plexus. So, the antero-posterior distance from plexus to the pleura was measured and found to be 3.11 ± 0.62 cms in Group 1 compared to 2.78 ± 0.64 cms in Group 2. This is also a significant difference denoting that plexus is farther from pleura, such that pleural injury is less likely in Group 1.

A total of 3 patients developed tourniquet pain during application in Group 1 and 14 patients had such pain in Group 2. They were given 5ml subcutaneous

infiltration of 1% Lignocaine at the distal end of axillary hairline, just above the tourniquet. Procedure continued after pain relief.

No untoward events were reported. Except for vascular puncture in 6 cases of Group 2 compared to one patient in Group 1. And it is statistically significant also. All those happened during initial phases of study. All those cases were followed up and found to have no major complications in post-operative period.

All patients were followed up till the sensory blockage is completely reversed. After that, when the patients demanded analgesia, the study was closed in those patients and first dose of analgesia is given in the form of opioids and NSAIDS as per the procedure and pain.

DISCUSSION

This study was done to analyse and find a comfortable and easier way of blocking brachial plexus where other approaches like interscalene, supraclavicular are unable or tedious to perform. This study also addresses the easier way of doing an infraclavicular block with minimal adverse effects.

The Brachial plexus at the infraclavicular level was found to more superficial in the proximal end of delto-pectoral groove, close to inferior border of clavicle, near the first part of axillary artery. This may be attributed to the positioning of the arm, which was tried in this study, with arm abducted to 110° at the shoulder with an external rotation and elbow flexion to 90°. This facilitates the ultrasound beam to traverse very less tissue and thus the identification of plexus is easier than the classical sub-coracoid approach. Once the plexus are visualised more clearly, the block can be performed faster.

Since the plexus moves towards the skin without dragging the chest wall, the distance between pleura and the plexus is increased. So, the risk of pneumothorax is almost nil with the medial approach.

The medial cord, which usually lies in between the axillary artery and the axillary vein, is found mostly lateral or postero-lateral to the artery in the plexus. So, the cord is within the reach of the needle. Need for going close and posterior to the artery is made unnecessary by moving proximal in the delto-pectoral groove.

Also, the involvement of medial cord is more possible in this approach than the classical approach. This was evident by ulnar sparing in only one patient comparing to nine patients in classical approach.

As the cords were arranged to one side of artery, the need for approaching the cord between vessels is avoided. Thus, the incidence of vascular puncture is very much avoided.

The medial side of arm supplied by musculocutaneous nerve is spared less in medial approach than classical approach. So, the incidence of tourniquet pain is less in medial approach. But the intercosto-brachial involvement is almost similar in both groups. So, if the tourniquet was fastened or inflated close to axillary hair line, patient complained of pain. After 30 mins of performing the block, if there was pain on inflation of tourniquet in intercosto-brachial area, 1% lignocaine 4-5ml was given subcutaneously, just below hairline and above the tourniquet.

Though the sensory duration was more in medial approach, which was significant too, the difference was in minutes which may be an additional finding. The duration of motor blockade is similar in both approaches.

CONCLUSION

If the patient is able to keep the limb in the discussed position and surgery being distal to mid humerus, the approach to infraclavicular plexus, at the level of apex of delto-pectoral groove, 3-4cm proximal to the classical sub-coracoid level is beneficial by being an easier way of identification of plexus, faster approach to block the plexus with minimal untoward events.

Conflicts of interest: Nil

Financial support: Nil

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PROFORMA

NAME : I.P.NO: ASA:

AGE & SEX:

WEIGHT : BMI:

DATE & TIME OF ADMISSION: DATE& TIME OF DISCHARGE:

DIAGNOSIS:

PROCEDURE:

HISTORY:

CLINICAL EXAMINATION: PR, BP, SPO2, RS, CVS, P/A and CNS

BASIC INVESTIGATIONS:

a) Complete Blood Count

b) Blood grouping & typing,

c) BT,CT

d) Urine routine

e) Blood urea, RBS, Serum Creatinine, Serum electrolytes

f) CXR-PA view

g) ECG,ECHO

- All of which will be done in pre-operative assessment, as per the need.

ANAESTHETIC TECHNIQUE:

Ultrasound guided infraclavicular brachial plexus block with two different positioning of arm

PROCEDURE:

Patients received ultrasound guided infraclavicular brachial plexus block using 15 mL of 0.5% bupivacaine and 10ml of 2% Lignocaine

Group 1: with patient in supine, head turned to opposite side with arm abducted to 110deg, externally rotated and elbow flexed to 90deg. Block at apex of delto pectoral groove, proximally

Group 2: with patient in supine, head turned to other side and arm adducted close to trunk. Block in classical sub-coracoid approach.

Procedures are explained in detail in methodology.

- Evaluation of PR, BP, SpO2 till end of the procedure
- Continuous ecg monitoring was carried out throughout the procedure
- Monitoring of vitals every 15min: (anxiolytics, sedatives, antiemetics and others to be mentioned)

VITALS	Preop	5min	15min	30min	45min	1hr	1hr15 min	1hr 30min	2 hr
Pulse									
BP									
SpO2									
Side effects									

- Immediate postoperative pain intensity
- Anaesthesia recovery time:

Sensory:

Motor:

- Postop period: Monitoring of vitals was done

SIDE EFFECTS (if any): drowsiness, pruritus, nausea/vomiting, Horner's syndrome, phrenic nerve palsy, pneumothorax, respiratory depression, bradycardia, hypotension, and hypoxemia are also to be noted.

