COMPARISON BETWEEN CONVENTIONAL TECHNIQUE AND ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES

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CERTIFICATE

This is to certify that this dissertation entitled **"COMPARISON BETWEEN CONVENTIONAL TECHNIQUE AND ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES"** is a bonafide original work of **Dr. K. REVATHI** in partial fulfilment 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 - 2016. The period of study was from SEPTEMBER 2013 - JULY 2015

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DECLARATION

I, **Dr. REVATHI,** solemnly declare that this dissertation entitled "**COMPARISON BETWEEN CONVENTIONAL TECHNIQUE AND ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES"** is a bonafide and genuine research work carried out by me in the Department of Anaesthesiology, Thanjavur Medical College Hospital, Thanjavur, during September 2013 to July 2015 under the guidance and supervision of **Prof. Dr. Shanthi Paulraj, M.D**., Department of Anaesthesiology.

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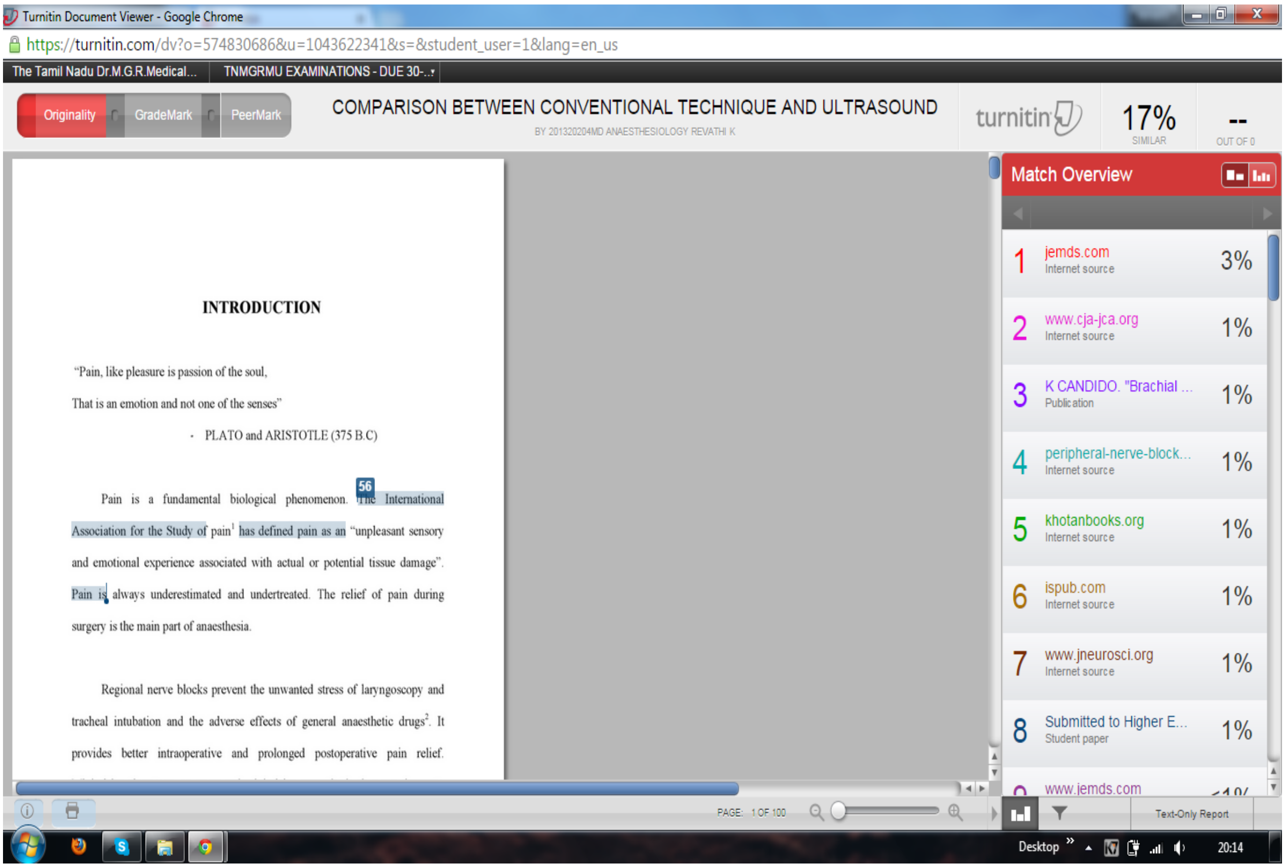
INTRODUCTION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INTRODUCTION
"Pain, like pleasure is passion of the soul,
That is an emotion and not one of the senses"
- PLATO and ARISTOTLE (375 B.C)
Pain is a fundamental biological phenomenon. The International Association for the Study of pain[1] has defined pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage". Pain is always underestimated and undertreated. The relief of pain during surgery is the main part of anaesthesia.
Regional nerve blocks prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects of general anaesthetic drugs[2]. It provides better intraoperative and postoperative pain relief.
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LIST OF ABBREVIATIONS

µg	-	microgram
ASA	-	American Society of Anaesthesiologists(classification)
ECG	-	Electrocardiogram
cm	-	centimetre
mg	-	milligram
mm of Hg	-	millimetres of mercury
ml	-	millilitre
gm	-	gram
kgs	-	kilograms
LA	-	Local Anaesthetic
min	-	minute
mins	-	minutes
pKa	-	Dissociation constant
gms%	-	grams per decilitre
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

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INTRODUCTION

"Pain, like pleasure is passion of the soul,

That is an emotion and not one of the senses"

- PLATO and ARISTOTLE (375 B.C)

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". Pain is always underestimated and undertreated. The relief of pain during surgery is the main part of anaesthesia.

Regional nerve blocks prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects of general anaesthetic drugs[2]. It provides better intraoperative and prolonged postoperative pain relief. Minimising the stress response and minimising anaesthetic drug requirements are beneficial to the patients with various cardio respiratory comorbidities.

Brachial plexus blocks provide a wonderful alternative to general anaesthesia for upper limb surgeries. They achieve near-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 postoperative pain, vasospasm and edema.

Among the various approaches of brachial plexus block, supraclavicular approach is considered easiest and effective. It also has the reputation of providing most complete and reliable anaesthesia for upper limb surgeries. It is carried out at the level of trunks of brachial plexus where it is more compact i.e., at the middle of brachial plexus, resulting in homogenous spread of anaesthetic solution throughout the plexus with a faster onset and complete block.

The first brachial plexus block was performed by William Stewart Halsted in 1889[2]. He used cocaine to perform the block after directly exposing the brachial plexus within the neck. In 1911[3], Kulenkampff introduced the classical supraclavicular approach of brachial plexus block. In 1964[4], Winnie and Collins introduced subclavian perivascular approach of brachial plexus block.

The conventional subclavian perivascular paresthesia technique being a blind technique may be associated with higher failure rate, injury to nerves and vascular structures[5]. To minimize these drawbacks, various techniques and approaches were described. Among them, Ultrasound visualization of anatomical structure is the only method offering safe block of superior quality by optimal needle positioning[6].

Ultrasound has improved success rate with excellent localization and improved safety margin[6]. But, even now, most of the anaesthesiologists prefer conventional techniques for supraclavicular brachial plexus block as it is cost effective and faster to perform.

This study was designed to compare the time honoured, well proven conventional subclavian perivascular approach after eliciting paresthesia and the recently popularising ultrasound guided technique for supraclavicular brachial plexus block with regards to time taken for the procedure, onset and duration of block, success rate, overall effectiveness of the block and incidence of complications involved.

AIM OF THE STUDY

The main objectives of this study was to compare the effects of supraclavicular brachial plexus block using conventional subclavian perivascular paresthesia technique with ultrasound-guided technique in terms of

a) Time taken for the procedure
b) Onset and duration of sensory blockade
c) Onset and duration of motor blockade
d) Success rate
e) Effectiveness of the block and
f) Incidence of complications

HISTORY[2]

1. 1826- According to the specific theory of Johannes P. Muller, pain is conducted in the nervous system

2. 1855- Rynd described the idea of introducing a solution of morphine hypodermically around a peripheral nerve

3. 1858 – "Theory of pain was a separate and distinct sense" was formulated by Mortiz S.Schiff

4. 1884 – William Halsted and Alfred Hall succeeded in the idea of injecting cocaine into nerve trunk

5. 1911 – G. Hirschel performed the first percutaneous axillary brachial plexus block

6. 1911 – D. Kulenkampff performed the first supraclavicular brachial plexus block

7. 1940 – Patrick defined the classical supraclavicular approach

8. 1943 - Lidocaine was synthesized by Lofgren and Lundqvist

9. 1949- Bonica and Moore defined multiple injection "walking the rib" technique

10. 1956 – Bupivacaine was synthesized by Ekenstam

11. 1962- Greenblatt and Denson- introduced the nerve stimulator into clinical practice of Anaesthesiology

12. 1963 – Bupivacaine was introduced into clinical practice by Telivuo

13. 1964- Winnie introduced interscalene and subclavian perivascular approach for brachial plexus block

14. 1965 - Melzack and Wall propounded the Gate Control Theory of pain.

15. 1970's- Ultrasound was introduced into peripheral nerve block techniques.

ANATOMY OF BRACHIAL PLEXUS[7,8,9]

Knowledge of the formation of brachial plexus and its ultimate cutaneous and muscular distribution is absolutely essential to the intelligent and effective use of brachial plexus anaesthesia for upper limb surgeries. Close familiarity with the vascular, muscular and fascial relationships of the plexus is equally essential for mastering various techniques, for it is these perineural structures which serve as the landmark by which needle may accurately locate the plexus percutaneously.

FORMATION OF BRACHIAL PLEXUS[7]:

Brachial plexus is formed by the union of ventral rami of lower four cervical nerves (C5, 6,7,8) and first thoracic nerve (T1) with frequent contributions from C4 or T2.When contribution from C4 is large and from T2 is lacking, the plexus appears to have a more cephaloid position and is termed "Prefixed". When contribution from T2 is large and from C4 is lacking, the plexus appears to have a caudal position and is termed "postfixed". Usually prefixed or postfixed positions are associated with the presence of either a cervical rib or an anomalous first rib[1].

ROOTS:

Represent the anterior primary divisions of lower four cervical and first thoracic nerves. They emerge from the intervertebral foramina and fuse above the first rib to form the trunks.

TRUNKS:

The roots combine above the first rib to form the three trunks of the plexus. C5 and C6 unite at the lateral border of the scalenus medius and form the “Upper trunk”. C8 and T1 unite behind the scalenus anterior to form “lower trunk” and C7 continues as a sole contributor to “middle trunk”.

DIVISIONS:

As the trunks pass over the first rib and under the clavicle, each one of them divides into anterior and posterior divisions.

CORDS:

The fibres, as they emerge from under the clavicle, recombine to form three cords. The “lateral cord” is formed by anterior divisions of upper and middle trunks, lateral to the axillary artery. The anterior division of lower trunk descend medial to the axillary artery forming the “medial cord”. The posterior divisions of all three trunks unite to form the “posterior cord”, at first above and then behind the axillary artery. The medial and lateral cords give rise to nerves that supply the flexor surface of upper extremity, while nerves arising from posterior cord supply extensors.

MAJOR TERMINAL NERVES:

Each of these cords gives off a branch that contributes to/or become one of the major nerves to the upper extremity. The lateral and median cords give off lateral and medial heads of the medial nerve and continue as major terminal nerves, the lateral cord terminating as musculocutaneous nerve and medial cord as ulnar nerve. Posterior cord gives off axillary nerve as its major branch and then continues as the radial nerve.

DISTRIBUTION OF BRACHIAL PLEXUS:

These are divided into those that arise above the clavicle – the supraclavicular branches and those that arise below it, the infraclavicular branches.

Supraclavicular branches:

From roots:

1. Nerves to scaleni and longus colli – C5,6,7,8
2. Branch to phrenic nerve – C5
3. Dorsal scapular nerve – C5
4. Long thoracic nerve – C5,6,(7)

From trunks:

1. Nerve to subclavius – C5,6
2. suprascapular nerve – C5,6

Infraclavicular branches: They branch from cords but their fibres may be tracked back to spinal nerves.

Lateral cord:

1. Lateral pectoral nerve – C5,6,7
2. Musculocutaneous nerve – C5,6,7
3. Lateral root of median nerve – C5,6,7

Medial cord:

1. Medial pectoral nerve – C8, T1
2. Medial cutaneous nerve of forearm – C8, T1
3. Ulnar nerve – C8, T1
4. Medial root of median nerve – C8, T1
5. Medial cutaneous nerve of arm – C8, T1

Posterior cord:

1. Upper subscapular nerve – C5, 6
2. Thoracodorsal nerve – C 6, 7, 8
3. Lower subscapular nerve – C5, 6
4. Axillary nerve – C5, 6
5. Radial nerve - – C5, 6, 7, 8, T1

RELATIONS OF BRACHIAL PLEXUS[3]:

In its passage from the cervical transverse processes to the first rib, the plexus is "sandwiched" between the anterior and middle scalene muscles and invested in the fascia of those two muscles. The 'interfascial compartment', along with subclavian artery crosses the first rib immediately in front of the trunks. Artery is close to scalenus anterior and plexus close to scalenus medius. Subclavian vein is separated from the artery by the scalenus anterior. The fascia covering the muscles is derived from the perivertebral fascia, which splits to invest these muscles and rejoins again at their lateral margins to form an enclosed space, the interscalene space.

As the plexus crosses first rib, the three trunks are 'stacked' one on top of the other vertically. Not infrequently, the inferior trunk gets trapped behind and even beneath the subclavian artery above the rib, during embryologic development. This may be the reason why local anaesthetic drugs injected via interscalene technique sometimes fail to provide anaesthesia in the distribution of ulnar nerve, which may be buried deep within inferior trunk behind or beneath the subclavian artery.

After crossing the first rib, they split to form 2 divisions and then 3 cords, and the subclavian artery becomes the axillary artery. In the lower axilla, cords divide into nerves for the upper limb.

THE BRACHIAL PLEXUS SHEATH[8]

Volume of the sheath: 42ml.

Shape of the sheath: Cylindrical to conical – Wide proximally and narrow distally.

Length: 8-10cms long.

The connective tissue of the prevertebral fascia and the anterior and middle scalene muscles envelop the brachial plexus as well as the subclavian and axillary artery in a neurovascular "sheath". Anatomic dissection, histologic examination and CT scanning after injection of radiocontrast into the sheath demonstrate the existence of connective tissue septae which extend inward from the fascia surrounding the sheath and they frequently adhere to the nerves and vessels leaving no free space between the layers and compartmentalizing the components of the sheath.

Anaesthetic Implication[11]:

Because of these connective tissue septae, anaesthesia might be complete and rapid in onset in some nerves, but delayed and incomplete or completely absent in others.

The incidence of partial block is an exception rather than the rule, so septa apparently are of little clinical significance as the local anaesthetic can percolate through them.

TECHNIQUE OF BRACHIAL PLEXUS BLOCK[11,12]

Surgical anaesthesia of the upper extremity and shoulder can be obtained following neural blockade of the brachial plexus at several sites. The various approaches that can be used for this blockade are as follows

1. Interscalene approach
2. Supraclavicular approach
    a. Classic approach
    b. Plumb –bob technique
    c. Subclavian perivascular technique
    d. Lateral approach
    e. Peripheral nerve locator guided technique
    f. Ultrasound guided techniques
3. Axillary approach
4. Infraclavicular approach

MECHANISM OF ACTION OF LOCAL ANAESTHETIC DRUGS IN NERVE BLOCKADE[12,13,14]

Impulse blockade by local anesthetic drugs may be summarized by the following chronology:

- Solution of local anaesthetic is deposited near the nerve. Removal of free drug molecules away from this locus is a function of tissue binding, removal by the circulation and local hydrolysis of amino-ester anaesthetics. The net result is penetration of the nerve sheath by the remaining free drug molecules.

- Local anaesthetic molecules then permeate the nerve’s axon membranes and reside there and in the axoplasm. The speed and extent of these processes depend on a particular drug’s p*K*a and on the lipophilicity of its base and cation species.

- Binding of local anesthetic molecules to sites on voltage-gated Na+ channels prevent the opening of those channels by inhibiting the conformational changes that underlie channel activation. Local anesthetic drugs bind in the channel’s pore and also occlude the path of Na+ ions.
- During onset or recovery from local anesthesia, impulse blockade is incomplete and partially blocked fibres are further inhibited by repetitive stimulation, which produces an additional use-dependent binding to Na+ channels.
- One local anesthetic binding site on the Na+ channel may be sufficient to account for the drug's resting (tonic) and use-dependent (phasic) actions. Access to this site may potentially involve multiple pathways, but for clinical local anesthetic drugs, the primary route is the hydrophobic approach from within the axon membrane.

• The clinically observed rate of onset and recovery from blockade are governed by the relatively slow diffusion of local anesthetic molecule into and out of the whole nerve, not by their much faster binding or dissociation from ion channels. A clinically effective block that may last for hours can be accomplished with local anesthetic drugs that dissociate from Na+ channels in a few seconds.

COMPLICATIONS[15]

Vascular puncture

The incidence of subclavian arterial puncture is very common in conventional supraclavicular brachial plexus block. It is best to withdraw and redirect the needle on perceiving arterial pulsation at the needle tip. Internal jugular vein may also get punctured during skin wheal infiltration. Simple digital compression is required before proceeding.

Pleural puncture

The most significant complication of supraclavicular approach for blocking brachial plexus is the development of pneumothorax. Pneumothorax must be suspected when there is dyspnoea, cough or pleuritic chest pain but the diagnosis can be confirmed only by chest

x-ray after 6 hours.

Phrenic nerve block

As per the literature, phrenic nerve block occurs in 40-60% of patients because of the spread of local anaesthetic solution to the anterior surface of anterior scalene muscle. The effect is avoided if anaesthetic drug is deposited deep on the middle trunk on division or cord. This is rarely symptomatic. Radiographic confirmation may be obtained.

Recurrent laryngeal nerve block

Right sided supraclavicular brachial plexus block causes transient dysphonia in 1% of cases. It is because, right recurrent laryngeal nerve gets blocked when it loops around right subclavian artery. Whereas, left recurrent laryngeal nerve is far away from the left subclavian artery and thus, it is not blocked with left supraclavicular block.

Nerve damage or neuritis

It results from the needle trauma or faulty positioning of anaesthetised arm preoperatively. Other remote causes include excessive tourniquet time, concentrated solution with vasoconstrictor and susceptible host tissue.

Horner's syndrome

It consists of ptosis, miosis, anhydrosis and enophthalmos. It usually follows stellate ganglion block. It is rare with supraclavicular block.

Toxic reaction to drug

It is likely to occur if there is over dosage of drug or inadventent intravascular injection is made, but can be avoided with proper negative aspiration test before injection of drug.

BASICS OF ULTRASOUND[5,6,16]

The frequency of medical ultrasound ranges between 2 MHz and 13 MHz. The average wave length in this band is about 1 mm. This limits the resolution to structures that are larger than 1 mm. Most nerves of interest range in size from 2 mm to 10 mm. Veins and arteries of interest are typically 3 mm to 15 mm.

Many factors contribute to the quality and resolution of the ultrasound image. In general, higher frequency probes generate higher resolution images. Unfortunately, high frequency ultrasound waves (8 MHz to 13 MHz) are rapidly attenuated in tissue so that high frequency probes are best suited for structures less than 5 cm deep to the skin.

The ultrasound beam may be refracted as it passes through tissue. When this occurs, a nerve or other organ may appear at a different anatomical location than its actual site. Fat globules below the skin, in the muscle and around nerves are about 1 mm in diameter. These globules serve as diffraction sites for the incident and reflected ultrasound beam and cause a speckled appearance in the image. Fat is also extremely efficient at absorbing ultrasound so that a very little of the beam is returned to the receiver. For these reasons, obese patients can be very difficult to image.

The image formed of a nerve on ultrasound is very sensitive to the angle of incidence of the beam relative to the nerve. Sometimes changing the angle of incidence by only a few degrees can bring the nerve into focus. This phenomenon is thought to be caused by diffraction of the type described above. Modern platforms allow the user to adjust the brightness (gain) of the entire image or more superficial (near field) and deep (far field) structures.

