"COMPARISON BETWEEN ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BRACHIAL PLEXUS BLOCK TO ASSESS THE QUALITY OF SURGICAL ANAESTHESIA AND INTRAOPERATIVE TOURNIQUET PAIN: PROSPECTIVE RANDOMISED OBSERVER BLINDED STUDY"

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"COMPARISON BETWEEN ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BRACHIAL PLEXUS BLOCK TO ASSESS THE QUALITY OF SURGICAL ANAESTHESIA AND INTRAOPERATIVE TOURNIQUET PAIN: PROSPECTIVE RANDOMISED OBSERVER BLINDED STUDY"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

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ABSTRACT

Title-"Comparison between Ultrasound Guided Supraclavicular and Infraclavicular Brachial Plexus Block to assess the quality of Surgical anaesthesia and Intraoperative Tourniquet pain- Prospective Randomized Observer blinded Study"

Background&Aims-

Brachial plexus block is a reliable technique of regional anaesthesia for procedures of upper limb. Both Supraclavicular block and Infraclavicular brachial plexus block techniques are used for brachial plexus blockade. Present study aims to compare supraclavicular block with Infraclavicular brachial plexus block using USG in turns of quality and tourniquet pain.

Materials&Methods-

76 subjects scheduled for elective procedures of upper limb were categorized into two groups with computer based randomization into Supraclavicular group-Group S and Infraclavicular group-Group I. USG was used to perform all the blocks. Both the groups were compared in terms of time taken to perform block, time taken for sensory & motor block onset, time taken for complete blockade, intraoperative tourniquet pain and complications intraoperatively and postoperatively.

Results-

The time taken to perform block was more in "Group I" when compared to "Group S". Block onset time and total blockade time of sensory and motor components was less in "Group I" than "Group S". Duration of blockade was more in "Group I" than Group S". Incidence of tourniquet pain was less in "Group I". No intraoperative complications were observed in both the groups.

Conclusion-

Onset time for Infraclavicular block was shorter with more duration of blockade. Incidence of tourniquet pain was also less with similar rate of success. Therefore Infraclavicular brachial plexus block can also be a better alternative to supraclavicular block in upper limb procedures.

Keywords-

Supraclavicular block, Infraclavicular block, Ultrasound, Tourniquet

LIST OF ABBREVIATIONS

ASA- American Society of Anaesthesiologists

USG- Ultrasound Guidance

GA- General Anaesthesia

BP-Brachial plexus

BPB- Brachial plexus block

ICB-Infraclavicular block

SCB-Supraclavicular block

IP-In-plane

OOP-Out of Plane

LA-Local Anaesthetic

LAST-Local Anaesthetic systemic toxicity

NRS- Numerical rating score

mins- Minutes

Min-Minimum

Max-Maximum

kg-Kilogram

ml- milliliters

NBM-Nil by mouth

NIBP- Non invasive blood pressure

PR-Pulse Rate

RR-Respiratory rate

SpO2-Saturation percentage of oxygen

Iv-Intravenous

HS-Highly significant

VS-Very significant

S- Significant

NS-Not Significant

mg-Milligram

MHz-Megahertz

RS-Respiratory system

CVS-Cardiovascular system

CNS-Central nervous system

GIT-Gastrointestinal Tract.

S.D.-Standard deviation

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INTRODUCTION

Regional anaesthesia is thought to be better as they prevent unwanted exposure to general anesthesia and airway instrumentation. They also have rapid recovery and improved postoperative analgesia.[1]

Brachial plexus block is a commonly used regional anaesthesia technique for upper limb surgeries. It is suitable to be used as alternative technique to GA or also it can be used along with GA to achieve ideal operating conditions by providing muscular relaxation, maintaining hemodynamic stability intraoperatively and providing postoperative analgesia.[1]

Large part of sensory and motor innervation to upper limb is provided by brachial plexus therefore blocking it is a very effective method of providing anaesthesia from shoulder to fingertips.[2]

There are different approaches to brachial plexus block. The most commonly used technique is supraclavicular brachial plexus block. It provides reliable anaesthesia to entire upper limb and can be used for arm, forearm, elbow and hand surgeries. It is more easier approach as it is more superficial but prevalence of adverse events such as pneumothorax, injury to phrenic nerve, injury to vascular structures, Horner’s syndrome are more frequent with supraclavicular brachial plexus block.[3]

An alternative technique is needed with same success rate to overcome such complications. Infraclavicular brachial plexus can be used as an alternative. USG has improved safety, efficacy and decreased the rate of failure of this approach.[4] The incidence of complications is lower in Infraclavicular block and it is simple and safe block. The major drawback is that they lie deeper so this block is difficult to perform for less experienced Anesthesiologists and in obese patients.[5]

In procedures on the upper limb, tourniquets are utilized to give the physician a clean operating room. When using a tourniquet on the upper limb, pain may be felt. Tolerance relies on the patient's pain threshold, the length of time used, the pressure and diameter of the cuff, and the type of block used. Patients who have tourniquets inflated feel a vague, dull ache in the limb, which is accompanied by a rise in blood pressure and pulse rate. [6] Mostly Musculocutaneous nerve, Medial cutaneous nerve, Intercostobrachial nerve are responsible for the sensation of tourniquet discomfort.

Till now studies compared the incidence of Tourniquet pain in Infraclavicular block is less compared to the Axillary brachial plexus block. In our literature we did not find the study comparing incidence of tourniquet pain between Supraclavicular brachial block and Infraclavicular brachial block.

In present study we assessed quality of surgical anesthesia between USG guided Supraclavicular brachial block and Infraclavicular brachial block. Along with the surgical anaesthesia we also assessed the incidence of intraoperative Tourniquet pain between Supraclavicular and Infraclavicular block.

OBJECTIVES

PRIMARY OBJECTIVE:

Comparison of onset & complete blockade of sensory and motor components of brachial plexus and intraoperative Tourniquet pain in USG guided Supraclavicular and Infraclavicular Brachial plexus.

SECONDARY OBJECTIVE:

Comparison of Duration of Block, Block performance time and Intraoperative and postoperative complications in Ultrasound Guided Supraclavicular and Infraclavicular block.

REVIEW OF LITERATURE

For upper extremity surgery, brachial plexus block has been a regular practise.[8] The prevalence of problems like pneumothorax and unintentional vascular injury has led to an increase in the use of ultrasound guided BPBs as an anaesthetic approach for upper limb surgery.

In a double blind randomized control study conducted by Abhiyana RJ et al[5]in 2017 compared "Supraclavicular and Infraclavicular approaches to brachial plexus block for upper limb surgeries using both ultrasound and nervestimulator" among 60 subjects . The time taken for performing block in infraclavicular technique was less compared to that of supraclavicular approach however there was no difference in the rate of success. Compared to supraclavicular block there was sooner onset in terms of sensory blockade in infraclavicular block whereas onset of motor blockade in both the approaches was same. In supraclavicular approach the complications occurred were pneumothorax,Horner's syndrome and diaphragmatic paresis. This study concluded that the sensory block onset, time take to perform block and complications rate were significantly less when block was performed by infraclavicular approach.

In 2017 a systemic review of RCTs was conducted by Park et al[7] where they compared supraclavicular and infraclavicular block after assessing ten RCT's involving 676 patients. They have observed that there was no difference in incidence of successful block, time taken for performing block,the onset and total duration of block. There was a significantly higher rate of partial blockade of radial nerve at 30 mins with Infraclavicular block than the Supraclavicular block, but in sub group analysis it was found that double or triple injection technique in Infraclavicular brachial plexus block had no incidence of incomplete radial blockade. They also observed that there was less ulnar nerve sparing in Infraclavicular brachial plexus approach when multiple injection technique was used when compared to supraclavicular brachial plexus block. They further analyzed that procedure related paresthesia i.e. Horner's syndrome, diaphragmatic paresis were greater in Supraclavicular block when compared to Infraclavicular block.

A prospective double blinded study done by Chun Woo Yang et al[8] in 2010 compared "the efficacy of supraclavicular BPB and Infraclavicular BPB using neurostimulation" among 100 patients and observed that there was no significant difference in the time taken to perform block, sensory &motor block onset, grade of blockade or block's success and duration of blockade. Horner's syndrome was more frequent in supraclavicular block compared to Infraclavicular block. There was incidence of pneumothorax in supraclavicular approach. They inferred that effects were alike in both the blocks. Infraclavicular block could be favoured over supraclavicular block due to fewer incidences of complications.

In 2013, a systemic review conducted by Ki Jinn Chin et al[9], they compared Infraclavicular brachial plexus block with other brachial plexus approaches. The main objective was to assess the efficacy and safety of Infraclavicular approach compared to other approaches. They included 15 studies with 1020 participants and concluded that infraclavicular technique had shown more safety and efficacy than other approaches in terms of surgical anaesthesia, and there was lower incidence of pain due to tourniquet. When compared to the axillary block, it was a substantially more reliable blockade for musculocutaneous nerve.

In 2021 in a systemic review conducted by Alan.D.Kaye et al[10], they reviewed various studies comparing supraclavicular and infraclavicular brachial block with ultrasound and peripheral nerve stimulator. They also reviewed articles comparing Interscalene block, supraclavicular block and infraclavicular block. They have found out that supraclavicular and infraclavicular block are better when compared with interscelene block but infraclavicular block was superior to supraclavicular block due to its faster onset, denser motor blockade, lesser incidence of complications & lower need for supplemental analgesia.

Amany El-Sawy et al.[11] conducted a study in 2014 among 60 patients comparing “ultrasound-guided supraclavicular vs infraclavicular brachial nerve block in chronic renal failure patients undergoing arteriovenous fistula creation”. Time to perform block, level of blockade of sensory & motor components in the areas of the median nerve, radial nerve, musculocutaneous nerve, as well as block-related pain at 10,20 and 30mins was compared. They found that there was no statistically significant difference in block performance time, pain related to the block, level of sensory or motor component blockade. At 10 minutes, there was no statistically significant difference in the sensory block grade in the ulnar nerve supply area, but at 20 and 30 minutes, the supraclavicular group greatly outperformed the infraclavicular group. In regard to the motor block grade in the area supplied by ulnar nerve, the block length, the initial call for analgesia, adverse effects and satisfaction of patients there was no difference found which was significant statistically. They concluded that both methods could deliver excellent postoperative analgesia and adequate sensory and motor block.

In 2019 in a RCT conducted by David Brenner et al[12], where they compared “efficacy of axillary vs infraclavicular brachial plexus block in preventing tourniquet pain” among 80 patients. They observed the occurrence of pain due to tourniquet, including its onset, intensity, and accompanying hemodynamic variations, as well as block parameters such as block effectiveness, onset time, distribution, and the likelihood of adverse events. They found that there was no significant difference in the occurrence of tourniquet pain with either of the blocks for the surgeries of moderate duration. However they also concluded that Infraclavicular block is better at other parameters like block performance time, block duration, sensory and motor blockade.

In 2021, in a Randomised control trial conducted by Parvati Sreelal et al[13] in 60 patients undergoing procedures for forearm under Supraclavicular or Infraclavicular brachial plexus block; compared the time to perform block, duration of block and associated problems such as Horner's syndrome , injury to vascular structures and pneumothorax. They inferred that block performance time was similar between two groups and duration of analgesia was comparable between two groups. Incomplete radial nerve blockade was higher in ICB group. There was greater incidence of horner syndrome in SCB group than ICB group and puncture of subclavian artery was observed in one case in supraclavicular block group which was statistically insignificant. They inferred that supraclavicular block was superior to Infraclavicular brachial plexus block as Infraclavicular block had significant dermatomal sparing and complications associated with supraclavicular brachial plexus block were transient and statistically insignificant.

In a study conducted by Genevieve arcand, Stephen Williams et.al.[14] in 2005 among eighty patients posted for elective upperlimb surgeries, on block performance time and quality of motor blockade in supraclavicular and infraclavicular USG guided blocks. The drug regimen they used was 0.5% bupivacaine+ 1:200000 epinephrine +2% lignocaine. Their hypothesis was infraclavicular block performance time would be shorter than that of supraclavicular block, but they observed that it took same time to achieve the block of motor & sensory components and time taken to perform block was also same in both infra and supra clavicular block; hence they concluded that infraclavicular block can be potentially as good as supra clavicular block and can be used effectively in upperlimb surgeries using USG.

M.J.Fredrickson et.al.[15], conducted a randomized observer blinded study in sixty patients posted for elective surgeries of hand & wrist under supraclavicular and infraclavicular block using ultrasonography. Their objectives were to evaluate "speed of onset of corner pocket" in both the blocks; requirement of local infiltrations, requests for GA. They observed quicker onset of sensory blockade in infra clavicular block in comparision with supra clavicular block. They concluded that ultrasonography guided infra clavicular block can be potentially used instead of supraclavicular block. Their results proved infra clavicular block is better than supraclavicular block in rapid onset of successful block either using USG or depositing drug lateral to subclavian artery.

In study conducted by Mustafa Tayfun Aldemir et al[16] in 2018 on "Comparison of Infraclavicular and Supraclavicular brachial plexus block in upper extremity surgeries" among 50 patients.They utilized a nerve stimulator to perform blocks and following parameters i.e., time to perform block, depth of needle, time taken for the block to act, duration of sensory and motor block, time for initial complain of pain. In this study they concluded that there was no significant difference statistically in duration of motor and sensory blockage and onset of postoperative pain but the time to perform block, depth of needle and time taken for the block to act were substantially lower in supraclavicular block, so they inferred that supraclavicular block is superior to infraclavicular block.

In 2008, Belen De Jose Maria et al[17], conducted a randomized control trial comparing SCB &ICB in paediatric patients with both USG and nerve stimulator and concluded that both were effective in children and there was no evidence of pneumothorax in both blocks. Time to perform block was less in supraclavicular block.

In 2002, Sandhu et al [18] had performed Infraclavicular brachial plexus block in 126 patients and found that 114 blocks were successful without any further anaesthetic requirement or the need to switch to general anaesthesia. Local or perineural administration was necessary in nine cases and three patients required GA.They concluded in their study that ultrasound had facilitated accurate deposition of drug and there is increase in successful performance of block and decrease in complications. Additionally, they inferred that none of the patients had tourniquet pain.

In 2021, in a study conducted by Linda-Le Wendling et al[19], where they performed intercostobrachial nerve block along with supraclavicular block in one set of patients and only supraclavicular block in another set of patients and concluded that the occurrence of pain due to tourniquet in a dense supraclavicular block was less even without giving intercostobrachial nerve block and the tourniquet pain was manageable with small amounts of systemic analgesia.

