A dissertation on

COMPARISION OF MAGNESIUM SULPHATE AS AN ADJUVANT WITH ROPIVACAINE VS PLAIN ROPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK – RANDOMIZED CONTROLLED STUDY.

Dissertation Submitted to

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI - 600 032

With partial fulfillment of the regulations

for the award of the degree of

M.D. ANAESTHESIOLOGY

BRANCH-X

COIMBATORE MEDICAL COLLEGE

COIMBATORE

MAY 2020

UNIVERSITY REGISTRATION NO: 201820655

CERTIFICATE I

This is to certify that this dissertation entitled, "**COMPARISION OF MAGNESIUM SULPHATE AS AN ADJUVANT WITH ROPIVACAINE VS PLAIN ROPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK – RANDOMIZED CONTROLLED STUDY"** submitted by **Dr.M.PRASANNA KUMAR** in partial fulfilment for the award of the Degree of M.D.(Anaesthesiology) by The Tamilnadu Dr.M.G.R.Medical University, Chennai is a bonafide record of the research work done by him, under the guidance of **Dr. K. KALYANA SUNDARAM M.D, Associate** Professor, Department of Anaesthesiology, Coimbatore Medical College during the academic year 2018-20 in the Department of Anaesthesiology, Coimbatore Medical College, Coimbatore-641014. This dissertation is a record of fresh work done by the candidate **Dr.M.PRASANNA KUMAR,** during the course of the study (2018-2020). This work was carried out by the candidate himself under my supervision.

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DECLARATION

I Solemnly declare that the dissertation titled "**COMPARISION OF MAGNESIUM SULPHATE AS AN ADJUVANT WITH ROPIVACAINE VS PLAIN ROPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK RANDOMIZED CONTROLLED STUDY"** was done by me from JANUARY 2019 to AUGUST 2019 under the guidance and supervision of **Prof.Dr.K.KALYANA SUNDARAM M.D.,**

This dissertation is submitted to **The Tamilnadu Dr.M.G.R. Medical University** towards the partial fulfilment of the requirement for the award of MD degree in Anaesthesiology (Branch X)

Place: Coimbatore **Dr.M.PRASANNA KUMAR**

Date:

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CERTIFICATE OF APPROVAL

To
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Dear **Dr.M.Prasannakumar**

The Institutional Ethics Committee of Coimbatore Medical College, reviewed and discussed your application for approval of the proposal entitled **"Comparison of Magnesium sulphate as an adjuvant with Ropivacaine versus plain Ropivacaine in ultrasound guided Supraclavicular brachial plexus block – Randomised comparative study."**No.0178/2018.

The following members of Ethics Committee were present in the meeting held on 17.12.2018.conducted at MEU Hall, Coimbatore Medical College Hospital Coimbatore-18

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We approve the Proposal to be conducted in its presented form.

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I sincerely thank all the Asst. Professors **DR.R.RAJESH RATHNAM M.D.,** for their guidance and help.

I thank all my **PATIENTS**, who formed the backbone of this study without whom this study would not have been possible.

Lastly, I am ever grateful to the **ALMIGHTY GOD** for always showering His blessings on me and my family.

DR.M.PRASANNAKUMAR.

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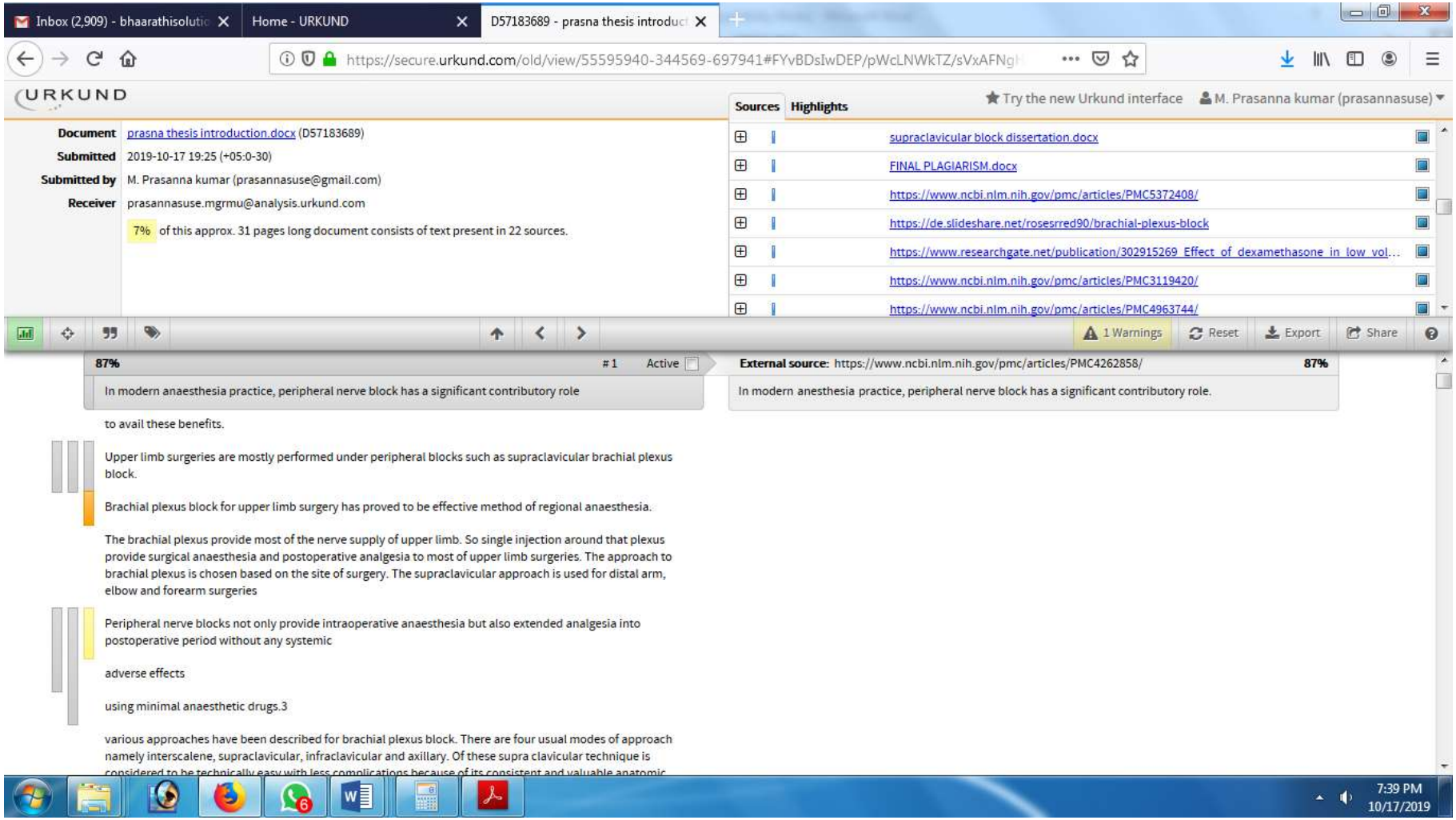
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Upper limb surgeries are mostly performed under peripheral blocks such as supraclavicular brachial plexus block.
Brachial plexus block for upper limb surgery has proved to be effective method of regional anaesthesia.
The brachial plexus provide most of the nerve supply of upper limb. So single injection around that plexus provide surgical anaesthesia and postoperative analgesia to most of upper limb surgeries. The approach to brachial plexus is chosen based on the site of surgery. The supraclavicular approach is used for distal arm, elbow and forearm surgeries
Peripheral nerve blocks not only provide intraoperative anaesthesia but also extended analgesia into postoperative period without any systemic
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using minimal anaesthetic drugs.3
various approaches have been described for brachial plexus block. There are four usual modes of approach namely interscalene, supraclavicular, infraclavicular and axillary. Of these supra clavicular technique is
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CERTIFICATE – II

This is to certify that this dissertation work titled "**Comparison of magnesium sulphate as an adjuvant with ropivacaine vs plain ropivacaine in ultrasound guided supraclavicular brachial plexus block – randomized controlled study"** of the candidate **DR.M.PRASANNA KUMAR** with registration Number- **201820655** for the award of M.D in the branch of Anaesthesiology. I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **7%** (Seven percentage) of plagiarism in the dissertation.

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CONTENTS

CONTENTS

LIST OF ABBREVATIONS

IV	: Intravenous
Hrs	: Hours
Mins	: Minutes
Sec	: Seconds
Kg	: Kilogram
Mg	: Milligram
Mcg	: Microgram
Ml	: Millilitre
SD	: Standard deviation
NS	: Nerve stimulator
USG	: Ultrasonogram
SCB	: Supraclavicular brachial plexus block
Na^+	: Sodium
K^+	: Potassium

INTRODUCTION

INTRODUCTION:

"Regional anaesthesia" is the term first used by Harvey Cushing in 1901 to describe pain relief by nerve block. Regional nerve blocks are based on the concept that pain is conveyed by nerve fibre, which are amenable to interruption anywhere along their pathway. Regional anaesthesia is a boon in the emerging era of pain management. It has been accepted as a safe and effective method for various surgical procedures including upper limb surgeries. It also prolongs analgesia during surgery and postoperative period.

Effective management of postoperative pain relieves suffering and leads to earlier mobilization, fewer pulmonary and cardiac complications, and a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, reduced cost of care and increased patient satisfaction.

In modern anaesthesia practice, peripheral nerve block has a significant contributory role to avail these benefits. Upper limb surgeries are mostly performed under peripheral blocks such as supraclavicular brachial plexus block. Brachial plexus block for upper limb surgery has proved to be effective method of regional anaesthesia. The brachial plexus provide most of the nerve supply of upper limb. So single injection around that plexus provide surgical anaesthesia and postoperative analgesia to most of upper limb surgeries. The approach to brachial plexus is chosen based

on the site of surgery. The supraclavicular approach is used for distal arm, elbow and forearm surgeries

Peripheral nerve blocks not only provide intraoperative anaesthesia but also extended analgesia into postoperative period without any systemic adverse effects using minimal anaesthetic drugs.[3] various approaches have been described for brachial plexus block. There are four usual modes of approach namely interscalene, supraclavicular, infraclavicular and axillary. Of these supra clavicular technique is considered to be technically easy with less complications because of its consistent and valuable anatomic relationship with respect to subclavian artery.

Ultrasound(USG)- guided supraclavicular brachial plexus block allows better visualization of underlying structures, movement of needle and direct spread of local anaesthetics and thereby making the procedure safe and effective as compared to landmark guided technique.[1]

Under Ultrasound guidance, performing peripheral nerve blocks decreases the complications associated with blind techniques such as intravascular injection, pneumothorax, hematoma, etc., by better visualization of local anaesthetic spread, leading to lesser amount of local anaesthetic to provide anaesthesia.[5]

Ropivacaine is a local anaesthetic drug belonging to the aminoamide group. Ropivacaine in comparison to Bupivacaine is less cardiotoxic and less neurotoxic.[8] As compared with Bupivacaine, Ropivacaine produces

less intense motor block, and of shorter duration, permitting earlier mobilization and discharge.

