A COMPARATIVE STUDY OF SUBCLAVIAN PERIVASCULAR APPROACH WITH PARA SCALENE APPROACH OF BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES USING NERVE STIMULATOR

Dissertation submitted

in partial fulfilment of the requirements

for award of the degree

M.D. (Anaesthesiology)

Branch X

GOVT. KILPAUK MEDICAL COLLEGE

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU

APRIL 2016

CERTIFICATE

This is to certify that this dissertation entitled **"A COMPARATIVE STUDY OF SUBCLAVIAN PERIVASCULAR APPROACH WITH PARA SCALENE APPROACH OF BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES USING NERVE STIMULATOR "** submitted by **Dr.N. KARTHIKEYAN** in partial fulfilment for the award of the degree Doctor of Medicine in Anaesthesiology by The Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide work done by him at GOVERNMENT KILPAUK MEDICAL COLLEGE, CHENNAI, during the academic year 2013-2016.

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DECLARATION

I, **Dr. N. KARTHIKEYAN**, solemnly declare that this dissertation, entitled "**A COMPARATIVE STUDY OF SUBCLAVIAN PERIVASCULAR APPROACH WITH PARA SCALENE APPROACH OF BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES USING NERVE STIMULATOR "**, has been prepared by me, under the expert guidance and supervision of **Prof.Dr.R. KUNDHAVI DEVI , MD., DA.,** Professor of Anaesthesiology, Government Kilpauk Medical College Hospital, Chennai and submitted in partial fulfilment of the regulations for the award of the degree M.D.(Anaesthesiology) by The Tamil Nadu Dr. M.G.R. Medical University and the examination to be held in April 2016.

This study was conducted at Government Kilpauk Medical College Hospital and Government Royapettah Hospital, Chennai. I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Place: Chennai

Date: **(Dr. N. KARTHIKEYAN)**

ACKNOWLEDGEMENT

I wish to express my sincere thanks to **Prof. Dr. R. Narayana Babu, MD, DCH.,** Dean, Government of Kilpuak Medical College, Chennai for having kindly permitted me to utilize the facilities of the college for the conduct of the study.

I am grateful to the Professor and Head of the Department of Anesthesiology, Govt.Kilpauk Medical College, **Prof. Dr. T.Murugan., M.D., D.A.,** for his motivation, valuable suggestions, and for providing all necessary arrangement for conducting the study.

I am extremely grateful and indebted to **Prof**. **Dr. R. Kundhavi Devi, M.D., D.A,** Department of Anaesthesiology, Government Kilpauk Medical College, and Chennai for her concern, inspiration, meticulous guidance, expert advice and constant encouragement in preparing this dissertation.

I also express my sincere gratitude to all other Professors of Anaesthesiology, KMC, **Prof. Dr. Valli sathyamoorthy, M.D., D.A., Prof. Dr. M. Bhavani, M.D., Prof. Dr. A. Chandrasekar, M.D.,** for their constant motivation, encouragement and valuable suggestions.

I thank all the Assistant Professors and tutors of Anesthesiology KMCH and GRH for their keen interest and support without which this study would not have been possible.

I am thankful to the Institutional Ethical Committee for their guidance and approval of the study.

I also thank my entire colleague postgraduates for supporting me throughout the study.

I thank the Department of Orthopaedics and the Department of Plastic surgery, KMCH and GRH and their faculty members for their kind cooperation and permitting me to use the hospital facilities for the study.

I also thank the theatre personnel for their co-operation and assistance.

I wish to thank all the patients whose willingness and patience made this study possible.

I finally thank God Almighty for His blessings in successfully completing the study.

INTRODUCTION

Regional anaesthesia is the anaesthesia of an anatomic part produced by the application of a chemical capable of blocking conduction in nerve tissue associated with the part, there by one region of the body is made insensitive to pain in response to surgical stimuli[35]. The agent must not damage the tissue permanently and the functional derangement must be reversible. The higher centres of brain are spared, so that the patient is conscious during the surgical procedure.

Regional anaesthesia has many advantages over general anaesthesia for upper limb surgeries, especially in emergency surgeries.

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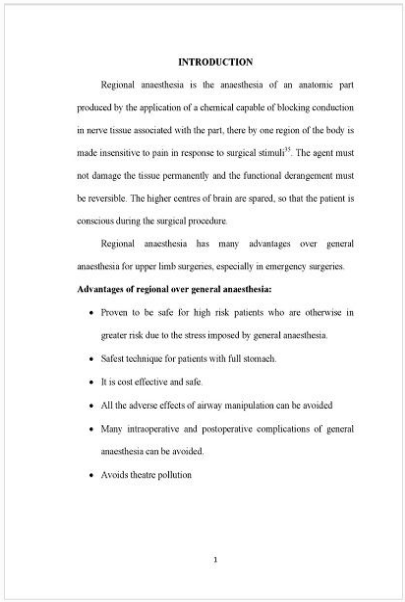

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Regional anaesthesia has many advantages over general anaesthesia for upper limb surgeries, especially in emergency surgeries.

Advantages of regional over general anaesthesia:

- Proven to be safe for high risk patients who are otherwise in greater risk due to the stress imposed by general anaesthesia.
- Safest technique for patients with full stomach.
- It is cost effective and safe.
- All the adverse effects of airway manipulation can be avoided
- Many intraoperative and postoperative complications of general anaesthesia can be avoided.
- Avoids theatre pollution

1

CONTENTS

ABSTRACT

Objective: To compare parascalene approach of brachial plexus block with the classical subclavian perivascular approach in patients undergoing upper limb surgeries using nerve stimulator

Materials and methods: Sixty patients (age 20 - 50 years) undergoing upper limb surgeries were randomly assigned to two groups, Group A (n=30) receiving brachial plexus block using subclavian perivascular approach and Group B (n=30) receiving brachial plexus block using parascalene approach. Insulated needles and a nerve stimulator were used with both techniques. Time required for performing the block, onset of sensory and motor block, sensory block to pin prick, success rate, complications and rescue analgesia requirement were compared.

Results: Time required for performing the block (4.7±0.92 min vs.2.9 ±0.84 min) were significantly shorter and sensory block level to pinprick is higher (shoulder level), the overall success rates were high, complications and rescue analgesia requirement are low in Group **B** as compared to Group A.

Conclusion: Supraclavicular block of brachial plexus by Parascalene approach provides an adequate sensory blockade and motor blockade, with less time to perform block, level of sensory block is higher (upto shoulder), high success rate and less complications when compared to subclavian perivascular approach.

Key words: Regional anaesthesia, brachial plexus block, parascalene approach, subclavian perivascular approach, local anaesthetics, nerve stimulator

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- Only method of anaesthesia, which prevent all afferent impulses from the site of surgery from reaching the central nervous system. Hence the need for poly pharmacy is eliminated.
- Causes least physiological disturbances when compared to general anaesthesia
- Along with complete pain relief and total muscle relaxation it produces vasodilatation, which improves blood circulation, prevents tissue hypoxia and blood loss.
- Postoperative pain relief is ensured for a longer duration by using long acting anaesthetic drug and for several days if a continuous block using catheter technique is employed.

Blockade of brachial plexus is a useful regional anaesthesia for upper limb surgeries.There are different approaches but the ones frequently employed for blocking of brachial plexus[2] include

1. Interscalene approach
2. Supraclavicular approach
3. Infraclavicular approach and
4. Axillary approach

HISTORY

William Steward Halsted first performed brachial plexus block in 1885. In 1911, Kulenkampff and Hirshel described the first percutaneous brachial plexus block by supraclavicular and axillary routes respectively. Continuous brachial plexus block technique was first described by F. Paul Ansbro in 1946.

Since then many approaches of brachial plexus block have been tried to increase the rate of success and reducing the risk and complications. Among the various techniques the most widely practiced methods are

1. The classical technique described by **Patric** (1940)
2. Vertical Plumb Bob approach described by Brown
3. 1st rib walk over technique described by Bonica and Moore
4. Classical Subclavian perivascular approach described by Winnie and Collins in 1964
5. Parascalene approach by Vongvises, P and Panijayanond in 1979
6. Raj and Sims described an infraclavicular approach using peripheral nerve stimulator in 1973 and 1977 respectively.

BRACHIAL PLEXUS BLOCK APPROACHES

INTERSCALENE APPROACH :

Root level blockade

ADVANTAGES:

- This is ideal for shoulder surgery
- Cervical plexus can also be blocked by this method
- Clear landmarks appreciated
- Lower volume sufficient for block
- Lesser chance of pneumothorax than in supraclavicular block

DISADVANTAGES:

- An unreliable block for forearm and hand surgeries as there is inadequate anaesthesia in the ulnar nerve distribution
- Supplemental block necessary for blocking intercostobrachial nerve
- May also block phrenic nerve, vagus, recurrent laryngeal nerve and cervical sympathetic nerves.
- Inadvertent entry of drug to the epidural and subarachnoid space may produce dangerously high epidural, subdural, spinal anaesthesia.
- Intra vascular injection into vertebral artery may also occur.

SUPRACLAVICULAR APPROACH :

Block done at the trunk level

ADVANTAGES:

- Most compactly arranged form of nerve fibres – High success rate
- Most intensive blockade achieved
- Smaller volume being required
- Quicker onset achieved
- All of the nerves are being reliably blocked
- Catheter can be inserted for prolonged procedures like hand transplant surgeries.

Hence the supraclavicular approach is the method of choice for blocking the brachial plexus

DISADVANTAGES:

- Demonstrable paraesthesia (by the blind technique) is unpleasant for the patient.
- 0.5 – 6% of pneumothorax incidence seen

INFRACLAVICULAR APPROACH :

Block at the level of cords

Disadvantages are the axilla and proximal medial arm skin are not anaesthetized (intercostobrachial and medium cutaneous brachii nerves

are spared), hemothorax, pneumo thorax, chylothorax are likely complications which may occur.

AXILLARY APPROACH :

ADVANTAGES:

- Provides excellent anaesthesia for surgeries below the elbow.
- Ease of performance, even in paediatric patients
- Easily demonstrable landmarks.
- Safest of all the techniques.
- Paraesthesia here is not necessary

DISADVANTAGES :

- Inadequate anaesthesia of the radial aspect of forearm and dorsum of hand as there is sparing in the musculocutaneous nerve distribution.
- Tourniquet pain is not well tolerated.
- Also abducting the arm by 90 degrees for giving the block may be painful and even dangerous in traumatic lesions of the upper extremity.
- Difficult to perform in obese individuals.
- Hematoma formation.

Of the several local anaesthetic drugs, bupivacaine is the most commonly used drug in the regional block technique, mainly due to its long duration of action and common availability.

To prolong the duration of anaesthesia, various drugs have been studied as adjuvant to the local anaesthetic solution and techniques like the continuous catheter placement in the plexus have evolved. These adjuvant drugs ideally are expected to prolong the analgesic effect without causing any side effects or prolonging motor blockade. Commonly used adjuvants to local anaesthetic solution are epinephrine, sodium bicarbonate, alpha 2 agonists like clonidine, dexmeditomedine, opioids like fentanyl, buprenorphine and steroids like dexamethasone.

This study is intended to compare the supraclaviuclar brachial plexus blockade by two different approaches with regard to 1)the success rate, 2)time required to perform the block, 3)onset of blockade, 4)sensory block level to pin prick, 5)complications and 6)requirement of rescue analgesia.

AIM AND OBJECTIVES

To compare the Subclavian perivascular and Parascalene approach of supraclavicular brachial plexus block

OBJECTIVES:

To evaluate

- Clinical success rate of block.
- Time required to perform the block.
- Onset of sensory, motor block and surgical adequacy.
- Level of sensory block to pin prick.
- Complications
- Rescue analgesia

ANATOMY OF BRACHIAL PLEXUS[11-15]

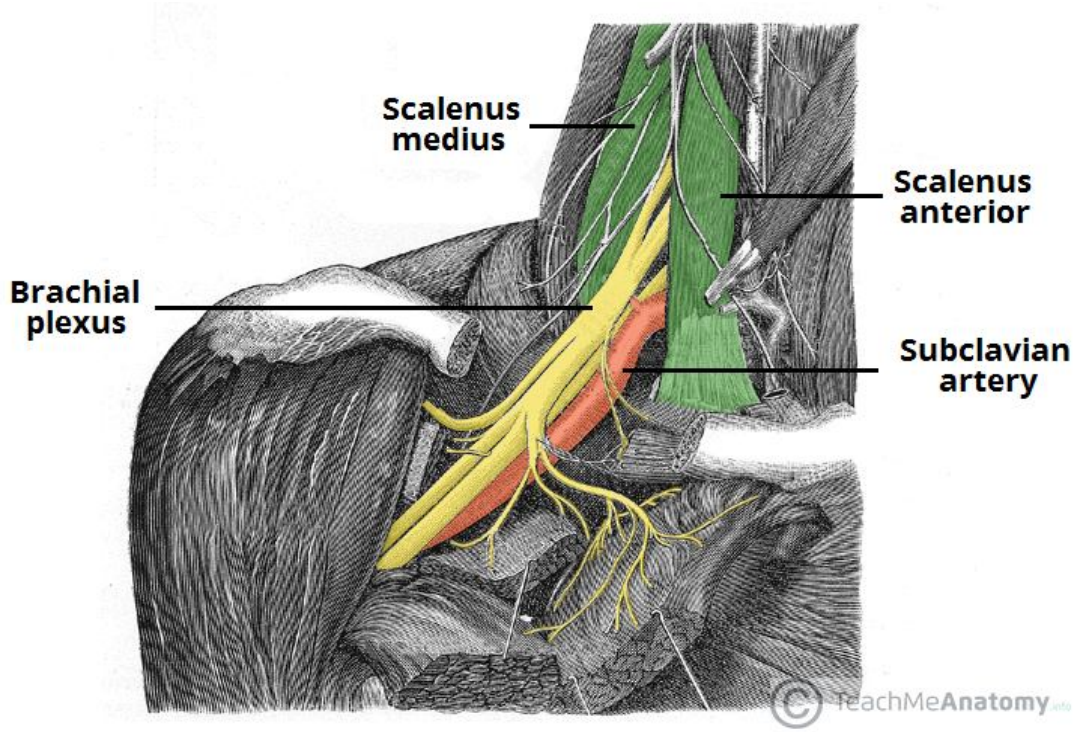
Mastering the Brachial Plexus anatomy and its distribution is absolutely essential for the precise and effective use of brachial plexus analgesia for surgeries of the upper limb. A thorough understanding of the vascular, muscular and fascial relationships of the plexus throughout its formation and distribution is equally essential in order to perform the various techniques of brachial plexus blocks.

The Upper limb is innervated by Brachial plexus. The plexus consists of

1. Roots
2. Trunks
3. Divisions
4. Cords
5. Branches

This is formed by Ventral rami of 5^{th} to 8^{th} Cervical and 1^{st} Thoracic nerves. It receives occasional contributions from 4^{th} Cervical (prefixed) above and 2^{nd} Thoracic nerve (post fixed) below. These nerves unite to form trunks, which lie in the neck above the Clavicle. It passes through the fascia enclosed space between the Scalenus Anterior and the Scalenus Medius muscle. It is accompanied by the Subclavian Artery. It enters the fascia over the muscle and forms the neurovascular bundle. This fascia becomes the axillary sheath in the axilla.

