COMPARISON OF ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BLOCKS FOR UPPER EXTREMITY SURGERIES

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CERTIFICATE

This is to certify that this dissertation entitled "**COMPARISON OF ULTRASOUND GUIDED SUPRA CLAVICULAR AND INFRACLAVICULAR BLOCKS FOR UPPER EXTREMITY SURGERY**" is a bonafide original work of **Dr. M. SHANTHI** in part fulfillment of the requirements for **Doctor of Medicine in Anaesthesiology-Branch X** examination of the Tamilnadu Dr.M.G.R Medical University to be held in APRIL – 2017. The period of study was from JULY 2014 – JULY 2016

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DECLARATION

I, Dr. M. SHANTHI, declare that this dissertation entitled "**COMPARISON OF ULTRASOUND GUIDED SUPRA CLAVICULAR AND INFRACLAVICULAR BLOCKS FOR UPPER EXTREMITY SURGERY"** is a bonafide and genuine research work carried out by me in the Department of Anaesthesiology, Thanjavur Medical College Hospital, Thanjavur, during July 2014 to July 2016 under the guidance and supervision of Prof. Dr. Shanthi Paulraj M.D., Department of Anaesthesiology.

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INTRODUCTION [1,2,3,4]

Pain is a fundamental biological phenomenon. The international association for the study of pain [1] has defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. The art and science of anaesthesia is leased and developed in releasing the surgical and chronic pain.

Regional nerve blocks are thought to be better than other forms of anaesthesia

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LIST OF ABBREVIATIONS

Sc	-	Supraclavicular block
Ic	-	Infraclavicular block
ug	-	microgram
ASA	-	American Society of Anaesthesiologists (classified)
ECG	-	Electrocardiogram
cm	-	centimeter
mg	-	milligram
mm of Hg	-	millimeters of mercury
ml	-	milliliter
gm	-	gram
kgs	-	kilograms
LA	-	Local Anaesthetic
min	-	minute
mins	-	minutes
pKa	-	Dissociation constant
gms%	-	grams per deciliter
S.D.	-	Standard Deviation
SBP	-	Systolic Blood Pressure
DBP	-	Diastolic Blood Pressure
MAP	-	Mean Arterial Pressure
IM	-	intramuscular
IV	-	Intravenous
Na^+	-	Sodium
BT	-	Bleeding Time
CT	-	Clotting Time

INTRODUCTION

Pain is a fundamental biological phenomenon. The international association for the study of pain [1] has defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. The art and science of anaesthesia is leased and developed in releasing the surgical and chronic pain.

Regional nerve blocks are thought to be better than other forms of anaesthesia because they prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects general anaesthetic drugs [2]. It provides better intra operative and prolonged postoperative pain relief minimising the stress response and minimising anaesthetic drug requirements. They are beneficial to the patients with various cardio respiratory co morbidities

Brachial plexus block provide a wonderful alternative to general anaesthesia for upper limb surgeries. It achieves ideal operative conditions by providing complete and prolonged pain relief, muscle relaxation, maintaining stable intra operative hemodynamics and adequate sympathetic block . The sympathetic block decreases post operative pain, vasospasm and edema.

The conventional landmark oriented techniques being a blind technique may cause injury to nerves and vascular structures [3].To minimize these drawbacks, various techniques and approaches were described. Among them, anatomical structures visualized by ultrasound is the only method offering a safe block of best quality by accurate positioning of needle [4].

Ultrasound has improved success rate with excellent localisation and improved safety margin[4]

This study was designed to compare the ultrasound guided technique for supra clavicular and infra clavicular brachial plexus block with regards to block performance time, Overall effectiveness, commonly escaped nerves and incidence of adverse effects in both the procedures.

AIM AND OBJECTIVES OF THE STUDY:

To compare the block performance time, overall effectiveness, commonly escaped nerves and the incidence of adverse events in ultrasound guided supra clavicular and infra clavicular blocks.

HISTORY [5,6]

- 1852-1922 – William Halsted first performed the brachial plexus block
- 1911 – First percutaneous supra clavicular block was performed by German surgeon Diedrich kulenkampff (1880-1967) [5]
- 1875-1963 – George Hirschel described a percutaneous approach to the brachial plexus from the axilla
- 1946 – F.paul Ansbro was the first to describe & continuous brachial plexus block technique
- 1964 – Winnie & Collins first described subclavian perivascular block. Raj first described the infra clavicular approach to the brachial plexus[6].
- 1977- Selander explained a method for continuous brachial plexus block using an intravenous catheter secured in the axilla.
- 1989 – Ting & Sivagnanaratnam were among the first to utilize Ultra sonography to confirm the location of the needle while performing the axillary block and observe the spread of local anaesthetic solution. They reported 100% success rate without complications during this very first study visualising the needle tip and axillary anatomy at all times.
- 1994 – Kapral et al demonstrated that ultrasound for supra clavicular blocks resulted in more effective anaesthesia than axillary block for the Brachial plexus distribution

ADVANTAGES OF ULTRASOUND IN NERVE BLOCKS: [7,8,9,10]

Ultrasound guidance is more helpful for superficial blocks such as Supra clavicular, inter scalene, axillary and femoral blocks. Brachial plexus are easily visualized by high frequency linear array transducer (providing very high resolution images)

While in randomized controlled trials this has not been proven, visualizing the pleura and the subclavian artery may reduce the incidence of pneumothorax and/ or hematoma.

In addition, seeing the blood vessels during the block should minimize the incidence of local anaesthetic toxicity by avoiding intra vascular injection of local anaesthetic agent.

Increased success rate is a result of ease of visualization and in experienced hands when compared with nerve stimulation alone, the block performance time is reduced.

Low amount of local anaesthetic is needed to block a variety of plexuses & nerves.[7,8,9,10]

BRACHIAL PLEXUS ANATOMY [11]

The brachial plexus provides innervation of the upper limb. The plexus consists of the

☐ Roots,trunks, divisions, cords, terminal nerves

ROOTS : [11]

These are formed from the anterior primary rami of C5, C6, C7, C8 and T1. In addition there may be a contributions from C4 and T2.if the plexus is formed from C4-C8,It is prefixed plexus. If the plexus is formed from T2,then it is called post fixed plexus. The roots are joined together and form the trunks.

TRUNKS:

☐ C5and C6 roots join to form the upper trunk

☐ C7 root forms the middle trunk

☐ C8 and T1 roots join to form the lower trunk.

DIVISIONS:

Trunks are divided into ventral & dorsal divisions which supply the anterior and posterior aspects of the limb.

CORDS :

☐ Ventral divisions of the upper and middle trunk unites to form the lateral cord.

☐ Ventral division of the lower trunk forms the medial cord.

☐ Dorsal divisions of all the trunks unites to form the posterior cord.

BRANCHES :

BRANCHES FROM THE ROOT:

1. long thoracic nerve (C5,C6,C7)

   Motor supply- serratus anterior

2. dorsal scapular nerve

   Motor supply- Rhomboids (C5)

   Levator scapulae

3. Nerve to subclavius

BRANCHES FROM THE TRUNK:

1. Suprascapular Nerve (C5,C6)

   Motor supply- supra spinatus& infra spinatus

2. Nerve to Subclavius (C5,C6)

BRANCHES FROM THE CORD:

LATERAL CORD:

1. Lateral pectoral Nerve (C5,C6,C7)

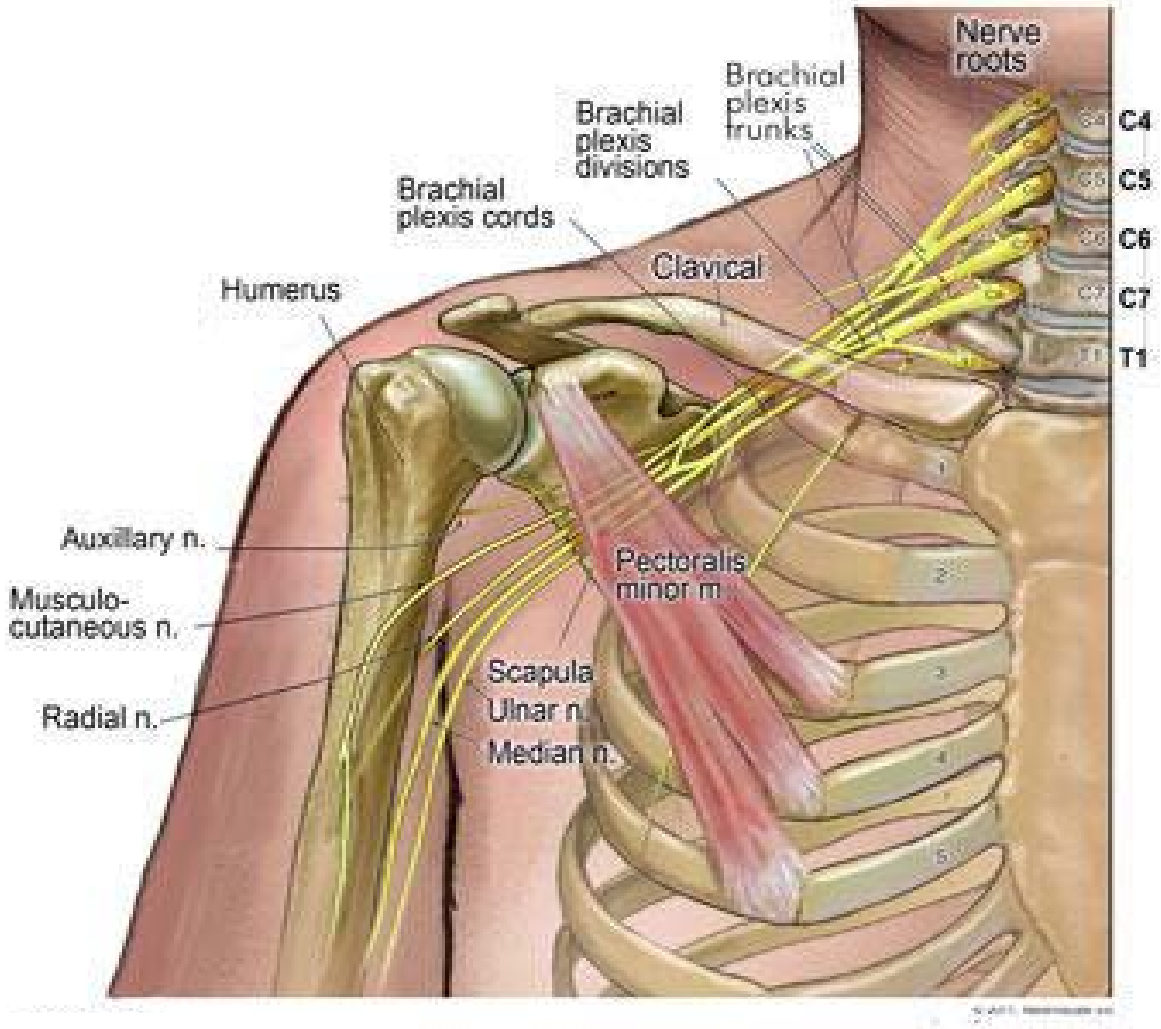
   Motor supply ; pectoralis major and minor

2. Musculocutananeous Nerve(C5,C6,C7)

   Motor- Coraco brachialis ,biceps,brachialis

   Sensory supply-lateral cutaneous nerve of arm

3. Median nerve- Lateral root (C5,C6,C7)


Nerve roots
Brachial plexis trunks
Brachial plexis divisions
Brachial plexis cords
Clavical
Humerus
C4
C5
C6
C7
T1
Auxillary n.
Musculo-cutaneous n.
Radial n.
Pectoralis minor m.
Scapula
Ulnar n.
Median n.

MEDIAL CORD:

1. Medial pectoral Nerve(C8,T1)
2. Medial cutaneous nerve of arm(C8,T1)& forearm(C8,T1)
3. Ulnar nerve(C7,C8,T1)

   Motor : flexor digitorum profundus, Palmaris brevis, flexor carpi ulnaris,

   Sensory: dorsal and palmar cutaneous branches.

   Deep terminal branch of ulnar nerve

   Flexor abductor opponens digiti minimi, four palmar interossei,four dorsal interossei, two lumbricals, adductor pollicis
4. Medial root of median nerve(C8,T1)

   Motor :Pronator teres,flexor carpi radialis, flexor digitorum superficialis, ,Palmaris longus, two lateral lumbricals.

   Anterior interosseus branch:

   Motor :flexor digitorum profundus, pronator quadratus, abductor pollicis brevis, flexor pollicis brevis ,opponens pollicis,flexor pollicis longus.

POSTERIOR CORD:

1. Upper subscapular nerve(C5,C6)

   Motor : sub scapularis
2. Thoraco dorsal Nerve (C6,C7,C8)

   Motor : Lattisimus dorsi
3. Lower subscapular nerve(C5,C6)

Motor : Sub scapularis

4. Axillary nerve(C5,C6)

   Motor :Teres minor, deltoid

   Sensory- upper lateral cutaneous nerve of arm

5. Radial nerve(C5,C6,C7,C8,T1)

   Motor :Triceps,brachio radialis, extensor carpi radialis longus

   Sensory-posterior cutaneous nerve of arm and forearm ,lower lateral cutaneous nerve of arm

   Posterior interosseous branch of radial nerve

   Motor :Supinator, extensors of thumb

   Superficial branch of radial nerve

   Sensory- Dorsum of hand

ANATOMICAL LOCATION:

The plexus hitch is formed by the C5-C8,T1 nerve roots are coming from the corresponding inter vertebral foramen and passes behind the foramen transversorium. Then it lies between the anterior and posterior tubercles of the corresponding transverse process. The five roots are situated between the anterior and medial scalene muscles.C5&C6 roots are unite to form the upper trunk , C7 continues as middle trunk,C8 &T1 unite to form the lower trunk.