Ropivacaine acts by blocking the generation and the conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of nerve impulses, and by reducing the rate of rise of the action potential. Specifically they block the sodium channel and decreases the chances of depolarization and consequent action potentials. In general, the progression of anaesthesia is related to the diameter, myelination and conduction velocity of affected nerve fibres.

Local anaesthetic drugs are widely used throughout anaesthetic practice, but the limited duration of action of various local anaesthetics continues to be a matter of concern for anaesthetists. A variety of adjuvants have been tried to hasten the time of onset and prolong the duration of analgesia of nerve blocks with varying degrees of success.

Several attempts have been made to prolong the effect of sensory and motor blockade of supraclavicular brachial plexus by using various drugs such as Narcotics, Verapamil, Clonidine, Dexmedetomidine, Tramadol and Magnesium sulphate($MgSO_4$). Better knowledge of the pain mechanisms has highlighted the role of central sensitisation and N-methyl-D- aspartate (NMDA) receptors in post surgical pain.

Magnesium is a naturally present cation in the body. It is the second most plentiful intracellular cation after potassium. Magnesium blocks competitively the entry of calcium in the presynaptic endings leading to reduced release of acetyl choline. Anti-nociceptive effects of magnesium are due to the regulation of calcium influx into the cell and antagonism of NMDA receptors. [8]

Magnesium sulphate is a non competitive N-methyl-D-aspartate (NMDA) receptor antagonist in the central nervous system and peripheral nervous system. The NMDA receptor complex contains binding sites for antagonists such as magnesium. Magnesium sulphate potentiates local anaesthetic agents and hence, it is used as an adjuvant in peripheral nerve blocks.

Many clinical investigations have demonstrated that magnesium administration during general anaesthesia has reduced anaesthetic requirement and postoperative analgesic consumption. Magnesium as an adjuvant enhances the analgesic properties of established anaesthetics.

This study is conducted to find out the efficacy of magnesium sulphate as an adjuvant to Ropivacaine in ultrasound guided supraclavicular brachial plexus block

HISTORY OF BRACHIAL PLEXUS BLOCK

The first local anaesthesia was performed by French surgeon Ambrose by mechanical compression of nerves. It was in the year 1884, an Austrian ophthalmologist Carl Koller experimented himself with two percent solution of cocaine by instilling into his eyes and then check its effectiveness by pricking eye with needle. The first brachial plexus was performed by William Steward Halsted in 1884. By surgical approach Halsted instilled 0.1 percent of cocaine into brachial plexus. It was George Crile in 1897 used similar technique. He exposed sternocleidomastoid muscle and deposited cocaine just behind the muscle as a therapeutic measure for upper limb surgery. It was in 1900 Harvey Cushing who was Halsted surgical resident coined the term regional anaesthesia. Intravenous regional anaesthesia was described by August Bier in 1908. In 1911, G. Hirschel described the first percutaneous brachial plexus through axillary approach. In the same year Kulenkampff described first percutaneous supraclavicular approach. He placed needle superficial to first rib and pleura and injected 10ml of procaine solution into his own plexus at mid clavicular position lateral to subclavian artery. Direction of needle was backward, inward and downward. He identified the plexus by eliciting paraesthesia.

Zerringston in 1926 carried out Kulenkampff technique without the paraesthesia technique. As soon as deep cervical fascia has been penetrated 30 ml of 2 percent procaine was injected. Leonard corning placed

tourniquet to prolong analgesia by preventing blood from removing local anesthetic drug from its active site. Henrich added epinephrine to prolong effect of cocaine which was described as chemical tourniquet. In 1917 Bazy and Pauchet described infraclavicular approach to brachial plexus which was later popularized by P.Raj in 1973. In 1943 Lofgren and Lundquist synthesized lignocaine. In 1963 bupivacaine was synthesized by Ekenstam and Telivuo. It was Perthus who used electrical stimulation to locate brachial plexus. In the initial days X-ray technology using radio opaque contrast showed spread of local anaesthesia but not able to visualize neural structures, so later ultrasound was introduced in clinical practice which not only located neural structures but also showed local anaesthesia spread. The first direct use of ultrasound for brachial plexus block was performed by Kapral et al in 1994.

AIM & OBJECTIVES

AIM AND OBJECTIVES

PRIMARY OBJECTIVE

The aim of the study is to evaluate the effect of addition of magnesium sulphate to ropivacaine in ultrasound guided supraclavicular blocks in terms of duration of sensory and motor blockade.

SECONDARY OBJECTIVES:

1. To assess the duration of postoperative pain relief by Visual analogue scale and the time to first rescue analgesic.
2. To assess the onset of sensory & motor blockade.
3. To evaluate the hemodynamic stability and complications.

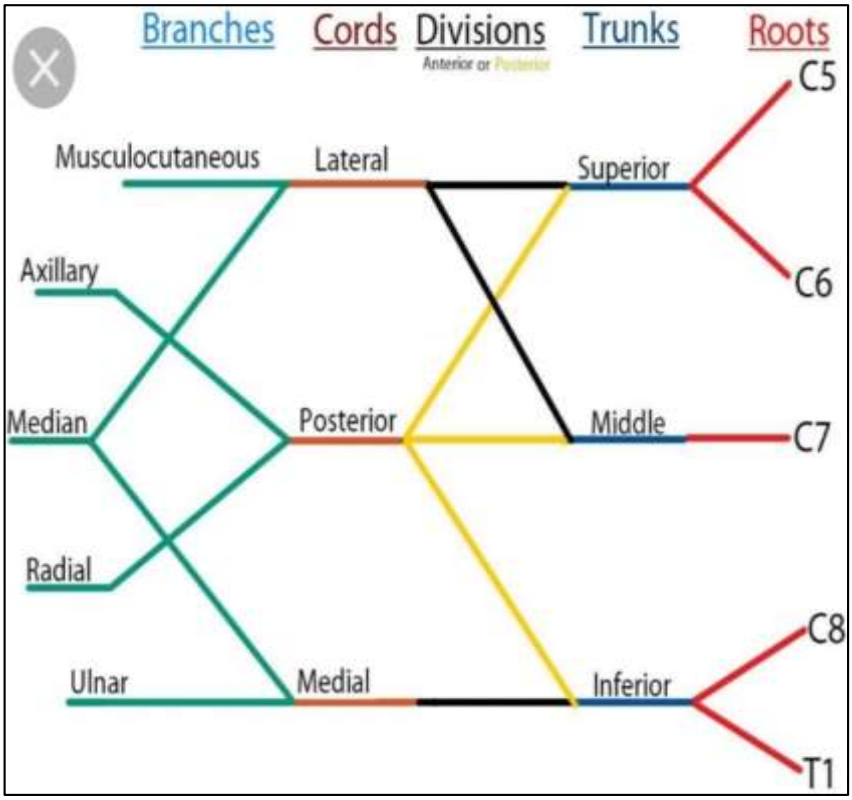
RESEARCH QUESTION / HYPOTHESIS

Does the addition of magnesium sulphate to ropivacaine as an adjuvant affect the duration of ultrasound guided supra clavicular brachial plexus block?.

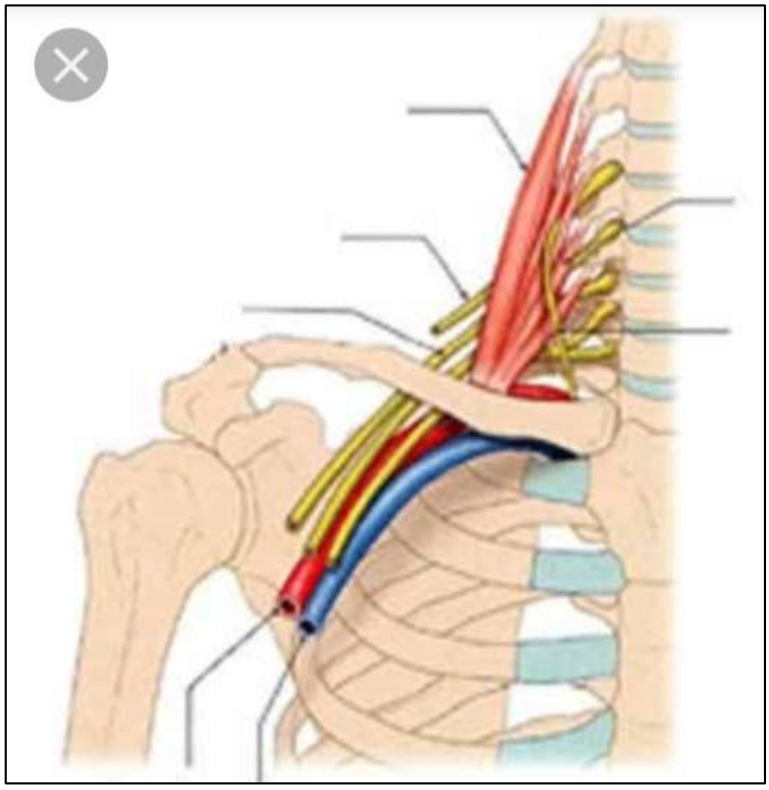
REVIEW ON ANATOMY OF THE BRACHIAL PLEXUS

The roots of the brachial plexus is formed by the anterior rami of C5 to T1. In some situations, the plexus may start from the C4 root and is called prefixed and it may also include the T2 root and is called post fixed. The roots finally emerge from the intervertebral foramina and form trunks, three in number, namely, upper trunk, middle trunk and the lower trunk between two muscles, scalenus anterior and scalenus medius. Upper trunk is formed by C5 and C6, middle trunk by C7 and the lower trunk by C8 and T1.

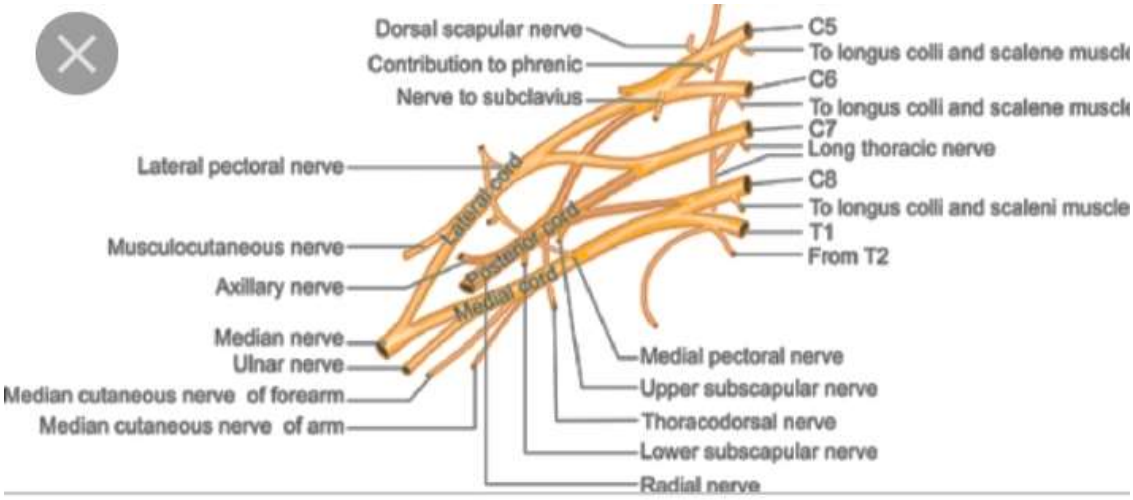
Each trunk then gives off two divisions behind the clavicle – anterior division and posterior division. These trunks then enter into the axilla where they combine to form cords. Lateral cord is formed by the fusion of the anterior division of the upper and middle trunk. Medial trunk by the anterior division of the lower trunk and the posterior cord by the posterior divisions of all the three trunks. The cords then give off the terminal branches of the brachial plexus supplying the various dermatomes and muscles of the upper limb.