RELATIONS OF BRACHIAL PLEXUS



Anterior relations

The skin, superficial fascia, platysma and supraclavicular branches of the superficial cervical plexus, the deep fascia and external jugular vein. The clavicle is in front of the lower part and scalenus anterior is in front of the upper part.

Posterior relations

Scalenus medius and the long thoracic nerve of Bell.

Inferior relations

Related to the first rib.

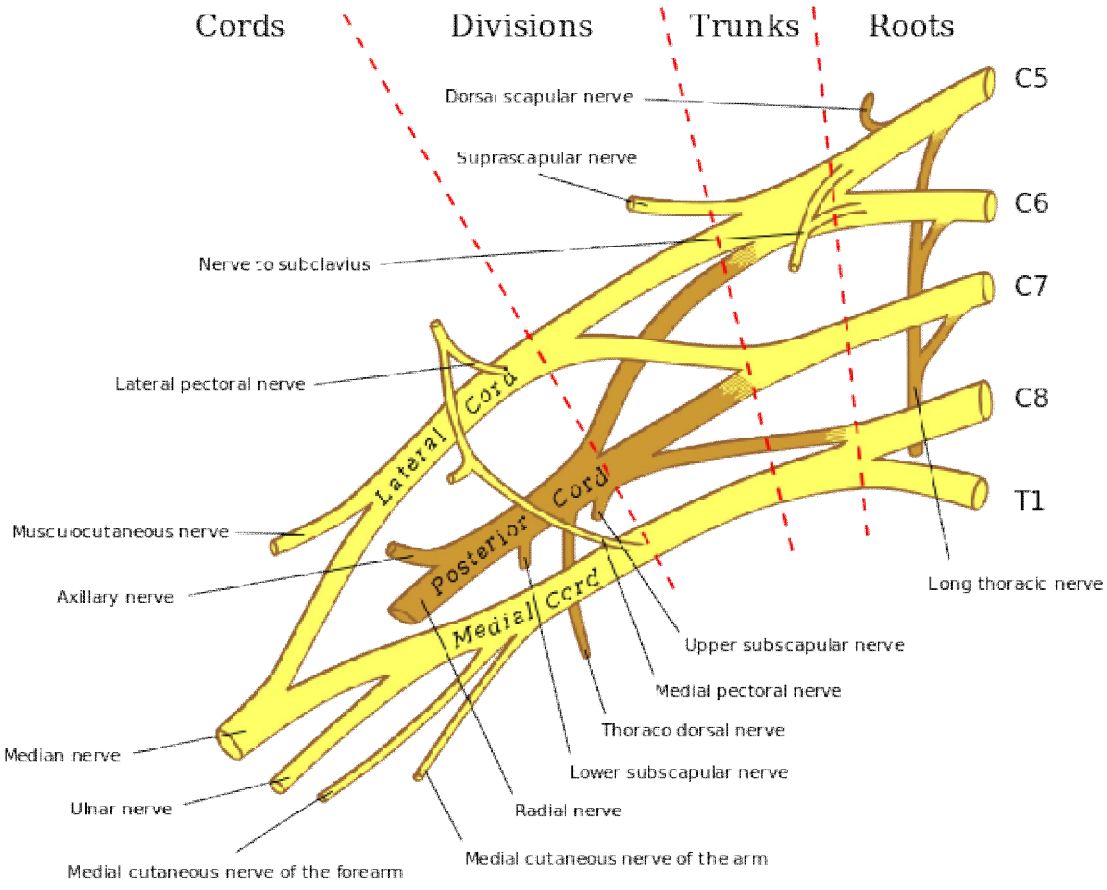
Superior relations

Lies first above and then lateral to the subclavian artery.

Middle and inferior cervical sympathetic ganglion gives sympathetic contribution to the plexus

ANATOMICAL ILLUSTRATION OF THE BRACHIAL PLEXUS

Axilla / Behind Clavicle / Posterior / Between Scalene muscles Triangle



Roots

- Formed by the ventral rami of spinal nerves C5-C8 and T1 (occasionally C4 or T2).

Trunks

- Upper trunk – anterior rami of C5 & C6 joins to form the upper trunk
- Middle trunk – formed by anterior ramus of C7
- Lower trunk – anterior rami of C8 & T1.

Divisions

- Trunks divide into two divisions, namely 3 anterior divisions and 3 posterior divisions.

Cords

- Lateral cord – anterior divisions of upper and middle trunks (C5 – C7)
- Medial cord – anterior divisions of lower trunk (C8 – T1)
- Posterior cord – posterior divisions of all the three trunks (C5 – T1)

Branches

From roots

- Nerve to serratus anterior C5 – C7
- Muscular branches to long cervices muscle C5 – C8
- Nerve to the three scalene muscles C5 – C8
- Nerve to rhomboids, levator scapulae C5
- A branch to phrenic nerve C5

- Nerve to subclavius muscle C5 & C6

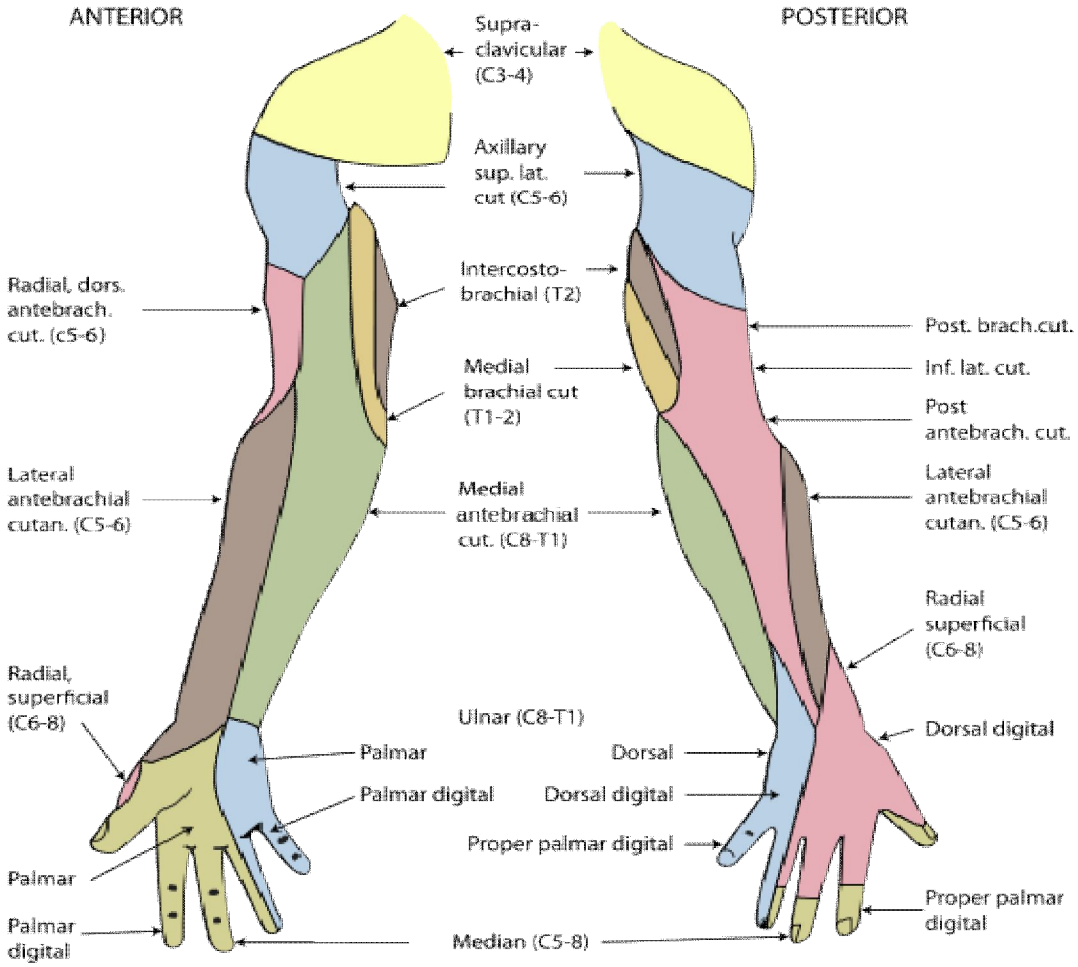
From trunks

- Suprascapular nerve C5 & C6

From cords (in relation to axillary artery)

- Lateral cords (three):
    - Lateral pectoral nerve C5 – C7
    - Lateral root of the median nerve C5 – C7
    - Musculocutaneous nerve C5 – C7
- Medial cord (five):
    - Medial root of median nerve C8 – T1
    - Medial pectoral nerve C8 – T1
    - Medial cutaneous nerve of forearm C8 – T1
    - Medial cutaneous nerve of arm C8 – T1
    - Ulnar nerve C8 – T1
- Posterior cord
    - Radial nerve C5 – T1
    - Axillary nerve C5 – C8
    - Thoraco dorsal nerve C6 – C8
    - Upper and lower subscapular nerves C5 – C6

SENSORY INNERVATION OF UPPER LIMB



The upper arm (medial aspect) is not anesthetized by any brachial plexus block technique, since this area is innervated by the intercostobrachial nerve T2. This nerve can be blocked by subcutaneous infiltration across the upper medial aspect of the arm using 4 ml of local anaesthetic solution for surgical anaesthesia or tourniquet. Brachial plexus blockade can be done at the roots, trunks, cords or peripheral branches level. Each level of blockade has a specific distribution of anaesthesia, merits, demerits and complications.

PHARMACOLOGY[37]

LOCAL ANAESTHETICS:

Local anaesthetics are those drugs that produce reversible conduction blockade of impulses along central and peripheral nerve pathways after regional anaesthesia.

They block the origination and also conduction of impulses pertaining to nerve mainly at all parts of specific neurone where they come in contact without causing any structural damage to the neurone

Thus to say, not only sensory impulses but motor impulses are also interrupted when this drug is being applied to a mixed nerve, leading on to muscular paralysis and loss of the autonomic control.

HISTORY :

Cocaine - First introduced Local anaesthetic in 1884 by Koller in ophthalmology.

Prilocaine - First introduced synthetic Local anaesthetic by Emborn in 1905

Lignocaine - Synthesized by Lofgren in 1943

Bupivacaine - Synthesized by Ekenstam in 1956, introduced in

clinical practice by Telivuo in 1963

The local anaesthetics are classified into

- Amide group
- Ester group

ESTER LINKED TYPE LOCAL ANAESTHETICS:

- COCAINE
- CHLOROPROCAINE
- PROCAINE
- TETRACAINE
- BENZOCAINE

AMIDE LINKED LOCAL ANAESTHETICS:

- LIGNOCAINE
- BUPIVACAINE
- DIBUCAINE
- PRILOCAINE
- ROPIVACAINE

The clinically useful type of local anaesthetic drugs are the poorly water soluble, weak bases with amphiphilic type of property. The

chemical structure of the drug consists of secondary or tertiary type of amine (hydrophilic) on one side and an aromatic residue on the other side (lipophilic) with hydrocarbon chain in the middle. The hydrocarbon chain and lipophilic aroma tic ring are joined by an ester type or amide type linkage – basis for classification of local anaesthetics.

Marketed as water soluble hydrochloride salts – its acidic pH contributes to the stability of local anaesthetics. Acidic pH is important especially when epinephrine, which is unstable at alkaline pH, is added to the local anaesthetic.

Features of amide local anaesthetics are found to be in contrast to ester type local anaesthetics.

Amide local anaesthetics are specific in the following features :

- Produce much intense and a longer lasting anaesthesia
- Bind to the protein alpha 1 acid glycoprotein in plasma
- Not at all hydrolysed by the enzyme plasma esterases
- Very rarely may cause hypersensitivity reactions. No reported cross sensitivity has been seen with ester type local anaesthetics (produce metabolites related to paraaminobenzoic acid which evokes allergic reactions)

ADDITIVES:

- Liposomal : To prolong duration of action and reduces systemic toxicity
- Alkalinisation :
  - ✓ Shortens onset of neural blockade
  - ✓ Enhances the depth of motor and sensory blockade
  - ✓ Increases the spread of epidural blockade
- Epinephrine :
  - ✓ Duration of action of local anaesthetics is directly proportional to the time the drug is in contact with nerve fibres
  - ✓ As most local anaesthetics have intrinsic vasodilator property (except ropivacaine and levobupivacaine), addition of epinephrine (1: 2,00,000 or 5 mcg/ml)
    - ❖ Decreases systemic absorption
    - ❖ Increases duration of action
    - ❖ Increases conduction blockade by increasing neuronal uptake of local anaesthetics
    - ❖ Its alpha adrenergic effect also causes some degree of analgesic effects
- Low molecular weight dextran : Prolongs duration of action and decreases rate of systemic absorption

MECHANISM OF LOCAL ANAESTHETIC DRUG ACTION:

These drugs are found to block the conduction of nerve impulses by decreasing the penetration of sodium ions in the period of upstroke of the action potential.

Local anesthetics bind to alpha subunit of inner portion of Na+ channel

↓

Inhibits the passage of Na+ ions through ion selective Na+ channel

↓

Rate of depolarization slows

↓

Threshold potential not attained

↓

No propagation of action potential

↓

Conduction blockade

OTHER SITES OF ACTION :

- Blockade of voltage dependent K+ channel
- L type calcium channel blockade
- G protein coupled receptors

FREQUENCY DEPENDENT BLOCKADE:

- Local anaesthetics gain access to receptors only when Na+ channel is in activated open state
- Depends on nerve's characteristic frequency activity as well as to its anatomic properties

Hence to say here is, the nerve is actually resistant to the action of blocking in the resting state and the blockade develops rapidly in repeatedly stimulated nerve.

The frequency of this multiple stimulation is also a contributing factor on which the degree of blockade is relying. So the degree of blockade relies on many vital factors.

Greater level of blockade quality has been seen with higher stimulation frequency. And moreover the exposure to a large concentration of calcium is actually seen to decrease the inactivation of sodium channels and thereby it is lessening the degree of the block. This process of interruption of impulses travel by these local anesthetic drugs are found to be not mainly due to the hyperpolarisation but indeed the resting potential of the membrane is not changed because the channels of potassium will be getting blocked only at a very high local anesthetic level.

LOCAL ANAESTHETICS	**Pka**
AMIDES	
Bupivacaine and Ropivacaine	8.1
Lignocaine and Prilocaine	7.8
Etidocaine	7.7

Mepivacaine	7.6
ESTERS	
Chloroprocaine	9.0
Procaine	8.9
Cocaine	8.7
Tetracaine	8.2

The onset of blockade is linked to drug's own status of p -ka. Those drugs with lesser p –ka (ex. Lignocaine, Mepivacaine) are found to have quick onset of action, the reason for this being, nearly 30% to 40% of that drug is in the base form without dissociation at the normal body level p-H of 7.4 and this exact form is going to penetrate the axon.

The drugs which are actually found to be having high p-ka values namely:

- Procaine
- Tetracaine
- Bupivacaine

are really having slower onset of action as 15% is in base form without ionization except chloroprocaine which has quicker onset of action even though it is possessing a high rate of p-ka of as high as 9.1.