Parameters	Group 1	Group 2
Time taken for block		
Onset time of motor block		
Duration of motor block		
Onset of sensory block		
Duration of sensory block		

vascular puncture		
Distance artery		
distance from the artery to the posterior surface of the rib or the surface of the lung or pleura		
Tourniquet pain		

OTHER QUESTIONAIRRES USED IN THE STUDY

1) H/O Any Known allergy to Local Anaesthetics/ any drugs
2) H/O Previous Neurological deficit
3) H/O Any Bleeding diathesis
4) Any infection/Local sepsis at block site
5) H/O Any Anti-Psychiatric drugs
6) H/O Any systemic illness-Hypertension Diabetes Mellitus, Bronchial Asthma, Seizure disorder, Pulmonary Tuberculosis.
7) H/O of smoking ,COPD, Exertional dyspnoea,

   decreased urine output (Complaints related to CVS, RS,

   and RENAL system)

ஆராய்ச்சி தகவல்கள் படிவம்

தலைப்பு:

கை தசைகள் மற்றும் தசைநார்கள், தோல் ஒட்டு முதலிய அறுவை சிகிச்சைக்காக கழுத்து பட்டை எலும்பின் கீழ்பகுதியில், ஸ்கேன் உதவியுடன் ஊசி மூலம் மயக்க மருந்து செலுத்தும் இரண்டு முறைகளின் ஒப்பீடு

ஆய்வின் நோக்கம்:

கைகளில் செய்யப்படும் அறுவை சிகிச்சைகளுக்கு, கழுத்து பட்டை எலும்பின் கீழ், இரு வேறு இடங்களில், ஸ்கேன் உதவியுடன் ஊசி மூலம் மயக்க மருந்து செலுத்தி, ஒப்பீடு செய்யப்படும். இரு வேறு இடங்களில் செலுத்துவதால் ஏற்படும் பயன்கள் மற்றும் எந்த இடத்தில் செத்தப்படும் மயக்க மருந்து பக்க விளைவுகள் இன்றி பாதுகாப்பானது என்பதை ஒப்பிட்டு பார்க்கும் ஒரு ஆராய்ச்சி ஆகும்.

செயல்முறை:

கைகளில் உள்ள தசைகள், எலும்புகள் மற்றும் தோல் ஆகியவற்றின் பல்வகையான உணர்வுகள் மற்றும் செயல்பாடுகளை கட்டுப்படுத்தும் நரம்புகள், கழுத்திலிருந்து கழுத்து பட்டை எலும்பின் பின்புறமாக இறங்கி கைகளுக்குள் செல்கின்றன. அவற்றை, கழுத்து பட்டை எலும்பின் கீழ், ஸ்கேன் உதவியுடன் மயக்க மருந்து செலுத்தி, வலியின்றி அறுவை சிகிச்சை மேற்கொள்ளப்படும். அந்த நரம்புகளை இரு வேறு இடத்தில், கையினை இரு வேறு வகையில் நிலைப்படுத்தி ஊசியின் மூலம் மயக்க மருந்து செலுத்தி அவற்றின் செயல்முறை எளிமை, பயன்கள், பாதுகாப்பான முறை எது போன்றவற்றை அறியும் பொருட்டு இந்த ஆராய்ச்சி செய்யயப்படுகிறது.

பலன்கள்:

1. கையின் நிலைபாடு மாற்றும் போது நரம்புகள் தோலின் அருகில் வரும் என்று எதிர் பார்க்கப்படுகிறது.
2. நுரையீரல் மற்றும் அதன் மேல் இருக்கும் சவ்வு, நரம்புகளை விட்டு விலகி செல்லும் வாய்ப்புகள் அதிகரிக்ககூடும்.
3. ஸ்கேன் துணையுடன் ஊசி செலுத்தப்படுவதால், ரத்த நாளங்கள் காயப்படுத்துவது குறையும்.
4. நரம்புகள் ஒரு புறமாக சேர்ந்து காணப்படுவதால், மயக்க மருந்து செலுத்தும் முறை எளிமையாக இருக்கும் எனவும் எதிர்பார்க்கப்படுகிறது.

பக்க விளைவுகள்:

ஒவ்வாமை, மயக்க மருந்து சீராக பரவாமை, வாந்தி, நாடிதுடிப்பு சீரற்ற தன்மை, போன்ற பக்க விளைவுகள் வெகு சிலருக்கு ஏற்பட வாய்ப்புள்ளது. அவை ஏற்படாமல் இருக்க தக்க தடுப்பு முறைகள் பின்பற்றப்படும். ஏற்பட்டால், மாற்று மருந்துகள் உடனடியாக செலுத்தி சரி செய்யப்படும்.

ஆராய்ச்சி ஒப்புதல் கடிதம்

தலைப்பு :

கை தசைநார் அறுவைசிகிச்சை மற்றும் தோல் ஒட்டு அறுவை சிகிச்சைக்காக கழுத்து எலும்பின் கீழ்பகுதியில் ஊசி மூலம் மயக்க மருந்து செலுத்தப்படும் இரண்டு செயல்முறைகளின் ஒப்பீடு.