ANATOMY OF BRACHIAL PLEXUS



RELATION OF BRACHIAL PLEXUS TO SUBCLAVIAN ARTERY



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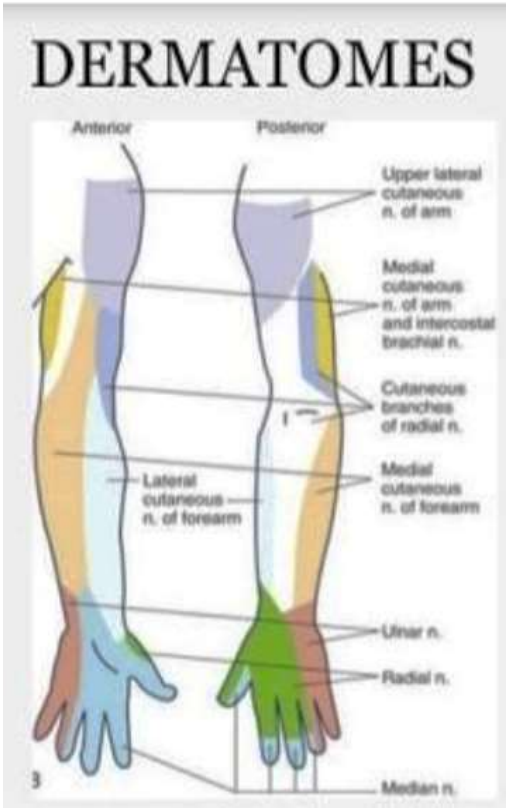


DERMATOME SUPPLIED BY BRACHIAL PLEXUS

BRACHIAL PLEXUS BLOCK

Blocking the brachial plexus at various levels has brought about the role of the 4 types of brachial plexus block most commonly used.

- Interscalene block: blocking roots between the scalene anterior and Medius resulting in anaesthesia of the shoulder, arms and elbows.
- Supraclavicular block: drug is deposited at the level of trunks resulting in anaesthesia of the shoulders to the fingers.
- Infraclavicular block: below the clavicle, which blocks the distal arm, elbow, forearm, wrist and hand.
- Axillary block: terminal nerves of the brachial plexus at various positions in relation to the axillary artery and blocks the elbow, forearm and hand.

Peripheral nerve block started with the blind landmark technique and had advanced with nerve locator to ultrasound guided blocks with the help of sono anatomy. With the blind technique, incidence of complications like hematoma, pleural puncture and intravascular drug administration was more. In the peripheral nerve locator, still being a blind technique, all the above mentioned complications were still common and eliciting the twitches were found to be difficult in the distal arm and forearm than the proximal arm. Then with advantage of real time imaging of anatomical structures , regional blocks under ultrasound guidance had gained its popularity. Complications like pneumothorax, intravascular drug

administration and hematoma formation with blind landmark technique can be avoided with ultrasound guided blocks.

Visualization: the probe is placed in the supraclavicular fossa. The pulsating subclavian artery is used as the landmark, which can be confirmed with doppler. A compact group of nerves, generally termed as a “honeycomb” appearance or a “bunch of grapes” is seen superior and lateral to the subclavian artery. The nerves appear as hypoechoic structure amidst the connective tissues which are hyperechoic.

Position of the patient: placing a shoulder roll between the shoulder blades such that the shoulder is elevated of the bed by 45 degrees. Alternative method is by semi sitting position – beach chair position helps to comfort the patient, lowers the arms by gravity and brings the plane of imaging closer to the plane of display. The patients head should be turned to the opposite side, with the operator stands at the head end or at the side of the bed.

Equipment used in the study:

- -Ultrasound machine
- -a small linear probe with frequency of 5 – 10 Mhz is used
- -B Braun stimpulex serrated echogenic needle is used for better visibility.
- -A block tray – sterile gown, gloves and gauzes.

- 10 ml syringes for block drug, 5 ml syringes for saline, 2 ml syringe for local infiltration at needle entry site.
- Chlorhexidine / betadine.

Technique: after adequate aseptic precautions, the supraclavicular fossa is draped with a central hole towel. The ulnar aspects of both hands of the operator are placed on the patient for best control on transduce and needle. A lateral to medial plane needle is used. Most pioneers suggest multiple injection technique to ensure complete plexus anaesthesia. Hydro dissection with saline to confirm the position of the tip of the needle and better visualization of needle is advised. Initially the needle is directed deep and the local anaesthetic is deposited below the artery to push the plexus towards the skin. This makes the subsequent needle passes easier. Then the local anaesthetic is injected around the plexus superiorly and laterally.

REVIEW OF DRUGS

LOCAL ANAESTHETICS:

Local anaesthetic drugs create analgesia by interrupting nerve conduction by blocking the sodium channels and preventing the movement of ions.

Normally the nerve conduction involves propagation of electrical impulses by movement of various ions like sodium (Na+) which is highly extracellular and potassium(K+) which is highly intracellular, across the nerve cell membrane.

In the resting state, the nerve membrane is more permeable to K+ ions than to Na+ ions, thereby creating a negatively charged interior resulting in a resting membrane electrical potential of 60-70 mv across the membrane. The action potential arises, when the distal end of the sensory nerve is exposed to a stimulus, as a result the electrical potential across the membrane and the permeability is altered. With increase in permeability, sudden influx of Na+ intracellularly creates a positively charged interior and depolarization sets in. The current depolarizes adjacent segment causing a wave of depolarization up the nerve. Repolarization takes place with reversal in the movement of ions and restoring the electrical balance.

In short, local anaesthetics acta at the sodium channel preventing the generation and conduction of transmission of nerve impulses by

binding to the α subunit of the sodium channel and inhibits the channel activation and thereby preventing influx of Na+ ions preventing depolarization.

STRUCTURE ACTIVITY RELATIONSHIP OF LOCAL ANAESTHETICS

Local anaesthetic consists of hydrophilic and hydrophobic domains separated by intermediate ester or amide linkage. Based on these links local anaesthetics are classified into amides and esters. These linkages determine the potency and duration of the local anaesthetics. Greater the lipid solubility, greater is the potency and longer is the duration of action.

The pKa - Ph at which 50% of the drug is ionized and the remaining 50 % is unionized. It generally correlates with the speed of onset of action of most amide LA drugs; the closer the pKa to the body Ph, the faster the onset. The coexistence of the two states of the drug - the ionized and unionized form – is important because drug penetration of the nerve membrane by the local anaesthetic requires the base (unionized) form to pass through the nerve lipid membrane; once in the axoplasm of the nerve, the base form can accept a hydrogen ion and equilibrate into the ionized form. The ionized form is predominant and produces a blockade of the Na+ channel at the α subunit.

An ester or an amide linkage is present between the lipophilic end (benzene ring) and the hydrophilic end (amino group) of the molecule. The type of linkage determines the site of metabolic degradation of the drug. Ester-linked local anaesthetics are metabolized in plasma by pseudo cholinesterase, whereas amide-linked drugs undergo metabolism in the liver.

When a local anaesthetic drug is deposited in proximity to a peripheral nerve, it diffuses from the outer surface toward the core along a concentration gradient. Consequently, nerves located in the outer mantle of the mixed nerve are blocked first. When the volume and concentration of local anaesthetic solution deposited in the vicinity of the nerve are adequate, the local anaesthetic eventually diffuses inward to block the more centrally located fibres. In this way, the block evolves from proximal structures to distal structures. Smaller amounts and lower concentrations of a drug only block the nerves in the mantle and smaller and more sensitive central fibres.

ONSET OF BLOCKADE

In general, local anaesthetics are deposited as close to the nerve as possible, preferably into the tissue sheaths or epineural sheaths of the nerves. The actual site of local anaesthetic injection and its relationship to the nerve structures is much better understood since the advent of the use of ultrasound guidance during nerve blockade. Intraneural or sub-

epineural injections reportedly occur relatively frequently with some peripheral nerve blocks. These data must be interpreted with caution because the term intraneural injection is often used loosely to denote injections within epineurium or even tissue sheaths that envelope the peripheral nerves or plexus. However, neurological injury is much more likely to occur should an intraneural injection occur intra fascicular.

The rate of diffusion across the nerve sheath is determined by the concentration of the drug, its degree of ionization (ionized local anaesthetics diffuses more slowly), its hydrophobicity, and the physical characteristics of the tissue surrounding the nerve.

DURATION OF BLOCKADE

The duration of nerve block anaesthesia depends on the physical characteristics of the local anaesthetic and the presence or absence of vasoconstrictors. The most important physical characteristic is lipid solubility. In general, local anaesthetics can be divided into three categories: short acting(e.g., 2-chloroprocaine, 45-90 minutes), intermediate duration (e.g., lidocaine, mepivacaine, 90-180 minutes), and long acting (e.g., bupivacaine, levobupivacaine, ropivacaine, 4-18 hours). The degree of block prolongation with the addition of a vasoconstrictor appears to be related to the intrinsic vasodilatory properties of the local anaesthetic; the more intrinsic vasodilatory action the local anaesthetic has, the more prolongation is achieved with addition of a vasoconstrictor.

DIFFERENTIAL SENSITIVITY OF NERVE FIBRES

Smaller nerve fibres are more susceptible to the action of local anaesthetic than large fibres. Smaller fibres are preferentially blocked because a shorter thickness of axon is required to be blocked to halt the conduction completely. Myelinated fibres are more easily blocked than nonmyelinated fibres because local anaesthetic pools near the axonal membrane. This is why C-fibres, which have a small diameter (but are unmyelinated), are the most resistant fibres to local anaesthetics.