BASIC SCIENCES

Brachial plexus is a somatic plexus formed by the anterior rami of C5 to C8, and most of the anterior ramus of T1. The plexus originates in the neck, passes laterally and inferiorly over rib I, and enters the axilla. All the major nerves that innervate the upper limb originate from the brachial plexus, mostly from the cords. [21]

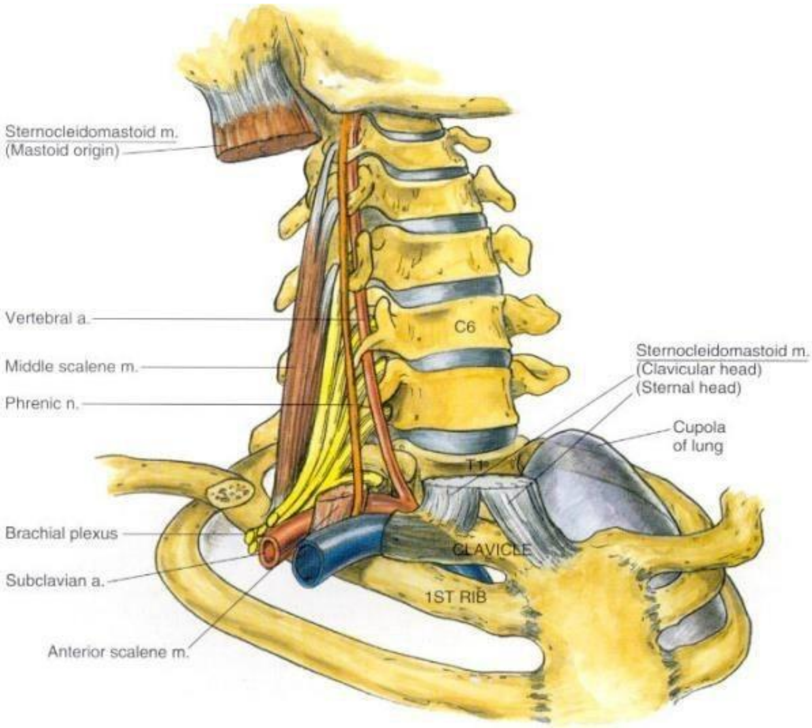


Figure 1- Anatomy of Brachial Plexus

Parts of brachial plexus (21-22)

- Roots
- Trunks
- Divisions
- Cords
- Nerves

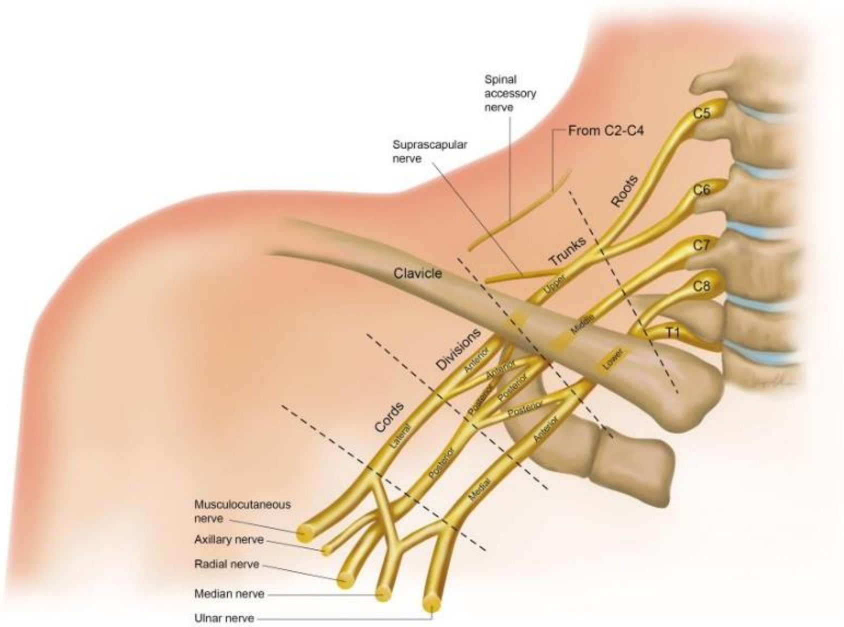


Figure 2- Parts of Brachial Plexus

ROOTS

Brachial plexus roots originate from the anterior rami of C5-C8 spinal nerves and most of T1.They pass between the anterior scalene and middle scalene muscles and enter posterior triangle of the neck. They lie superior and posterior to subclavian artery.

The origin of the plexus may shift by one segment either upward or downward and it is known as prefixed or postfixed plexus.

In prefixed segment contribution by C4 is large and from T2 is absent and in postfixed segment contribution from T1 is large and T2 is always present. C4 is absent and contribution from C5 is reduced.

TRUNKS

Roots join to from the three trunks of brachial plexus. They pass laterally over the first rib and enter the axilla.

Superior trunk- Formed by the union of C5 and C6 roots.

Middle trunk- It is the continuation of C7 root.

Inferior trunk- Formed by the union of C8 and T1 roots.

DIVISIONS

Each trunk divides into anterior and posterior division. The anterior divisions ultimately supply the anterior compartment of the arm and forearm through the peripheral nerves which arise from them. Nerves which are associated with the posterior compartment of arm and forearm arise from the posterior divisions.

CORDS

The three cords originate from the divisions. They are associated with the second part of axillary artery.

Lateral Cord- It is formed by the union of anterior divisions of upper and middle trunks (C5-C7); Medial cord-It is formed by the union of anterior division of lower trunk (C8-T1) Posterior cord-It is formed by the union of posterior divisions of all three trunks (C5-T1).

There are three parts of the axillary artery named for their positions above (medial to), behind, and below (lateral to) the pectoralis minor muscle. Typically, with a ultrasonogram probe placed to view the transverse axis of the cords, the medial cord lies inferior, the lateral cord superior, and the posterior cord posterior to the first part of the axillary artery. Immediately beyond the pectoralis minor muscle, the three cords diverge into the terminal branches, including the median, ulnar, radial axillary, and musculocutaneous nerves.

The phrenic nerve normally descends anterior the scalenus anterior muscle and crosses the muscle from lateral to medial as it descends and passes under the clavicle and through the superior thoracic aperture into the superior mediastinum.

Terminal branches of Brachial Plexus:

In distal axilla, the cord gives rise to terminal branches namely the ulnar, medial and radial nerves.

Branches of the roots:

Nerve to serratus anterior C5, C6,C7

Nerve to rhomboids C5(minor & major)

Branches of the trunk:(arise from the upper trunk)

Supra scapular nerve(C5,C6)

Nerve to subclavius(C5,C6)

Lateral cord:

Lateral pectoral nerve(C5, C6,C7)

Median nerve (lateralroot)(C5,C6,C7)

Musculocutaneous nerve(C5,C6,C7)

Medial cord:

Medial pectoral nerve(C8,T1)

Medial cutaneous division of arm (C8,T1)

Medial cutaneous division of fore arm(C8,T1)

Ulnar nerve (C8,T1)

Median nerve(medial root C8,T1)

Posterior cord:

Upper and lower subscapularnerve(C5,C6)

Thoraco dorsalnerve (C6, C7, C8) O

Axillary nerve (C5,C6)

Radial nerve (C5,C6,C7,C8)

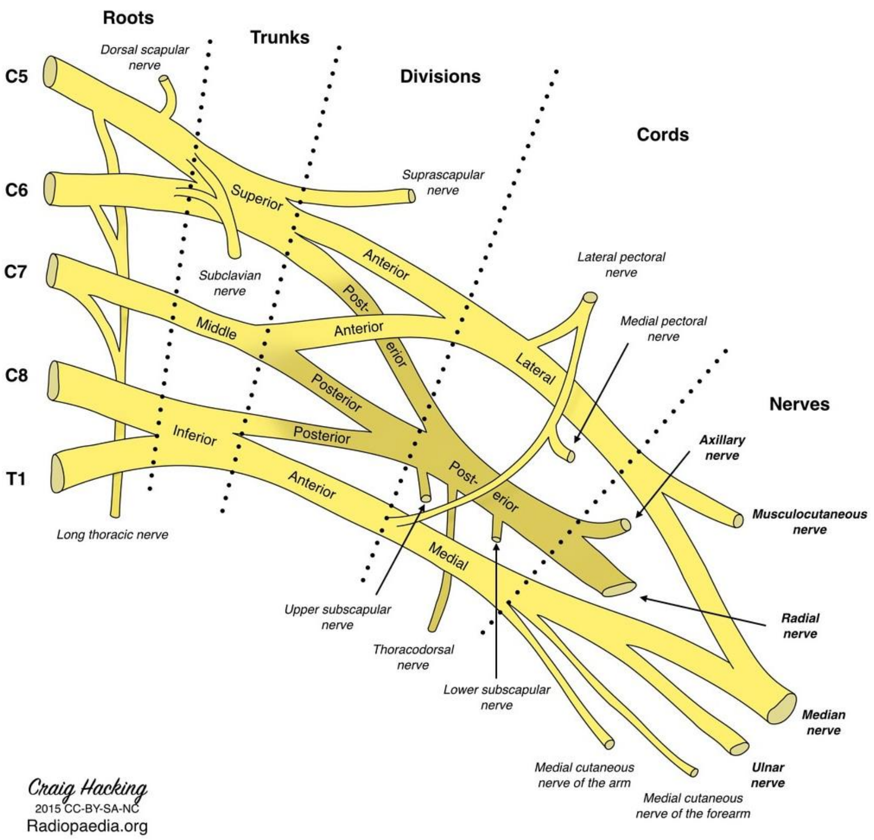


Figure 3-Schematic Diagram of Brachial Plexus

Landmark Technique[4]

Roots

The roots lie between the inter scalenus (anterior & medial) muscles. It is situated cephalo posterior to the second part of subclavian artery. It is the ideal landmark for classical interscalene block.

Trunks

In the posterior triangle, upper and middle trunks emerge above the subclavian artery as they traverse the first rib, but the lower trunk passes behind the artery. The trunks are enclosed by the skin, platysma and deep fascia superficially. Trunks are overlied by external jugular vein, inferior belly of omohyoid and supraclavicular nerves. The trunks are easily identified by palpation. This landmark is often used for perivascular approach of brachial plexus block.

The divisions emerge from the trunks at the lateral border of first rib and exists behind the clavicle, and then descends into axilla. The rib hitching technique of brachial plexus is performed in this area.

Cords

The cords lie around the axillary artery at the apex of axilla. The Medial cord lies behind the artery,but the posterior and lateral cords are situated lateral to the artery. The infraclavicular approach causes the blockade at the junction of divisions &cords.

Different approaches of brachial plexus block[4]

The various approaches for brachial plexus include:

- Intersceleneapproach
- Supraclavicularapproach
- Infraclavicular approach
- Axillaryapproach

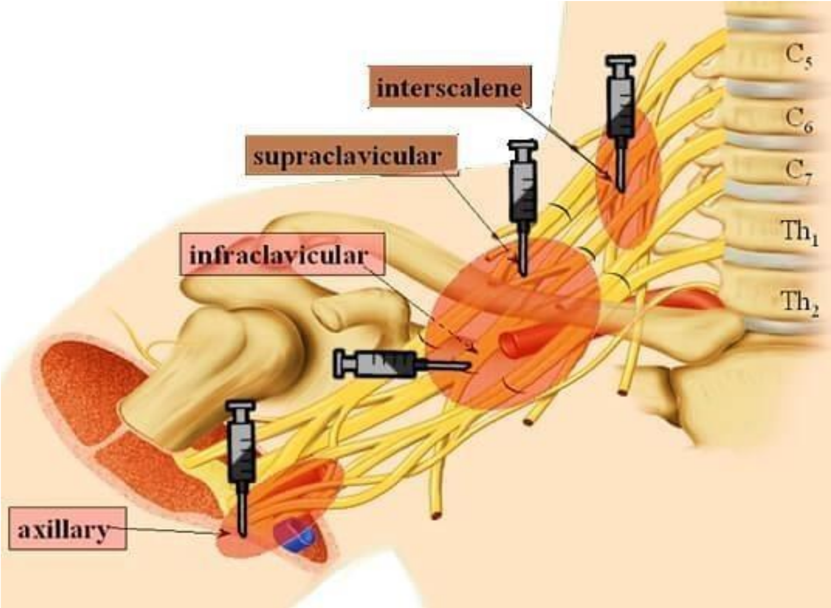


Figure 4-Different Approaches of Brachial Plexus Block

Interscalene Brachial plexus Block[4]

It is indicated for surgical anaesthesia of the shoulder surgeries such as rotator cuff repair, acromioplasty, hemiarthroplasty and total shoulder replacement, humerus fractures upper arm, forearm but often insufficient for surgeries involving the medial aspect of the forearm or hand. It effectively blocks the proximal nerve roots, distal cervical plexus, and important nerves such as the suprascapular, which exit proximally from the plexus. Frequently it spares the lowest branches of the plexus (C8,T1) and is not suitable for distal upper limb procedures.

Supraclavicular Brachial Plexus Block[4]

It is indicated in surgeries involving arm, elbow, forearm and hand surgery. It targets the trunks or divisions of the brachial plexus depending on the location of the injection site. Here the brachial plexus is confined to its smallest surface area so success rate of block is high. The three trunks carry the entire sensory, motor, and sympathetic innervation of the upper extremity, with the exception of the uppermost part of the medial side of the arm.

Infraclavicular Brachial Plexus Block[4]

It is indicated in surgeries involving arm, elbow, forearm and hand surgeries. It targets the cords of the brachial plexus and the nerves can be blocked next to the second part of the axillary artery at the level of the coracoid process. It offers excellent analgesia of entire arm and allows introduction of continuous catheters to provide prolonged post-operative pain relief. However the plexus at this level is situated deeper and it is more challenging to give the block.

Axillary Brachial Plexus Block[4]

It is useful in elbow, forearm and hand surgeries. It blocks four nerves Musculocutaneous, Radial, ulnar and median nerves. The nerves targeted for axillary block course distally with the axillary artery and vein along the humerus from the apex of the axilla. This block is useful for surgery of the elbow, forearm, and hand. The ulnar, median, and radial nerves are the primary targets. The musculocutaneous nerve often leaves the plexus (via the lateral cord) proximal to this point and may be blocked separately during the axillary block (in the coracobrachialis muscle) or at mid-humeral locations (along its diagonal course through or beyond the coracobrachialis muscle).

Landmark Technique for Brachial plexus block.[27]

Interscelene Brachial plexus block-

It targets the roots of brachial plexus. The interscalene groove is palpated by rolling the fingers posteriorly off the lateral border of the sternocleidomastoid muscle. It lies between the inter scelenes muscles (Anterior and medial). After the patient relaxes, the prominent transverse process of C6 can often be felt directly in the groove and should be marked.

Supraclavicular Brachial plexus block.

It targets the trunks or divisions of the brachial plexus. The clavicle is palpated and midpoint of the clavicle is marked. A point is placed posterior to clavicle in sternocleidomastoid groove. Needle will be inserted at an angle of 45 degree in parasagittal plane at the superior border of the clavicle along the lateral edge of the sternocleidomastoid.

Infraclavicular Brachial plexus block-

There are different approaches of giving Infraclavicular brachial plexus block using landmark technique. With the patient’s arm adducted and their hand resting on their abdomen, the medial aspect of the coracoid process is palpated. Needle is placed where clavicle meets the medial border of corocoid process at an angle of 0-15 degree. Usually posterior or medial cord of brachial plexus comes in contact.

Axillary Brachial plexus block-

The axillary artery is marked as high in its course through the axilla. It is usually felt in the intramuscular groove between the coracobrachialis and the triceps muscles. It also passes between the insertions of the pectoralis major and the latissimus dorsi muscles on the humerus.The artery should be palpated and needle should be placed in cephalad direction and injected inferiorly and superiorly around the artery.

Limitations of Landmark Technique:

There are many variations in the anatomy of the brachial plexus, and in the course of the terminal nerves and vascular elements. Some of these variations may contribute to difficulty in performing peripheral nerve block since there may be unexpected nerve stimulator responses (e.g., if two nerves are conjoined) or poor localization by nerves stimulator or by ultrasonogram imaging (e.g., if the nerve follows a substantially different path), like prefixed (C4-C8), postfixed, (C5-T2), Then continuous, tubular sheath has been shown unlikely, especially in the axillary region

SONOANATOMY OF BRACHIALPLEXUS[30,32]

Ultrasound is a recently emerging technique for regional anesthesia. Ultrasound guided peripheral nerve blockade was first performed in supraclavicular region by La Grange and colleagues in 1978. Later developed by Kapral and coworkers in 1994.

Advantages of Ultrasound:

- Enabling real time visualization of brachial plexus, rib, pleura and pulsating subclavian artery.
- Increase in safety because we can appreciate the needle placement and local anesthetic spread during the injection and enables further needle repositioning if needed.
- Rapid onset of nerve block occurs due to drug deposition near the plexus.
- Lesser volume of drug is needed than conventional techniques

ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BRACHIAL PLEXUS BLOCK.