பெயர் :

பாலினம் :

வயது :

தேதி :

உள் நோயாளியின் எண் :

ஆராய்ச்சி சேர்க்கை எண் :

எனக்கு கை எலும்பு முறிவு அறுவை சிகிச்சை செய்ய மயக்குநர் கழுத்தில் ஊசி போடுதல் மூலம் கழுத்து நரம்பு தாண்டப்பட்டு கையில் சுண்டி இழுக்கும் உணர்வின் போது மருந்தை செலுத்தி வலியில்லாமல் செய்து அறுவை சிகிச்சை மேற்கொள்ள எனக்கு முழு சம்மதம் அளிக்கிறேன். இதன் மூலம் எனக்கு செலுத்தப்பட்ட மயக்க மருந்தினால் எனது கை மரத்துப்போகும் என்றும், அசைவுகள் இருக்காது என்றும், என்ற சுய நினைவு இழக்காமலும், அறுவை சிகிச்சை செய்யும்போது வலி இருக்காது என அறிந்து கொண்டேன்.

இந்த ஆராய்ச்சி விவரங்களும் அதன் நோக்கங்களும் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது. எனக்கு விளக்கப்பட்ட விசயங்களை நான் புரிந்துகொண்டு எனது சம்மதத்தை தெரிவிக்கிறேன்.

இந்த ஆராய்ச்சில் பிறரின் நிர்பந்தம் இன்றி எனது சொந்த விருப்பத்தின் பேரில்தான் பங்கு பெறுகிறேன். மற்றும் நான் இந்த ஆராய்ச்சியின் விபரங்களை கொண்ட தகவல் தாளை பெற்றுக் கொண்டேன். நான் என்னுடைய சுய நினைவுடன் மற்றும் முழு சுதந்திரத்துடன் இந்த மருத்துவ ஆராய்ச்சியில் என்னை சேர்த்துக் கொள்ள சம்மதிக்கிறேன்.

இந்த ஆராய்ச்சியில் பங்கேற்பது என்னுடைய விருப்பத்தின் பேரில்தான் இருக்கிறது. மேலும் எந்நேரமும் இந்த ஆராய்ச்சியில் பின்வாங்கலாம் என்பதையும் தெரிந்துகொண்டேன்.

இந்த சிறப்புப் பரிசோதனைகளின் முடிவுகளை ஆராய்ச்சியின் போது அல்லது ஆராய்ச்சியின் முடிவின்போது எனக்கு அறிவிப்பார்கள் என்பதையும் அறிந்துகொண்டேன்.

எனக்கு விளக்கப்பட்ட விசயங்களை முழுமையாக புரிந்துகொண்டு இந்த ஆராய்ச்சியில் பங்கு கொள்ள எனது முழு மனதுடன் ஒப்புக்கொள்கிறேன்.

ஆராய்ச்சியாளர் கையொப்பம் பங்கேற்பாளர் கையொப்பம்

தேதி :

NAME	AGE	SEX	WEIGHT	BP								
				PRE-OP	5MINS	10MINS	15MINS	30MINS	45MINS	60MINS	90MINS	120MINS
RAVICHANDRAN	36	M	59	120/80	108/60	118/72	120/84	118/68	118/68	120/80	116/82	120/80
ASOKAN	48	M	64	110/70	120/80	110/70	114/74	120/74	116/80	120/80	110/70	110/70
ANANDHAN	45	M	68	106/66	126/84	108/72	108/76	106/68	108/72	118/72	116/80	106/70
TAMIL	44	F	59	120/82	118/82	118/74	120/74	116/72	118/76	120/78	118/74	116/78
TAMILARASAN	39	M	70	118/78	120/80	120/80	124/80	120/78	118/76	116/72	120/82	120/68
PRIYA	49	F	55	120/80	108/74	126/88	118/78	120/80	116/78	120/80	126/88	120/80
VADIVU	48	F	63	110/60	118/80	116/80	108/60	120/80	110/60	118/80	116/80	116/80
BHAVANI	37	F	54	108/60	120/80	120/84	120/80	110/70	108/60	120/80	120/84	120/84
MAGA	39	F	58	120/80	110/70	116/60	126/84	120/86	120/80	110/70	116/60	116/60
SEETHA	49	F	71	126/84	120/86	108/78	118/82	120/80	126/84	120/86	108/78	108/78
DEVI	38	F	55	118/82	120/80	124/72	120/80	120/80	118/82	120/80	124/72	124/72
RANI	46	F	59	120/80	120/80	120/80	108/74	100/60	120/80	120/80	120/80	120/80
RAJA	39	M	54	108/74	100/60	118/72	118/80	108/64	108/74	100/60	118/72	118/72
RAMU	29	M	48	118/80	108/64	110/76	108/74	100/60	118/72	108/64	122/82	110/76
VARADHAN	33	M	54	120/80	130/90	120/84	118/80	108/64	110/76	130/90	124/72	120/84
DURAI	49	M	63	116/76	144/92	118/72	120/80	130/90	120/84	144/92	120/80	118/72
PANDI	44	M	58	110/70	116/88	122/82	120/80	110/70	116/60	148/82	120/84	122/82
MARI	29	M	50	110/70	126/84	130/90	126/84	120/86	108/78	136/90	118/72	118/74
MUTHUMARI	27	F	54	120/86	118/74	108/60	120/80	120/84	120/80	110/70	108/60	120/80
SARASWATHY	36	F	62	120/80	116/60	120/80	110/70	116/60	126/84	120/86	120/80	110/70
SARASU	25	F	45	120/80	114/62	124/72	138/92	108/74	100/60	118/72	118/72	120/80
VIKRAM	29	M	66	100/60	126/88	120/80	110/70	118/80	108/60	120/80	122/82	120/80
PRAVEEN	24	M	59	108/64	142/88	118/72	128/74	108/74	120/80	110/70	130/90	126/84
RAGHUL	37	M	66	130/90	150/86	110/76	108/68	118/80	126/84	120/86	108/60	120/80
ARUN	44	M	70	144/92	148/82	120/84	128/78	120/80	118/82	120/80	120/80	110/70
GOWTHAM	33	M	53	120/80	136/90	118/72	148/92	120/80	120/80	120/80	124/72	138/92
VASU	41	M	54	108/72	128/78	120/84	128/78	126/84	108/74	100/60	120/80	110/70
ANNAMALAI	25	M	58	138/90	106/72	118/72	148/92	120/80	118/72	108/64	118/72	128/74
MANICKAM	44	M	62	146/70	138/86	122/82	106/64	110/70	110/76	130/90	110/76	108/68
SIVAGAMI	37	F	65	120/80	118/72	124/72	138/92	138/92	120/84	144/92	120/84	128/78
LAKSHMI	50	F	59	122/84	136/86	130/90	150/88	110/70	122/82	106/64	118/72	148/92
SANTHOSH KUMAR	46	M	49	108/70	104/60	134/88	120/80	150/86	124/72	138/92	120/84	128/78
VEERAIYA	39	M	52	110/60	120/84	128/74	118/88	148/82	120/80	110/70	118/72	148/92
RAGU	29	M	53	120/70	124/68	138/92	120/80	120/80	110/70	142/88	122/82	106/64
MUTHUSAMY	28	M	58	110/80	134/92	110/70	100/60	118/72	128/74	150/86	124/72	138/92