EFFECTS ON VARIOUS ORGAN SYSTEM

1. Central nervous system: site for premonitory signs of rising blood concentrations of local anaesthetic in awake patients. Symptoms include circumoral numbness, paraesthesia of the tongue, dizziness, tinnitus and blurring of vision. Excitatory signs include agitation, nervousness, feeling of impending doom. Muscle twitching heralds onset of tonic clonic seizures. Even higher concentrations produce CNS depression. Seizures are treated with benzodiazepine injection intramuscularly or intravenously.
2. 2. Respiratory system: depresses the hypoxic drive and depression of the medullary respiratory centres can lead to apnea. Local anaesthetics relaxes the bronchial smooth muscles.
3. Cardiovascular system: depresses the myocardial automaticity, contractility and conduction velocity. At higher concentrations it

can cause arrhythmias, heart block, depression of ventricular contractility and hypotension. Cardiovascular toxicity requires at least three times the toxic dose to produce seizures.

4. Immunological: hypersensitivity reactions to local anaesthetics are uncommon. Esters appear more likely to produce reactions especially if derivatives of para-aminobenzoic acid, a known allergen is added to the drug. Commercial preparation containing methyl paraben can also provoke such reactions.
5. Musculoskeletal: injection of local anaesthetic concomitantly with epinephrine or steroids can cause myonecrosis.
6. Haematological: it mildly depresses coagulation and enhance fibrinolysis.

SYSTEMIC LOCAL ANAESTHETIC TOXICITY

The risk of such adverse reactions is proportional to the concentration of local anaesthetic achieved in the circulation.

Plasma concentration of local anaesthetics

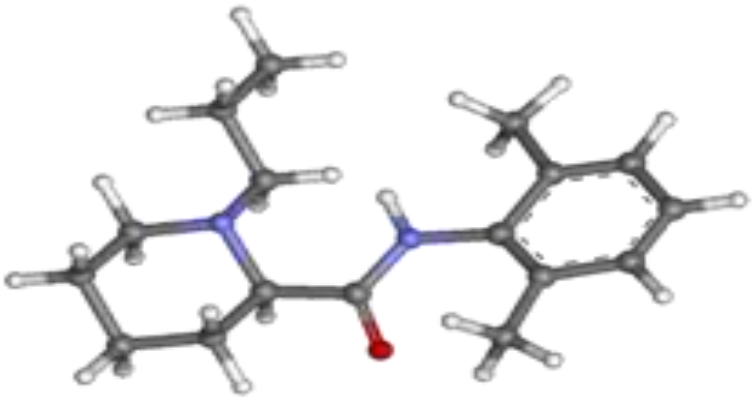
The following factors determine the plasma concentration of local anaesthetics:

- The dose of drug administered
- The rate of absorption of the drug
- Site injected, vaso activity of the drug, use of vasoconstrictors
- Biotransformation and elimination of the drug from the circulation

- Accidental intravascular injection.

ROPIVACAINE

Ropivacaine was developed after bupivacaine was noted to be associated with cardiac arrest, particularly in pregnant women. Ropivacaine was found to have less cardiotoxicity than bupivacaine in animal models. Ropivacaine hydrochloride is a local anaesthetic belonging to the amino amide group. The name ropivacaine refers to both the racemate and the marketed S- enantiomer. Ropivacaine HCl is chemically described as S-[-]-1- propyl-2,6- pipecoloxylidide hydrochloride monohydrate. The chemical structure of the drug is



Ropivacaine blocks the generation and conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of nerve impulse, and by reducing the rate of rise of the action potential. Ropivacaine is extensively metabolised in the liver and excreted in the urine. The mean half life is 1.8 ± 0.7 h

after intravascular administration and 4.2±1 h after epidural administration. Ropivacaine is indicated for regional anaesthesia and acute pain management. [11]

CONTRAINDICATIONS:

Ropivacaine is contraindicated for intravenous regional anaesthesia(IVRA).

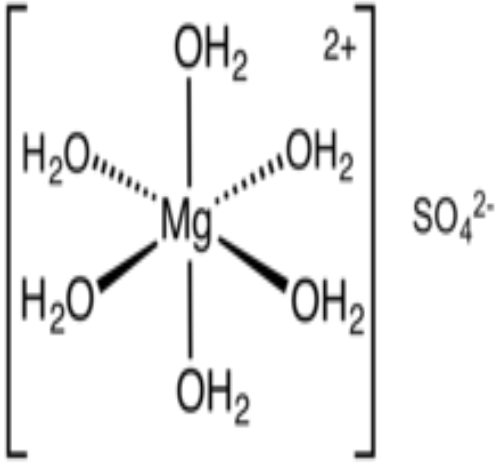
ADVERSE EFFECTS:

Adverse drug reaction are rare when it is administered correctly. Most Adverse drug reaction relate to administration technique (resulting in systemic exposure) or pharmacological effects of anaesthesia, however allergic reactions can rarely occur. Systemic exposure to excessive quantities of ropivacaine mainly result in central nervous system(CNS) and cardiovascular effects. CNS effects usually occur at lower blood plasma concentrations and additional cardiovascular effects present at higher concentrations, though cardiovascular collapse may also occur with low concentrations. CNS effects may include CNS excitation(nervousness, tingling around the mouth, tinnitus, tremor, dizziness, blurred vision, seizures followed by depression and apnea. Cardiovascular effects include hypotension, bradycardia arrhythmias and/or cardiac arrest- some of which may be due to hypoxemia secondary to respiratory depression. Celepid, a commonly available intravenous lipid emulsion, can be effective in treating severe cardiotoxicity secondary to local anaesthetic overdose. [11]

MAGNESIUM SULPHATE:

Magnesium sulfate is an inorganic salt with the formula $MgS0_4.7H_20$. it is often encountered as the heptahydrate sulfate mineral epsomite, commonly called as Epsom salt. The overall global annual usage in the mid-1970s of the monohydrate was 2-3 million tons, of which the majority was used in agriculture.

Epsom salt has been traditionally used as a component of both salts. Epsom salt can also be used as a beauty product. Athletes use it to soothe sore muscles, while gardeners use it to improve crops. It is also effective in the removal of splinters.



Magnesium is the second most plentiful cation of the intracellular fluids. It is essential for the activity of many enzyme systems and plays an important role with regard to neurochemical transmission and muscular excitability. Magnesium sulfate reduces striated muscle contractions and

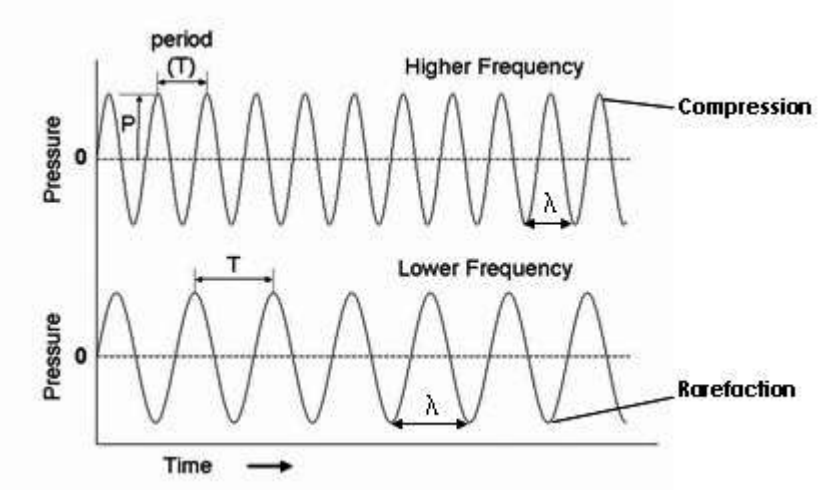
blocks peripheral neuro muscular transmission by reducing acetyl choline release at the myoneural junction. Additionally, magnesium inhibits Ca2+ influx through dihydro-pyridine sensitive voltage dependent channels. This accounts for much of its relaxant action on vascular smooth muscle. It causes direct inhibition of action potentials in myometrial muscle cells. Excitation and contraction are coupled which decreases the frequency of contractions. Magnesium sulphate is administered both IV and IM. The drug is protein bound and also has extracellular distribution and it is excreted unchanged in urine.

Uses include:

- oral magnesium sulfate is commonly used as a saline, osmotic laxative.
- Replacement therapy for magnesium deficiency.
- It is used as an anti-arrhythmic agent for Torsade's de pointes in cardiac arrest under the ECC guidelines and for managing quinidine induced arrhythmias.
- As a bronchodilator after beta-agonist and anticholinergic agents have been tried, e.g, in severe exacerbations of asthma.
- Magnesium sulfate is effective in decreasing the risk that pre-eclampsia progression to eclampsia

PHYSICS OF ULTRASOUND

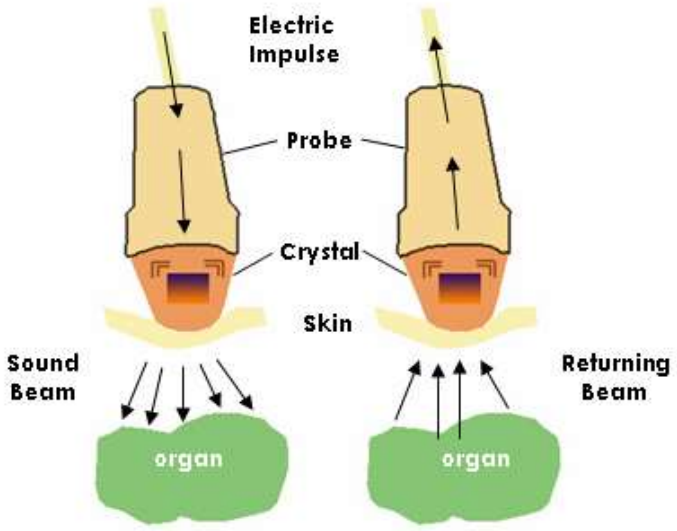
The frequency at which human can hear ranges between 20-20,000 Hz. But ultrasound uses the frequency of more than 20,000 Hz (or 20 KHz) and commonly used medical ultrasound is in the range of 2.5-15MHz.Here, sound energy is transmitted mechanically in the substances as a wave form with alternative rarefactions and compression.



The speed of sound varies for different biological media but the average value is assumed to be 1,540 m/sec (constant) for most human soft tissues. The speed of sound (c) can be calculated by multiplying wavelength (λ) x frequency (f). Thus sound with a high frequency has a short wavelength and vice versa.

An ultrasound wave is generated when an electric field is applied to an array of piezoelectric crystals located on the transducer surface. Electrical stimulation causes mechanical distortion of the crystals resulting in vibration and production of sound waves (i.e. mechanical energy). The conversion of electrical to mechanical (sound) energy is called the converse piezoelectric

effect Each piezoelectric crystal produces an ultrasound wave. The summation of all waves generated by the piezoelectric crystals forms the ultrasound beam. Ultrasound waves are generated in pulses (intermittent trains of pressure waves) and each pulse commonly consists of 2 or 3 sound cycles of the same frequency.



