"A PROSPECTIVE RANDOMIZED CLINICAL STUDY TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"

By
DR. SUMEDHA R BHAT

Dissertation submitted to the

B.L.D.E. (DEEMED TO BE) UNIVERSITY
SHRI B. M. PATIL MEDICAL COLLEGE
HOSPITAL AND RESEARCH CENTRE
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In partial fulfilment of the requirements for the degree of

DOCTOR OF MEDICINE
IN
ANAESTHESIOLOGY

Under the guidance of
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ABBREVATIONS

ASA- American Society of Anaesthesiologists

ECG- Electrocardiogram

HR- Heart rate

BP- Blood Pressure

I.V- Intravenous

Inj - Injection

NIBP- Non-invasive Blood Pressure

SPO_2- Oxygen Saturation

S.D- Standard Deviation

VAS- Visual Analog Scale

USG- Ultrasonography

mcg- Microgram

mg- Milligram

kg- Kilogram

mL- Millilitre

hrs- Hours

mins- Minutes

p- ‘p’ value

Sl. No.- Serial number

OTSB- Onset time of sensory block

OTMB- Onset time of motor block

TCSB- Time for complete sensory block

TCMB- Time for complete motor block

TDSB- Total duration of sensory block

TDMB- Total duration of motor block

IcBN- Intercostobrachial nerve

ABSTRACT

INTRODUCTION- Axillary plexus block is used as regional anaesthetic technique for elbow, forearm and hand surgery and popular because of its ease, reliability and safety. This route avoids the potential complications like diaphragmatic paresis, pneumothorax and cervical sympathetic nerve blockade associated with the other routes of brachial plexus block.

AIM- This study was conducted to compare the effects of adding fentanyl and buprenorphine to local anaesthetics in ultrasound guided brachial plexus block via axillary approach.

OBJECTIVES -PRIMARY OBJECTIVES

1) Onset time of sensory and motor block
2) Time to achieve complete sensory and motor block
3) Duration of analgesia and motor block

SECONDARY OBJECTIVE- Side effects and complications

SUBJECTS- Prospective randomised study was conducted on 60 patients ASA I & II who were posted for forearm wrist and hand surgeries. Patients were allotted in Group A and Group B of 30 each.

METHODS- In both the groups volume of drug used was 21ml. Group A received Inj lignocaine 2% with adrenaline (1:200000) 10ml, Inj Bupivacaine 0.5% 10ml, Inj Fentanyl 50 micrograms. Group B received Inj lignocaine 2% with adrenaline (1:200000) 10ml, Inj Bupivacaine 0.5% 10ml, Inj Buprenorphine 0.3mg. 10ml of drug was injected around each nerve under ultrasound guidance. Primary and secondary outcomes were noted

RESULTS- The mean onset of sensory and motor block was significantly faster in Group B (OTSB-2.8±0.6 mins, OTMB- 4.7±0.8 mins) when compared to Group A (OTSB-4.4±0.8mins, OTMB- 6.9 ±1.4 mins). The mean time to achieve complete sensory and motor block in group B was significantly earlier (TCSB-8.2±0.8 mins, TCMB- 11.2±1.0 mins) than Group A (TCSB- 11.0 ±0.8 mins, TCMB- 14.0 ±1.2 mins).The mean total duration of sensory, motor block and the duration of analgesia was prolonged in Group B (TDSB-277.3±9.8 mins, TDMB- 310±9.9 mins) when compared to Group A (TDSB- 230.5±11.3 min, TDMB- 256.3 ±14.5 mins). In Group B 3 patients complained of nausea and vomiting with p value of 0.076 which is statistically not significant and no serious complications was observed in the perioperative period in any of the groups.

CONCLUSION- Buprenorphine as an adjuvant to local anaesthetics has early onset of sensory and motor blockade, time to achieve complete sensory and motor block is less and has prolonged duration of analgesia without any significant clinical side effects.

KEY WORDS: Axillary plexus block, ultrasonography, fentanyl, buprenorphine.

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INTRODUCTION

The axillary brachial plexus block was first described by William Stewart Halstead at St. Luke's Roosevelt Hospital Centre, New York City in 1884. It is a commonly used regional anaesthetic technique for elbow, forearm and hand surgery and popular because of its ease, reliability and safety.

This route avoids the potential complications like diaphragmatic paresis, pneumothorax and cervical sympathetic nerve blockade associated with the other routes of brachial plexus block.[1,2] It is useful in patients with significant comorbidities like cardiovascular and respiratory disease and provides superior analgesia and avoids common side effects associated with general anaesthesia.[3]

Peripheral nerve blocks and an opioid sparing analgesic have become standard anaesthesia practice all over the world. Unfortunately local anaesthetic have limited duration of analgesia. So adjuvants are added to local anaesthetics to improve the quality, onset of regional blockade or to prolong postoperative analgesia time.[3]

This study is conducted to compare the effects of adding adjuvants like fentanyl and buprenorphine to local anaesthetic bupivacaine in brachial plexus block via axillary approach under ultrasound guidance.

The features that are observed are the onset time of sensory and motor blocks, the time to achieve complete sensory and motor blocks and the duration of analgesia and motor blocks, along with side effects or complications.

AIMS AND OBJECTIVES OF THE STUDY

AIM:

To compare the effects of adding fentanyl and buprenorphine to local anaesthetic in ultrasound guided brachial plexus block via axillary approach

OBJECTIVES:

- **PRIMARY OBJECTIVES**

1) Onset time of sensory and motor block
2) Time to achieve complete sensory and motor block
3) Duration of analgesia and motor block

- **SECONDARY OBJECTIVE**

1) Side effects and complications

REVIEW OF LITERATURE

HISTORY OF BRACHIAL PLEXUS BLOCK:

1911-1912, Kulenkampff described percutaneous supraclavicular approach for the first time. He pointed out that above the clavicle the plexus lie under the skin as it passes over the first rib and is accessible to a percutaneous technique. The midpoint of the clavicle and subclavian artery provide a constant landmark, most frequently at the point where external jugular vein intersects the clavicle. He performed this on himself first and used 5 ml of Novocain. Later he increased it to10 ml and was able to obtain complete anaesthesia. Direction of the needle was backwards, inwards and downwards. He emphasized that the purpose of the technique was not to hit the rib but to find the trunks by eliciting paraesthesia. He said that the rib just prevented pleural penetration. He used 4 cm needle.[4,5]

In 1926, Livingston, carried out Kulenkampff's technique without producing paraesthesia as soon as the deep cervical fascia had been penetrated, 30 ml of 2% procaine was injected. He wrote that the plexus and the artery are separated from the surrounding structures by a fascial investment.[4]

In 1940, Patrick chose to lay down a "wall of anesthetic" through which the plexus pass in its course over the first rib, where 60-70 ml of solution was injected during 5-6 insertions. The technique became the "standard technique" of supraclavicular block, subsequently referred to by many as the "classical supraclavicular technique".[4]

In 1942 Knight modified Patrick's technique. He made the three injections through three separate needle insertion, parallel to one another. For the first time he utilized a directly caudal direction of needle insertion. In 1944, Murphey used a single injection technique and used

lateral border of anterior scalene muscle as the landmark and direction of needle insertion was caudal as with Knight's technique, not medial or dorsal, as with most other techniques.

In 1949, Bonica and Moore utilized Kulenkampff's and Patrick's technique and developed a technique which began with utilizing the classical landmarks for direction of needle insertion and demanded a definite paraesthesia prior to first injection. Then continued as Patrick's technique and laid down a wall of anaesthetic solution by "walking the rib" and made multiple injections during each withdrawal of the needle.

By late 1940s, clinical experience with brachial plexus block during peacetime and wartime surgery was extensive, and new approaches of brachial plexus block began to be described.

In 2006, Ali Movafegh et al. conducted a study y to evaluate the effect of lidocaine with dexamethasone on the onset and duration of axillary brachial plexus block. 60 patients scheduled for elective forearm and hand surgery were randomly allocated to receive axillary brachial plexus block with either 34 mL lidocaine 1.5% with 2 mL of isotonic saline chloride (control group, n 30) or 34 mL lidocaine 1.5% with 2 mL of dexamethasone (8 mg) (dexamethasone group, n30).. After block performance, sensory and motor blockade of radial, median, musculocutaneous, and ulnar nerves were recorded at 5, 15, and 30 min. They concluded that the addition of 7 dexamethasone to lidocaine 1.5% solution in axillary brachial plexus block prolongs the duration of sensory and motor blockade.[(6)]

Dhrubajyothi Sarkar, Gurjeeth Khurana, Amit Chaudhary, J P sharma (2010) evaluated the efficacy of fentanyl and buprenorphine in improving the blockade characteristics when used as an additives in supraclavicular block. Three groups Group A, B, C were selected. Group A received the mixture of lignocaine 2% with adrenaline (1:2,00,000) 10ml+Bupivacaine (0.5%) 20ml+distilled water 10ml. Group B received 0.3mg buprenorphine

and Group C received 50microgram fentanyl in addition to above local anaesthetics in same volume and concentrations. It was concluded that the addition of buprenorphine to local anaesthetics provide long lasting analgesia without any significant increase in the complications.(7)

Fatma Gad El-rab Askar et al. (2017) compared the analgesic efficacy of fentanyl when added to bupivacaine for infraclavicular brachial plexus block in forearm orthopaedic surgeries and concluded that addition of fentanyl to bupivacaine significantly prolongs the duration of analgesia with greater duration of sensory blockade compared to bupivacaine for infraclavicular brachial plexus block.(3)

Karakaya et al (2001) conducted a trial to evaluate the analgesic and anaesthetic effects of adding fentanyl to bupivacaine in axillary brachial plexus block among three groups,40 mL bupivacaine 0.25% (group B), 40 mL bupivacaine 0.25% with fentanyl 2.5 μg/mL (group BF), or 40 mL bupivacaine 0.125% with fentanyl 2.5 μg/mL (group DBF) and concluded that the addition of 100 μg/mL fentanyl to 0.25% bupivacaine almost doubles the duration of analgesia following axillary brachial plexus block when compared with 0.25% bupivacaine alone.(8)

Candido et al (2002) evaluated the efficacy of adding buprenorphine to local anaesthetic for brachial plexus block through supraclavicular approach to provide postoperative analgesia. Patients were divided in to Group 1 and Group 2. Group 1 received 40ml local anaesthetic alone and group 2 received same local anaesthetic + buprenorphine 0.3mg and concluded that addition of buprenorphine provided 3 fold increase in duration of postoperative analgesia with

complete analgesia persisting for 30hrs and beyond the duration provided by local anaesthetic alone in 75% of the patients.[9]

Shirish G.Chavan, Alka R. Koshire, Prasad Panbude (2011) A comparative study was carried out to evaluate the analgesia efficacy and side effects of addition of fentanyl to local anaesthetic undergoing forearm and elbow surgeries with brachial plexus block through supraclavicular approach and concluded that the mean duration of analgesia is extended if fentanyl is added to local anaesthetic.[10]

Siamak Yaghoobi, Mahyar Seddighi, Zohreh Yazdi, Razieh Ghafouri, and Marzieh Beigom Khezri(2013) studied the comparison of postoperative analgesia effect of dexamethasone and fentanyl added to lignocaine through axillary approach in forearm fracture and concluded that the addition of dexamethasone to lignocaine significantly prolonged the duration of analgesia compared with fentanyl/ lignocaine mixture or lignocaine alone using axillary block in patients undergoing forearm fracture surgery.[11]

Nishikawa *Et al* studied the effect of adding fentanyl to lidocaine for axillary brachial plexus block in 66 patients scheduled for elective hand and forearm surgery and concluded that addition of fentanyl to lidocaine in axillary brachial plexus block can increase the success rate and prolongs the duration of analgesia, but it delays the onset time of sensory blockade as compared with the same dose of lidocaine.[12]

ANATOMY[13]

BRACHIAL PLEXUS:

The effective use of brachial plexus blockade for upper limb surgeries needs thorough knowledge about the anatomy of the brachial plexus. It is essential to know about the formation, distribution, its vascular, muscular and fascial relationships to master this technique. The fibres that constitute the plexus are composed of roots, trunks, cords, divisions and terminal nerves.

FORMATION OF THE PLEXUS

ROOTS

The plexus is formed by the anterior primary rami of 5th to 8th cervical nerves and 1st thoracic nerve. Occasionally 4th cervical nerve is combined with the plexus.

TRUNKS

The roots emerge from the intervertebral foramina and lie between the anterior and posterior tubercles of the respective transverse process. As the roots descend between the scalenus anterior and medius, C5 and C6 roots unite to form the upper trunk. C7 root continues as the middle trunk and C8 and T1 unit to form the lower trunk. Each trunk divides into anterior and posterior divisions behind the clavicle and form cords in the axilla.

CORDS

The stream of six divisions join up into three cords; lateral, medial and posterior and are composed of as follows. Anterior divisions of upper and middle trunks unite to form the lateral cords. Anterior division of the lower trunk continues as the medial cord posterior divisions of upper, middle and lower trunks unite to form the posterior cord.

BRANCHES

Branches are given off from roots, trunks and cords.

BRANCHES FROM ROOTS

1) Nerve to the serratus anterior C5, C6 and C7.