PR									SPO2				
PRE-OP	5MINS	10MINS	15MINS	30MINS	45MINS	60MINS	90MINS	120MINS	PRE-OP	5MINS	10MINS	15MINS	30MINS
88/min	78/min	84/min	82/min	88/min	86/min	78/min	88/min	84/min	98%	99%	98%	97%	100%
84/min	88/min	86/min	84/min	84/min	80/min	88/min	84/min	82/min	100%	99%	100%	98%	100%
94/min	90/min	88/min	88/min	88/min	88/min	90/min	88/min	88/min	100%	99%	99%	98%	99%
82/min	78/min	78/min	82/min	82/min	84/min	84/min	84/min	78/min	100%	99%	98%	99%	98%
80/min	76/min	76/min	78/min	76/min	74/min	74/min	72/min	76/min	99%	99%	99%	97%	100%
82/min	80/min	78/min	74/min	74/min	74/min	74/min	76/min	74/min	99%	100%	99%	98%	99%
88/min	86/min	80/min	88/min	82/min	88/min	84/min	82/min	86/min	99%	98%	98%	99%	98%
72/min	76/min	74/min	72/min	74/min	78/min	76/min	76/min	72/min	99%	100%	99%	99%	99%
68/min	66/min	66/min	68/min	64/min	64/min	70/min	68/min	64/min	100%	99%	99%	99%	99%
82/min	78/min	78/min	82/min	82/min	84/min	84/min	84/min	78/min	99%	98%	99%	100%	99%
80/min	76/min	76/min	78/min	76/min	74/min	74/min	72/min	76/min	100%	99%	99%	99%	98%
86/min	78/min	84/min	82/min	88/min	86/min	78/min	88/min	84/min	100%	99%	99%	100%	100%
86/min	88/min	86/min	84/min	84/min	80/min	88/min	84/min	82/min	99%	98%	99%	99%	99%
86/min	90/min	88/min	88/min	88/min	88/min	90/min	88/min	88/min	98%	99%	100%	98%	98%
84/min	78/min	78/min	82/min	82/min	84/min	84/min	84/min	78/min	100%	99%	99%	99%	99%
74/min	76/min	76/min	78/min	76/min	74/min	74/min	72/min	76/min	99%	99%	98%	99%	99%
88/min	66/min	66/min	68/min	64/min	64/min	70/min	68/min	64/min	99%	99%	99%	99%	98%
84/min	78/min	78/min	82/min	82/min	84/min	84/min	84/min	78/min	99%	99%	100%	100%	98%
76/min	76/min	76/min	78/min	76/min	74/min	74/min	72/min	76/min	100%	99%	98%	99%	99%
78/min	78/min	84/min	82/min	88/min	86/min	78/min	88/min	84/min	99%	99%	99%	100%	99%
84/min	88/min	86/min	84/min	84/min	80/min	88/min	84/min	82/min	99%	99%	98%	99%	99%
74/min	90/min	88/min	88/min	88/min	88/min	90/min	88/min	88/min	99%	98%	99%	98%	100%
72/min	84/min	84/min	80/min	84/min	78/min	78/min	82/min	72/min	100%	99%	100%	98%	99%
68/min	74/min	78/min	78/min	74/min	72/min	76/min	84/min	88/min	100%	99%	99%	98%	99%
82/min	86/min	88/min	86/min	86/min	86/min	66/min	88/min	84/min	100%	99%	98%	99%	98%
80/min	80/min	84/min	86/min	86/min	82/min	78/min	80/min	88/min	99%	99%	99%	97%	100%
86/min	88/min	88/min	88/min	86/min	86/min	76/min	78/min	84/min	99%	100%	99%	99%	99%
86/min	84/min	82/min	80/min	84/min	78/min	78/min	86/min	72/min	100%	99%	99%	99%	99%
86/min	74/min	76/min	78/min	74/min	72/min	88/min	86/min	68/min	99%	98%	99%	100%	99%
84/min	64/min	74/min	78/min	78/min	78/min	90/min	88/min	84/min	100%	99%	99%	99%	98%
74/min	84/min	82/min	80/min	84/min	78/min	84/min	80/min	72/min	100%	99%	99%	100%	100%
88/min	74/min	82/min	82/min	84/min	84/min	74/min	78/min	88/min	99%	98%	99%	99%	99%
76/min	86/min	78/min	76/min	74/min	74/min	72/min	78/min	84/min	98%	99%	100%	98%	98%
78/min	80/min	68/min	64/min	64/min	70/min	68/min	64/min	72/min	100%	99%	98%	99%	99%
88/min	88/min	82/min	82/min	84/min	84/min	84/min	78/min	88/min	99%	99%	99%	100%	99%