MINIMUM CONCENTRATION (Cm) :

- Necessary to produce conduction blockade
- Directly proportional to nerve fibre diameter
- Indirectly proportional to
  - ✓ pH of tissue
  - ✓ Frequency of nerve stimulation

PHARMACOKINETICS :

- Absorption depends upon
  - ✓ Site of injection
  - ✓ Dosage
  - ✓ Use of epinephrine
  - ✓ Pharmacologic characters of drug used
- Plasma concentration depends upon
  - ✓ Tissue distribution
  - ✓ Rate of clearance of drug
- Distribution depends upon
  - ✓ Lipid solubility
  - ✓ Protein binding
  - ✓ Cardiovascular status
  - ✓ Hepatic function
  - ✓ Age

- **LUNG EXTRACTION :**
  - ✓ Lung is capable of extracting lidocaine, bupivacaine, prilocaine from circulation thereby limiting the concentration of drug reaching systemic circulation
  - ✓ Propanolol impairs bupivacaine extraction by lungs, it also decreases plasma clearance of lidocaine and bupivacaine by reducing blood flow to the liver and hepatic metabolism inhibition
- **PLACENTAL TRANSFER :**
  - ✓ Plasma protein binding influences rate and degree of diffusion of local anaesthetics across the placenta(↑protein binding → ↓placental transfer)
  - ✓ Ester local anaesthetics due to rapid hydrolysis have very low rate of placental transfer.
  - ✓ Acidosis in foetus due to prolonged labour causes accumulation of local anaesthetics in the foetus (Ion trapping)
  - ✓ The degree of ionization and lipid solubility of the drug determine the extent of placental transfer. Rate of placental transfer is low with lipid insoluble, ionized drugs
- **CLEARANCE :**
  - ✓ Amide local anaesthetics – depends on hepatic metabolism
  - ✓ Ester local anaesthetics – by rapid hydrolysis in plasma/liver

- **METABOLISM :**
    - ✓ Amide local anaesthetics – Microsomal enzymes in the liver
    - ✓ Ester local anaesthetics – Hydrolysis in plasma/liver (cholinesterase enzyme)
    - ✓ Renal elimination of unchanged drug is less than 5% as local anaesthetics are poorly water soluble

RACEMIC MIXTURES :

- Pipecoloxylidide local anaesthetics (Bupivacaine, Levo bupivacaine, Ropivacaine, Mepivacaine) are chiral drugs – Their molecular structure possess asymmetric carbon atom
- Enantiomers of a chiral drug may vary in their pharmacodynamics, pharmacokinetics and toxicity
- S enantiomers are considered to produce less neurotoxicity and cardio toxicity

SIDE EFFECTS :

ALLERGIC REACTIONS :

Account for <1% of adverse reactions to local anaesthetics. Majority of adverse responses are due to excess local anesthetic plasma concentrations. More common in ester linked local anesthetics.

Manifestations like rash, urticaria, laryngeal edema, hypotension and bronchospasm is highly suggestive of a local anesthetic induced

allergic reaction. Accidental intravascular injection of the local anesthetic with adrenaline manifests as hypotension associated with syncope or tachycardia.

Use of an intradermal test requires injection of preservative free preparations of local anesthetic solutions.

Local Anaesthetic	Therapeutic plasma concentration
Lidocaine	1 – 5 mcg/ml
Bupivacaine	< 3 mcg/ml

SYSTEMIC ACTION PERTAINING TO LOCAL ANAESTHETICS:

Any of the local anaesthetic drug when it is injected or if it is locally applied, it will be absorbed into the circulation and produces deleterious effects on the vital organs when the concentration of the drug exceeds the toxic limits.

CENTRAL NERVOUS SYSTEM :

NEURAL SYSTEM:

All these locally acting drugs produce continuous events of stimulation and that is sequentially followed by depression. The powerful

CNS STIMULATING drug, the so called cocaine drug - in sequence it causes

- Euphoria
- Increased excitability
- Confusion
- Restlessness
- Tremor
- Muscle twitches
- Convulsive events
- Unconscious state
- Respiratory depression
- Finally - death

The above clinical features depend on plasma concentration level. Numbness of the tongue and circumoral tissues is the first sign of local anaesthetic toxicity – reflecting drug delivery to highly vascular tissues. As plasma concentration of local anesthetics increase, it crosses blood brain barrier causes restlessness, skeletal muscle twitching (first seen in face and extremities), vertigo, tinnitus, slurred speech, difficulty in focussing and it predicts the onset of tonic clonic seizures. Seizures classically followed by central nervous system depression accompanied by hypotension and apnoea.

1. SEIZURES

CAUSES :

- Unopposed excitatory pathways due to selective depression of inhibitory cortical neurons by local anaesthetics
- Inhibition of the release of neurotransmitters particularly gamma aminobutyric acid

Local Anaesthetic	**Plasma concentration associated with CNS effects**
Lidocaine, Mepivacaine, Prilocaine	5 – 10 mcg/ml
Bupivacaine	4.5 – 5.5 mcg/ml

It is recommended that the plasma venous concentration of lidocaine should be monitored when the cumulative epidural does of lidocaine is > 900mg

There is an inverse relationship between PaCo2 and seizure threshold, reflecting variations in cerebral blood flow and resultant delivery of drugs in the brain. Hyperkalemia can facilitate depolarisation and increase local anaesthetic toxicity.

Treatment – Ventilation of patient's lungs with oxygen, Intravenous benzodiazepines, Hyperventilation of lungs (controversial)

2. TRANSIENT NEUROLOGICAL SYMPTOMS :

- Manifest as severe pain in the posterior thighs buttocks and lower back
- Incidence – Increased in hyperbaric lidocaine, addition of adrenaline
- Etiology – Not known
- Onset – 6 to 36 hours after recovery from spinal anaesthesia
- Recovery – 1 to 7 days

3. CAUDA EQUINA SYNDROME :

- Diffuse injury across the lumbosacral plexus
- Manifest as Paraplegia, bowel and bladder sphincter dysfunction, sensory anaesthesia

4. ANTERIOR SPINAL ARTERY SYNDROME :

- Manifest as lower extremity paresis with a variable sensory deficit
- Etiology – Uncertain
- Risk factors – Advanced age, Peripheral vascular disease
- Differential diagnosis – Epidural abscess or hematoma compressing spinal cord

CARDIOVASCULAR EFFECTS :

Bupivacaine produces cardiovascular depression and arrhythmias at high doses or during accidental intravascular administration.

The effects on cardiac tissue are :

- Automaticity depressed
- Excitability reduced
- Contractility blunted
- Conductivity slowed
- Effective period of refractoriness lengthened

The above effects on the cardiac tissue are caused by the following actions:

- Blockade of Sodium, Potassium, Calcium channels
- Direct myocardial depression
- Relaxation of arteriolar smooth muscles
- Inhibition of cyclic adenosine mono phosphate

Risk Factors :

- Pregnant mothers are highly sensitive to local anaesthetic drugs.
- Patient on Beta adrenergic blockers, Calcium channel blockers, Digitalis, Anti dysrhythmic drugs

- Tachycardia, use of phenylephrine, epinephrine

Local Anaesthetic	Plasma concentration associated with CVS effects
Lidocaine	5 – 10 mcg/ml
Bupivacaine	8 – 10 mcg/ml

Mechanism Of Action :

- All local anaesthetics prolongs P – R and QRS interval by depressing the Vmax (maximal depolarization rate of the cardiac action potential)
- Both bupivacaine and lidocaine block cardiac sodium channels during systole, whereas during diastole, highly lipid soluble bupivacaine dissociates off at a slow rate – accounts for the persistent depressant effect on Vmax and cardiac toxicity (also through direct brainstem effect)
- Bupivacaine is notorious to produce Ventricular tachycardia and fibrillation.

Treatment :

- The patient must be ventilated with 100% oxygen
- Basic and advanced cardiac life support must be initiated.

- Bretylium, sotalol and amiadarone are drugs of choices for bupivacaine induced arrhythmias.
- Lipid emulsion (20%) therapy **:**
    - ✓ Bolus – 1.5 ml/kg (lean body mass) intravenously over 1 min followed by continuous infusion of 0.25 ml/kg/min
    - ✓ Recommended approach – Implement lipid therapy on the basis of clinical severity and rate of progression of local anaesthetic toxicity
    - ✓ If there is persistent cardiovascular collapse, repeat bolus once or twice and double the infusion rate to 0.5ml/kg/min
    - ✓ Continue infusion for at least 10 minutes after attaining circulatory stability
    - ✓ Recommended upper limit : Approximately 10 mL/kg over the first 30 minutes
- Avoid vasopression, calcium channel blockers, beta blockers
- Reduce individual epinephrine doses to < 1mcg/kg (Epinephrine can impair resuscitation from local anaesthetic systemic toxicity)

METHEMOGLOBINEMIA :

- Rare but potentially life threatening complication
- Caused by prilocaine, benzocaine, cetacaine, lidocaine, nitroglycerin, phenytoin and sulphonamides

- Central cyanosis usually occurs when methemoglobin concentration exceeds > 15%
- Confirmed by qualitative measurements of methemoglobin by cooximetry
- Treatment :
    - ✓ Methylene blue – 1 - 2mg/kg IV over 5 minutes

VENTILATORY RESPONSE TO HYPOXIA :

- Lidocaine decreases and bupivacaine stimulates the ventilatory response to carbondioxide.

HEPATOTOXICITY :

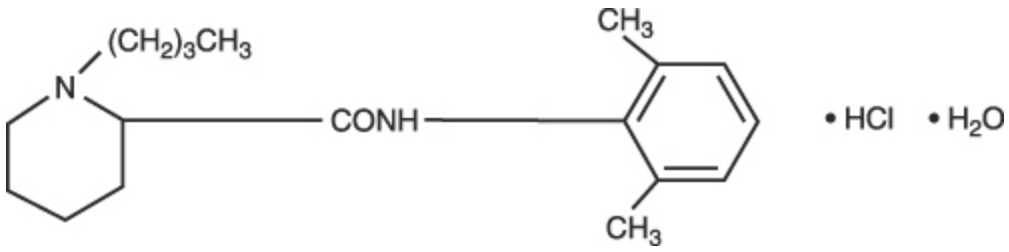
- Bupivacaine causes elevated liver transaminases.
- Injury can be direct toxic, an allergic reaction (most likely) or idiosyncratic metabolic abnormality

PHARMACOLOGY OF BUPIVACAINE

Bupivacaine:

The chemical structure of Bupivacaine is 1-butyl-2-piperidylformo-2', 6'-xylidide hydrochloride. It belongs to the amide class of local anaesthetic drugs.

Molecular structure:



Molecular formula: $C_{18}H_{29}ClN_2O$

It is an amino amide type of long acting local anaesthetic agent.

Presentation:

As a clear colourless 0.25%, 0.5% solution.

Physiochemical properties[18]:

- Molecular weight : 288
- P^{ka} : 8.1
- Liposolubility : 30

- Partition coefficient : 346
- Protein binding : 95%
- Vd : 54 L
- Elimination $T_{1/2}$: 157 min
- Clearance : 0.32 L/min
- Onset of action : 1 - 17 min (route and dose-dependent)
- Duration of action : 2 - 9 hr (route and dose-dependent)
- Half life : Neonates - 8.1 hr, Adults - 2.7 hr
- Time to peak plasma concentration (for peripheral, epidural or caudal block) : 30-45 min
- Metabolism : Hepatic
- Excretion : Renal (6% unchanged)
- Fetal/Maternal ratio : 0.2 - 0.4

The molecules of bupivacaine have an asymmetric carbon atom, with a chiral centre, which exhibits optical isomerism. So commercial preparation of bupivacaine contains 50:50 ratio of Levo and Dextro

rotatory isomer. So the presence of both the isomers is called a Racemic mixture.

Pharmacodynamics:

In general, the diameter, myelination and conduction velocity of affected nerve fibres determine the progression of anaesthesia. Small fibres are more sensitive than larger fibres[17] and require a longer period for recovery. Sensory pain fibres are usually blocked first, followed by fibres that transmit sensations of temperature, touch, and deep pressure. Unmyelinated nerves are blocked more readily than myelinated nerves.

Pharmacokinetics:

The absorption of local anaesthetic is related to the site of injection (intercostal > epidural > brachial plexus > subcutaneous). The total dose and peak plasma concentration have linear relationship. Dosage is 2.5mg/kg, maximum dose – 175mg.

Bupivacaine is mainly bound to alpha 1 acid glycoprotein. It is more protein bound (95%). Less than 3% of bupivacaine circulates free in plasma. The free concentration of the drug is responsible for the toxic manifestations.

In protein deficient conditions like under nutrition and nephrotic syndrome, less amount of protein will be available to bind the drug

leading to increased free fraction of the drug, causing toxic manifestations even at minimal doses.

The drug metabolism occurs mainly in the liver. Hepatic Cytochrome P450 plays major role in the metabolism. Mainly CYP1A2 and CYP3A4 isoform. Aromatic hydroxylation, N – dealkylation, amide hydrolysis and conjugation are possible metabolic pathways. Excretion occurs mainly in the renal system and partly in the faeces.

Hepatic Cytochrome enzyme system mediated metabolism of bupivacaine produce metabolites. The major metabolite of bupivacaine measured in blood or urine after spinal/epidural anaesthesia is N desbutylbupivacaine.

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Uses

Bupivacaine is used in Epidural analgesia, subarachnoid block, regional nerve blocks, retrobulbar block in the ophthalmic surgeries, and local infiltration.

Spinal anaesthesia:

Bupivacaine is most commonly used in spinal anaesthesia than lidocaine as lidocaine produces higher incidence of transient neurologic

symptoms. The onset time of sensory and motor blockade of hyperbaric bupivacaine is less when compared to isobaric bupivacaine. Addition of opioid with bupivacaine results in improved quality of both sensory and motor blockade with less hemodynamic alterations. In parturients the intrathecal placement of bupivacaine along with sufentail provided labor analgesia and allowed the patients to ambulate.

Stout's principles for spread of solutions :

- Height of anesthesia varies directly with concentration
- Extent of anesthesia is directly proportional to speed of injection, volume of fluid, specific gravity of hyperbaric solutions
- Extent of anesthesia is inversely proportional to rapidity of fixation, spinal fluid pressure
- With isobaric or hypobaric solutions, extent depends on position of the patient

Physiological effects:

Hypotension (33%), bradycardia (13%) at higher level of blockade, eg. above T4.

Epidural anaesthesia:

Bupivacaine produces prolonged sensory blockade. Motor anaesthesia is more intense and of longer duration. The addition of epinephrine 1:2,00,000 does not appear to offer an advantage in terms of

duration of action. Epidural anaesthesia for labour or caesarean delivery is similar with 0.5% bupivacaine or ropivacaine. 0.25% bupivacaine and 0.25% ropivacaine administered as intermittent doses into the epidural space are equally efficacious in providing relief of labour pain. More lipid solubility and protein binding of bupivacaine, limits its passage across the placenta to foetus.

Post operative analgesia:

Epidural analgesia:

Similar doses of bupivacaine, levobupivacaine and ropivacaine produce comparable post operative pain relief. A continuous infusion of bupivacaine in lower dilutions with additives produces an effective postoperative pain relief.

Wound infiltration:

In a concentration of 0.125%, post incision wound infiltration produces good post operative analgesia following various surgeries.

Regional nerve block:

Prolonged duration of blockade with good postoperative analgesia and less toxicity makes it as an ideal choice for nerve blocks. Addition of opioids appears to be ineffective in altering the results of the block

Ophthalmic surgery :

Bupivacaine produces effective peribulbar anaesthesia and better post operative analgesia than ropivacaine.

Paediatric anaesthesia:

In paediatric patients, there is no difference with regard to postoperative analgesia provided by bupivacaine, levobupivacaine and ropivacaine. It is increasingly used in spinal anaesthesia, caudal blocks, epidural anaesthesia and continuous epidural infusion for post operative pain relief. For infant spinal anaesthesia the appropriate dose is 1mg/kg for bupivacaine and ropivacaine (0.5%). For caudal blocks the recommended dose is 2mg/kg.