2) Muscular branches to

a. Longus cervices C5-C6

b. Three scalene muscles C5-C8

c. Rhomboids C5

3. Twig to the phrenic nerve C5

BRANCHES FROM THE TRUNKS

1) Suprascapular nerve C5-C6 (Upper trunk)

2) Nerve to subclavius C5-C6

BRANCHES FROM THE CORDS

Lateral Cord

1) Lateral pectoral nerve C5-C7
2) Lateral branch of median nerve C5-C7
3) Musculocutaneous nerve C5-C7

Medial Cord

1) Medial pectoral nerve C8-T1

2) Medial branch of median nerve C8-T1

3) Medial cutaneous nerve of arm C8-T1

4) Medical cutaneous nerve of forearm C8-T1

5) Ulnar nerve (C7, C8, T1)

Posterior Cord

1) Upper subscapular nerve (C5-C6)

2) Lower subscapular nerve (C5-C6)

3) Nerve to lattismus dorsi C6, C7, C8

4) Axillary nerve C5-C6

5) Radial nerve C5-T1

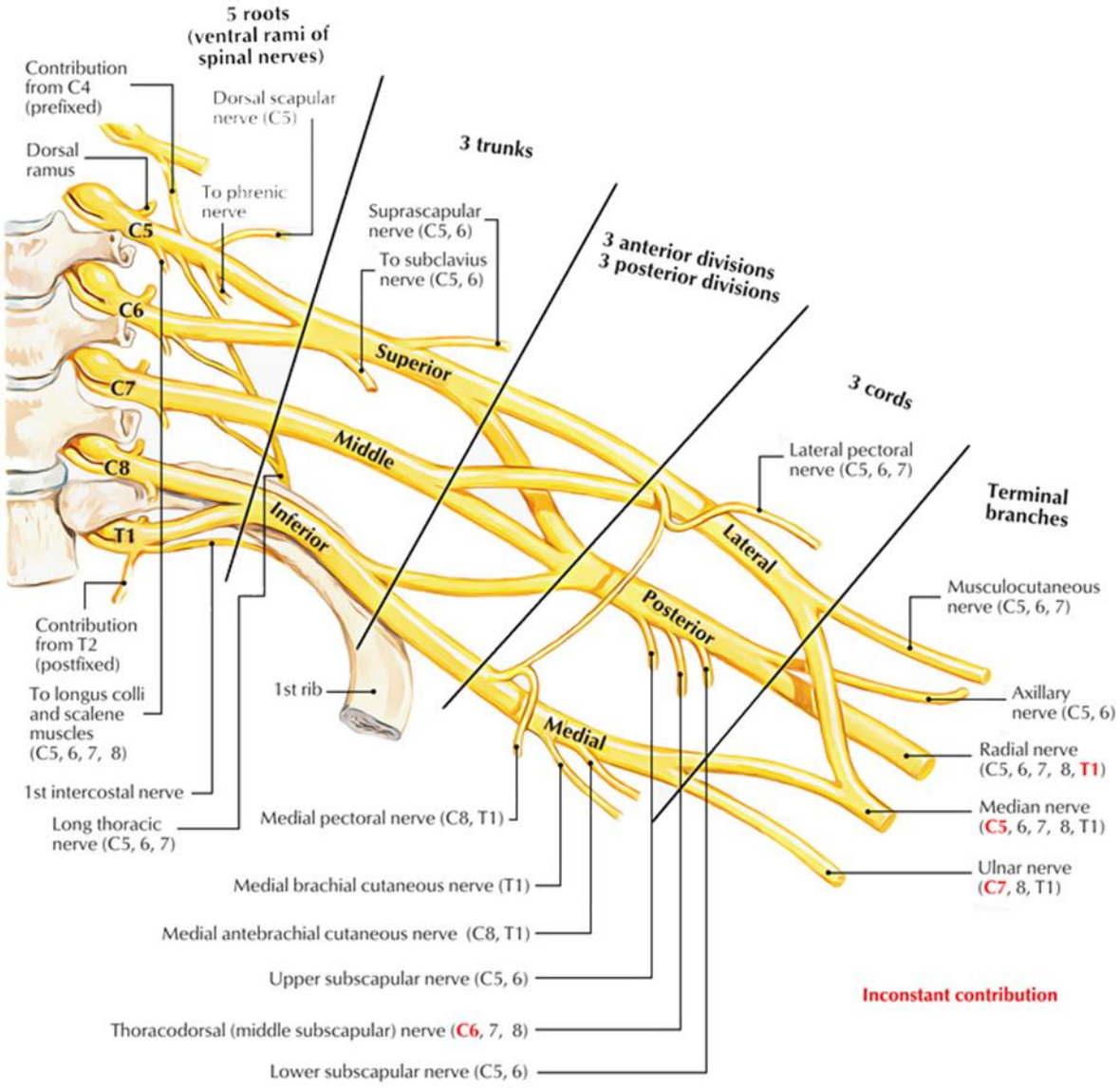


Fig 1 BRACHIAL PLEXUS

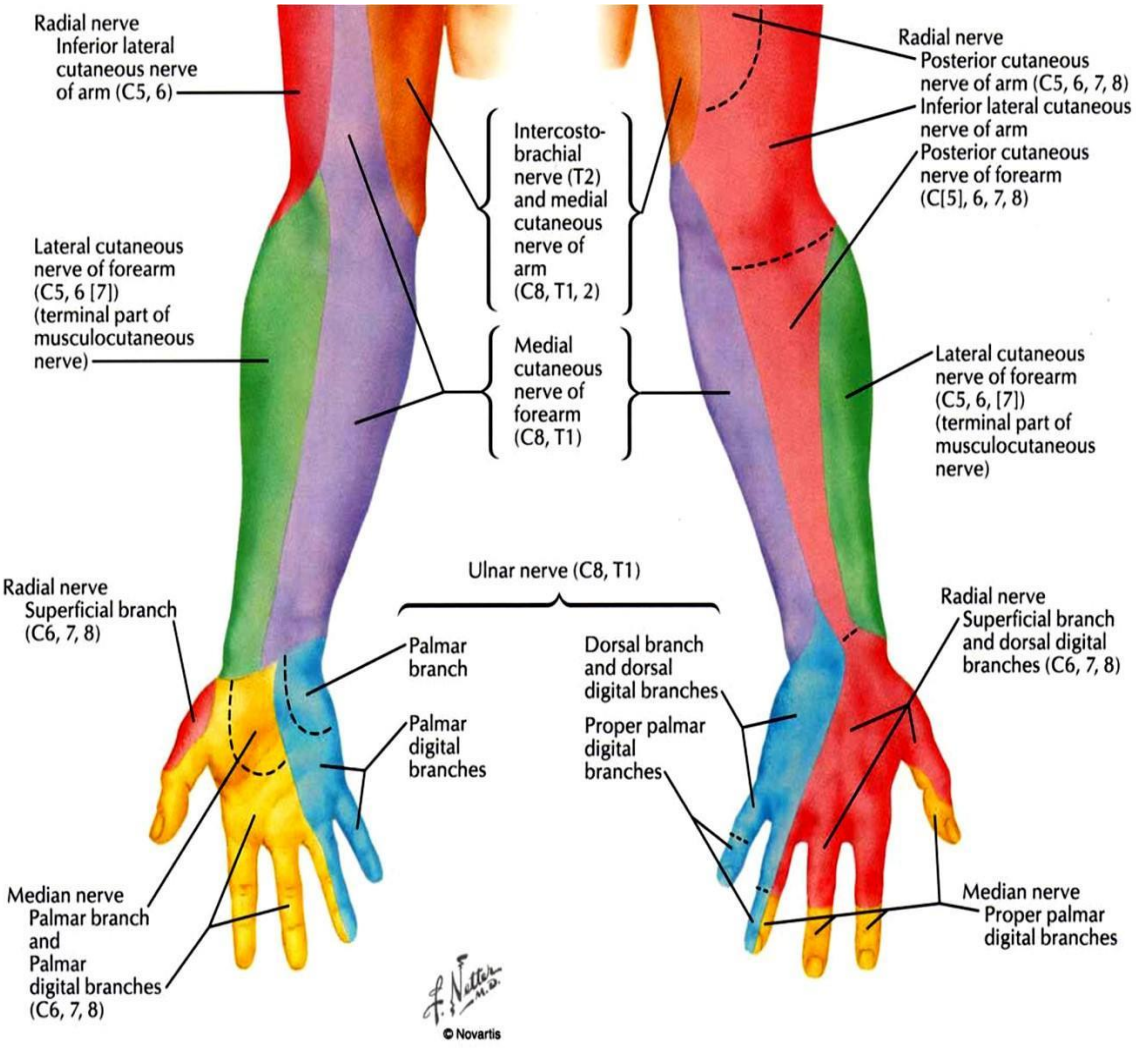


Fig. 2- Sensory Innervations of Palmar and Dorsal Surface

RELATIONSHIP OF THE BRACHIAL PLEXUS [14]

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

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

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

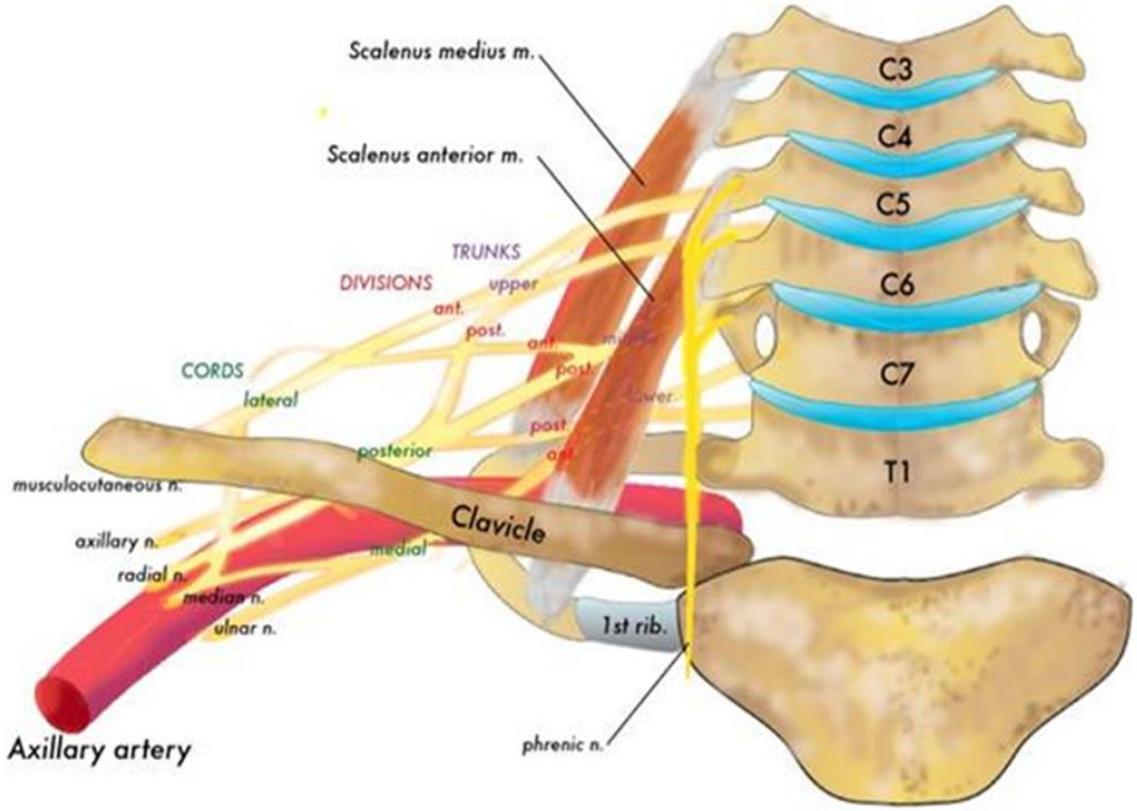


Fig 3 RELATIONSHIP OF THE BRACHIAL PLEXUS

Brachial Plexus sheath

In its course brachial plexus is in close relationship to certain structures. In its position between anterior and middle scalene muscles the plexus lie superior and posterior to 2nd and 3rd part of the subclavian artery which is also located between two muscles. Anteromedial to the lower trunk and posteromedial to the artery lies the dome of the pleura. Winnie, Radonjic, Sudarsana Rao, Akkineni, and Zia Durrani,(15) pointed out the fascial barriers that surround these structures and factors influencing the distribution of local anaesthetics in the sheath.

The prevertebral fascia divides and invest to the anterior and middle scalene muscles and then fuses at the lateral margins to form enclosed interscalene space. Therefore as the nerve roots leave the transverse process, they emerge between the two walls of fascia that cover the anterior and middle scalene muscles and in their descent towards the first rib to form trunks of the plexus, the roots may be considered to be sandwiched between anterior and the middle scalene muscles, the fascia of which serves as a sheath for the plexus.

As the roots pass down through this space, they converge to form trunks of the brachial plexus. Together with subclavian artery they invigilate the scalene fascia which form subclavian perivascular sheath, which in turn becomes the axillary sheath as it passes under the clavicle. All the techniques for blocking of brachial plexus involve the location of nerves and injection of local anaesthetic mixture within the fascial sheath.

DIFFERENT TECHNIQUES OF BRACHIAL PLEXUS BLOCK USING USG

A] Blocks above the clavicle

Level of the roots - Interscalene brachial plexus block

Trunks - Subclavian brachial plexus block

B] Blocks below the clavicle

Division/Cords - Infraclavicular brachial plexus block

Cords/Terminal nerves - Axillary brachial plexus block

Ultrasound allows direct visualization of peripheral nerves, the block needle, and local anaesthetic distribution. This imaging modality has proven highly useful to guide targeted drug injections and needle placement.