Supraclavicular Brachial Plexus block[4]

The supraclavicular block targets the trunks and divisions of the brachial plexus. The patient is positioned with the head turned approximately 45 degrees to the contralateral side. The linear probe is placed in a coronal oblique plane at the lateral end and just above the upper border of the clavicle. It is then moved medially until the subclavian artery is seen. With the subclavian artery in the middle the plexus is located superolateral to the artery, and the neurovascular structure structures lie above the first rib. Trunks/divisions of the brachial plexus appear as a cluster of hypoechoic grape like structures. A 50 mm needle is carefully advanced in-plane (lateral to medial) maintaining needle visualization throughout, and local anaesthetic deposited either close to the angle formed at the junction of first rib and subclavian artery, or injected carefully between divisions of the plexus.

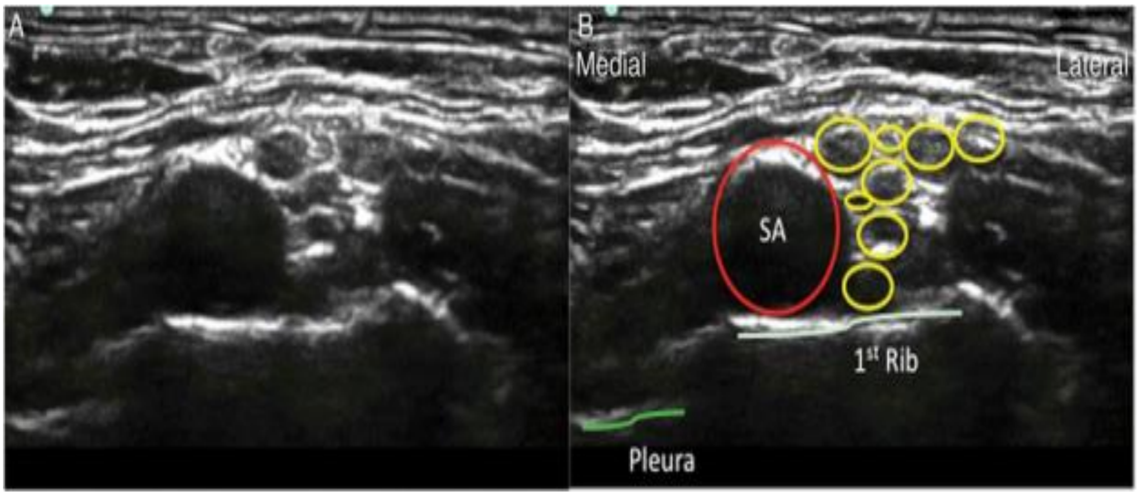


Figure 5-Supraclvicular Brachial plexus block

Infraclavicular Brachial Plexus block[4,31]

Infraclavicular brachial plexus block targets the cords of the brachial plexus,and the nerves can be blocked next to the second part of the axillary artery at the level of the corocoid process. Brachial plexus block in the infraclavicular area offers excellent analgesia of the entire arm.The patient is positioned supine with the head turned approximately 45 degrees to the contralateral side with the arm aducted or abducted. Immediately medial and inferior to the corocoid process linear probe is positioned in a parasaggital plane, brachial plexus are visualized around axillary artery . Approximately 4-5 cm deeper lies the axillary neurovascular bundle.The large axillary vein lies medial and caudad to the artery. The lateral cord of the plexus is often readily visualizd as a hyperechoic structure medial cord lies between the axillary artery and vein , whereas posterior cord can be hidden deep to an axillary artery acoustic shadow. The needle is introduced in the parasagittal plane and directed posterior to the artery. Local anaesthetic is best deposited in a horseshoe between 3 and 11 o'clock . The plexus is often easier to visualize if the arm is abducted.

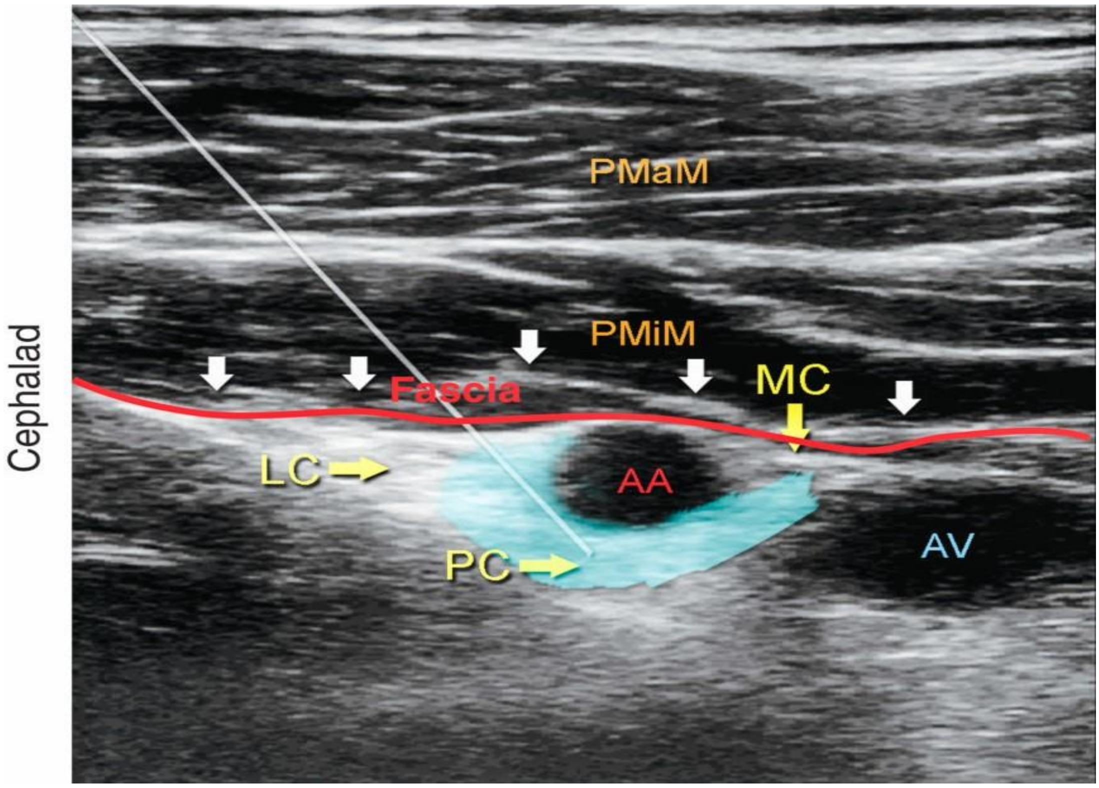


Figure 6- Infraclavicular Brachial plexus block

ULTRASONOGRAPHY[22-24]

Ultrasound waves are sound waves with a frequency greater than 20,000Hz. These frequencies are above the audible upper limit of human hearing. Medical ultrasound is the application of this ultrasound waves to visualize the internal organs of our human body. The frequencies used for this purpose, ranges from 3 to 20 MHz. In recent years, ultrasound is widely used in anaesthesia for obtaining vascular access and performing peripheral nerve blocks. Ultrasound guided techniques helps in increasing success rate and reduce its complications.

Ultrasound Pulse Generation

The ultrasound transducer contains multiple piezoelectric crystals which are interconnected electronically. When mechanical energy is applied to these crystals and some ceramics, they generate electrical energy. This phenomenon known as the "Piezoelectric Effect" was first described by the Curie brothers in 1880. They also described the "Reverse Piezoelectric effect", wherein application of electricity to these crystals produced vibrations which generate ultrasound waves.

Ultrasound Wavelength and Frequency

The wavelength and frequency are inversely related. High frequency ultrasound waves (10 to 20 MHz) give images with a high axial resolution but are more attenuated as we go deeper. Therefore, these transducers are optimal to image the superficial structures. Low frequency ultrasound waves (2 to 8 MHz) penetrate deeper but provide low axial resolution and are used to image deeper structures.

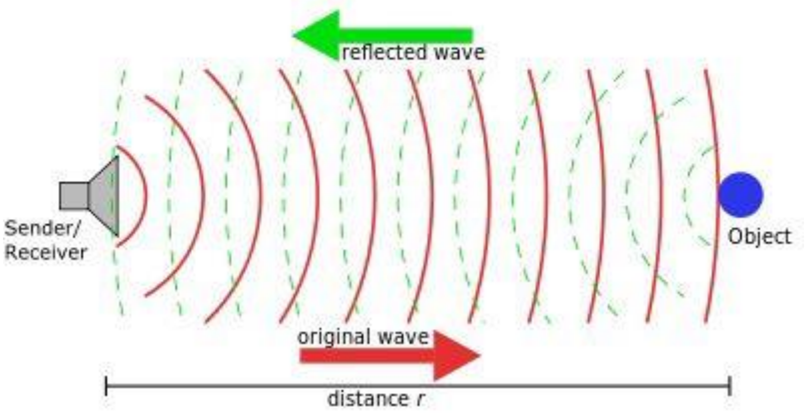


Figure 7-Principles of Ultrasonography

Ultrasound Tissue Interaction:

As the ultrasound waves travel through tissues, they are partly transmitted to deeper structures, partly reflected back to the transducer as echoes, partly scattered, and partly transformed to heat.

Reflection

For image generation, the echoes returned after hitting a tissue interface is of interest to us. The amount of echo returned after hitting a tissue interface is determined by a tissue property called acoustic impedance. The intensity of a reflected echo is proportional to the mismatch in acoustic impedances between two mediums.

Refraction

The change in the direction of the ultrasound waves after hitting an interface between two media with different velocities of sound transmission is refraction. This causes artefacts as the returning echoes are incorrectly located.

Scattering

Ultrasound waves which incident on the tissues at right angles are reflected back to the transducer. If the waves are not at right angle, then the returning echoes are scattered in all directions in a non-uniform manner

Absorption

Some of the ultrasound waves are absorbed by the tissue and are converted to heat.

Attenuation

As the ultrasound waves travel through tissue, the returning echoes will become weaker due to absorption, scattering and refraction.

Diffraction

The spreading out of the ultrasound waves as its moves further away from the source is diffraction.

Construction

The ultrasound probe has an array of individual transducers which acts as both a transmitter and a receiver. Each transducer emits a short burst of ultrasound and is quiescent until it detects the echoes returning. This is called "Pulsed Ultrasound". The speed of ultrasound in our body tissues is fairly constant at a speed of 1540m/s. The time taken for an echo to return is used determine the distance between the tissue and the probe.

Across the plane of an image, the ultrasound image is swept to form two dimensional images one line at a time. These lines are then summated to produce a frame. The frames are repeated to produce a real-time image. The brightness of the image depends upon the amplitude of the returning echo from the anatomical interfaces.

Scanning Modes

A-mode (amplitude mode): This displays a single echo signal against time to measure depth.

B-mode (brightness mode): It is a two-dimensional image produced using an array of transducers and a series of reflected echoes.

M-mode (motion mode): is a specialized type of B-mode imaging where one particular line is ensonified repeatedly to examine a moving structure plotting out how the structure moves with time.

Ultrasound controls

Gain alters the brightness of the image by amplifying the received signal.

Time-Gain Compensation (TGC) differentially amplifies signals from different depths, allowing equal amplitudes from all depths to be displayed.

Focus adjusts the beam to be at its narrowest at the required depth to image the region of interest. It thereby improves lateral resolution

Depth can be adjusted to have the structure that is being examined to be in the centre of the screen.

Approaches and techniques

There are two basic approaches to ultrasound guidance. With the out-of- plane technique, the needle tip crosses the plane of imaging as an echogenic dot. With the in-plane approach, the entire tip and shaft of the advancing needle are visible.

Out-of-plane:

This technique involves insertion of needle at the midpoint of probe such that the needle cuts across the ultrasonic beam. The image obtained is a cross section of the needle shaft or tip. Path to target is shorter as compared to in-plane technique, but visibility of needle is not optimum, indirect markers like tissue movement or hydrodissection is needed to confirm placement.

Advantages:

1) Most similar to other approaches to regional block (nerve stimulation or palpation)

2) Shorter needle path than with in-plane approaches

3) Along the nerve path (catheters)

Disadvantages:

Unimaged needle path, crossing the plane of imaging without recognition.

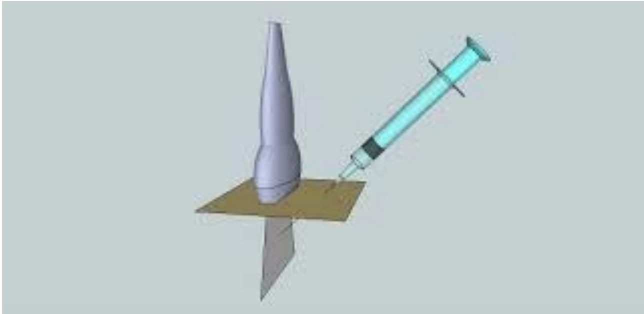


Figure 8-Out of plane approach

In-plane (IP):

In this technique needle is inserted along the length of ultrasound probe. It aligns the entire length of the beam with the shaft of needle. The image displayed will depict the entire needle shaft and its tip thereby improving the precision of nerve blocks. But the needle visibility depends on angle of insertion and the needle traverses a longer path to reach the target area.

Advantages:

Most direct visualization.

Disadvantages:

1) Partial line-ups (creating a false sense of security when the needle tip is not correctly identified.

2) Some unimaged needle path occurs with IP approach, but typically less than with OOP approach.

3) Longer paths and therefore more structures to cross with the block needle.

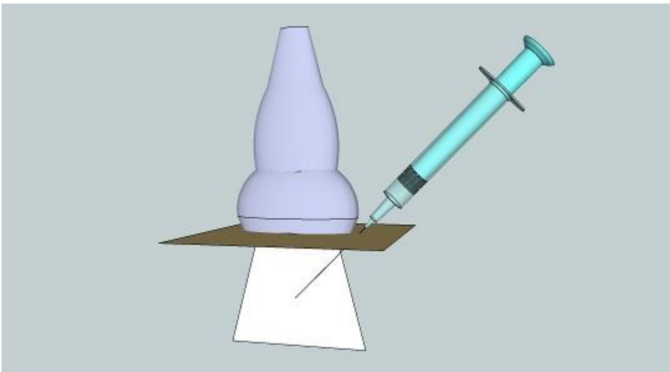


Figure 9-Inplane approach of ultrasonography

Ultrasound probes

Commonly used are three types

- Linear high frequency (6 to 12 MHz) probes which has high resolution and lesser penetration and is ideal for visualizing superficial structures.

- Curvilinear low frequency probes (2-5MHz) which has low resolution, higher penetration and is ideal for deeper structures like intraabdominal organs.

- Phased Array Probe also has low frequency (2MHz – 7.5MHz) gives a large depth with a small acoustic window, ideal for chest ultrasound

Figure 10-Ultrasound probes

Imaging

Ultrasound image is produced by echoes received as the Ultrasonic beam interacts with the tissues it travels through. Acoustic impedance of a structure is the function of the elasticity and density of the particular tissue. Materials with higher acoustic impedance transmit sound faster, and do not allow for continued compression by the impending wave. The sound beam is attenuated while traversing various tissues within the body. The beam will be scattered somewhat when it encounters varying tissues on the way with different acoustic impedances or it may be reflected back from structures and returns back to the transducer. Refraction and absorption by tissues may also attenuate the waves. Those tissues that reflect the wave are termed echoic and those which do not reflect the wave are termed anechoic. Always use plenty of sterile ultrasound gel to remove the air interface between the skin and probe. Air does not allow the passage of the ultrasound beam even though it has low Acoustic impedance. Bone has high acoustic index so it appears to be white on the ultrasound image as it is hyper reflective to the beam. Blood and other fluids appear to be black on the image since they are anechoic in nature. Soft tissue appears as grey on the sonographic image as they have medium echogenicity.

The nerves appear round or oval in transverse view and are hypo-echoic or they appear as honeycomb structures with septations inside them. Nerves are bordered by a hyper-echoic layer of connective tissue. Blood vessels will appear as circular hypoechoic to anechoiec structures with a well-defined hyper- echoic border which is the vessel wall. Veins are compressible with thinner walls whereas arteries have thicker walls and appear pulsatile in nature. Muscles have fibrous-lamellar texture and appear as heterogeneous or homogeneous hypoechoic structures with hyper-echoic septa in between.