The trunks emerge between the two scalene muscles and passes downwards and laterally across the base of posterior triangle,and then passes across the 1st rib. At the lateral border of the 1st rib each trunk further divides into anterior and posterior division behind the clavicle. The anterior and posterior divisions unites and form the three cords.

a) lateral cord- it is formed by the anterior divisions of upper and middle trunks.

b)medial cord- it is a continuation of the anterior division of the lower trunk

c) posterior cord – formed by all the three posterior divisions.

These are named according to the relation to the axillary artery.

.

Sympathetic contributions of this plexus are derived from middle cervical ganglion, also stellate ganglion.

RELATIONS

ROOTS

This part of the plexus lies above the second part of the subclavian artery and between the scalene muscles.

TRUNKS

In the posterior triangle, the trunks are covered by prevertebral fascia.

It is superficially placed,covered by skin,platysma and deep fascia

Structures crossing the trunks

Omohyoid-Inferior belly of omohyoid muscle.

External jugular vein

Transverse cervical artery

SUPRACLAVICULAR NERVES

The upper and, middle trunks lies above the subclavian artery as they pass across the first rib. The lower trunk lies behind the artery and may groove the rib immediately posterior to the subclavian groove

DIVISIONS:

At the lateral border of first rib behind the clavicle, subclavius muscle ,supra scapular vessels (which lies immediately posterior to the clavicle), the trunks bifurcate into divisions then it descends into the axilla.

CORDS:

Cords are formed at the apex of the axilla. These cords are named in relation to the artery.

1. Lateral cord- lateral to the axillary artery
2. Posterior cord- at first lateral to the artery ,when it comes behind the pectoralis minor it lies posterior to the artery
3. Medial cord- at first it lies behind the artery ,, but when it comes behind the pectoralis minor it lies medial to the artery.

ANATOMICAL LANDMARK TECHNIQUE AND NERVE STIMULATION TECHNIQUE

In the early 20th century as described by kulenkampff and Persy, the Supraclavicular block provides more consistent & effective regional anaesthesia to the upper extremity than any other approaches to Brachial plexus blockade. In this technique the needle is inserted towards the first rib in where the plexus is present relating it closely to the subclavian artery. Out of many modifications proposed, the "plumb POB technique" is most important in where the needle insertion point is at the junction of clavicle and the clavicular head of sternocleidomastoid muscles. The direction of the needle is antero-posterior. The needle may be redirected cephalad in small steps or caudad of 20 – 30 degree if the brachial plexus contact is not achieved by the initial needle pass, while the initial needle entry site is maintained in the sagittal plane. In all anatomical landmark methods, paraesthesia is being used as a method of identification of the Brachial plexus.

Localization of the Brachial plexus using nerve stimulator lead to more effective and reliable blocks, but the risk of complications remained high.

Traditionally Supraclavicular blocks were associated with a high risk of complications like pneumothorax, phrenic nerve block, intravascular injection,epidural drug injection,nerve injury & horner's syndrome

ANATOMY OF PERIPHERAL NERVES

Autonomic postganglionic efferent and nociceptive afferent C fibres are non myelinated. These axons have only single Schwann cell sheath. Large motor and sensory fibres are myelinated. Myelin sheath enhances the nerve conduction and causes the action potential impulse to flow through the axoplasm to node of ranvier. Active impulses are regenerated in nodes of ranvier. Sodium channels are rich in nodes of ranvier in myelinated nerve fibres. These channels are essential for impulse generation and propagation. In unmyelinated nerve fibers ,these sodium channels are present throughout the length.

PHYSIOLOGY OF NERVE CONDUCTION

The Nerve cells maintain a negative resting potential difference of -60 to -90mv. During rest, it is impermeable to sodium ions and permeable to potassium ions .this gradient was maintained by $Na^{+}K^{+}$ATPase. Permeation of these ions occur via ion channel, a specialized protein.

Action potential: During the stimulus, the nerve cell membrane became permeable to sodium ions and changing the membrane potential to positive .the threshold for sodium ion channel opening is -55mv.During depolarisation,both sodium and potassium ion channels are in open configuration.(Na>K). So excess positive ions enter intracellularly and reversal of membrane potential to +35mv. The membrane depolarization extends to the nearby area and cause more opening of sodium channels and increasing the inward current.This events continues until some of the sodium channels became inactivated and also k+ channel are still opened and result in a net outward current and produces repolarization. Now the threshold above its resting state,so it is refractory to next stimulus. Over time,sodium channel inactivation decays, potassium channel became closed state and resting threshold is restored.

Sodium channel has one large alpha subunit and one or two small beta subunits. Alpha subunit has four domains which is homologous DI-DIV and each has six helical regions (S1-S6) to span the membrane. It can be in three states:

open,inactivated and resting state. local anaesthetics acts by blocking these sodium channels.

BASICS OF ULTRASOUND [12]

The frequency of ultrasound for medical purpose ranges from 2 MHz to 13 MHz. Restricting the resolution to structures greater than 1 mm, the mean wave length in this band is 1mm. Majority of them comes between 2 mm and 10 mm. 3 mm to 15 mm are the basic reading for veins and arteries.

Universally, higher resolution images are produced by higher frequency probes. Contradictly, rapid attenuation of high frequency ultrasound waves (8 MHz to 13 MHz) occurs in tissue because of which high frequency probes are perfectly used for structures below 5 cm under the skin.

Reflection of the ultrasound beam occurs when it penetrates through tissue resulting in a nerve or other structures appearing at a variable anatomical location than their exact location. In the image speckled appearance can occur because of fat globules at various levels around nerves which are about 1 mm in diameter acting as diffraction sites. They also take in ultrasound causing a very little of the beam coming back to the receiver. Because of such reasons, it is very difficult to image obese patients.

On the nerve, the ultrasonic nerve image is very sensitive to the ultrasound beam's angle of incidence. Changing the angle by a some degree sometimes brings the nerve into focus (caused by beam diffraction) . Modern ultrasound machine allows the user in changing the brightness (gain) of the more superficial (near field) or deep (far field) structures or even the entire image.

IMAGE OF VESSELS

Arteries and veins are usually identified by their pulsatile nature and compressibility respectively. We can use Color flow Doppler imaging for this purpose. By convention, red denotes blood flowing towards the probe and blue denotes away from the probe while Blood flowing perpendicular appears black. Velocity gates used to quantify flow velocity for detecting arteries and veins (high velocities and low velocities respectively)

PROBE SELECTION

Arrangement of the transducer elements can be either in linear or curved arrays. Superficial structures are detected by linear arrays by creating rectangular images while deeper structures are identified by curved arrays with wedge shaped images. Linear array resolution is higher than the resolution of curved array. While straight line is retained by a phased array. From a set of linear transducers, a wedge shaped image is formed because of a phase delay created by the elements firing in sequence. At these higher harmonic frequencies, Image resolution can be enhanced by hearing for the echo. Since the harmonics are of very low amplitude only transducers that have sufficient power output can be used.

Nerves are usually dark (hypoechoic) above the collar bone and white (hyperechoic) below the collar bone. The reasons are not known, but may be related to the depth, relative amount of fat and stroma within the nerves themselves. Nerves are hypo or hyperechoic, round and reticulated structures

in ultrasound cross section. On ultrasound, nerves appear as linear, hypo or hyperechoic streaks when imaged along their long axis. Bones are usually very bright white as they are hyperechoic. Veins and arteries are black without color flow Doppler imaging.

Most nerves have some fascia around them. Between the fascia and the epineurium, there is usually a potential space. When a needle punctures the fascia, local anaesthetic can usually be deposited between the nerve and the fascia resulting in a black ring surrounding the nerve. In conditions of absent fascia or its adherence to the epineurium, the needle may enter into the nerve causing it to swell by administering local anaesthetics.

NERVE IMAGING STUDY WITH ULTRASOUND: [13]

With a high-resolution ultrasound imaging, the Fascicles of peripheral nerves can be detected. The most distinguishing feature of nerves by fascicular echo texture is the “honeycomb” architecture. On ultrasound scans more central nerves, like cervical ventral rami, having minimal fascicles, can appear as mono fascicular.

On the area of the targeted peripheral nerve, the nerve fascicles can be clinched by sliding a broad linear transducer.

Nerves can appear round, oval, or triangular. In the absence of major branching nerve, cross-sectional area is same and constant though the shape can be changing [13]. Because of entrapment or in some other neuromuscular disorders like type IA Charcot-Marie-Tooth disease, the peripheral nerves are

pathologically enlarged. Enlarged peripheral nerves can be seen in patients with diabetic neuropathy. In ultrasound-guided regional anesthesia, it is evident that direct nerve imaging has led to a phenomenal outcome, but still the identifying nearby structures like the fascia, muscles and other tissues is difficult in this endeavor.

These significant structures favoring distribution of local anaesthetic that the nerve contact with needle is not mandated. Successful drug injections must always clarify the borders of the nerve .

ULTRASOUND AND ITS ARTIFACTS IN REGIONAL ANAESTHESIA:[14,15,16]

There are several common assumptions in the ultrasound imaging. First of all, the velocity of sound is assumed to be around 1540 msec. This estimate was achieved from measurements on soft tissue at physiological body temperature.

When the local heterogeneities exist, then artifactual bending of the block needle can be seen with sonography, the so-called bayonet artifact. The Speed of sound artifacts and the refraction at the interface of tissues are related to the time-of-flight considerations and the different speeds of sound respectively[14,15,16].

Also, straight linear path to and from the tissue are taken by sound waves. When this is not the case, the reverberation artifacts occur from the multipath echoes.

Then comet tail artifact is a type of reverberation artifact. At the low receiver gain, the comet tail is seen as a typical tapering series of discrete and clear echo bands just deep to a strongly reflecting structure.Then spacing between the bands represents the distance seen between the anterior and posterior side walls of the object.

When the object is perpendicular to the beam, Internal clear reverberations arising from within the object cause the artifact of comet tail.

Moreover the pleura is a strong reflector that causes the comet tail artifact.Reverberation echoes are usually seen while strong specular reflections are being received.

During supraclavicular block, the mirror-image artifacts can be observed from the reverberation. While the pleura is adjacent to the subclavian artery, the mirror-image artifacts can occur with gray-scale type sonographic imaging.

Third to say, all reflectors are considered on one central ray of the transducer beam. In cases of exemption, slice thickness artifacts (ie) out-of-plane artifacts are also observed.

Unlike adjacent tissue, acoustic enhancement will be caused by biologic fluids since they don’t significantly attenuating the sound beam.

Deep to vessels , the acoustic enhancement artifacts may be erroneously interpreted as the nerves.

For example, in axilla acoustic enhancement lying below the axillary artery can be misinterpreted as the radial nerve. Likely in the Infra clavicular region, acoustic enhancement below the axillary artery is taken wrongly for the posterior cord of the brachial plexus. .

LOCAL ANAESTHETICS:

Local anesthetics bind with alpha subunit of sodium potassium ATPase pump and block from inside of the cell. Resting membrane potential is not altered by local anesthetics. The impulse conduction is slowed down, the rate of rise and magnitude of the action potential is decreased and threshold for excitation is raised progressively, when increasing the concentration of local anesthetics resulting in the abolishment of propagation of impulse.

When the sodium channel is in activated and inactivated state, local anesthetics have greater affinity. And also its action is both voltage and time dependent.

FREQUENCY DEPENDENT BLOCKADE:

Local anesthetic action is effective when the nerve fibres are activated rapidly. Also called as use dependent blockade or phasic block.

More depolarization causes more affinity with local anesthetics.

local anesthetics dissociates from inactivated channels slowly than from resting channels.

Order of sensitivity to local anesthetics;

a)small myelinated axons: A γ ,Aδ

b) large myelinated: Aα, Aβ

c)least sensitive : small non myelinated C fibres.

Other channels blocked by local anesthetics; calcium, potassium ,NMDA

STRUCTURE OF LOCAL ANAESTHETICS:

It has three groups,

1)lipophilic made up of benzene ring

2) hydrophilic made up of tertiary amine

3) intermediate chain by ester /amide

These local anesthetics are weak bases. Lipid solubility determines the potency.

Local anesthetics are poorly soluble in water hydrophobic organic solvents.So these drugs are prepared as water soluble hydrochloride salts with a PH of 6-7.

Epinephrine is unstable in alkaline solution. So commercial preparations of local anaesthetics with adrenaline solutions are prepared as acidic solution with PH 4.

5)Amino ester: procaine, chloroprocaine, tetracaine, cocaine

AMINOAMIDES:

lignocaine,bupivacaine,ropivacaine,mepivacaine,prilocaine,etidocaine.

Cm- minimum concentration of local anesthetic that will block nerve impulse conduction. Factors determining the cm are nerve fibre type, size,

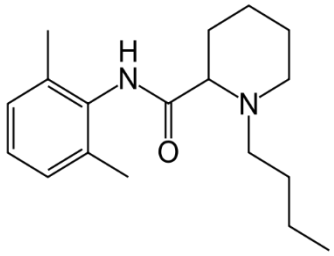
myelination, frequency of nerve stimulation, PH(acidic PH antagonize the block), electrolyte (hypercalcemia, hypokalemia antagonize block)

Lipid solubility and concentration of non ionized form are determining factors for onset of action.

Local anesthetics having pka nearing physiological PH will have fast onset property,and a higher concentration of non ionized base.

Increasing the dose or concentration of local anesthetics cause prolonged duration of action and reduce the onset time.but it will cause local anesthetic toxicity. To avoid the side effects of local anesthetics and improve the efficacy and onset adjuvants are added with local anesthetics.

PHARMACOLOGY OF BUPIVACAINE:



Bupivacaine is an amide type local analgesic drug. It is a hydrochloride salt of 1-butyl-N-(2, 6-dimethylphenyl) piperidine-2- carboxamide.