45MINS	60MINS	90MINS	120MINS	TIME TAKEN FOR BLOCK (In Mins)	sensory onset (in mins)	motor onset (in mins)	sensory duration	motor duration	vascular puncture	distance from skin (in cms)	distance to pleura (in
98%	100%	100%	100%	3	10	12	12	8	no	3.2	2.5
100%	99%	100%	98%	6	21	25	13	7.5	yes	3.2	4
100%	100%	99%	99%	3	10	12	12.5	8	no	3.4	2.5
100%	100%	99%	98%	10	10	12	15	8	no	3.2	3
100%	99%	99%	99%	7	10	12	14	7	no	3.4	4
99%	99%	98%	99%	5	11	25	13	7	no	4	2.5
98%	98%	100%	99%	5	10	17	16	7.5	no	3.5	2.5
99%	99%	99%	99%	8	10	15	14	8	no	3.5	4
99%	99%	98%	99%	3	10	15	15	10	no	4	3
99%	99%	99%	99%	3	21	15	13.5	9	no	3.5	2.5
99%	98%	99%	100%	3	18	18	14.5	9	no	5.7	3
98%	100%	98%	99%	8	10	20	14	8.5	no	4.5	3
99%	99%	99%	99%	5	10	20	13.5	8.5	no	5.7	2.5
99%	98%	99%	98%	5	10	22	14	8	no	3.5	2.5
99%	99%	99%	99%	10	10	18	12.5	7	no	3.5	3.5
98%	99%	99%	100%	8	12	18	12	6	no	3.2	3.5
100%	98%	99%	100%	5	10	20	11	6.5	no	4.5	2.5
99%	99%	99%	99%	3	12	25	15	7	no	4	2.5
98%	98%	100%	99%	3	20	14	14	7	no	4	2.5
99%	99%	99%	99%	3	12	14	13.5	8	no	4	4
99%	99%	100%	98%	3	10	12	16	8.5	no	5.7	2.5
98%	98%	100%	99%	3	11	14	14	9	no	3.5	2.5
100%	99%	100%	98%	5	12	15	12.5	9	no	3.2	4
100%	100%	99%	99%	3	10	25	12	8	no	3.5	3.5
100%	100%	99%	98%	3	18	25	15	8.5	no	4.5	3.5
100%	99%	99%	99%	4	10	15	14	8	no	4	3
99%	99%	99%	99%	4	10	12	13.5	6.5	no	5.7	3.5
99%	99%	98%	99%	7	21	25	15	7	no	4.5	4
99%	99%	99%	99%	3	11	20	14	7	no	4	2.5
99%	98%	99%	100%	3	10	15	13	7.5	no	4	2.5
98%	100%	98%	99%	3	10	20	15	8	no	3.5	2.5
99%	99%	99%	99%	3	12	15	14.5	8	no	5.5	4
99%	98%	99%	98%	6	10	15	13	7.5	no	5	3.5
98%	98%	100%	99%	3	21	12	13	7	no	4.5	3.5
99%	99%	99%	99%	3	20	14	14	8	no	5	4

sensory quality						motor quality					
axillary	median	radial	ulnar	musculocu	intercostol	axillary	median	radial	ulnar	musculocutar	tourniquet pain
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	2	1	3	3	3	3	2	0
3	3	3	3	2	1	3	3	3	3	3	0
3	3	3	3	2	1	3	3	2	1	2	0
3	3	3	3	2	1	3	3	3	3	3	1
3	3	3	3	2	1	2	3	3	3	2	0
3	3	3	3	2	2	3	3	3	3	2	0
3	3	3	3	2	1	3	2	3	2	2	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	2	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	2	3	3	3	3	2	0
3	3	3	3	3	3	3	2	3	2	3	0
3	3	3	3	3	3	3	3	3	3	3	1
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	2	3	3	3	3	2	0
3	3	3	3	3	1	3	3	2	3	3	0
3	3	3	3	3	2	3	3	3	3	2	0
3	3	3	3	2	2	3	3	3	3	3	0
3	3	3	3	2	1	3	3	3	3	3	0
3	3	3	3	2	1	3	3	3	3	2	0
3	3	3	3	3	1	3	3	3	3	2	0
3	3	3	3	2	3	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	2	0
3	3	3	3	2	1	3	3	3	3	2	0
3	3	3	3	3	2	3	3	3	3	3	0
3	3	3	3	3	2	2	3	3	3	3	0
3	3	3	3	3	3	3	3	3	3	2	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	2	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	1	3	3	3	3	3	0
3	3	3	3	3	2	3	3	3	3	3	0