Basic principles of ultrasound guided nerve blocks.

- First involves the identification of anatomical structures like muscles, fascia, blood vessels and bones.
- Visualization of the nerve plexus or the fascial plane where drug should be deposited.
- Should be able to differentiate between normal and altered anatomy of the region scanned.
- Identify the correct plane for needle insertion to avoid trauma to vessels
- Strict aseptic technique
- Real time visualization of needle when it is inserted inside.

-Once the target is reached, inject a small volume of drug or saline and see the spread and confirm location, else reposition the needle.

- Do frequent aspiration during injection of drug to rule out intravascular injection.

- Complete visualization of the spread of total volume of local anaesthetic drug injected.

- Always keep ready all resuscitation equipment, drugs and standard monitoring.

LOCAL ANAESTHESIA (OR) REGIONAL ANAESTHESIA:[26]

Local anesthesia can be defined as loss of sensation, in a discrete region of the body caused by disruption of impulse generation or propagation. Nerve fibers can be classified according to fiber diameter, presence (type A and B) or absence (type C) of myelin, and function. The nerve fiber diameter influences conduction velocity. Larger diameter correlates with more rapid nerve conduction. The presence of myelin also increases conduction velocity. This effect results from insulation of the axolemma from the surrounding media, forcing current to flow through periodic interruptions in the myelin sheath (i.e., nodes of Ranvier) Local anesthetics act on a wide range of molecular targets, but they exert their predominant desired clinical effects by blocking sodium ion flux through voltage-gated sodium channels. Voltage-gated sodium channels are complex transmembrane proteins comprising large alpha subunits and much smaller beta subunits.

Intravenous infusions of lipid emulsions have become a standard treatment of LAST . The mechanism by which lipid is effective is not clear but is likely related to its ability to extract bupivacaine (or other lipophilic drugs like Ropivacaine) from aqueous plasma or tissue targets, thus reducing their effective free concentration (“lipid sink”). Accordingly, solutions of lipid emulsion should be stocked and readily accessible in any area where major conduction blockade is performed, as well as locations where overdoses from any lipophilic drug might be treated

BUPIVACAINE [3,25-26]

Bupivacaine is an amino amide class of local anaesthetic drug. It was first synthesized by Ekenstam in 1957 and its clinical use was started by LJ Telivuo in 1963. Since then, it has become one of the widely used local anaesthetic agents clinically.

Bupivacaine consists of a tertiary amine attached to a substituted aromatic ring by an amide linkage. The butyl group attached to the piperidine nitrogen makes bupivacaine more lipid soluble and potent. The molecular weight is 288. It is a chiral drug that exists as two enantiomeric forms – dextrorotary (R-) and levorotary (S-) forms. The pure levorotary form Levobupivacaine produce less cardiotoxicity compared to that of the racemic mixture.

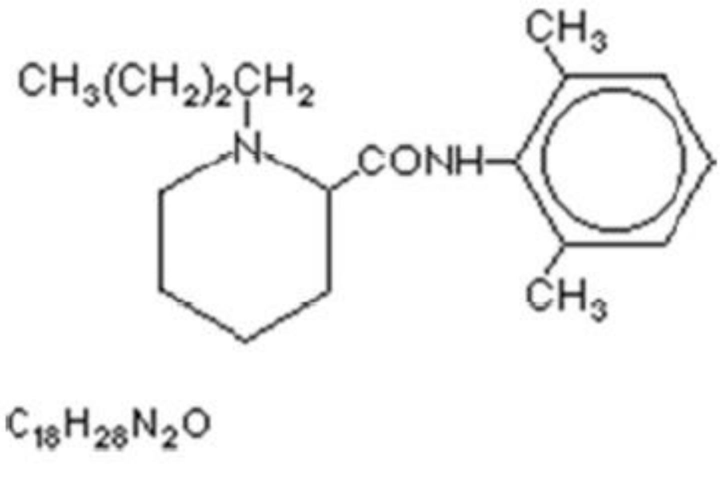


Figure 11- Structure of Bupivacaine

PHARMACODYNAMICS

Bupivacaine permeates the nerve's axon membranes and accumulate within the axoplasm. Binding to sites on voltage-gated Na+ channels prevent opening of the channels by inhibiting the conformational changes that underlie channel activation.

On comparison with lignocaine, it is four times more potent but the onset of action is slower. The duration of action is considerably longer. The sensory blockade caused by bupivacaine is much more than the motor blockade.

PHARMACOKINETICS

It is a weak base with a pKa of 8.1. Bupivacaine is highly protein bound (95%) and most important plasma protein binding site is alpha1 acid glycoprotein. At physiological pH of 7.4, 17% is non-ionised.

The onset and duration of action depend on the dose, concentration, route of administration and vascularity of the site of administration. The volume of distribution is 54 L. The elimination half-life is 210 minutes. The Clearance is 0.32 L/min. Bupivacaine undergoes biotransformation in liver by aromatic hydroxylation, N-dealkylation, amide hydrolysis, and conjugation. The metabolites are excreted via the kidney. Less than 5% of the drug is excreted unchanged.

Dosage and preparations

Maximum dose of bupivacaine 2-3 mg/kg. Preparations available include 0.25%, 0.5% solutions in 10 ml and 20 ml vials, preservative free 0.5% bupivacaine and 0.75% bupivacaine for intrathecal injections.

Uses

- Peripheral nerve block (0.25-0.5%)
- Epidural Anaesthesia (0.25-0.5%)
- Spinal Anaesthesia (0.5%, 0.75%)
- Caudal Anaesthesia (0.25-0.5%)
- Infiltration Anaesthesia (0.25-0.5%)

Contraindications

- Known hypersensitivity to local anaesthetics

- Intravenous regional anaesthesia (IVRA)

Adverse effects

Local Anaesthesia Systemic Toxicity– Plasma concentration greater than 5mcg/ml due to overdosage, unintentional intravascular injection and slow metabolic degradation causes systemic toxicity.

Central Nervous System Toxicity

Non-specific signs of toxicity are metallic taste, circumoral numbness, diplopia, tinnitus, dizziness. Excitation is characterized by restlessness, anxiety,dizziness, tinnitus, blurred vision or tremors. Then, there is a depression of central nervous system causing drowsiness, unconsciousness and cardiac arrest.

Cardiovascular system effects

Part of the cardiac toxicity that occurs with high plasma concentrations of bupivacaine occurs because of the blockade of cardiac sodium channels. Accidental intravenous injection of bupivacaine causes cardiac dysrhythmias, atrioventricular block, ventricular tachycardia and ventricular fibrillation, bradycardia and asystole.

Pregnancy increases the sensitivity of cardiotoxic effects of bupivacaine.

TOURNIQUET[28,33]

Tourniquet is a compressive device that occlude blood flow to the limbs to create bloodless surgical field and decrease the perioperative blood loss. It is a constricting or compressing device used to control venous and arterial circulation to an extremity for a period of time. They are also used for intravenous regional anesthesia (Bier's block) to prevent the central spread of local anesthetics.

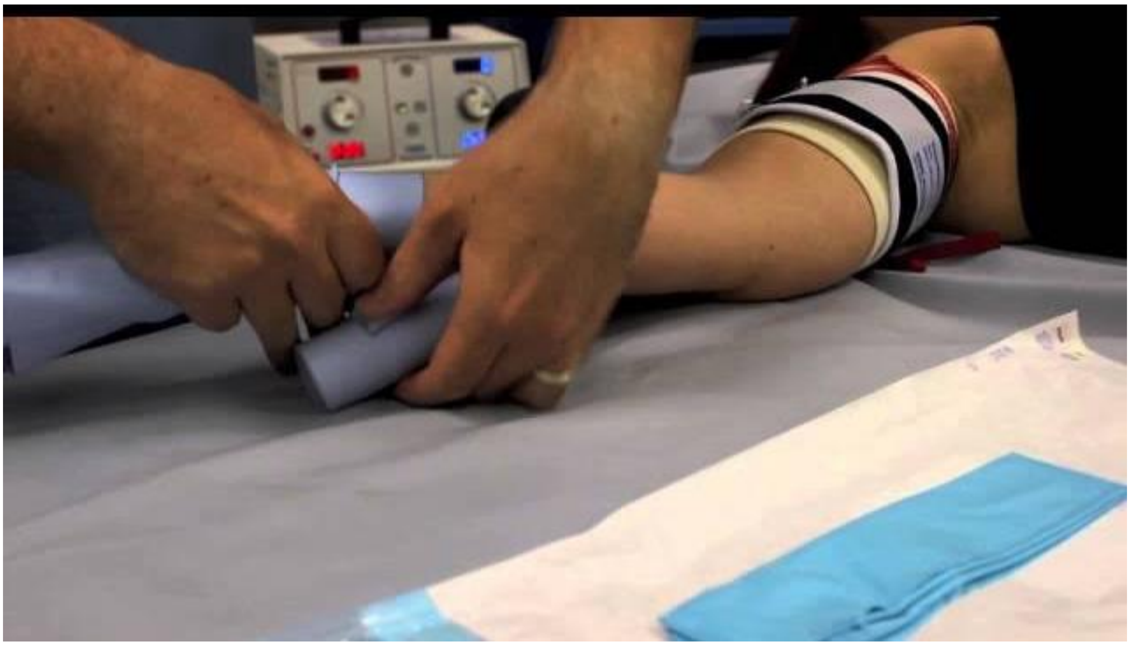


Figure 12- Upperlimb Tourniquet

Types of tourniquets

Emergency tourniquets: A tightly tied band applied around a limb (upper or lower) to prevent severe blood loss from limb trauma during emergency.

Surgical tourniquets: Surgical tourniquets enable the surgeons to work in a bloodless operative field by preventing blood flow to a limb and allow surgical procedures to be performed with improved accuracy, safety, and speed. They have two basic designs - noninflatable and inflatable.

Noninflatable (nonpneumatic) tourniquets: Noninflatable tourniquets are made of rubber or elastic cloth. Now-a-days, their surgical use alone is limited because they have been replaced by modern tourniquet systems.

Pneumatic tourniquet: Pneumatic tourniquets use compressed gas to inflate a bladder or cuff to occlude or restrict blood flow. A regulating device on the tourniquet machine can control the amount of cuff pressure exerted on the limb. The pressure is provided by an electrically driven pump or by a central compressed air supply.

Components of pneumatic tourniquets

The five basic components are:

- An inflatable cuff (bladder)
- A compressed gas source
- A pressure display
- A pressure regulator
- Connection tubing.

Tourniquet Cuff Pressure

The pressure to which a tourniquet cuff should be inflated depends on a number of variables: The patient’s age, skin, blood pressure, shape and size of the extremity, and the dimensions of the cuff. The tourniquet pressure should be minimized in the effort to produce a bloodless surgical field. Lower pressures are thought to prevent injury of normal tissue. Despite many years of tourniquet use, the optimal inflation pressure to accomplish this objective is not yet established by a research study. Surgical texts recommend cuff pressures of 200-300 mmHg for adults

Various methods have been implemented in an effort to lower effective cuff pressure-

1.Double tourniquet technique, to change the point of compression

2. Controlled hypotension to bring down systolic blood pressure can also be used to decrease direct cuff pressure against the tissue

3. Doppler technique and pulse oximetry to confirm the absence of the arterial pulse to determine the minimum inflation pressure

4. Tourniquet inflation based on limb occlusion pressure (LOP)

5. Cuff pressure synchronization with systolic blood pressure.

Tourniquet Pain

Tourniquet pain is described as a poorly localized, dull, tight, aching sensation at the site of tourniquet application. During general anesthesia, it manifests as an increase in heart rate and mean arterial pressure. It is more common under general anesthesia (53-67%) and occurs most often during lower-limb surgeries. The exact etiology is unclear, but it is thought to be due to a cutaneous neural mechanism. The pain is thought to be mediated by the unmyelinated, slow conducting C fibers that are usually inhibited by the A-delta fibers. The A-delta fibers are blocked by mechanical compression after about 30 min, while the C fibers continue to function. Tourniquet compression leads to release of prostaglandins by the injured cells. These prostaglandins increase pain perception by sensitizing and exciting pain receptors. Also, limb ischemia causes central sensitization via NMDA receptor activation due to repeated nociceptive afferent input from the affected limb.

Pain may be experienced with tourniquet use on the upper limb. The perception of tourniquet pain is most likely due to the Musculocutaneous nerve, Medial cutaneous nerve and Intercostobrachial nerves.[12]

Tourniquet Pain management

Intraoperatively tourniquet pain in upper limb can be managed by a dense block or subcutaneous ring anaesthesia or by intravenous sedation.

Numerical Rating Score(NRS)[29,35]

Numerical rating scales (NRS) are the simplest and most commonly used scales. The numerical scale is most commonly 0 to 10, with 0 being “no pain” and 10 being “the worst pain imaginable.” The patient picks (verbal version) or draws a circle around the number that best describes the pain dimension, usually intensity.

Advantages of NRSs include simplicity, reproducibility, easy comprehensibility, and sensitivity to small changes in pain. Children as young as 5 years who are able to count and have some concept of numbers (i.e., that 8 is larger than 4) may use this scale. Although claimed to be not necessarily linear, NRSs correlate well with the VAS.

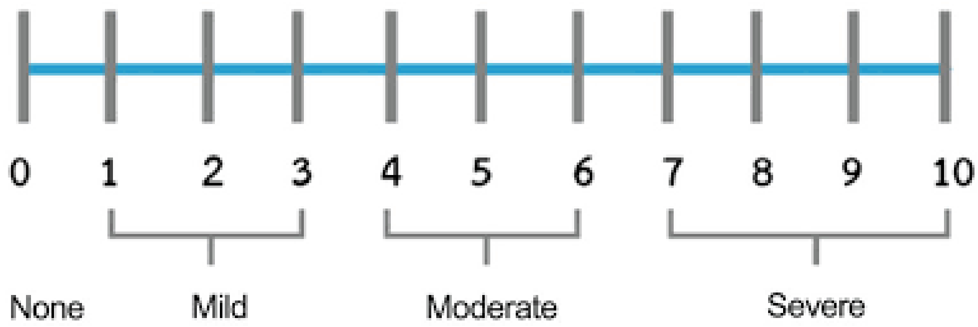


Figure 13-Numerical Rating Score

MATERIAL AND METHODS

Title "Comparison between Ultrasound Guided Supraclavicular and Infraclavicular Brachial Plexus Block to assess the quality of Surgical anaesthesia and Intraoperative Tourniquet pain" which was done in "Department of Anaesthesiology, KLE'S Dr.Prabhakar Kore Hospital, Belagavi during the period of January 2021 to December 2021".

Type of study: Prospective Randomized Observer blinded Study.

Source of Data: Patients aged 18-60 years, of either gender, belonging to American Society of Anesthesiologists I and II, underwent upper limb surgery under USG guided regional anaesthesia in "KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar, Belagavi -10" during the period from January 2021 to December 2021.

Type of study: Prospective Randomized Observer blinded Study.

Duration of Study and study population:

Adult patients posted for surgery of upper limb under regional anesthesia between January 2021-December 2021 at "KLE'S Dr.Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar, Belagavi-10. "were recruited as per inclusion and exclusion criteria.

Sample Size- A total of 76 patients.

Sampling procedure- A one year observer blinded prospective randomized control study. Randomization will be achieved by computer generated randomization chart.

Sample Size Calculation:

Formula for calculation of size of the sample

Based on mean and standard deviation formula for minimum sample size

$$n = \frac{(z_\alpha + z_\beta)^2 (s_1^2 + s_2^2)}{(\bar{X}_1 - \bar{X}_2)^2}$$

$z\alpha$- linked with the level of significance

$z\beta$-linked with the power of the test.

For 5% level of the significance $z\alpha = 1.96$ and $z\beta = 0.84$ for 80% power of the test[1].

Mean values for the first group were (9.57) and the second group were (11.53).

s1 is the standard deviation of the first group (3.19) and s2 is the standard deviation of the second group (2.90).