It was synthesized in Sweden by Ekenstam and his colleagues in 1957.

First used clinically by L.J. Telivuo in 1963.

Pka is 8.2

Molecular weight	-	288
Protein binding	-	95%
Lipid solubility	-	28
Elimination half life	-	210mts
Toxic plasma concentration	-	>1.5µg/ml
Approximate duration of action	-	175mts

The drug is very stable in acids, alkalis and repeated autoclaving. Bupivacaine 0.5% is the preferred strength. Higher concentration result in greater variability of spread[13]. Bupivacaine is 4 times potent than lidocaine, hence 0.5 % solution is equivalent to 2 % lidocaine. It is more cardiotoxic than lidocaine and which is aggravated by hypoxia, hypercapnia and by pregnancy. It causes less motor block compared to sensory block .It is not recommended for

intravenous regional analgesia. Duration of action is between 5 to 16 hours and is the longest acting local anaesthetic, which is related to binding to nerve tissue. Small percentage of a given dose of drug is excreted unaltered in the urine while the remainder is metabolised in liver.

USES:

Spinal anesthesia

Epidural anesthesia

Caudal anesthesia

Continuous epidural anesthesia

Peripheral nerve block

Infiltration anesthesia

Onset time and duration of action

Site of action	*Onset (minutes)*	*Duration (minutes)*
Intrathecal	5	90-120
Epidural	15-20	165-225
Brachial plexus	10-20	600

PHARMACOKINETICS:

Once injected intrathecally, it gets absorbed by the nerve rootlets and it is rapidly absorbed from the injection site, but the absorption rate depends on the vascularity and the presence of vasoconstrictors.

Because of high lipid solubility it easily penetrates nerve and vascular tissue. 80-95% of absorbed bupivacaine binds to the plasma proteins.

DISTRIBUTION:

Rapid distribution phase: (α)

Slow disappearance phase: (β)

Biotransformation:

Possible pathways of metabolism of bupivacaine include aromatic hydroxylation and conjugation. Only the N-dealkylated metabolite, N-desbutyl bupivacaine has been measured in blood (or) urine after epidural (or) spinal anesthesia. Alpha1 acid glycoprotein is the most important plasma protein binding site of bupivacaine and its concentration is increased by many clinical situations including post operative trauma.

EXCRETION:

It is through the kidney, 4-10% of the drug is excreted unchanged.

MODE OF ACTION:

Bupivacaine binds to the intra cellular portion of voltage gated sodium channels and blocks sodium influx into nerve cells which prevents depolarization,no initiation or conduction of a pain signal can occur.

a) Site of action:

i) The spinal nerve rootlet fine nerve filaments having a large surface area are exposed to the local anesthetics.

ii) Posterior and lateral aspects of the spinal cord.

b) Sodium Channel blockade:

They impede sodium ion access to the axon interior by occluding the transmembrane sodium channels thus delaying the process of depolarization and axon remains polarized. It is a non-depolarisation blockade.Thus the resting membrane potential is maintained and depolarization in response to stimulation is inhibited.

The mechanism by which local anaesthetics block sodium channel conductance as follows,

a. local anesthetics in the cationic form block the receptors on sodium channels of cell membrane by acting on it. The local anaesthetic can reach the sodium channel either via the lipophilic pathway directly across the lipid membrane or via the axoplasmic opening. this mechanism accounts for 90% of the nerve blocking effects of amide local anaesthetics.

The second mechanism of action is by membrane expansion .this is a non specific action in contrast to the more specific drug receptor interaction.

PHARMACODYNAMICS:

It has got a longer duration of action but a slower onset.

Cardiovascular system:

It reduces cardiac output by reducing the sympathetic tone, by slowing the heart rate and by reducing the venous return, it produces a fall in arterial blood pressure but it is relatively slow and is seldom very profound. It produces

a fall in central venous pressure. It causes an increase in lower limb blood flow. It causes a reduction in incidence of deep vein thrombosis.

Respiratory System:

It relaxes bronchial smooth muscle. It causes apnea due to phrenic and intercostal nerve paralysis or depression of the medullary respiratory center following direct exposure to drug.

Gastro intestinal tract:

There is an increase in gastro intestinal motility and emptying of the gastric contents are better.

TOXICITY:

Toxicity is related to plasma level of unbound drug and more likely due to an inadvertent intravenous injection. Systemic toxicity reactions primarily involve central nervous system and cardio vascular system. The blood level required to produce central nervous system toxicity is less than that required to produce circulatory collapse.

Central Nervous System Toxicity:

The patient may have circumoral numbness, dizziness, and tongue paresthesia immediately. Blurred vision and tinnitus may follow. Excitatory signs such as nervousness, agitation, restlessness, paranoia will precede central nervous system features (drowsiness, slurred speech, unconsciousness). Tonic clonic seizures follows muscle twitching. Respiratory arrest often follows.

Cardiovascular System Toxicity:

In fast conducting tissue of purkinje fibres and ventricular muscle, the rate of depolarization is decreased. The rate of recovery of bupivacaine induced block is slower than that of lignocaine. Extremely high concentration of the drug causes sinus bradycardia, hypotension, idioventricular rhythms, atrio ventricular heart block, and life threatening arrhythmias such as ventricular fibrillation, ventricular tachycardia and cardiac arrest.

Dosage and preparation available:

The dosage of bupivacaine depends on,

Area to be anaesthetized,The vascularity of the tissue to be blocked,

The number of neuronal segments to be blocked,Individual tolerance and

Technique of local anesthesia.

Available concentrations:

0.25%,0.5%

0.25%,0.5% soluble in isotonic saline

0.5% 0.75% solution in 8% dextrose hy

Perbaric

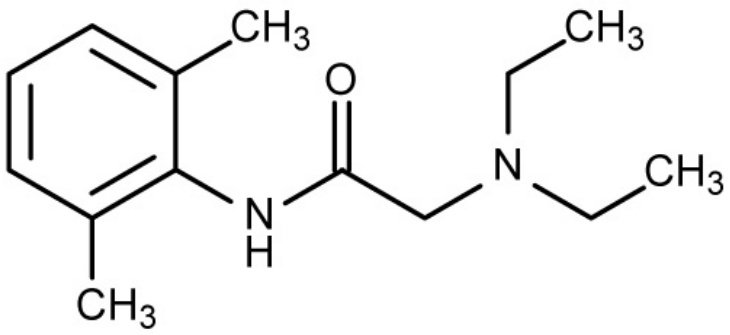
These doses can be repeated in 3-4 hours but maximum dose is 400mg in 24 hours.

Type of block	concentration	Dosage in ml	Dosage in mg
Local infiltration	0.25-0.5%	5-20ml	Upto 75 mg
Brachial plexus block	0.25-0.5%	20-40ml	75-225 mg
Intercostals block	0.25-0.5%	3-5ml	15-20mg per each nerve
Epidural block	0.25-0.5%	15-20ml	50-200mg
Caudal block	0.25-0.5%	15-30ml	75-150mg
Subarachnoid block	0.5%	2-4 ml	10-20mg

PHARMACOLOGY OF LIGNOCAINE[17,18,19,20,21]

Lignocaine was synthesized by Lofgren in Sweden in 1943. Lofgren and Lundqvist discovered its anaesthetic properties in 1948 and it was introduced into clinical practice in 1949 by Gordh.

STRUCTURE



CHEMICAL NAME

Its chemical name is n-diethyl aminoacetyl 2, 6xylidinehydrochlorine monohydrate. It contains a aromatic system attached by a tertiary amine using an intermediate chain. Tertiary amine is a base. Lignocaine is 65% protonated at pH 7.4.

Molecular weight of the base is 234 and that of hydrochloride salt is 270. Its pKa is 7.9.

MECHANISM OF ACTION

The action of a local anaesthetic is on the cell membrane of the axon, on which it produces electrical stabilization. The large transient increase in the

permeability to sodium ions necessary for propagation of the impulse is prevented, thus the resting membrane potential is maintained and depolarized in response to stimulation is inhibited. The rate of rise of the action potential is reduced, causing a delay in conduction and eventually, the propagation of nerve impulse fails.

PHARMACODYNAMICS

a) Cardiovascular system

Lignocaine stabilizes the electrical activity of any excitable tissue. It stabilizes aberrant conduction and the automaticity in abnormal or damaged fibres and suppresses cardiac arrhythmia. So, it is useful in treatment of ventricular arrhythmia.

It causes vasoconstriction at lower concentration and vasodilation at higher concentration due to stimulation and inhibition of calcium release respectively.

b) Central nervous system

It produces sedation, light headedness, sometimes anxiety and restlessness. With more marked toxicity, numbness of tongue, circumoral numbness, muscle twitching and visual disturbance can occur. Severe toxicity proceeds to convulsion and coma with cardiac respiratory depression, as a result of medullary depression.

c) Autonomic nervous system

Preganglionic sympathetic blockade leads to vasodilation.

d) Respiratory system

Plasma levels of 3 to 4 ug/ml increases the sensitivity of medullary respiratory centres to carbon-di-oxide and the slope of the carbon-di-oxide response curve is shifted to the left. On the other hand, plasma levels of 8 to 10 ug/ml produce respiratory depression and flattening of the carbon-di-oxide response curve.

PHARMACOKINETICS

Absorption is slow in regional anaesthesia, where as when given intravenously, peak values are reached immediately.

Molecular weight	234
pKa	7.9
Protein binding	64%
Partition co-efficient	2.9
Volume of distribution steady state	1.3 L
T1/2 (min)	96
Clearance (l/min)	12.6

It is metabolized in liver amide hydrolysis by microsomal enzymes, hydroxylation and dealkylation. 70% of the drug is metabolized during a single passage through liver. One of the metabolite, monoethyl glycinexylidine is moderately toxic and is an effective anti arrhythmic agent.

MAXIMUM SAFE DOSE

Lignocaine with epinephrine – 7mg/kg

Lignocaine without epinephrine – 3mg/kg

AVAILABLE PREPARATIONS

1. 5% heavy for spinal anaesthesia
2. 1% and 2% vial for peripheral nerve blocks and epidural anaesthesia (with and without adrenaline)
3. 2% Lignocaine (without preservative) for intravenous use.
4. Topical solution 2 to 4%
5. 4% topical spray
6. 2.5% Lignocaine in combination with 2.5% Prilocaine as EMLA cream.
7. 2.5 – 5% ointment
8. 2% jelly
9. 10% suppositories
10. 10% aerosol
11. 5% topical patch

REVIEW OF LITERATURE

1. Paediatric anaesthesia (2008 sep ; 18(9) 1838-844)

   Dr. Jose Maria B, Banus E, Navarro egra M, Serranos, Perello M, Mabrok M conducted a randomized comparative study in 80 paediatric patients to compare the efficacy of supraclavicular vs infraclavicular group. Ropivacaine 0.5% was administered up to a maximum of 0.5 ml/kg. They found that the supraclavicular approach of the brachial plexus was faster to perform than the infraclavicular one[22].

2. Chin KJ, Singh M, Velayutham V, Chee V (Anaesthesia& analgesia) 2010 oct ; 111(4):1072 conducted a randomized controlled study to evaluate the efficacy and safety of Infra clavicular block compared to other Brachial plexus block in providing regional anaesthesia of the lower arm. They concluded that infraclavicular block is a safe and simple technique with an efficacy comparable to other Brachial plexus block and more reliable blockade of the musculo cutaneous and axillary nerve [23]

3. Sandhu NS, CapanLM ; British Journal of Anaesthesia, 2002 Aug ; 89(2) : 254-9 conducted an ultrasound guided infraclavicular brachial plexus block in 126 patients and found that an excellent block permitted surgery without a need for any supplemental anaesthetic or conversion to general anaesthesia in 114 patients. They also concluded that the use of

ultrasound has the potential to improve the success & decrease the complications of infraclavicular brachial plexus block [24].

4. J Fredrickson etal ; journal of the association of anaesthetist of Great Britian and Ireland @ 2009 july volume 69, issue 7 pages 738-744 conducted a randomized observer – blinded comparative study between the speed of onset of corner pocket supraclavicular and infra clavicular USG guided brachial plexus block using 2% lidocaine 25-30 ml with adrenaline 5ug/ml. Painless surgery without supplementation was higher in infra clavicular group as a result of more complete anaesthesia in the ulnar Nerve compared with group supraclavicular[25].
5. Salazar CH, Espinosa W. Reg. Anaesthesia pain med 1999 sep – oct 24 (5) conducted an observational study with 3 different local anaesthetic mixtures (group I – 2% lidocaine + 0.5% bupivacaine with adrenaline 1:2,00,000) group II (1% lidocaine + 0.25% bupivacaine with adrenaline 1:2,00,000) &group III (1.5% lidocaine + 0.37% bupivacaine with adrenaline 1:2,00,000) they concluded that the infra clavicular approach is effective. It produes reliable anaesthesia and is associated with minimal complications and side effects [26].
6. Ootaki, Chiyo M.D., Hayashi, Hideaki M.D.(Regional Anaesthesia& pain medicine – Issue 6 – p600-604)conducted a study on ultrasound guided infra clavicular brachial plexus block in 60 patients with 1.5%

lidocaine with 1:2,00,000 epinephrine. In 95%[57 out of60] of patients surgery was performed without supplementation [27].