ULTRASOUND GUIDED AXILLARY BRACHIAL PLEXUS BLOCK

The axillary approach to brachial plexus was first demonstrated in 1884 by William Halsted when he injected cocaine under direct vision.[16] In 1911, G. Hirschel performed the first percutaneous axillary block.[17] It was only after Burnham's publication in 1959.[18] that this block gained popularity among anaesthetists.

Reding in 1921 is thought to be the first to highlight the importance of the neurovascular sheath in the axillary plexus block. His description of the anatomy of the brachial plexus within the axilla included discussion of nerve bundle surrounded by a fascial sheath. Reding was also aware that blocking of the musculocutaneous nerve required injection of local anaesthetic within the coracobrachialis muscle since nerve was not contained within the sheath.[19]

In 1958 Preston Burnham, an orthopedic surgeon revived the neurovascular sheath approach for blocking the brachial plexus. While repairing an axillary laceration in a child, Burnham noted that the nerves entering the axilla were proximal to the axillary artery. Additionally, a fascial sheath surrounded both nerves and vasculature. If the sheath were entered with one pass of a needle, multiple nerves could be bathed with local anaesthetic.

In 1981, Abramowitz and Cohen described the use of Doppler ultrasound to identify the axillary artery for the first time, thereby aiding the performance of axillary plexus block for upper limb surgery.[20] But the use of B-mode ultrasound in 1989 for axillary block performance heralded the era of ultrasound-guided peripheral nerve block.[21]

Axillary brachial plexus block offers several advantages over other approaches. The technique is relatively simple, and complications are very less as compared to interscalene (spinal cord, vertebral artery puncture) or supraclavicular (pneumothorax). The block is easy to perform because of its superficial location.

Indication:

- Surgical anaesthesia for elbow, forearm, and hand procedures,
- Cutaneous anesthesia for superficial procedures of the inner arm, for example, brachiobasilic fistula formation,
- Chronic pain treatment.

Anatomic consideration of axillary block include the following:[22]

- The neurovascular bundle is multi-compartmental.
- The important landmark is the axillary artery.
- There is a large degree of anatomical variability in nerve positions around the axillary artery, extended scanning up and down the arm is recommended to locate the nerves accurately.
- At this level, the musculocutaneous nerve has already left the sheath and lies with the coracobrachialis muscle.
- Adequate anaesthesia for the tourniquet requires intercoastobrachial nerve block (IcBN). IcBN is the lateral branch of the anterior ramus of T2 and provides cutaneous innervation to the upper medial and posterior part of the arm. It can be blocked by subcutaneous infiltration along the medial aspect of the arm from the anterior axillary line to the border of triceps. Using a landmark technique 5 – 10 ml of local anaesthetic is required.

Patient positioning- All of the axillary block techniques require the patient to be positioned supine, with the arm abducted 90° and the head turned toward the contralateral side. The axillary artery pulse should be palpated and its location marked as a reference point.

Techniques of Axillary Block-[22] Several methods of identifying the axillary sheath have been described, all with reportedly good results

- Paresthesia technique- Paresthesia can be sought with a 25-gauge, 2-cm needle, beginning with radial nerve or with the nerves supplying the surgical site. Smaller needles and a short needle bevel may be associated with a less frequent risk of nerve damage. Each paresthesia is injected with 10 mL of local anaesthetic.
- A nerve stimulator can also be used with an insulated needle to locate the nerves. Stimulation with a low current threshold (0.5 mA). This decreases onset time, but increases block performance time compared with higher threshold stimulation (1.0 mA).
- A short-bevel needle can be advanced until the axillary sheath is entered, as evidenced by a fascial click, whereupon 40 to 50 mL of solution is injected after negative aspiration.
- A transarterial technique can be used, whereby the needle pierces the artery and 40 to 50 mL of solution is injected posterior to the artery. Alternatively, half of the solution is injected posterior and half is injected anterior to the artery. Great care must be taken to avoid intravascular injection with this technique, particularly because the pressure of injection within the compartments of the axillary sheath may move anatomic structures in relation to the immobile needle.

Ultrasound Anatomy [23]

The patient is made comfortable in supine position with the arm abducted and the elbow flexed to 90 degrees. After skin and probe preparation, a linear, high frequency transducer is placed in the transverse plane at the lateral border of pectoralis major muscle to obtain the best view of the brachial plexus. Image quality is optimised with selection of appropriate depth, focus range and gain. The structures of interest are very superficial with the pulsating axillary artery localised within 1 cm. Easing the pressure on the transducer often reveals one or more axillary veins which is often located medially to the artery. Surrounding the axillary artery, one will find the three out of four terminal branches of the brachial plexus: the median (superficial and lateral to the artery), the ulnar (superficial and medial to the artery) and the radial (posterior and lateral or medial to the artery) nerves. They often have honey comb appearance with heterogeneous echogenecity. The fourth terminal branch, the musculocutaneous nerve is often seen as a hyperechoic flattened oval shape nerve in the plane between the biceps and coracobrachialis muscles. There is a considerable variation in the position of the nerves among individuals. The most common nerve seen at 11-12 o'clock position is median nerve, the ulnar nerve at 2-3 o'clock, the radial nerve at 4-6 o'clock and in relation to the artery the musculocutaneous nerve is seen at 8-9 at o'clock [24]

The needle is inserted in plane from the cephalad aspect and drug is deposited anterior and posterior aspect of axillary artery. This method is also called as perivascular method of axillary brachial plexus block. In other method we target each nerve individually and give drug at each nerve and visualize drug spread. This method is called perineural method of axillary brachial plexus block. The musculocutaneous nerve is separately blocked in both methods. Two or three redirections and injections are usually necessary for reliable blockade

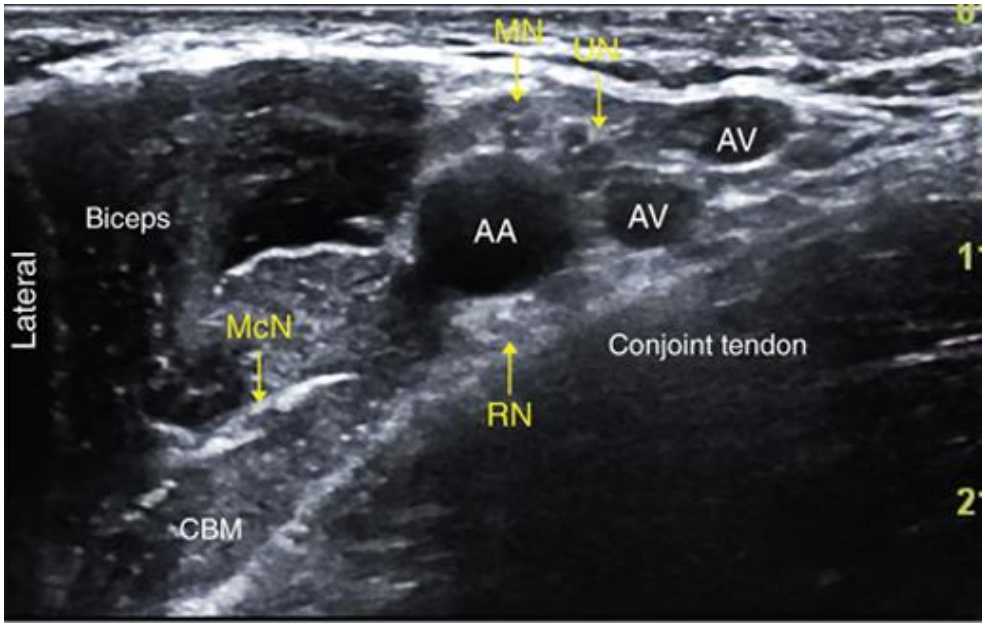


Figure 4: USG Image of Axillary Block

AA-axillary artery, AV- Axillary vein CBM-coracobrachialis, McN-musculocutaneous nerve, UN-ulnar nerve, RN-radial nerve, MN-median nerve

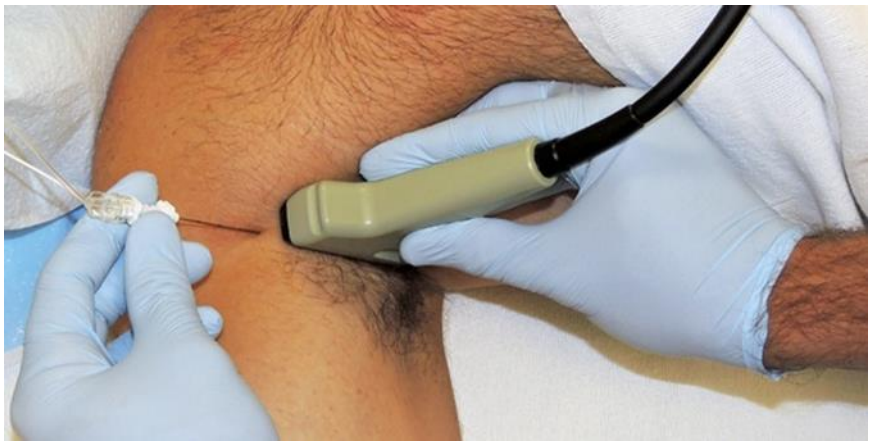


Figure 5: Probe And Needle Placement For USG Guided Axillary Block

PHARMOCOLOGY OF LOCAL ANAESTHETICS [25]

Local anaesthetics produce reversible conduction blockade of impulses along central and peripheral nerve pathways. With progressive increases in concentrations of local anaesthetics, the transmission of autonomic, somatic sensory, and somatic motor impulses is interrupted, producing autonomic nervous system blockade, sensory anaesthesia, and skeletal muscle paralysis in the area innervated by the affected nerve.

MECHANISM OF LOCAL ANAESTHETICS [25]

Local anaesthetics prevent transmission of nerve impulses (conduction blockade) by inhibiting passage of sodium ions through ion-selective sodium channels (a specific receptor for local anaesthetic molecules) in nerve membranes. Failure of sodium ion channel permeability to increase slows the rate of depolarization such that threshold potential is not reached and thus an action potential is not propagated

Chemical structure [26]

Based on chemical structure local anaesthetics can be classified

{A} Aminoesters- Procaine, cocaine, tetracaine, choroprocaine. They have an ester linkage between the benzene ring and the intermediate chain. These are hydrolyzed in plasma by pseudocholinesterase. Primary metabolite of ester compounds is paraminobenzoic acid (PABA), which has allergic potential.

{B} Aminoamides- Lidocaine, mepivacaine, bupivacaine, ropivacaine. They have an amide link between the benzene ring and intermediate chain. These are degraded in the liver by microsomal enzymes. The amide drugs are not metabolized to paraaminobenzoic acid and do not produce allergic reactions. Multi-dose vials of amide local anaesthetic may contain methylparaben which is a paraaminobenzoic acid derivative with allergic potential.

ADJUVANT DRUGS [27]

1) Epinephrine- Epinephrine is a commonly used additive to local anaesthetics when performing peripheral nerve blocks. Epinephrine has been shown to increase block intensity as well as duration of anaesthesia and analgesia with intermediate-acting local anaesthetics. As a vasoconstrictor with strong alpha1 effects, epinephrine decreases systemic absorption of the local anaesthetic limiting peak plasma levels and prolonging block time. The drug also provides a marker for intravascular injection in dilute concentrations due to its beta-1 effects. Adjuvant use of epinephrine will have systemic effects, including tachycardia and increased cardiac inotropy, and therefore its use in patients with a significant cardiac history should be carefully considered. The drug should probably be avoided when performing a block to an area receiving diminished or absent anastomotic blood flow. Due to concerns about ischemic neurotoxicity, doses administered in concentrations of 1:400,000 (2.5mcg/ml) or less may be prudent. Epinephrine administered perineurally decreases extrinsic blood supply when administered in higher concentrations, though there is no evidence this effect is detrimental to humans.

2) Clonidine-It prolongs duration of local anaesthetics by synergistic alpha-2effects. It has lesser or no prolongation with Bupivacaine and Ropivacaine but prolongs the duration with Mepivacaine-Lidocaine by 40-400% with the addition of 100 micrograms of clonidine. Larger doses are not additive and cause more side effects.

3) Sodium bicarbonate, hyaluronidase: onset time was reduced, and the duration was variable.

4) Opioids: Onset time was reduced, and the duration was prolonged, but reports were controversial.

5)Dexamethasone- The drug clinically appears to lengthen the sensory, motor, and analgesic time of peripheral nerve blocks when added to both intermediate and longer-acting local anaesthetics. The mechanism by which this effect occurs has yet to be determined. At the time

of writing, a number of studies have been published showing a beneficial effect of dexamethasone as an adjunct to local anaesthetics in regional anaesthesia and pain medicine procedures. Dexamethasone use in epidural steroid injections is increasingly popular among pain practitioners because of the medications pharmacologic profile in comparison with other corticosteroids: dexamethasone is nonparticulate and void of neurotoxic preservatives. Concern over ischemic neurotoxicity has been raised due to the drugs effect, like epinephrine, of decreasing normal nerve tissue blood flow as demonstrated by topical application of 0.4% dexamethasone to the exposed sciatic nerve in rats. As when using epinephrine, it would seem prudent to properly select candidates for adjunctive use of dexamethasone excluding patients at greatest risk for ischemic nerve injury (e.g., poorly controlled diabetes, pre-existing nerve injury, or demyelinating disorder).