Adverse effects

Fall in blood pressure (33%) followed by nausea (21%), vomiting (14%), headache (9%), procedural pain (8%) and dizziness (6%). Allergic manifestations are rare. Accidental intravascular injection produces systemic toxicity.

Drug interactions

Hepatic Cytochrome enzyme inhibitors such as ketaconazole and methyl xanthenes affects bupivacaine metabolism.

LIGNOCAINE

Lignocaine was synthesized in 1943 in Sweden by Loffgren of AB Astra. It is chemically a tertiary amide, diethyl aminoacetyl, 2.6, xylidine hydrochloride monohydrate. It is a local anaesthetic of moderate potency and duration but of good penetrative powers and rapid onset of action.

It is a stable compound at room temperature. Epinephrine prolongs the action of lignocaine and reduces the rate of systemic absorption by producing vasoconstriction and also reduces the systemic toxicity. Tachyphylaxis can occur with repeated injections. Concentration of epinephrine added is kept at 5 mcg / ml (1: 200,000 dilution) of Local anesthetic.

Pharmacokinetics

Molecular weight	- 271
Pka	- 7.8
Protein binding	- 70%
Lipid solubility	- 2.9
Volume of distribution	- 91 litres
Clearance	- 0.95 litres / minute
Elimination half life	- 96 minutes

Metabolism

The principle metabolic pathway of lidocaine is oxidative dealkylation in Liver to monoethylglycine xylilide followed by hydrolysis

of this metabolite to xylidide. Hepatic disease can decrease the rate of metabolism of Lidocaine.

Dose :

- Safe dose 3mg/kg without epinephrine
- 7mg/kg with epinephrine
- Epinephrine upto 5 mcg /ml (1 in 200,000) does not give rise to systemic effects Blood concentration of local anaesthetic drug is highest following intercostal block followed in order of decreasing concentration, epidural, brachial plexus block and subcutaneous infiltration.

Therapeutic uses :

- Topical anaesthesia (2-4%)
- EMLA Cream (eutectic mixture of lignocaine 2.5%, prilocaine 2.5%)
- Local infiltration and peripheral nerve block
- Regional anaesthesia (Spinal / epidural)
- Intravenous regional anaesthesia (Biers block)
- Stress attenuation and prevention of rise in intra cranial tension, suppression of the ventricular cardiac dysrhythmias (using preservative free lignocaine)

PHYSIOLOGICAL BASIS OF PERIPHERAL NERVE STIMULATOR TECHNOLOGY

Nerve stimulation was first described by Perthes in 1912. Electrical Nerve stimulation of peripheral nerves is now more commonly used in clinical practice. The ability of a nerve stimulator to evoke a motor response depends on the intensity, duration, and polarity of the stimulating current used and the {needle (stimulus) - nerve } distance. Application of threshold current to the nerve fibres is essential to propagate a nerve impulse. Peripheral nerve stimulation is typically performed using a rectangular pulse of current.

RHEOBASE is the minimal threshold current required to stimulate a nerve with along pulse width.

CHRONAXIE is the minimum duration of a stimulus required to stimulate a nerve at twice the strength of rheobase. Chronaxie is used to express the relative excitabilities of different tissues. It is possible to stimulate A- alpha (motor) fibres without stimulating A-delta and C fibres that transmit pain. Moreover, mixed nerves can be located by evoking a motor response without causing patient discomfort.

Intensity of stimulation will be variable as determined by coulomb's law [e = k (q/r 2) k - constant, q - minimum stimulating current, r - distance of the needle tip from the nerve].

A very high stimulus current is required for nerve stimulation when the distance between needle tip and the nerve is far. If there is great distance, the stimulus strength required to stimulate the nerve may produce significant pain and systemic effects. A stimulating current of <0.5 mA is associated with high rates of success of peripheral nerve stimulator assisted peripheral nerve block.

Characteristics of an ideal peripheral nerve stimulator (PNS) :

1. Constant current output - A particular current not the voltage stimulates the nerve. Therefore, the current delivered by the device should not vary with changes in the resistance of the external circuits.
2. Digital display of the delivered current
3. Variable output control
4. Clearly identifiable control
5. Option for different pulses
6. A wide range of current output 0.1-5.0mA
7. Battery indicator

Peripheral nerve stimulator settings

MIXED NERVE (eg - Sciatic nerve)

Current(dial) - 1 mA

Current duration - 0.1 ms

Frequency - 1 - 2 Hz

SENSORY NERVE (eg- Lateral femoral cutaneous and saphenous nerves)

Current (dial) - 2 - 5mA

Current duration - 1 ms

Frequency - 1 Hz

DIABETIC NEUROPATHY

Current (dial) - 2 mA

Current duration - 0.3 ms

Frequency - 1-2 HZ

PERIPHERAL NEUROANATOMY

C and A∂ fibres are the main peripheral nociceptors. The skin joints and periosteum are richly innervated with C and A ∂ nociceptors as well as the non nociecptive AB sensory fibres.

A ∂ are responsible for the sensation of first pain, the initial sharp pain experienced following an injury. C fibres are unmyelinated and are responsible for second pain, the slowly building throbbing burning pain experienced following an injury.

Peripheral neurochemistry and neurotransmitters:

Commonly released inflammatory mediators implicated in pain and hyperalgesia include bradykinins, potassium, substance P cytokines, histamine, serotonin and prostaglandins (it is here that dexamethasone

plays a vital role in prolonging analgesia in nerve blocks when used as an additive). These peripheral neurotransmitters either activate or sensitise the peripheral noiceptors to pain

Classification of Sensory Fibers

Sensory receptors	**Speed of transmission**	**Sensory function**	**Myelination**
C Fibres	0.5 -2m/sec	Noxious chemical, Mechanical, thermal activation (Slow burning second pain)	Unmyelinated
A-Alpha fibres	70 -120m/sec	Noxious chemical thermal, mechanical stimuli, (sharp fast, first pain)	Lightly myelinated
A-Beta fibres	30 -70m/sec	Nonpainful, light,touch, pressure, vibration proprioception	Heavily myelinated
A-Gamma fibres	30-70m/sec	Proprioception/Motor to muscle spindle	Myelinated
A-δ fibres	12-30 m/sec	Pain, cold, touch	Myelinated
B fibres	3 -15 m/sec	Pre ganglionic autonomic (sympathetic)	Myelinated

PHARMACOKINETICS OF LOCAL ANAESTHETICS IN BRACHIAL PLEXUS BLOCKADE[34]

When a local anaesthetic is injected around a nerve trunk, fibres situated in the periphery of the trunk (mantle fibres) will be first blocked and those in the centre of the trunk (core fibres) last. Further, transmission in peripherally placed fibres will be blocked over a longer length of time compared to central fibres. Thus analgesia will appear first and last longest in the territory supplied by the peripheral fibres. If the pool of local anaesthetics is small or if the injection was not accurate or too dilute, the fibres in the centre will escape blockade.

Theory of Winnie

The trunks are arranged so that the central fibres are the longest supplying the extremities of the limb while shorter fibres are arranged more peripherally as their area of supply is more proximal. Winnie groups the fibres into two: the peripheral mantle fibres which contain the motor fibres and core fibres which are mainly inner sensory. Peripheral motor fibres supply the muscles of the forearm and the central fibres carry sensation from the hand.

Thus the onset of block in the limb occurs as follows:

- Loss of motor power to the shoulder and upper arm
- Loss of sensation on the upper arm
- Loss of motor power of the forearm
- Loss of sensation to the hand.

So the spread of block is from proximal to distal.

REVIEW OF LITERATURE

Technique and drug

The supraclavicular brachial plexus block is one of several techniques of the brachial plexus block. The block is performed at the level of trunks of brachial plexus, confined to a very small surface area. It produces rapid onset, predictable and dense anaesthesia. Kulenkampff of Germany in 1911 performed the first percutaneous supraclavicular approach. This technique was later published in 1928 by **Kulenkampff** and **Perksy** (classic approach).

1. Vongvises, P., and Panijayanond described parascalene approach of brachial plexus block, conducted in 100 patients undergoing upper extremity surgery and found that it was a useful, simple, safe, and reliable technique for brachial plexus block, avoiding the complication of pneumothorax (1979)[19]
2. Bernard dalens et al prospectively evaluated parascalene approach with subclavian perivascular approach in 120 children, 60 patients in each group. Insulated needles and a nerve stimulator were used with both techniques. The parascalene approach proved to be easier and more reliable while also being almost free of complications, although both techniques produced a high degree

of sensory blockade in almost all infraclavicular branches of the brachial plexus (1987)[17]

3. Anaesthesia and analgesia vol: 60 (page 352 to 355) – No.5: May 1981 Volker Hempel, MD," Meno van Finck, MD,f and Elmar Baumgartnerf. A Longitudinal Supraclavicular Approach to the Brachial Plexus for the Insertion of Plastic Cannulas.
4. Pramot Vongvises et al conducted computed tomographic study of parascalene block in 20 cases regarding the relation between the needle position to the brachial plexus and the dome of the pleura and found that in the parascalene block, needle entry site level is higher to the dome of the pleura, thus the complication of pneumothorax is less. (1997)[18]
5. Kyung Hee kim, Keon Jung Yoon et al performed parascalene technique for brachial plexus block in 206 cases undergone upper extremity and shoulder surgeries, studied the cases retrospectively and concluded that this approach is safe, reliable method for providing proper anaesthesia for upper extremity and shoulder surgeries without any remarkable complications except Horner's syndrome for 3 cases (1997)
6. Carlo D. Franco prospectively collected data from 1001 subclavian perivascular brachial plexus blocks performed using nerve stimulator according to Winnie's approach. Concluded the above

technique was both highly successful and safe without any complications (2000)[20]

7. European Journal of Anaesthesiology: Volume 17, Issue 2, pages 120–125, February 2000 : Brachial plexus block using a new subclavian perivascular technique: the proximal cranial needle approach. Department of Anaesthesia, Centro Traumatologico Ortopedico, Careggi, Firenze, Italy, Dr P. Pippa, Via A Righi, 28, I-50047 Prato, Italy. We describe the proximal cranial needle approach for brachial plexus blockade; clear surface markings and cranial direction of the needle lead to satisfactory results with a low incidence of complications.
8. Regional Anaesthesia and Pain Medicine, Vol 27, No 4 (July–August), 2002: pp 402–428. : Brachial Plexus Anaesthesia: Essentials Of Our Current Understanding Joseph M. Neal, M.D., James R. Hebl, M.D., J. C. Gerancher, M.D., and Quinn H. Hogan, M.D.
9. Arauzo P., Ortega J. P compared axillary plexus block using nerve stimulator with parascalene block using paraesthesia technique for surgeries about the elbow on 64 patients and found that parascalene technique was easy to use and provide excellent anaesthetic condition for trauma surgery around the elbow without arm mobilization or the use of a nerve stimulator (2005).

10. Bhattarai BK, Baral PR compared Winnie's subclavian perivascular approach with parascalene approach of brachial plexus block in 60 children. They concluded that parascalene approach can be used as a sole anaesthetic technique in children undergoing surgeries around the elbow.(2006)
11. Faramarz Mosaffa, Mohammad Mehdi Ghiamat conducted a study on 50 cases using parascalene approach of brachial plexus block by eliciting paraesthesia and concluded that the technique is simple, safe and reliable without any complications (2006)
12. Nguyen Hoang C, Fath Erwin, Wirtz Sebastian, et al. Anesth. Analg. Sep 2007;105:872-5
13. Young Duck Shin, Keun Seok Lee et al published a case report on parascalene brachial plexus block using ultrasound for performing arthroscopic shoulder surgery and found that Ultrasound technology is valuable to anaesthesiologists to localize nerves and the needle placement during the parascalene approach to block the brachial plexus (2009)
14. Chethanananda T N, Ramesh M C conducted prospective non randomized open level study on subclavian perivascular technique of brachial plexus block on 66 patients undergoing elective upper limb surgeries. Their study concluded that this approach

consistently provide an effective block for the surgery of the upper extremity.(2014)

15. Alpaslan Apa, Hulya Basar conducted a study in 60 healthy adult patients using parascalene approach in Brachial plexus block using the surface landmarks based on bony prominences undergoing elective upper extremity surgery and found that the technique had high success rate and was considered a safe alternative to the classically described techniques.
16. Regional Anaesthesia and Pain Medicine, Volume 25, Issue 1, Pages 41-46: C.Franco, Z.Vieira**.** 1,001 subclavian perivascular brachial plexus blocks: Success with a nerve stimulator.

    Results: Nine hundred seventy-three blocks (97.2%) were completely successful; 16 blocks (1.6%) were incomplete and needed supplementation; and 12 blocks (1.2%) failed and required general anaesthesia, giving a success rate for regional anaesthesia of 98.8%.

    Conclusions: The subclavian perivascular block consistently provides an effective block for upper extremity surgery. We believe that we have demonstrated a nerve stimulator technique that is both highly successful and safe without any major complications.
17. Transscalene Brachial Plexus Block: a New Posterolateral Approach for Brachial Plexus Block

Depending on the approach to the upper brachial plexus, severe complications have been reported. We describe a novel posterolateral approach for brachial plexus block which, from an anatomical and theoretical point of view, seems to offer advantages. 27 patients were scheduled to undergo elective major surgery of the upper arm or shoulder using this new trans - scalene brachial plexus block. The success rate was 85.2% for surgery. 2 patients required additional analgesia with IV sufentanil. In two others, regional anaesthesia was inadequate.

The side effects of this technique included reversible recurrent laryngeal nerve blockade in 2 patients and a reversible Horner syndrome in 1 patient. Further studies are needed to compare the trans -scalene brachial plexus block with other approaches to the brachial plexus

18. Winnie AP, Collins VJ. The subclavian perivascular technique of brachial plexus anesthesia. *Anesthesiology* 1964; 25 : 353-63.
19. Lanz E, Theiss D. Evaluation of brachial plexus block. Comparison between supraclavicular and interscalene approach. *Anaesthesist* 1979;28 : 57-62.
20. Dupré LJ, Danel V, Legrand JJ, Stieglitz P. Surface landmarks for supraclavicular block of the brachial plexus. *Anesth Analg* 1982; 61:28-31.

MATERIALS AND METHODOLOGY

60 patients of ASA I & II category of both sexes in the age group of 20 – 50 years posted for upper limb surgeries at the Department of Orthopaedics and the Department of Plastic surgery, Government Kilpauk Medical College Hospital and Government Royapettah Hospital formed the study group.

This study was designed as a prospective randomized comparative study. After receiving the approval of Institutional ethical committee and informed consent, the patients were randomly allocated into 2 groups receiving supraclavicular brachial plexus block with the help of Inmed nerve stimulator (Group A – Subclavian perivascular approach and group B – Parascalene approach).