7. Sandhu NS, Manne IS, Medabalmi PK, Caplan IM J ultrasound Med 2006 Dec 25 (12) 1555-61 conducted a retrospective analysis of 1146 patients. The data from this retrospective study suggest that sonographic guidance provide a high success rate (99.3%) and improved safety and virtually eliminates failure and complications [28].
8. Ponnambala Namasivayam, Vijaya Anandh Mahendran; University journal of surgery and surgical specialities 2015 conducted a randomized controlled study to compare US guided supra clavicular vs infra clavicular brachial plexus block for upper limb surgeries using a local anaesthetic mixtures of 0.5% bupivacaine and 2% llignocaine with adrenaline given in a dose of 0.5ml/kg. They found that infra clavicular approach produces better blockade than supra clavicular approach in spite of longer performance time for infraclavicular block[29].
9. Williams, Stephen R; Chouinard, PhilippeArcand, Genevieve, Harris, Patric, Ruel, Monique, Bondreault, Daniel, Girard, Francois, (Anaesthesia and analgesia November 2003- volume 97- issue 5 – pp151 – 1523) conducted a prospective study in a group of 80 patients& concluded that ultrasound guidance speeds the execution of supra clavicular block[30].

10. Keith Anderson; oxford Journal of anaesthesia (2009) conducted a study on ultrasound guided infra clavicular block. The conclusion of the study is that the infra clavicular brachial plexus blocks are an alternative to supraclavicular block for anaesthetising the upper arm. Complications are rare,less frequent than supra clavicular approach[31].
11. Leonard v Bunting in a study on ultra sound guided infra clavicular brachial plexus block hypothesized that infra clavicular approach was found to have denser anesthesia and fewer complications compared to the supra clavicular approach.
12. Zhi yuen beh,M.shahnaz hasan,Hou yee lai,M.kassim in the year july 2015 published an article on ‘posterior parasaggital in- plane ultra sound guided infra clavicular brachial plexus block’.In this study,they demonstrated that the posterior parasagittal in-plane approach is a feasible and reliable technique with high success rate [32].
13. (Pediatric anesthesia volume 13, issue 2) E. Fleischmann M D,P.Marhofer M D,B.Waltl M D,C.Sitzwohi M D conducted a study comparing lateral Infra clavicular vs axillary approach.They concluded that Infra clavicular brachial plexus blocks can be safely performed in children and that they add to the spectrum of sensory and motor blockade seen with the axillary approach [33].

MATERIALS AND METHODS

Study design: Prospective double blinded Control study

Study population: All patients undergoing elective upper limb surgery

Sample size: 50 patients

Sampling technique: Randomized sampling

Statistical test of significance: Student's unpaired t test, Chi square test

After obtaining approval from the institutional ethical committee, Thanjavur medical college, thanjavur, the study was conducted in 50 ASA I and ASA II patients ,aged from 17 to 60 years who underwent elective upper limb surgeries. 2 groups of 25 each were seperated and named supra clavicular block and the other group infraclavicular block. Before including the patients for the study, all patients were explained about the procedure and written informed consent was taken from the patient and the patient's attenders. Result values were recorded using a preset proforma.

INCLUSION CRITERIA:

1.ASA grade1/2.

2. Elective upper limb surgeries

3. Patients of either sex aged 17-60 years

4.Total body weight 40-60kg

EXCLUSION CRITERIA:

1. Patient refusal
2. Patient with coagulopathy / peripheral neuropathy
3. Allergy to local anaesthetics

Each patient was randomly allocated into one of the two groups of 25 patients each using computerized random numbers.

GROUP SC: Supra clavicular brachial plexus given with ultrasound guidance.

GROUP IC: Infra clavicular brachial plexus block given with ultrasound guidance

Block was performed with 15 ml of 0.5% bupivacaine and 15 ml of 1.5% lignocaine with adrenaline 1:2,00,000 in both the groups.

PREANAESTHETIC EVALUATION:

Pre-anaesthetic evaluation was conducted for all the patients. The patients were suitably treated if there was any significant comorbid medical illness. Basic investigations such as Hemoglobin (Hb%), bleeding time, clotting time, serum urea, serum creatinine, blood sugar, electrocardiography (ECG) and chest X-ray PA view were done.

As per the fasting guidelines, all the patients were kept nil per oral. Tablet alprazolam 0.5 mg and tablet ranitidine 150 mg were given to all patients the night before surgery. Written informed consent was taken.

IN THE OPERATING ROOM

Peripheral intravenous line was accessed using 18 G intravenous cannula. Intravenous fluid was started for all patients and was shifted to operating room.

EQUIPMENTS:

a. FOR THE PROCEDURE:

A sterile tray containing,

1. Disposable syringes – 10 ml, 5 ml
2. Bowl containing surgical spirit and sterile gauze pieces
3. Towels and towel clips
4. Sponge holding forceps
5. Drugs: 15 ml of 0.5% bupivacaine and 15 ml of 1.5% lignocaine with adrenaline (1:2,00,000)
6. 10cm and 50 cm extension line
7. 20 G sonoplex needle

Sonoray DS – 50 ultrasound machine with 10-6 MHz linear transducer

b. FOR EMERGENCY RESUSCITATION

The anaesthesia workstation, laryngoscope with appropriate size blades, correct size connectors and endotracheal tubes were kept ready.

- Airways (oropharyngeal and nasopharyngeal)

- suction apparatus with a suction catheter
- Anaesthetic agents and resuscitation drugs
- IV fluids were kept ready

MONITORS: Pulse oximetry, non – invasive blood pressure monitor and electro-cardiogram (ECG) were connected and baseline parameters were recorded for all patients. Injection midazolam 0.05mg/kg intramuscularly was given as pre-procedure anxiolytic.

POSITIONING FOR BOTH THE PROCEDURES:

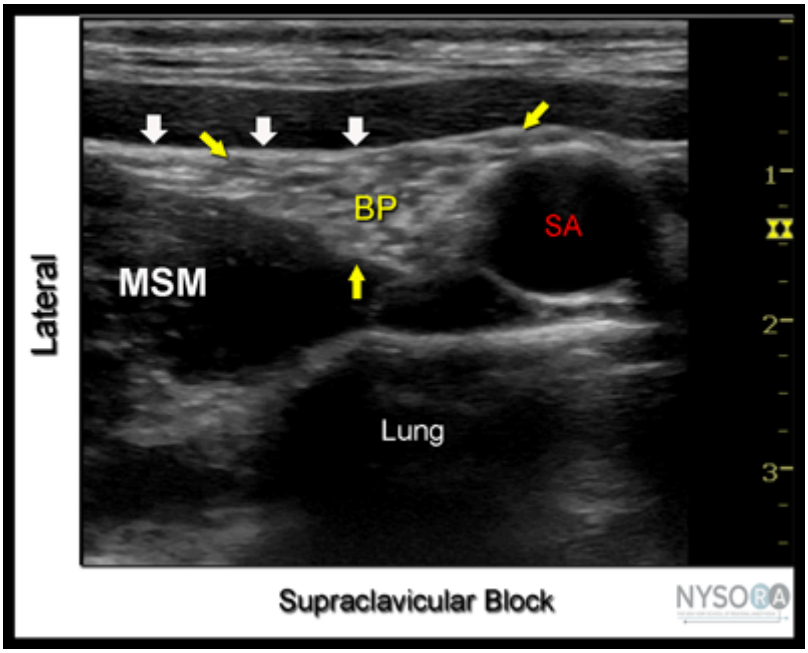
With head end of the table elevated, patient was made to lie supine and head turned to opposite side, arm adducted for supraclavicular approach, abducted for infraclavicular approach and hand extended along the side towards the ipsilateral knee as far as possible. A folded sheet or small pillow was placed below the shoulder making the area more approachable.

GROUP SC, ULTRASOUND[3,4,34]:

In group sc, after real time visualization of the vessels, nerves and bones with “in-plane approach” block was performed. This procedure was done using Sonoray ultrasonogram machine with 10-6 MHz transducer by the using 20G sonoplex needle. After sterile preparation of the skin and ultrasound probe, procedure site was draped. The brachial plexus was visualized by placing the transducer in the sagittal plane in the supraclavicular fossa behind the middle-

third of the clavicle. Two distinct appearance of the brachial plexus was seen at the supraclavicular region, it either appeared as 3 hypoechoic circles with hyperechoic outer rings or as a grape like cluster of 5 to 6 hypoechoic circles, located lateral and superior to the subclavian artery between the anterior and middle scalene muscles at the lower cervical region.

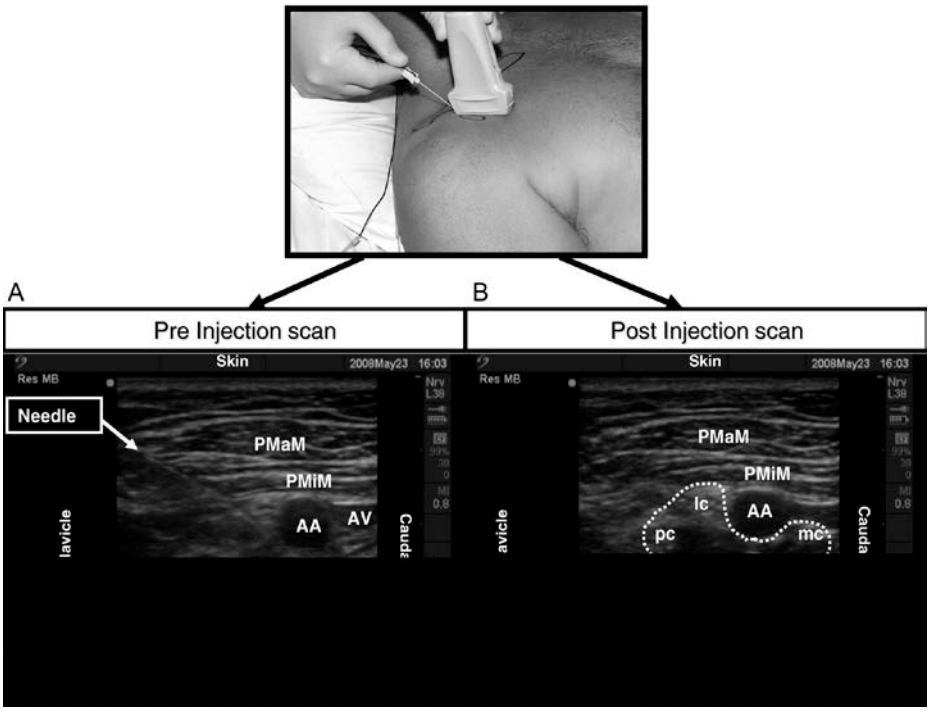
A 20 G sonoplex needle was connected to a 10 cm extension line, which in turn was connected to a 10 ml disposable syringe containing the local anaesthetic solution. The whole line was primed with the drug. Then the needle was inserted from the lateral end of transducer from the lateral to medial direction and the needle movement was observed in real time.



Once the needle reached the plexus, predetermined volume of 30 ml of local anaesthetic solution was administered inside the brachial plexus sheath after negative aspiration of blood to avoid accidental intravascular needle

puncture and the spread of local anaesthetic drug was observed in tissue planes. Initially, the needle was placed deep to the more caudal elements of the plexus so that the brachial plexus rises closer to the skin surface with the injection of local anaesthetic solution.

Under sonographic vision, the proper spread of local anaesthetic solution around the considered nerves was regularly monitored, and needle tip position was regularly adjusted with minor movements during injection. The multiple injection technique was used to deposit the total amount of drug . 3-minutes massage was performed to facilitate an even drug distribution.



GROUP IC, ULTRASOUND GUIDANCES

In group IC, after real time visualization block was performed. This procedure was also done using sonoray ultrasonogram machine with 10.6 MHz

transducer by the “in plane approach” using 20 G sonoplex needle. The arm is abducted to 90 degree. This method reduced the distance between skin and the plexus facilitating visualization of the pectoralis muscles and the brachial plexus cords.

After disinfecting the area and draping, just inferior to the clavicle and medial to the coracoid process scanning usually begins. Injecting the local anaesthetic until its spread surrounding the artery is documented by ultrasound is the goal of the technique. It is not mandatory to identify and target individual cords. Instead injecting the local anaesthetic in a U-shaped pattern surrounding the artery (cephalad, posterior and caudal) is enough for blocking all the three cords.

The transducer is positioned in the parasagittal plane to identify the axillary artery which can be made between 3-5 cm and if it is done, the hyperechoic cords of the brachial plexus identified.

A 20 G sonoplex needle was connected to a 50 cm extension line which in turn was connected to a 10 ml disposable syringe containing the local anaesthetic solution. The whole line was primed with the drug. With the point of insertion just inferior to the clavicle, from the cephalad aspect the needle is inserted “in-plane “. By aiming the needle towards the posterior aspect of the axillary artery crossing the pectoralis group of muscles, and by careful aspiration, 1 to 2 ml of local anaesthetic is injected thereby confirming the

needle placement properly and all the three cords are blocked by spreading 30 ml of local anaesthetic.

ASSESSMENT OF PARAMETERS:

All the patients were monitored for

- Time taken for the procedure
- No. of needle advancement
- Overall effectiveness of block
- Success rate
- Commonly escaped nerve
- Incidence of complications

TIME TAKEN FOR THE PROCEDURE:

In both the groups, the time taken for the procedure is calculated from the time of insertion of needle to its removal.

ASSESSMENT OF SENSORY BLOCKADE:

Hollmen's sensory scale was used to evaluate sensory blockade:

Sensory block was assessed by pin prick with 23 G hypodermic needle in skin dermatomes supplied by four major nerves (radial, median, ulnar and musculocutaneous nerves) once in every minute for initial 5 minutes and then every 2 minutes upto 10 minutes and then every 5 minutes for 30 minutes and every half an hour after that.

1. Normal sensation of pin prick
2. Pinprick felt as sharp pointed but weaker compared to the area in the opposite limb
3. Pinprick recognized as touch with blunt object
4. No perception of pin prick

ASSESSMENT OF MOTOR BLOCKADE:

Lavoie's scale was used for evaluation of motor blockade

0% block - flexion and extension in both the hand and arm against resistance

33% block - flexion and extension in both the hand and arm against gravity but not against resistance

66% block - flexion and extension movements in the hand but not in the arm

100% block - no movement in the entire upper limb

OVERALL EFFECTIVENESS OF THE BLOCK:

1) Totally effective: indented surgical procedure being able to be performed with no sedation. For statistical convenience, Hollmen's sensory scale 3 or 4 in areas supplied by all four major nerves of upper limb after 30 minutes of the procedure were considered as totally effective block.