A sample size of 76 was obtained using these values.

The minimum number of cases in each of the two groups was 38.

Inclusion Criteria:

- American Society of Anaesthesiologist (ASA) physical status I to II
- Age between 18 to 60 years.
- Patients undergoing elective upper-limb procedures under USG guided Supraclavicular and Infraclavicular brachial plexus block.
- Patients with BMI less than 30.
- Patients who had given written informed consent.

Exclusion Criteria:

- Patients undergoing emergency surgeries.
- Patients with coexisting lung diseases, pregnancy.
- Local anaesthetic allergy

- Deformities of chest
- Who do not fulfill inclusion criteria.

Ethical Clearance: The approval by the institutional Ethical and Research Committee, Jawaharlal Nehru Medical College, Belagavi, was taken before starting the study.

Informed Consent:

Type of research and the intervention being done was explained to all of the patients who met the selection criteria.

Prior to enrollment, we acquired written informed consent from each patient.

Methodology:

After acquiring an informed consent and acquiring approval from ethical committee,76 members were included in the study after fulfilling the inclusion criteria. Using computer-based randomization, patients were divided into 2 groups.

GroupS: 38 members were enrolled for ultrasound guided Supraclavicular block.

GroupI: 38 members were enrolled for ultrasound guided Infraclavicular block.

A thorough pre-anaesthetic evaluation was done a day before surgery. On the day of Surgery after confirming the NBM status the patient was shifted to operation theatre. Baseline monitors (Non-invasive blood pressure, Pulse oximeter, and ECG) were attached and parameters noted. Ringer lactate was started through wide bore IV cannula.

Under strict asepsis, an initial scan was carried out using Sonosite Ultrasound machine. 8-15MHz linear probe (B-probe) was used to perform the block. A 22-gauge 50mm insulated short bevel needle was used to perform the block. Injection Bupivacaine 0.5% with a dosage of 25ml was used for the block. Each block's scanning duration and the time between the positioning of the needle and its removal were recorded. Anaesthesiologist who was experienced executed the blocks.

Ultrasound Guided Supraclavicular Brachial plexus block technique:

The supraclavicular block was carried out with patient lying supine, head inclined towards contralateral side and arm adducted against side of body. The linear probe was placed in coronal or oblique plane just above clavicle at around midpoint. Trunks,divisions of brachial plexus trunks and divisions are visualized above the first rib lateral to subclavian artery. The needle was placed in sheath of the plexus & Injection Bupivacaine 0.5% was injected. Spread of the drug within the brachial plexus and centrifugal distribution into the trunks and divisions was seen.

Ultrasound Guided Infraclavicular Brachial plexus block technique:

Infraclavicular block was performed with patient in supine position. The transducer was positioned in deltopectoral groove below the clavicle in parasaggital plane. The limb that had to get operated was either abducted or is placed against the body. After the parts painted and draped, using in plane technique needle was pointed towards the target. Posterior to axillary artery Injection Bupivacaine 0.5% was deposited to attain U-shaped distribution surrounding artery.Lateral cord,medial cord were also infiltrated with drug (Triple injection technique). "The time between the drug injection and the total loss of pinprick sensation was used to characterise the start of sensory block, whereas the time between the drug injection and the full motor block was used to define the onset of motor block." This was noted at an interval of 5 minutes upto 30 minutes until total blockade was attained.

If total sensory block wasn't attained after 30 minutes, then it was considered failed block and the study was abandoned and patient was supplemented with adequate analgesia or converted to general anesthesia.

Results were determined by an observer who was blinded about the block performed. Evaluation of score for sensory blockade was determined with needle prick by testing the territories supplied by brachial plexus. The sensory blockage was evaluated using the scoring method used by Abhinaya et al.[5]

Test	Score
Sharp Pain	0
Touch Sensation	1
No Sensation	2

Time which was taken to reach score of 2 was recorded and was considered as time to achieve total Block.

The quality of motor block was observed using the four-point rating scale which had been taken from the study done by Abhinaya et al[5]:

Test	Score
"Flexion-extension in hand & arm against resistance[5]"	0
"Flexion-extension in hand, arm against gravity but no movement against resistance[5]"	1
"Flexion-extension in hand but not in the arm[5]"	2
"No flexion-extension in arm&hand.[5]"	3

Time taken to attain a score of 3 was noted which was considered as time take n to achieve complete motor block.

Tourniquet pain was assessed at 30 minutes after it had been inflated, then for every 10 minutes interval till the end of surgery, patients were questioned for any discomfort. Pain had been assessed according to the NRS.

NRS - tool used for assessment of pain due to tourniquet as adapted by David Brenner et al.

0	No Pain
1-3	Mild Pain
4-6	Moderate Pain
7-9	Severe Pain
10	Worst Imaginable Pain

If score is>5 rescue analgesia of Inj fentanyl 1mcg/kg was given with patient breathing spontaneously. Patients were assessed for any other intraoperative and postoperative complications for 48hours.

Terminologies:

"**Block performance time-** Time taken from insertion of needle to removal of needle LA injection".

"Sensory block onset - Time taken for onset of loss of pin prick sensation over dermatomes supplied by BP".

"**Total sensory blockade onset -**the interval between LA administration and total loss of pinprick sensation."

"**Motor blockade onset-**Time taken for the onset of weakness from the injection of LA which is assessed by flexion and extension."

"**Complete motor blockade onset**- Time taken for total loss of power from injection of LA."

"**Duration of block** was defined as time taken to return back from Grade 3 of motor blockade to Grade 1."

"It was considered as successful block when there was grade 3 sensory and motor blockage or sparing of single nerve territory."

"Failure to carry out the desired surgical procedure while under a block was regarded as a failed block (sparing of greater than one nerve even after 30 minutes of block), and there was need to convert into general anesthesia."

Complications-Patient were monitored for problems both during surgery like vascular injury, development of hematoma and for 24 hours following surgery for any injury to nerve, pnemothorax, Horner's syndrome, diaphragmatic paralysis.

Statistical Analysis:

The study was focused on comparison of two groups.

Mean and Standard deviation was computed for continuous quantitative data.

Continuous variables between groups were compared with suitable statistical tools such as unpaired student t test. Student paired t test was used to compare two quantitative variables in a group.

Rates, ratios, and percentages were used to express the categorical data.

Using the Chi-square test or Fisher's exact test, the relationship between the result, clinical, and demographic factors was examined.

Median was used to represent discrete variables. For comparing discrete variables, nonparametric tests were utilised.

The comparison was represented using the appropriate graphs.

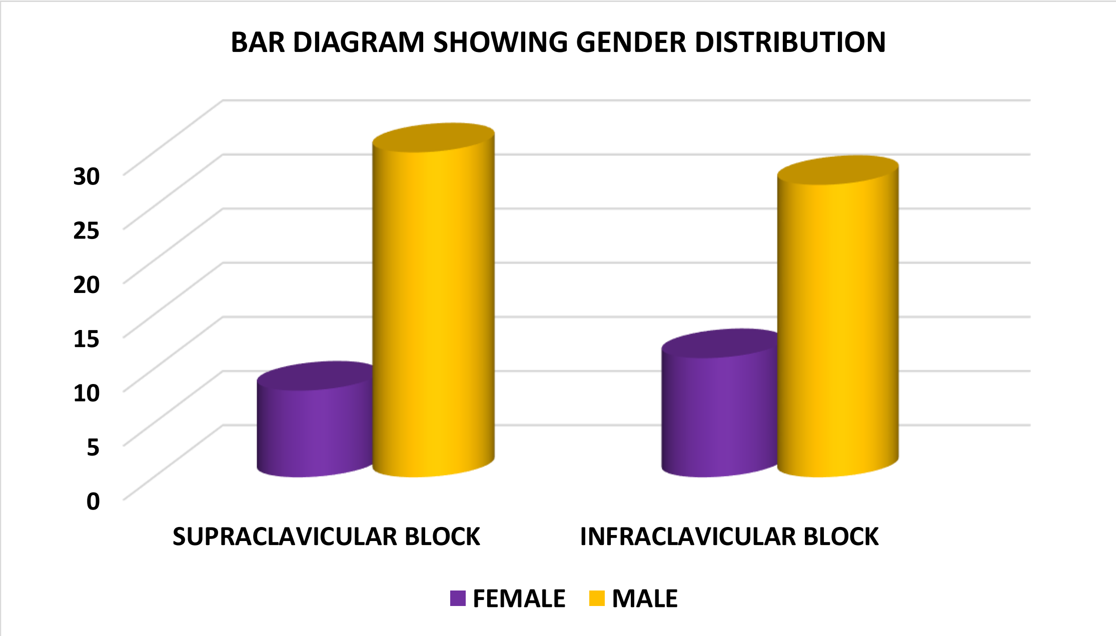
A value of p less than 5% (0.05) was deemed significant for each test.

RESULTS

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
GENDER	**NUMBER**	**%**	**NUMBER**	**%**
FEMALE	8	21.1	11	28.9
MALE	30	78.9	27	71.1
TOTAL	38	100.0	38	100.0

Table 1-Gender Distribution of the sample

GRAPH 1

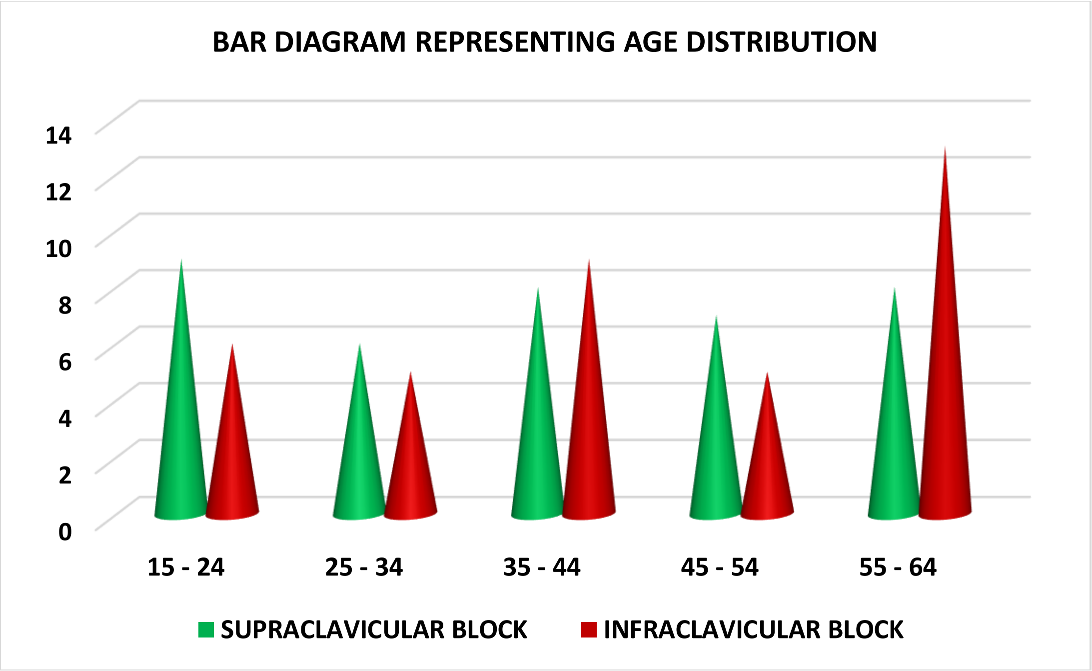


There was no extreme variation in gender distribution in Group S and Group I in our study.

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
AGE	**NUMBER**	**%**	**NUMBER**	**%**
15 - 24	9	23.7	6	15.8
25 - 34	6	15.8	5	13.2
35 - 44	8	21.1	9	23.7
45 - 54	7	18.4	5	13.2
55 - 64	8	21.1	13	34.2
TOTAL	38	100.0	38	100.0

Table 2-Age Distribution of Sample

GRAPH 2



	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	Mean	**S.D.**	**Minimum**	**Maximum**	**Mean**	**S.D.**	**Minimum**	**Maximum**	**p Value**	**Inference**
Age	38.32	14.61	18	60	43.79	14.72	18	60	0.1080	NS

As seen the average age of Group I (43.79 years) was more than that of Group S (38.32 years). The minimum age was 18 years and maximum age was 60 years in both the groups S and I.

Table 3-Demographic data of the sample

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**	**INFERENCE**
HEIGHT	166.92	7.28	150	176	165.00	7.99	145	176	0.2766	NS
WEIGHT	63.42	6.72	40	74	63.03	6.81	50	80	0.8000	NS
BMI	22.77	2.34	16	27	23.22	2.80	17.3	31.3	0.4495	NS

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
ASA	**NUMBER**	**%**	**NUMBER**	**%**
1	26	68.4	20	52.6
2	12	31.6	18	47.4
TOTAL	38	100.0	38	100.0

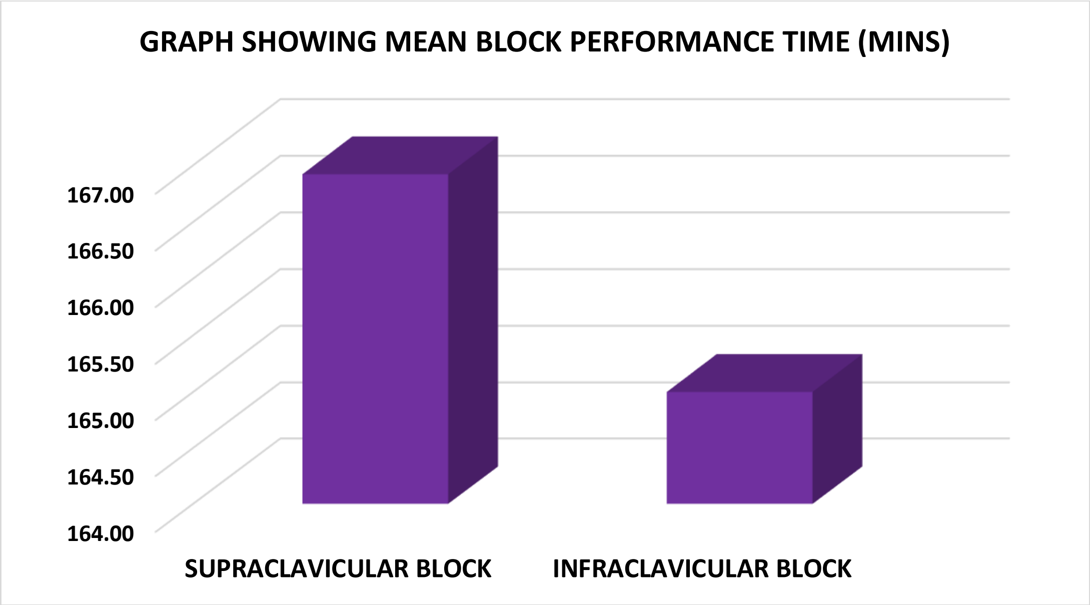
There is no significant difference between two groups in terms of demographic distribution.