BUPIVACAINE

Bupivacaine is a local anaesthetic agent with long duration of action. It is one of the homologous series synthesized by Ekenstam [28] in 1957 and its first clinical use was made in 1963 by LJ Telivuo.

Pharmacology:[28,29,30]

Bupivacaine hydrochloride is 2 piperidine carboxamide, 1 butyl N-2, 6 dimethyl phenyl, monohydrochloride, monohydrate. Bupivacaine molecule is a tertiary amine separated from an aromatic ring system that is a benzene ring by a chain. The tertiary intermediate amine is a base that is a proton acceptor. The chain contains an amide linkage (-NHCO-) hence it is classified as an aminoamide compound. This amide linkage contributes to the anaesthetic potency.

- The aromatic ring system gives a lipophilic character to its portion of molecule whereas the tertiary amine end is relatively hydrophilic.

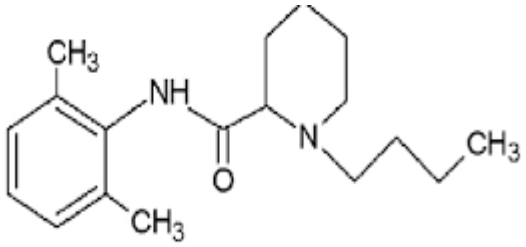


Figure 6: Chemical structure of bupivacaine

Structure - Activity relationship:

Bupivacaine being more lipophilic (because of butyl group) it is very potent and produces longer lasting blocks. pKa of any drug is defined as the hydrogen ion concentration specific for each drug at which the concentration of local anaesthetic base is equal to the concentration of charged cation. pKa for Bupivacaine hydrochloride is 8.1 at 36°C.

Safety dose- 2-3mg/kg

Concentration clinically used

- For Infiltration- 0.125%- 0.25%
- For peripheral nerve blocks- 0.25%- 0.5%
- Surgical or obstetrical epidural- 0.125%-0.75%
- Spinal- 0.5% heavy

PHARMACODYNAMICS

Mechanism of action: [31]

The uptake of the drug by the tissues is due largely to lipophilic absorption. This shifts effective pKa downward and thereby favours the neutral base form.

Local anaesthetics acts on sodium channels and thus causes nerve block[32,33,34]. Bupivacaine blocks impulses by reducing the currents through voltage-activated Na + channels. The inhibition is not specific; however, K+ currents are also reduced. Binding of Bupivacaine to sites on voltage gated Na+, channels prevents opening of the channels by inhibiting conformational changes.

PHARMACOKINETIC: [29,30,35]

The concentration of Bupivacaine in the blood is determined by the amount injected, the rate of absorption from the site of injection, the rate of tissue, distribution and the rate of bio-transformation and excretion of the drug.

Absorption:

The systemic absorption of Bupivacaine is determined by the site of injection, dosage and addition of a vasoconstrictor agent. The maximum blood level of Bupivacaine is related to the total dose of the drug administered at any particular site of injection.

Distribution:

The distribution of Bupivacaine can be described by two or three compartment model. The rapid distribution phase (alpha) phase is believed to be related to uptake by rapidly equilibrating tissues, that is tissues which have a high vascular perfusion. The slower phase (beta) is mainly a function of distribution to slowly equilibrating tissues and the bio-transformation and excretion of the compound.

More highly perfused organs show higher concentration of the drug. Bupivacaine is rapidly extracted by lung tissue. The highest percentage of injected dose of the local anaesthetic is found in skeletal muscle.

Biotransformation and excretion:

Bupivacaine undergoes enzymatic degradation primarily in the liver. The excretion of Bupivacaine occurs via the kidney. Less than 5% of the unchanged drug is excreted via the kidney into the urine. The major portion of the injected agent appears in the urine in the form of various metabolites. 2, 6 pipecoloxylidide is a N-dealkylated metabolite of Bupivacaine. Renal clearance of the drug is related inversely to its protein binding capacity and to the pH of urine.

Toxicity of Bupivacaine: [36,37]

It is relatively free of side effects if administered in an appropriate dosage. It is more cardiotoxic than Lignocaine and this is made worse by hypoxia, hypercapnia and by pregnancy.

1. Central nervous system toxicity:

CNS is more susceptible to Bupivacaine. The initial symptoms involve feeling of light headedness and dizziness followed by visual and auditory disturbance. Disorientation and occasional feeling of drowsiness may occur. Objective signs are usually excitatory in nature which includes shivering, muscular twitching and tremors; initially involving muscles of the face (perioral numbness) and part of extremities. At still higher doses cardiovascular or respiratory arrest may occur. Acidosis increases the risk of CNS toxicity from Bupivacaine, since the elevation of PaCO2 enhance cerebral blood flow, so that more anaesthetic is delivered rapidly to the brain.

2. Cardiovascular system toxicity:

Bupivacaine depresses rapid phases of depolarization (Vmax) in purkinge fibres and ventricular musculature to a greater extent than Lignocaine. It also decreases the rate of recovery from a dependent block than that of Lignocaine. This leads to incomplete restoration of Vmax between action potential at high rates, in contrast to complete recovery by Lignocaine. This explains why Lignocaine has antiarrhythmic property while Bupivacaine has arrhythmogenic potential. High level of Bupivacaine prolongs conduction time through various parts of heart and extremely high concentration will depress spontaneous pacemaker activity, resulting in bradycardia and arrest. Cardiac resuscitation is more difficult following Bupivacaine induced cardiovascular collapse and hypoxia along with acidosis which markedly

potentiates cardiac toxicity. Bretylium but not Lignocaine could raise the ventricular tachycardiac threshold that was lowered by Bupivacaine.

3. Respiratory system:

Respiratory depression may be caused if excessive plasma level is reached which in turn results in depression of medullary respiratory centre.

4. Autonomic nervous system:

Myelinated preganglionic beta fibres have a faster conduction time and are more sensitive to the action of local anaesthetic including Bupivacaine. Involvement of preganglionic sympathetic fibres is the cause of widespread vasodilatation and consequent hypotension that occurs in epidural and paravertebral block. When used for conduction blockade all local anaesthetic particularly Bupivacaine produces higher incidence of sensory blockade than motor fibres.

LIGNOCAINE

Lignocaine[38,39,40], the first amino amide type local anaesthetic was first synthesised under the name xylocaine by Swedish chemist Nils Lofgren in 1943. His colleague Bengt Lundqvist performed first injection anaesthesia experiments on himself and was first marketed in 1949.

Lignocaine may be prepared in two steps by the reaction of 2,6 xylidine with chloroacetyl chloride followed by the reaction with diethylamine

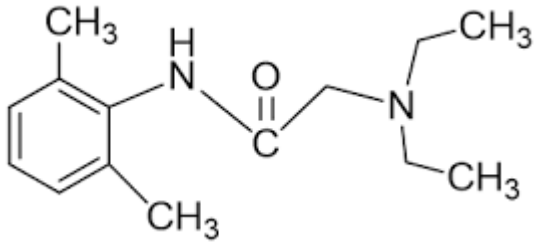


Figure 7: Chemical structure of Lignocaine

Pharmacokinetics

Lignocaine is mostly 95% metabolized (dealkylated) in the liver by CYP3A4 to the pharmacologically active metabolites monoethylglycinexylidide(MEGX) and then subsequently to inactive metabolite glycine xylidide. MEGX has a longer half life than lignocaine but also is a less potent sodium channel blocker.

The elimination half life of lignocaine is approximately 90-120 minutes in most patients. This may be prolonged in patients with hepatic impairment or congestive heart failure.

Therapeutic effects of lignocaine are generally associated with plasma levels of 6 to 25 micromole/litre (1.5 to 6microgm free base per ml). The blood to plasma distribution ratio is

approximately 0.84. Objective adverse manifestations becomes increasingly apparent with plasma levels above 6microgm free base per ml.

The plasma protein binding of lignocaine is dependent on drug concentration and the fraction bound decreases with increasing concentration. At concentration 1 to 4 microgram free base per ml, 60-80% of lignocaine is protein bound. In addition to lignocaine concentration, the binding is dependent on plasma concentration of the alpha 1 acid glycoprotein.

Lignocaine readily crosses the placenta and blood brain barrier. Dialysis has negligible effects on kinetics of lignocaine.

Pharmacodynamics

Nervous system:

Lignocaine alerts signal conduction in neurons by blocking fast voltage gated sodium channels in the neuronal cell membrane that are responsible for signal propagation. With the sufficient blockage the membrane of post synaptic neuron will not depolarize and will thus fail to transmit an action potential. This creates anaesthetic effect by not merely preventing pain signals from propagating to the brain but by stopping them before they begin. Careful titration allows for high degree of selectivity in blockage of sensory neurons, whereas higher concentrations will also effect other modalities of neuronal signaling.

Cardiovascular system

Attenuates phase 4 diastolic depolarization, decreases automaticity, decreases action potential duration, and raises ventricular fibrillation threshold; inhibits conduction of nerve impulses from sensory nerves.

Adverse reactions

Adverse experiences following the administration of lignocaine are similar in nature to those observed with other amide anaesthetic agents. Adverse reactions may result from high plasma level caused by excessive dosage or may result from hypersensitivity, idiosyncrasy, or diminished tolerance on the part of the patient. Serious adverse experience are generally systemic in nature. The following types are the most commonly reported.

Central nervous system

Apprehension, confusion, grandmal seizures[41], dizziness, drowsiness, euphoria, hallucinations, headache, light headedness, mood changes, nervousness, sensation of heat, cold, numbness, tremors, twitching, unconsciousness. Animals and humans data suggested that bupivacaine caused convulsions and are accompanied by hypoxia, hypercapnia and acidosis[42].

Cardiovascular system

Bradycardia, hypotension, cardiac arrest.

Eye and Ent

Blurred or double vision, conjunctival hyperemia, corneal epithelial changes, diplopia, tinnitus, visual disturbances.

Gastrointestinal system

Nausea, vomiting

Local effects

Erythema, petechiae, edema, injection site reactions, including bruising, burning, contusion, hemorrhage, pain, sloughing, venous thrombosis or phlebitis (with topical application)

Respiratory system

Respiratory depression and arrest

Miscellaneous

Hypersensitivity reaction. Burning upon installation (ophthalmic). Difficulty in breathing and swallowing, numbness of lips and tongue, other parasthesia, including heat and cold.

Indications

Centrineuraxial blocks

Peripheral nerve blocks

Paracervical blocks

Retrobulbar blocks

Sympathetic nerve block

Type 1 antiarrythmic agent

The acute management of ventricular arrythmias such as those occurring with acute MI or during cardiac manipulation such as in cardiac surgery.

Contraindications

History of hypersensitivity to the local aneasthetic of amide type

Stokes - Adams syndrome

Wolff – Parkinsons - White syndrome or with severe degree of sinoatrial or atrioventricular or intraventricular block in the absence of cardiac pacemaker

BUPRENORPHINE

Buprenorphine[43,44,45], is a semi synthetic highly lipophilic agonist antagonist opioid derived from the opium alkaloid thebaine. It is 33 times more potent than morphine.

Mechanism of action

It is a partial agonist at mu receptor. Its affinity to mu receptor is 55 times greater than that of morphine. It also binds to delta and kappa receptors and acts as antagonist. Buprenorphine binds with high affinity and also blocks voltage gated Na channels and this leads to local anaesthetic property of buprenorphine.

Pharmacokinetics

Buprenorphine undergoes extensive first pass metabolism and has low oral bioavailability. But its bioavailability is extensive in sublingual route. Administered sublingually drug produces satisfactory analgesia. The time to achieve maximum plasma concentration is 40 minutes to 3.5 hours when given sublingually or orally whereas 5 minutes after IM injection. Its peak effect may take up to 3 hours and duration up to 10 hours. The drug remains in the tissues for several days. Elimination half life is 24 – 60 hours. Since it is highly lipophilic, its association and dissociation from the receptor is very slow. Half life for dissociation is 166 minutes, compared to 7minutes for fentanyl. So plasma levels may not parallel clinical effects.

Protein binding- 96%

Volume of distribution -2.8L

Plasma clearance - 20ml / Kg

Metabolism:

Liver by dealkylation and conjugation to norbuprenorphine and buprenorphine- 3 glucuronide through CYP3A4. One of the major active metabolites is norbuprenorphine which is a full agonist at mu receptor and a partial agonist at kappa receptor. But it has 1/50th of antinociceptive potency and 10 times that of respiratory depressive potency when compared to buprenorphine. Buprenorphine 3 glucuronide and norbuprenorphine 3 glucuronide are also biologically active. Buprenorphine 3 glucuronide has affinity for the mu receptor and delta receptor but no affinity for kappa receptor. Norbuprenorphine 3 glucuronide has no affinity for mu and delta receptor but bind to kappa opioid receptor and produces sedative effect but do not depress the respiration.

Excretion- Most are excreted in bile through faeces and 10-35% in urine. Therefore, pharmacokinetics are not much altered in patients with renal impairement.

Interactions:

1) CYP3A4 inhibitors – buprenorphine actions will get potentiated when

used along with the drugs like azole antifungal agents, macrolides,

ART drugs.

2) CYP3A4 inducers – buprenorphine actions will be decreased by the

drugs like phenobarbitone, phenytoin, benzodiazepines, carbamazepine,

opioid analgesics, general anaesthetic drugs, phenothiazones, sedative

hypnotics, alcohol and other CNS depressant drugs.