IMAGE OF VESSELS:

Arteries can usually be distinguished by their pulsatile nature. Veins can be distinguished by their compressibility. Colour flow Doppler imaging can also be used to identify and distinguish arteries and veins. By convention, blood flowing towards the probe is coloured red. Blood flowing away from the probe is coloured blue. Blood flowing perpendicular to the probe remains black. Velocity gates can be set to measure the flow velocity. High velocities are usually arteries. Low velocities are usually veins.

PROBE SELECTION:

Transducer elements can be arranged in linear or curved arrays. Linear arrays create rectangular images and are most useful for superficial structures. Curved arrays create wedge-shaped images and are most useful for deeper structures. Because the beam disperses in a curved array, its resolution is usually lower than a linear array. A phased array retains the elements in a straight line. But the elements fire in sequence creating a phase delay between each element. The net result is a wedge-shaped image from a set of linear transducers. Because this signal is averaged, its resolution is also lower than a standard linear array. Most probes have transducers that emit the highest amplitude of their ultrasound wave at a specific fundamental frequency. Harmonics of this frequency are also emitted at lower amplitudes. By listening for the echo at these higher harmonic frequencies, image resolution can be enhanced. Because the harmonics are of very low amplitude, only transducers that have sufficient power output can be used for this harmonic imaging.

Above the collar bone, nerves are usually dark (hypoechoic) and below the collar bone, nerves are usually white (hyperechoic). The reasons for this dichotomy are not known, but it may be related to the depth of the nerves and the relative amount of fat and stroma within the nerves themselves. On ultrasound cross section, nerves are round, hypo- or hyperechoic, reticulated structures. When imaged along their long axis, nerves appear as linear, hypo or hyperechoic streaks, on ultrasound. Bones are hyperechoic and usually very bright white. Arteries and veins are black unless color flow Doppler imaging is used.

Most nerves have some fascia around them. There is usually a potential space between the fascia and the epineurium. When a needle punctures the fascia, local anesthetic can usually be deposited between the fascia and the nerve.

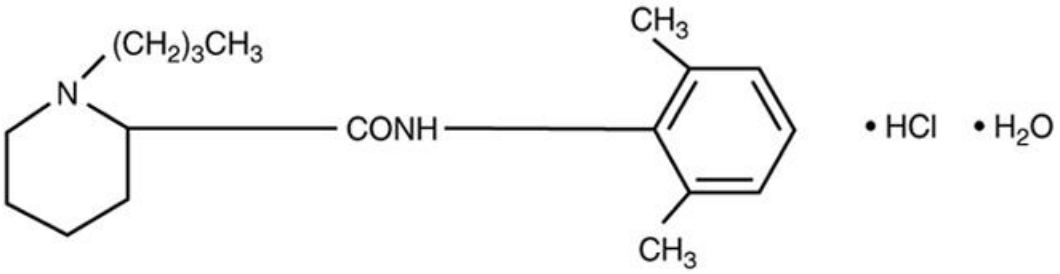
This creates a black (hypoechoic) ring around the nerve. In some cases the fascia adheres to the epineurium or is missing. In that case, the needle may puncture the nerve and the nerve will swell as the local anesthetic is injected.

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

Source: Bupivacaine was synthesised by A.F. Ekenstam and his colleagues in Sweden in 1957.

Chemistry: The chemical name is 1-n-butyl-DL-piperidine-2 carboxylic acid-2, 6 dimethyl amilide hydrochloride.

The molecular formula is $C_{18}N_2OH_{28}HCl$.



Chemical structure

Addition of a butyl group to piperidine nitrogen atom of mepivacaine forms bupivacaine. Bupivacaine is 3.5 times more lipid soluble and 2.4 times more potent than mepivacaine

Bupivacaine Hydrochloride is available in sterile isotonic solutions with and without epinephrine (as bitartrate) 1:200,000 for injection via local infiltration, peripheral nerve block and caudal and lumbar epidural blocks. Solutions are clear and colourless.

Multiple-dose vials contain methylparaben 1mg/ml added as a preservative. Sodium metabisulfite 0.1mg/ml is added as an antioxidant and anhydrous calcium disodium edetate 0.1mg/ml is added as a stabilizer. Single-dose solutions contain no added bacteriostat or anti-microbial agent and unused portions should be discarded after use.

Physiochemical properties:

1) **Solubility** **:** The base is sparingly soluble, but the hydrochloride is readily soluble in water.
2) **Stability and sterilization** **:** Bupivacaine is highly stable and can withstand repeated autoclaving.
3) **pH of saturated solution** **:** 5.2
4) **Specific gravity** **:** 1.021 at 37^{0}C
5) **pKa** **:** 8.1
6) **Protein Binding** **:** 95%
7) **Volume of Distribution** **:** 73 litres
8) **Clearance** **:** 0.47 litres
9) **Half – life** **:** 210 minutes
10) **Toxic plasma concentration** > 3mcg/ml

USES

1) Spinal anaesthesia

2) Epidural anaesthesia

3) Caudal anaesthesia

4) Combined Spinal Epidural anaesthesia

5) Peripheral Nerve Block

Anaesthetic properties:

Potency:

Bupivacaine is approximately three to four times more potent than lidocaine. The duration of action of its motor blockade is two to three times longer than lidocaine.

Placental Transfer:

Plasma protein binding influences the rate and degree of diffusion of local anesthetic drugs across the placenta. Bupivacaine, which is highly protein bound (approximately 95%), has an umbilical vein-maternal arterial concentration ratio of about 0.32. Acidosis in the fetus, which may occur during prolonged labour, can result in accumulation of local anesthetic molecules in the fetus (ion trapping).

Distribution:

Rapid distribution phase (α)– In this phase, the drug gets distributed to highly vascular region. $t_{1/2}$ of α – 2–7 mins

Slow distribution phase (β)– Drug distributes slowly to equilibrating tissues. $t_{1/2}$ of β – 28 mins

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
- Technique of Regional anaesthesia

These doses may be repeated in 3-4 hours. 3 mg/kg is the maximum dose. The addition of vasoconstrictor produces a very slight increase in the duration of action. However the peak blood level is significantly reduced, thereby minimizing the systemic toxicity.

ACTIONS:

Central nervous system:

Overdose of bupivacaine will produce light headedness and dizziness followed by visual and auditory disturbances such as difficulty in focusing a point and tinnitus. Disorientation and drowsiness can also occur. Shivering and tremors of muscles of face and distal part of extremities can occur. Ultimately, generalized tonic clonic convulsions occur. Further increase in dose causes respiratory arrest. Since bupivacaine is a potent drug, smaller doses can cause rapid onset of toxic symptoms when compared to other drugs.

Autonomic nervous system:

Bupivacaine does not inhibit the noradrenaline uptake and hence has no sympathetic potentiating effect. Myelinated preganglionic beta fibres have a faster conduction time and are more sensitive to Bupivacaine. Involvement of preganglionic sympathetic fibres is the cause of widespread vasodilatation and consequent hypotension that occurs in epidural and paravertebral block. In conduction blockade, it produces higher incidence of sensory than motor blockade.

Neuro-muscular junctions:

Bupivacaine like other local anaesthetics can block motor nerves if present in sufficient concentration but has no effect on the neuromuscular junction as such.

Cardiovascular system:

The primary cardiac electrophysiologic effect of local anaesthetic agent is a decrease in the maximum rate of depolarization in the purkinje fibres and ventricular muscle. This is due to decrease in the availability of sodium channels. Bupivacaine decreases cardiac output by decreasing sympathetic tone, heart rate and venous return. It also decreases central venous pressure. There is an increase in blood flow to lower limbs with decrease in incidence of deep vein thrombosis.

Bupivacaine is highly arrythmogenic. It reduces the cardiac contractility by blocking the calcium transport. In lower concentration, it produces vasoconstriction while in higher concentration, it causes vasodilatation.

Respiratory system:

Respiratory depression may be caused if excessive plasma level is reached or it may be due to paralysis of respiratory muscles as in high spinal or total spinal anaesthesia.

PHARMACODYNAMICS:

The onset of action of bupivacaine is between 4 and 6 minutes. Maximum anaesthesia is obtained between 15 and 20 minutes. The duration of anaesthesia varies according to the type of block. The average duration for nerve blocks is about 5 to 6 hours.

Toxicity:

The toxic plasma concentration is 4-5μg/ml. Maximum plasma concentration rarely approaches toxic levels. Non specific local irritant effects on nerve tissue have been noted in human subjects. No evidence of permanent damage has been found in clinical dosage.

PHARMACOKINETICS:

Bupivacaine can be detected in the blood within 5 minutes of infiltration or following either epidural or intercostal nerve blocks. Plasma levels are related to the total dose administered. Peak levels of 0.14 to 1.18 μg/ml will be found within 5 minutes to 2 hours after the administration of anaesthesia and they gradually decline to 0.1 to 0.34μg/ml by 4 hours.

Metabolism:

Because bupivacaine is an amide, the liver is the primary site of metabolism. The drug is metabolized partly by N-dealkylation primarily to pipecolyloxylidine. N-disbutyl-bupivacaine and 4-hydroxy bupivacaine are also formed.

Excretion:

About 10% of drug is excreted unchanged in urine within 24 hours; 5% is excreted as pipecolyloxylidine. Glucoronide conjugate is also excreted.

Adverse reactions:

Adverse reactions occur with excessive plasma levels which may be due to overdose, inadvertent intravenous injections or slow metabolic degradation. These manifest by effects on central nervous system and cardiovascular system. In obstetrics, fetal bradycardia may occur. Allergic reactions include urticaria, bronchospasm and hypotension.

Treatment of adverse reaction:

Treatment is mainly symptomatic. After initiation of basic life support and Advanced cardiac life support protocol, a rapid bolus of Intralipid 20%, 1.5 ml/kg (or roughly 100 ml in adults), should be administered without delay and followed if necessary by an infusion of 0.25 ml/kg/min for the next 10 minutes (Recommendation of Weinberg and colleagues).

Monitoring equipments, oxygen source, airway equipments and drugs to terminate convulsions such as midazolam, lorazepam, diazepam or thiopental should be kept ready. Ventricular fibrillation or tachycardia is treated by amiodarone (5mg/kg iv) or by defibrillation (2-6 joule/kg).

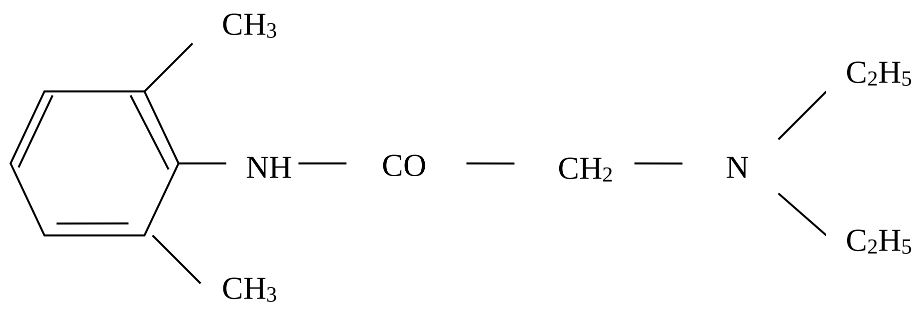
Cardiovascular collapse / CNS ratio:

Dose of bupivacaine required to induce irreversible cardiovascular collapse is three times the dose required to produce convulsions.

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

Lignocaine was synthesized by Lofgren in Sweden in 1943. **Lofgren** and **Lundqvist** discovered its anesthetic 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, 6 xylidine hydrochloride monohydrate. It contains a tertiary amine attached to an aromatic system by 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 anesthetic 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 depolarization 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 arrhythmias. So, it is useful in treatment of ventricular arrhythmias.

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 disturbances can occur. Severe toxicity proceeds to convulsion and coma with cardio 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 µg/ml increases the sensitivity of medullary respiratory centers 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 µg/ml produce ventilatory depression and flattening of the carbon-di-oxide response curve.

PHARMACOKINETICS:

Absorption is slow in regional anesthesia, 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
t ½ (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 glycine xylidide is moderately toxic and is an effective antiarrhythmic agent.

MAXIMUM SAFE DOSE

Lignocaine with epinephrine -7mg/kg

Lignocaine without epinephrine – 3mg/kg

AVAILABLE PREPARATIONS

1. 5% heavy for spinal anesthesia
2. 1% and 2% vial for peripheral nerve blocks and epidural anesthesia (with and without adrenaline)
3. 2% Lignocaine (without preservative) for intravenous use.
4. Topical solutions 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. Gajendra Singh[22] and Mohammed Younus Saleem (International Journal of Scientific Study: November 2014:2;8) conducted a prospective randomized, comparative study in 60 patients to compare the efficacy of ultrasound guided supraclavicular block with conventional (blind) technique eliciting paresthesia. Block was performed using 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline in both groups. They found that the success rate of block was more with US group compared to conventional group. Time taken for ultrasound guided technique was longer than conventional technique. Also the duration of analgesia was longer with very fewer complications in ultrasound group compared to the conventional approach.
2. Veeresham et al[23] (Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 37, May 07; Page: 6465-6476) conducted a prospective randomized study to compare the effects of supraclavicular brachial plexus block using conventional paresthesia technique and ultrasound technique in 60 patients with 30 patients in each group. Each patient received 25 ml of 0.5% bupivacaine, 5 ml distilled water and 0.25ml of sodium bicarbonate. They concluded that ultrasound guided supraclavicular block has higher success rate with fewer complications and longer duration of block compared to conventional technique.

3. Mithun Duncan et al[24] (Anesth Essays Res. 2013 Sep-Dec; 7(3): 359–364) conducted a prospective randomized control study to compare nerve stimulator and ultrasound guided supraclavicular block. 60 patients were randomly divided into two groups: Ultrasound (Group US) and Nerve Stimulator(Group NS). Both groups received 1:1 mixture of 0.5% bupivacaine and 2% lignocaine with 1:200000 adrenaline according to the patient’s body weight. They observed that there was no significant difference in onset of sensory and motor block between the 2 groups. The difference in the block execution time and success rates is not statistically significant. A failure rate of 10% in US and 20% in NS group was observed and was statistically insignificant ($P = 0.278$). No complication was observed in either group. They finally concluded that ultrasound guidance for performing supraclavicular brachial plexus block ensures a high success rate and a decreased incidence of complications that are associated with the blind technique. However, their study had not proved the superiority of one technique over the other.
4. Williams Stephan et al[25] (Anesthesia and Analgesia 2003;97(5): 1518-1523) conducted a prospective study in 80 patients to assess the quality, safety and execution time of supraclavicular block of the brachial plexus using ultrasonic guidance and neurostimulation compared with a supraclavicular technique that used anatomical landmarks and neurostimulation. Blocks were performed using 1:1 mixture of 0.5% bupivacaine and 2% lidocaine

with epinephrine 1:200,000 in both the groups. The onset of motor and sensory block for the musculocutaneous, median, radial and ulnar nerves was evaluated over a 30 minutes period. At 30 minutes, 95% of patients in Group US and 85% of patients in Group NS had a partial or complete sensory block of all nerve territories (P=0.13) and 55% of patients in Group US and 65% of patients in Group NS had a complete block of all nerve territories (P=0.25). Surgical anesthesia without supplementation was achieved in 85% of patients in Group US and 78% of patients in Group NS (P=0.28). No patient in Group US and 8% of patients in Group NS required general anesthesia (P=0.12). The quality of ulnar block was significantly inferior to the quality of block in other nerve territories in Group NS, but not in Group US; but it was statistically insignificant. The block was performed in an average of 9.8 minutes in Group NS and 5.0 minutes in Group US (P=0.0001). No major complication occurred in either group. They concluded that ultrasound-guided neurostimulator-confirmed supraclavicular block is more rapidly performed and provides a more complete block than supraclavicular block using anatomic landmarks and neurostimulator confirmation.

5. Dr. Shweta S. Mehta, Dr. Shruti M. Shah NHL[26] (Journal of Medical Sciences; Jan 2015:4:1) conducted a study to compare ultrasound guided with peripheral nerve stimulator guided technique for supraclavicular brachial plexus block in 50 patients with 0.5% bupivacaine 25-35ml. They

concluded that ultrasound guided technique is an improved nerve block technique with more success rate, decreased complication rate, faster onset and less time consuming as compared to nerve stimulation technique.

6. Duggan E1 et al[27] (Reg Anesth Pain Med.2009 May-Jun;34(3):215-8) conducted a study in 21 patients to determine the minimum effective volume of local anesthetic mixture required to produce an effective supraclavicular block for surgical anesthesia using an ultrasound (US)-guided technique. They have injected an initial 30 ml of local anesthetic solution (50:50 mixture of 2% lidocaine and 0.5% bupivacaine with epinephrine) and subsequently varied it by 5 ml for each consecutive patient according to the response of previous patient. The minimum effective anesthetic volume in 50% of patients (ED50) was determined using the Dixon and Massey up-and-down method as 23 ml. The effective volume in 95% of patients (ED95) was calculated using probit transformation and logistic regression as 42 ml. According to this study, the calculated volume of local anesthetic mixture required for Ultrasound guided supraclavicular block (42 ml) does not seem to differ from the recommended volume for conventional technique.

7. Vincent W. S. Chan et al[28] (Anesthesia and Analgesia 2003;97:1514 –7) conducted a study to evaluate state-of-the-art ultrasound technology for supraclavicular brachial plexus block in 40 outpatients. In this study, the block was successful after one attempt in 95% of the cases, with one failure

attributable to subcutaneous injection and one to partial intravascular injection. There was no incidence of pneumothorax in their study.

8. Leslie C. Thomas et al[29] (The ochsner Journal 11:246-252, 2011) conducted a prospective, randomized study in 41 patients with inexperienced anesthesia residents, to compare the differences in ultrasound and nerve stimulation guided interscalene brachial plexus block. They observed that the US group required significantly less time to conduct the block (4.3±1.5 minutes) than the NS group (10 ± 1.5 minutes), P=0.009. Moreover, the US group has a faster onset of sensory block 12 ± 2 minutes than NS group 19 ± 2 minutes(P =0 .02) and motor block (US group, 13.5 ±2.3 minutes; NS group, 20.2 ± 2.1 minutes; P 0 .03). Success rates were not statistically different (US group, 95%; NS group, 91%). No differences in operative time, postoperative pain scores, need for rescue analgesics or incidences of side effects were noted. They concluded that the use of Ultrasound technology in an academic medical center facilitates safe, cost-effective and quality care.

9. Hickey et al[30] (Anesthesia and Analgesia. 1989 Jun;68(6):767-71) conducted a study to define the influence of location of paresthesia in subclavian perivascular block in 156 adult patients who underwent orthopedic hand and forearm surgery. The location of paresthesia elicited trunk prior to the deposition of 30 ml of a solution containing 1% mepivacaine, 0.2% tetracaine and 1:200,000 epinephrine, was recorded. Twenty minutes later the quality of the block in the distribution of the

superior, middle and inferior trunks of the brachial plexus was evaluated. Anesthesia in each of the three trunks was compared with the three sites where the paresthesia was elicited (superior, middle, or inferior trunk). A middle trunk paresthesia was the most successful in producing surgical anesthesia of all three trunks. A superior trunk paresthesia was most often elicited. It resulted in a significantly lower incidence of inferior trunk anesthesia than a middle or inferior trunk paresthesia. Complications include arterial puncture (25.6%), Horner's syndrome (64.1%) and recurrent laryngeal nerve block (1.3%) with no instances of symptomatic phrenic nerve block or symptomatic pneumothorax.

10. A.P.Winnie[4] and V.J.Collins (Anaesthesiology; may- june 1964) published a paper regarding the subclavian perivascular approach. They explained that 25 ml of local anaesthetic drug used in the subclavian perivascular approach can produce the same effect when 50ml of the same anaesthetic solution used in axillary approach. They remarked that 98% of patients encountered surgical anaesthesia in subclavian perivascular technique.
11. R. Bhat et al[31] (Indian Journal of plastic surgery;1994:27:2:79-81)

    Subclavian perivascular approach was attempted for brachial plexus block in 160 cases in this study with an overall success rate of 85%.
12. Raizada et al[32] (Indian Journal of Anaesthesia. 2002; 46 (3): 193-19) conducted a study in 60 patients who underwent upper limb procedure under supraclavicular block to determine whether the compounding of

drugs is beneficial or not. They concluded that compounding of lignocaine and bupivacaine provided the benefit of early onset and postoperative analgesia without the use of high volume of individual drug. Lignocaine-bupivacaine mixture carries the benefit of shorter onset of action similar to lignocaine and has a longer duration of action similar to bupivacaine without increasing the dose of both the drug.