2) Partially effective: intended surgical procedure being able to be performed with minimal sedation. Patients with Hollmen's sensory scale 3 or 4 in 2 or 3 major nerve distribution areas and scale 2 or 3 in the areas supplied by 1 or 2 major nerves after 30 minutes of the procedure, were considered as partially effective blocks. The patients were sedated intraoperatively after the block was classified (i.e. after 30 minutes of the procedure). When required, injection pentazocine (0.5 mg/kg) bolus dose and intermittent doses of injection ketamine (0.5 mg/kg) was given intravenously to supplement the anaesthesia.
3) Failed block: intended surgical procedure not being able to be preformed under the block, and requiring conversion to general anaesthesia. Hollmen's sensory scale less than or equal to 2 in more than 2 major distribution areas even after 30 minutes of the procedure were considered as failed block.

SUCCESS RATE:

All the totally and partially effective blocks were considered as successful blocks in this study.

COMPLICATIONS:

Patients were observed intraoperatively and 24 hours postoperatively for complications.

INTRAOPERATIVE COMPLICATIONS:

1. Vessel puncture and hematoma formation
2. Any toxic or allergic reaction to the drug

POSTOPERATIVE COMPLICATIONS:

1. Nerve injury
2. Pneumothorax
3. Phrenic nerve block
4. Horner’s syndrome
5. Recurrent laryngeal nerve block

All the patients were administered with supplemental oxygen and intravenous fluids throughout the operative procedure.

OBSERVATON AND RESULTS

This prospective single blinded randomized controlled study was done in 50 ASA I and II patients of either sex aged from 17 to 60 years who underwent upper limb surgeries under ultrasound guided supraclavicular and ultrasound guided infraclavicular brachial plexus block.

Comparison of ultrasound guided supraclavicular and infraclavicular block on the basis of

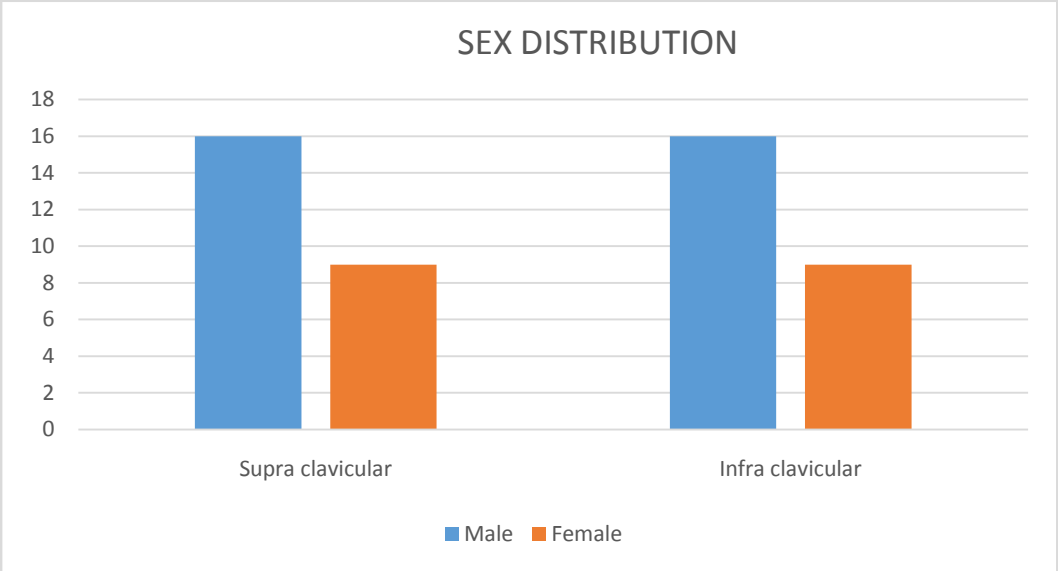
1. Gender of the patients
2. Weight of the patients
3. Time taken for procedure
4. No. Of needle passes
5. Overall effectiveness
6. Success rate
7. Analgesic supplementation
8. Conversion to GA
9. Commonly escaped nerves
10. Complications

TABLE 1

Comparison of Ultrasound Guided Supraclavicular and Infraclavicular Block on the Basis of Gender of the Patients.

Group		Frequency	Percent
SC	MALE	16	64.0
	FEMALE	9	36.0
	Total	25	100.0
IC	MALE	16	64.0
	FEMALE	9	36.0
	Total	25	100.0

As shown in table 1 and graph 1, the male:female ratio in group SC and group IC where 16:9 and 16:9 respectively. The groups are comparable.



GRAPH 1 **Comparison of Ultrasound Guided Supraclavicular and Infraclavicular Block on the Basis of Gender of the Patients**.

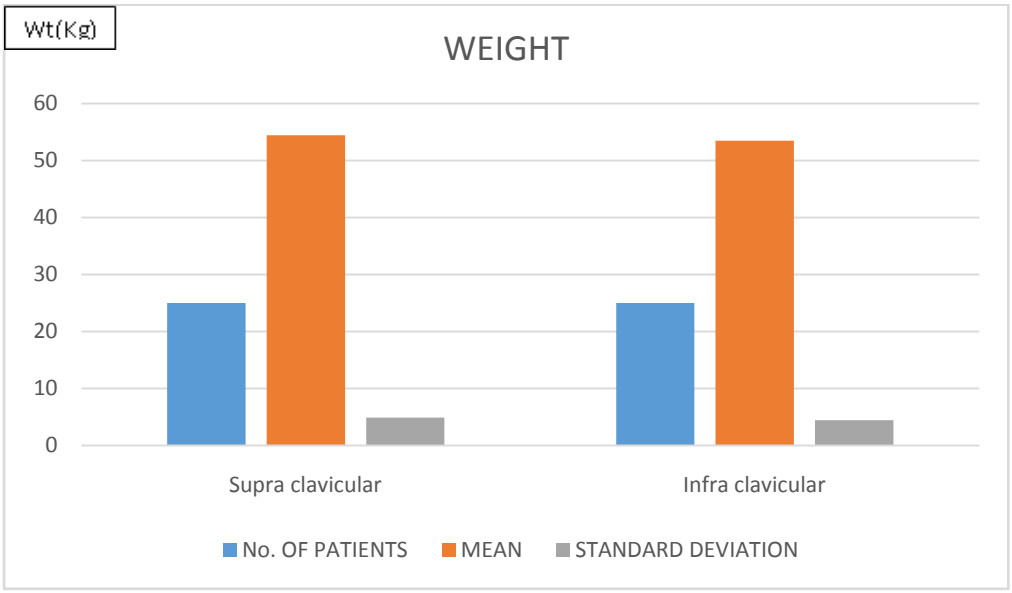
TABLE 2

Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Weight Of The Patients.

	Group	No. Of patients	Mean	Std. Deviation	P value By t test
WT{KG}	SC	25	54.44	4.89	0.471
	IC	25	53.48	4.44	

Student's unpaired t test

P value - 0.471(>0.05) Not significant



GRAPH 2 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Weight Of The Patients.**

TABLE 3

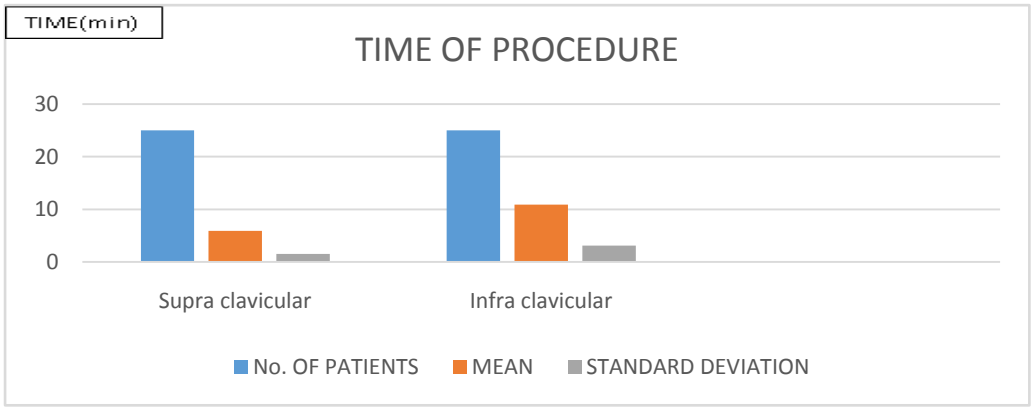
Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Time Taken For The Procedure.

	Group	No. Of patients	Mean [min]	Std. Deviation	P value by t test
TIME OF PROCEDURE	SC	25	5.88	1.53	
	IC	25	10.88	3.11	0.0001

Student's unpaired t test

P value-0.0001 (<0.01) **Highly significant**

This statistical analysis by students unpaired t test showed that ultrasound guided supraclavicular block was significantly faster to perform when compared to ultrasound guided infraclavicular block



GRAPH 3 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Time Taken For The Procedure.**

TABLE 4

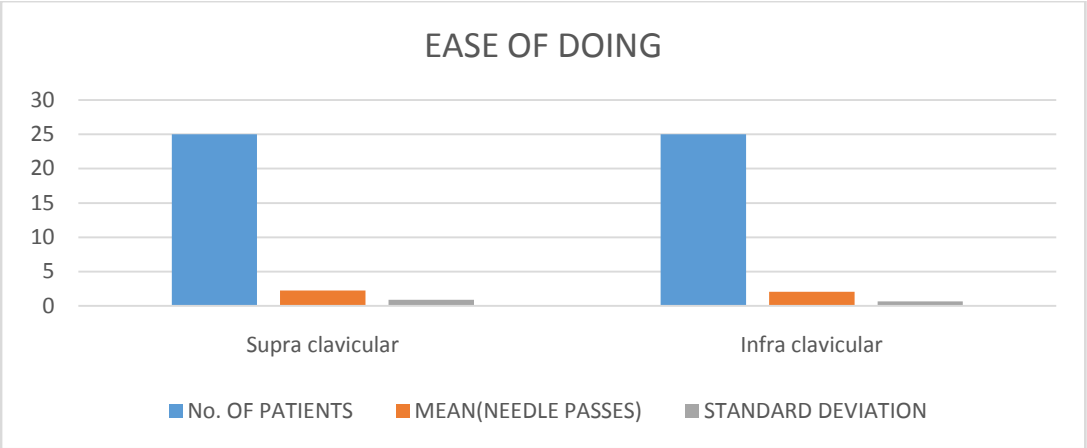
Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Number Of Needle Advancement

	Group	No.Of patients	Mean (needle passes)	Std. Deviation	P value By t test
No. OF NEEDLE ADVANCEMENT	SC	25	2.24	0.879	
	IC	25	2.04	0.67	0.37

Student's unpaired t test

P value-0.37(> 0.05) Not significant

Number of needle passes in ultrasound guided infraclavicular brachial plexus block is less then compared with ultrasound guided supra clavicular brachial plexusblock



GRAPH 4 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Number Of Needle Advancement**

TABLE 5

Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Overall Effectiveness Of The Block

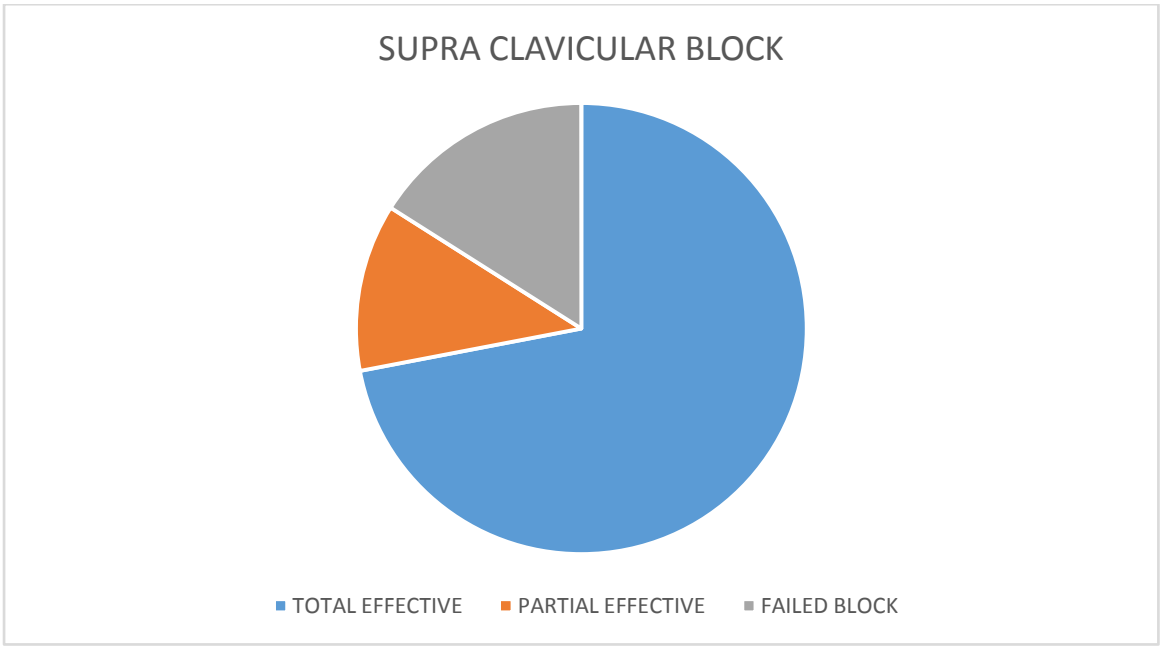
Group	**Overall Effectiveness**				**Fischer Exact**
	Totally Effective	**Partially Effective**	**Failed Block**	**Total**	**P value**
SC	18	3	4	25	
IC	23	0	2	25	
Total	41	3	6	50	0.05