NAME		SEX	WEIGHT	BP								
				PRE-OP	5MINS	10MINS	15MINS	30MINS	45MINS	60MINS	90MINS	120MINS
SUMITHRA	24	F	53	118/80	114/76	120/84	108/60	114/62	130/90	120/86	118/72	108/78
NAGARATHINAM	49	M	64	118/64	118/82	116/60	120/80	126/88	144/92	120/80	110/76	148/82
RANJANI	34	F	63	136/82	126/84	108/78	124/72	142/88	116/88	120/80	120/84	138/92
KRISHNAMOORTRHY	44	M	71	126/88	114/62	120/80	120/80	150/86	126/84	100/60	116/60	110/70
SUGANTHI	35	F	73	116/80	126/88	120/80	118/72	148/82	118/74	108/64	108/78	128/74
PRABHADEVI	46	F	69	120/84	142/88	110/70	110/76	108/78	116/60	130/90	108/60	108/68
MANGALESWARI	39	F	59	116/60	150/86	120/86	108/78	148/82	114/62	126/88	120/80	128/78
PANDI	48	M	62	108/78	148/82	120/80	124/72	138/92	126/88	142/88	124/72	148/92
JOTHILAKSHMI	53	F	58	124/72	138/92	120/80	120/80	110/70	142/88	120/86	120/80	128/78
MEENAKSHI	44	F	66	120/80	110/70	100/60	118/72	128/74	150/86	148/82	118/72	148/92
NAJIMA	51	F	69	118/72	128/74	108/64	110/76	108/68	148/82	118/76	110/76	106/64
PERUMAL	49	M	61	110/76	108/68	130/90	120/84	128/78	136/90	124/72	116/74	138/92
MUNIYANDI	54	M	62	120/84	128/78	144/92	118/72	148/92	136/72	128/72	120/80	110/70
PUSHPAM	46	F	64	118/72	148/92	114/62	120/84	128/78	144/92	120/80	130/90	120/80
MOOKAN	49	M	73	122/82	106/64	126/88	118/72	148/92	114/62	120/80	110/70	120/80
VASUDEVAN	42	M	61	130/90	150/88	142/88	122/82	106/64	126/88	126/84	120/86	120/84
KALYANI	38	F	76	134/88	120/80	150/86	124/72	138/92	120/80	108/74	100/60	136/82
BALUISAMY	43	M	60	128/74	118/88	148/82	120/80	110/70	100/60	118/80	108/64	126/88
RAMALINGAM	28	M	62	122/80	126/78	108/78	148/82	120/80	124/72	138/92	126/88	116/80
AARTHY	23	F	59	136/84	108/66	124/72	138/92	120/80	120/80	110/70	142/88	138/92
THIYAGARAJAN	51	M	58	124/72	120/80	110/70	118/78	120/84	128/78	144/92	128/78	110/70
SUMATHI	33	F	56	154/92	126/84	120/86	120/80	136/82	126/88	110/70	148/92	128/74
RAJA	40	M	54	146/78	118/82	120/80	110/60	126/88	142/88	120/86	128/78	108/68
SUDHAKAR	34	M	57	138/90	120/80	120/80	108/60	116/80	150/86	120/80	148/92	128/78
MANIMARAN	36	M	70	126/74	108/74	100/60	120/80	120/84	148/82	120/80	106/64	148/92
JEYANTHI	28	F	63	132/78	118/80	108/64	126/84	116/60	136/90	100/60	138/92	128/78
SELVARAJ	28	M	68	106/72	108/74	100/60	118/82	108/78	136/72	108/64	110/70	148/92
RAMACHANDRAN	44	M	59	108/80	118/80	108/64	120/80	124/72	144/92	130/90	120/80	106/64
IRUSAPPAN	36	M	71	112/68	120/80	130/90	108/74	120/80	114/62	144/92	120/80	138/92
BASKAR	30	M	65	118/80	120/80	110/70	118/72	118/72	126/88	114/62	120/84	150/88
LAKSHMIKANTHAN	29	M	59	108/72	116/76	144/92	118/72	120/80	130/90	126/88	136/82	120/80
KANTHI	39	M	54	110/70	110/70	116/88	122/82	120/80	110/70	142/88	126/88	118/88
MAGESHWARI	33	F	50	130/94	110/70	126/84	130/90	126/84	120/86	150/86	116/80	120/80
MAGESH	32	M	62	120/82	110/70	116/60	126/84	120/86	120/80	148/82	120/86	100/60
GOKUL	45	M	64	116/74	120/86	108/78	118/82	120/80	126/84	120/80	120/80	120/80