13. A. P. Baranowski et al[33] (Anaesthesia; may 1990;45:5:362-5) found no significant difference in the success rate of block between the conventional paresthesia technique and peripheral nerve stimulator guided technique for brachial plexus block. They advocated the use of the nerve stimulator technique to the patients with possible risk of neurological damage associated with paresthesia and to the patients who have technical difficulties in introducing catheter for continuous brachial plexus blockade.

MATERIALS AND METHODS

Study Design	: Prospective Single Blinded Case Control Study
Study population	: All patients undergoing elective upper limb Surgery
Sample size	: 60 patients
Sampling Technique	: Randomized sampling
Statistical Test of Significance	: Student's 't' test was used to test the significance of difference between quantitative variables and Yate's chi square test was used for qualitative variables

After obtaining approval from the institutional ethical committee, Thanjavur Medical College, Thanjavur, the study was conducted in 60 ASA I or ASA II patients, aged from 17 to 60 years who underwent elective upper limb surgeries under supraclavicular 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 grade 1 or 2 patients
2. Elective upper limb surgeries

3. Patients of either sex, aged 17 to 60 years with total body weight more than 50 kg

EXCLUSION CRITERIA:

1. Patient refusal
2. Patients below 17 and above 60 years of age and with total body weight less than or equal to 50kg
3. Patients with coagulopathy or peripheral neuropathy
4. ASA grade III or IV patients
5. Allergy to local anaesthetics

Each patient was randomly allocated into one of the two groups of 30 patients each using computerised random numbers.

- Group-C: Supraclavicular brachial plexus block given by conventional subclavian perivascular technique after eliciting paresthesia.
- Group- US: Supraclavicular brachial plexus block given with ultrasound guidance.

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

PREANAESTHETIC EVALUATION:

All the patients underwent thorough pre-anesthetic evaluation and ASA risk was stratified. The patients were stabilized if there was any significant comorbid medical illness. Basic investigations such as Hemoglobin (Hb)%, bleeding time, clotting time, serum urea, serum creatinine, blood sugar, blood grouping and cross matching, Urine: albumin, sugar and microscopy, Electrocardiography (ECG) and chest

X-ray PA view were done

All the patients were kept nil per oral as per the fasting guidelines. 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 18G intravenous cannula. All the patients were premedicated with injection glycopyrrolate 8µg/kg intramuscularly (IM) 45 minutes before starting the procedure. Intravenous fluid was started for all patients and was shifted to operating room.

Equipments:

a. For the procedure:

A portable tray covered with sterile towel containing,

1. Disposable syringes – 10 ml, 5 ml
2. Disposable hypodermic needles of 5 cm length 22G-1 and 24G-1

3. Bowl containing surgical spirit and sterile gauze pieces
4. Sponge holding forceps
5. Towels and towel clips
6. Drugs: 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline(1:2,00,000).
7. 20 G spinal needle
8. 10 cm extension line

Sonoray DS- 50 Ultrasound Machine with 10-6 MHz linear transducer

b. For emergency resuscitation.

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

- Working suction apparatus with a suction catheter
- Airways (oropharyngeal and nasopharyngeal)
- IV fluids
- Anesthetic agents and resuscitation drugs were kept ready

Monitors: Pulse oximetry, non-invasive blood pressure monitor on the opposite upper limb and electro-cardiogram (ECG) were connected and baseline parameters were recorded for all patients.

POSITIONING FOR BOTH THE PROCEDURES:

Patient was made to lie supine with head turned to opposite side of the intended block, arm adducted and hand extended along the side towards the ipsilateral knee as far as possible. A small pillow or folded sheet was placed below the shoulder to make the field more prominent.

PROCEDURE[4,6,35,36,37]

GROUP C, CONVENTIONAL[4,35,36,37]

In Group C, block was performed by conventional subclavian perivascular technique by eliciting paresthesia. The patient was positioned as mentioned above. After sterile preparation of the site, draping was done. The patient was asked to raise the head slightly off the table so that the lateral border of the sternocleidomastoid muscle can be identified as it inserts onto the clavicle. On deep palpation lateral to the artery, interscalene groove was identified. The groove was followed down to the root of the neck and the subclavian artery was palpable in this position.

A 22 gauge, 5 cm Huber point needle was inserted at the lowest point of the interscalene groove (where the skin is beginning to flatten out over the supraclavicular fossa), tangential and posterior to the subclavian artery. The plexus was identified by eliciting paresthesia which should be evident in area below the shoulder.

After eliciting paresthesia, a 10ml syringe was mounted on the needle and after negative aspiration of blood, 30 ml of local anaesthetic solution was injected. 3-minutes massage was performed to facilitate an even drug distribution.

If paresthesia had not been elicited even after 20 minutes, the patients were excluded from the study and given other mode of anaesthesia.

GROUP US, ULTRASOUND[5,6,36]

In group US, block was performed after real time visualization of the vessels, nerves and bones with "in-plane approach". This procedure was done using Sonoray ultrasonogram machine with 10-6 MHz transducer by the "in-plane approach" using 20G spinal 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 appearances 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 spinal 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 anesthetic 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 anesthetic solution.

The proper spread of local anaesthetic solution around the considered nerves was continuously evaluated under sonographic vision, and needle tip position was continuously adjusted with minimum movements during injection under sonographic vision to optimize the impregnation of nerve structures. The multiple injection technique was used to deposit the total amount of drug. 3-minutes massage was performed to facilitate an even drug distribution.

ASSESSMENT OF PARAMETERS:

All the patients were monitored for

- Time taken for the procedure
- Onset and duration of sensory neural blockade
- Onset and duration of motor blockade
- Overall effectiveness of block
- Success Rate
- 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 23G 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

Onset of sensory block was assessed as the time interval between administration of drug and perception of pin prick as touch (Hollmen's scale 3) in any one of the major nerve distribution area.

Duration of sensory block was defined as the time elapsed between the injection of drug and appearance of pain requiring analgesia (Hollmen's scale less than or equal to 1) in all the 4 major nerve distribution areas.

ASSESSMENT OF MOTOR BLOCKADE:

Lavoie's scale was used for evaluation of motor blockade:

Grade 1- 0% – flexion and extension in both the hand and arm against resistance

Grade 2 -33%- flexion and extension in both the hand and arm against gravity but not against resistance

Grade 3- 66%- flexion and extension movements in the hand but not in the arm

Grade 4- 100%- No movement in the entire upper limb

Onset of motor blockade was assessed as the time interval between administration of drug and loss of flexion or extension movements in the arm (Lavoie's scale 3)

Duration of motor block was defined as the time elapsed between injection of drug and complete return of muscle power(Lavoie's scale 1)

OVERALL EFFECTIVENESS OF THE BLOCK:

1) **Totally effective**: Intended 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 perfomed 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 watched 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.

Heart rate, non-invasive blood pressure and oxygen saturation were monitored and recorded at 0, 3, 6, 10, 15, 20, 30, 45, 60, 90, 120, 240, 480 minutes.

- All patients were monitored for 24 hours post-operatively
- Rescue analgesics were given to the patients at the onset of pain postoperatively (Hollmen's sensory scale 1).

OBSERVATION AND RESULTS

This prospective single blinded randomized controlled study was done in 60 ASA I and II patients of either sex aged from 17 to 60 years, posted for upper limb surgeries under supraclavicular brachial plexus block. The study was undertaken to evaluate the time taken for the procedure, onset and duration of blockade, success rate, overall effectiveness of block and complications of the conventional subclavian perivascular approach of supraclavicular brachial plexus block performed versus ultrasound guided approach.

DEMOGRAPHIC DATA

Table 1: Age-Wise Distribution of study groups

Age in years	Group C		Group US		t* value	p value	Significance
	No.	%	No.	%			
17-30	11	36.7	12	40	0.13	0.89	Not Significant
31-45	10	33.3	10	33.3			
46-60	9	30	8	26.7			
TOTAL	30	100	30	100			

As shown in Table 1 and Graph 1, the minimum age of the patient was 17 years and the maximum age was 60 years. The total number of persons in

Group C in the age group 17-30 years is 11 while in Group US, it is 12.

The total number of persons in Group C in the age group 31-45 years is 10 and in Group US also, it is 10. The total number of persons in Group C in the age group 46-60 years is 9 while in Group US, it is 8. Samples are age matched with p value of 0.89(p>0.05), hence statistically not significant. So, the age distribution between the two groups is comparable.

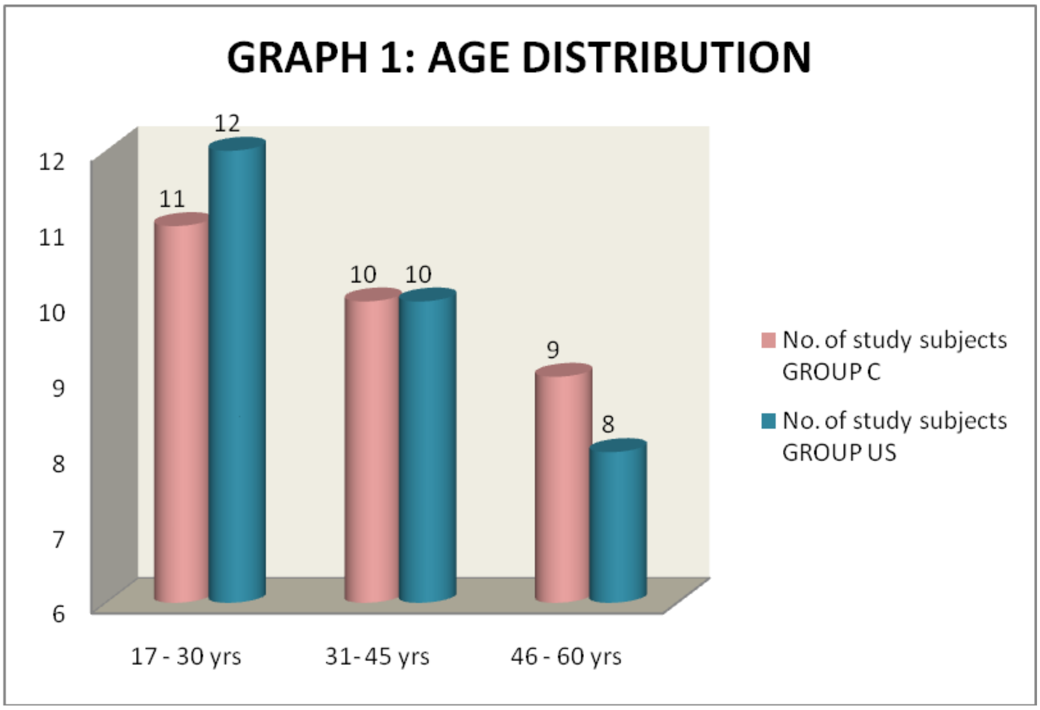


Table 2: Comparison of conventional and ultrasound guided block on the basis of gender of the patients

Gender	Study Group		p value	Significance
	Group C	Group US		
Male	19	22	0.428	Not Significant
Female	11	8		

As shown in the table 2 and graph 2, the gender distribution (male: female ratio) in group C was 19:11 while in group US, it was 11:8. P value was 0.428 (p>0.5). Hence, it is not significant and the groups are comparable.

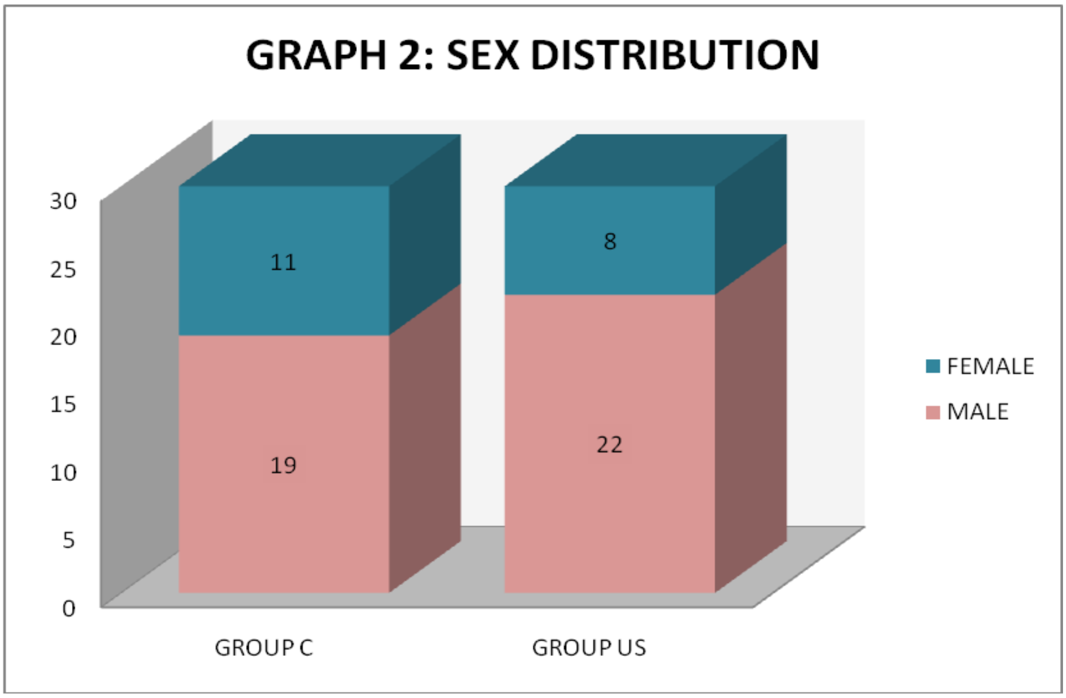


Table 3: Comparison of conventional and ultrasound guided block on the basis of mean body weight of the patients:

Study Group	Mean±SD (kgs)	Mean Difference	t* value	p value	Significance
Group C	61.3±7.77	1.53	0.471	0.319	Not Significant
Group US	60.47±7.56				

As shown in the table 3 and graph 3, the mean weight of the patient in group US was 60.47±7.56 kilograms and in group C, it was 61.3±7.77 kilograms and it is not statistically significant(p=0.319).

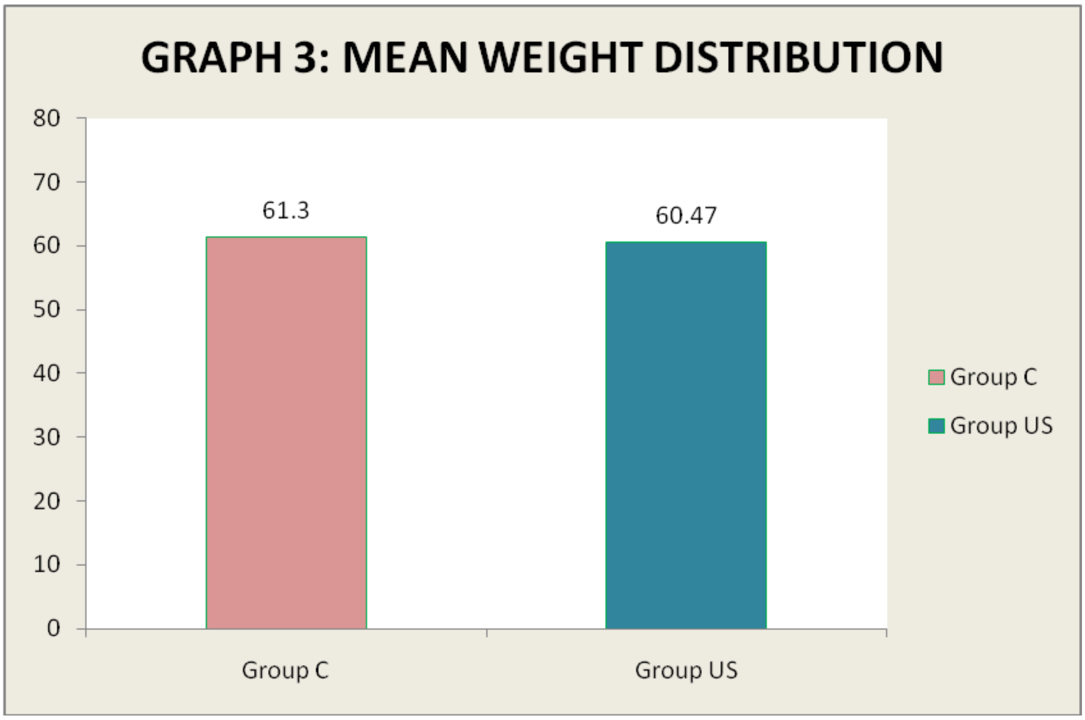


Table 4: Comparison of conventional and ultrasound guided block on the basis of time taken for the procedure

Study Group	Mean±SD (mins)	Mean Difference	t* value	p value	Significance
Group C	5.66±1.7	3.03	4.17	0.000	Highly Significant
Group US	8.7±2.36				

* Student's unpaired t test   Highly significant - $p<0.001$

As shown in Table 4 and graph 4, the mean time taken to perform a conventional block was 5.66±1.7 minutes and in group US, it was 8.70 ± 2.36 minutes. The statistical analysis by student's unpaired 't'test showed that, conventional technique was significantly faster to perform when compared to ultrasound guided technique ($p<0.001$).

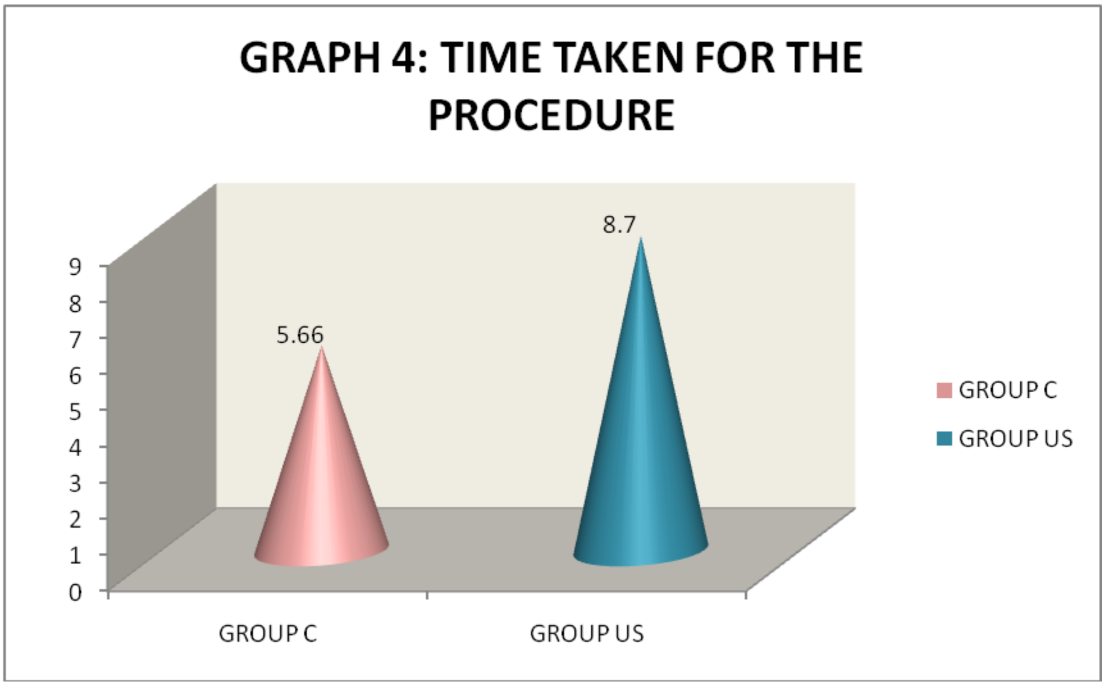


Table 5: Comparison of conventional and ultrasound guided block on the basis of time taken for the onset of sensory blockade

Study Group	Mean±SD (mins)	Mean Difference	t* value	p value	Significance
Group C	10.89±8.11	2.77	3.16	0.003	Highly Significant
Group US	8.11±2.67				

* Student's unpaired t test Highly significant - p<0.01

As shown in Table 5 and graph 5, the mean time for the onset of sensory block in group C was 10.89±8.11 minutes and in group US, it was 8.11 ± 2.67 minutes. The statistical analysis by student's unpaired 't'test showed that the time taken for the onset of sensory block in group US was significantly faster when compared to group C (p= 0.003)

Table 6: Comparison of conventional and ultrasound guided block on the basis of time taken for the onset of motor blockade:

Study Group	Mean±SD (mins)	Mean Difference	t* value	p value	Significance
Group C	13.00±3.7	2.58	2.81	0.007	Highly Significant
Group US	10.42±3.16				

* Student's unpaired t test   Highly significant - p<0.01

As shown in Table 6 and graph 5, the mean time for onset of motor block in group C was 13±3.7 minutes and in group US, it was 10.42 ±3.16 minutes. The statistical analysis by student's unpaired 't' test showed that the time for onset of motor block in group US was significantly faster when compared to group C (p= 0.007).