There are 2 types of commonly used ultrasound probes: the linear or flat probe and the curved, or curvilinear. Selection of the proper probe depends on a few factors. The depth of the target structure is probably the most important criterion. As structures get farther away from the probe surface, the ability of the sound waves to be reflected back diminishes. A curved probe has the advantage of producing readable images at great depth, but peripheral images lose some resolution. The outer edges of the sound waves are not returned in the same amount as they are produced. Hence, the edges of the image may not produce a sharp or even readable picture. Conversely, the flat probe can produce a larger, sharper image for more superficial structures but loses resolution at depth more easily then does the curved probe.[29]

As waves travel deeper through the biological medium, it gets attenuated by losing heat energy. Attenuation (energy loss) is due to:

1) Absorption (conversion of acoustic energy to heat)

2) Reflection

3) Scattering at interfaces

Thus in ultrasound higher frequency leads to more attenuation and lesser penetration while the lesser frequency leads to more depth of penetration. Therefore superficial structures are better seen with high frequency waves and the deep structures with low frequency waves.

Resolution is the ability of the ultrasound machine to distinguish two structures that are close together as separate. Spatial resolution is influenced by axial and lateral resolution, both of which are closely related to ultrasound frequency. Axial resolution refers to the ability to distinguish two structures that lie along the axis (i.e. parallel) of the ultrasound beam as separate and distinct. Axial resolution is determined by the pulse length. A high frequency wave with a short pulse length will yield better axial resolution than a low frequency wave. These concepts of penetration and resolution are thought to be inversely related. For example, deeper structures require greater penetration to obtain images. This produces poor images, hence, poor resolution.

Echogenicity refers to the structure's ability to absorb or reflect ultrasound waves. Structures such as a needle or bone, reflect more and are usually imaged as white or "hyperechoic." Liquid or air-filled spaces are

generally considered “hypoechoic,” as they reflect fewer waves and are imaged as black. For example a needle is generally seen as a hyperechoic dot when viewed in cross section.

Ultrasound in the practice of anaesthesia is used primarily for imaging structures relative to needle placement.[30]Structures can be visualized in a cross section or longitudinal section. The 2 techniques used to image the needle’s location are in-plane and out-of-plane technique. The out-of-plane technique allows visualization of the needle as a dot crossing the ultrasound beam. This technique is popular for vascular access, as it produces an image of the vessel in cross section. This also allows for angle variation, because imaging is not intended to see the length of the needle. The out-of-plane technique is accomplished by first obtaining an image, then introducing the needle under the beam plane in the middle of the wide portion of the probe. It is useful to place the target in the middle of the screen.

The in-plane technique produces an image of the entire needle, most importantly the tip, as it is directed to a particular structure. This is done by first obtaining an image and then placing the needle under the narrow or side portion of the probe. It should be noted that the ultrasound beam is very thin. If the needle travels outside the beam, it will not be seen. A probe with a needle guide will assist with the in-plane technique; however, needle guides are not often used. The in-plane technique allows the performance of regional blocks with greater safety and helps reduce the incidence of accidental vascular puncture or nerve contact. Guides are not often used. The in-plane technique allows the

performance of regional blocks with greater safety and helps reduce the incidence of accidental vascular puncture or nerve contact.

Ultrasound-guided regional blocks can be thought of in 2 categories: perivascular and circum neural. The perivascular technique has gained popularity with many providers, as the goal of the injection is to infiltrate around a vessel known to have nerves in close proximity to it. This image is considerably easier to obtain and interpret, as well as to complete injections, compared with the circum neural technique. As discussed earlier, arteries are distinguished from any other structure because of their large pulsating size and characteristic dark round appearance. Popular sites for this technique are the axillary or subclavian arteries for upper extremity blocks.

The circum neural technique is equally effective but requires the provider to image the nerve itself. Nerve tissue usually appears white in the ultrasound image, but it can change to black as the beam varies from a perpendicular angle. Nerves can be difficult to differentiate depending on the composition of surrounding tissue and the quality of the image. Both techniques require the provider to image the needle tip, in relation to the target structure, to rule out contacting it.

Effective administration of any regional anaesthetic necessitates prior study of anatomy. Ultrasound-guided blocks are no exception. Proper interpretation of the image is important to prevent injury and to place the local anaesthetic correctly. Imaging for any regional anaesthetic should be

methodical, beginning with large, easily identifiable structures and progressing to smaller target areas, vessel-rich nerves.

The in-plane technique is preferred because it is desirable to see the tip of the needle in relation to the structure to be surrounded with local anaesthetic. The practitioner should aim the needle toward the side of, not directly at, the nerve. This technique will minimize accidental contact with the structure and allow easier manoeuvre deep to it. After negative aspiration, the provider begins to administer local anaesthetic, allowing it to diffuse circumferentially around the entire structure if possible.

It is desirable to capture an image of proper local anaesthetic spread, without needle contact of the nerve, for medical-legal requirements, as well as billing purposes.

The image can be displayed in a number of modes:

1) Amplitude (A) mode

2) Brightness (B) mode

3) Motion (M) mode

Among the 3 modes, the B mode is most commonly used for ultrasound guided regional anaesthesia

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Ultrasonographic guidance helps to improve the success, accuracy and safety of regional anaesthesia. It also increases the speed of onset, the quality of analgesia, and reduces the incidence of vascular injury. The quality of ultrasonographic nerve images for each nerve location depends upon the transducer quality and type of ultrasound machine. The selection of transducer frequency and the knowledge of anaesthesiologist in interpreting the sonographic anatomy related to the peripheral nerve block, along with good hand- eye coordination is needed to follow needle during advancement.

Correct positioning of the patient and sterile technique are important. Aseptic precaution is more important when catheter is used for continuous analgesia. The transducer probe is covered by means of disposable plastic cover. Sterile gel should be used to minimize infection. The nerve stimulators can be combined with ultrasound imaging for nerve blocks. The anatomical image is provided by ultrasonography and nerve stimulation induced motor response gives functional information of the blocked nerve. Observing the

spread of local anaesthetic is valuable in ultrasound guided nerve block. The passage of needle through the structures can be assessed by ultrasonography.

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

The era of upper limb anaesthesia began from the 1900s. In 1924 Kulenkampff put forward the various indications, techniques and associated dangers with brachial plexus anaesthesia. First brachial plexus block was performed by William Stewart Halsted in 1885, less than year after Karl Coller demonstrated the anaesthetic properties of cocaine on eye of a patient. The first percutaneous supra clavicular block was performed by Kulenkampff in Germany in 1911 reportedly on him. Since then the technique has been modified by several investigators.

Different approaches to Supraclavicular Brachial plexus block

The clinical practice began with the percutaneous approach, where using the clavicle as the landmark, a needle is inserted in the midpoint, lateral to Subclavian artery pulsations. Eliciting paraesthesia when the needle is in proximity to the plexus helps in the identification of the plexus or otherwise hitting the first rib can be used as a landmark, where the drug is deposited.

Major complications of the landmark technique are phrenic nerve palsy, Horner's syndrome, pneumothorax and intravascular injection. Because of these problems, the use of the landmark technique was being questioned.

It was then a newer approach of the supraclavicular brachial plexus block was introduced; the lateral approach, where the needle was inserted 1 cm above the medial 2/3rd and lateral 1/3rd, directed medially and inwards at an angle of

20 degrees to the skin, parallel to the clavicle avoiding the external jugular vein, eliciting paraesthesia. In this method, the needle is away from the pleura, chances of vessel puncture were less and success rates were high.

In a study conducted by **Arvind Kumar et al** in 2013 [13], the classic conventional technique was compared with the lateral approach. His study consisted of two groups, conventional versus lateral approach, 50 patients each. He concluded that the lateral approach had better outcomes, with better patient compliance and lesser incidence of trauma to vital structures.

A randomized controlled trial was conducted by **Dilip et al** in 2003 [8], recruiting 250 patients undergoing upper limb surgeries by lateral approach of the brachial plexus block where the needle was advanced medially from the junction of the medial two third and lateral one third of the clavicle in order to avoid structures like the pleura, neural structures like the phrenic nerve and vessels. Patients belonged to age group of 18- 50 years and it was seen that there was immediate pain relief after 20 ml solution of mixture of 10 ml of 2% lignocaine, 6 ml of 0.5% bupivacaine and 4 ml normal saline was injected. Average onset and duration of analgesia was 3 minutes and 180-200 minutes respectively. Average onset and duration of motor loss was 6-8 minutes and 120-150 minutes respectively. 6% cases had vessel puncture but no serious complications were noticed.

Techniques of block

There are different techniques of performing a brachial plexus block for upper limb surgeries. Various studies have been conducted comparing the techniques.

In past few years, there has been a shift in established methods of nerve location by elicitation of paraesthesia to identification of the proper motor response on nerve stimulation. Both of these techniques are reported to have a low sensitivity for detection of needle to nerve contact.

The anatomical variations from patient to patient and reduced patient compliance making neural structures difficult to access with neve stimulator, brought the advent of real time imaging with ultrasound. The advantage here is that the plexus under vision can be blocked.

A review article published by **Farheen and Antony** in 2011 [14] , concluded that brachial plexus block provided excellent intraoperative as well as postoperative analgesia with minimal complication and increased patient satisfaction. Onset of motor and sensory blockade was shortened and duration of block prolonged under ultrasound guided blocks . US guidance also decreased the risk of vascular puncture during the procedure.

In a comparative study by **De Jose et al** in 2008 [15] , Eighty children aged 5-15 years were compared for the success rate, complication and time for performance of US guidance of supraclavicular and infraclavicular brachial plexus blocks. Out of the 80 children scheduled for upper limb surgery, forty patients were assigned into group S providing supraclavicular block, and the

other forty were assigned into group I providing infraclavicular block. All blocks performed were exclusively under US-guided. Ropivacaine 0.5% was administered up to a maximum of 0.5 ml x kg until appropriate US-guided-spread was achieved. In the US-guided supraclavicular brachial plexus blocks, the duration of the sensory block was 6.5 +/- 2 h and of the motor block was 4 +/- 1 h. The volume of ropivacaine used in this group was 6 +/- 2 ml. In group I, 88% of blocks achieved surgical anaesthesia without any supplemental analgesia compared with 95% in group S (P = 0.39; difference=7%; 95% Confidence interval (CI): -10% to 24%).The mean time (SD) to perform the block in group I was 13 min (range 5-16) and in group S: 9 min (range 7-12); the 95% CI for this difference was 2-6 min and was statistically significant (P < 0.05). The study concluded that supraclavicular brachial plexus block was faster to perform than infraclavicular approach.

In 2009, **Tran et al** [16] ,conducted a randomized, prospective comparison between ultrasound-guided supraclavicular, infraclavicular, and axillary brachial plexus blocks. One twenty patients were divided into three groups. Each group had 40 patients i.e. supraclavicular brachial plexus (SCB)group had forty patients, interscalene group (ICB) had forty patients, axillary block group(AXB) had forty patients. There was no statistical differences between the 3 groups in terms of total anaesthesia-related time (23.1-25.5 mins), success rate (95%-97.5%), block-related pain scores, vascular puncture, and paraesthesia. Supraclavicular and infraclavicular approaches when compared with ultrasound-guided AXBs, showed that AXB required a higher number of

needle passes both a longer needling time, and a longer performance time. However, Supraclavicular blocks resulted in a higher rate of Horner syndrome.