PR									SPO2				
PRE-OP	5MINS	10MINS	15MINS	30MINS	45MINS	60MINS	90MINS	120MINS	PRE-OP	5MINS	10MINS	15MINS	30MINS
78/min	86/min	86/min	86/min	80/min	78/min	78/min	86/min	86/min	99%	100%	99%	98%	99%
82/min	86/min	86/min	82/min	86/min	86/min	82/min	86/min	84/min	98%	100%	100%	99%	100%
86/min	88/min	86/min	86/min	86/min	86/min	88/min	86/min	86/min	99%	99%	99%	100%	100%
84/min	80/min	84/min	78/min	78/min	82/min	86/min	86/min	80/min	99%	99%	98%	98%	98%
78/min	78/min	74/min	72/min	74/min	78/min	80/min	78/min	78/min	99%	99%	98%	99%	99%
86/min	82/min	88/min	82/min	84/min	82/min	88/min	86/min	88/min	98%	99%	99%	99%	98%
86/min	82/min	84/min	86/min	80/min	82/min	86/min	84/min	86/min	100%	99%	99%	99%	100%
78/min	78/min	76/min	76/min	76/min	76/min	74/min	74/min	78/min	99%	98%	99%	98%	99%
78/min	78/min	78/min	78/min	74/min	74/min	74/min	78/min	76/min	98%	99%	98%	99%	98%
84/min	80/min	84/min	78/min	78/min	82/min	86/min	86/min	80/min	99%	99%	99%	99%	99%
78/min	78/min	74/min	72/min	74/min	78/min	80/min	78/min	78/min	99%	99%	99%	99%	99%
88/min	86/min	86/min	86/min	80/min	78/min	78/min	86/min	86/min	98%	98%	99%	99%	98%
84/min	86/min	86/min	82/min	86/min	86/min	82/min	86/min	84/min	99%	100%	98%	99%	99%
88/min	88/min	86/min	86/min	86/min	86/min	88/min	86/min	86/min	99%	99%	100%	99%	99%
82/min	80/min	84/min	78/min	78/min	82/min	86/min	86/min	80/min	99%	98%	99%	99%	99%
76/min	78/min	74/min	72/min	74/min	78/min	80/min	78/min	78/min	99%	99%	98%	99%	99%
74/min	78/min	78/min	78/min	74/min	74/min	74/min	78/min	76/min	99%	99%	99%	100%	99%
82/min	80/min	84/min	78/min	78/min	82/min	86/min	86/min	80/min	99%	98%	99%	99%	99%
74/min	78/min	74/min	72/min	74/min	78/min	80/min	78/min	78/min	100%	99%	98%	98%	100%
64/min	86/min	86/min	86/min	80/min	78/min	78/min	86/min	86/min	99%	99%	99%	99%	99%
82/min	86/min	86/min	82/min	86/min	86/min	82/min	86/min	84/min	99%	100%	99%	99%	100%
76/min	88/min	86/min	86/min	86/min	86/min	88/min	86/min	86/min	100%	99%	99%	99%	100%
78/min	82/min	78/min	78/min	82/min	82/min	80/min	80/min	78/min	98%	100%	99%	100%	100%
84/min	80/min	76/min	76/min	78/min	76/min	88/min	78/min	86/min	99%	99%	99%	99%	100%
74/min	86/min	78/min	84/min	82/min	88/min	84/min	82/min	86/min	99%	99%	99%	98%	98%
86/min	86/min	88/min	86/min	84/min	84/min	74/min	88/min	86/min	99%	99%	100%	99%	99%
86/min	86/min	90/min	88/min	88/min	88/min	64/min	86/min	86/min	99%	98%	99%	98%	99%
86/min	84/min	78/min	78/min	82/min	82/min	84/min	80/min	78/min	98%	99%	98%	99%	98%
84/min	74/min	76/min	76/min	78/min	76/min	74/min	74/min	78/min	99%	99%	99%	99%	99%
74/min	88/min	66/min	66/min	68/min	64/min	86/min	86/min	86/min	99%	99%	99%	99%	99%
78/min	84/min	78/min	78/min	82/min	82/min	80/min	80/min	78/min	98%	98%	99%	99%	98%
84/min	84/min	78/min	78/min	82/min	86/min	88/min	78/min	86/min	99%	100%	98%	99%	99%
74/min	74/min	72/min	74/min	78/min	80/min	78/min	82/min	86/min	99%	99%	100%	99%	99%
86/min	78/min	78/min	74/min	74/min	74/min	78/min	76/min	78/min	100%	99%	98%	98%	100%
86/min	84/min	78/min	78/min	82/min	86/min	86/min	80/min	86/min	99%	99%	99%	99%	99%