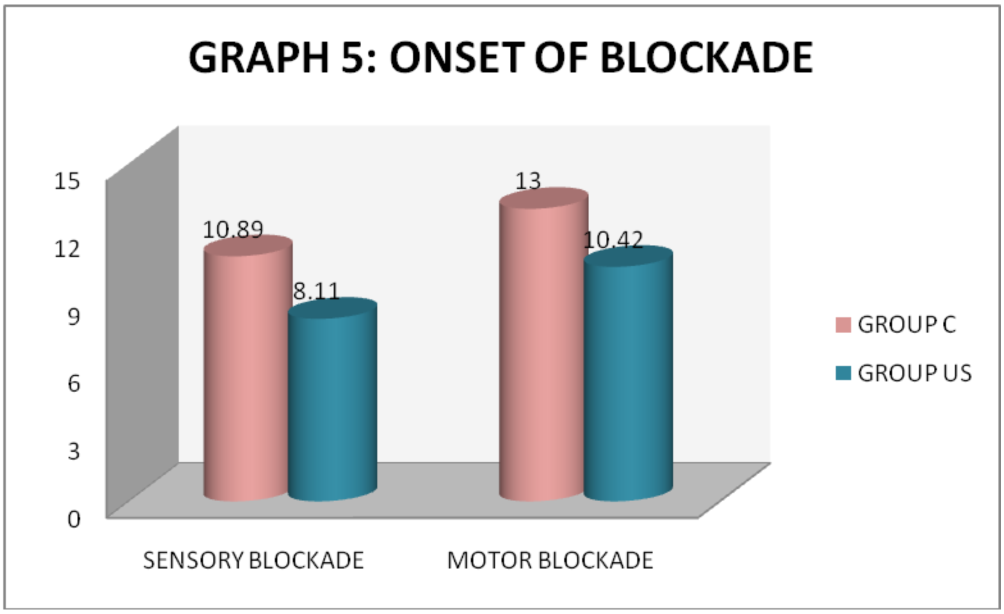


Table 7: Comparison of conventional and ultrasound guided block on the basis of duration of sensory blockade

Study Group	Mean±SD (hrs)	Mean Difference	t* value	p value	Significance
Group C	5.41±1.1	0.91	3.34	0.001	Highly Significant
Group US	6.32±0.97				

* Student’s unpaired t test Highly significant - p<0.01

As shown in Table 7 and graph 6, the mean duration of sensory block in group US was 6.32 ±0.97 hours and in group C was 5.41±1.1hours. The statistical analysis by students unpaired ‘t’ test showed that the duration of sensory block in group US was significantly longer when compared to group C with p value of 0.001 (p < 0.01).

Table 8: Comparison of conventional and ultrasound guided block on the basis of duration of motor blockade

Study Group	Mean±SD (hrs)	Mean Difference	t* value	p value	Significance
Group C	5.04±1.08	0.77	3.08	0.003	Highly Significant
Group US	5.82±0.83				

* Student's unpaired t test Highly significant - p<0.01

As shown in Table 8 and graph 6, the mean duration of motor block in group US was 5.82 ±0.83 hours and the group C was 5.04±1.08 hours. The statistical analysis by students unpaired 't' test showed that the group US has longer duration of motor blockade when compared to group C and it is statistically significant (p < 0.01).

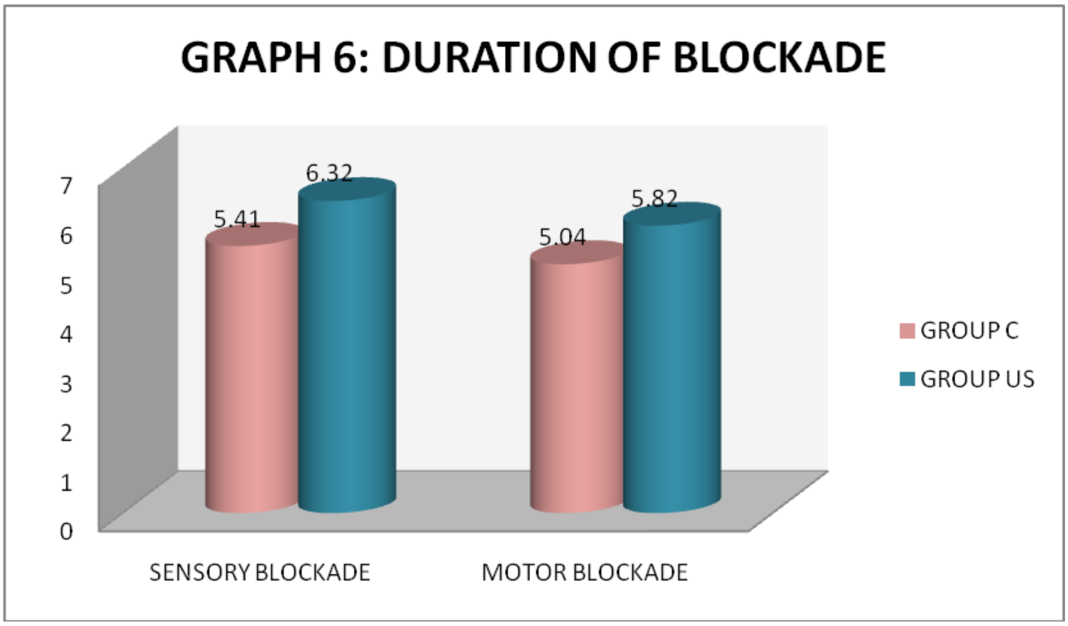


Table 9: Comparison of conventional and ultrasound guided block on the basis of requirement of intraoperative analgesic supplementation

Study group	Analgesic Supplementation		Chi-square value	p value	Significance
	Required	Not Required			
Group C	9	21	7.68	0 .006	Highly Significant
Group US	1	29			

Chi Square test Highly Significant - p<0.01

As shown in the table 9 and graph 7, in Group US, 1 out of 30 patients required analgesic supplementation during surgery and in conventional group, it was 9 out of 30 patients. The chi square value is 7.68. The requirement of analgesics was significantly reduced in ultrasound group than in conventional group. (p = 0.006)

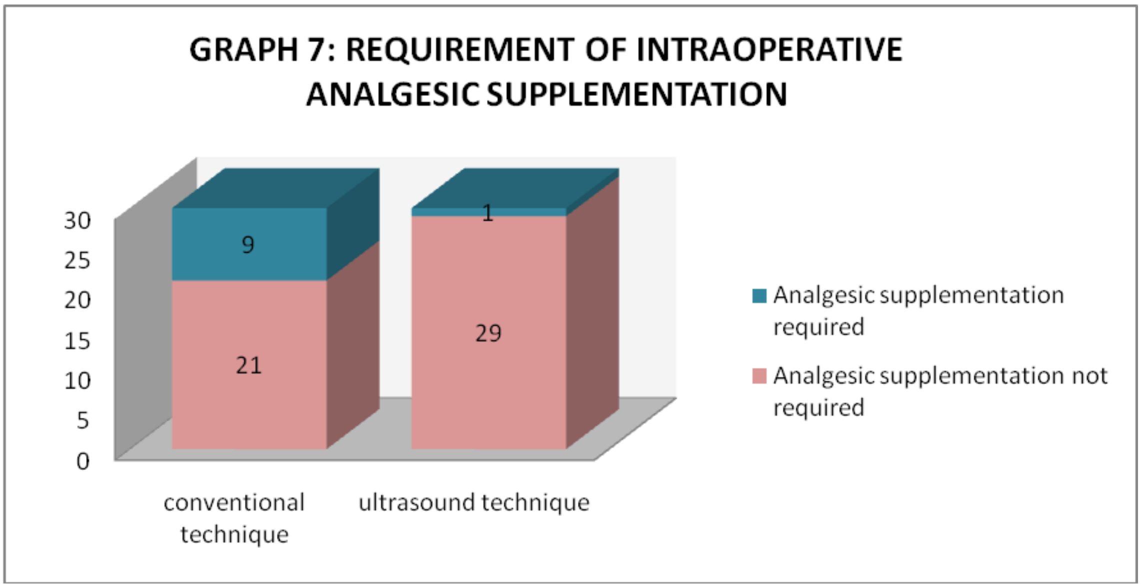


Table 10: Comparison of conventional and ultrasound guided block on the basis of overall effectiveness of the block

Study Group	Totally effective	Partially effective	Conversion to GA	Chi Square	p value	Significance
Group C	22	6	2	6.53	0.038	Significant
Group US	29	1	0			

Chi square test Significant- $p<0.05$

As shown in the table 10 and graph 8, in group US, 29 patients(96.67%) had totally effective blockade, and in 1 patient the block was partially effective(3.33%) and there was no conversion to General Anaesthesia in US group. Whereas in group C, only 22 patients had totally effective block, in 6 patients the block was partially effective and in 2 patients block was totally failed and required conversion to general anaesthesia. This difference is statistically significant by chi-square test with p value of 0.038(χ^2 = 6.53, $p<$ 0.05)

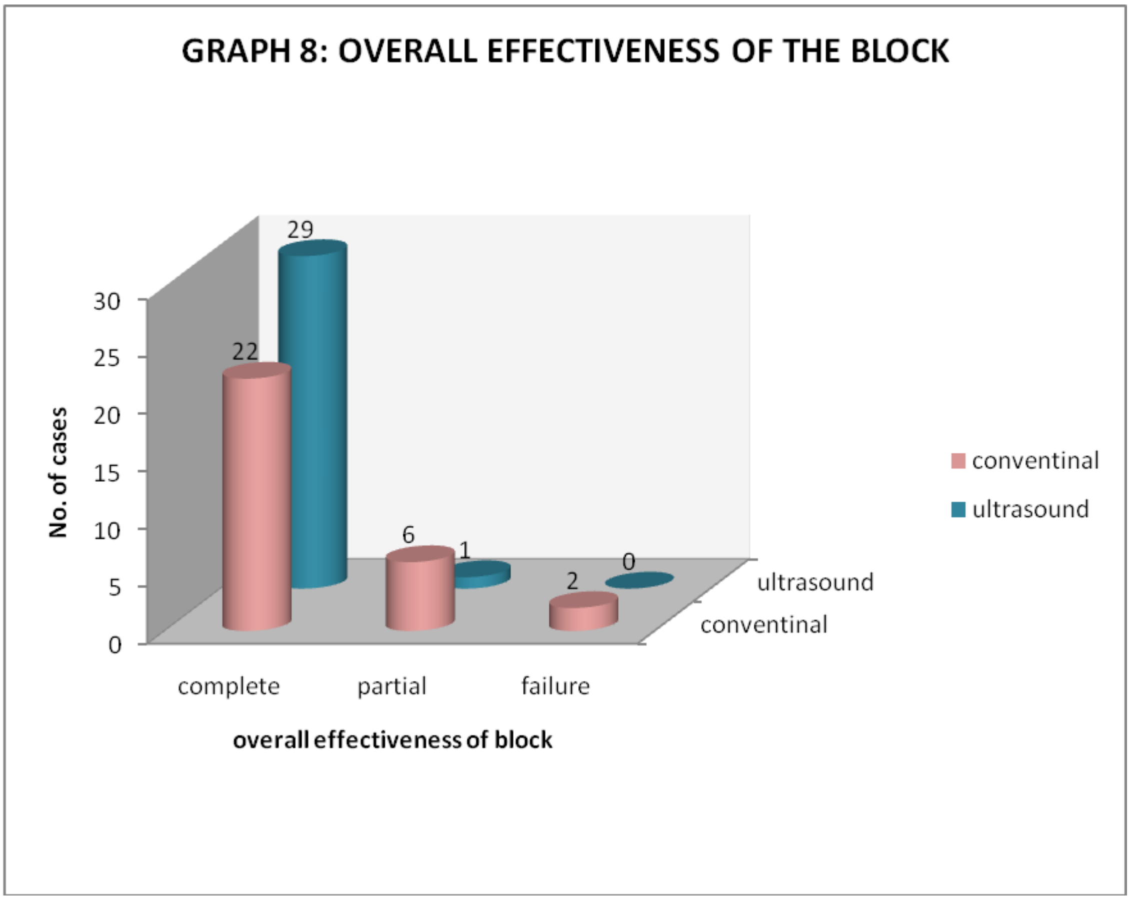

GRAPH 8: OVERALL EFFECTIVENESS OF THE BLOCK
No. of cases
30
25
20
15
10
5
0
29
22
6
1
2
0
complete
partial
failure
overall effectiveness of block
ultrasound
conventinal
conventinal
ultrasound

Table 11: Comparison of conventional and ultrasound guided block on the basis of success rate:

Group	Success		Chi square	p value	Significance
	No.	%			
GROUP C	28	93.33	2.069	0.150	Not significant
GROUP US	30	100			

Chi square test p>0.05, not sinificant

As shown in the table 11 and graph 9, in group C, 28 out of 30 cases had successful block (93.33% success rate). In group US, all the 30 cases had successful block (100% success rate). But, this difference is not statistically significant (p=0.150).

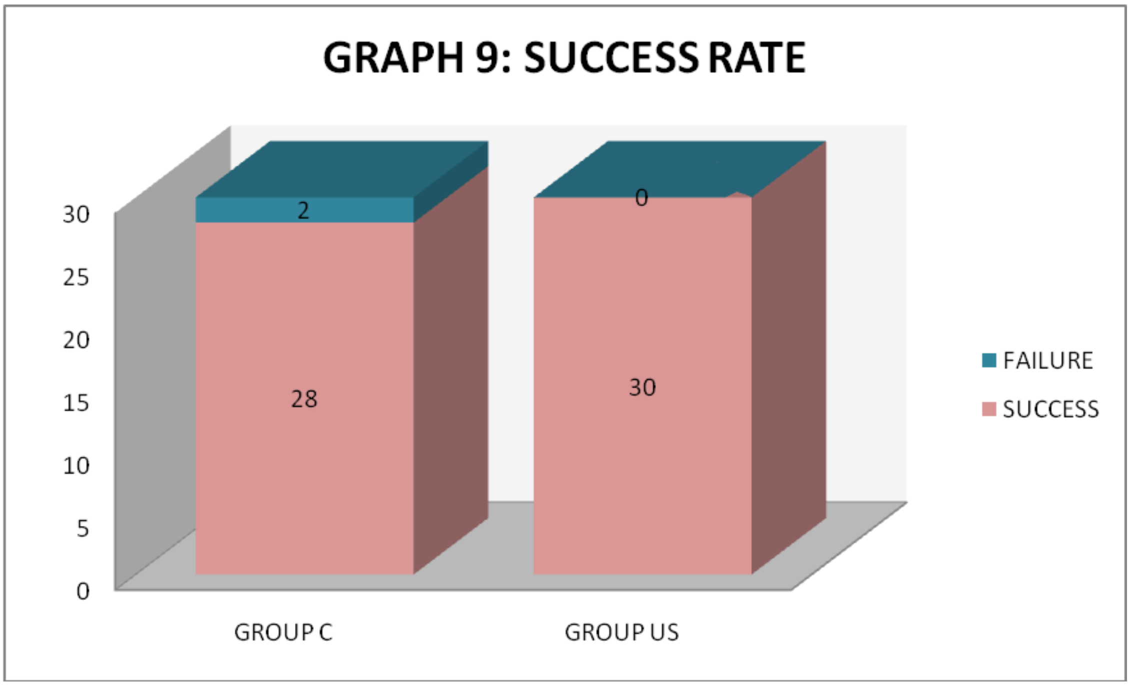


Table 12: Comparison of conventional and ultrasound guided block on the basis of complication:

Complication	Group C	Group US
Vessel puncture/ Hematoma	4	1
Drug Toxicity	0	0
Nerve injury	0	0
Pneumothorax	0	0
Phrenic nerve blockade	0	0
Horner's Syndrome	0	0
RLN block	0	0

Table 13: Statistical Analysis of incidence of vessel puncture between the study groups

Study Group	**Vessel puncture**		**Chi-square value**	**p value**	**Significance**
	Present	Absent			
Group C	4	26	1.96	0.16	Not Significant
Group US	1	29			

As shown in the tables 12 and 13 and graph 10, 4 among 30 patients in

Group C had vessel puncture (13%) and 1 among 30 patients in Group US (3%). Chi square value is 1.96 and p value is 0.16 which is not significant. No other complication was elicited in either of the groups.