Study of different local anaesthetics

With the availability of a wide range of local anaesthetics, various studies have been conducted comparing their efficacy in peripheral nerve blocks. Bupivacaine is a widely used long acting local anaesthetic agent and extensively used in clinical practice.

In a Randomized double-blind comparative study of 0.25% ropivacaine and 0.25% bupivacaine for brachial plexus block by **Hickey et al** in 1991 [19] , 44 patients had undergone upper limb surgeries and divided into two groups. One group received ropivacaine 0.25% (112.5 mg) and the other, bupivacaine 0.25% (112.5 mg), both without epinephrine. The mean onset time for analgesia ranged from 11.2 to 20.2 min, and the mean onset time for anaesthesia ranged from 23.3 to 48.2 min. The onset of motor block differed only with respect to paresis in the hand, with bupivacaine demonstrating a shorter onset time than ropivacaine. The duration of sensory and motor block also was not significantly different between the two groups. The mean duration of analgesia ranged from 9.2 to 13.0 h, and the mean duration of anaesthesia ranged from 5.0 to 10.2 hours. This study observed that the dose (0.25%)required in order to block brachial plexus was not sufficient.

Various comparative studies have shown that ropivacaine has lesser cardiovascular and central nervous systemic toxicity compared to bupivacaine.

However, it has slower onset of sensory blockade and similar motor blockade compared to bupivacaine.

Iamaroon A et al in 2014 [20] , conducted a study where they compared Femoral nerve block (FNB) with varying concentrations of bupivacaine, 0.25 % versus 0.5 %, used for postoperative analgesia after anterior cruciate ligament (ACL) reconstruction. In their study one hundred patients were randomized to receive FNB with 20 mL of 0.25% or 0.5% bupivacaine. Data regarding demographic, effectiveness of FNB, time to first pain, time to first analgesic, pain scores, morphine use, and recovery of sensory and motor function were recorded. from their study, they found that the median time to first morphine requirement was 12 hours in 0.5% bupivacaine group and 10 hours in 0.25% bupivacaine group ($p = 0.048$) and the pain score at 18 hours was lower in 0.5% bupivacaine group compared with 0.25% bupivacaine group. They finally concluded that FNB with 0.5% bupivacaine provided longer time to first analgesic and lower narcotic requirements after patellar tendon graft ACL reconstruction when compared to 0.25% bupivacaine.

Similarly, bupivacaine was compared with other local anaesthetics.

A study was conducted by **Raizada N** in 2002 [21] , comparing the onset of sensory and motor block and duration of supraclavicular block using lignocaine and bupivacaine. Sixty patients were randomly divided in three groups. Twenty patients in each group, group 1 received 30 ml of 1% lignocaine with 1:200000 adrenaline, groups 2 mixture of 10 ml of 1.5 % lignocaine and

20 ml 0.25% bupivacaine, group 3, 10 ml of 2 % lignocaine and 20 ml of 0.5% bupivacaine. Parameter observed were onset of motor and sensory block, duration of analgesia and hemodynamic changes with the groups. There was no significant difference between the onset time and duration of sensory block between group II and III. In group I, onset time for sensory block was significantly faster and duration of sensory block significantly less as compared to the other two groups ($p<0.05$). The onset time for motor block was significantly less and duration significantly higher in group III as compared to group II. No hemodynamic changes were observed. The study concluded as that 1% lignocaine with adrenaline was not suitable for conducting surgery under brachial plexus block. Mixture of 1.5% lignocaine and 0.25% bupivacaine provided good anaesthesia for short surgical procedures. However, for long and emergency operative procedures, combination of 2% lignocaine and 0.5% bupivacaine was found to be the best.

Similarly, **Vaghadia et al** in 1999 [22] ,conducted a multi-centre trial to compare the efficacy of ropivacaine 7.5 mg/ml versus bupivacaine 5 mg/ml in supraclavicular brachial plexus anaesthesia. 104 ASA I-III adults participated in the trial. These patients were divided into two groups ,52 in each group. One group received 30 ml of ropivacaine 7.5 mg/ml and the other group received bupivacaine 5.0 mg/ml. Mean duration of analgesia for the five nerves was between 11.3 and 14.3 hr with ropivacaine and between 10.3 and 17.1 hour with bupivacaine. Quality of muscle relaxation judged as excellent by the investigators was not significantly different (ropivacaine - 35/49, bupivacaine -

30/49). The median time to first request for analgesia was comparable between the two groups (11-12 hr). One patient developed a grand mal seizure shortly after receiving bupivacaine and recovered consciousness within 30 min. There were no serious adverse events in the ropivacaine group. Thirty ml ropivacaine 7.5 mg/ml (225 mg) produced effective and well tolerated brachial plexus block of long duration by the subclavian perivascular route. The results were similar with 30 ml bupivacaine 5.0 mg/ml.

Jeon et al, In March 2010 used 1% Mepivacaine 40 ml successfully in supraclavicular block with a speed of onset at 13.8± 5.5 mins [25].

Subsequently Ozmen **e**t al investigated addition of 2 % lidocaine and bupivacaine in lateral sagittal infraclavicular block in upper limb surgeries. Parameters that was observed were sensory and motor blockade. One hundred and twenty patients of ASA1-2 aged between 18-65 yrs. age group were part of the trial. Forty patients in each group. Group B: 20 mL (5 mg/mL) bupivacaine, Group B + L: 10 mL (5 mg/mL) bupivacaine + 10 mL (20 mg/mL) lidocaine. Group L: 20 mL (20 mg/mL) lidocaine. The block onset time was very long in the bupivacaine group ($P < 0.001$). Motor block developed the fastest in the lidocaine group and the bupivacaine + lidocaine group ($P < 0.001$). Motor block regression was the fastest in the lidocaine group and the slowest in the bupivacaine + lidocaine group ($P < 0.001$). Loss of cold and touch sense was the fastest in the bupivacaine + lidocaine group and the lidocaine group ($P < 0.001$). Loss of sense of pain was the fastest in the bupivacaine + lidocaine

group (P < 0.001). Postoperative analgesia requirement time was the longest in the bupivacaine + lidocaine group (P < 0.001).

There were no differences among the satisfaction scores.

ULTRASOUND IN BRACHIAL PLEXUS BLOCK

With the major disadvantage of pneumothorax with the landmark technique, due to the close proximity of the pleura with the trunks posterolateral to the subclavian artery, the use of supraclavicular block had been hampered. But with the advent of the two-dimensional ultrasound, the sonographic images were used to localize the structures and to guide the injecting needle.

Valery Piacherski et al [23] , conducted a prospective randomized study of 1105 nerve blocks in 762 patients by means of three methods of peripheral nerves and plexuses identification to compare the safety and efficiency of the methods of regional anaesthesia. Patients were divided into 3 groups. 1st group: the identification of the correct placement was done by eliciting paraesthesia (572 blocks were performed on 395 patients); 2nd group: an electrical nerve stimulator was used to locate the nerve (164 blocks on 110 patients);3rd group: the location of the nerve was identified using ultrasonic visual guidance. In 1st group 8 (1.4%) accidental intravascular injections of local anaesthetic, 1 case of Horner syndrome (0.17%), 1 case of phrenic nerve paralysis were registered. In Group 1, 17 cases had other methods of anaesthesia by reason of inefficiency of the block. In 2nd group 1 case (0.61%) of intravascular injection was noticed. The block was ineffective in a single case. There were no complication noted in the 3rd group. All the blocks were effective.

In 2003 **William et al** [24] ,conducted a prospective study comparing the quality, safety and execution time of the supraclavicular block under ultrasound guidance and nerve stimulation. Their study consisted of eighty patients divided into two groups, Group US (blocks performed under ultrasound) and Group NS (blocks performed under nerve stimulation). Blocks were performed using 0.5% bupivacaine and lignocaine 2% with adrenaline (1: 200000) as the anaesthetic mixture. The onset for the motor and sensory block was evaluated over a period of 30 minutes. At 30 minutes, 95% of the patients of the ultrasound group and 85 % of the nerve stimulation group had partial or complete sensory block of all nerve territories and 55% of patients in Group US and 65% of patients in Group NS had a complete motor block of all nerve territories. Surgical anaesthesia without supplementation was achieved in 85% of patients in

Group US and 78% of patients in Group NS. No patient in Group US and 8% of patients in Group NS required general anaesthesia. The quality of ulnar block was significantly inferior to the quality of block in other nerve territories in Group NS, but not in Group US. The block was performed in an average of 9.8 min in Group NS and 5.0 min in Group US. They concluded that ultrasound-guided and neurostimulator-confirmed supraclavicular block can be performed rapidly and provides a more complete block than supraclavicular block using anatomic landmarks and neurostimulator.

In 2013 **Duncan et al** [25] ,conducted a comparative study of nerve stimulator versus ultrasound guided supraclavicular brachial plexus block. They noted the block execution time, time of onset of sensory and motor block,

quality of block and success rates. A total of 60 patients were enrolled in this prospective randomized study and were randomly divided into two groups: US (Group US) and NS (Group NS). Both groups received 1:1 mixture of 0.5% bupivacaine and 2% lignocaine with 1:200000 adrenaline. The failed blocks were supplemented with general anaesthesia. They concluded that there was no significant difference between patient groups with regard to demographic data, the time of onset of sensory and motor block and comparing the two groups, the difference in the block execution time and success rates was not statistically significant.

In 2010, **Jeon DG and Kim Wi** [26] ,in their case series attempted to obtain reliable clinical data on ultrasound guided supraclavicular blocks and to demonstrate the higher success rate and fewer complications, and design an injection method for patients whose brachial plexus cannot be located. Their study consisted of 105 patients who received an ultrasound-guided supraclavicular block. 40 ml of 1% mepivacaine was used. The groups were divided into two groups - Group A (n = 92, patients who had visible brachial plexus) and Group B (n = 13, patients whose brachial plexus could not be located, where the drug was given superior lateral to the subclavian artery). After the blocks, the clinical characteristics such as the success rate, the time to onset, the extent of the sensory block, and occurrence of complications were evaluated. They suggested that the Success rate of Group A was higher than that of Group B and all patients could be operated on under sedation. The time to onset of Group A was shorter than that in Group B. The overall time to onset

was 13.8 +/- 5.5 min. There were no serious complications such as pneumothorax and they concluded that ultrasound-guided supraclavicular block is very effective in even patients whose brachial plexus cannot be located.