BLOCK PERFORMANCE TIME

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
BLOCK PERFORMANCE TIME (MINS)	8.26	1.70	5	15	11.42	1.78	8	15	< 0.0001	HS

Table 4- Comparison of time taken to perform block

GRAPH 3



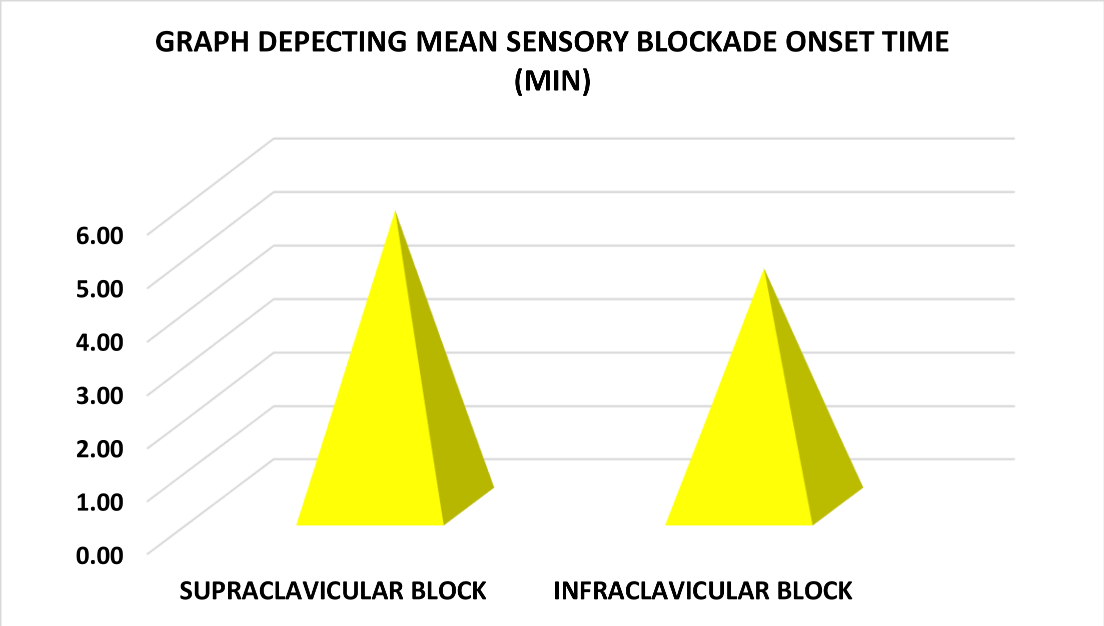
In present study mean time taken to perform block in Group I was 11.42mins and in Group S was 8.26mins and it was significant statistically. Minimum time taken was 8 mins in Group I and 5 mins in Group S. The maximum time was 15mins in both the groups.

ONSET OF SENSORY BLOCKADE

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
SENSORY BLOCKADE ONSET TIME (MIN)	5.55	0.80	4	7	4.47	0.51	4	5	< 0.0001	HS

Table 5- Comparison of time taken for onset of Sensory blockade

GRAPH 4



Mean Sensory onset time was early in Group I with mean of 4.47mins and in Group S 5.55mins and was significant statistically. Minimum time for onset in Group I and Group S was 4 mins and maximum time for onset in Grp I was 5 mins & in Grp S was 7mins.

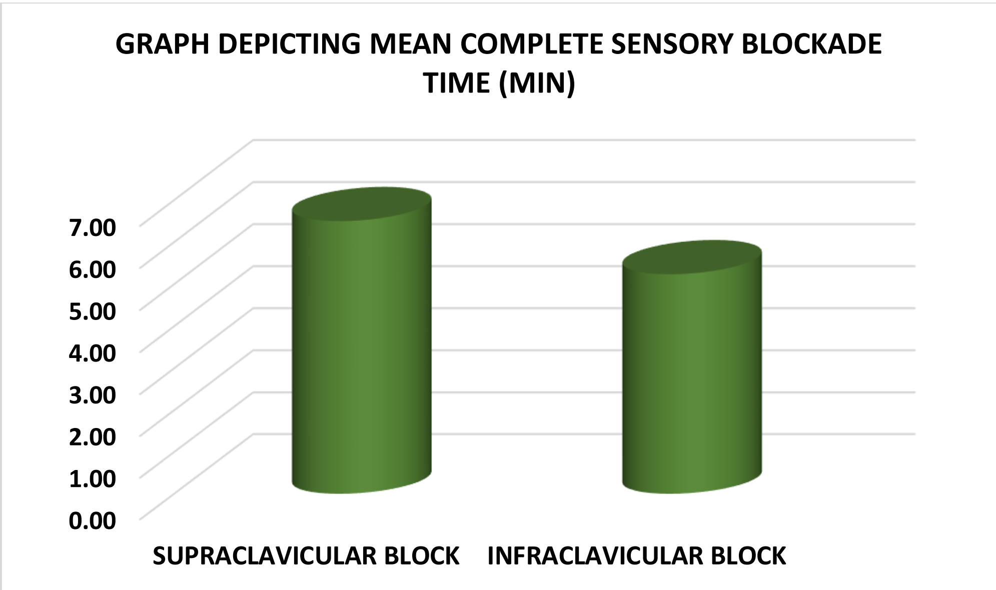
COMPLETE SENSORY BLOCKADE TIME

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
COMPLETE SENSORY BLOCKADE TIME (MIN)	6.50	1.03	5	9	5.24	0.75	4	7	< 0.0001	HS

Table 6- Comparison of time taken for complete sensory blockade

Mean Complete Sensory blockade time was early in Group I with mean of 5.24mins and in Group S 6.50mins and was significant statistically. The minimum time in Group I was 4 mins and Group S was 5 mins and maximum time in Group I was 7 mins and in Group S was 9mins.

GRAPH 5



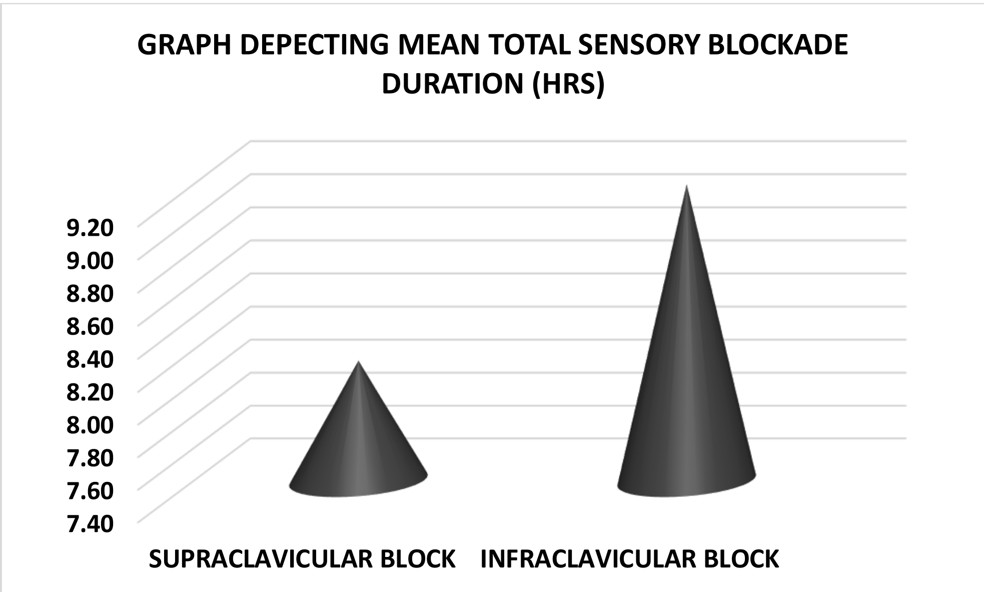
TOTAL DURATION OF SENSORY BLOCKADE

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
TOTAL SENSORY BLOCKADE DURATION (HRS)	8.13	0.43	6.5	9	9.20	0.80	7	11	<0.0001	HS

Table 7- Comparison of total duration of Sensory blockade

Total duration of sensory blockade was more in Group I with mean of 9.2 hours than Group S with mean of 8.13 hours and was statistically significant($p<0.0001$) Minimum time in Group S was 6.5 hours and maximum time was 9 hours and minimum time in group I was 7 hours and maximum time was 11 hours.

GRAPH 6



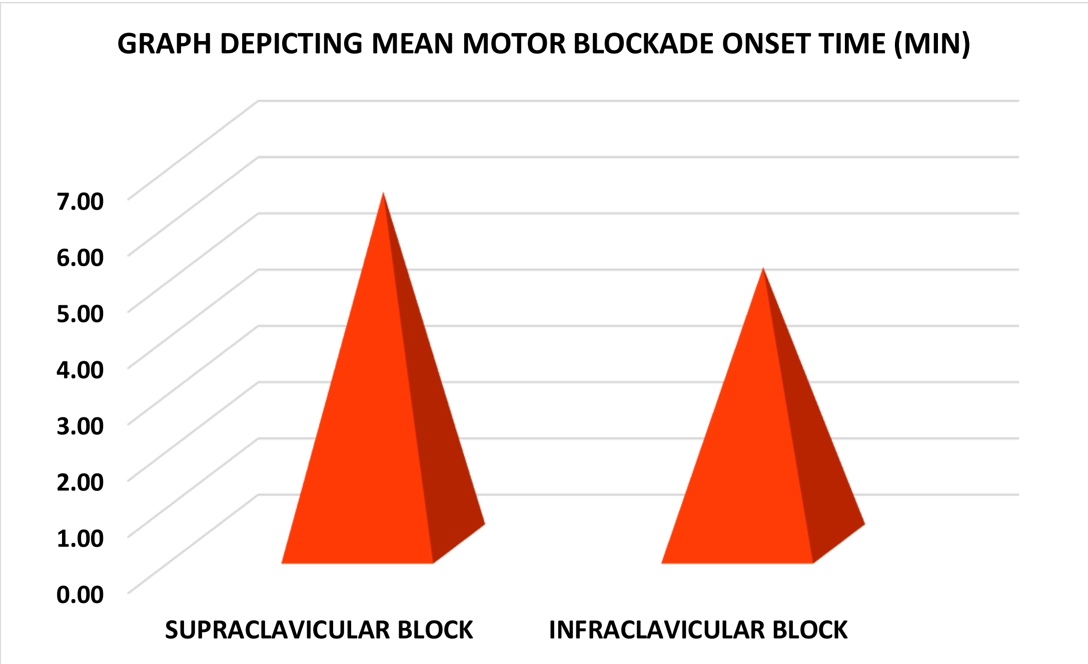
ONSET OF MOTOR BLOCKADE

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D	MIN	MAX	MEAN	S.D	MIN	MAX	P VALUE	INFERENCE
MOTOR BLOCKADE ONSET TIME (MIN)	6.26	0.92	5	8	4.92	0.88	4	8	< 0.0001	HS

Table 8-Comparison of time taken for onset of motor blockade

Mean Motor onset time was early in Group I with mean of 4.92 mins than Group S which was 6.26 mins and was statistically significant. The minimum onset time in Group I was 4mins and Group S was 5 mins and maximum onset time in Group I and Group S was 8 mins.

GRAPH 7



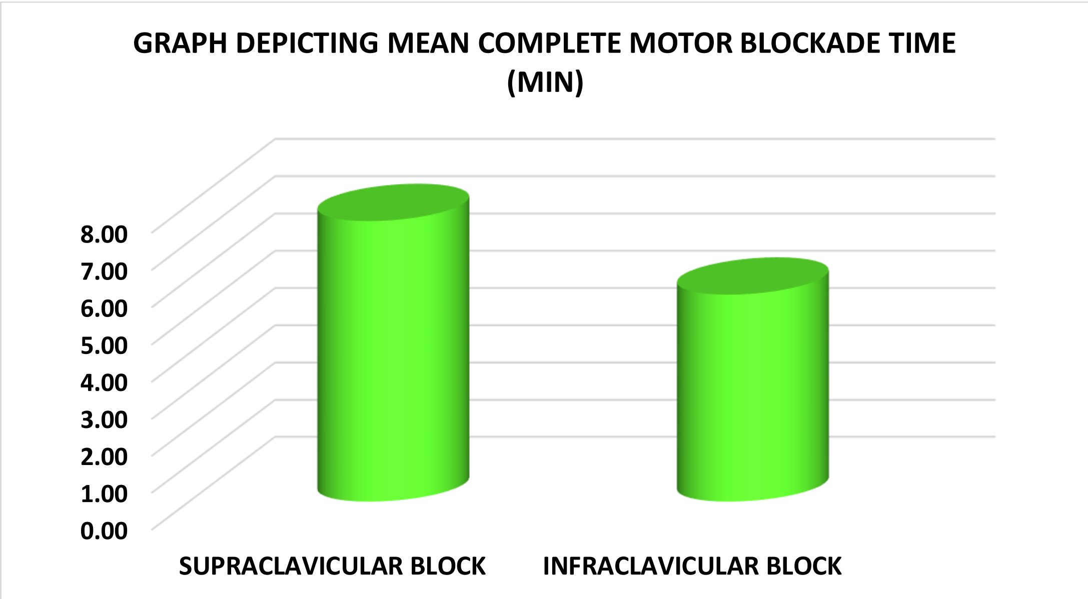
COMPLETE ONSET OF MOTOR BLOCKADE TIME

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**P VALUE**	**INFERENCE**
COMPLETE ONSET OF MOTOR BLOCKADE TIME (MIN)	7.55	1.27	5	10	5.58	0.95	4	7	< 0.0001	HS

Table 9- Comparison of time taken for complete motor blockade

Mean Complete Motor blockade time was early in Group I with mean of 5.58mins and in Group S was 7.55mins and was statistically significant($p<0.0001$). The minimum time in Group I was 4 mins and Group S was 5 mins and maximum time in Group I was 7 mins and in Group S was 10 mins.

GRAPH-8



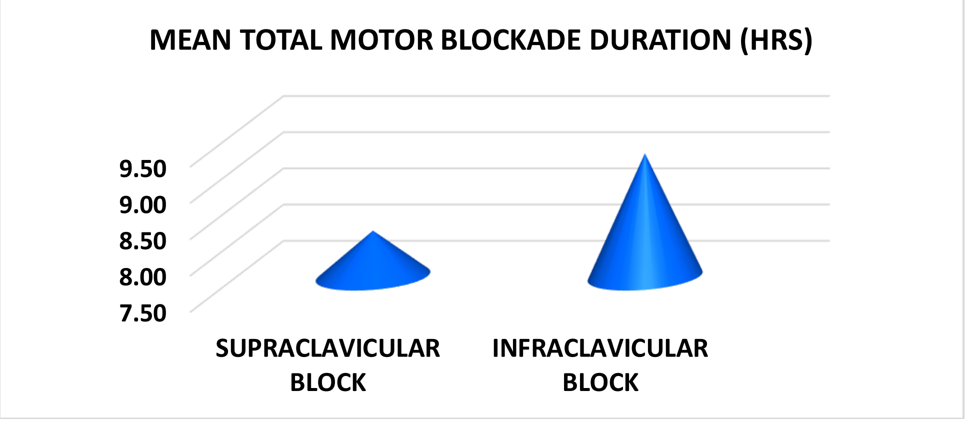
DURATION OF TOTAL MOTOR BLOCKADE

	SUPRACLAVICULAR BLOCK				INFRACLAVICULAR BLOCK					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	P VALUE	INFERENCE
TOTAL MOTOR BLOCKADE DURATION (HRS)	8.13	0.43	6.5	9	9.20	0.80	7	11	<0.0001	HS

Table 10- Comparison of total duration of motor blockade

Total duration of motor blockade was more in Group I with mean of 9.2 hours than Group S with mean of 8.13 hours and it was statistically significant ($p<0.0001$). Minimum time in Group S was 6.5 hours and maximum time was 9 hours and minimum time in group I was 7 hours and maximum time was 11 hours.