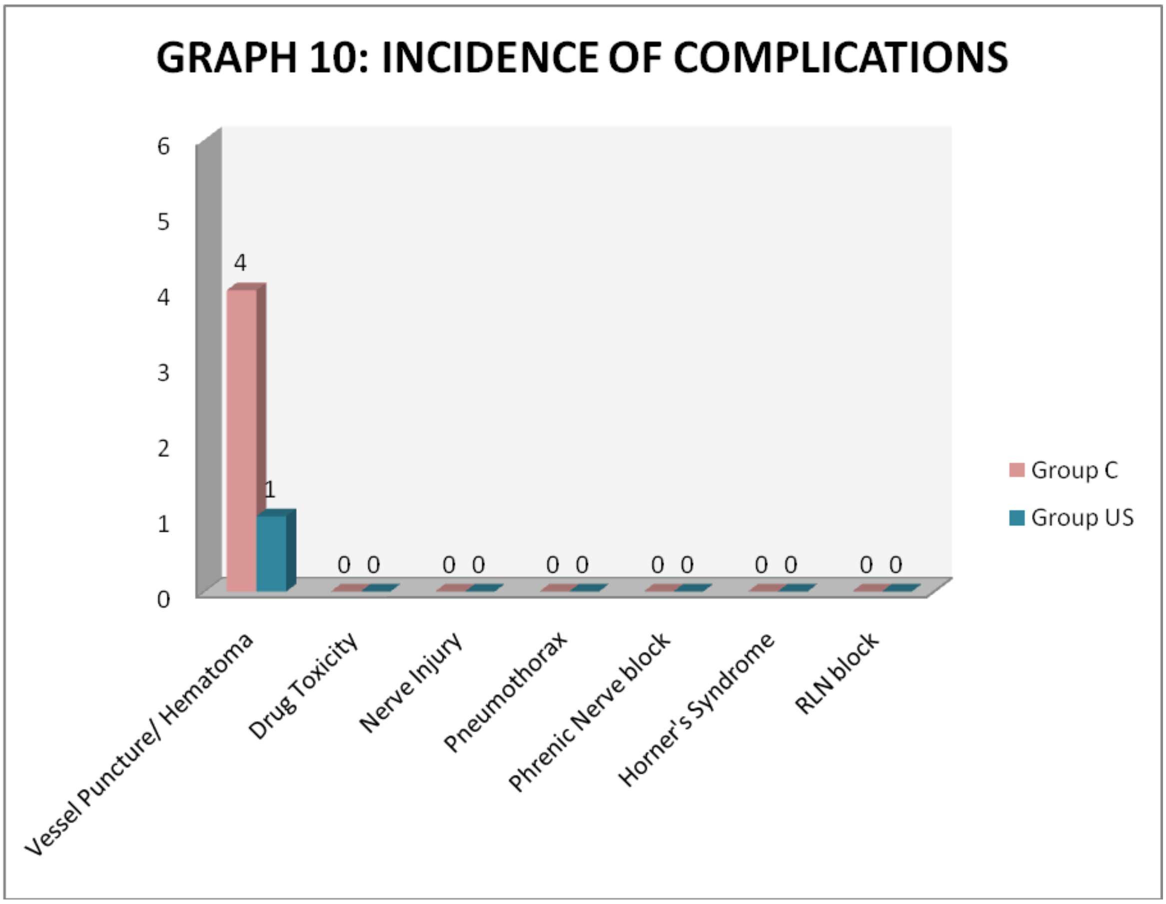


Table 14: Comparison of conventional and ultrasound guided block on the basis of pulse rate (beats / min)

Time of Assessment	Mean+/- SD		Mean Difference	t* Value	p Value	Significance
	Group C	Group US				
0 min	93.57±14.3	93.4±15.8	0.17	0.043	0.97	NS
3 mins	91.43±14.9	91.93±15.2	0.50	0.129	0.90	NS
6 mins	91.53±15.38	89.93±14.64	1.6	0.413	0.68	NS
10 mins	91.43±14.36	88.63±15.25	2.8	0.732	0.47	NS
15 mins	91.63±15.15	86.3±15.52	5.33	1.347	0.18	NS
20 mins	91.23±16.37	84.87±15.82	6.37	1.532	0.13	NS
30 mins	90.0±15.2	83.73±15.39	6.27	1.587	0.12	NS
45 mins	87.83±15.37	82.27±13.30	5.57	1.5	0.14	NS
1 hour	86.27±15.28	82.17±13.67	4.1	1.095	0.28	NS
1 ½ hours	84.47±15.24	81.03±13.17	3.43	0.934	0.36	NS
2 hours	82.77±14.24	80.27±12.69	2.5	0.718	0.48	NS
4 hours	83.54±14.62	80.00±12.79	3.53	0.996	0.32	NS
8 hours	82.94±13.25	78.50±13.00	4.43	1.308	0.196	NS

* Student's unpaired t test NS = Not Significant (p value > 0.05)

As shown in the table 14 and graph 11, there is no significant change in the pulse rate between the 2 groups. (p>0.05)

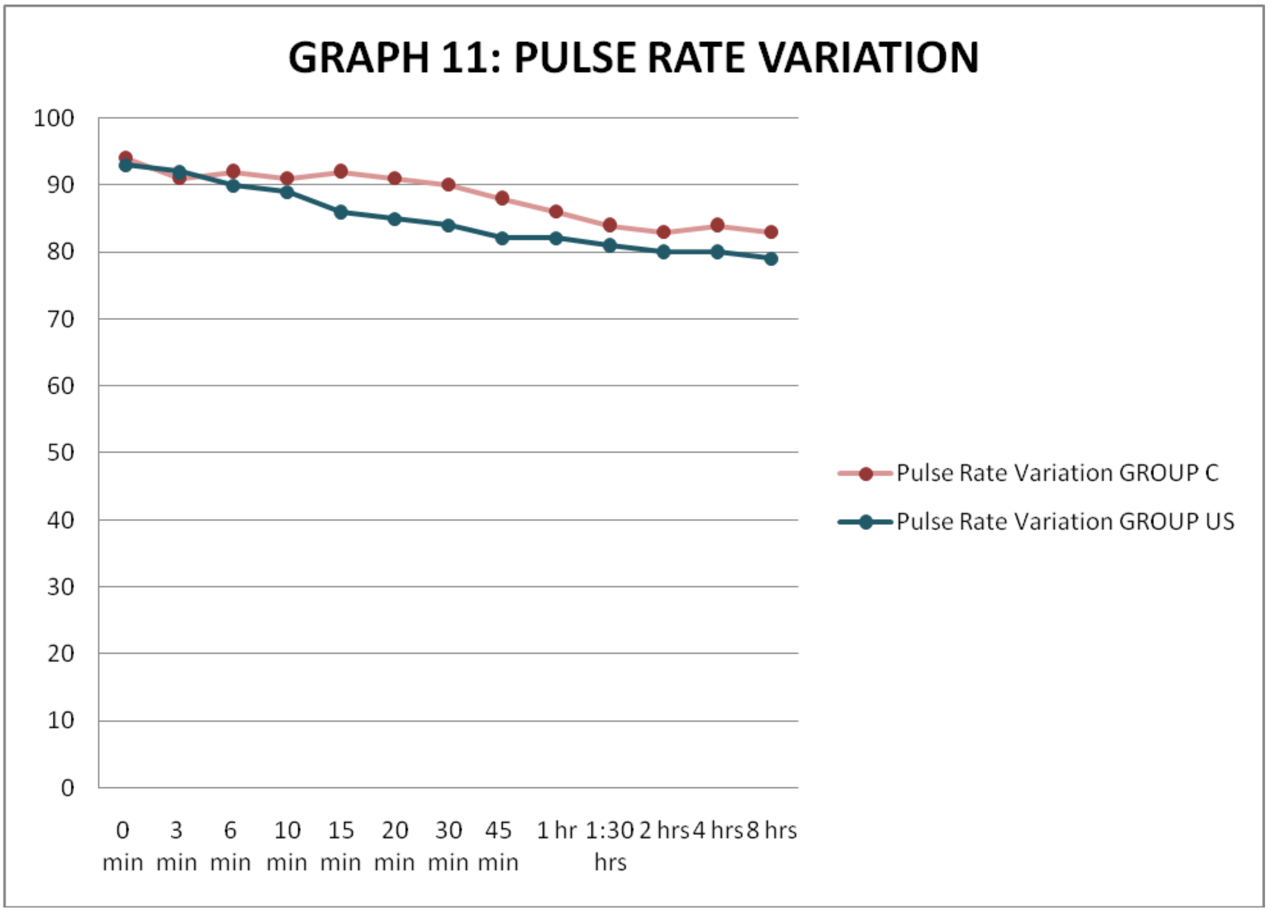

GRAPH 11: PULSE RATE VARIATION
100
90
80
70
60
50
40
30
20
10
0
0 min
3 min
6 min
10 min
15 min
20 min
30 min
45 min
1 hr
1:30 hrs
2 hrs
4 hrs
8 hrs
Pulse Rate Variation GROUP C
Pulse Rate Variation GROUP US

Table 15: Comparison of conventional and ultrasound guided block on the basis of Systolic blood pressure

Time of Assessment	Mean+/- SD		Mean Difference	t* Value	p Value	Significance
	Group C	Group US				
0 min	126.23±10.66	128.37±9.52	2.13	0.818	0.417	NS
3 mins	124.27±9.85	124.30±9.82	0.03	0.013	0.990	NS
6 mins	123.97±12.59	122.93±11.75	1.03	0.329	0.744	NS
9 mins	123.30±12.72	120.47±10.37	2.83	0.946	0.348	NS
12 mins	122.43±10.46	118.87±11.03	3.57	1.285	0.204	NS
20 mins	122.50±8.52	118.13±9.97	4.37	1.823	0.073	NS
30 mins	121.53±9.93	117.97±8.94	3.57	1.462	0.149	NS
45 mins	120.63±9.40	118.47±10.38	2.17	0.847	0.401	NS
1 hour	121.87±9.52	118.27±9.76	3.6	1.447	0.153	NS
1 ½ hours	118.90±9.47	117.57±9.53	1.33	0.544	0.589	NS
2 hours	120.13±9.02	117.90±7.98	2.23	1.016	0.314	NS
4 hours	119.70±8.50	117.37±8.02	2.33	1.093	0.279	NS
8 hours	119.80±8.70	118.23±7.05	1.57	0.765	0.447	NS

* Student's unpaired t test NS = Not Significant (p value > 0.05)

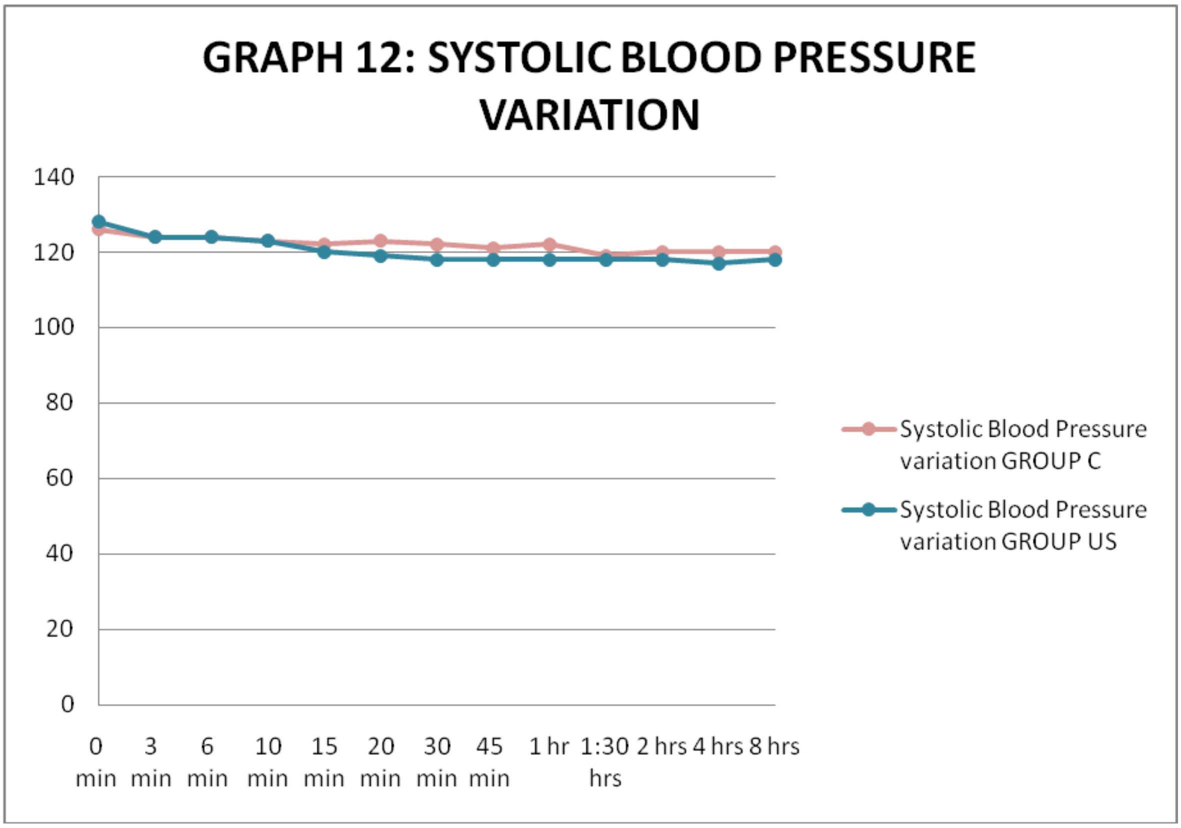
As shown in the table 15 and graph 12, there is no significant change in the systolic blood pressure between the 2 groups (p>0.05). There was no episode of hypotension in both the groups.

Table 16: Comparison of conventional and ultrasound guided block on the basis of Diastolic blood pressure

Time of Assessment	Mean± SD (mm of Hg)		Mean Difference	t value	p value	Significance
	Group C	Group US				
0 min	83.07±8.36	84.20±7.52	1.13	0.552	0.583	NS
3 mins	81.20±8.30	81.87±8.88	1.33	0.997	0.323	NS
6 mins	81.03±9.12	80.33±9.03	0.70	0.299	0.766	NS
10 mins	79.17±8.07	79.30±9.06	0.13	0.06	0.952	NS
15 mins	80.10±8.28	78.93±9.16	1.17	0.517	0.607	NS
20 mins	78.43±6.21	78.63±9.22	0.2	0.099	0.922	NS
30 mins	78.97±6.93	78.5±8.22	0.47	0.238	0.813	NS
45 mins	77.97±8.05	77.7±8.67	0.27	0.123	0.902	NS
1 hr	78.67±7.50	76.6±7.79	2.07	1.047	0.30	NS
1 ½ hrs	77.97±6.70	75.53±8.34	2.63	1.348	0.183	NS
2 hrs	77.37±6.64	77.73±6.02	0.37	0.221	0.826	NS
4 hrs	78.01±6.81	76.9±7.10	1.20	0.668	0.507	NS
8 hrs	77.43±6.13	77.17±5.95	0.27	0.171	0.865	NS

* Student's unpaired t test NS = Not Significant (p value > 0.05)

As shown in the table 16 and graph 13, there is no significant change in the diastolic blood pressure between the 2 groups. (p>0.05)


GRAPH 12: SYSTOLIC BLOOD PRESSURE VARIATION
140
120
100
80
60
40
20
0
0 min
3 min
6 min
10 min
15 min
20 min
30 min
45 min
1 hr
1:30 hrs
2 hrs
4 hrs
8 hrs
Systolic Blood Pressure variation GROUP C
Systolic Blood Pressure variation GROUP US

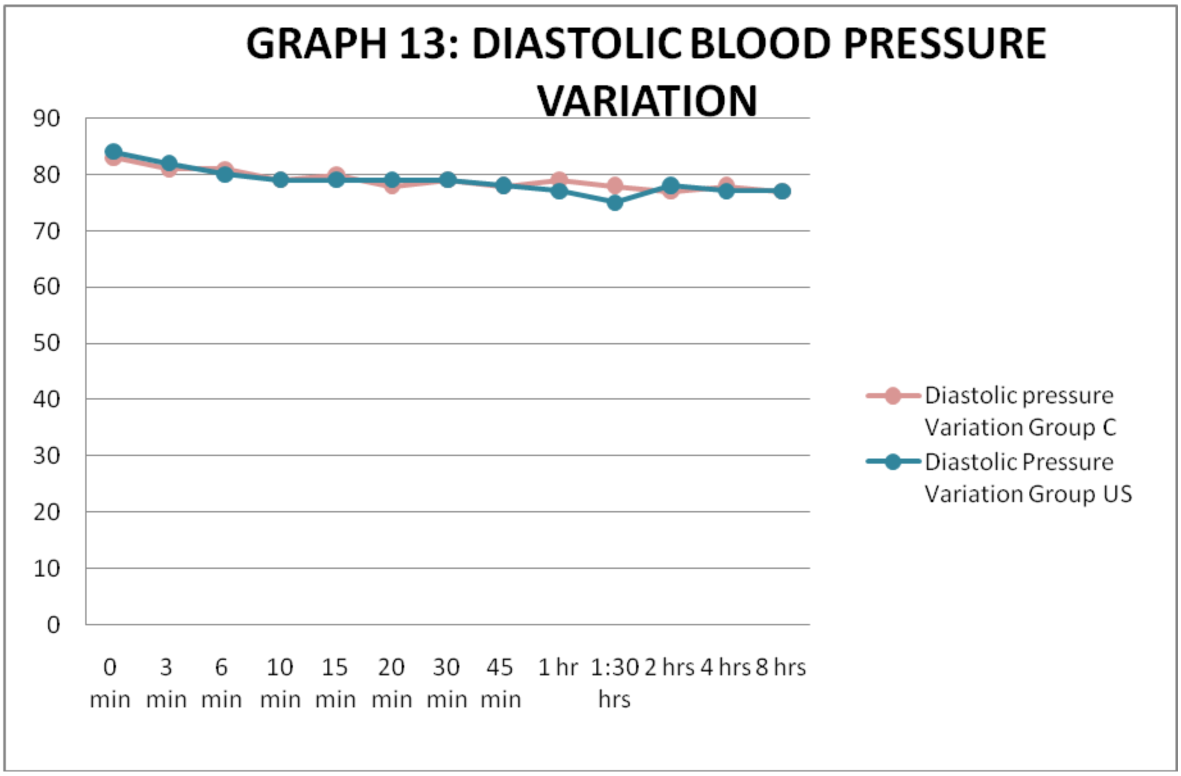
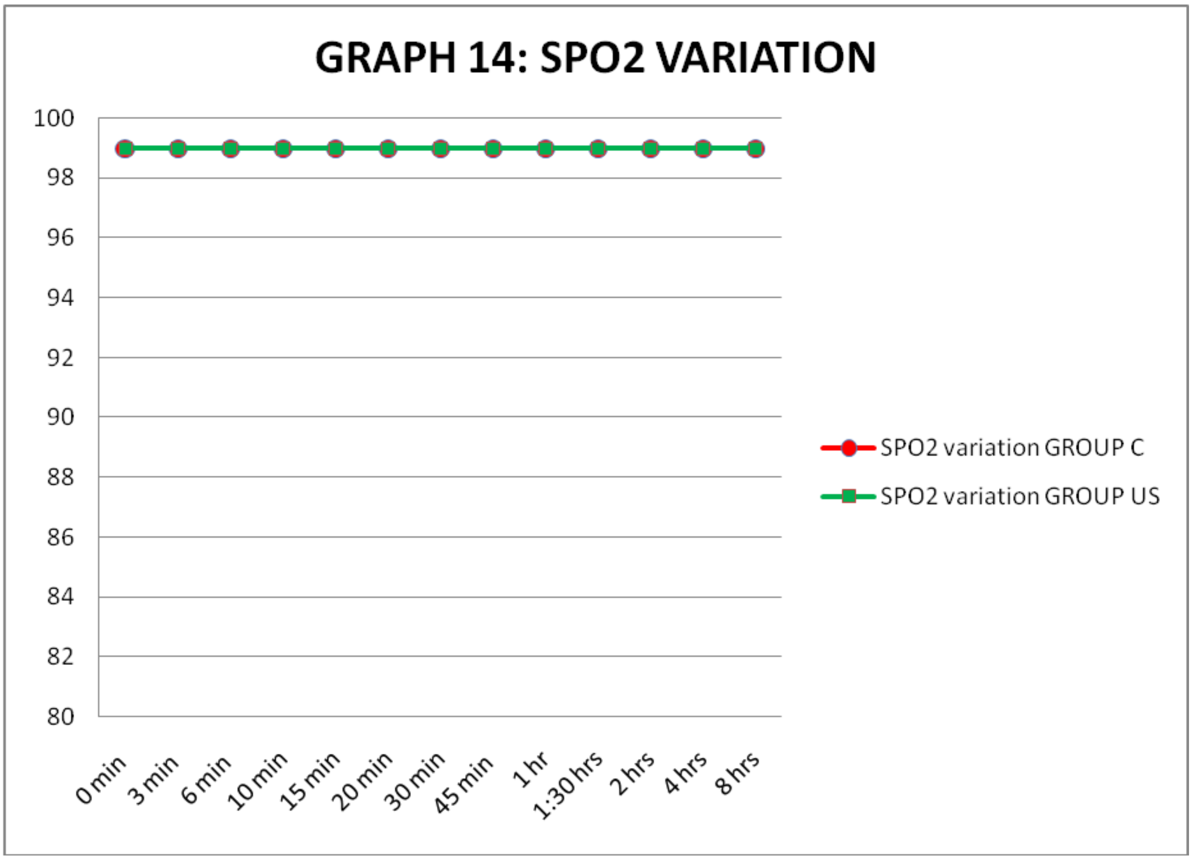

GRAPH 13: DIASTOLIC BLOOD PRESSURE VARIATION
90
80
70
60
50
40
30
20
10
0
0 min
3 min
6 min
10 min
15 min
20 min
30 min
45 min
1 hr
1:30 hrs
2 hrs
4 hrs
8 hrs
Diastolic pressure Variation Group C
Diastolic Pressure Variation Group US

Table 17: Comparison of conventional and ultrasound guided block on the basis of oxygen saturation

Time of Assessment	Mean+/- SD		Mean Difference	t* Value	p Value	Significance
	Group C	Group US				
0 min	98.9±0.92	99.07±0.83	0.167	0.736	0.464	NS
3 mins	98.8±0.89	99±1.05	0.20	0.797	0.429	NS
6 mins	98.9±0.84	99.07±1.05	0.167	0.678	0.501	NS
9 mins	98.9±0.84	99.03±0.81	0.133	0.624	0.535	NS
12 mins	99.1±0.71	99.07±0.94	0.033	0.154	0.878	NS
20 mins	99.1±0.71	99.03±1.03	0.067	0.291	0.772	NS
30 mins	99.07±0.78	99±0.91	0.067	0.304	0.762	NS
45 mins	98.93±0.83	99.17±0.83	0.233	1.088	0.281	NS
1 hour	99±0.69	99..07±0.94	0.067	0.311	0.757	NS
1 ½ hours	99.13±0.73	99.17±0.95	0.033	0.152	0.879	NS
2 hours	98.97±0.76	99.1±0.99	0.133	0.582	0.563	NS
4 hours	98.97±0.93	98.9±0.99	0.067	0.268	0.789	NS
8 hours	98.9±0.88	98.8±0.96	0.1	0.419	0.677	NS

* Student's unpaired t test NS = Not Significant (p value > 0.05)

As shown in the table 17 and graph 14, there is no significant change in the oxygen saturation between the 2 groups (p>0.05). There was no episode of desaturation.