Inclusion criteria

- Consented patients
- ASA I and II
- 20 – 50 years
- Both sexes
- Weight 50 – 70 kilograms

Exclusion criteria

- Patients refusal
- ASA III & ASA IV
- Coagulation disorders
- Allergy to any of the drugs used in the study
- Any distortion of local anatomy, contractures
- Local infection

Equipment

- Sterile tray
- Sterile towel, gauze packs
- Disposable 2ml, 5ml, 10ml syringes
- Sterile gloves, marking pen and surface electrodes
- 50mm long, 22G short bevel insulated stimulating needle
- Peripheral nerve locator

Drugs

- 0.5% bupivacaine vial
- 2% lignocaine with adrenaline (1:2,00,000) vial

Intraoperative and post operative monitor

- Pulse oximeter
- NIBP
- ECG

A total of 60 patients who come under the above mentioned inclusion criteria were selected. Patients who were selected were counselled about the risks and benefits involved in performing the block. After getting informed and written consent, patients willing to be included in the study were enrolled and analyzed.

Patients were all preoperatively evaluated preoperatively, clinically examined. Proper investigations were done prior to the assessment. Procedures were explained in detail and written consent was obtained.

All patients were kept in nil per oral state at least for 8 hours before taking up for the procedure. Intravenous access was obtained with 18G intavenous cannula. Local anaesthetic test dose was done. Inj. Ranitidine 50 mg and Inj. Ondansetron 4 mg were given intravenously. All patients were pre medicated with Inj .Midazolam (0.02 – 0.05 mg/kg) intravenously 10 minutes before the procedure.

Boyle machine, suctioning equipment, laryngoscope with blades of all sizes, endotracheal tubes, laryngeal mask airways, manual resuscitation bag with mask were kept ready. The procedure was carried out in the theatre where facilities for resuscitation were available.

Before shifting the patient to operation theatre, patients were grouped into group A and group B by computer randomization.

Group A (n=30) receiving supraclavicular brachial plexus block using Subclavian perivascular approach

Group B (n=30) receiving supraclavicular brachial plexus block using Parascalene approach

Initially the pre procedure parameters were recorded i.e. Pulse rate, BP, SpO_2 and ECG. Positioning of the patient and surface landmarks were similar in both groups. Needle insertion point only differs. Then the block was administered under sterile aseptic precautions.

Time to perform the block (from the skin puncture time to completion of injection of local anaesthetics), time for onset of sensory and motor blockade, complications, requirement of rescue analgesia were noted. Patients were monitored haemodynamically and observed vigilantly for development of any complications.

Positioning of the patient during subclavian perivascular and parascalene blocks:

- Patient placed in supine position with head turned to the side opposite to the side to be blocked.
- The arms are at the patient's side with the hands pointing towards the knee.

- The arm on the side to be blocked may be pulled to depress the clavicle and the shoulder.
- A rolled towel is placed lengthwise between the shoulders along the spine to give the best exposure to the area.

Surface landmarks

Important landmarks for supraclavicular block include the interscalene groove behind the posterior border of the sternocleidomastoid muscle, subclavian pulse, the midpoint of the clavicle, and Chassaignac's tubercle. The interscalene groove can be identified by placing a finger behind the sternocleidomastoid muscle and then rolling laterally to feel the groove in between the scalene anterior and scalene medius muscle. Manoeuvres help to identify landmarks include asking the patient to lift their head against resistance to identify sternocleidomastoid muscle. Sniffing accentuates the scalene muscles. The groove can be followed towards the clavicle.

The needle puncture site in Group A (Subclavian perivascular technique) was identified by sliding the palpating finger down the interscalene groove till arterial pulsation of the subclavian artery was felt. The skin and subcutaneous tissue is infiltrated with 2ml of 2% lignocaine. A 22 G short bevel 50mm insulated needle was inserted in caudad direction till the fascial pop was felt after piercing the neurovascular

sheath. The direction of the needle will be dorsally tangential to subclavian artery in the longest dimension of interscalene space.

The needle insertion point in Group B (parascalene technique) was identified by locating Chassaignac's tubercle, the transverse process of C6, located by palpation in the interscalene groove, just posterior to the sternocleidomastoid muscle, at the level of the cricoid cartilage and a line drawn from it to the midpoint of the clavicle. The point dividing the upper two thirds and lower one third in the line was identified as the puncture site. The skin and subcutaneous tissue is infiltrated with 2ml of 2% lignocaine. The needle, 22G, 50mm long insulated short bevel needle, directed posteriorly at right angle to the skin.

In both groups, the block will be performed using a nerve stimulator connected to the proximal end of 50mm, 22 G insulated needle which is set at 3mA. The needle position is adjusted while decreasing the current to 0.5 mA until a constant motor contraction response of the middle and ring fingers were elicited.

A cough from the patient is a warning sign that the pleura is being contacted by the needle. Incremental doses of 15 ml , 0.5% bupivacaine with 15 ml ,2% lignocaine with adrenaline (1 : 2,00,000) injected slowly with intermittent aspiration as a precaution to avoid intravascular injection.

After injecting the local anaesthetic the block is tested for both sensory (using pin prick) and motor (using muscle power) and is compared with same stimulation or power in the contralateral arm. Motor block is evaluated by thumb abduction (Radial nerve), thumb adduction (Ulnar nerve), thumb opposition (Median nerve) and flexion of the elbow in supination and pronation of the forearm (Musculocutaneous).

The Hollmen's scale is used in the study for assessing both sensory and motor blockade.

Hollmen's scale

Sensory blockade (Grade)

0 - normal sensation of pin prick

\+ - pin prick felt as sharp pointed but weaker compared with the same area in other extremity

++ - pin prick is felt as touch with blunt object

+++ - no perception of pin prick.

Onset of blockade means minimum grade 2 and complete blockade means minimum grade 3

Motor blockade (Grade)

0 - normal muscle function

\+ - slight depression in muscle function as compared with pre-anesthetic power

++ - very weak muscle action persisting in muscle

+++ - complete block with absent muscular function.

Onset of blockade means minimum grade 2 and complete blockade means minimum grade 3.

Sensory and motor block were evaluated after completion of injection of local anaesthetic drug and time required for performing the block, the time of onset of sensory, motor block and surgical adequacy, level of sensory block to pin prick was noted. Post operatively patient was monitored for 24 hours

Onset of blockade both sensory & motor is defined as a minimum of grade 2 in Hollmen's scale. Block was considered complete when sensory and motor scores were atleast grade 3 in Hollmen's scale.

Patients in whom the block was insufficient, were supplemented with either Inj. Fentanyl (2 µ/kg) or local infiltration at the surgical site. Patients in whom the block was failed, were converted to general anaesthesia using Inj. Glycopyrrolate (5µ/kg), Inj. Propofol (2mg/kg), Inj. Atracurium (0.5mg/kg loading dose followed by 0.1mg/kg every 30 minutes) and reversed with Inj. Neostigmine (50µ/kg) and Inj. Glycopyrrolate (5µ/kg) at the end of surgery.

Monitoring

Baseline vital signs Pulse rate/ BP/ SpO_2 were recorded and monitored. Adverse events comprised more than 20% fall in blood pressure in the baseline value considered hypotension, <60 pulse rate per

minute considered as bradycardia, Spo_2 of < 90% considered hypoxemia. If hypotension or bradycardia occurs it was treated accordingly.

Time required for performing the block, Onset completion of blockade, duration of blockade, Level of sensory block to pin prick, Successful blockade, Complications of the block was assessed.

STATISTICAL TOOL

The information collected regarding all the selected cases were recorded in a Master Chart. Frequencies, percentages, means, standard deviations, chi square and 'p' values were calculated. Kruskul Wallis chi-square test was used to test the significance of difference between quantitative variables and Yate's chi square test for qualitative variables. A 'p' value less than 0.05 is taken to denote significant relationship.

OBSERVATION AND RESULTS

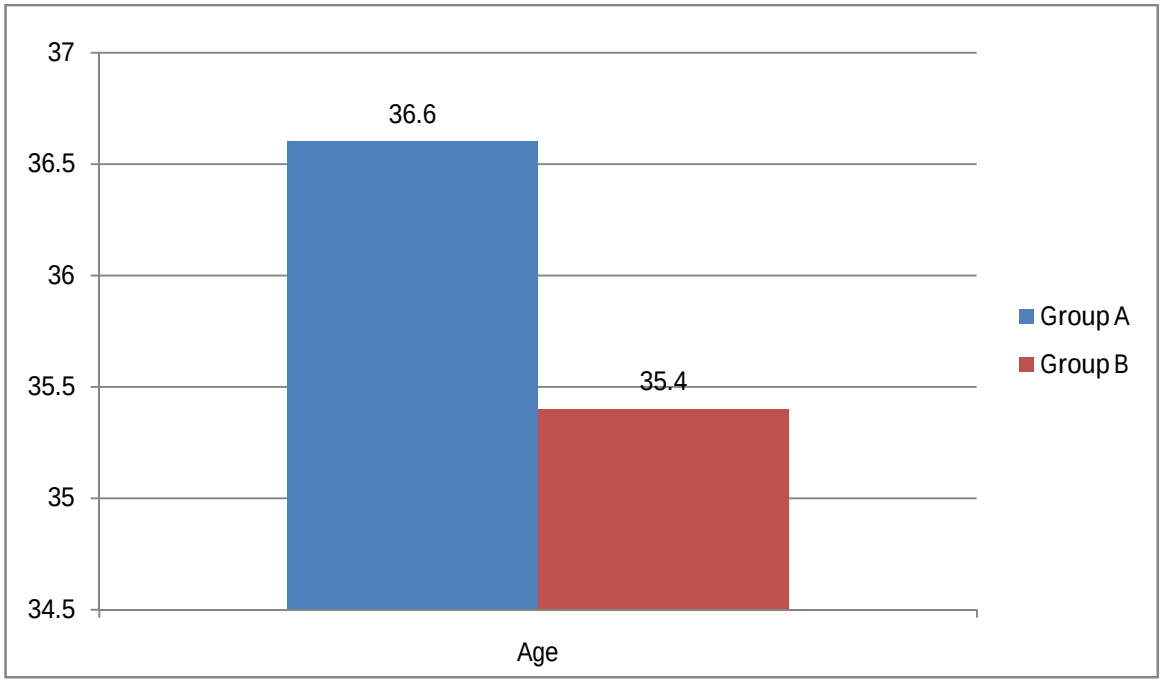
This study comprised of two groups.

Group – A: 30 patients received subclavian perivascular approach .

Group – B: 30 patients received Parascalene approach.

DEMOGRAPHIC PROFILE: ANALYSIS OF AGE AMONG THE GROUPS

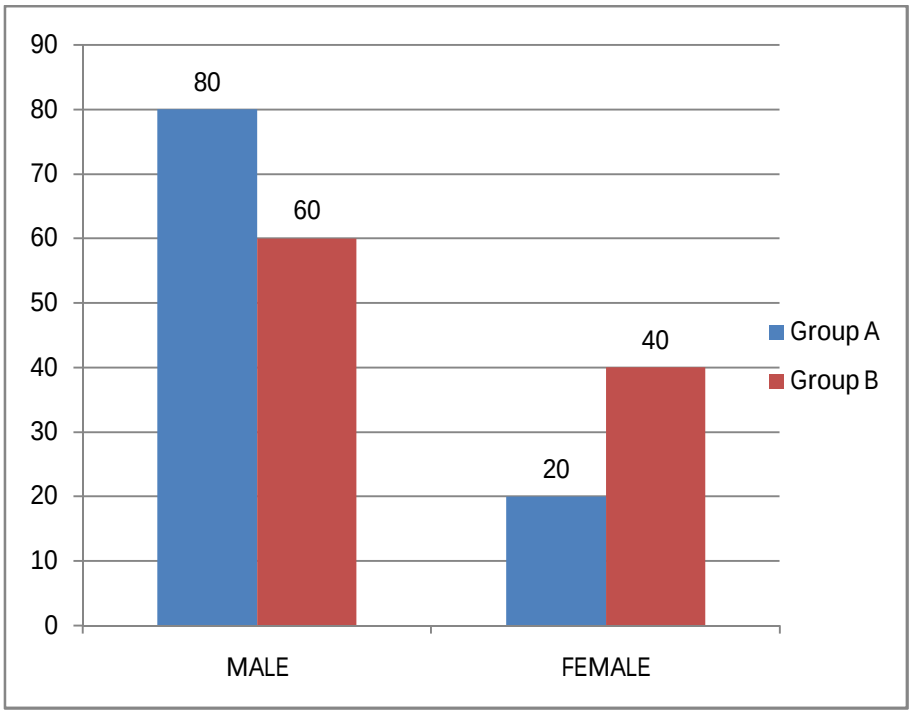
	Group	N	Mean	Standard Deviation	P-value
Age(years)	Group A	30	36.6 years	11.6 years	0.5385 Not significant
	Group B	30	35.4 years	10.8 years	



The mean age in group A was 36.6 years ± 11.6 years standard deviation and in the group B it was 35.4 years ± 10.8 years standard deviation. P value = 0.5385: Not significant.

ANALYSIS OF SEX DISTRIBUTION BETWEEN THE GROUPS

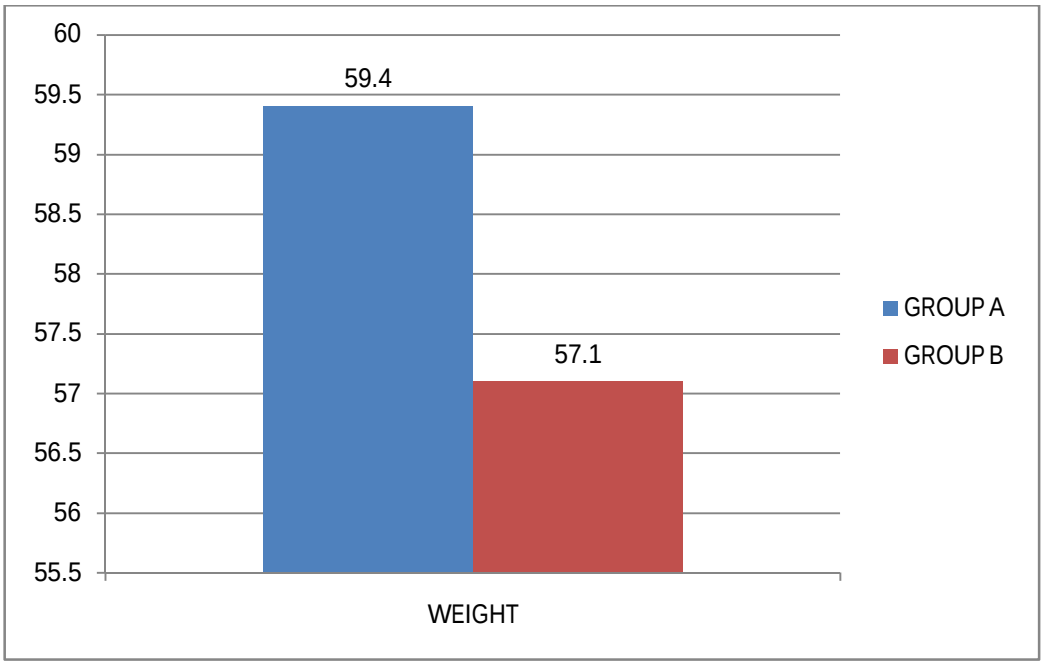
Sex	Group A		Group B	
	No	%	No	%
Male	24	80	18	60
Female	6	20	12	40
Total	30	100	30	100
'p'	0.159 Not significant			



Sex distribution in Group A was 24 males and 6 females and in the Group B were18 males and 12 females. P value is 0.159 - Not significant.