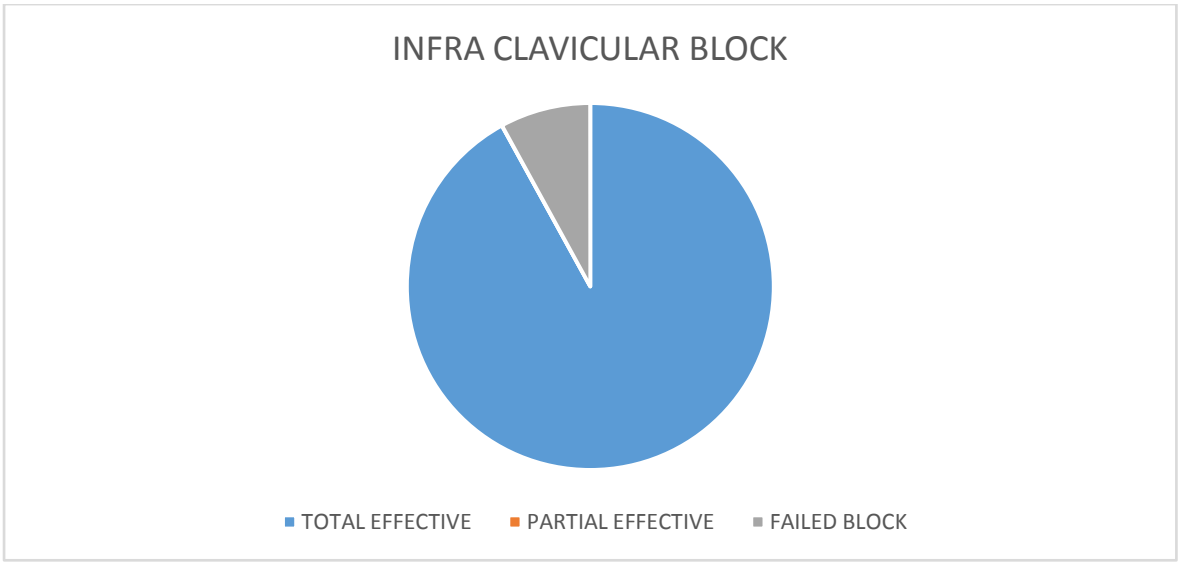
]Fischer exact P value

P value – 0.05 **Significant**

The statistical analysis by Fischer exact p value showed that ultrasound guided infraclavicular brachial plexus block is overall

effective when compared with ultrasound guided supraclavicular brachial plexus block.





GRAPH 5

Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Overall Effectiveness Of The Block

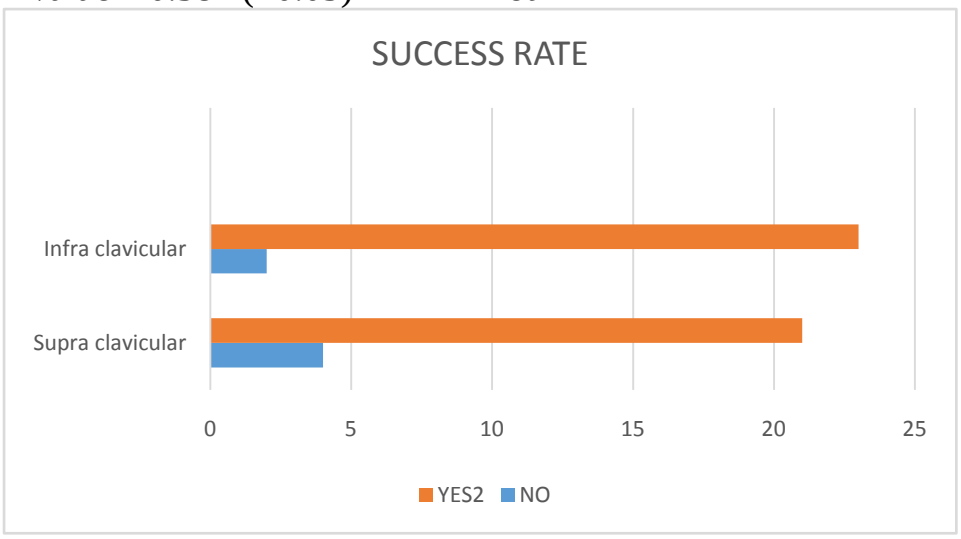
TABLE 6

Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Success Rate

Group	Success Rate [No.of Patients]		Total	X^2 test p value
	YES	NO		
SC	21 (84%)	4 (16%)	25	0.38
IC	23 (92%)	2 (8%)	25	
Total	44	6	50	

Chi square test

P value – 0.384 (>0.05) Not significant



GRAPH 6 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Success Rate**

TABLE 7

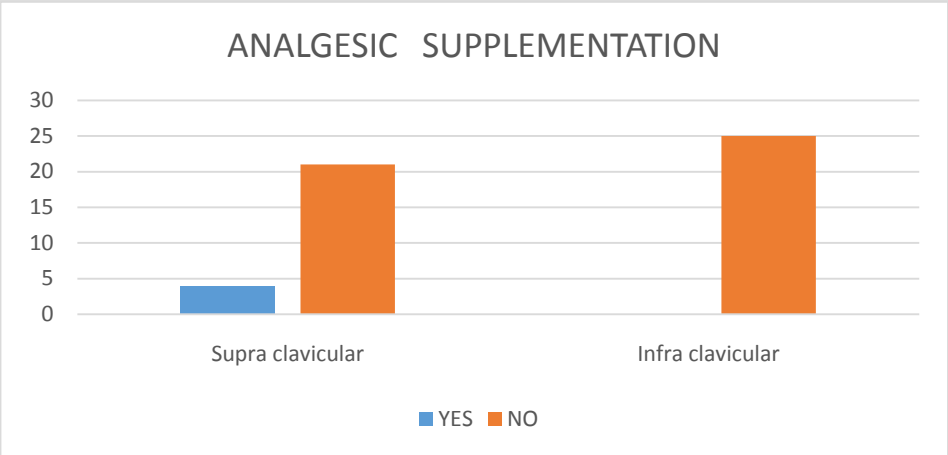
Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Analgesic Supplementation

Group	Analgesic Supplementation		Total	X^2 test p value
	YES	NO		
SC	4 (16%)	21 (84%)	25	0.037
IC	0 (0%)	25 (100%)	25	
Total	4	46	50	

Chi square test

P value – 0.03 (<0.05) Significant

The requirement of intra operative analgesics was reduced in ultrasound guided infraclavicular brachial plexus block.



GRAPH 7 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Analgesic Supplementation**

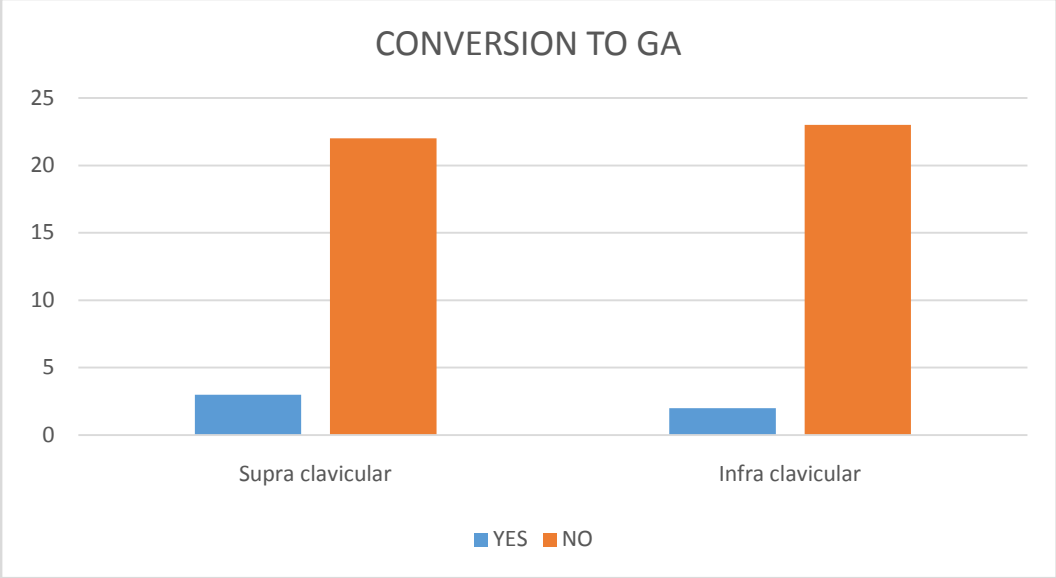
TABLE 8

Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Requirement Of General Anaesthesia

Group	Conversion to GA		Total	**X^2 test p value**
	YES	NO		
SC	3 (12%)	22 (88%)	25	0.63
IC	2 (8%)	23 (92%)	25	
Total	5	45	50	

Chi square test

P value -0.63(>0.05) Not significant



GRAPH 8 **Comparison Of Ultrasound Guided Supraclavicular And Infraclavicular Block On The Basis Of Requirement Of General Anaesthesia**

TABLE 9

COMMONLY ESCAPED NERVES

NERVES	USG GUIDED SUPRA CLAVICULAR BLOCK	USG GUIDED INFRA CLAVICULAR BLOCK
Axillary Nerve	-	-
Ulnar Nerve	3	-
Radial Nerve	-	-
Median Nerve	-	-
Medial Cutaneous Nerve of Arm	-	-
Medial Cutaneous Nerve of Forearm	-	-
Musculocutaneous Nerve	-	-

TABLE 10

COMPLICATIONS

	SUPRACLAVICULAR BLOCK	INFRA CLAVICULAR BLOCK
Vessel Puncture	4	-
Phrenic N Block	-	-
Horner's Syndrome	-	-
Recurrent Laryngeal Nerve Injury	-	-
Pneumothorax	1	-
Nerve Injury	-	-

DISCUSSION

Surgical procedures involving hand and forearm can be performed either with general anaesthesia or regional anaesthesia techniques. In general anaesthesia, patients have the risks of airway manipulation, hemodynamic instability,post operative cognitive dysfunction and post-operative nausea and vomiting. Anaesthesia with regional techniques can overcome the complications associated with general anaesthesia. Also regional anaesthesia techniques have the advantage of decreasing morbidity, mortality, providing superior post-operative analgesia, being cost effective and lower in the rate of serious complications when compared to general anaesthesia. Regional anaesthetic technique with peripheral nerve block enables the patients to be discharged on the same day, thus facilitating day care surgery.

In upper limb the entire sensory and motor blockade can be achieved by blocking the brachial plexus and has stood the test of time for upper limb surgeries. Interscalene block, supra clavicular block and axillary blocks are routinely performed blocks for upper limb surgeries. Infra clavicular block has been commonly used recently. Among the various approaches of brachial plexus block, supraclavicular block is considered the easiest, and it also provides the most reliable, uniform, predictable anaesthesia for upper extremity and blocks at the level of trunks and divisions.

Hence it is one of the most popular techniques used for upper limb surgeries. Recently, Infraclavicular block is also considered as effective as supraclavicular block. The cords of the brachial plexus are blocked in Infraclavicular approaches where the block is performed at the level of trunks and divisions. It is an excellent block for providing either surgical anaesthesia or postoperative analgesia for all distal upper limb procedures. This block is typically performed between the anterior shoulder and chest wall, in the deltopectoral groove. It is considered that, supra clavicular approach is associated with more incidence of pneumothorax. Infraclavicular block is supposed to decrease the risk of pneumothorax. Hence, it is decided to compare the efficacy and complications of supra and Infra clavicular approaches of brachial plexus block.

Initially nerve blocks were performed with elicitation of paraesthesia. The classical approach using paraesthesia was a blind, landmark technique and be associated with higher failure rates and injury to the nerves and surrounding structures. Later nerve stimulator was invented with higher success rate and to decrease the complications. This technique ensures a better blockade than conventional paraesthesia technique. Both the landmark and nerve stimulator techniques can cause neurovascular injuries, which will lead to permanent nerve damage, injury to the pleura leading to pneumothorax and also had more failure rates.

The problem with landmark technique is that the landmarks are variable from patient to patient. When searching blindly for the plexus, needle with the sharp edge can damage or pierce the vessels, nerves and other anatomical structures. Ultra-sonogram is a real time imaging radiological tool. Working with radiological tool gains more importance than paresthesia and peripheral nerve stimulator technique. By applying for exact localization of plexus / nerves and vessels, this technique has revolutionized the regional anaesthesia field, in where suitable frequency ultrasound probes have been successfully tried. Due to the advantage of real time visualization, ultrasonogram reduces the number of needle passes to reach the target nerve groups, which in turn shorten the block performance time, and increases the success rate.

The success rate of for both type brachial plexus blocks has been improved by ultrasound with perfect localization as well as appreciable safety margin. Ultrasonogram is better than any other radiological tool for needle guidance in peripheral nerve block. It also provides real time examination of the nerve, and also it provide visualization of the needle manipulation and local aaesthetic spread.

DOSE OF THE DRUG:[35,36,37]

We have used 30ml of 1:1 ratio of 0.5% inj. bupivacaine and 1.5% of inj. lignocaine with adrenaline for both the groups

According to Trans et al [35], the effective volume of local anesthetic solution in supraclavicular block in 90% patients using ultrasound technique was 32ml. Dae geun joen et al[37] in the Korean journal of anesthesia published a study in which they mentioned that ED90 for local anaesthetic solution was 30ml without any toxic effects.

Gajendra singh et al[36] also used the same drug combination for ultrasound guided nerve blocks.

A Study conducted by duggan, El beheiry, perlas on the minimum effective volume of local anesthetic for ultrasound guided supra clavicular brachial plexus block showed that ED50 is 23ml and ED95 is 42ml without any major complications. The minimum effective volume was determined using Dixon and massey up and down method.