In a case series: Ultrasound – guided supraclavicular black using a curvilinear probe in 104 day-case hand surgery patients by Tsui et al[11]Kathleen Doyle at al, Kinny et al retrospectively reviewed 104 patients charts from first 6 months using this block approach for upper extremity surgery. Block success, completion and recovery time post-block analgesia requirement, acute complication rate, and duration of hospital stay were evaluated and categorized based on the practitioner who performed the block. During the performance of each block, the brachial plexus was revised using a curvilinear probe, and the needle was advanced in-place in an anterolateral-to-posteromedial direction. The plexus, needle, and spread of local anaesthetic could be clearly visualized in each case. Surgical regional anaesthesia was achieved in 94.2% of blocks. The block was the sole method of postoperative analgesia in 85.6% of patients, and the overall block completion time was 20.2 +/- 9.2 min. There were no occurrences of clinical pneumothorax during the study period. They concluded that using ultrasound guidance and nerve stimulation during supraclavicular blockade, the curvilinear probe enables a large field of view. Adequate resolution in larger patients and excellent needle visibility that allows access to the plexus while avoiding pleura and subclavian artery

Arcand et al and Willams et al [24], they compared ultrasound guided (USG) infraclavicular and supraclavicular blocks for performance time and

quality of block. They included 80 patients in their study. All blocks were performed using ultrasound visualization with a 7.5-MHz linear probe and neurostimulation. They hypothesized that infraclavicular approach would result in shorter performance time with quality of block similar to that of supraclavicular approach.

Z.J.Koscielniak-nielson, B.S.Frederiksen et al[9]comparing two approaches using 7.5MHZ linear probe in 120 patients, the block performance and latency times, surgical effectiveness, adverse events and patients acceptance were recorded. The mean block performance time was 5.7 min in the supraclavicular group and 5.0min in the infraclavicular group which was in significant. Block effectiveness is superior in later group. The supraclavicular group patients had a significantly poorer block of the median and ulnar nerves, but a better block of the axillary nerve. Sensory scores at 10,20 and 30 mins were not significantly different. Patients acceptance of the block was similar in both groups and hence they concluded that infraclavicular block had a fastest onset, better surgical effectiveness and fewer adverse events. Block performance time and patients acceptance of the procedure were similar in both groups.

In the study by Sandhu NS, capan et al [27] , using ultrasound guidance, infraclavicular brachial plexus block was performed in 126 patients. An important aspect of this standardized technique included (i) imaging axillary artery and the three cords of the brachial plexus posterior to the pectoralis minor muscle, (ii) marking the position of the ultrasound probe before introducing a

Touchy needle, (iii) maintaining the image of the entire length of the needle at all times during its advancement, (iv) depositing local anaesthesia around each of the three cords and (v) placing a catheter anterior to the posterior cord when indicated. They observed an excellent block permitted surgery in 114 (90.4%) patients, without a need for any supplemental anaesthetic or conversion to general anaesthesia. In nine (7.2%) patients local or perineural administration of local anaesthetic, and in three (2.4%) conversion to general anaesthesia, was required. Mean times to administer the block, onset of block and complete block were 10.0 (SD 4.4), 3.0 (1.3) and 6.7 (3.2) min, respectively. They concluded that the use of ultrasound appears to permit accurate deposition of the local anaesthetic perineurally, and has the potential to improve the success and decrease the complications of infraclavicular plexus block.

Chun Woo Yang et al, HeeUk Kwon et al, Choon-Kyu Cho et al [28] did a prospective double blind study in 100 patients undergoing upper limb surgeries to compare the clinical effects of vertical infraclavicular and supraclavicular plexus block using nerve stimulator. They compared the block performance related to pain, quality of block, duration of sensory and motor block, patient satisfaction at the end of surgery. They observed no significant differences in the block performance related pain, frequency of the stimulated nerve type, evaluation of sensory and motor block quality, or the success of the block. There were no significant differences in the duration of the sensory and motor block. There was a significant difference in the incidence of Horner's Syndrome. Two patients had a pneumothorax in the supraclavicular approach.

There were no significant differences in the patient satisfaction. So they concluded that both infraclavicular and supraclavicular brachial plexus block had similar effects. The infraclavicular approach may be preferred to the supraclavicular approach when considering the complications.

In a study by Chan, Rawson, Odukoya et al,[29] they evaluated the state of the art ultrasound technology for supra clavicular brachial plexus block in 40 outpatients. Ultrasound imaging was used to identify the brachial plexus before the block, guide the block needle to reach the target nerves and visualize the pattern of local anaesthetic spread. Needle position was further confirmed by nerve stimulation before injection. The block was successful after one attempt in 95% of the cases, with one failure attributable to subcutaneous injection and one to partial intravascular injection. Pneumothorax did not occur. The suggested that a high resolution ultrasound probe can reliably identify a brachial plexus and its neighbouring structures in the supraclavicular region. The technique of real time guidance during needle advancement can quickly localize the nerves. Distinct patterns of local anaesthetic spread observed on ultrasound can further confirmed accurate needle location.

ItiShri, SandeepSahu, R.K.Mehtaetal [30] in their study of continuous vertical infraclavicular brachial plexus block for post-operative pain relief in orthopedic surgery investigated 60 patients undergoing unilateral upper limp surgery regarding the efficacy of post-operative analgesia and physiotherapy. Their patients received an infraclavicular block and peri neural catheter post operatively. The patients were divided into, normal saline group, those

receiving 0.125 % bupivacaine and those receiving 0.25 % bupivacaine boluses at 6th hourly interval. Pain scores, motor block, satisfaction scores and symptoms of catheter and local anaesthetic related complications were recorded in 3 groups over 48 hours. They concluded that after moderately painful orthopaedic surgery 0.125% bupivacaine administered through infraclavicular brachial plexus perineural catheter decreased pain and improved overall satisfaction.

In another study by Dingemans, Archand and William et al [31,] they did a prospective randomized study in 72 patients scheduled for hand or forearm surgery regarding the speed of execution and quality of ultrasound guided infraclavicular block with either with ultra sonography alone or ultrasound combined with nerve stimulator. They concluded that ultrasound guided infraclavicular block is rapidly performed and yields higher success rate when visualization of local anaesthetic spread is used as the end point of injection. Postero-lateral spread of local anaesthetic around axillary artery predicts successful block, circumventing the need for direct nerve visualization.

Geneviève Arcandet al [32] , did not report any cases of pneumothorax by ultrasound guided supraclavicular block confined the incidence of 1%–4% reported for "blind" supraclavicular block.

Stephen R Williams et al [33] ,assessed the quality, safety, and execution time of supraclavicular block of the brachial plexus using ultrasonic guidance and neurostimulation compared with a supraclavicular technique that used anatomical landmarks and neuro stimulation. They concluded that ultrasound-

guided neurostimulator-confirmed supraclavicular block is more rapidly performed and provides a more complete block than supraclavicular block using anatomic landmarks.

Stephan Kapral et al,[34] prospectively studied 40 patients (ASA grades I &II) undergoing surgery of the forearm and hand, to investigate the use of ultrasonic cannula guidance for supraclavicular brachial plexus block and its effect on success rate and frequency of complications. Satisfactory surgical anaesthesia was attained in 95% of both groups. Because of the direct ultrasonic view of the cervical pleura, they had no cases of pneumothorax. An accidental puncture of subclavian or axillary vessels, as well as neurologic damage, was avoided in all cases. They concluded that ultrasonography-guided approach for supraclavicular block combines the safety of axillary block with the larger extent of block of the supraclavicular approach.

Klaastad O, Sauter AR, Dodgson MS [35,] concluded that ultrasound guidance may provide a higher success rate for brachial plexus blocks than conventional guidance by nerve stimulator. However, the studies were not large enough to conclude that ultrasound will reduce the risk of nerve injury, local anaesthetic toxicity or pneumothorax. Ultrasound may reveal anatomical variations of importance for performing brachial plexus blocks. They concluded that the potential for ultrasound to improve efficacy and reduce complications of brachial plexus blocks requires larger scaled studies.

J. Fredrickson, A. Patel, S. YoungandS. Chinchanwala[36] ,compared the onset time of brachial plexus block using 2% lidocaine 25-30 ml with

adrenaline 5 μg.ml^{-1} into the ‘corner pocket’ inferolateral/lateral to the subclavian artery to a triple point injection around the axillary artery. Complete sensory blockade in all four nerve territories at 30 min was achieved in 57% in group supraclavicular and 70% in group infraclavicular (p = 0.28). Painless surgery without the requirement for block supplementation was higher in group infraclavicular compared with group supraclavicular (19/30, 67%; p = 0.01). Of the 11 failures in group supraclavicular, nine were due to incomplete ulnar nerve territory anaesthesia. These results do not support the concept of rapid onset successful supraclavicular block via a simple ultrasound-guided local anaesthetic injection inferolateral to the subclavian artery.

Amany El-Sawy, Nashwa Nabil Mohamed, Mohamed Ahmed Mansour, Mona Ramadan Salem [37], Sixty adult patients with chronic renal failure, scheduled for creation of arteriovenous fistula of the distal upper extremity were randomly divided into two equal groups: ultrasonic guided supraclavicular brachial plexus block was given and ultrasonic guided infraclavicular brachial plexus block was given. For both groups we used20–25 cm 1:1 volumes of 0.5% bupivacaine and 2% lidocaine. The measured parameters were block performance time and related pain, the degree and duration of sensory and motor block, patient discomfort, first call for analgesics, complications and the patient’s satisfaction. There was no statistically significant difference between both groups as regard the block performance time, the block related pain, the degree of sensory and motor block in the areas supplied by the median, radial and musculocutaneous nerves at 10, 20 and

30 min. There was no statistically significant difference as regard the sensory block grade in the area supplied by the ulnar nerve at 10 min, but it was significantly higher in the Supraclavicular than Infraclavicular at 20 and 30 min. No statistically significant difference as regard the motor block grade in the area supplied by the ulnar nerve, the block duration, first call for analgesia, complications and patients' satisfaction.

ADJUVANTS IN PERIPHERAL NERVE BLOCKS:

Similar study was conducted by **Anjan Das and Sandip Roy** [3] , in hundred patients posted for elective forearm and hand surgeries under ultrasound guided supraclavicular brachial plexus block, using ropivacaine and magnesium sulphate, who were divided into two equal groups (RM and RN)in a randomized double blind study. For group RM 30 ml 0.5%ropivacaine plus 150 mg magnesium sulphate was used and group RN 30 ml ropivacaine and 1 ml normal saline was used. Sensory and motor block onset times and block durations, time to first analgesic use, total analgesic need, postoperative Visual Analog scale(VAS), hemodynamic variables, and side effects were recorded for each patient. There was no significant difference between the onset of motor and sensory blockade and was clinically insignificant. Whereas significant difference was found in the sensory and motor block durations in the group receiving magnesium sulphate. The duration of analgesia was prolonged in the magnesium sulphate group and was statistically significant. RM group required less of rescue analgesics than in group

RN in first 24 hrs of post operative period and the difference is statistically highly significant. Regarding the side effects, group RM suffered from slightly more nausea and hypotension however it was statistically insignificant.