GRAPH 14: SPO2 VARIATION
100
98
96
94
92
90
88
86
84
82
80
0 min
3 min
6 min
10 min
15 min
20 min
30 min
45 min
1 hr
1:30 hrs
2 hrs
4 hrs
8 hrs
SPO2 variation GROUP C
SPO2 variation GROUP US

DISCUSSION

Brachial plexus block has been proven to be a valuable method of providing anesthesia for surgery of the forearm and hand. The most common technique is the supraclavicular approach of brachial plexus because of its ease of performance and increased extent of blockade. In previous days, various blind techniques were used to find the brachial plexus sheath. The most important among them is by eliciting paresthesia in the subclavian perivascular approach.

Although nerve stimulator technique improves the success rate of supraclavicular brachial plexus block, it is not used routinely. Even after the invention of ultrasound, most of the anaesthesiologists are still practising conventional blind technique for peripheral nerve blocks especially supraclavicular brachial plexus block.

So, we have planned for a prospective randomized single blinded study in Thanjavur medical college hospital, Thanjavur to compare the efficacy of ultrasound guided technique of supraclavicular brachial plexus block with the conventional subclavian perivascular technique.

Patient characteristics across the groups:

The patients in our study did not vary much with respect to age, sex and weight. The p value was 0.896 for age-wise distribution among the groups and 0.319 for weight distribution ($p>0.05$) and are not significant. The mean age group for conventional group in our study was 37.9±14.08 years and in ultrasound group, it was 37.43±13.44 years. The mean weight of the patients in the conventional group was 61.3±7.77kgs and in ultrasound group, it was 60.47±7.56kgs. Hence, both the groups are comparable.

Changes in the perioperative cardiovascular parameters:

There were no significant differences between the study groups with respect to the pattern of changes in pulse rate, systolic blood pressure, diastolic blood pressure and oxygen saturation perioperatively. The above mentioned parameters were recorded at 0 min, 3 mins, 6 mins, 10 mins, 15 mins, 20 mins, 30 mins, 45 mins, 1 hr, 2 hrs, 4 hrs, 8 hrs. The p values measured during these intervals for the above mentioned variables were found to be not significant.($p>0.05$).

Gajendra Singh et al[22] in their study to compare ultrasound guided versus conventional supraclavicualr block, concluded that heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, oxygen saturation were comparable between the study groups (ultrasound vs conventional) and did not change significantly in the intra or postoperative period.($p>0.05$)

Kapral et al[38] compared the efficacy of ultrasound guided technique with nerve stimulator guided supraclavicular block. In this study also there is no significant change in hemodynamics between the groups

The above mentioned study results, regarding the hemodynamic variables, were concordant with our study.

Dose of the drug:

We have used 30 ml of 1:1 ratio of 0.5% Inj.Bupivacaine and 2% Inj. Lignocaine with adrenaline for both the groups. **Gajendra Singh et al**[22] also used the same drug combination for both conventional and ultrasound guided groups.

In a study by **Duggan et al**[27] to determine the minimum effective volume of lignocaine- bupivacaine mixture for ultrasound guided supraclavicular block, he concluded that ED50 is 23ml(i.e., effective dose for 50 Patients is 23ml) and ED95 is 42ml without any major complications. They found no difference in the volume of drug needed in ultrasound guided technique when compared to conventional technique.

According to **Tran et al**[39], the effective volume of local anaesthetic solution in supraclavicular block in 90% patients using ultrasound technique was 32 ml. **Dae Geun Jeon et al**[40] in the Korean journal of Anaesthesia published a study in which they mentioned that ED90 for local anaesthetic solution was 30 ml without any toxic effects.

Hickey et al[30] conducted a study to define the influence of location of paresthesia in subclavian perivascular block. They have used 30 ml volume for conventional technique. **Raizada et al**[32] also used 30 ml of local anaesthetic solution for blind subclavian perivascular technique.

So, we have decided to take a total volume of 30ml of anaesthetic solution. For comparison purpose, we have used the same volume in conventional subclavian perivascular technique also.

Choice of the drug:

In our study, we have used 15 ml of 0.5% Inj. Bupivacaine and 15 ml of 2% Inj. Lignocaine with 1:2,00,000 adrenaline invariably to all the patients. This dosage had not crossed the toxic limit for both lignocaine with adrenaline (7 mg/kg) and bupivacaine with adrenaline (2 mg/kg) as the least body weight of the patient in our study was 52 kg.

According to **Raj et al**[41], local anaesthetics when compounded act independently, as if they were used alone. This was supported by a study conducted by **Raizada et al**[32] in 2002. In their study, they have concluded that the lignocaine- bupivacaine mixture in 1:1 ratio carries the benefit of shorter onset of action similar to lignocaine and a longer duration of action similar to bupivacaine without increasing the dose of both the drugs.

Time taken for the procedure:

The mean time taken for ultrasound guided supraclavicular block in our study was 8.7± 2.36 minutes and for conventional technique it was 5.66± 1.7 minutes. The p value was 0.000. Hence, conventional technique is significantly faster to perform than ultrasound guided technique ($p<0.005$).

This study shows that conventional approach by eliciting paresthesia is technically feasible than ultrasound technique. The time delay in ultrasound guided technique was found to be due to the variable sonoanatomy, difficulty in orienting the shaft and the tip of the needle longituidinal to the probe and due to the difficulty in keeping the probe at one point.

Gajendra Singh et al[22] conducted a study between conventional and ultrasound guided supraclavicular block. They concluded that the mean time taken for an ultrasound guided supraclavicular block was 10.1± 1.15 minutes and for conventional technique it was 5.43± 1.45 minutes. In this study also, conventional technique is significantly faster to perform than ultrasound guided technique ($p<0.0001$). This is more similar to our study.

Veeresham et al[23], in their study to compare ultrasound with conventional technique of supraclavicular brachial plexus block, found that the mean time taken for the procedure was 5.37±1.45 minutes in conventional group whereas, it was 9.97±2.44 minutes in ultrasound group ($p<0.0001$). This is concordant with our study.

In a study by **Mithun Duncan et al**[24] to compare the efficacy of ultrasound guided technique with nerve locator guided method, the time taken for them in ultrasound group was 7.27±3.87 minutes which is similar to our study.

According to **Vincent W.S. Chan et al**[28], the supraclavicular block procedure took 9.0±4.4 minutes with ultrasound which is also similar to our study.

But, in a study done by **Stephan William et al**[25], they found that the procedure time for ultrasound guided technique was 5.0± 2.4 minutes and for nerve stimulator technique they took 9.8 minutes. This is contradictory to our study. In their study, they have commented that the time delay in nerve stimulator group was due to the time spent in identifying and marking the anatomy in nerve stimulator technique.

Onset of sensory block:

The mean onset time for sensory blockade in ultrasound group (US) was 8.11±2.67 minutes and in conventional group it was 10.89±8.11 minutes. The difference between the 2 groups was statistically significant with a p value of 0.003($p < 0.05$).

This can be due to the direct visualization of structures in ultrasound group. Moreover, we can administer the drug intrafascially with ultrasound guidance. **Sivashanmugham et al**[42], in their study inferred that the injection of local anaesthetic solution intrafascially resulted in more faster onset of block than an extrafascial injection.

Moreover in ultrasound guided supraclavicular block, we have followed a lateral to medial approach. This is more or less similar to the conventional lateral approach.

According to **Sahu et al**[43], there was significantly faster onset of blockade in lateral approach compared to subclavian perivascular approach. This may be attributed to the needle placement and path taken, which is parallel to the course of the plexus, resulting in more area of plexus getting deposited with the drug initially when compared to the subclavian perivascular approach.

According to **Shweta S. Mehta et al**[26], the onset of sensory blockade was significantly faster in ultrasound guided technique (6.64±0.89 minutes) than conventional nerve stimulator technique (9.64±1.14 minutes). This is concordant with our study.

Gajendra Singh et al[22], in their study administered 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine. The mean onset of sensory blockade was 10.83 ±2.94 minutes in ultrasound group and 11.60±3.48 minutes in conventional paresthesia group but this slight delay was not statistically significant.

Veeresham et al[23], in their study found that the onset of sensory blockade was almost similar in both ultrasound (11±2.97 minutes) and conventional techniques (11.27±3.48 minutes). It is contradictory to our study.

Mithun Duncan et al[24], in their study administered 1:1 mixture of 0.5% lignocaine and 2% bupivacaine and they found that the onset of sensory block was 5.47 minutes in ultrasound group and 5.90 minutes in nerve stimulator group. It supported our study.

According to **Vincent W.S.Chan et al**[28], the mean onset time of sensory blockade in ultrasound guided technique with lignocaine bupivacaine combination was 5.4±1.8 minutes. According to **Raizada et al**[32], the mean onset of sensory block with lignocaine- bupivacaine combination in subclavian perivascular technique was 11.25±5.79 minutes. These studies support ours.

Onset of motor blockade:

The mean onset of motor block in conventional technique was 13±3.7 minutes and in ultrasound group was 10.42±3.16 minutes. The p value was 0.007. Thus, it was evident that there is significantly faster onset of motor block in ultrasound group when compared to conventional group. In our study, the onset of motor blockade in supraclavicular block was found to be delayed than that of sensory blockade in both the groups.

In a study done by **Gajendra singh et al**[22], the onset of motor blockade was within 14.56±4.49 minutes in ultrasound group and 16.8±3.43 minutes in conventional group with a p value of 0.02(statistically significant). This is concordant with our study.

Mithun Duncan et al[24] also used 0.5% Inj. bupivacaine and 2% Inj. lignocaine in 1:1 ratio. They found that ultrasound guided technique has faster onset of motor block than nerve stimulation technique. This is concordant with our study.

Shweta S. Mehta et al[26] conducted a study to compare the efficacy of ultrasound guided supraclavicular block with peripheral nerve stimulator technique. The mean onset of motor block in their study was 10.1±1.14 minutes for ultrasound group and 12.18±1.48 minutes in nerve stimulator group. This result was concordant with our study.

Raizada et al[32], in their study with 2% lignocaine 10 ml and 0.5% bupivacaine 20 ml, found that the onset of motor block was 14.07±7.4 minutes in subclavian perivascular technique by eliciting paresthesia

The reason for this discrepancy in the onset time was found to be due to the direct real time visualisation of plexus sheath with the help of ultrasound.

Duration of sensory blockade:

The mean duration of sensory blockade in ultrasound group (US) was 6.32 ± 0.97 hours and in group C(conventional), it was 5.41 ± 1.1 hours. This difference between the two groups was statistically significant with p value 0.001($p<0.05$)

Gajendra singh et al[22], in their study, on comparison between ultrasound guided and paresthesia eliciting technique found that the duration of sensory blockade was significantly prolonged in ultrasound group(397.93 ±

67.32 minutes.) when compared to conventional group (352.22 ±87.50 minutes).It is concordant with our study.

Veeresham et al[23], in their study found that the duration of sensory block was prolonged in ultrasound group (444.16±116 minutes) than conventional group(393.2±95.33 minutes). It is similar to our study.

According to **William Stephen et al**[25], the duration of analgesia is prolonged in ultrasound group (846 ± 53 minutes) when compared to nerve stimulator group(652 ± 47 minutes). It is concordant with our study.

Mithun Duncan et al[24] also found a slight prolongation of sensory blockade in US group (429.5 minutes) when compared to NS group(401.13 minutes) but it was not statistically significant.

Vincent WS chan et al[28], observed that the duration of block in ultrasound guided supraclavicular block, with 40ml of 1:1 mixure of Inj. 2% lignocaine with adrenaline and Inj. 0.5% bupivaicane, was 11.4 ± 4.2 hours.

Thus from this study, it is evident that ultrasound guided supraclavicular block had longer duration of analgesia compared to conventional parasthesia technique.

Duration of Motor blockade

The mean duration of motor blockade in group US was 5.82 ± .83 hours and in group C, it was 5.04±1.08 hours. The difference between the two groups was statistically significant with p value of 0.003 ($p < 0.05$).

Gajendra singh et al[22], in their study with the same drug combination found that the duration of motor blockade was significantly prolonged in US group (343.45 ± 60.84 minutes) than paresthesia group (305.19 ± 60.08 minutes). This is concordant with our study.

Overall effectiveness of block:

Out of the 30 cases studied under ultrasound group, 29 blocks were complete and 1 block was inadequate with sparing of ulnar nerve segment, none of the patients had failed block. Thus 97% of patients attained complete block, 3% had partial blockade and 0% failure.

Out of the 30 cases studied under subclavian perivascular approach 22 blocks were complete, 6 were partial and 2 totally failed blocks. Thus statistically 73% of patients attained complete block, 20% had partial blockade and 7% failure.

This was statistically analysed with chi square test and p value was 0.038 ($p<0.05$). Thus ultrasound guided technique had significantly higher success rate than conventional subclavian perivascular paresthesia eliciting method.

According to **Gajendra Singh et al**[22], ultrasound guided technique had provided more effective blocks than conventional paresthesia eliciting technique. This is similar to our study.

Marhofer et al[44], in their study, found that the quality of sensory block was significantly better in US group than nerve stimulator. This is also concordant to our study.

The drawback in our study was that we have not used nerve stimulator in addition to anatomical landmarks for identifying the nerves. However **Baranowski and Pither**[33], in their study did not observe any difference in success rate of nerve block by using either nerve stimulator or conventional paresthesia method. This study was supported by studies done by **Nithin Sathyan et al**[45] and **Horlocker et al**[46].

Success rate:

In our study, the success rate was 93.33% in conventional subclavian perivascular technique and 100% in ultrasound guided technique.

According to a similar study by **Gajendra singh et al**[22], the success rate was 90% in ultrasound group and 73.33% in conventional group.

According to the study by **Mithun Duncan et al**[24], the success rate was 90% in ultrasound group compared to 80% in nerve stimulator group. **Stephan Kapral et al**[38] achieved 95% success with ultrasound compared to 85% with nerve stimulator. **William Stephan et al**[25] reported 100%success with ultrasound and 92% with nerve stimulator. These study results are similar to ours. **Yuan JM et al**[47], in their study with 1321 patients proved a higher success rate(98%) with ultrasound compared to nerve stimulator.

In 1964, **Winnie and Collins**[4] demonstrated 98% success with subclavian perivascular technique. They have used 25- 50 ml of local anaesthetic solution for their study. But after that no reports proved this much success rate. **Chethananda et al**[50] described 90% success rate with subclavian perivascular technique with 30 ml local anaesthetic solution. **R Bhat et al**[31] in their study with 160 patients attained 85% success with subclavian perivascular approach.

This discrepancy can be due to needle migration while injecting the drug in case of conventional paresthesia technique and also due to real time imaging possibility with ultrasound. Moreover, we can change the needle direction under ultrasound guidance while injecting the drug.

In our study, the overall success rate in the ultrasound group was similar to the above mentioned studies. But, when compared statistically, it was insignificant. This could probably be explained by the relatively smaller group of patients taken for the study.

Complications:

Among the 30 cases in ultrasound group, only one patient had vascular puncture of subclavian artery which resolved immediately with compression for

15 minutes. There was no incidence of pneumothorax, nerve injury or local anaesthetic toxicity in ultrasound group.

Among the 30 patient in conventional group, 4 patients had vascular puncture, in which only one went for hematoma formation which resolved within two days.

No other complication was elicited in this group. The difference between the two groups was not statistically significant with p value 0.16(p>0.05).

Chethananda et al[50] reported the puncture of subclavian vessel in 15 among 66 patients in subclavian perivascular technique without hematoma formation or any other major complications. **Raizada et al**[32] reported 5 cases of hematoma formation among 60 patients in blind paresthesia technique which resolved in 3-4 days.

Winnie and Collins[4] suggested that hematoma is rare with 22 G huber point needle.

Yuan JM et al[47], from their study in 1321 patients, observed decreased incidence of vessel puncture and decreased risk of complete hemi diaphragmatic paresis with ultrasound. **Gajendra singh et al**[22] and **Veeresham et al**[23] also had observed a significant reduction in the incidence of vessel puncture in ultrasound guided technique when compared to conventional paresthesia technique.

In previous days, pneumothorax was a more frequent complication of supraclavicular block with reported incidence of 0.6% to 6.1%. With the advent of ultrasound, supraclavicular block has enjoyed renaissance with reduced incidence of pneumothorax.

Gauss et al[53], reported an incidence of pneumothorax in 4 out of 6366 patients in ultrasound guided supraclavicular block. i.e., the incidence is 0.06%. They quoted that the incidence of pneumothorax in ultrasound group in their study, may be due to faulty image setting, inability to obtain the view of needle tip and inadequate supervision by inexperienced trainee anaesthesiologists.

One rare incidence, massive hemothorax was reported by **Shivkumar singh et al**[54] with perivascular paresthesia technique. Another rare incidence, bronchospasm was reported by **Rohini Bhat et al**[55] following conventional supraclavicular brachial plexus block

Kaufmann et al[56] reported that 7 patients presented with severe nerve injury, established in paresthesia technique. In most of the cases, the injection was administered as a routine procedure by an experienced anesthesiologist. The patient histories suggest that the condition, in most cases could have been avoided if careful attention had been given to the occurrence of pain during the nerve block.

In our study, the complications were statistically insignificant between the conventional and ultrasound group. This is probably due to the use of short 5 cm Huber-point needle and the injection of drug immediately after eliciting paresthesia in all cases in conventional group.

So, it is likely that the risk of devastating iatrogenic disability can be minimized if few basic principles are respected during the administration of peripheral nerve blocks.

SUMMARY

60 patients of ASA grade I and II undergoing upper limb surgeries were randomly assigned into two groups, Group C and Group US. In Group C, supraclavicular brachial plexus block was done by conventional subclavian perivascular approach by eliciting paresthesia and in group US, by the ultrasound guided approach. 15ml of 0.5% bupivacaine and 15ml of 2% lignocaine with 1:2,00,000 adrenaline as the local anaesthetic was used for both the groups.

Parameters observed were time taken for the procedure, onset of sensory and motor blockade, duration of sensory and motor blockade, overall effectiveness of the block, success rate, analgesic supplementation required and complications.

This study shows that:

1. The onset of sensory and motor blockade is found to be earlier in the ultrasound guided technique compared to the conventional subclavian perivascular technique.
2. The duration of sensory and motor blockade is found to be prolonged in ultrasound guided technique than conventional subclavian perivascular technique.
3. Analgesic requirement is reduced in ultrasound guided technique compared to conventional subclavian perivascular technique.

4. Complications and their incidence are slightly more in conventional subclavian perivascular technique than ultrasound guided technique but was not significant.
5. Ultrasound guided technique has a higher success rate compared to the conventional subclavian perivascular technique but it was not significant statistically.
6. Overall effectiveness of the block was significantly better in ultrasound guided technique than conventional subclavian perivascular technique.
7. Time taken for the block performed by ultrasound was little longer than the conventional subclavian perivascular technique.

CONCLUSION

From our study, we conclude that, Ultrasound guided supraclavicular block for upper limb surgeries when compared to conventional subclavian perivascular technique has a rapid onset of both sensory and motor blockade, prolonged duration of blockade, reduced analgesic requirement both intra- and postoperatively, increased success rate with fewer complications. Only limitation of ultrasound guided technique is that it takes a little longer time to perform than the conventional technique.