De Q.H. Tran, Shubada Dugani conducted study on the minimum effective volume of lidocaine for ultrasound guided infraclavicular block. They conducted the study with 1.5% inj.lignocaine with 5 microgram/ml epinephrine-35ml.

Kapral S, krafft p conducted a study on the ultrasound guided supraclavicular approach for regional anesthesia of the brachial plexus. They conducted the study using 0.5% bupivacaine – 30ml.They compared ultra sound guided supra clavicular and ultra sound guided axillary block and concluded that ultrasound guided approach for supra clavicular block combines the safety of axillary block with the larger extent of the block of the supra clavicular approach.

Subramanyam et al in a study compared lateral vs medial needle approach for ultrasound – guided supra clavicular block.They used 30 ml local anesthetic mixture [1:1 ratio of 2% lignocaine and 0.5% bupivacaine with 1:200000 epinephrine]was injected to all patients.

BLOCK EXECUTION TIME:[38]

In our study, block execution time for ultra sound guided supra clavicular block was lesser when compared with the time taken for ultrasound guided infra clavicular block.

According to Arab SA et al,block performance time for single injection Ultrasound guided supra clavicular brachial plexus block was shorter compared to triple injection technique.

In Ultrasound guided Supraclavicular versus Infraclavicular brachial plexus nerve block done by Amany El sawy , nawsha nabil mohammed

,ultrasound guided supraclavicular block showed block performance time of 9 minutes in a study done by chan and his colleagues and 5 min in a study done by Williams and his colleagues.

For the performance of an infraclavicular block sandu and capan used 10mins , Dingemans and his colleagues used 3.1 mins , Gurkan and his colleagues used 7.1 mins and and sauter and his colleagues used 4.1 mins.

The block performance time taken by infraclavicular block is larger than the supraclavicular block in our study.This may be due to the fact that it depends on the experience of the anaesthesiologist and also the difficulty to reach the posterior cord which is deeply placed in position and also the medial cord which is placed in between the axillary artery and the axillary vein.

Ponnambala namasivayam and his colleagues in a study showed that supraclavicular block has shorter performance time than infraclavicular block.

De jose maria et al , in a study comparing Ultra sound guided supra clavicular and Ultra sound guided infra clavicular block in children concluded that supraclavicular approach was faster to perform than infraclavicular one.

Williams et al , in a study concluded that ultrasonic guidance decreases the block execution time of supraclavicular block.

Shweta S Mehta, Dr shruti M shah[38] in a comparative study of supraclavicular brachial plexus block by nerve stimulator vs ultrasound guided

method concluded that the ultrasound guided supra clavicular brachial plexus block carries the advantage with less number of needle passes and speedy performance

This study was supported by Ahmed et al Daba et al, supraclavicular brachial plexus with ultrasound required shorter duration of time.

COMMONLY ESCAPED NERVES:[25,29]

In our study,we encountered sparing of ulnar nerve in 3 patients in the ultrasound guided supra clavicular block. Fredrickson MJ et al[25] in a study on ‘Speed of onset of corner pocket supraclavicular and infra clavicular ultrasound guided brachial plexus block’concluded that,Out of the 11 failures in group supraclavicular ,many were due to incomplete ulnar nerve territory anesthesia.

Ponnambala namasivayam et al[29] in their study concluded that the sensory block of ulnar nerve was significantly better in Group infra clavicular with ‘p’ value of 0.013. This may be due to the fact that we encountered difficulty in reaching the corner pocket between the first rib and the subclavian artery in Group Supra clavicular. This is the site where lower trunks are situated. Hence the result of sensory block of ulnar nerve were better with infraclavicular approach than with the Group- Supra clavicular.

Subramanyam et al in a study showed that the rate of onset of ulnar nerve blockade in ultrasound guided supra clavicular block was much lower and thus ulnar sparing remains an issue. It effects in the understandable reluctance of the anesthetist in placing the needle tip resulting in local anesthetic close to the rib, fearing puncture of pleura.

OVERALL EFFECTIVENESS OF BLOCK[24,28,30]

Out of the 25 cases studied under ultrasound guided supraclavicular group 18 were totally effective ,3 partially effective and 4 failed block. Thus, 72% attained complete block, 12% had partial blockade and 16% failed block.

Out of the 25 cases studied under ultrasound guided infraclavicular group, 22 blocks were totally effective,no partial block and 2 failed block. Thus 92% attained complete block and 8% failed block.This was statistically analysed and fischer exact p value was 0.05(significant)

Thus the IC group has significantly higher success than the SC group.

According to N.S. Sandhu and L.M. Caplan [24] , ultrasound guidance improves the effectiveness of infraclavicular block.

Arcand G Williams SR[30] in a study compared ultrasound- guided infraclavicular and supraclavicular blocks. They hypothesized that infraclavicular approach would result in a similar quality of block that of supraclavicular block.

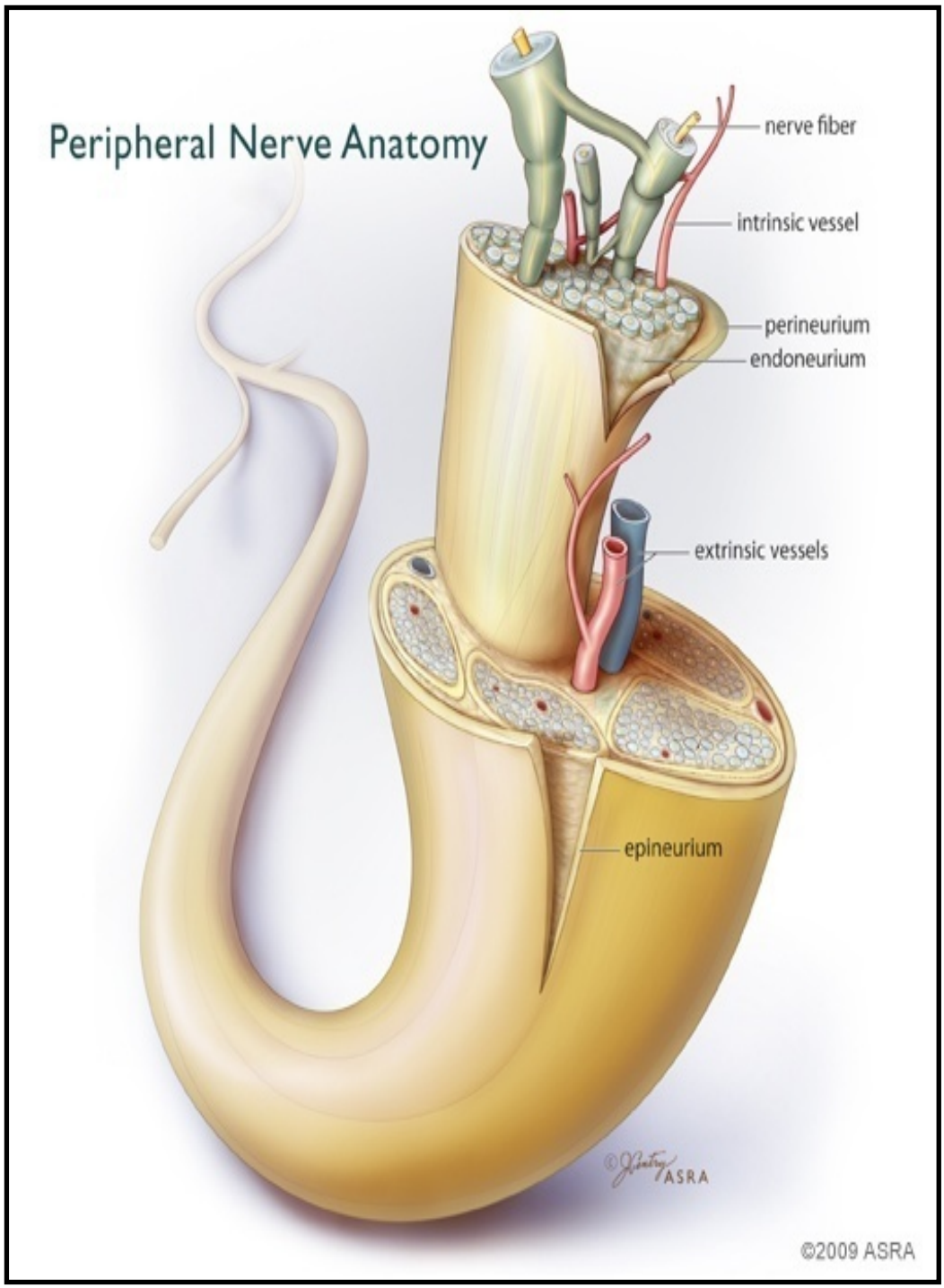
Marhofer et al found that ultrasound guidance improves the overall success rate for infraclavicular block than nerve stimulation.

Sandhu NS, Manne JS[28] conducted a retrospective study in 1146 cases of sonographically guided infraclavicular brachial plexus block. In 1138 patient, the block was successful.

Bowens et al demonstrated 96% success rate when the posterior cord [6 o' clock] position was targeted during the block and all patients had a pain score </= 3 in the post operative period.

Vienna group recently studied that lateral infra clavicular block of the brachial plexus by using ultrasound guidance was found to be successful in all the children, providing excellent anesthesia.

According to Joseph M Neal et al, patterns of local anesthetic blockade and clearance are determined by peripheral nerve anatomy. Mantle fibres on the nerve's periphery first absorbs the local anesthetics, resulting in blockade that manifests itself proximal to distal. Conversely, distal to proximal pattern is followed by block resolution, suggesting that local anesthetic is preferentially cleared from the core fibres by the core's vascularity. This was supported by Bigeleisen PE et al in a study on quantitative architecture of the brachial plexus and surrounding compartments and their possible significance for plexus blocks.


Peripheral Nerve Anatomy
nerve fiber
intrinsic vessel
perineurium
endoneurium
extrinsic vessels
epineurium
ASRA
©2009 ASRA

ANALGESIC SUPPLEMENTATION[29]

In our study, out of 25 patients,4 patients in ultra sound guided supra clavicular group required analgesic supplementation [inj fentanyl 2micrograms/kg and inj.midazolam 0.05mg/kg.

Ponnambala namasivayam et al[29] in a randomized controlled study comparing ultrasound guided supraclavicular and infraclavicular block for upper limb surgeries compared 60 patients in supra clavicular group and 60 patients in infraclavicular group. Out of the 60 patients in supra clavicular group, 18 patients were supplemented with inj. midazolam 0.25mg/kg and inj .fentanyl 1microgram/kg intraoperatively and 4 patients were supplemented inj. midazolam 0.25mg/kg alone intraoperatively .

In Infraclavicular group, out of the 60 patients, 9 patients were supplemented with inj. midazolam 0.25mg/kg and inj. fentanyl 1microgram/kg intraoperatively, 7 patients were supplemented with inj. midazolam 0.25mg/kg alone intraoperatively. Hence our study concludes that patients in infraclavicular block requires less intra operative supplementation than supraclavicular block

COMPLICATIONS[39,40]

Loubert et al, Williams et al[39] in a study concluded that ultrasound guidance may reduce but not eliminate complications of peripheral nerve blocks.

Bhatia et al described the incidence of pneumothorax using Ultrasound guided supraclavicular block is 0.7% in a case report.

Klastaad et al[40] conducted a study of brachial plexus block with or without Ultrasound guidance. In that study, he reports that studies were not large enough to conclude that ultrasound will reduce the risk of nerve injury,local anesthestic toxicity or pneumothorax.

Kapil gupta et al in a study concluded that despite using the correct technique and latest devices like the ultrasound, while performing brachial plexus block one should keep high index of suspicion of pneumothorax.

Subramanyam et al found out that although the incidence of pneumothorax in ultra sound guided supra clavicular is reduced and may be avoided in experienced hands,reports still continue to appear.

In 1999,kapral and colleagues presented their lateral infra clavicular approach to the brachial plexus which is as safe as the axillary approach in terms of complications.

The findings of Greher and colleagues suggest that all infra clavicular brachial plexus blocks should be performed under ultrasound visualization.The distance between the brachial plexus and pleura can be increased by selecting a more lateral approach,to avoid inadvertent puncture of the cervical pleura.

SUMMARY

50 patients of ASA grade 1 and 2 undergoing upper limb surgeries were randomly assigned into two groups,group SC and group IC.group SC received ultrasound guided supra clavicular block.group IC received ultrasound guided infra clavicular block.15 ml of 0.5% bupivacaine and 15 ml of 1.5% lignocaine with 1:200000 adrenaline as the local anaesthetic was used for both the groups.

Parameters observed were block performance time, overall effectiveness of block, commonly escaped nerves, analgesic supplementation and complications

This study shows that :

Block performance time required for ultrasound supra clavicular block is shorter compared to ultrasound guided infra clavicular block.

Escape of nerves is slightly more in ultrasound guided supra clavicular block.

Overall effectiveness of the block is better in ultrasound guided infra clavicular block.

Complications is also less with ultrasound guided infra clavicular block compared with ultrasound guided infra clavicular block.

CONCLUSION

From our study, we conclude that, ultrasound guided infra clavicular block for upper extremity surgeries when compared to ultrasound guided supra clavicular block has better overall effectiveness, associated with less escaping of nerves and less complications.only limitation of ultrasound guided infra clavicular block is that it takes a longer time to perform than the ultrasound guided supra clavicular block.

BIBLIOGRAPHY

1. "PART III : Pain terms, A current list with definitions and notes on usage " [PP 209-214] . Classification of chronic pain, second edition,IASP taskforce on taxonomy, edited by H.Merskey, N.Bogdue IASP press, Seatle, 1994.