ANALYSIS OF WEIGHT AMONG THE GROUPS

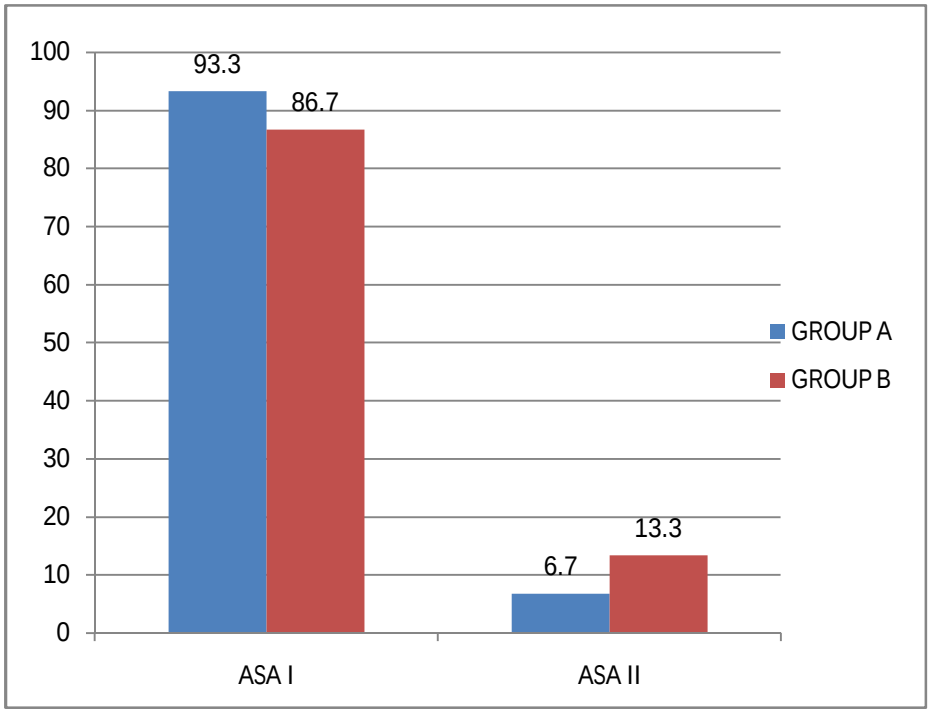
	Group	N	Mean	Standard Deviation	P-value
Wt in Kg	Group A	30	59.4	6.3	0.1693 Not significant
	Group B	30	57.1	7.0	



The mean weight in Group A was 59.4 kgs ± 6.3 standard deviation and in the Group B it was 57.1 kgs ± 7.0 standard deviation. P value = 0.1693 Not significant.

ANALYSIS OF ASA STATUS AMONG GROUPS

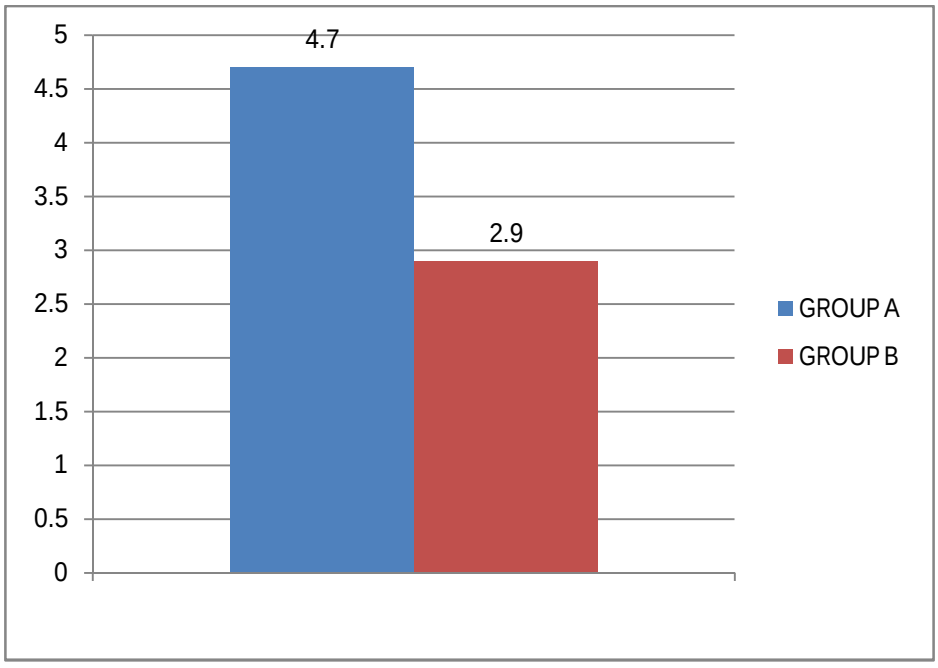
ASA status	GROUP A		GROUP B	
	No	%	No	%
1	28	93.3	26	86.7
2	2	6.7	4	13.3
'p'	0.3354 Not significant			



ASA status of both the groups did not exhibit any significant difference (p = 0.3354).

ANALYSIS OF TIME TO PERFORM BLOCK AMONG GROUPS

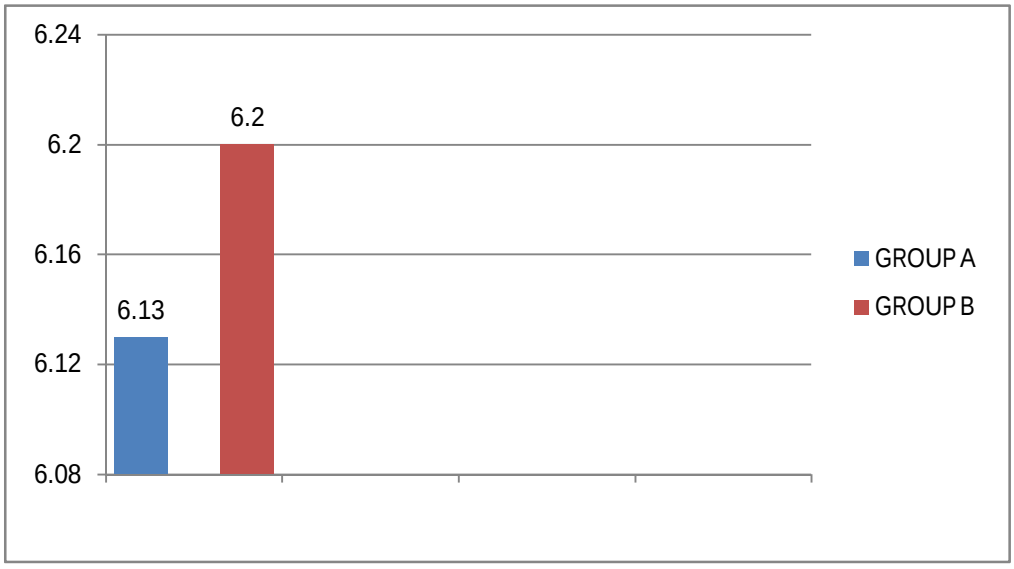
Parameter	**Time to perform block (in minutes)**	
	GROUP A	**GROUP B**
Mean	4.7	2.9
SD	0.92	0.84
'p'	0.0001 Significant	



Time to perform block in group – A with the mean of 4.7 and standard deviation of 0.92. Time to perform block in group – B with mean of 2.9 and standard deviation of 0.84. p value is 0.0001- Significant.

ANALYSIS OF TIME FOR ONSET OF SENSORY BLOCK AMONG GROUPS

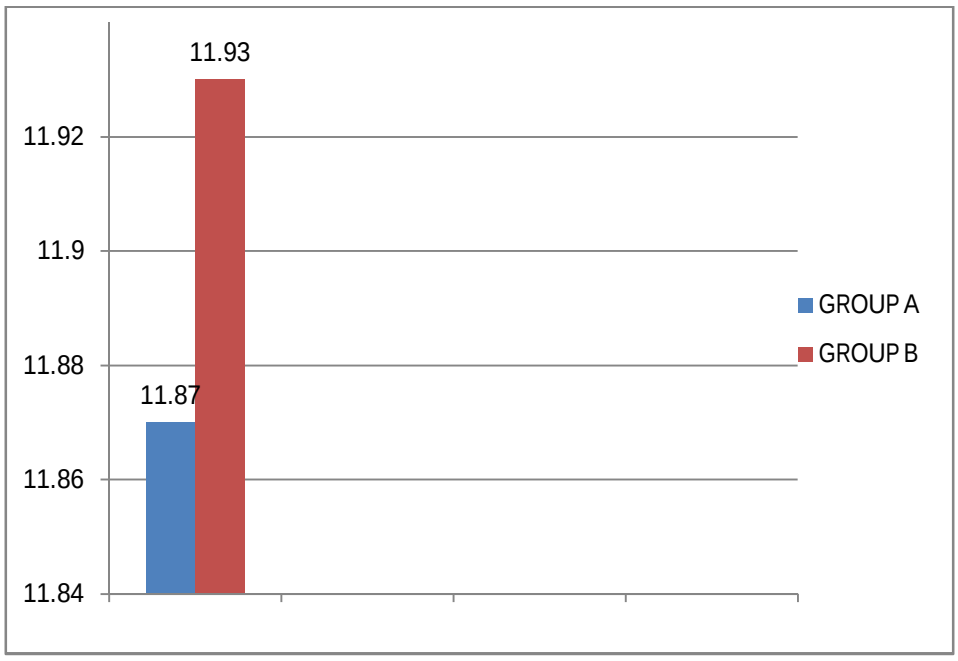
Parameter	**Time for onset of sensory block (in minutes)**	
	GROUP A	**GROUP B**
Mean	6.13	6.2
SD	1.28	1.42
'p'	0.8915 Not significant	



Time for onset of sensory block Group – A with the mean value of 6.13 and standard deviation of 1.28. Time for onset of sensory block in group – B with mean value of 6.2 and standard deviation of 1.42. p value is 0.8915 – Not significant.

ANALYSIS OF TIME FOR ONSET OF MOTOR BLOCK AMONG GROUPS

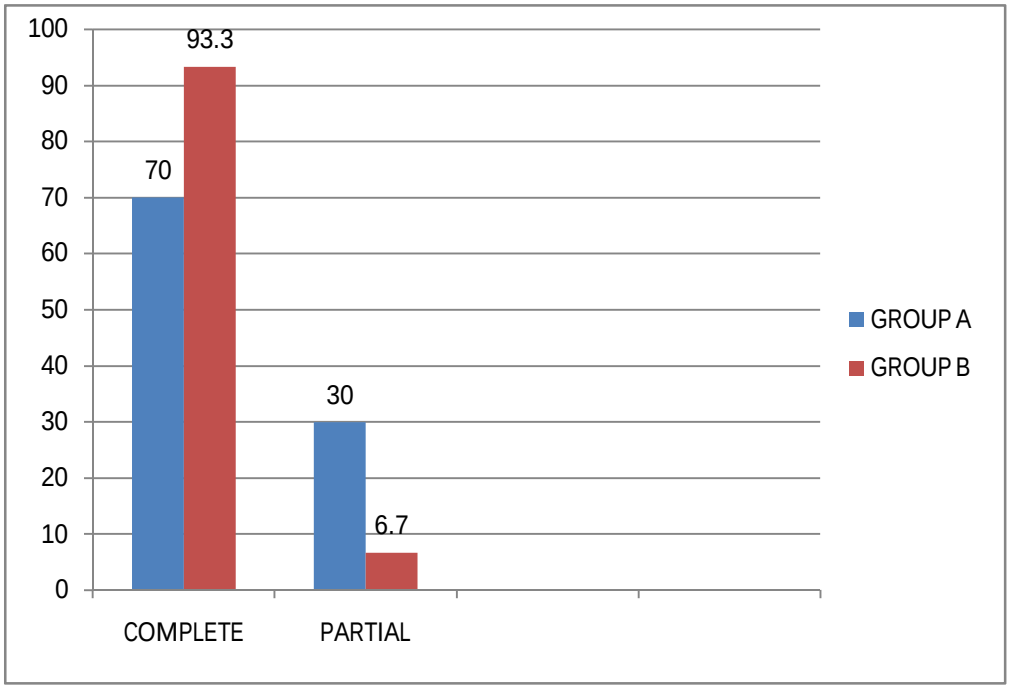
Parameter	Time for onset of motor block (in minutes)	
	GROUP A	**GROUP B**
Mean	11.87	11.93
SD	1.68	1.78
'p'	0.8801 Not significant	



Time for onset of motor block Group – A with the mean value of 11.87 and standard deviation of 1.68. Time for onset of motor block in group – B with mean value of 11.93 and standard deviation of 1.78. p value is 0.8801- Not significant.

ANALYSIS OF SUCCESS OF PROCEDURE AMONG GROUPS

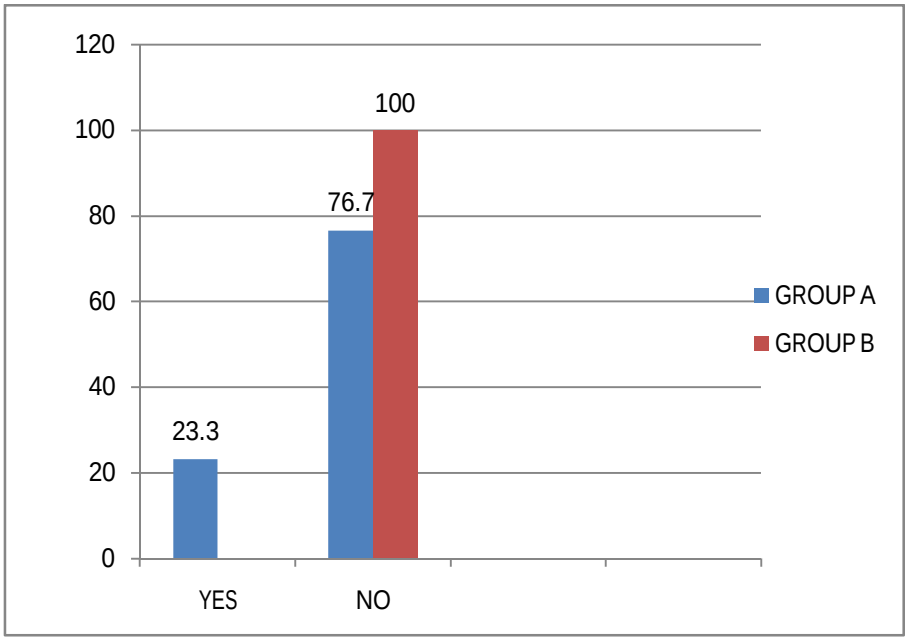
Success of procedure	GROUP A		GROUP B	
	No	%	No	%
Complete	21	70	28	93.3
Partial	9	30	2	6.7
'p'	0.0453 Significant			



The procedure was more successful in the group B nearly about 93.3% compared with 70% of the group A. P value is 0.0453 – Significant.