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PROFORMA

COMPARISON BETWEEN CONVENTIONAL TECHNIQUE AND ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES

Name:	Age/sex:	I.P. no.:
Weight:	Hospital:	Date:

Preoperative condition:

Vitals:	**Systemic examination**:	**Airway Examination**
Pulse Rate:	C.V.S.:	
B.P. :	R.S. :	
SpO_2 :	Others:	

Investigations:

Hb%:	FBS/RBS:	ECG:	CXR:
Blood Urea:	Serum Creatinine:	Urine:	

Preoperative diagnosis:

Proposed surgery:

ASA grade:

Anaesthetic technique: supraclavicular approach to brachial plexus block

Group C: conventional subclavian perivascular technique

Group US: ultrasound guided technique

Local anaesthetic mixture:

15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline in both the groups.

Time taken for the procedure: ……………….. mins

Time taken for the onset of sensory block: ………………... mins

Time taken for the onset of motor block: …………………. mins

Complications (if any): **yes/no**

1. Vessel puncture(hematoma)
2. Any toxic or allergic drug reaction to the drug
3. Nerve injuries
4. Pneumothorax
5. Phrenic nerve block
6. Horner's syndrome
7. Recurrent laryngeal nerve block

Overall Effectiveness of the block:

Gr1- Totally effective

Gr2- Partially effective

Gr3- Failure

Success Rate:

Success/Failure

Analgesic supplementation : Yes / No

Conversion to GA : Yes / No

VITALS CHART

Time (mins)	PR	SBP mm Hg	DBP mm Hg	SPO_2%
0				
3				
6				
10				
15				
20				
30				
45				
60				
90				
120				
240				
480				

Complete recovery of motor blockade: …………………………………

Complete recovery of sensory blockade: ……………………….................

CONVENTIONAL TECHNIQUE

sl no	Name	Age	Sex	IP no	Weight (kg)	Time taken for procedure	Onset of block: Sensory (min)	Onset of block: Motor (min)	Duration of block: Sensory (hrs)	Duration of block: Motor (hrs)	Complications if any: Vessel Injury/ Hematoma	Drug Toxicity	Nerve Injury	Pneumothorax	Phrenic Nerve Block	Horner's Syndrome	RLN block	Overall Effectiveness of block	Success Rate	Analgesic supplementation	Conversion to GA
1	Sumathi	37	F	17112	62	4	10	12	6	5.25	No	No	No	No	No	No	No	Total	Success	No	No
2	Gunaseelan	18	M	2393	52	4	15	18	6.5	5.75	Yes	No	No	No	No	No	No	Total	Success	Yes	No
3	Gurumoorthy	58	M	5708	54	5	9	11	5.25	5	Yes	No	No	No	No	No	No	Total	Success	No	No
4	Azhagudurai	43	M	1367	70	3	7	10	5.25	4.25	No	No	No	No	No	No	No	Total	Success	No	No
5	Maheshwari	33	F	11360	63	5	13	15	7	6.5	No	No	No	No	No	No	No	Total	Success	No	No
6	Balaji	27	M	9262	52	3	20	20	4	3	No	No	No	No	No	No	No	Partial	Success	Yes	No
7	Rohini	23	F	16730	50	4	6	8	5	5.5	No	No	No	No	No	No	No	Total	Success	No	No
8	Prabaharan	26	M	44092	62	2	17	20	4	3.5	Yes	No	No	No	No	No	No	Partial	Success	Yes	No
9	Gouthaman	34	M	114	74	5	10	13	5.75	5.5	No	No	No	No	No	No	No	Total	Success	No	No
10	Revathy	23	F	13672	54	4					No	No	No	No	No	No	No	Failure	Failure	Yes	Yes
11	Bhavani	36	F	8859	70	10	7	7	6.5	6	No	No	No	No	No	No	No	Total	Success	No	No
12	Saradha	50	F	21036	55	4	8	12	5.75	5.5	No	No	No	No	No	No	No	Total	Success	No	No
13	Marimuthu	24	M	10751	56	3	18	18	3	2.5	No	No	No	No	No	No	No	Partial	Success	Yes	No
14	Mohammed Gani	58	M	17564	63	13	10	12	5.25	4.75	No	No	No	No	No	No	No	Total	Success	No	No
15	Saminathan	30	M	14301	65	5	12	15	5	4.5	Yes	No	No	No	No	No	No	Total	Success	No	No
16	Ramya	22	F	17077	55	6	15	12	5	5.5	No	No	No	No	No	No	No	Total	Success	No	No
17	Senthilkumar	38	M	2312	65	6	10	10	6	6.5	No	No	No	No	No	No	No	Total	Success	No	No
18	Shanmugathai	57	M	16405	63	5	8	9	7	7	No	No	No	No	No	No	No	Total	Success	No	No
19	Sathyaselan	21	M	17909	54	5	9	11	5.75	5	No	No	No	No	No	No	No	Total	Success	No	No
20	Allirani	60	F	9332	60	2	10	13	6.25	6	No	No	No	No	No	No	No	Total	Success	No	No
21	Dhanabakyam	52	F	1846	54	5					No	No	No	No	No	No	No	Failure	Failure	Yes	Yes
22	Subramani	57	M	6476	60	4	10	15	5	3	No	No	No	No	No	No	No	Partial	Success	Yes	No
23	sethupathy	23	M	39	61	5	7	10	5.5	5	No	No	No	No	No	No	No	Total	Success	No	No
24	Pandiyan	31	M	14818	60	7	6	10	6	5.5	No	No	No	No	No	No	No	Total	Success	No	No
25	Sanjeev	38	M	14283	57	5	6	8	7	5.5	No	No	No	No	No	No	No	Total	Success	No	No
26	Amala	42	F	19876	55	6	12	15	5.5	5	No	No	No	No	No	No	No	Total	Success	No	No
27	Arun	24	M	17891	65	12	17	19	3	4.5	No	No	No	No	No	No	No	Partial	Success	Yes	No
28	Syed mohammed	34	M	16581	75	10	10	13	6.25	6	No	No	No	No	No	No	No	Total	Success	No	No
29	Govindasamy	55	M	14279	72	15	8	10	5.5	5	No	No	No	No	No	No	No	Total	Success	No	No
30	Anjammal	49	F	1342	56	3	15	18	3.5	4.25	No	No	No	No	No	No	No	Partial	Success	Yes	No

CONVENTIONAL TECHNIQUE

sl no	pulse rate/min: 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr	SBP(mm Hg): 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	109	99	102	101	98	94	91	90	86	85	87	84	84	130	122	123	115	115	115	111	114	119	117	113	111	112
2	120	110	108	106	108	98	100	110	113	111	109	112	118	122	110	104	96	102	104	103	112	116	108	112	114	109
3	89	86	84	85	83	81	78	74	70	71	70	74	78	130	128	129	134	130	125	126	120	112	118	117	108	126
4	74	56	62	66	67	70	71	69	72	64	65	60	72	118	116	106	106	107	104	105	108	112	114	116	110	108
5	102	105	106	108	112	104	99	98	97	84	86	87	90	142	141	139	140	138	130	128	129	125	130	137	140	140
6	98	99	102	105	107	112	106	103	100	98	95	94	94	118	121	125	117	109	119	122	120	119	107	114	116	120
7	94	95	97	97	98	96	94	90	85	84	85	84	80	125	124	120	119	116	121	123	115	114	120	117	114	110
8	112	108	109	105	108	120	121	111	105	101	99	100	95	121	120	119	118	120	125	114	109	118	120	110	120	120
9	74	70	68	68	69	67	66	64	64	65	70	62	64	129	127	128	129	126	125	126	121	119	125	128	126	124
10	122	124	125	120	119	130	109	107	102	98	99	105	106	128	125	126	127	126	130	124	120	118	112	119	120	118
11	98	95	96	94	97	98	99	95	94	92	90	88	89	125	120	121	118	123	122	119	120	117	110	119	120	116
12	99	100	102	98	97	95	88	84	85	83	80	82	84	108	112	107	109	114	117	114	110	113	118	115	119	110
13	78	85	84	89	95	94	100	94	86	77	79	81	80	116	118	118	118	123	128	130	124	129	121	125	128	120
14	79	78	77	79	80	75	78	70	72	71	72	71	74	127	124	128	127	127	126	120	119	125	120	117	115	120
15	88	84	85	101	98	96	97	92	90	88	84	85	80	129	130	130	121	126	132	131	124	126	124	121	120	126
16	95	97	99	97	98	96	94	95	94	95	93	92	90	115	116	118	116	119	120	117	113	119	111	118	121	118
17	94	92	86	84	85	86	84	80	81	78	76	74	75	129	126	128	126	118	116	117	118	120	111	113	114	110
18	113	111	110	110	106	114	117	113	111	115	111	108	106	140	140	129	134	130	128	123	122	127	130	124	129	130
19	75	72	69	68	65	64	63	64	60	62	59	62	61	128	120	118	116	115	113	111	114	116	115	109	112	108
20	99	94	95	94	93	91	86	88	87	84	83	85	90	142	139	145	142	138	136	139	137	135	135	128	129	127
21	98	102	114	108	109	96	92	94	90	89	86	88	76	140	136	150	141	146	132	136	142	132	130	129	122	134
22	102	98	96	98	102	99	97	104	112	114	108	109	90	136	130	134	140	132	126	130	136	148	136	140	126	124
23	112	104	92	90	89	87	86	91	91	87	84	91	86	136	130	139	143	129	129	134	126	131	129	128	132	128
24	86	80	78	74	72	73	75	74	76	77	73	80	77	111	114	99	104	112	108	101	99	98	98	101	103	105
25	80	81	81	79	76	78	77	72	72	71	68	67	70	132	131	130	135	129	128	129	131	127	125	126	124	127
26	86	85	84	85	85	83	81	77	75	74	76	75	77	119	120	121	119	120	122	117	115	114	116	119	114	120
27	99	103	105	102	107	110	115	104	98	95	94	96	94	109	110	111	110	108	115	127	124	129	105	110	108	110
28	78	79	80	81	76	74	75	73	67	68	66	69	70	120	122	121	120	119	123	120	124	120	121	127	125	124
29	69	67	68	68	69	66	67	59	58	57	56	60	60	112	108	107	115	116	118	112	119	120	109	115	117	120
30	85	84	82	83	81	90	94	96	95	96	80	81	78	150	148	146	144	140	138	137	134	138	132	137	134	130

sl no	DBP(mm Hg): 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	77	70	71	68	73	72	69	74	75	76	73	70	71
2	78	70	72	70	66	68	70	74	70	76	70	71	68
3	90	88	89	85	87	81	79	73	68	77	80	75	86
4	82	79	67	69	66	67	75	71	70	74	70	70	72
5	92	91	94	89	88	85	86	82	90	85	81	92	90
6	81	76	79	82	81	76	74	83	89	71	79	75	80
7	82	81	79	76	82	76	81	79	83	75	79	77	70
8	81	79	82	75	83	78	77	69	74	77	74	80	80
9	87	88	87	85	84	83	87	81	83	85	84	86	86
10	89	85	84	82	80	76	79	74	78	81	79	80	76
11	85	81	84	75	80	77	82	74	79	80	75	79	80
12	69	68	68	69	70	74	72	66	73	74	68	75	71
13	79	77	78	77	83	85	87	88	84	81	85	81	82
14	84	85	84	84	86	83	81	78	75	83	79	78	80
15	83	81	84	78	81	79	80	78	82	79	78	77	70
16	74	71	76	72	74	79	80	81	79	76	74	72	79
17	88	84	82	84	79	76	74	70	72	68	72	75	74
18	92	90	88	84	86	84	83	81	82	82	86	84	80
19	74	72	71	68	69	68	67	69	70	71	68	70	70
20	96	94	91	86	84	83	85	89	87	82	81	86	78
21	100	92	96	92	99	90	88	96	86	81	83	76	78
22	90	90	92	96	91	88	89	87	92	93	90	84	80
23	89	84	92	76	81	80	79	87	78	77	81	84	80
24	72	73	64	69	70	69	68	62	61	63	67	68	71
25	91	90	91	92	94	88	89	90	86	87	84	83	81
26	78	80	81	79	75	73	71	69	70	71	70	75	80
27	69	70	72	71	68	74	76	73	79	71	68	64	70
28	79	81	75	79	81	82	80	75	76	83	74	79	80
29	68	70	67	73	74	76	70	79	81	70	78	85	70
30	93	90	91	90	88	83	91	87	88	90	91	92	90

sl no	SPO2: 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	100	100	100	100	100	100	100	100	100	100	100	100	100
2	99	100	99	99	99	100	99	99	99	99	99	99	99
3	99	98	98	98	99	99	98	99	99	98	99	98	98
4	98	98	98	97	99	98	98	97	98	98	98	98	98
5	98	98	98	98	98	98	98	98	98	98	98	98	98
6	99	99	99	99	99	99	99	99	99	99	99	99	99
7	100	100	100	100	100	100	100	100	100	100	100	100	100
8	100	99	99	99	99	99	100	100	99	100	99	100	99
9	99	98	98	99	99	99	98	98	99	98	99	99	99
10	99	99	99	99	99	99	99	99	99	99	99	99	99
11	99	98	99	99	99	98	99	99	99	99	99	99	99
12	99	99	100	100	99	100	99	100	99	100	100	100	100
13	99	99	98	98	98	98	99	98	98	99	98	98	99
14	99	99	99	99	99	99	99	99	99	99	99	99	99
15	99	99	99	99	99	99	98	98	99	99	99	99	98
16	97	97	98	99	99	99	99	99	99	99	98	97	97
17	100	100	99	98	98	99	100	99	98	99	99	99	100
18	97	97	98	99	100	100	99	99	100	100	97	97	97
19	100	100	100	100	100	100	100	100	100	100	100	100	100
20	98	98	98	98	98	98	98	98	98	98	98	98	98
21	100	99	100	100	100	100	100	99	99	100	99	100	99
22	98	99	99	98	98	99	98	98	99	99	99	98	98
23	99	99	99	100	100	99	100	99	100	100	100	100	99
24	100	100	100	100	100	100	100	100	100	100	100	100	100
25	99	99	99	99	99	99	99	99	99	99	99	99	99
26	99	99	100	99	100	99	100	100	99	99	99	100	100
27	100	100	100	100	100	100	100	100	100	100	100	100	100
28	99	98	99	98	99	99	99	98	98	99	99	99	99
29	97	98	97	98	99	99	99	99	99	99	99	99	99
30	98	98	98	98	98	98	98	98	98	98	98	98	98

US GUIDED

Sl No	Name	Age	Sex	IP no	Weight (kg)	Time taken for procedure	Onset of block: Sensory (min)	Onset of block: Motor (min)	Duration of block: sensory (hrs)	Duration of block: Motor (hrs)	Complications if any: Vessel Injury/ Hematoma	Drug Toxicity	Nerve Injury	Pneumothorax	Phrenic Nerve Block	Horner's Syndrome	RLN block	Overall Effectiveness of Block	Success Rate	Analgesic supplementation	Conversion to GA
1	Md Raffiq	26	M	19704	62	10	7	10	6	5.5	No	No	No	No	No	No	No	Total	Success	No	No
2	Divyanathan	48	M	17142	82	12	10	14	4.5	4	No	No	No	No	No	No	No	Total	Success	No	No
3	Navamani	60	F	5068	52	13	8	12	7.5	7	No	No	No	No	No	No	No	Total	Success	No	No
4	Rooban	26	M	7085	60	10	18	20	6.75	6	No	No	No	No	No	No	No	Partial	Success	Yes	No
5	Jothi	19	F	5361	53	10	6	9	8	7	No	No	No	No	No	No	No	Total	Success	No	No
6	Rajadhurai	37	M	3138	64	12	5	7	7	7	No	No	No	No	No	No	No	Total	Success	No	No
7	Sivaji	28	M	3416	65	11	6.5	8	7.25	6.5	No	No	No	No	No	No	No	Total	Success	No	No
8	Antony vimal	19	M	8719	55	8	7	10	7	5.5	No	No	No	No	No	No	No	Total	Success	No	No
9	Anjugam	34	F	3451	52	10	10	12	6.5	5.75	No	No	No	No	No	No	No	Total	Success	No	No
10	Kannan	30	M	67000	63	9	5	8	7.5	6.4	No	No	No	No	No	No	No	Total	Success	No	No
11	Esther	34	F	11499	65	8	8	10.4	6	5	No	No	No	No	No	No	No	Total	Success	No	No
12	Selvakumar	20	M	7669	55	10	7.5	11	5.5	5	No	No	No	No	No	No	No	Total	Success	No	No
13	Devabalan	22	M	13485	54	5	9	12	8	7.5	No	No	No	No	No	No	No	Total	Success	No	No
14	Pannerselvam	45	M	14373	67	8	8.5	10	5.75	5.5	No	No	No	No	No	No	No	Total	Success	No	No
15	Anandhavalli	53	F	7448	68	13	5	5	7	6.2	No	No	No	No	No	No	No	Total	Success	No	No
16	Vetriselvan	29	M	14314	60	6	6	8	6	5.5	No	No	No	No	No	No	No	Total	Success	No	No
17	Sumathi	37	F	14959	53	8	7	8	6.5	6.5	No	No	No	No	No	No	No	Total	Success	No	No
18	Pannerselvam	54	M	16300	60	8	7	10	5	5.5	No	No	No	No	No	No	No	Total	Success	No	No
19	Palanivel	40	M	14270	75	8	10	8	5.25	5.5	No	No	No	No	No	No	No	Total	Success	No	No
20	Chandrasekaran	60	M	8684	64	11	11	15	4.5	4	No	No	No	No	No	No	No	Total	Success	No	No
21	Nallathambi	40	M	13789	59	10	8	12	5.5	5.25	2	No	No	No	No	No	No	Total	Success	No	No
22	Sevagaperumal	39	M	18301	66	10	5	8	6.25	6	No	No	No	No	No	No	No	Total	Success	No	No
23	Santhanakrishnan	27	M	9294	57	8	12	15	4.5	5	No	No	No	No	No	No	No	Total	Success	No	No
24	Muthusiva	28	M	20850	60	8	6	8	7.2	6.4	No	No	No	No	No	No	No	Total	Success	No	No
25	Mathiazhagan	45	M	15330	67	4	8	10	6.5	6	No	No	No	No	No	No	No	Total	Success	No	No
26	Shanmugam	55	M	18212	65	6	10	12	6	5.5	No	No	No	No	No	No	No	Total	Success	No	No
27	Thilagavathy	48	F	14670	58	7	9	11.5	6.4	5.8	No	No	No	No	No	No	No	Total	Success	No	No
28	Baskar	25	M	887	55	5	6	7	7	6.5	No	No	No	No	No	No	No	Total	Success	No	No
29	Salimabeevi	58	F	18241	58	7	8	7	6.8	6.4	No	No	No	No	No	No	No	Total	Success	No	No
30	Selvaraj	31	M	16704	65	6	10	15	6	5	No	No	No	No	No	No	No	Total	Success	No	No

Sl No	Pulse rate(Beats/Min): 0 min	3 min	6 mins	10 mins	15 mins	20 mins	30 mins	45 mins	1 hr	90 mins	2 hrs	4 hrs	8 hrs
1	110	104	102	98	94	93	92	91	85	84	85	81	78
2	73	75	69	62	64	63	64	65	64	59	60	62	59
3	84	86	89	90	85	80	78	75	76	78	74	75	74
4	114	108	99	100	112	116	109	107	111	112	108	109	110
5	124	118	106	103	100	99	98	99	104	96	95	92	86
6	98	112	105	103	106	110	113	106	108	107	104	100	95
7	116	94	108	112	96	84	89	86	87	85	87	86	83
8	98	96	92	86	74	76	75	73	78	77	72	79	75
9	88	92	90	88	82	80	74	73	75	74	75	75	74
10	96	98	92	94	90	85	78	79	77	78	77	78	76
11	108	112	111	108	106	108	107	97	94	95	94	90	92
12	94	95	90	82	83	84	90	82	80	77	74	80	76
13	98	96	94	92	91	90	90	91	92	90	93	92	86
14	69	68	69	68	67	68	67	66	67	68	67	65	63
15	107	104	98	99	97	98	95	92	90	91	89	94	86
16	108	106	104	105	101	98	94	93	94	92	86	84	80
17	95	92	94	93	92	85	81	78	76	75	75	74	76
18	84	82	78	76	75	77	85	76	74	68	64	65	64
19	72	68	65	64	60	58	59	54	55	56	58	55	54
20	59	58	55	53	50	49	48	74	75	76	72	64	58
21	85	86	84	82	83	81	78	75	74	76	76	74	70
22	90	88	86	84	80	81	80	82	80	78	79	80	83
23	98	97	98	98	97	88	86	86	86	85	85	84	86
24	102	104	103	102	102	98	96	88	86	84	84	88	90
25	80	75	74	73	68	67	66	66	65	67	68	69	70
26	94	93	93	94	95	96	88	87	86	86	87	87	96
27	68	67	68	70	68	66	62	60	61	62	63	61	62
28	80	78	76	75	74	72	76	74	72	70	71	70	70
29	98	96	102	100	96	98	97	98	99	95	94	96	93
30	112	110	104	105	101	98	97	95	94	90	92	91	90