Contraindications:

1. Allergic to the drug

2. Severe respiratory insufficiency

3. Severe hepatic impairment

4. Acute alcoholism or delirium tremens

PHARMACOLOGICAL ACTIONS:

Cardiovascular system:

Buprenorphine produces vasodilatation and a decrease in heart rate and blood pressure. Postural hypotension is prominent. Pulmonary edema has been reported.

Central nervous system:

It produces significant respiratory depression with a ceiling effect after doses of 0.15 to 1.2mg. Increased doses do not produce further depression and may actually result in increased ventilation due to antagonistic action. Because of the high affinity and slow dissociation from the receptor its reversal is limited. High doses of naloxone are required for reversal of respiratory depression. In the epidural space, the high lipid solubility limits the cephalad spread of the drug and likelihood of delayed respiratory depression than morphine. Sedation, drowsiness, miosis, nausea and vomiting are similar to morphine. Dysphoria is unlikely. constipation is less prominent than morphine.

Respiratory system

The subjective respiratory depressant effects are unequivocally slower in onset and lasts longer than those of morphine. Maximum respiratory depression is observed at about 3 hours.

Respiratory depression has not been observed in clinical trial. In anaesthetised patient buprenorphine reduces respiratory rate and volume. In postoperative period buprenorphine buprenorphine produces tendency towards respiratory acidosis and small decrease in respiratory rate(15%) and minute volume(16%).

Gastrointestinal system

It does not necessarily produce constipation, it causes nausea and vomiting 10-20%. It increases intrabilliary pressure.

ADVERSE EFFECTS:

Central nervous system:

Headache, Migraine, Drowsiness, Somnolence, Miosis

Respiratory system:

Respiratory depression, Cough

Gastrointestinal system:

Constipation, Nausea, Vomiting, Abdominal pain, Loose stools, Dyspepsia

Urinary retention

Skin:

Pruritis, Rash

Musculoskeletal system:

Arthralgia, Myalgia, Muscle spasm

Psychiatry:

Anxiety, Depression, Insomnia, nervousness

USES:

1) As an analgesic for long lasting painful conditions like cancer pain.

2) For control of postoperative pain.

3) As an analgesic component of balanced anaesthesia (4.5-12microg/Kg)

4) For intraoperative and postoperative analgesia by intrathecal, epidural and also through peripheral nerve blocks.

5) As a maintenance drug for opioid depression patients as an alternative to methadone.

FENTANYL

Fentanyl is an opioid group of analgesics. It acts on opioid receptor and therefore when given pre-emptively gives hemodynamic stability and analgesia. Fentanyl is vital to balanced general anaesthesia by its quality of covering all characteristics of balanced anaesthesia like analgesia, narcosis and attenuation of stressor responses.(46)

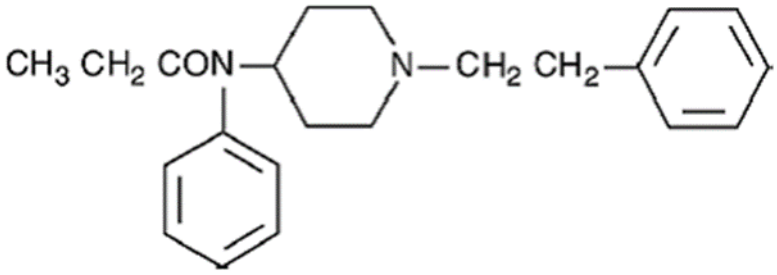


Figure 8: Chemical structure of fentanyl

Mechanism of Action:

Opioid receptors:

Fentanyl binds to the different opioid receptors and activates them to perform actions.

There are three important classes of opioid receptors and these are:

- **mu receptors** - This receptor has three subtypes, the receptors mu 1, mu 2 and mu 3. Activation of these receptors in the brainstem and thalamus may lead in relief of pain, sedation and euphoria, as well as respiratory depression, constipation and physical dependence.(46)

- **kappa receptors** - This receptor is present in the limbic system, the diencephalon, brain stem, and spinal cord. This receptor activation produces pain relief, sedation, respiratory depression and dependency.[46]
- **delta receptors** - This receptor is widespread in the brain as well as in the spinal cord and gastrointestinal tract. This receptor's stimulation contributes to both analgesic and antidepressant implications, but may also trigger respiratory depression.[46]

Pharmacokinetics:

Fentanyl's lipophilic structure means it readily crosses the blood–brain barrier which shows as a characteristic delta wave appearing on the EEG. There is significant variation in fentanyl pharmacokinetics between individuals. Plasma levels decrease quickly after an intravenous dose of bolus (half-life distribution approximately 13 min). Its terminal half-life in normal individuals is 3–4 hours, but in some patients it may be as long as 7–8 hours. Due to its elevated lipid solubility and comprehensive tissue uptake, the volume of distribution is comparatively high (almost 4 Litres/kg), and clearance is slightly lower than hepatic blood flow. Fentanyl is largely metabolized in the liver by N- dealkylation and hydroxylation, and within 1–2 minutes metabolites can be identified in the blood. Over a period of several days, about 70% of the medication is excreted in urine as inactive metabolites.[46]

Fentanyl dose:

The analgesic dose of fentanyl is 1-2 mcg/kg. It is also available as skin patches.[46]

Adverse effects:

Being an opioid it has its adverse effects like:

- respiratory depression,
- nausea,
- vomiting,
- itching

Fentanyl, like other opioid analgesics, causes respiratory depression in a dose-dependent manner. Cardiovascular stability is evident even in higher doses. High doses (50–150 mcg/kg) causes profound sedation and unconsciousness may occur. When given in high doses muscular rigidity of the chest wall may occur, high dose fentanyl anaesthesia also reduces or eliminates the stress response to surgery.

METHODOLOGY

SOURCE OF DATA:

This study was carried out in the Department of Anaesthesiology, B.L.D.E (Deemed to be University) Shri. B M PATIL Medical College and Hospital, Vijayapur.

METHOD OF COLLECTION OF DATA:

Study Design:

A randomised comparative study.

Study Period:

One and half year, from December 2018 to August 2020

Sample Size:

With Anticipated Mean Difference of mean duration of analgesia between the study groups as 205.36 min and Anticipated SD as 1800.1 min the minimum sample size per group is 27 (≈30) With 95% power and 1% level of significance [7].

Total sample size 30+30=60

By using the formula:

$$n = \frac{(z_\alpha + z_\beta)^2 \, 2 \, SD^2}{MD^2}$$

Where, Z= Z statistic at a level of significance

MD= Anticipated mean difference

SD= Anticipated Standard deviation

Randomization:

The study population of 60 with age, sex and weight matched was randomly selected and divided by computer generated random number tables into two groups with 30 patients in each group.

Group A: Patients were given Axillary block under ultrasound guidance with 10ml of 2% Lignocaine with adrenaline, 10ml of 0.5% Bupivacaine and 50microgm of Fentanyl

Group B: Patients were given Axillary block under ultrasound guidance with 10ml of 2% Lignocaine with adrenaline, 10ml of 0.5% Bupivacaine and 0.3mg of Buprenorphine

Results were recorded using a pre-set proforma.

INCLUSION CRITERIA:

- Age 18-60 years of both the sexes
- American Society of Anaesthesiologist (ASA) grade I and II
- Patients for forearm, wrist and hand surgeries

EXCLUSION CRITERIA:

- Patient refusal
- Infection at the site of injection
- History / findings of allergy to local anaesthetics

Medical disorders like pre-existing neuropathy, psychiatric illness, coagulopathy and bleeding disorders or any other contraindication

Preanaesthetic evaluation

Patients were included in the study by thorough pre-operative evaluation which include the following:

History:

History of underlying medical illness, previous history of surgery, anaesthetic exposure and hospitalization were elicited.

Physical examination:

1. General condition of the patient.
2. Vital signs- heart rate, blood pressure, respiratory rate.
3. Height and weight
4. Examination of cardiovascular system, respiratory system , central nervous system and the vertebral system.
5. Airway assessment by Mallampati grading.

Investigations:

Investigations required in this study were routine standardized procedures like:

Complete blood count, BT, CT, Urine routine, Random blood sugar, Blood urea, Serum creatinine, Chest radiograph, ECG, HIV and HBsAg.

Equipment for Axillary block:

- Sterile tray and a trolley
- 10cc disposable syringes.
- Ultrasound Machine (sonosite M-Turbo), a linear probe with a frequency of 7-15 mhz.
- Povidine Iodine, spirit, cotton ball and Sponge holding forceps, small bowl.
- Long needle and 3 way with 10 cm extension.
- Drugs- 2% lignocaine with adrenaline, 0.5%Bupivacaine, Inj Fentanyl and Inj Buprenorphine.

Procedure:

- Informed written consent was taken from the patient.
- Patients were kept nil by mouth for at least six hours prior to the surgery.
- The following monitoring devices: Pulse Oximeter, NIBP, ECG were connected and baseline values were recorded.
- IV line was secured with 20 Gauge I.V cannula and patients were premedicated with inj. Glycopyrrolate 0.01mg/kg I.V, inj. Midazolam 0.05mg/kg I.V and inj. Ondansetron 0.15 mg/kg I.V.
- Patient was positioned supine with arm abducted 90 degree and head turned towards contralateral side. The axillary artery was palpated and its location marked as reference point.
- The block site was painted with povidine iodine and spirit then draped with sterile towel. Sterile gel was applied to the ultrasound probe and probe covered by sterile cover.
- The USG probe placed over axilla axillary artery and vein visualized in cross section. Brachial plexus were identified surrounding the artery. The needle was inserted

superior (lateral) to the transducer and advanced inferiorly (medially) towards plexus under direct visualization. Local anaesthetic injected around each nerve after aspiration.

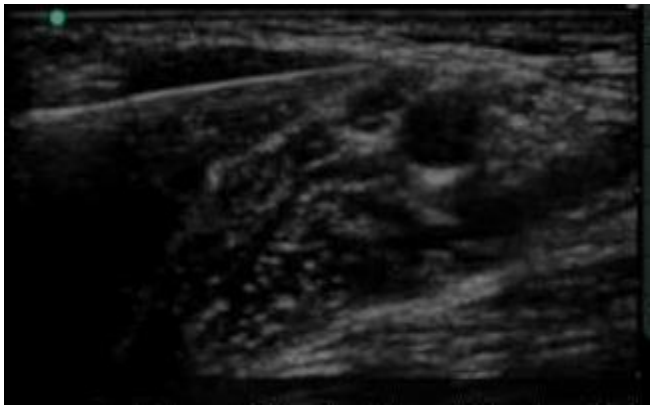


Figure 9: Sonoanatomy of axillary artery with nerves

- Group A received 10ml of 2% lignocaine with adrenaline (1:200000)+10ml of 0.5%bupivacaine + Fentanyl 50microgram.
- Group B received 10ml of 2% lignocaine with adrenaline (1:200000)+10ml Bupivacaine 0.5% +buprenorphine (0.3mg).

- Following completion of the LA injection, the sensory block was evaluated by a Hollmen scale Score

[1] = Normal sensation of pinprick

[2] = Weaker sensation of pin prick felt as compared with other upper limb

[3] = Pin prick recognized as touch with blunt object

[4] = No perception of pin prick.

The findings were recorded at an interval of 2 min till a complete sensory block is achieved i.e Hollmen Score=4.

- The onset time of the sensory block (OTSB) was taken as the time interval in minutes from time-0 till the sensory block started appearing i.e Hollmen score > 1, while the time for the complete sensory block (TCSB) was taken from time-0 till the complete sensory block was achieved i.e Hollmen Score=4. The total duration of the Sensory Block (TDSB) was taken as the duration of the time in minutes between TCSB till the time when the Hollmen score reached <4 in the postoperative period.
- The motor block was evaluated by using the Modified Bromage Scale (MBS) for the upper extremity on 3point scale.
- Grade 0 - normal motor function - full extension of elbow, wrist and fingers.

  Grade 1 - decrease motor strength with ability to move fingers and or wrist

  Grade 2 - complete motor blockade with inability to move fingers.
- The onset time of the motor block (OTMB) i.e MBS score=1 and the time for complete motor block (TCMB) i.e MBS score=2 were also recorded in all cases.
- All patients were observed for side effects such as:

  vessel injury, haematoma, nausea and vomiting, dyspnoea, fall in respiratory rate or oxygen saturation, any symptom/sign of LA toxicity, ECG changes, sedation etc.
- Postoperatively, pain was assessed using visual analogue scale consisted of a 10 cm line, where the patients were asked to mark the pain intensity on the line in between 0 (no pain) to 10 (worst possible pain). On complaint of pain (i.e. VAS>4), Inj Paracetamol 1g IV was supplemented.

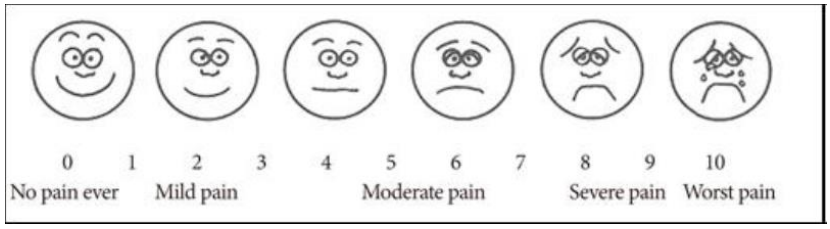


Figure 10: Visual Analogue Scale

OBSERVATIONS AND RESULTS

Comparative study between effects of adding Fentanyl and Buprenorphine to local anaesthetics in ultrasound guided brachial plexus block via axillary approach done on 60 patients divided in to 2 groups of 30 each in the age group of 18-60 years.