2. RAJ PP Historical aspects of regional anaesthesia 1st ed chapter 1 in : textbook of regional anaesthesia, 2002 may p 3-15

3. Carty S, Nicholls B : Ultrasound guidance for regional anaesthesia. Contin educ. anaesthesia crit care pain 2007; 7:20.4

4. Grey AT. Ultrasound guidance for regional anaesthesia. In : Miller RD, editer Miller's anaesthesia 7th ed. philadelphia: Churchill living stone Elsevier, 2010 p 1675-86

5. Lee JA, Atkinson RS, Rushman GB. A synopsis of anaesthesia 10th ed. England IOP publishing Ltd; 1987.p.618

6. 1964 - Winnie & Collins - A.P Winnie and V.J. Collins. The subclavian perivascular technique of Brachial plexus anaesthesia Anaesthesiology; may - june 1964.

7. Marhofer P, Schrogendorfer K, Wallner T, koinig H, Mayer N, Kapral S. Ultrasonographic guidance reduces the amount of local anaesthetic for 3 in 1 blocks. Regional anaesthesia and pain medicine 1998; 23(6) : 584 - 588

8. Eichenberger U, Stocklis, Marhofer P, et al. Minimal local anaesthetic volume for peripheral nerve block, a new ultrasound guided, nerve dimension based method. Regional anaesthesia and pain medicine 2009;34(3) : 242-246.

9. Latke D; Marhofer P, Zeitlinger M et al. Minimal local anaesthetic volumes for sciatic nerve block; evaluation of ED 99 in volunteers British Journal of Anaesthesia 2010; 104(2): 239-244

10. Marhofer P, Eichenberger U, Stocklis, et al. Ultrasonographic guided axillary plexus blocks with low volumes of local anaesthetics;a cross over volunteer study anaesthesia 2010; 65(3) : 266-271

11. Harold Ellis Stanley Feldman, The Brachial plexus; Anatomy for Anaesthetists 8th edition, 2004,153-180

12. Barys Ihnatsenka and Andre p Boezaart applied sonoanotomy of the posterior triangle of the neck international journal shoulder surgery. 2010 jul - sep; 4(3): 63-74

13. Cart wright MS, shin HW, passmore LV, Walker Fo, ultrasonographic findings of the normal ulnar nerve in adults; arch phys med Rehabil 288(3); 394-396, 2007.

14. Scanlan KA Sonographic artifacts and their origins AJR AMJ Roentgenol 1991,156;1267-72

15. Fornage BD Sonographically guided core- needle biopsy of breast masses the bayonet artifact. AJR AMJ Roentgenol 1995; 164: 1022-3

16. Gray AT, Schafhalter- Zoppoth I. "Bayonet artefact" during ultrasound guided transarterial axillary block. Anaesthesiology 2005; 102; 1291-2

17. Pramila Bajaj drugs in clinical Anaesthesia paras 1st ed 2005

18. BruntonLL, LazoJS. parker KL. local anaesthetics In; Goodman and Gilman 's the pharmacological basis of therapeutics 11th edn 2006; p 369 - 387

19. Stoelting RK. Local anaesthetics In; pharmacology and physiology in anaesthetic practice 4th edn 2006; p 174-207 David L Brown, Atlas of Regional anaesthesia- third edition.

20. K.D. Tripathi local anaesthetics; Essential of medical pharmacology, 5th edition, 2003, 320-330

21. Charles B. Berde, Gray R. sir/chart: pharmacology of local anaesthetics; Ronald D Miller; 7 th edition; 913-940

22. De Jose Maria B, Banus E, Navarro Egea M, Serrano s, Perello M, Mabrok M ultrasound guided supraclavicular vs infraclavicular brachial plexus blocks in children pediatric anaesthesia 2008; 18:838-44.

23. Chin KJ, Singh M, Velayutham V, CheeV infraclavicular brachial plexus block for regional anaesthesia of the lower arm anaesth analg 2010 oct ; 111(4):1072. doi: 10.1213/ANE 0b013e3181abac5d

24. SandhuNS, caplan LM; British journal of anaesthesia, 2002 aug; 89(2):254-9

25. J Fredrickson et al; journal of the association of anaesthetist of Great British and Ireland @ 2009 july volume 69, issue 7 pages 738-744

26. Salazar CH, Espniosa W infraclavicular brachial plexus ; variation in approach and results in 360 cases Reg anaes pain med 1999 sep- oct; 24[5]; 411-6

27. Chiyo ootaki M.D., Hideaki Hayashi M.D. ultrasound guided infraclavicular brachial plexus block. An alternative technique to anatomical landmark guided approach. regional anaesthesia and pain medicine november 2000, vol 25(6) : 600-604

28. Sandhu NS, Manne JS, Medabalmi PK, Caplan LM sonographically guided infra clavicular brachial plexus block in adults, a retrospective analysis of 1146 cases J ultrasound Med 2006 dec; 25(12): 1555-61

29. Ponnambala Namasivayam, Vijaya anandh Mahendran ; A randomized controlled study comparing USG guided supra clavicular vs infra clavicular brachial plexus block for upper limb surgeries vol 1, No 1 (2015)

30. Williams, Stephan R, Chouinard ultrasound guidance speeds execution and improves the quality of supra clavicular block. Anaesthesia & analgesia november 2003 vol 97- issue 5: pg 1518-1523

31. Keith Anderson; Oxford journal of anaesthesia contin educ anaesth crit care paris (2009) 9(5); 139-143

32. Zhi yuen Beh, M shahnaz Hasan posterior parasagittal in plane ultrasound guided infra clavicular brachial plexus block. a case series BMC anaesthesiology 2015; 15:105

33. E.Fleischmann MD, P Marholer MD, M.Greher MD, brachial plexus anaesthesia in children; lateral infraclavicular vs axillary approach vol 13, issue 2 feb 2003 pages 103-108.

34. Morgan clinical anaesthesiology, peripheral nerve blocks; 2008;325-337

35. Tran De, Dugani Shubada, Correa Jose A, Dyachenko Alina, Alsenosy Nafa, Finlayson Roderick J. minimum effective volume of lidocaine for ultrasound guided supra clavicular block. Regional anaesthesia & pain medicine : september/october 2011;36;5:466-469

36. Gajendra singh, Mohammed younus saleem. Comparison between conventional technique and ultrasound guided supraclavicular block in upper limb surgeries, international journal scientific study; nov 2014; vol 2; issue 8 : 169-170

37. Dae Geun Jeon, seok kon kim, Bong Jin Kang, Min A kwon, jae Gyok Song and Soo Mi Jeon comparison of ultrasound guided supraclavicular block according to the various volumes of local anaesthetic korean journal of anesthesiology 2013 june 64(6) : 494-499

38. Shweta S Mehta, Dr Shruti M Shan - comparative study of supraclavicular brachial plexus block by nerve stimulator v/s ultrasound guided method - NHL journal of medical sciences volume 4 issue 1; P:49-51

39. Loubert C, Williams SR, Helie F et al. Complication during ultrasound guided regional block: accidental intravenous injection of local anaesthetic anaesthesiology 2008; 108; 759-760

40. Klaastad O Sauter AB brachial plexus block with/ without ultrasound guidance curr opin anaesthesiology 2009 oct; 22[15]: 655-60.

PROFORMA

NAME : AGE / SEX :

I.P No : WEIGHT :

HOSPITAL : DATE :

PRE OP CONDITION :

VITALS :

PR - BP - SPO_2 -

SYSTEMIC EXAMINATION

CVS - RS -

OTHERS -

AIRWAY EXAMINATION

INVESTIGATIONS

Hb% - FBS / RBS -

BLOOD Urea - ECG - CXR -

Creatinine –

Pre Operative Diagnosis :

Proposed Surgery :

ASA Grade :

ANAESTHETIC TECHNIQUE:

Gropu US :

Group UI :

I. Local Anaesthetic Mixture :

15 ml of 0.5% Bupivacine

15 ml of 1.5% Lignocaine

Inj Adrenaline 5ug/ml

II. Ease of Doing :

Time taken for the procedure _____min

No. Of Needle advancements _____

III. Quality of Block :

Totally effective -

Partially effective -

Failure -

Analgesic supplementation - YES / NO

Conversion to GA - YES / NO

IV. Commonly Escaped Nerves :

Axillary

Radial

Ulnar

Median

Medial Cutaneous Nerve of arm

Medial Cutaneous Nerve of forearm

V. Adverse Effects : YES / NO

1. Vessel puncture
2. Any toxic / allergic reactions
3. Nerve injuries
4. Pneumothorax
5. Phrenic Nerve block
6. Horners's Syndrome
7. Recurrent Laryngeal Nerve block

GROUP SC

S.NO	NAME	AGE/SEX	WT(KG)	EASE OF DOING		OVERALL EFFECTIVENESS	SUCCESS RATE	ANALGESIC SUPPLEMENTATION	CONVERSION TO GA	COMMONLY ESCAPED NERVES						ADVERSE EFFECTS						
				TIME OF PROCEDURE (min)	NO. OF NEEDLE ADVANCEMENT					AXILLARY	ULNAR	RADIAL	MEDIAN	MED. CUT N. OF ARM	MED. CUT N. OF FOREARM	VESSEL INJURY	TOXIC/ ALLERGIC	NERVE INJURY	PNEUMOTHORAX	PHRENIC N.BLOCK	HORNER'S SYND.	RLN BLOCK
1.	SEENIYAMMAL	41/F	63	5	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	THAMARAISELVAN	47/M	60	6	3	TE	Y	N	N	-	-	-	-	-	-	Y	-	-	-	-	-	-
3.	SELVI	42/F	60	4	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	VENUGOPAL	40/M	56	5	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	VEERAIYAN	60/M	60	5	4	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	MANIVASAGAN	18/M	57	6	3	FB	N	N	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	SARAVANAN	23/M	58	7	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	ANANDH KUMAR	36/M	52	5	4	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	SAMINATHAN	35/M	52	8	3	TE	Y	N	N	-	Y	-	-	-	-	-	-	-	-	-	-	-
10.	DHARAMANI	55/F	59	7	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	MURALIRAJ	22/M	54	6	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	VANAROJA	40/F	54	6	1	PE	Y	Y	N	-	-	-	-	-	-	-	-	-	Y	-	-	-
13.	UTHIRAPATHY	44/M	58	4	3	TE	Y	Y	N	-	Y	-	-	-	-	-	-	-	-	-	-	-
14.	RAMKI	15/M	48	10	2	FB	N	N	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	ABDUL SARTHAR	55/M	60	8	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
16.	PARAMESWARI	25/F	45	5	1	FB	N	N	N	-	Y	-	-	-	-	-	-	-	-	-	-	-
17.	EKAMBARAM	55/M	52	8	1	PE	Y	Y	N	-	-	-	-	-	-	-	-	-	-	-	-	-
18.	AMALANANTHAN	44/M	53	6	2	PE	Y	Y	N	-	-	-	-	-	-	Y	-	-	-	-	-	-
19.	GANDIMATHI	40/F	48	5	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
20.	VALLIKANNU	35/F	56	6	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
21.	CHITRAVEL	43/M	53	4	3	FB	N	N	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
22.	ALAMELU	60/F	48	4	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
23.	ADHISESHAN	19/M	49	7	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
24.	JAIHIND	19/M	48	4	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
25.	GANDHIMATHI	60/F	58	6	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-

GROUP IC

S.NO	NAME	AGE/SEX	WT(KG)	EASE OF DOING		OVERALL EFFECTIVENESS	SUCCESS RATE	ANALGESIC SUPPLEMENTION	CONVERSION TO GA	COMMONLY ESCAPED NERVES						ADVERSE EFFECTS						
				TIME OF PROCEDURE (min)	NO. OF NEEDLE ADVANCEMENT					AXILLARY	RADIAL	MEDIAN	MED. CUT N. OF ARM	MED. CUT N. OF FOREARM	ULNAR	VESSEL INJURY	TOXIC/ ALLERGIC	NERVE INJURY	PNEUMOTHORAX	PHRENIC N.BLOCK	HORNERS SYND.	RLN BLOCK
1.	BEER MOHAMMED	20/M	58	18	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	UMA	40/F	60	15	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	SOUNDARYA	23/F	54	13	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	BHARATHI	30/F	48	8	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	PALANIVEL	38/M	55	12	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	NIVETHA	22/F	46	14	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	ABRAHAM	27/M	51	11	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	VARMAN	32/M	48	15	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	ARUL SELVAN	20/M	50	10	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	NEELAKANDAN	23/M	48	8	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	KUPPUSAMY	47/M	56	6	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	RAJENDRAN	48/M	48	8	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
13.	SANTHA	30/F	49	6	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
14.	THANGARASU	60/M	50	8	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	ARIVAZHAGAN	42/M	58	10	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
16.	REGINA BEGAM	55/F	53	9	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
17.	NADESAN	60/M	56	11	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
18.	ABRAHAM	30/M	53	10	2	FB	N	N	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
19.	PARVATHI	60/F	52	15	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
20.	RAHMATH KANI	40/F	52	8	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
21.	JEYA KUMAR	40/M	59	10	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
22.	SETHUPATHY	23/M	61	12	2	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
23.	PANDIYAN	31/M	60	15	3	FB	N	N	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
24.	SANJEEV	28/M	57	10	1	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-
25.	AMALA	42/F	55	10	3	TE	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-

KEY TO MASTER CHART

WT (KG)	-	Weight in kilogram
Min	-	Minutes
RLN	-	Recurrent Laryngeal Nerve
M	-	Male
F	-	Female
TE	-	Totally Effective
FB	-	Failed Block
PE	-	Partially Effective
Y	-	Yes
N	-	No

CONSENT FORM

I …….. hereby give consent to participate in the study conducted by Dr. M. SHANTHI post graduate in Department of Anaesthesiology, Thanjavur Medical College and Hospital, Thanjavur and to use my personal clinical data and result of investigation for the purpose of analysis and to study the nature of disease. I also give consent for future investigation.

Place :

Date :

Signature of Participant