GRAPH-9



	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
TOURNIQUET PAIN	**NUMBER**	**%**	**NUMBER**	**%**
YES	8	21.1	2	5.3
NO	30	78.9	36	94.7
TOTAL	38	100.0	38	100.0

Table 11-Comparison of Tourniquet pain

Using Chi-Square Test the P Value Is 0.0417 (S)

The number of cases having tourniquet pain was significantly more in supraclavicular block group

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
RESCUE ANALGESIA	**NUMBER**	**%**	**NUMBER**	**%**
YES	8	21.1	2	5.3
NO	30	78.9	36	94.7
TOTAL	38	100.0	38	100.0

Table 12- Comparison of rescue analgesia for tourniquet pain

Using Chi-Square Test the P Value Is 0.04 (S)

The number of cases requiring rescue analgesia is significantly more in supraclavicular block group

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
INTRAOPERATIVE COMPLICATIONS	**NUMBER**	**%**	**NUMBER**	**%**
YES	0	0.0	0	0.0
NO	38	100.0	38	100.0
TOTAL	38	100.0	38	100.0

Table 13- Intraoperative complications

There were no intraoperative complications in both the groups

	SUPRACLAVICULAR BLOCK		INFRACLAVICULAR BLOCK	
POSTOPERATIVE COMPLICATIONS	**NUMBER**	**%**	**NUMBER**	**%**
YES	0	0.0	0	0.0
NO	38	100.0	38	100.0
TOTAL	38	100.0	38	100.0

Table 14- Postoperative Complications

There were no postoperative complications in both the groups

DISCUSSION

Brachial plexus block is the most effective substitute for GA in procedures of upper-limb. It yields a better quality of analgesia and also avoids complications related to general anaesthesia. It helps in avoiding polypharmacy related to general anaesthesia.[1]

Brachial plexus block is a very convenient alternative mainly in patients with severe respiratory, cardiovascular comorbidities and in obese patients who have airway difficulties and in patients with anticipated difficult airway. It is also preferred in patients with comorbidities like diabetes mellitus by reducing perioperative fasting.[1]

With the advent of Ultrasound there is an increased ease for performing brachial plexus block. Using ultrasound there are fewer chances of complications related to brachial plexus like vascular injury and there is reduction in requirement of drug. [2]

Supraclavicular brachial block is executed at distal trunks& proximal divisions. At this level plexus more superficial and hence block is simpler to carry out. Plexus at this level are more compact hence a modest amount of local anaesthetic provides a reliable anaesthesia.[3] Infraclavicular block was performed at the level of cords and it has advantages of avoiding complications like pneumothorax, Horner's syndrome, diaphragmatic paralysis which are commonly associated with SCB. Onset of ICB is very rapid and it provided reliable anaesthesia similar to supraclavicular block.[5]

In present study we compared USG guided Supraclavicular block & Infraclavicular brachial plexus block in 76 patients who were randomly divided into 2 groups.

In present study, there was no extreme variation in gender distribution in the two groups. The differences in patient characteristics and demographic profile between the two groups were not statistically significant.

Age distribution between these groups was comparable. Mean age in supraclavicular group was 38.32 and in Infraclavicular group was 43.79 and it was not statistically significant (p=0.1080)

In present study mean time to perform block in Group S was 8.26± 1.70 minutes and group I was 11.42 ±1.78 mins that was significant statistically (p=<0.0001).This shows that time taken to perform block was comparatively less in SCB group than ICB group . This correlates with findings of study done by Belen De Jose et al[17], where time taken to perform block was shorter in supraclavicular block compared to Infraclavicular brachial plexus block. These findings are in contrast with the findings of study done by Abhinaya et al[5], where time taken to perform block was found to be shorter in Infraclavicular brachial plexus block than supraclavicular block .It also deviates from the studies conducted by Yang, Kwon et al[8] and Amany El sawy[11] and others where they compared supraclavicular technique to infraclavicular technique and inferred that there was no statistically significant difference in time taken to perform the block.

In present study onset and total blockade of sensory& motor component was early in group I than Group S which was found to be highly significant statistically(p<0.0001). Onset of complete sensory blockade 5.24±0.75 mins in Group I and was 6.50± 1.03 mins in Group S. Onset of complete motor blockade in Group I was 5.58±0.95 mins and 7.55±1.27 mins in Group S. This was in line with the study done by Ranganathan Abhinaya, Rajagopalan et al[5]and Koscielnaik et al[20] where they compared supraclavicular and Infraclavicular brachial plexus approach and observed beginning of sensory block and complete block of sensory and motor component was achieved early in Infraclavicular brachial plexus block and it was statistically significant .It differs from findings of Yang, Won et al [6]and Arcand et al [14] where statistically there was no significant variation in time of onset and time for total sensory and motor component blockade .

Duration of action of Infraclavicular block (9.20± 0.80 hrs) was more than supraclavicular block (8.13±0.43 hrs) and it was statistically significant. This was similar to the finding of Chun woo yang et al[6] where duration of action of Infraclavicular block was 827±175 mins and supraclavicular block was 763± 202mins but it was statistically insignificant. These findings deviate from the study of Mustafa et al[16], where they found that there is no difference in the duration of action of either block.

Incidence of tourniquet pain and requirement of rescue analgesia was less in Infraclavicular block than supraclavicular block that was found to be significant statistically (p-0.04). Chin Kj[9] and others in his review article compared incidence of tourniquet pain in Infraclavicular block with all other brachial plexus blocks and found that it was less in infraclavicular block. They inferred that Infraclavicular block provides a reliable anaesthesia to musculocutaneous nerve which helps in alleviating tourniquet pain. Similarly, Koscielnaik et al[20], described in there study that there was more patient satisfaction in Infraclavicular block than supraclavicular block due to less incidence of tourniquet pain but it was not quantified. But there is no proper evidence of why Infraclavicular block has less tourniquet pain compared to other blocks.

No intraoperative or postoperative complications were seen in both the groups.

CONCLUSION

The present study has concluded that USG guided infraclavicular block has faster onset of action, greater duration of blockade and less incidence of tourniquet pain with reliable surgical anaesthesia. Although there were no complications seen in present study in both the groups literature says that more complications were seen in supraclavicular block. Therefore, USG guided infraclavicular block can be a reliable alternative for supraclavicular block.

SUMMARY

76 cases of American society of Anesthesiologists physical status I, II who were posted for upper-limb procedures were divided randomly into Group S and Group I, by double-blind method. Both groups underwent a block technique using USG and 25 cc of 0.5% (w/v) bupivacaine as the local anaesthetic.

Following parameters were seen in present study-

- Time taken to perform block
- Sensory block onset
- Achievement of total sensory blockade
- Motor block onset
- Achievement of total motor blockade
- Total duration of block.
- Tourniquet pain
- Complications.

In present study the observations are as follows-

- Time taken to perform Infraclavicular brachial plexus block was more when it was compared to supraclavicular block. It was found to be significant statistically.
- Time taken for onset and achievement of total blockade of sensory and motor components was found to be quicker in Infraclavicular BPB when compared to supraclavicular BPB.
- Total duration of block was more in Infraclavicular approach than supraclavicular approach.

Altogether there was not much difference in the effectiveness of both the blocks.

SCOPE AND LIMITATIONS

1) All blocks were performed by experienced anaesthesiologists so there was no incidence of any complications like vascular puncture or pneumothorax so it cannot be generalized for beginners. In our institute Infraclavicular block was used relatively less due to which the block performance time might have increased in that group.
2) There was no usage of continuous catheter technique in our study. Studies have proven that it was easier to maintain a catheter using Infraclavicular approach. Further research might be needed to know the scope of catheters.
3) Fixed amount of drug was given rather than per kg body weight which might have affected the duration of blockade.
4) There is no proper evidence to prove that incidence of tourniquet pain was less in Infraclavicular block than supraclavicular block further research is needed to know why there is less tourniquet pain in ICB.

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ANNEXURE I

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH STUDY

- Mr. /Mrs. /Miss. ______________________________, we are requesting you to enroll yourself in the study titled **"COMPARISON BETWEEN ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BRACHIAL PLEXUS BLOCK TO ASSESS THE QUALITY OF SURGICAL ANAESTHESIA AND TOURNIQUET PAIN PREVENTION: PROSPETIVE RANDOMISED OBSERVER BLINDED STUDY"** conducted by REG NO. BA0120004, Post Graduate in M.D. Anaesthesiology under the guidance of Dr. ________________ Department of Anaesthesiology, J.N. Medical College, Belagavi under KAHER, Belagavi.
- Respected Sir/Madam, we request you to participate in our study as you are eligible for it. During the study you will be asked some questions regarding your medical history and you are supposed to answer to the best of your knowledge.
- Your participation in this research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with J.N.Medical College. If you decide to participate you are free to withdraw at any time.
- **Purpose of the study:**
- 1. To Compare the Sensory and Motor blockade in the terminal nerves of brachial plexus and Tourniquet pain between Supraclavicular and Infraclavicular brachial plexus block.
- 2. To Compare Onset and duration of blockade and complications between Supraclavicular and Infraclavicular block

- **Procedure Involved:** If you agree to enroll in my study, I will ask your present, past and family history. Then you will be clinically examined in detail. You will be allotted into one of the two groups randomly using computer generated software.

In Group S Supraclavicular brachial plexus block will be performed and Group I Infraclavicular brachial plexus blocked will be performed.

Benefits:

Prolonged anaesthesia and minimal hemodynamic changes

Patient will not be eligible for any kind of monetary benefits or free services by virtue of your participation in the study.

Risks:

Methods applied to do the study are safe.

Voluntary Participation/Withdrawal: Taking part in the study is voluntary. You may choose not to enroll in the study. Your decision will not change present or future health care services offered to you at KLE's Dr Prabhakar Kore Hospital.

Alternatives: Even if you decline our participation in the study you will get the routine line of management.

Privacy and Confidentiality:

The only people to know that you are as research subject are you and members of the research team. No information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with your identity remaining confidential.

Financial Incentives for participation:

No financial incentives are being offered to enrolled patients. It is purely being done with the idea of research and all the cost of the study will be borne by the investigator.

Compensation:

In the event of injury related to the study, treatment will be made available through KLES Hospital and MRC, Belagavi. There is no compensation or payment for such medical treatment by law. If you get injured you may contact REG NO. BA0120004 at Department of Anesthesiology, J.N. Medical College.

Questions:

In case you have any questions related to the study, in future or in case of study related injury or illness, you can contact REG NO. BA0120004, Department of Anesthesiology, J.N. Medical College, Belagavi. Phone number: 9000634346 Or Dr.______________Dept. Of Anesthesiology, J.N. Medical College, Belagavi

If you have any queries about your rights as a study subject, you may call Dr. Harsha Hegde, Chairperson, J.N. Medical College Institutional Ethical Committee and Scientist D ICMR, National Institute of Traditional Medicine, Belagavi.

ANNEXURE - II - PROFORMA

"COMPARISON BETWEEN ULTRASOUND GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BRACHIAL PLEXUS BLOCK TO ASSESS THE QUALITY OF SURGICAL ANAESTHESIA AND INTRAOPERATIVE TOURNIQUET PAIN: PROSPECTIVE RANDOMISED OBSERVER BLINDED STUDY"

Group allotted :

Name : Age :

Gender : Weight :

Height : Date of Examination :

Address : Occupation :

Pre examination evaluation

Past History

- HTN ☐ DM ☐ IHD ☐ Arrhythmia ☐ Valvular heart diseases ☐

General physical examination

Weight (Kg) : Height (in cm): BMI:

Temperature (^{0}F): Pallor:

Cyanosis : Icterus: Clubbing:

PR : BP: RR: SpO2:

Systemic examination:

RS : CNS :

CVS : GIT :

Preoperative physical status ASA Grade ☐ I ☐ II

Proposed Surgery:

Post-Operative baseline values:

HR: BP: SpO2:

Monitors Attached:

Pulse Oxymeter: NIBP: ECG:

Block Performance Time:

Sensory Blockade:

	Time(In Minutes)
a)Onset of Sensory blockade	
b)Time taken for complete blockade	
c)Total duration of blockade	

Motor Blockade:

	Time(In minutes)
a)Onset of Motor Blockade	
b)Time taken for complete blockade	
c)Total duration of Blockade	

Tourniquet Pain:

Time	
At 30mins	
40 mins	
50 mins	
60 mins	
70 mins	
80 mins	
90 mins	
100 mins	
110 mins	
120 mins	

Intraoperative Analgesia:

Rescue Analgesia: Yes ☐ No ☐

Time of request for first Intra Operative Rescue Analgesia-

Intraoperative Complications- Yes ☐ No ☐

Postoperative Complications- Yes ☐ No ☐

Signature of the Anaesthesiologist-

Signature of the Witness-

Signature of Chief Investigator-

METHODOLOGY:

After obtaining the approval from ethical committee and a written informed consent, a total of 76 members after fulfilling the inclusion criteria will be included in the study. Patients will be randomized based on computer based randomization into two groups.

Group S: 38 members will be enrolled for Supraclavicular block.
Group I: 38 members will be enrolled for Infraclavicular block.

A thorough pre-anaesthetic evaluation will be done a day before surgery.
On the day of Surgery after confirming the NBM status the patient will be shifted to operation theatre. Baseline monitors (Non-invasive blood pressure, Pulse oximeter, and ECG) will be attached and noted. Ringer lactate will be started through 18 gauge IV cannula.
Under aseptic precautions, a preliminary scan will be performed using Sonosite Ultrasound machine. A 8-15 MHz linear probe (B-probe) is used to perform the block. A 22 gauge 50mm insulated stimulation short bevel needle is used to perform the block. Injection Bupivacaine 0.5% with a dosage of 20 – 25 ml is used for the block. For each block the scanning time and the interval from insertion of needle placement to removal of the needle will be noted. All the blocks will be performed by an experienced anaesthesiologist.
Ultrasound Guided Supraclavicular Brachial plexus block technique: Ultrasound Supraclavicular Brachial plexus block technique: The Supraclavicular block will be performed with the patient in supine position and the head tilted to the opposite side and the arm is adducted against side of body. The linear transducer will be positioned in the coronal or oblique plane immediately superior to the clavicle at approximately its midpoint. The brachial plexus trunks and divisions are clustered vertically over the first rib on the lateral side of subclavian artery. The needle is placed in the brachial plexus sheath and Injection Bupivacaine 0.5% will be injected. Spread of the drug within the brachial plexus and centrifugal distribution into the trunks and divisions will be visualized. Motor response will be elicited to confirm correct needle placement.
Ultrasound Guided Infraclavicular Brachial plexus block technique: Infraclavicular block will be performed with patient in supine position. The transducer is placed

below the clavicle in the deltopectoral groove in a parasaggital plane. The operative limb will be either abducted or adducted. After the parts painted and draped, the needle will be directed towards the target area using an in-plane, short axis technique. Injection Bupivacaine 0.5% will be injected posterior to the axillary artery with the intention of achieving a U shaped distribution around the artery. It will also be deposited adjacent to lateral and medial cords.

If we are unable to give block in 10minutes then the study will be abandoned.

The onset and degree of sensory and motor block will be observed every 5 minutes for 30 minutes till the complete block is achieved.

If after 30 minutes complete sensory block is not achieved then it is said to failed block and the study is abandoned and patient will be supplemented with adequate analgesia or converted to general anesthesia.

The sensory score will be assessed by using needle prick method by testing the five individual nerves median nerve, radial nerve, ulnar nerve, musculocutaneous nerve, and medial cutaneous nerve of the forearm. The scoring system used by Abhinaya et al, will be followed for checking the sensory block

Test	Score
Sharp Pain	0
Touch Sensation	1
No Sensation	2

The quality of motor block will be observed using the four point scale adapted from the study done by Abhinaya et al,

Test	Score
Flexion and Extension in both the hand and arm against resistance	0
Flexion and extension in both the hand and arm against the gravity but not against the resistance	1
Flexion and extension movements in the hand but not in the arm	2
No movement in the entire upper limb.	3

At 30 minutes after the tourniquet is inflated and at 10 minutes interval thereafter for the duration of the surgery, patients will be asked for any discomfort. The pain will be assessed according to the Numerical Rating scale (NRS 0 to 10).

NRS will be used as a tool for assessment of tourniquet pain and guide for the treatment of the pain.