The following observations were made

Table: Distribution of Age between Study Groups

Parameters	Group A		Group B		P value
	Mean	SD	Mean	SD	
Age(yrs)	39.3	14.6	39.7	13.1	0.926

Figure: Distribution of Age between Study Groups

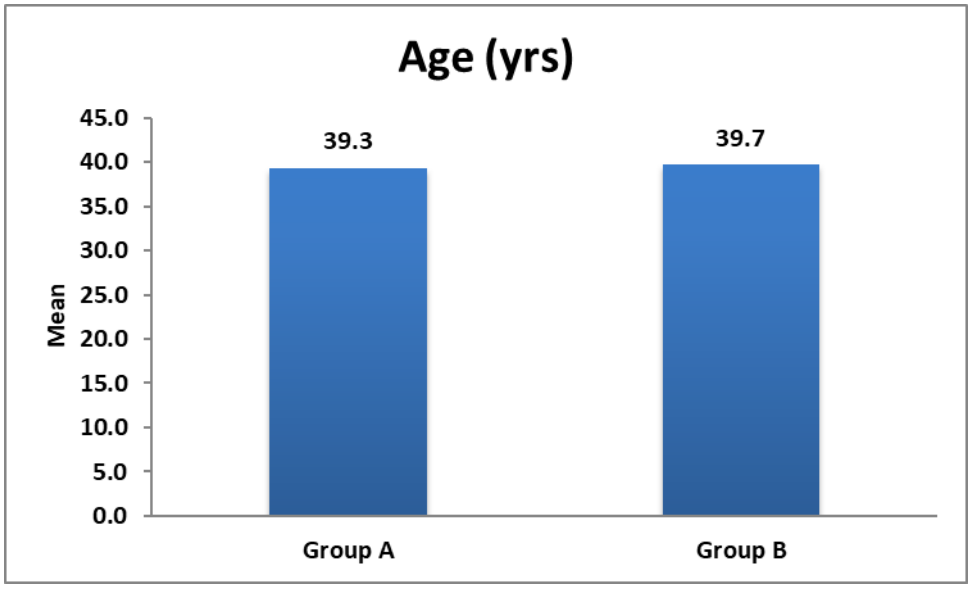
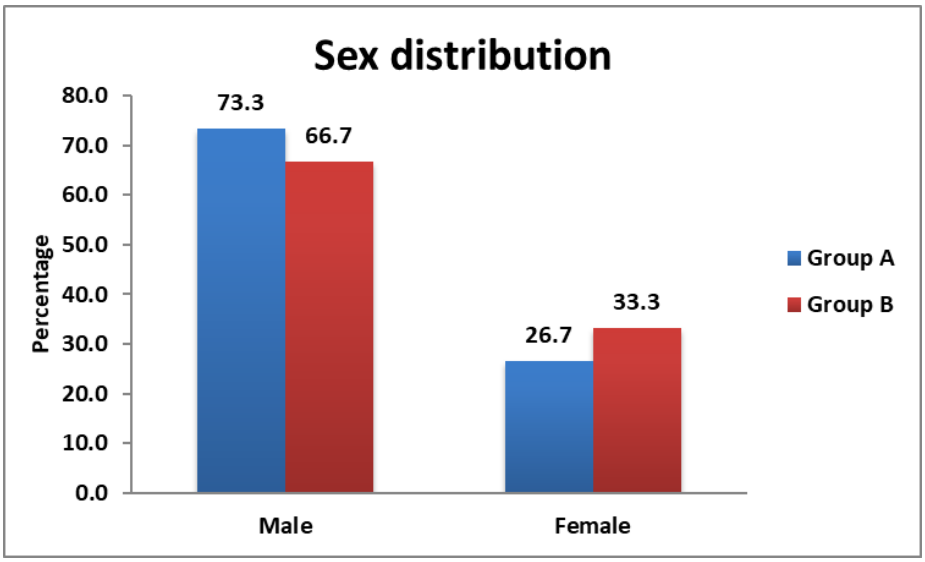


Table: Distribution of Sex between Study Groups

Sex	Group A		Group B		P value
	N	%	N	%	
Male	22	73.3	20	66.7	0.573
Female	8	26.7	10	33.3	
Total	30	100.0	30	100.0	

Figure: Distribution of Sex between Study Groups

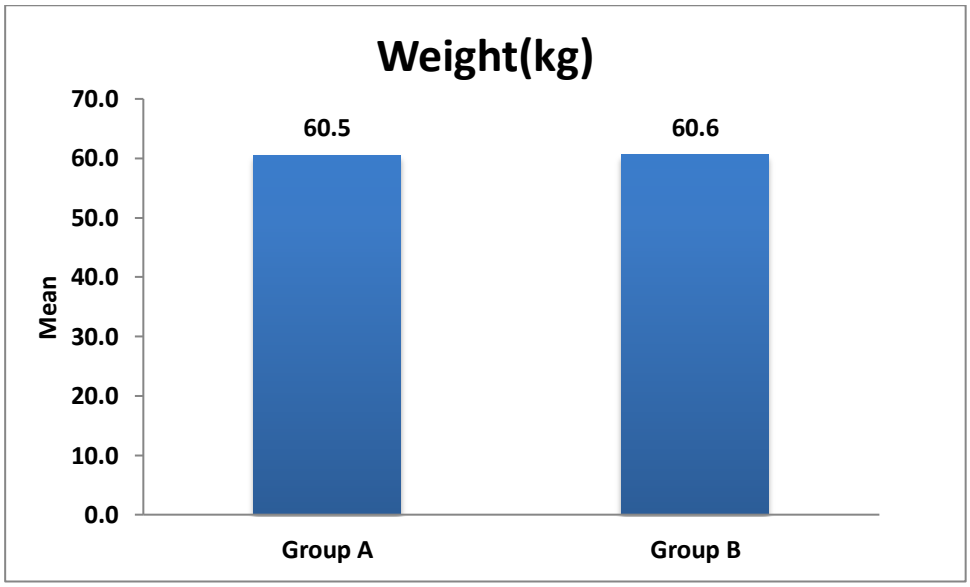


- In our study the demographic data (age and sex) was comparable in both the groups. The age of the cases were ranging from 18 to 60 years with the mean for Group A was 39.3 ± 14.6 and for Group B was 39.7 ± 13.1.
- Out of 30 participants, in Group A, 22 were males and 8 were females. In Group B, 20 were males and 10 were females out of the 30 participants. 'p' values of age and sex were 0.926 and 0.573 respectively.
- Thus, the demographic data of the two groups were not statistically significant.

Distribution of Weight between Study Groups

Parameters	**Group A**		**Group B**		**P value**
Weight (kg)	**Mean**	**SD**	**Mean**	**SD**	0.977
	60.5	9.1	60.6	8.7	

Distribution of Weight between Study Groups



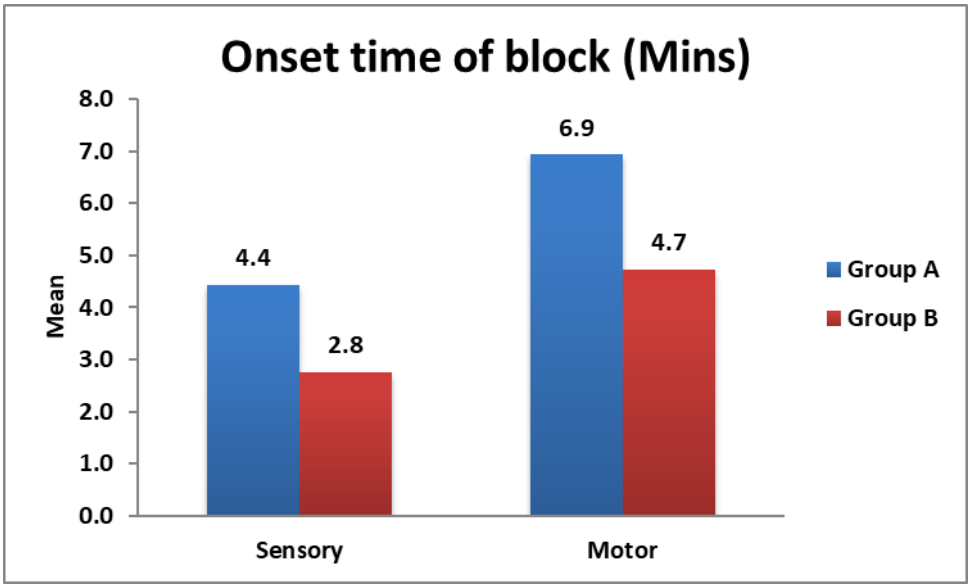
The mean weight of the patients in Group A is 60.5 ± 9.1 kg and in group B is 60.6 ± 8.7 kg with p value of 0.977. Weights of the patients in two groups are comparable and there was no statistically significant difference between the two groups.

Table: Onset time of block between Study Groups

Onset time of block (mins)	Group A		Group B		P value
	Mean	SD	Mean	SD	
Sensory	4.4	0.8	2.8	0.6	<0.001*
Motor	6.9	1.4	4.7	0.8	<0.001*

Note: * significant at 5% level of significance (p<0.05)

Figure: Onset time of block between Study Groups



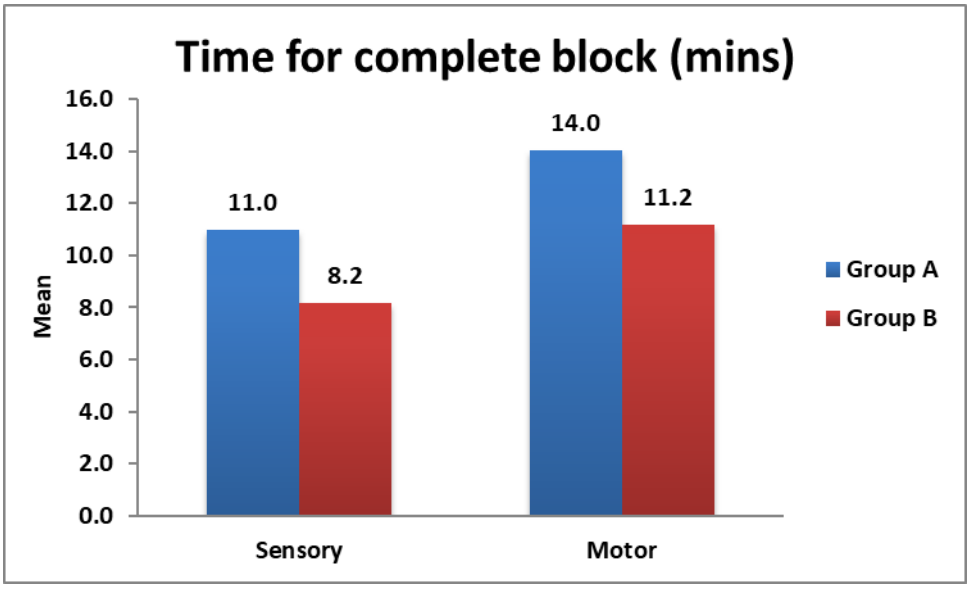
In Group A onset time of sensory block was 4.4±0.8 mins (Mean ± S.D), and onset time of motor block was 6.9±1.4 mins. where as in Group B onset time of sensory block was 2.8±0.6 mins, and onset time of motor block was 4.7±0.8 mins which is statistically significant (p value being <0.05)

Table: Time for complete block between Study Groups

Time for complete block (mins)	Group A		Group B		P value
	Mean	SD	Mean	SD	
Sensory	11.0	0.8	8.2	0.8	<0.001*
Motor	14.0	1.2	11.2	1.0	<0.001*

Note: * significant at 5% level of significance (p<0.05)

Figure: Time for complete block between Study Groups



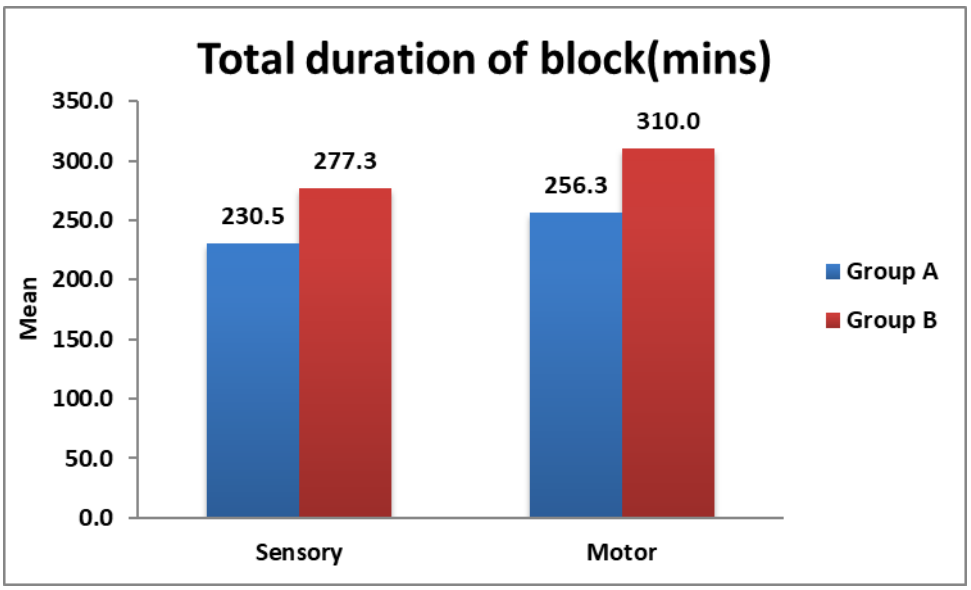
In Group A time for complete sensory block was 11.0±0.8 mins (Mean ± S.D), and time for complete motor block was 14.0±1.2 mins, where as in Group B time for complete sensory block was 8.2±0.8 mins, and time for complete motor block was 11.2±1.0 mins which is statistically significant (p value being <0.05)