ANALYSIS OF COMPLICATIONS AMONG GROUPS

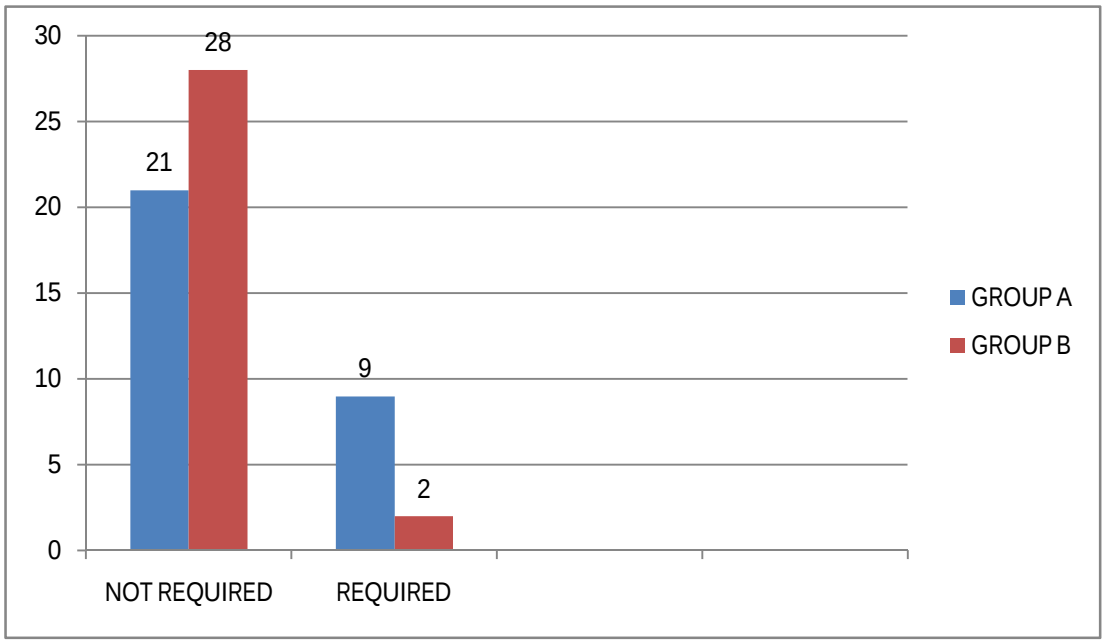
Complications	GROUP A		GROUP B	
	No	%	No	%
Complete	7	23.3	-	-
Partial	23	76.7	30	100
'p'	0.0053 Significant			



No complications in the group – A and 7 cases of complications like vessel injury in Group B. P value is 0.0053 - Significant.

ANALYSIS OF RESCUE ANALGESIA REQUIREMENT AMONG GROUPS

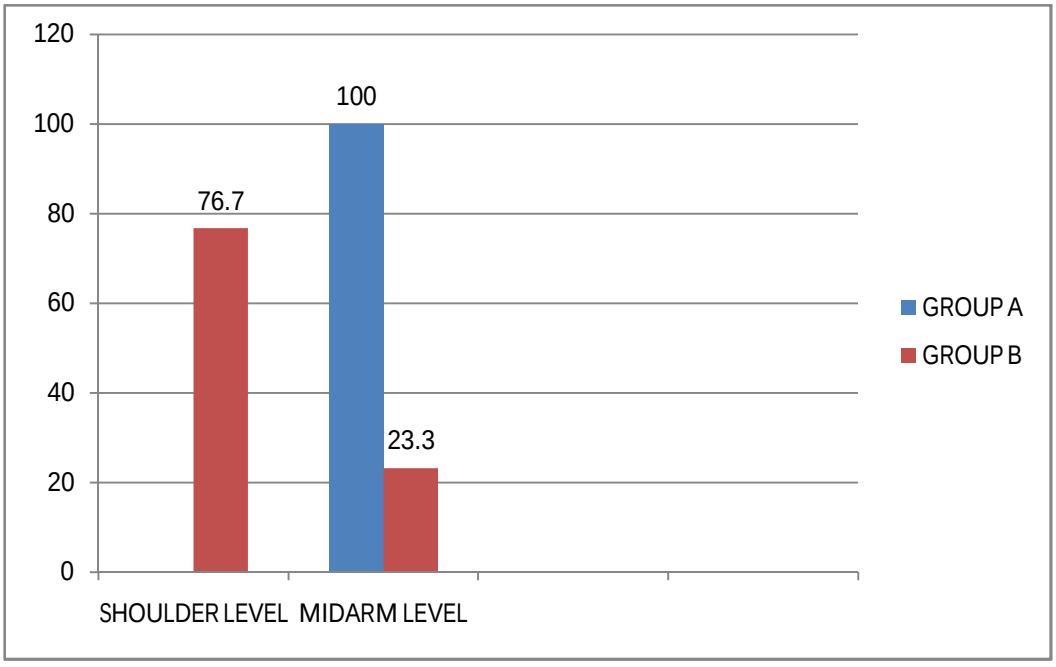
Rescue analgesia Requirement	GROUP A		GROUP B	
	No	%	No	%
Not Required	21	70	28	93.3
Required	9	30	2	6.7
P	0.0053 Significant			



The Rescue analgesia requirement in the group B (6.7%) is less than compared with 30% of the group A. P value is < 0.05 – Significant.

ANALYSIS OF LEVEL OF SENSORY BLOCK TO PIN PRICK AMONG GROUPS

Level of sensory block to pin prick	GROUP A		GROUP B	
	No	%	No	%
Shoulder level	-	-	23	76.7
Mid arm level	30	100	7	23.3



The Level of sensory block to pin prick upto the level shoulder level in the group B (76.7%) is more than compared with group A. P value is < 0.05 – Significant.

COMPLICATIONS

There were seven incidences of arterial puncture in the group A without formation of hematoma. Needle was again repositioned and drug administered. Block was successful. There was no other incidence of

- Pneumothorax
- Post operative neurological deficit
- Phrenic nerve palsy
- Horner’s syndrome
- Local anaesthetic toxicity

DISCUSSION

Brachial plexus blockade offered an excellent alternative technique to general anaesthesia for upper limb surgical procedures. Various approaches for successful performance of the blocks and for reducing the complication have already been described but the two approaches adopted in this study were found to be easy to perform with a successful outcome.

Supraclavicular technique was chosen for this study because it provides a rapid onset, dense and predictable anaesthesia with a high success rate. In this study two approaches of supraclavicular block are compared.

In the present study an attempt has been made to evaluate the subclavian perivascular approach on the clinical success rate of block, time required for performing the block, onset of sensory, motor block and surgical adequacy, level of sensory block to pin prick, complications, rescue analgesic requirement and it was compared with parascalene approach group

The analysis was based on demographic parameters like age, sex distribution and weight, time to perform the block, onset of sensory and motor blockade, success rate, level of sensory block to pin prick, complications and rescue analgesic requirement perioperatively.

Here in this study 60 patients were evaluated. They were randomly allocated to two groups i.e. group A (Subclavian perivascular approach group) and group B (Parascalene approach group).

By statistical analysis of two groups the age distribution in both groups was statistically not significant with a 'p' value of 0.5385 ($p > 0.05$).

When comparing the weight of the patients in two groups it was statistically not significant with a p value of 0.1693 ($p > 0.05$). Both the groups were comparable in relation to age and weight.

Time to Perform Block

Time to perform block in group – B (Parascalene approach) with mean of 2.9 and standard deviation of 0.84, Group – A (subclavian perivascular approach) with the mean of 4.7 and standard deviation of 0.92. The difference was statistically significant ($p = 0.0001$**).**

Onset to Sensory Blockade

Time for onset of sensory block in in group – B (Parascalene approach) with mean value of 6.2 and standard deviation of 1.42. Group – A (Subclavian perivascular approach) with the mean value of 6.13 and standard deviation of 1.28. There was no significant difference ($p = 0.8915$).

Onset of Motor Blockade

Time for onset of motor block in in group – B (Parascalene approach) with mean value of 11.93 and standard deviation of 1.78.

Group – A (Subclavian perivascular approach) with the mean value of 11.87 and standard deviation of 1.68. There was no significant difference ($p = 0.8801$).

Successful Block

The procedure was more successful in 93.3% of the group B (Parascalene approach group) compared with 70% of the group A (subclvian perivascular approach group) . The difference was statistically significant ($p = 0.0453$).

Complications

No complications in the group B (Parascalene approach group) compared to 7 cases of vessel injury in group A (subclavian perivascular approach). This difference was statistically significant ($p = 0.0053$).

Rescue analgesia requirement

The rescue analgesia requirement in the group B (Parascalene approach group) (6.7%) is less than compared with 30% of the group A (Subclavian perivascular approach group) . This difference was statistically significant ($P < 0.05$).

Level of sensory block to pin prick

The level of sensory block to pin prick upto the level shoulder level in the group B (Parascalene approach group) (76.7%) is more than compared with group A (Subclavian perivascular group). This difference was statistically significant ($P < 0.05$).

SUMMARY

1. Time to perform block was shorter in supraclavicular block by parascalene approach when compared to subclavian perivascular approach.
2. Onset of both motor and sensory blockade were same in both groups.
3. Success rate was 90% in group B (parascalene approach) when compared to group A (subclavian perivascular approach)
4. Level of sensory block to pin prick was higher (shoulder level) in parascalene approach compared with subclavian perivascular approach.
5. Complication like pneumothorax was nil in both approaches, vessel injury nil in parascalene approach when compared to 7 incidences in the subclavian perivascular approach.
6. Rescue analgesic requirement is less in group B, parascalene approach, when compared to group A, subclavian perivascular approach
7. These inferences provide evidence of the supraclavicular block by Parascalene approach is a very effective brachial plexus block with distinct advantages.

CONCLUSION

Supraclavicular block of brachial plexus by the parascalene approach provides an adequate sensory blockade and motor blockade, with less time to perform block, level of sensory block is higher (upto shoulder), high success rate and less complications when compared to subclavian perivascular approach.

BIBLIOGRAPHY

1. O' Alessio JG, Rosenblum M, Shea KP, et al: A retrospective comparison of interscalene block and general anaesthesia for ambulatory surgery – shoulder arthroscopy. Reg Anaesthesia 1995, 20: 62 – 68.
2. Joseph M. Neal, James R. Hebl, J. C. Gerancher, Quinn H. Hogan. Brachial plexus Anaesthesia: Essentials of our current understanding. Regional anaesthesia and pain medicine, vol 27, 2002, 4: 402-428.
3. J.C. Gerancher. Upper extremity nerve blocks. Anaesthesiology clinics of North America. June 2000, vol. 18, no.2.
4. Chilvers CR, Kinahan A, Vaghadia H et al: Pharmacoeconomics of intravenous regional anaesthesia versus general anaesthesia for outpatient hand surgery. Can J Anaes 1997, 44: 1152-1156.
5. Thompson AM, Newman RJ, Semple JC. Brachial plexus anaesthesia for upper limb surgery: a review of eight years experience. J Hand Surg [Br] 1988 May; 13(2): 195-8.
6. Urban MK, Urquhart B. Evaluation of brachial plexus anaesthesia for upper extremity surgery. Reg Anesth 1994; 19:175-82.
7. Cross GD, Porter JM. Blood flow in the upper limb during brachial plexus anaesthesia. Anaesthesia 1988, 43: 323-326.

8. Brand L, Papper EM. A comparison of supraclavicular and axillary techniques for brachial plexus blocks. Anaesthesiology 1961, 22: 226-229.
9. Moore DC, Bridenbaugh LD, Eather KF; Block of the upper extremity: supraclavicular approach vs. Axillary approach. Arch surg 1965, 90: 68-72.
10. Fleck JW, Moorthy SS, Daniel J, Dierdof SF. Brachial plexus block – A comparison of supraclavicular lateral perivascular and axillary approaches. Regional Anaesthesia 1994, 19(1): 14-7.
11. Cornish PB, Greenfield LJ. Brachial plexus anatomy. Regional anaesthesia 1997, 22: 106-107.
12. Williams PL, Warwick R, Dyson M, Bannister LH. The brachial plexus. In: Gray's anatomy. 37th ed. London: Churchill Livingstone, 1989: 1131-37 and 1150-1153.
13. Rorie D.K. the brachial plexus sheath. Anat. Rec. 1974, 187: 451.
14. Thompson GE, Rorie D.K. Functional anatomy of the brachial plexus sheath. Anaesthesiology 1983, 59: 117-122.
15. Partridge B.L., Kartz J, Berirshke K. Functional anatomy of the brachial plexus sheaths – implications for anaesthesia. Anaesthesiology 1987, 6:743-747.
16. Winnie AP, Collins VJ. The subclavian perivascular approach of brachial plexus anesthesia. Anesthesiology 1964; 25: 353-363.

17. Dalens B, Vanneuville G, Tanguy A. A new parascalene approach to the brachial plexus in children: A comparison with supraclavicular approach. Anesth Analg 1987; 66: 1264-1271.
18. Vongvises P, Beokhaimook N. Computed tomographic study of parascalene block. Anesth Analg 1997; 84: 379
19. Vongvises, P and Panijayanond T : A parascalene technique of brachial plexus anaesthesia. Anesth Analg 58: 267-273, 1979.
20. Carlo D. Franco and Zairo E.G. Vieira : Regional Anaesthesia and Pain Medicine,Vol25,No1(January–February),2000: pp 41–46
21. McNeely JK, Hoffman GM, Eckert JE. Post operative pain relief in children from the parascalene injection technique. Reg Anesth 1991; 16: 20.
22. Leak WD, Wichell SW. Regional anaesthesia in pediatric patients: review of clinical experience. Reg Anesth 1982; 7: 64.
23. Call Reig L, de Vicente Sole J, Estany Raluy E. Parascalene block for shoulder arthroscopic surgery. Rev Esp Anestesiol Reanim 2004; 51: 247-52.
24. Vijayan R. The Practice of Regional Anaesthesia in Developing Countries. In P. Prithvi Raj (Ed) Textbook of Regional Anaesthesia, Churchill Livingstone, Philadelphia 2002: 86

25. Pande R. Pande M, Bhadani U, Pandey CK, Bhattacharya A. Supraclavicular brachial plexus block as a sole anaesthetic technique in children: an analysis of 200 cases. Anaesthesia 2000; 55: 798-802.
26. Maruyama M, Hashizume C, Kitagawa E. Parascalene brachial plexus block. Masui 1989; 38: 1647-52.
27. Monzo Abad E, Baeza Gil C, Galindo Sanchez F,Hajro M, Gonzalez Menendez A, Kim-Darov V. Parascalene Brachial plexus block: experience of 10 years. Rev Esp Anestesiol Reanim 2004; 51: 61-9.
28. Lanz E, Theiss D, Jankovic D. The extent of blockade following various techniques of brachial plexus block. Anesth Analg 1983; 62: 55-8.
29. Quang Hieu De Tran, Antonio Clemente, Julian Doan, Roderick J. Finlayson : Brachial plexus blocks: a review of approaches and techniques. Canadian journal of anaesthesia August 2007 / 54: 8
30. Hickey R, Garland TA, Rammamurthy S. Subclavian perivascular block: Influence of location of paraesthesia. Anesth Analg 1989; 68: 767-71
31. Kim KH, Yoon KJ, Kang JK, Kim JL, Lim CH, Lee MW, et al. The parascalene technique of brachial plexus block for the operation of the upper extremity and shoulder. Korean J Anaesthesiology 1997; 32: 782-6.

32. Barthram C N. Nerve stimulators for nerve location—Are they all the same? A study of stimulator performance. Anaesthesia 1997;52:761-764

33. Raj P, Rosenblatt R, Montgomery SJ. Use of the nerve Stimulator for peripheral blocks. Reg Anesth 1980;5:14-21.

34. Winnie AP, Tay C-H, Patel KP, Ramamurthy S, Durrani Z. Pharmacokinetics of local anaesthetics during brachial plexus blocks. Anesth Analg 1977; 56:852-61.