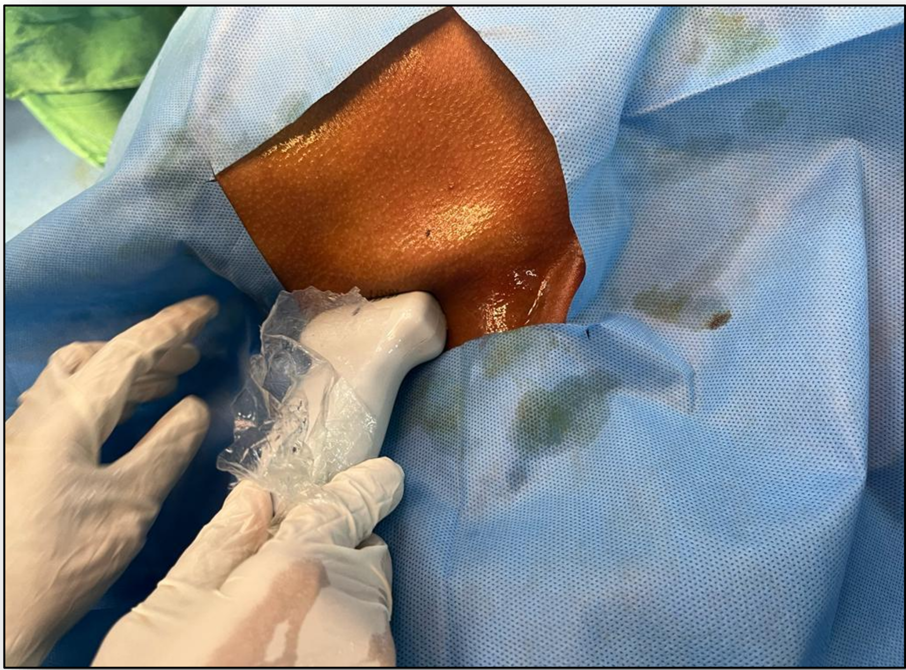
0	No Pain
1-3	Mild Pain
4-6	Moderate Pain
7-9	Severe Pain
10	Worst Imaginable Pain

Patient will be assessed for any other intraoperative and postoperative complications for 48hours.Pnemothorax usually occurs with delayed onset of symptoms and it can take up to 24 hours for the symptoms to develop. Thus we assess the patient upto 48 hours after the block.

ANNEXURE – IV - PHOTOGRAPHS

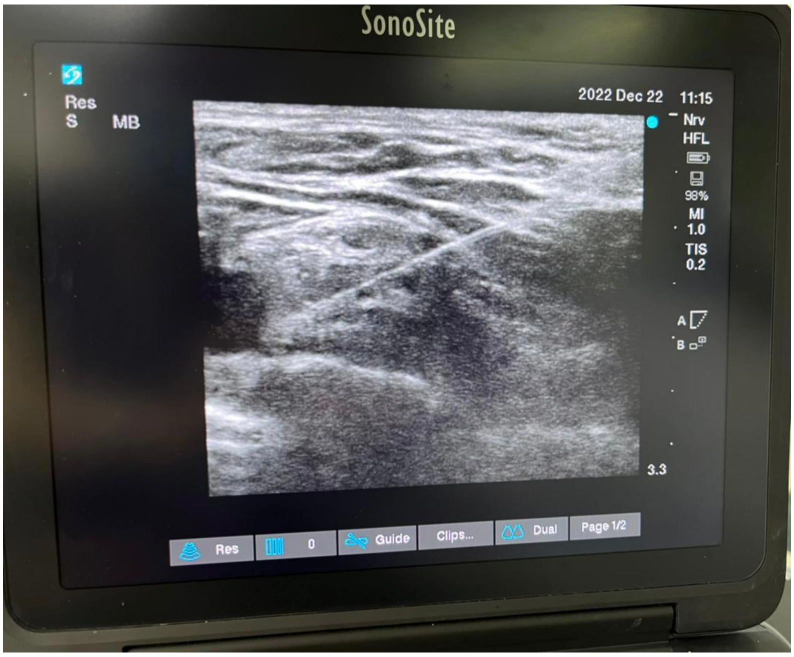
PHOTOGRAPH 1: USG machine with probe

PHOTOGRAPH 2: Linear ultrasound probe

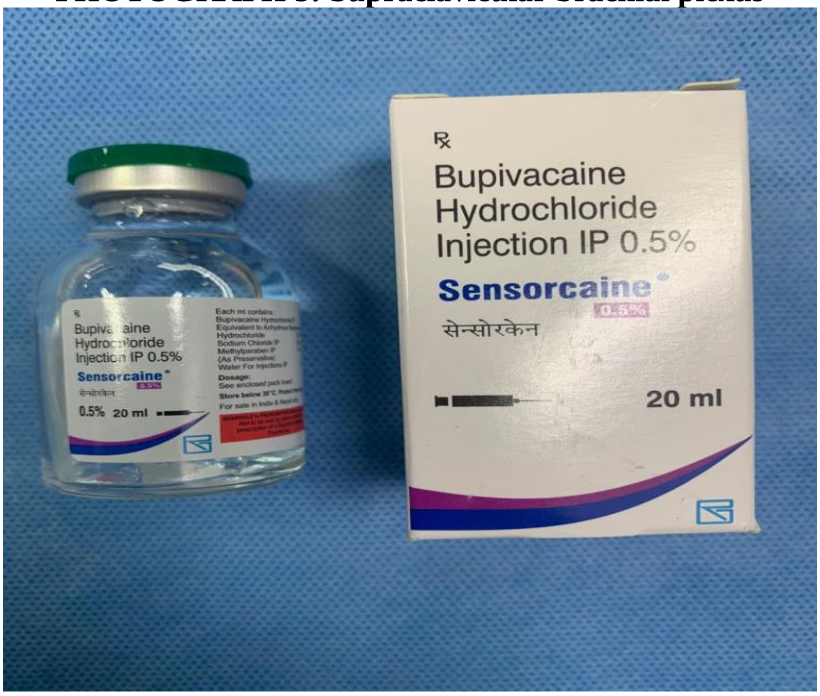


PHOTOGRAPH 3: Performance of block

PHOTOGRAPH 4: Infraclavicular brachial plexus



PHOTOGRAPH 5: Supraclavicular brachial plexus



PHOTOGRAPH 6:0.5% Bupivacaine

ANNEXURE – V - KEY TO MASTER CHART

ASA	American society of Anaesthesiologists (Grades I – II)
cm	Centimeter
kg	Kilogram
min	Minutes
hrs	Hours
BMI	Body mass index
NRS	Numerical Rating Score

MASTER CHART

S. No.	NAME	AGE (Yrs)	SEX	HEIGHT (CMs)	WEIGHT (Kg)	BMI	ASA	Block Performance time(in mins)	Sensory Blockade			Motor Blockade			Tourniquet Pain			Rescue Analgesia		Intraoperative complications		Postoperative Complications	
									Onset(in mins)	Time taken for complete blockade(in mins)	Total duration(in hours)	Onset(in mins)	Time taken for complete blockade(in mins)	Total duration(in hrs)	Yes	No	NRS	Yes	No	Yes	No	Yes	No
1	Mahesh	18	Male	175	65	21.2	1	8	5	6	8	5	10	8		No			No		No		No
2	Yallaling Hasare	25	Male	167	70	25.1	1	8	5	7	8	6	10	8		No			No		No		No
3	Balu Bhairu Patil	56	Male	160	64	25	2	6	6	8	8	7	9	8		No			No		No		No
4	Mahaboob Pasha	39	Male	174	67	21.8	1	5	6	8	8.5	5	8	8.5		No			No		No		No
5	Sunitha Patil	36	Female	150	55	24.4	1	7	5	6	8	7	8	8		No			No		No		No
6	Mukund	22	Male	167	70	25.1	1	7	4	6	8	5	9	8	Yes		4	Yes			No		No
7	Manju Ramesh Hiremath	22	Male	172	63	21.3	1	8	4	5	8.5	6	7	8.5		No			No		No		No
8	Rajesh Suresh Lohar	29	Male	165	67	24.6	1	8	5	7	8	6	8	8	Yes		5	Yes			No		No
9	Priya Godi	30	Female	155	62	25.8	1	7	6	7	8	7	7	8		No			No		No		No
10	Ramesh Gundali	23	Male	162	55	21	1	7	6	8	8	6	9	8		No			No		No		No
11	Ranga Gowda	40	Male	169	60	21	1	8	6	8	8.5	6	8	8.5		No			No		No		No
12	Verappa	59	Male	172	72	24.3	2	9	7	9	8	5	7	8	Yes		4	Yes			No		No
13	Srikanth	25	Male	175	70	22.9	1	6	6	7	6.5	7	8	6.5		No			No		No		No
14	Ravi Ganesh	25	Male	170	70	24.2	1	8	6	7	8.5	5	7	8.5		No			No		No		No
15	Shivanand	47	Male	170	65	22.5	2	8	4	6	8.5	6	8	8.5		No			No		No		No
16	Jailani	48	Male	168	70	24.8	2	10	5	6	8	7	7	8		No			No		No		No
17	Pooja	50	Female	155	50	20.8	2	9	5	5	8	6	6	8	Yes		5	Yes			No		No
18	Manjunath	23	Male	170	65	22.5	1	10	5	5	7.5	6	8	7.5		No			No		No		No
19	Prajwal	20	Female	168	56	19.8	1	8	6	7	8	6	6	8		No			No		No		No
20	Sameer	36	Male	176	70	22.6	1	7	5	7	8.5	7	10	8.5	Yes		6	Yes			No		No
21	Sampat Naik	18	Male	173	60	20	1	8	5	7	8	5	9	8		No			No		No		No
22	Akshay	19	Male	175	60	19.6	1	8	6	6	8.5	7	7	8.5	Yes		5	Yes			No		No
23	Balasaheb	48	Male	170	70	24.2	2	8	6	7	8.5	7	7	8.5	Yes		4	Yes			No		No
24	Basavaraj	40	Male	170	64	22.1	1	8	6	8	8	6	8	8	Yes		5	Yes			No		No
25	Nannesab	38	Male	172	68	23	1	7	5	5	7.5	5	7	7.5		No			No		No		No
26	Sonali	18	Female	158	40	16	1	6	6	6	8	5	5	8		No			No		No		No
27	Satish Shankar	28	Male	165	55	20.2	1	10	7	7	9	5	5	9		No			No		No		No
28	Radha Bai	59	Male	158	65	26	2	10	5	7	8	7	9	8		No			No		No		No
29	Basanagoud	60	Male	165	65	23.9	1	15	5	6	8.5	8	8	8.5		No			No		No		No
30	Suvarna Patil	58	Female	160	65	25.4	2	10	7	7	8	8	8	8		No			No		No		No
31	Mallikarjun Gangappa	59	Male	169	74	25.9	2	9	5	5	8.5	7	7	8.5		No			No		No		No
32	Suvarna Yadal	60	Female	154	64	27	1	8	5	5	8	6	6	8		No			No		No		No
33	Shobha Sunsuddi	47	Female	152	56	24.2	1	7	6	6	8	6	6	8		No			No		No		No
34	Ramesh Mardimani	60	Male	167	66	23.7	2	9	5	5	8	7	7	8		No			No		No		No
35	Shivanand Pattan	38	Male	175	63	20.6	1	8	6	6	9	7	7	9		No			No		No		No
36	Najruddin Imam Mujawar	45	Male	174	67	22.1	2	9	6	6	8	6	6	8		No			No		No		No
37	Yallava Lakshman Komari	35	Female	166	62	23	1	10	7	7	8.5	8	8	8.5		No			No		No		No
38	Dayanand Metri	53	Male	170	60	20.8	2	10	6	6	8	7	7	8		No			No		No		No

S. No.	NAME	AGE (Yrs)	SEX	HEIGHT (CMs)	WEIGHT (Kg)	BMI	ASA	Block Performance time	Sensory Blockade			Motor Blockade			Tourniquet Pain			Rescue Analgesia		Intraoperative complications		Postoperative Complications	
									Onset	Time taken for complete block ade	Total duration(in hrs)	Onset	Time taken for complete block ade	Total duration(in hrs)	Yes	No	NRS	Yes	No	Yes	No	Yes	No
1	Akid Mohammad Rafiq	20	Male	168	60	21.3	1	14	5	6	10	4	5	10		No			No		No		No
2	Sunil	58	Male	170	70	24.2	2	12	4	5	8	5	5	8		No			No		No		No
3	Manoj Balakrishna	41	Male	165	73	26.8	2	10	4	5	10.5	5	6	10.5		No			No		No		No
4	Shabaddin B	40	Male	172	67	22.6	1	10	4	6	10	5	6	10		No			No		No		No
5	Saman Patil	32	Male	175	65	21.2	1	13	4	5	9	4	5	9		No			No		No		No
6	Swapnil	18	Male	170	50	17.3	1	12	4	5	10	4	4	10		No			No		No		No
7	Girija B	40	Female	160	80	31.3	1	12	5	6	9.5	5	5	9.5		No			No		No		No
8	Malu Handu	60	Female	145	63	30	2	10	4	6	9.5	5	6	9.5		No			No		No		No
9	Sidray Patil	35	Male	170	75	26	1	12	5	6	9	4	5	9		No			No		No		No
10	Mallappa	50	Male	172	70	23.7	2	10	5	6	9	5	6	9		No			No		No		No
11	Basavaraj	24	Male	165	62	22.8	1	13	4	6	8.5	4	7	8.5		No			No		No		No
12	Yallu Patil	53	Female	150	62	27.6	1	10	5	6	10	5	7	10		No			No		No		No
13	Kasturi	54	Female	150	50	22.2	2	12	5	5	11	6	6	11		No			No		No		No
14	Irrayya Sonkadi	18	Male	165	55	20.2	1	14	5	6	9	6	6	9		No			No		No		No
15	Jyotsna Shirodkar	60	Female	150	55	24.4	2	10	5	6	9	7	7	9		No			No		No		No
16	Shivalingappa	60	Male	170	65	22.5	2	10	4	4	9.5	4	4	9.5		No			No		No		No
17	Shalan	51	Female	150	50	22.2	2	12	4	4	10	4	4	10	Yes		5	Yes			No		No
18	Basavanthaya	60	Male	165	70	25.7	2	15	4	4	10	4	4	10		No			No		No		No
19	Vamshi	23	Male	175	70	22.9	1	10	5	5	10	5	5	10		No			No		No		No
20	Shyam Naik	59	Male	167	67	23.7	2	12	4	5	10	5	5	10		No			No		No		No
21	Raju	58	Male	170	55	19	2	14	5	6	7	8	5	7		No			No		No		No
22	Arjun Channappa	60	Male	165	60	22	2	13	5	6	10	6	7	10		No			No		No		No
23	Hanamanth A	42	Male	170	70	24.2	1	14	4	5	9	4	6	9	Yes		4	Yes			No		No
24	Vaishalini Sapakale	39	Female	160	55	21.5	2	13	5	5	9	5	5	9		No			No		No		No
25	Moharam Miyan	60	Male	172	62	21	2	14	5	5	9	6	6	9		No			No		No		No
26	Sunitha	30	Female	157	58	23.5	1	13	4	5	10	5	5	10		No			No		No		No
27	Chavusab Buddanavan	43	Male	168	62	22	1	10	4	4	8	5	5	8		No			No		No		No
28	Joao	60	Male	170	61	21.1	2	10	4	4	8	5	5	8		No			No		No		No
29	Rajeshwari	35	Female	157	60	24.3	1	12	4	4	9	5	5	9		No			No		No		No
30	Saifali	27	Male	176	60	19.4	1	12	5	5	9	5	5	9		No			No		No		No
31	Ramesh Yallappa	60	Male	168	62	22	2	10	5	5	8.5	5	5	8.5		No			No		No		No
32	Aniket	23	Male	175	65	21.2	1	10	5	5	9	5	5	9		No			No		No		No
33	Anand Naik	27	Male	170	65	22.5	1	8	5	6	9	5	7	9		No			No		No		No
34	Yallappa	33	Male	168	62	22	1	9	4	5	8.5	4	7	8.5		No			No		No		No
35	Sunanda	60	Female	157	65	26.4	2	9	4	5	9	4	6	9		No			No		No		No
36	Sachin Jamuna	39	Male	166	62	22.5	1	11	5	7	8.5	5	7	8.5		No			No		No		No
37	Raju Tavale	52	Male	162	62	23.6	1	9	4	5	9	4	6	9		No			No		No		No
38	Parasharam	60	Female	165	70	25.7	2	10	4	5	8.5	5	7	8.5		No			No		No		No