Table: Total duration of block between Study Groups

Total duration of block (mins)	Group A		Group B		P value
	Mean	SD	Mean	SD	
Sensory	230.5	11.3	277.3	9.8	<0.001*
Motor	256.3	14.5	310.0	9.9	<0.001*

Note: * significant at 5% level of significance (p<0.05)

Figure: Total duration of block between Study Groups

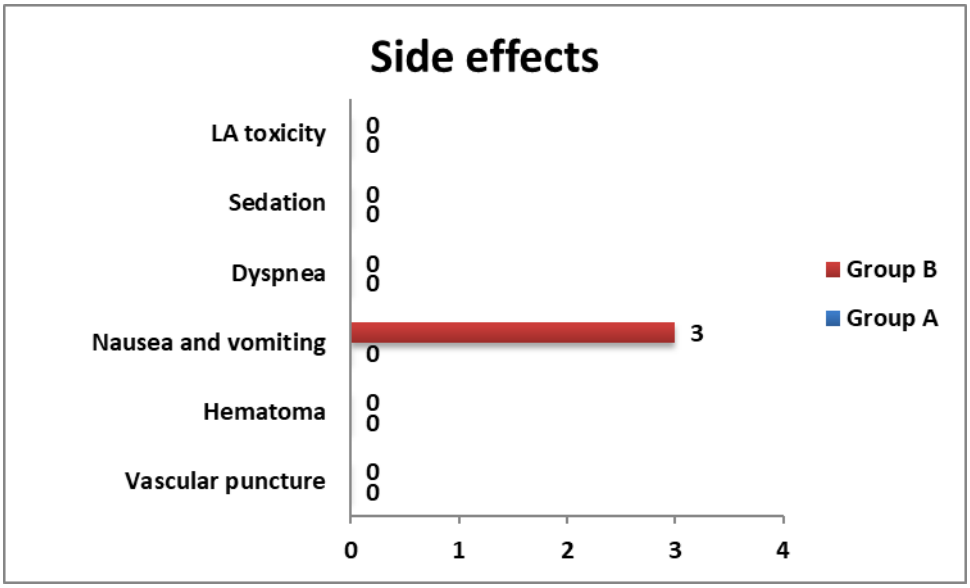


In Group A total duration of sensory block was 230.5±11.3 mins (Mean ± S.D), and total duration of motor block was 256.3±14.5 mins, where as in Group B total duration of sensory block was 277.3±9.8 mins, and total duration of motor block was 310.0±9.9 mins which is statistically significant (p value being <0.05)

Table: Side effects between Study Groups

Side effects	Group A		Group B		p value
	N	%	N	%	
Vascular puncture	0	0.0	0	0.0	-
Hematoma	0	0.0	0	0.0	-
Nausea and vomiting	0	0.0	3	10.0	0.076
Dyspnea	0	0.0	0	0.0	-
Sedation	0	0.0	0	0.0	-
LA toxicity	0	0.0	0	0.0	-

Figure: Side effects between Study Groups



In Group B 3 patients complained of nausea and vomiting with p value of 0.076 which is statistically not significant and no serious complications was observed in the perioperative period in any of the groups.

Statistical analysis

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean± standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation. Chi-square (χ^2) test was used for association between two categorical variables.

The formula for the chi-square statistic used in the chi square test is:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

The subscript "c" are the degrees of freedom. "O" is observed value and E is expected value.
C= (number of rows-1)* (number of columns-1)

The difference of the means of analysis variables between two independent groups was tested by unpaired t test.

The t statistic to test whether the means are different can be calculated as follows:

$$t = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}}$$

where $\bar{x}_1$ = mean of sample 1

$\bar{x}_2$ = mean of sample 2

n_1 = number of subjects in sample 1

n_2 = number of subjects in sample 2

${s_1}^2$ = variance of sample 1 = $\frac{\Sigma(x_1 - \bar{x}_1)^2}{n_1}$

${s_2}^2$ = variance of sample 2 = $\frac{\Sigma(x_2 - \bar{x}_2)^2}{n_2}$

If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant. Data were analyzed using SPSS software v.23 (IBM Statistics, Chicago, USA) and Microsoft office 2007.

DISCUSSION

Brachial plexus block is close to the ideal anaesthetic technique for upper limb surgeries for the patients, anaesthesiologists and surgeons. The axillary approach to the brachial plexus block enjoys great popularity as it is easy to perform and relatively safe.

The success of a peripheral nerve block is based on the ability to correctly identify nerves involved in the surgery, and place an adequate dose of local anaesthetic around them, to achieve a complete impregnation of all nerves involved in the surgery.

With the advent of ultrasound technology, it enables the anaesthesiologist to secure an accurate needle position and monitor the distribution of the local anaesthetic in real time, improves the quality of nerve block with a marked improvement in the success rate, shorter onset time and reduction in the volume required for successful block.[47,48,49,50,51] The introduction of Ultrasound guidance into clinical practice as a possible option to identify peripheral nerves, offers the potential advantage of optimizing the spread of the local anaesthetic solution around the nerves under sonographic vision.[52]

In our study Group A patients were given ultrasound guided axillary block with 10 ml of 2% lignocaine with adrenaline, 10ml of 0.5% Bupivacaine and Inj Fentanyl 50 microgram. Group B patients were given ultrasound guided axillary block with 10ml of 2% Lignocaine with adrenaline, 10ml of 0.5% Bupivacaine, Inj Buprenorphine 0.3mg.

In our study the demographic data (age, sex and weight) was comparable in both the groups. The age of the cases were ranging from 18 to 60 years with the mean for Group A was 39.3 ± 14.6 and for Group B was 39.7 ± 13.1.

Out of 30 participants, in Group A, 22 were males and 8 were females. In Group B, 20 were males and 10 were females out of the 30 participants. 'p' values of age and sex were 0.926 and 0.573 respectively. Thus, the demographic data of the two groups were not statistically significant.

The mean weight of the patients in Group A is 60.5 ± 9.1 kg and in Group B is 60.6 ± 8.7 kg. weights of the patients in two groups are comparable and there was no statistically significant difference between the two groups.

In Group A onset time of sensory block was 4.4±0.8 mins (Mean ± S.D), and onset time of motor block was 6.9±1.4 mins. where as in Group B onset time of sensory block was 2.8±0.6 mins, and onset time of motor block was 4.7±0.8 mins which is statistically significant (p value being <0.05). Thus the onset time of the sensory and the motor blocks was prolonged in fentanyl group when compared to buprenorphine group.

In Group A time for complete sensory block was 11.0±0.8 mins (Mean ± S.D), and time for complete motor block was 14.0±1.2 mins. where as in Group B time for complete sensory block was 8.2±0.8 mins, and time for complete motor block was 11.2±1.0 mins which is statistically significant (p value being <0.05). Thus the time for the complete sensory and motor block was lesser in Buprenorphine than fentanyl group.

Our study findings corelates with Nishikawa K et al,[12] who used100 µgm of fentanyl in 40 ml of 1.5% lidocaine with 1:2,00,000 epinephrine in the brachial plexus block by the axillary approach, we found a similar delay in the time which was required for the complete sensory block. They concluded that the decrease in pH of lignocaine from 6.2 to 5.2 by the addition of 100 µgm of fentanyl may have reduced the rate of nerve penetration of lidocaine, thus resulting in a slower onset of analgesia.

Our findings were in similar lines with studies by Dhrubajyothi Sarkar, Gurjeeth Khurana, Amit Chaudhary, J P sharma (2010) [7]. evaluated the efficacy of fentanyl and buprenorphine in improving the blockade characteristics when used as an additives in supraclavicular block. It was concluded that the onset time of the sensory block (OTSB) and the onset time of the motor block (OTMB) were the earliest in buprenorphine group, the time for the complete sensory block (TCSB) and the complete motor block (TCMB) was less in buprenorphine group with prolonged duration of analgesia and minimal incidence of nausea and vomiting, no significant adverse effect on the respiratory and haemodynamic parameters.

In Group A total duration of sensory block was 230.5±11.3 mins (Mean ± S.D), and total duration of motor block was 256.3±14.5 mins. where as in Group B total duration of sensory block was 277.3±9.8 mins, and total duration of motor block was 310.0±9.9 mins which is statistically significant (p value being <0.05). Thus the total duration of sensory, motor block and total duration of analgesia was prolonged in buprenorphine group.

This was also seen in the study done by Candido et al (2002),[9], Dixit R, Chakole V, Tadwalkar GV[53] evaluated the efficacy of adding buprenorphine to local anaesthetic for brachial plexus block through supraclavicular approach concluded that addition of buprenorphine provided 3 fold increase in duration of postoperative analgesia with complete analgesia persisting for 30hrs and beyond the duration provided by local anaesthetic alone in 75% of the patients.

Sanghvi KS, Shah VA, Patel KD[54] compared the effects of adding buprenorphine to bupivacaine and bupivacaine alone in axillary block and concluded that Buprenorphine significantly prolongs sensory block and lengthens duration of analgesia

Ashok Jadon, M R Panigrahi, S S Parida, Swastika Chakraborty, Prashant S Agrawal, Amrita Panda[55] studied the Efficacy of Buprenorphine with bupivacaine in Subclavian

Perivascular Brachial Block and concluded that the addition 3 µgkg-1 buprenorphine to 0.3% bupivacaine for perivascular brachial block in upper limb orthopedic surgery increase the time for complete sensory block. It improves the quality of block and lengthens the duration of analgesia.

In Group B 3 patients complained of nausea and vomiting with p value of 0.076 and were managed with inj ondansetron 0.15mg/kg, which is statistically not significant and no serious complications was observed in the perioperative period in any of the groups.

CONCLUSION

Ultra sound guided Axillary block with local anaesthetics and buprenorphine as an adjuvant has earlier onset of sensory and motor block with faster time to achieve complete sensory and motor block and provided significant longer duration of analgesia when compared to local anaesthetics used in axillary block with fentanyl as an adjuvant.

The addition of opioids to local anaesthetics in the brachial plexus block has no significant adverse effect on the respiratory and haemodynamic parameters when used in prescribed doses and has a minimal incidence of nausea and vomiting.

SUMMARY

"A PROSPECTIVE RANDOMIZED CLINICAL STUDY TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH" was carried out from December 2018 to august 2020 in the Department of Anaesthesiology at B.L.D.E (Deemed To Be University) Shri. B. M. Patil Medical College and Hospital, Vijayapur.

The study was designed to compare the effects of adding fentanyl and buprenorphine to local anaesthetics in brachial plexus block via axillary approach posted for elbow, forearm and hand surgery with respect to following parameters: onset time of sensory and motor block, time for complete sensory and motor block, total duration of sensory and motor block.

The study population of 60 with age, sex and weight matched was randomly selected and divided by computer generated random number tables into two groups with 30 patients between the age of 18 years to 60 years of ASA grade I and II in each group:

Group A: Patients were given ultrasound guided Axillary block with 10ml of 2% Lignocaine with adrenaline, 10ml of 0.5% Bupivacaine and 50microgm of Fentanyl.

Group B: Patients were given ultrasound guided Axillary block with 10ml of 2% Lignocaine with adrenaline, 10ml of 0.5% Bupivacaine and 0.3mg of Buprenorphine.

The observations and results were analysed statistically and were as follows: The demographic data of the two groups were not statistically significant.

In Group B onset time of sensory block (2.8±0.6 mins) and onset time of motor block(4.7 ± 0.8 mins) was earlier than onset time of sensory block (4.4 ±0.8 mins) and onset time of motor block (6.9±1.4 mins) in Group A, and was statistically significant.

In Group B time for complete sensory block (8.2±0.8 mins) time for complete motor block (11.2± 1.0 mins) was faster than time for complete sensory block (11.0±0.8 mins) and time for complete motor block (14.0±1.2 mins) in Group A, which was statistically significant

In Group B total duration of sensory block (277.3±9.8 mins) and total duration of motor block (310± 9.9 mins) was prolonged when compared to total duration of sensory block (230.5±11.3 mins) and total duration of motor block (256.3±14.5 mins) in Group A, and this difference was both clinically and statistically significant

In Group B 3 patients complained of nausea and vomiting with p value of 0.076 which is statistically not significant and no serious complications was observed in the perioperative period in any of the groups.

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B.L.D.E.Us, SHRI.B.M.PATIL MEDICAL COLLEGE, VIJAYAPUR – 586103

INSTITUTIONAL ETHICAL COMMITTEE,

Date : 8-11-18

1. Name of UG/PG Student/Researcher : Dr Sumedha. R. Bhat
2. Department : Anaesthesiology
3. Title : A prospective ..... Approach
4. Guide/Co-Guide/Principal Researcher : Dr Renuka Holyachi
5. Date of Admission (PG Only) : May 2018

Observation:

OK

I.E.C. Remarks: Ethical clearance accorded/be chairman after corrected revised version Is submitted by stipulated time.