35. Subclavian Perivascular Brachial Plexus Blocks : Success With a Nerve Stimulator : Carlo D.Franco and Zairo E.G.Vieira. Regional Anesthesia and Pain Medicine ,Vol25 ,No1 (January–February),2000:pp41–46

36. Subclavian Perivascular Technique of Brachial Plexus Anaesthesia : Chethanananda T N,Shashank M R, Swathi S, Ramesh M C. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 2279-0861.Volume 13, Issue 3 Ver. V. (Mar. 2014), PP 13-16

37. Miller's anaesthesia. 8th edition 2731-32

38. Collin's textbook of regional anaesthesia, 3rd edition vol 2

39. Stoelting's pharmacology and physiology in anaesthetic practice

INSTITUTIONAL ETHICAL COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Protocol ID. No.7/05/2015 Meeting held on 07/05/2015
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "Comparison of subclavian perivascular approach with para scalene approach of brachial plexus block for upper limb surgeries using nerve stimulator – For Dissertation Purpose" submitted by Dr.N.Karthikeyan, Post Graduate in MD (Anaesthesia), Govt. Kilpauk Medical College, Chennai.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE * Kilpauk, Chennai-10. * 14 MAY 2015

CHAIRMAN,
Ethical Committee
Govt. Kilpauk Medical College, Chennai

PROFORMA

Name: Age: Sex: IPno:
Ward/ SU Group:

Date of admission: Date of surgery:

ASA Physical Status:

Co- Morbidity: Patient on any drugs:

Preoperative examination:

BP: PR : Room air SpO2:

CVS : RS: CNS:

Diagnosis: Surgery being performed:

Investigations:

OBSERVATIONS:

	Group A	Group B
Successful blockade (Block sufficient for surgery)		
Time required for performing the block		
Onset of motor/sensory blockade		
Level of sensory block to pin prick		
Rescue analgesia		
Complications of the block		

CONSENT FORM

"A COMPARATIVE STUDY OF SUBCLAVIAN PERIVASCULAR APPROACH WITH PARA SCALENE APPROACH OF BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES USING NERVE STIMULATOR ",

Study centre: Department of Anesthesiology, Kilpauk Medical College

Participant name: Age: Sex:

I.P.No:

I confirm that I have understood the purpose of the procedure for the above study. I had the opportunity to ask questions and all questions and doubts have been answered to my satisfaction.

I have been explained about the pitfalls in the procedure and the management of it. I have been explained about the safety, advantages and disadvantages of the technique.

I understand that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason.

I understand that the investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study.

I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study.

Name of patient: Signature/Thumb impression:

Name of witness: Signature:

Address: Contact number:

Name of investigator: Signature:

Date:

Place:

நோயாளி ஒப்புதல் படிவம்

ஆராய்ச்சியின் விவரம் :

ஆராய்ச்சி மையம் : அரசு கீழ்பாக்கம் மருத்துவக் கல்லூரி மருத்துவமனை

நோயாளியின் பெயர் : நோயாளியின் வயது:

பதிவு எண் :

நோயாளி கீழ்கண்டவற்றுள் கட்டங்களை (✓) செய்யவும்

1 மேற்குறிப்பிட்டுள்ள ஆராய்ச்சியின் நோக்கத்தையும் பயனையும் முழுவதுமாக புரிந்து கொண்டேன். மேலும் எனது அனைத்து சந்தேங்களையும் கேட்டு அதற்கான விளக்கங்களையும் தெளிவுபடுத்திக் கொண்டேன். ☐

2 மேலும் இந்த ஆராய்ச்சிக்கு எனது சொந்த விருப்பத்தின் பேரில் பங்கேற்கிநேன் என்றும், மேலும் எந்த நேரத்திலும் எவ்வித முன்றிவிப்பு மின்றி இந்த ஆராய்ச்சியிலிருந்து விலக முழுமையான உரிமை உள்ளதையும் இதற்கு எவ்வித சட்ட பிணைப்பும் இல்லை என்பதையும் அறிவேன். ☐

3 ஆராய்சியாளரோ, ஆராய்ச்சி உதவியாளரோ, ஆராய்ச்சி உபயத்தாரரோ, ஆராய்ச்சி பேராசிரியரோ, ஒழுங்குநெறி செயற்குழு உறுப்பினர்களோ எப்போது வேண்டுமானாலும் எனது அனுமதியின்றி எனது உள்நோயாளி மற்றும் புற நோயாளி பதிவுகளை இந்த ஆராய்ச்சிக்காகவோ அல்லது எதிர்கால பிறஆராய்ச்சிகளுக்காகவோ பயன்படுத்திக் கொள்ளலாம் என்றும் மேலும் இந்த நிபந்தனை நான் இவ்வராய்ச்சிலிருந்து தகும் என்றும் ஒப்புக்கொள்கிறேன். ஆயினும் எனது அடையாளம் சம்பந்தப்பட்ட எந்த பதிவகளும் (சட்டபூர்வமான தேவைகள் தவிர) வெளியிடப்படமாட்டது என்ற உறுதிமொழியின் பெயரில் இந்த ஆராய்ச்சிலிருந்து கிடைக்கப்பெறும் முடிவுகளை வெளியிட மறுப்பு தெறிவிக்கமாட்டேன் என்று உறுதியளிக்கிறேன். ☐

4. இந்த ஆராய்ச்சிஆச்ன வாயின் அருகில் வரும் சீழ் கட்டியை குறித்தது. அந்த நோயின் தன்மையையும், பின் விளைவுகளையும் பற்றியும், அறுவை சிகிச்சையின் போது கீறி எடுக்கப்படும் சீழை பரிசோதனைக்கு அனுப்பி கிருமியின் தன்மையையும் அதற்கு உகந்த மருந்தை பற்றியும் அறிய நடத்தும் ஆராய்ச்சி என்பதை மருத்துவர் மூலம் அறிந்து கொண்டேன். ☐
5. இந்த ஆராய்ச்சிக்கு நான் முழுமனதுடன் சம்மதிக்கின்றேன் என்றும் மேலும் ஆராய்ச்சி குழுவினர் எனக்கு அளிக்கும் அறிவுரைகளை தவறாது பின்பற்றுவேன் என்றும் உறுதியளிக்கிறேன். ☐
6. இந்த ஆராய்ச்சிக்குத் தேவைப்படும் அனைத்து மருத்துவப்பரிசோதனைகளுக்கும் ஒத்துழைப்பு தருவேன் என்று உறுதியளிக்கிறேன். ☐
7. இந்த ஆராய்ச்சிக்கு யாருடைய எற்புறுத்தலுமின்றி எனது சொந்த விருப்பத்தின் பேரிலும் சுயஅறிவுடனும் முழுமனதுடனும் சம்மதிக்கின்றேன் என்று இதன் மூலம் ஒப்புக்கொள்கிறேன். ☐

நோயாளியின் கையொப்பம் / பெருவிரல் கைரேகை
இடம்: தேதி:

ஆராய்ச்சியாளரின் கையொப்பம்:
இடம்: தேதி:

MASTER CHART

S.no	GROUP	Name	AGE	SEX	IP NO	Wt in Kg	ASA Status	Diagnosis & Procedure	Success	Time to perform block in mins	onset of Sensory block in Mins.	onset of Motor block in Mins	Level of sensory block to pin prick	Complication	Resuce Analgesia
1	A	Vijayapratap	50	M	15660	66	2	# BB LT forearm - ORIF	yes	6	6	12	mid arm	nil	No
2	A	Nallasivam	46	M	17893	60	1	Olecranon bursitis with implant in situ - Bursitis excision	yes	3	8	13	mid arm	Vessel injury	No
3	A	Purushothaman	28	M	18337	58	1	# SOH LT - ORIF	yes	5	7	10	mid arm	nil	No
4	A	Deepak	50	M	18229	62	1	Left radial head # - radial head excision	Partial	4	9	11	mid arm	nil	yes
5	A	Suresh	47	M	18160	64	1	Closed LT 2nd MC shaft # - ORIF	yes	5	6	10	mid arm	Vessel injury	No
6	A	Palanisamy	25	M	17705	56	1	Infected malunited # BB LT forearm - Implant exit/ Exfix application	Partial	4	5	12	mid arm	nil	yes
7	A	Vijayakumar	22	M	19113	50	1	Malunited # BB RT forearm - Darrach's procedure	yes	6	5	14	mid arm	Vessel injury	No
8	A	Ponmozhi	45	F	13552	62	1	# SOH RT - ORIF	Partial	5	6	11	mid arm	nil	yes
9	A	Mohamed Imayath	40	M	19819	61	1	# BB LT forearm - ORIF	yes	4	5	10	mid arm	nil	No
10	A	Senthamarai	41	F	18372	51	1	LF unstable elbow - LF elbow arthrodesis	yes	6	7	14	mid arm	Vessel injury	No
11	A	Srividhya	23	F	15058	52	1	RT radius # - ORIF	yes	5	5	15	mid arm	nil	No
12	A	Praveen	42	M	20011	59	1	Compound # BB RT forearm - EXFIX application	Partial	4	6	12	mid arm	nil	yes

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13	A	Kamalakannan	45	M	19819	64	1	# BB LT forearm - ORIF	yes	5	5	10	mid arm	Vessel injury	No
14	A	Thulasiraman	24	M	10624	60	1	Cellulitis Rt UL- W D	yes	6	4	12	mid arm	nil	No
15	A	Murugan	44	M	20072	68	1	Carpel tunnel Syndrome - Medial nerve release	Partial	3	7	15	mid arm	nil	yes
16	A	Nandhakumar	49	M	19912	58	2	# BB forearm LT - ORIF	yes	4	8	14	mid arm	nil	No
17	A	Harish	34	M	20121	62	1	# ulna operated - implant removal	yes	5	6	11	mid arm	nil	No
18	A	Parameswari	48	F	7481	58	1	Raw area RT FA - SSG	Partial	6	8	13	mid arm	nil	yes
19	A	Lalli	42	F	20095	62	1	# olecranon operated - implant removal	yes	4	7	10	mid arm	Vessel injury	No
20	A	Sundararajan	21	M	7451	50	1	LT hand flap cover - Flap debulking	yes	3	5	14	mid arm	nil	yes
21	A	Kannan	29	M	20122	64	1	Head of 1st MCB RT # - k wire fixation	Partial	5	6	11	mid arm	nil	No
22	A	Prem	23	M	19993	51	1	Trigger finger LT - Release	yes	5	5	10	mid arm	Vessel injury	No
23	A	Needidevan	40	M	20165	60	2	Crush injury LT F3&4 - WD & k-wire fixation	Partial	5	7	14	mid arm	nil	yes
24	A	Shanthanam	21	M	19965	58	1	# olecranon RT forearm - ORIF	yes	4	6	12	mid arm	nil	No
25	A	Senthil kumar	21	M	8153	60	1	PTC LT index finger - contracture release & SSG	yes	6	8	13	mid arm	nil	No
26	A	Sanjeev	32	M	21036	65	1	FA cut injury RT - Wound debridement	yes	5	7	10	mid arm	nil	No

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27	A	Rakkamal	30	F	16895	51	1	LT ulna styloid # - ORIF	Partial	4	5	10	mid arm	nil	yes
28	A	Chakrapani	50	M	17843	64	2	# BB forearm - ORIF	yes	5	4	12	mid arm	nil	No
29	A	Gandhi	40	M	19658	66	1	# Radial shaft RT - ORIF	yes	4	6	11	mid arm	nil	No
30	A	Yoganathan	46	M	9154	60	1	Raw area RT hand - SSG	yes	5	5	10	mid arm	nil	No
31	B	Radhakrishnan	27	M	11508	64	1	Left distal radius malunion - Darrach's procedure	yes	5	4	9	mid arm	nil	No
32	B	Udhayakumar	50	M	10958	58	2	# BB RT forearm - ORIF	yes	4	6	12	shoulder level	nil	No
33	B	Sanjaykumar	25	M	9490	65	1	radius # - corrective osteotomy	yes	5	5	10	shoulder level	nil	No
34	B	Vijay	45	M	12003	55	1	LT humerus medial condyle # - K wire fixation	yes	4	4	12	shoulder level	nil	No
35	B	Malliga	25	F	11808	55	1	LT forearm Monteggia # - ORIF	yes	3	5	14	mid arm	nil	No
36	B	Kowsai	48	M	11999	64	1	United LT distal ulna - K wire in situ - K wire exit	yes	3	6	11	mid arm	nil	No
37	B	Yasodha	24	F	13543	54	1	# SOH LT - ORIF	yes	3	5	10	shoulder level	nil	No
38	B	Arjunan	32	M	14354	62	1	# BB LT forearm - ORIF	yes	4	7	14	shoulder level	nil	No
39	B	Sathish	35	M	14516	52	1	United # BB LT forearm - Implant exit	yes	3	5	15	shoulder level	nil	No
40	B	Selvi	28	F	13921	60	1	LT Distal ulna # - ORIF	yes	2	6	12	mid arm	nil	No

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41	B	Rajendharan	23	M	15049	58	1	Cubitus varus LT elbow - Corrective osteotomy with plating	yes	3	8	13	shoulder level	nil	No
42	B	Thukanam	36	M	13399	53	1	United # BB LT forearm - Implant exit	yes	3	7	10	shoulder level	nil	No
43	B	Savithiri	42	F	15469	63	1	# SOH LT - ORIF	Partial	3	9	11	shoulder level	nil	yes
44	B	Alagar	38	M	15895	50	1	RT Neck of humerus # - ORIF	yes	2	6	10	shoulder level	nil	No
45	B	Paneer pushpam	50	F	13734	62	2	LT proximal humerus # - ORIF	yes	3	5	12	shoulder level	nil	No
46	B	Jayamurugan	48	M	17034	56	1	# BB LT forearm - ORIF	yes	3	7	15	midarm	nil	No
47	B	Ranjith	30	M	18636	60	1	# SOH RT - ORIF	yes	3	8	14	shoulder level	nil	No
48	B	Murugan	46	M	9856	62	1	Cellulitis LT hand- Wound debridement	yes	2	6	11	shoulder level	nil	No
49	B	Jayakumar	41	M	6958	58	1	Raw area left BE stump - SSG	yes	3	8	13	shoulder level	nil	No
50	B	Shanthi	25	F	19565	50	1	# supracondylar humerus LT - ORIF	yes	3	7	10	shoulder level	nil	No
51	B	Manickam	35	M	21023	60	1	Elbow dislocation LT - ORIF	yes	2	7	11	mid arm	nil	No
52	B	Usha	33	F	18843	50	1	# BB FA LT - ORIF	yes	2	5	10	shoulder level	nil	No
53	B	Ramu	35	M	19239	54	1	# supracondylar humerus LT - ORIF	yes	3	4	11	shoulder level	nil	No
54	B	Karthicka	22	F	22166	56	1	LT thumb- WD, primary closure	yes	2	6	10	midarm	nil	No

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55	B	Vanaja	36	F	21912	55	1	*Non union Montegia # - ORIF*	Partial	3	5	14	shoulder level	nil	yes
56	B	Lakshmi	31	F	7156	53	1	Flexor tendon injury LT hand - Repair	yes	2	8	11	shoulder level	nil	No
57	B	Kavitha	50	F	22013	59	1	*Non union # SOH - ORIF*	yes	2	7	12	shoulder level	nil	No
58	B	Selvarani	36	F	18416	52	1	RT Distal radius # - ORIF	yes	2	9	15	midarm	nil	No
59	B	Murugesan	42	M	21966	62	1	# BB FA LT - ORIF	yes	2	6	14	shoulder level	nil	No
60	B	Pandi	24	M	22096	51	1	# LT Ulna - ORIF	yes	3	5	12	shoulder level	nil	No