45MINS	60MINS	90MINS	120MINS	TIME TAKEN	sensory onset	motor onset	sensory duration	motor duration	vascular puncture	distance from skin	distance to pleura(cms)	axillary
100%	99%	97%	98%	7	24	35	12.5	8	yes	4.5	2	3
100%	99%	100%	100%	7	32	25	11	7.5	no	4.5	3.7	3
100%	99%	99%	99%	8	22	28	11	8	no	5	2	3
100%	100%	98%	98%	10	22	25	12	8	no	5.5	2	3
100%	99%	99%	99%	10	22	25	13	7.5	yes	4.8	2	3
98%	100%	100%	100%	10	25	28	12.5	9	no	4.2	2.5	3
100%	100%	100%	98%	8	24	30	13	8	no	4.5	3.7	3
99%	100%	99%	100%	8	22	32	12	8.5	no	4.1	3.7	3
98%	100%	99%	100%	8	24	30	14	7	no	6.5	2	3
99%	100%	99%	99%	7	23	30	12	7.5	no	4.6	2	3
99%	100%	98%	98%	7	22	25	11.5	8	no	4.5	2	3
98%	100%	100%	100%	5	22	32	14	8	no	6.5	3.5	3
99%	100%	100%	99%	7	22	30	13	8.5	no	4.5	3.5	3
99%	99%	99%	99%	7	22	35	12.5	7.5	no	5	3	3
99%	98%	99%	99%	7	24	25	12	8.5	no	5	3	3
99%	100%	99%	100%	10	24	28	11	8	no	4.5	3.5	3
99%	99%	100%	99%	15	22	25	12	9	yes	5.5	3	3
99%	99%	99%	100%	8	30	32	13	7.5	yes	4.5	2.5	3
100%	99%	100%	100%	8	22	35	11	7	no	4.5	3	3
99%	100%	99%	100%	8	30	28	12.5	7	no	5	3	3
100%	99%	98%	100%	8	28	25	11.5	8	no	6.5	3	3
100%	99%	100%	100%	8	22	26	13	8.5	no	5.5	2	3
100%	99%	100%	100%	7	22	35	10.5	7.5	no	5	2.5	3
100%	99%	99%	99%	7	28	32	11.5	8	no	5.8	2.5	3
100%	100%	98%	98%	7	28	25	11	8	no	6	3.7	3
100%	99%	99%	99%	12	22	28	12	7.5	no	4.5	3.5	3
99%	100%	99%	100%	10	22	32	12.5	8.5	no	6	2.5	3
98%	100%	99%	100%	8	25	30	12	8	yes	4.5	2.5	3
99%	100%	99%	99%	8	25	30	11	7.5	yes	4.5	2	3
99%	100%	98%	98%	7	25	25	11.5	8	no	6	2	3
98%	100%	100%	100%	7	24	25	12	9	no	5.5	2.5	3
99%	100%	100%	99%	7	30	26	12.5	7.5	no	5.5	3.5	3
99%	99%	99%	99%	12	25	35	13	7.5	no	4.5	3.5	3
100%	99%	100%	100%	8	25	25	12.5	8	no	4.5	3	3
99%	100%	99%	100%	7	22	25	11	8.5	no	5.5	4	3

sensory quality					motor quality					tourniquet
median	radial	ulnar	musculocu	intercostob	axillary	median	radial	ulnar	musculocutane	pan
3	3	1	1	2	3	3	3	3	2	0
3	3	1	1	2	3	3	3	3	3	1
3	3	1	3	3	3	3	3	2	1	1
3	3	2	3	2	3	3	3	1	1	0
3	3	1	3	2	3	3	3	2	1	0
3	3	1	2	1	3	3	2	1	1	1
3	3	1	2	1	3	3	3	3	1	0
3	3	3	3	1	3	3	3	2	1	0
3	3	2	3	2	3	3	3	3	3	1
3	3	2	3	2	3	3	2	3	3	0
3	3	1	3	2	3	3	2	3	2	1
3	3	2	3	3	3	3	3	2	2	0
3	3	3	2	3	3	2	3	3	2	0
3	3	1	2	2	3	3	3	3	3	0
3	3	1	3	1	3	3	3	1	1	1
3	3	1	3	2	3	3	3	1	1	1
3	3	1	1	2	3	3	2	3	2	1
3	3	1	3	2	3	3	3	2	1	0
3	3	2	3	2	3	3	3	3	1	0
3	3	1	3	3	3	3	3	1	1	1
3	3	1	3	1	3	3	3	1	1	0
3	3	1	2	1	3	3	3	2	1	1
3	3	1	3	2	3	3	3	2	2	0
3	3	2	2	3	3	3	2	1	1	0
3	3	3	2	2	3	3	3	3	1	0
3	3	3	2	2	3	2	3	3	1	1
3	3	3	1	1	3	3	3	2	2	0
3	3	2	3	2	3	3	3	2	2	0
3	3	1	3	2	3	3	3	1	1	1
3	3	1	3	2	3	3	3	1	2	1
3	3	1	3	1	3	3	3	1	1	0
3	3	1	3	1	3	3	3	2	1	0
3	3	1	2	1	3	2	3	2	1	0
3	3	1	3	2	3	3	3	2	1	1
3	3	1	2	2	3	3	3	1	1	0

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ETHICS COMMITTEE CERTIFICATE

Name of the Candidate	:	Dr. Dr.C.B.Manoj kumar,
Designation	:	PG in MD., Anaesthesia
Course of Study	:	2017- 2020
College	:	MADURAI MEDICAL COLLEGE
Research Topic	:	Comparison of Two different approaches of Ultrasound guided infraclavicular block in upperlimb surgeries
Ethical Committee as on	:	17.05.2019

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary Chairman Dean / Convenor

Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc.(Hon)
CHAIRMAN
IEC - Madurai Medical College
Madurai

DEAN
Madurai Medical College
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17 MAY 2019
மதுரை - 625020

URKUND

Urkund Analysis Result

Analysed Document: thesis.pdf (D57393643)
Submitted: 10/21/2019 9:24:00 PM
Submitted By: cbmanoj.kumar1986@gmail.com
Significance: 0 %

Sources included in the report:

Instances where selected sources appear:

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