Sl No	0 min	3 mins	6 mins	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	128	121	120	118	115	116	117	119	122	126	116	110	110
2	148	126	127	123	123	121	127	120	119	118	121	122	125
3	136	139	148	140	141	139	130	128	135	133	127	128	130
4	136	122	126	129	136	128	130	126	125	121	120	124	121
5	120	118	112	107	102	96	100	102	105	103	106	108	109
6	120	127	125	125	121	121	122	120	121	120	120	123	121
7	128	124	123	121	128	124	127	122	122	126	128	127	127
8	112	110	102	106	105	115	126	122	122	120	122	108	110
9	130	138	135	128	129	127	128	124	122	118	121	122	120
10	124	118	115	106	105	112	107	113	112	118	119	115	122
11	128	127	126	124	128	124	119	119	120	119	117	118	120
12	120	117	111	108	106	108	108	110	106	109	112	108	108
13	132	128	124	126	120	124	118	120	121	125	123	125	126
14	118	115	108	104	106	103	108	103	110	107	112	110	109
15	128	126	125	122	116	116	115	113	119	118	114	110	120
16	118	114	108	109	107	98	108	112	113	111	109	107	114
17	128	114	116	109	111	112	109	104	103	96	108	112	118
18	139	124	118	114	111	115	115	114	117	119	118	120	124
19	140	135	136	132	129	128	120	126	128	134	130	129	128
20	150	149	147	139	135	129	127	156	150	134	127	130	130
21	128	120	118	119	116	121	129	124	120	121	127	124	120
22	130	129	128	128	126	120	118	115	112	108	114	109	110
23	126	120	122	124	121	120	119	117	118	116	118	116	110
24	112	106	105	107	108	110	106	109	104	103	100	110	110
25	140	138	139	130	128	122	124	126	120	118	125	127	120
26	138	140	141	136	130	131	129	128	126	130	128	126	124
27	130	128	129	128	129	130	125	126	120	122	121	120	120
28	118	115	116	114	106	108	104	109	110	107	104	110	110
29	121	117	113	115	107	108	109	108	105	107	106	103	110
30	125	124	125	123	121	118	115	119	121	120	124	120	121

Sl No	DBP(mm Hg): 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	79	74	78	77	82	85	72	71	76	79	85	78	75
2	90	87	86	81	80	79	87	78	76	74	79	80	83
3	96	95	98	97	96	91	86	85	89	79	90	94	92
4	92	84	86	87	94	88	91	89	85	83	80	84	80
5	80	74	68	69	63	58	61	70	65	60	71	62	67
6	80	83	84	82	81	80	81	80	81	81	80	85	80
7	74	78	74	75	80	82	84	71	70	68	78	75	70
8	74	70	68	76	74	78	84	89	82	82	82	80	76
9	80	91	96	90	89	84	92	86	81	74	78	80	82
10	86	79	77	66	69	70	71	69	70	78	78	73	80
11	81	79	80	76	78	74	77	78	75	76	76	77	76
12	81	79	74	79	74	80	78	75	76	78	79	75	74
13	94	86	84	89	82	85	79	81	80	83	82	86	85
14	74	70	69	64	65	63	71	68	71	72	75	74	72
15	89	86	83	85	84	89	78	76	74	78	80	75	80
16	78	72	69	68	67	62	70	74	73	60	73	68	71
17	78	71	73	71	70	70	69	61	60	54	70	69	74
18	82	66	65	65	67	71	72	74	80	83	85	86	80
19	90	90	89	87	91	92	87	85	82	84	80	81	84
20	###	98	85	84	86	90	85	###	95	88	84	82	85
21	80	84	81	78	79	81	85	84	75	72	79	78	79
22	90	89	88	88	86	80	78	74	75	72	70	68	70
23	86	85	80	81	77	79	78	75	75	74	73	70	70
24	70	69	68	67	69	68	67	70	69	66	65	68	70
25	92	95	93	91	90	89	87	86	84	83	81	83	80
26	95	97	93	90	89	86	85	84	87	85	86	81	80
27	91	88	87	85	86	88	87	84	85	81	85	82	80
28	81	75	74	68	69	71	64	65	66	69	70	70	70
29	81	79	75	76	70	70	70	67	66	64	65	68	70
30	82	83	85	87	81	76	79	81	75	80	73	75	80

Sl No	SPO2: 0 min	3 min	6 min	10 min	15 min	20 min	30 min	45 min	1 hr	90 min	2 hr	4 hr	8 hr
1	100	100	100	99	99	100	99	100	100	99	100	100	99
2	100	100	100	100	100	100	100	100	100	100	100	100	100
3	97	96	96	97	97	96	97	98	97	96	97	96	96
4	99	99	99	99	99	99	98	98	99	99	99	98	99
5	99	98	100	100	98	99	99	99	100	100	99	99	98
6	99	99	98	99	99	99	99	98	98	99	99	98	98
7	99	99	99	99	99	99	99	99	99	99	99	99	99
8	100	100	100	99	100	100	100	100	100	100	100	100	100
9	99	98	98	99	100	99	99	99	98	99	99	99	98
10	99	98	99	99	100	100	100	100	100	100	98	98	98
11	99	100	100	100	100	100	99	100	100	100	100	99	99
12	99	100	100	100	100	100	100	100	100	100	100	100	100
13	99	100	100	99	100	99	100	100	99	100	100	99	99
14	100	100	100	100	99	100	100	99	100	100	100	100	100
15	99	98	98	98	98	98	98	99	99	99	99	98	98
16	100	100	100	100	100	100	100	100	100	100	100	100	100
17	100	100	99	99	100	100	99	100	99	100	100	99	99
18	100	99	99	98	99	100	98	100	99	99	99	99	99
19	98	98	97	98	97	98	97	98	98	98	97	97	98
20	98	99	98	98	98	97	98	98	97	98	98	98	98
21	98	99	99	99	99	98	99	99	98	98	98	98	98
22	100	100	100	100	100	100	100	100	100	100	100	100	100
23	99	98	99	99	99	99	98	98	99	99	99	99	99
24	100	99	99	100	100	99	99	100	99	100	100	100	99
25	98	98	99	98	98	98	99	98	99	98	97	99	98
26	98	97	98	99	98	98	99	99	98	98	99	99	98
27	98	99	98	98	98	98	98	98	98	99	98	98	98
28	100	99	100	99	100	99	100	99	100	99	99	100	100
29	99	100	100	100	99	99	100	100	99	100	100	99	99
30	99	100	100	99	99	100	99	99	100	99	100	99	100

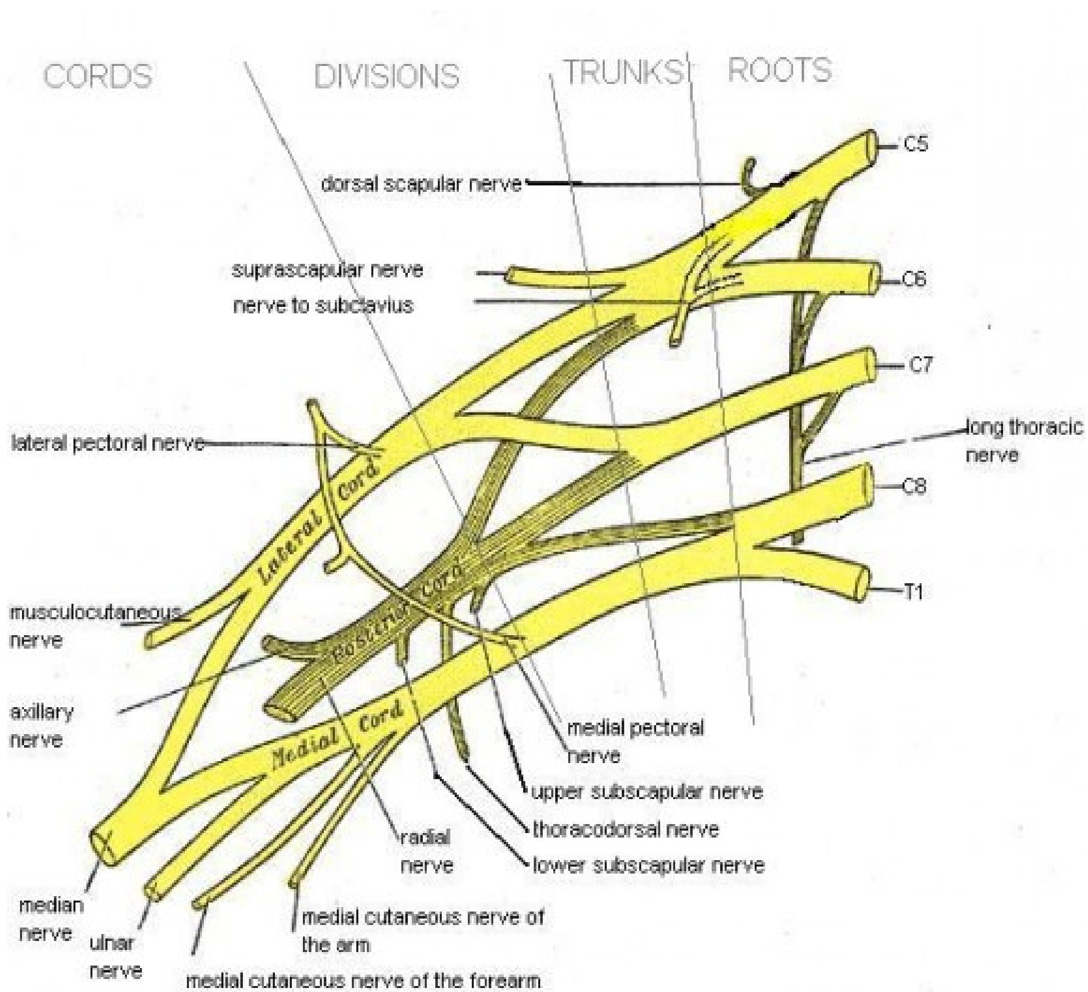
CONSENT FORM

I ____ hereby give consent to participate in the study conducted by **DR. K.REVATHI** post graduate in department of Anaesthesiology ,Thanjavur medical college & 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 further investigations

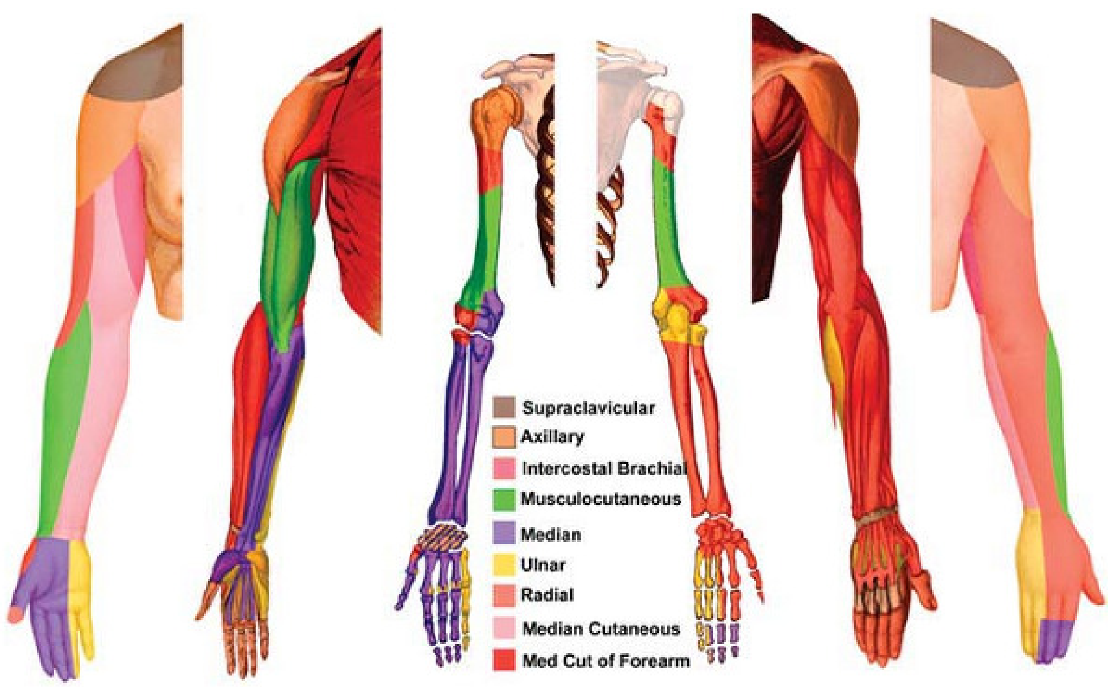
Place :

Date : Signature of participant

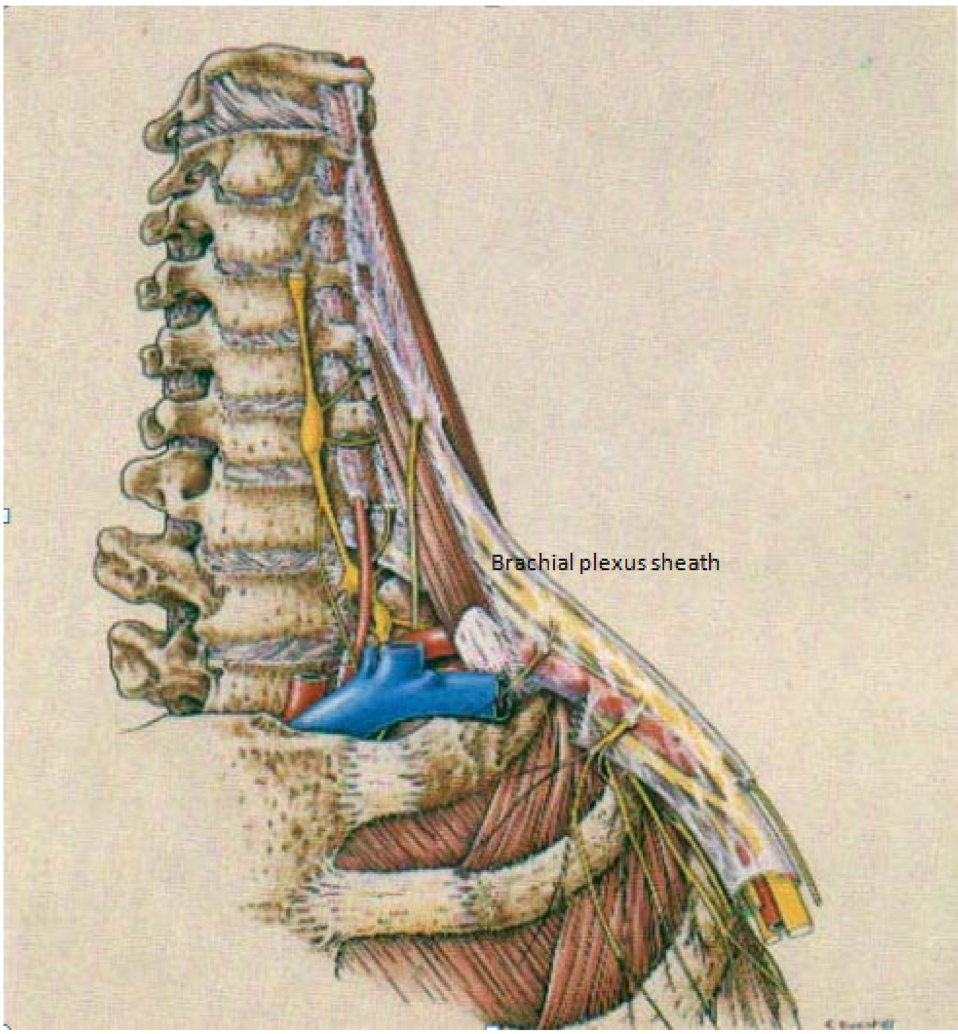
BRACHIAL PLEXUS ANATOMY



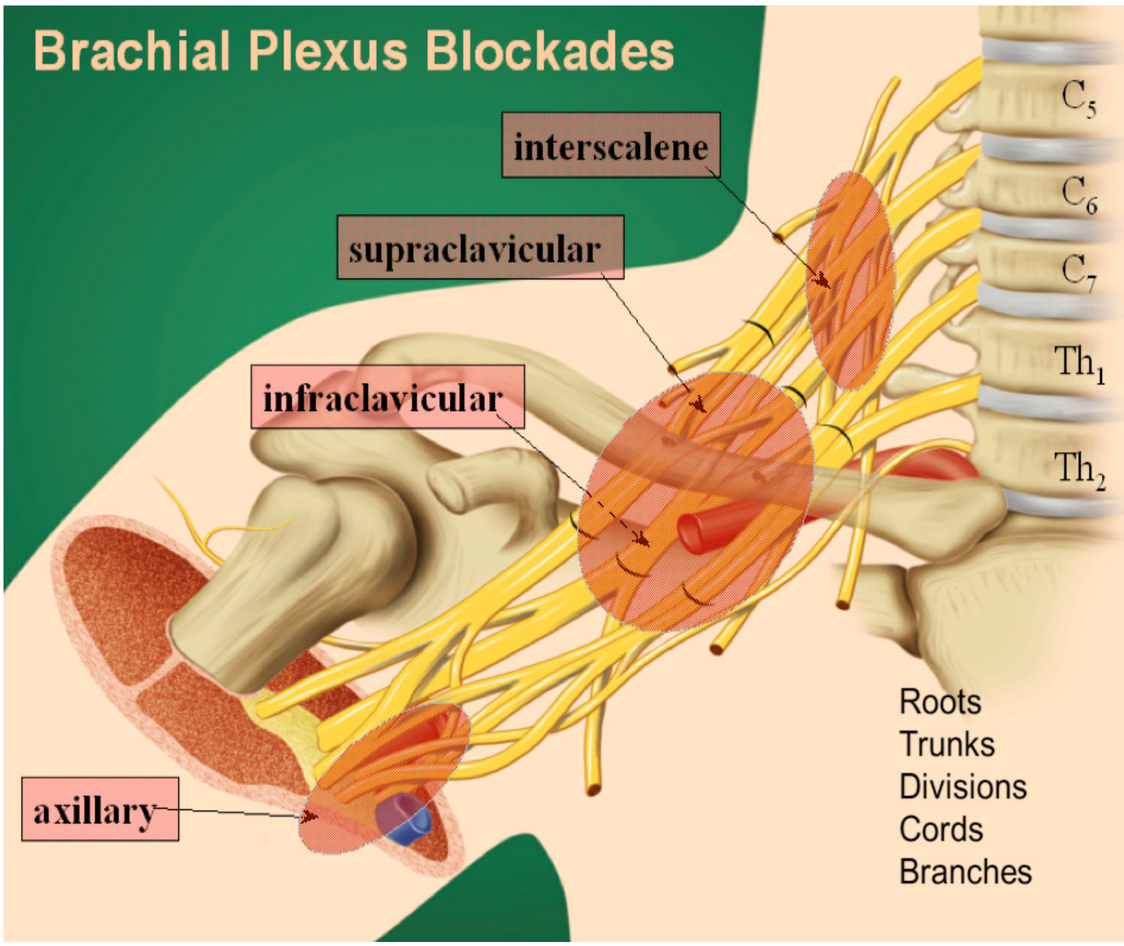
UPPER LIMB INNERVATION



BRACHIAL PLEXUS SHEATH



VARIOUS TECHNIQUES OF BRACHIAL PLEXUS BLOCKADE



Conventional Subclavian perivascular approach

Ultrasound guided approach

Ultrasound Image of Brachial Plexus in Supraclavicular Approach