1. Any alternation in Synopsis protocol should be intimated to E.C. in writing for review and approval.
2. Any adverse effects to subject of the study should be intimated in writing to E.C.
3. If study is stopped or an included patient is out of study inform E.C. the same with reason.

Signature of the Committee Members:

1. DR RAGHAVENDRA KULKARNI
2. DR TEJASWINI VALLABHA
3. DR.B.R.YELIKAR
4. DR P.BJAJU
5. DR CHANDRASHEKHAR BHUYYAR
6. DR PRANESH JAHAGIRDAR
7. SHRI.SURESH HAKKI
8. DR G V KUKARNI
9. DR.MOHD SHANNAWAZ
10. DR RAGHAVENDRA RAO

B.L.D.E (Deemed to be University)
SHRI.B.M.PATIL MEDICAL COLLEGE HOSPITAL & RESEARCH CENTRE
VIJAYAPUR – 586103

IEC/NO: 286/2018
17-11-2018

INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 13-11-2018 at 03-15 PM scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has accorded Ethical Clearance.

Title : A prospective randomized clinical study to compare the effects of adding fentanyl and buprenorphine to local anaesthetics in brachial plexus block via axillary approach.

Name of P.G. Student : Dr Sumedha.R.Bhat.
Department of General Anaesthesiology

Name of Guide/Co-investigator: Dr. Renuka Holyachi, Associate Professor of Anaesthesiology.

DR RAGHAVENDRA KULKARNI
CHAIRMAN
Institutional Ethical Committee
BLDEU's Shri B.M. Patil
Medical College,VIJAPUR-586103.

Following documents were placed before E.C. for Scrutinization:

1) Copy of Synopsis/Research Project
2) Copy of informed consent form.
3) Any other relevant documents.

SAMPLE INFORMED CONSENT FORM

B.L.D.E.(D.U) SHRI B.M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR – 586103, KARNATAKA

TITLE OF THE PROJECT :"A PROSPECTIVE RANDOMIZED CLINICAL STUDY TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"

PRINCIPAL INVESTIGATOR: **Dr Sumedha R Bhat**
Department of Anaesthesiology
BLDE Deemed to be university Shri B.M. Patil
Medical College Hospital & Research
Centre, Sholapur Road Vijayapur-586103
Email: sumedharbhat910@gmail.com

PG GUIDE **:** **Dr Renuka Holyachi**
Associate Professor
Department Of Anaesthesiology
BLDE Deemed to be university Shri B.M. Patil
Medical College Hospital & Research
Centre, Sholapur Road Vijayapur-586103
Email: renuka312@gmail.com

PURPOSE OF RESEARCH:

I have been informed that this study is **"TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"**

I have been explained about the reason for doing this study and selecting me/my ward as a subject for this study. I have also been given free choice for either being included or not in the study.

PROCEDURE:

I understand that I will be participating in the study: **"TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"**

BENEFITS:

I understand that my wards participation in this study will help in finding out is : **"TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"**

CONFIDENTIALITY:

I understand that medical information produced by this study will become a part of this Hospital records and will be subjected to the confidentiality and privacy regulation of this hospital.

If the data are used for publication in the medical literature or for teaching purpose, no names will be used and other identifiers such as photographs and audio or video tapes will be used only with my special written permission. I understand that I may see the photograph and videotapes and hear audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time. **Dr. SUMEDHA R BHAT** is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study, which might influence my continued participation.

If during this study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me.

And that a copy of this consent form will be given to me for keep for careful reading.

REFUSAL OR WITHDRAWL OF PARTICIPATION:

I understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital.

I also understand that **Dr. SUMEDHA R BHAT**will terminate my participation in this study at any time after he has explained the reasons for doing so and has helped arrange for my continued care by my own physician or therapist, if this is appropriate.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me/my ward, resulting directly due to my participation in this study, such injury will be reported promptly, then medical treatment would be available to me, but no further compensation will be provided.

I understand that by my agreement to participate in this study, I am not waiving any of my legal rights.

I have explained to _____ the purpose of this research, the procedures required and the possible risks and benefits, to the best of my ability in patient's own language.

Date: **Dr. SUMEDHA R BHAT**

(Investigator)

Patient's signature Witness to above signature

STUDY SUBJECT CONSENT STATEMENT:

I confirm that **Dr. SUMEDHA R BHAT** has explained to me the purpose of this research, the study procedure that I will undergo and the possible discomforts and benefits that I may experience, in my own language.

I have been explained all the above in detail in my own language and I understand the same. Therefore I agree to give my consent to participate as a subject in this research project.

_____ _____

(Participant) Date

_____ _____

(Witness to above signature) Date

SCHEME OF CASE TAKING

PROFORMA

STUDY: "A PROSPECTIVE RANDOMIZED CLINICAL STUDY TO COMPARE THE EFFECTS OF ADDING FENTANYL AND BUPRENORPHINE TO LOCAL ANAESTHETICS IN ULTRASOUND GUIDED BRACHIAL PLEXUS BLOCK VIA AXILLARY APPROACH"

PATIENT DETAILS : DATE:

I. Name: Age/ Sex: Wt: I.PNo:
Ward:

Group allotted by randomization: Group A / Group B

II. 1. Type of the surgery:

Duration of surgery:_____ (min)

2. Indication:

III. Significant History:

IV. General Physical Examination:

Pallor: Icterus: Cyanosis: Clubbing:

Koilonychia: Lymphadenopathy: Oedema:

Teeth: Dentures:

V. Vital Parameters

Pulse: Blood Pressure: Respiratory Rate: Temperature:

VI. Systemic Examination

1. CVS 2.RS:

3. CNS 4.Per Abdomen:

VII. Airway Assessment:

MP Grade: Cervical Spine:

Mouth opening: Neck Movement:

VIII. ASA Grade:

IX. Investigation

Hemoglobulin: TLC:

S. Urea: S. Creatinine:

LFT's: Platelet count:

Urine Routine:

Chest Xray: ECG:

Parameters	Group A	Group B
Onset time of sensory block (OTSB) min		
Onset time of motor block (OTMB) min		

Parameters	Group A	Group B
Time for complete sensory block (TCSB) min		
Time for complete motor block (TCMB) min		

Parameters	Group A	Group B
Total duration of sensory block (TDSB) min		
Total duration of motor block (TDMB) min		

Side Effects (if any) - vascular puncture Hematoma Nausea and vomiting

dyspnea sedation LA toxicity

KEY TO THE MASTER CHART

IP NO - Inpatient number

LA - Local anaesthetic toxicity

Min - Minutes

SL NO - Serial number

Wt- Weight

Yrs- Years

Group A (Fentanyl Group)

Sl No	IP No	Name	Age	Sex	Wt(kgs)	Onset time of block(Mins)		Time for complete block (mins)		Total duration of block(mins)		Side effects or complications					
						Sensory	Motor	Sensory	Motor	Sensory	Motor	Vascular puncture	Hematoma	Nausea and vomiting	Dyspnea	Sedation	LA toxicity
1	15122	Shyanoor	20	M	50	5	8	12	15	250	270	No	No	No	No	No	No
2	2228	Kartik	18	M	46	4	6	11	13	240	250	No	No	No	No	No	No
3	30829	Ningappa	60	M	60	4	6	11	14	220	250	No	No	No	No	No	No
4	14758	Siddramappa	45	M	64	4	9	12	15	230	265	No	No	No	No	No	No
5	14861	Shivasharan	30	M	50	5	8	11	14	245	260	No	No	No	No	No	No
6	14872	Praveen	20	M	55	5	8	11	15	225	275	No	No	No	No	No	No
7	14414	Sadashiv	25	M	57	4	6	11	14	220	280	No	No	No	No	No	No
8	13786	Gulzar	55	M	65	4	6	10	12	230	270	No	No	No	No	No	No
9	32601	Jyothi	18	F	48	5	6	10	12	235	255	No	No	No	No	No	No
10	33247	Santosh	30	M	60	4	5	11	14	225	240	No	No	No	No	No	No
11	1257	Siddamma	60	F	55	5	6	12	14	220	240	No	No	No	No	No	No
12	7980	Laxmi	38	F	60	3	5	10	12	220	245	No	No	No	No	No	No
13	30850	Abhishek	18	M	48	3	5	11	15	225	250	No	No	No	No	No	No
14	33621	Ramsingh	60	M	70	5	8	10	13	220	280	No	No	No	No	No	No
15	10375	Parashuram	40	M	74	4	8	11	14	225	260	No	No	No	No	No	No
16	33284	Namadev	27	M	58	4	6	11	16	230	250	No	No	No	No	No	No
17	11932	Mahimood	50	M	65	3	5	10	15	220	250	No	No	No	No	No	No
18	43531	Sohal	18	M	46	5	9	12	15	215	260	No	No	No	No	No	No
19	7890	Mallappa	55	M	62	4	5	9	10	230	245	No	No	No	No	No	No
20	8522	Shivanand	50	M	75	4	6	12	15	230	240	No	No	No	No	No	No
21	9012	Tanaji	51	M	72	4	6	10	15	220	230	No	No	No	No	No	No
22	12654	Hanumawwa	50	F	58	5	8	10	14	230	245	No	No	No	No	No	No
23	27	Mahadevi	40	F	55	6	7	12	14	225	240	No	No	No	No	No	No
24	4527	Anita	45	F	60	5	7	11	14	220	240	No	No	No	No	No	No
25	692	Vittal	30	M	75	5	7	12	15	235	245	No	No	No	No	No	No
26	10064	Poojappa	45	M	78	5	8	11	14	240	280	No	No	No	No	No	No
27	14951	Somaning	30	M	65	6	8	12	15	250	265	No	No	No	No	No	No
28	28946	Shankrappa	60	M	70	4	8	11	14	230	260	No	No	No	No	No	No
29	29737	Malabai	41	F	55	5	9	12	15	250	270	No	No	No	No	No	No
30	31248	Kamala	51	F	60	4	9	11	14	260	280	No	No	No	No	No	No

Group B (Buprenorphine group)

Sl No	IP No	Name	Age(yrs)	Sex	Wt(kgs)	Onset time of block(mins)		Time for complete block(mins)		Total duration of block(mins)		Side effects or complications					
						Sensory	Motot	Sensory	Motor	Sensory	Motor	Vascular puncture	Hematoma	Nausea and vomiting	Dyspnea	Sedation	LA toxicity
1	14153	Chandrashekar	29	M	60	4	6	9	11	280	320	No	No	No	No	No	No
2	14399	Basavaraj	33	M	65	3	4	8	10	270	310	No	No	No	No	No	No
3	14071	Suresh	45	M	60	3	5	8	11	270	320	No	No	No	No	No	No
4	31902	Sarubai	57	F	55	3	4	8	11	275	300	No	No	Yes	No	No	No
5	22349	Sugalabai	35	F	50	3	5	7	11	280	310	No	No	No	No	No	No
6	24923	Vinod	21	M	57	3	4	8	10	290	320	No	No	No	No	No	No
7	31883	Anand	24	M	62	4	6	9	12	260	310	No	No	No	No	No	No
8	23276	Suresh	30	M	65	2	4	7	11	270	300	No	No	No	No	No	No
9	32278	Ramesh	40	M	72	2	5	8	12	275	310	No	No	No	No	No	No
10	32930	Malakappa	32	M	70	2	4	9	11	290	320	No	No	No	No	No	No
11	32768	Laxmibai	40	F	45	3	5	9	12	270	290	No	No	No	No	No	No
12	32971	Anand	30	M	55	3	4	8	12	260	300	No	No	No	No	No	No
13	2053	Gurubai	60	F	60	3	6	8	12	290	330	No	No	Yes	No	No	No
14	1585	Mallamma	38	F	56	3	5	8	11	280	305	No	No	No	No	No	No
15	298	Abhishek	21	M	50	2	4	7	9	290	320	No	No	No	No	No	No
16	12602	Neelamma	47	F	54	3	5	8	10	290	310	No	No	No	No	No	No
17	9258	Chandraban	50	M	80	3	4	9	12	290	315	No	No	No	No	No	No
18	8568	Kirankumar	23	M	55	2	4	8	10	290	320	No	No	No	No	No	No
19	8591	Vishwanath	20	M	50	3	5	9	12	280	310	No	No	No	No	No	No
20	8686	Nanagowda	60	M	65	2	4	7	10	270	320	No	No	No	No	No	No
21	7080	Bhimanna	55	M	74	3	4	7	11	280	300	No	No	Yes	No	No	No
22	8080	Nimbewwa	60	F	50	2	4	8	11	260	290	No	No	No	No	No	No
23	171	Siddamma	60	F	53	3	5	9	12	275	300	No	No	No	No	No	No
24	420	Girija	55	F	58	3	4	8	11	280	310	No	No	No	No	No	No
25	9747	Madivalappa	40	M	72	2	4	7	11	290	320	No	No	No	No	No	No
26	34713	Mallesh	45	M	68	3	5	8	10	280	320	No	No	No	No	No	No
27	34660	Anand	30	M	63	2	6	9	12	270	300	No	No	No	No	No	No
28	35735	Revansidda	40	M	74	3	6	8	12	280	310	No	No	No	No	No	No
29	28936	Shivanand	45	M	65	2	5	9	12	270	300	No	No	No	No	No	No
30	29248	Pavitra	25	F	55	4	6	10	14	265	310	No	No	No	No	No	No