Similar to our study was also conducted by **Parvez Taneja and Manjit Singh** [12] , where 60 patients posted for elective forearm and hand surgeries under supraclavicular brachial plexus block were divided into two equal groups, RM and RN. For group RM 30 ml 0.5%ropivacaine plus 150 mg magnesium sulphate was used and group RN 30 ml ropivacaine and 1 ml normal saline was used. Onset of Sensory and motor blockade, duration of sensory and motor blockade, duration of postoperative analgesia(VAS) score, hemodynamic variables, and side effects were recorded for each patient. There was no statistical difference in age, weight and sex distribution between two groups. There was no statistical significance in the onset of sensory and motor block between two groups. Duration of motor blockade and sensory blockade was prolonged in RM group when compared to RN group and was statistically significant. There was no statistical significant difference in intraoperative parameters namely pulse, systolic BP and diastolic BP. There was statistically significant difference in the duration of analgesia in RM group. The incidence of nausea and hypotension was present, but was statistically insignificant.

Similar to our study was also conducted by **Dileep Gupta** and **Vandana Mangal** [8] **,** who did a study in 120 patients scheduled for

elective surgeries of upper limb under supraclavicular brachial plexus block in two groups. Group I received 24 ml of 0.5% ropivacaine plus normal saline. Group II received 24 ml of 0.5% ropivacaine plus 150 mg of magnesium sulfate plus 5.5 ml of normal saline. Sensory and motor block onset times and block durations, time to first analgesic use, total analgesic need, postoperative visual analogue scale(VAS), hemodynamic variables, and side effects were recorded for each patient. Demographic variables and baseline characteristics were comparable between two groups and no statistically significant difference was observed. Baseline parameters were comparable between the two groups and no statistical significance was observed. Regarding the onset of sensory block, there was no statistical significance. While the onset of motor block was delayed in group II and statistically significant difference was found between the two groups. Duration of motor block and duration of rescue analgesia were prolonged in group II, and the difference was statistically significant. VAS score between the two groups were significant at 6 and 12 hours.

MATERIALS & METHODS

METHODOLOGY:

STUDY DESIGN

This study is hospital based randomised controlled study.

STUDY PERIOD

January 2019 to August 2019.

SAMPLE SIZE

The study was conducted in a tertiary care hospital after obtaining due permission from the institutional ethical committee. A total of 40 patients of either sex, weighing, 50 to 70 kg undergoing elective upper limb surgeries of duration 1 to 4 hours were included in the study. The surgical interventions were surgeries on elbow, fore arm and wrist.

Sample Size Determination

In order to compare the primary outcome - duration of sensory blockade between the two groups (Ropivacaine + Magnesium vs Ropivacaine + Placebo) the following sample size has been calculated. Based on the estimates of duration of sensory blockade from Gupta D et al[1], the following sample size[2] of 36 (18 in each group) subjects undergoing supraclavicular brachial plexus aided by ultrasound was calculated to detect a minimum absolute difference of 113.3 minutes with 90% power at 1% level of significance.

Sample size $n = \frac{(\sigma_1^2 + \sigma_2^2)(Z_{1-\alpha/2}+Z_{1-\beta})^2}{\Delta^2}$

σ_1 = 73.3 (SD in Ropivacaine + 6ml normal saline)

σ_2= 100.2 (SD in Ropivacaine + 250mg Magnesium sulphate)

$Z_{1-\alpha}$= 2.58

$Z_{1-\beta}$ = 1.8

Δ = 113.3 (a difference between the mean sensory blockade times 377.7 and 491 minutes)

The sample size implies that 18 eligible subjects need to be recruited in each group (36 total). After accounting for attrition rate of 10% the sample size is **20** subjects per group (**40 total**).

Statistical Analysis Plan

The difference between the means of duration of sensory and motor blockade, VAS score and other continuous demographic data will be analysed using independent t test after checking for normality of data (Kolmogorov Smirnov test). Non parametric test will be used where relevant. Chi Square test for association will be employed to test for associations between categorical variables. A p value <0.01 will be considered statistically significant for sensory blockade duration.

Inclusion Criteria:

Age group 20-60 years

ASA physical status 1 and 2

Male and female patients

Elective surgery of upper extremity

Exclusion Criteria:

Patients with age less than 20 and greater than 60 years

ASA Physical status III and IV

Patients with coagulopathy or anticoagulants

Patient refusal

Known allergy to local anaesthetics

Psychiatric illness

Patients with peripheral neuropathy

Preoperative preparation

All the patients had undergone pre anaesthetic evaluation prior to surgery. All systems were examined including airway. The procedure to be carried out was explained and consent was obtained. All patients were kept nil per oral as per ASA guidelines.

Investigation:

Haemoglobin estimation

Complete blood count

Coagulation profile

Blood sugar and serum creatinine.

Urine-Albumin, sugar, microscopy

Chest X-ray PA view

ECG for patients above 35 years

Prior to Procedure

- Written Informed Consent:

- Intravenous access – Starting of an intravenous line with 18 or 20 gauge intravenous cannula on the contra lateral upper limb.
- Premedication – intravenous midazolam 1 mg was given so that the patient remained awake and cooperative throughout the procedure.
- Baseline Monitors are connected

Equipment

a) For the procedure

A) Portable tray covered with sterile towels containing

- Syringe 5ml, 10ml, 20ml
- Bowl containing iodine and spirit
- Sponge holding forceps
- Towel and towel clips
- Drugs:1. 0.75% ropivacaine 20 ml
- 2. 250 mg of magnesium sulphate[0.5 ml]
- Normal saline
- Ultrasound machine with linear probe of 10 - 15MHZ
- Sterile probe cover
- Insulated needle 10cm length

B) For emergency resuscitation

The anaesthesia machine, central and cylinder oxygen source, working laryngoscope, connectors, suction apparatus, oral and nasal airway, Drugs like atropine, adrenaline, ephedrine, intralipid emulsion.

Technique:

For the supraclavicular block, patient is positioned by lying flat with head turned to 40 degrees to opposite side and arm by side of patient. After painting and draping the ultrasound probe of 10-15 MHZ is used to visualize the cord. The ultrasound probe is positioned in supraclavicular fossa and moved laterally in order to locate subclavian artery. Once the artery is visualized the area lateral and superficial to it is explored until plexus is visualized as honeycomb appearance. The first rib and pleura should be seen clearly. The needle is entered by the in plane technique. Distinct pop is felt and seen when sheath is entered. Then assistant is asked to aspirate and inject the local anaesthetic. The spread of local anaesthetic can be immediately visualized.

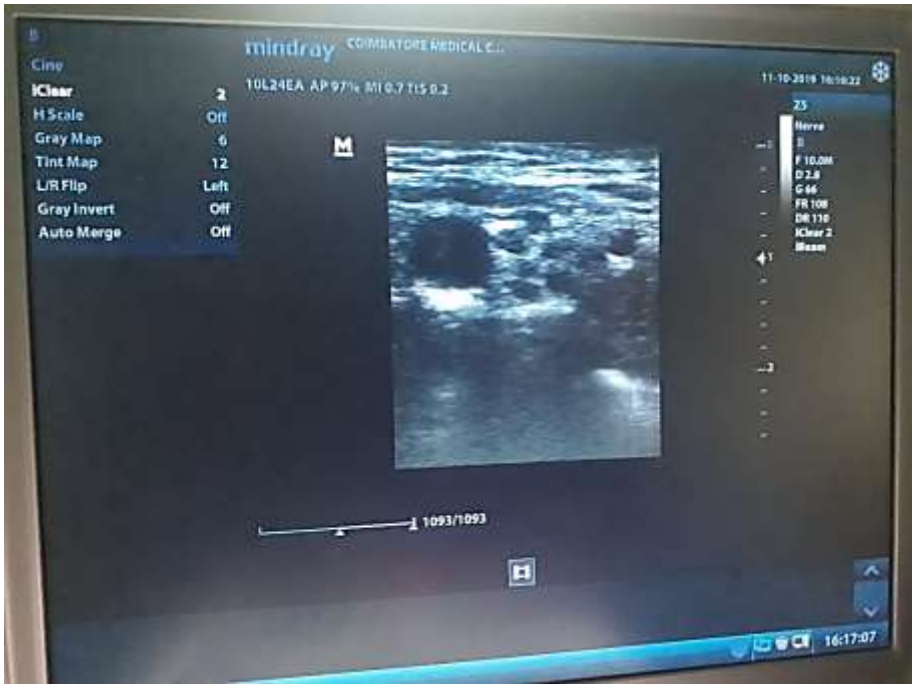
A total of 40 patients, divided randomly by computer allocated numbers into two equal groups.

Group I receiving 20 ml of 0.75% Ropivacaine + 0.5 ml Magnesium sulphate 250 mg

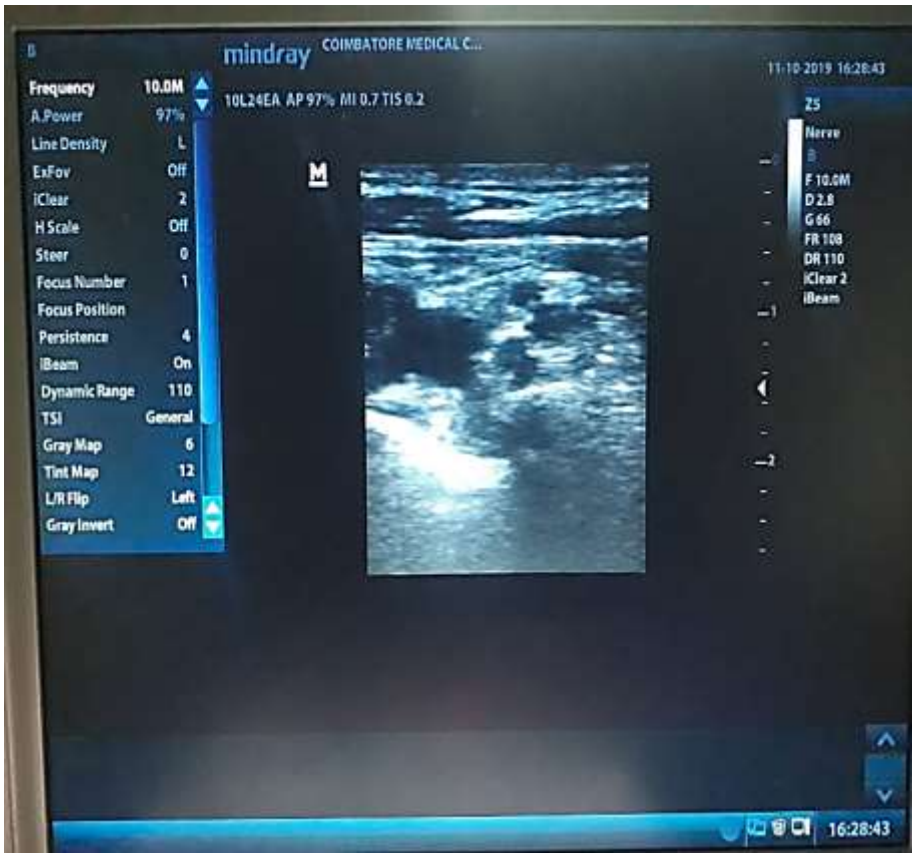
Group II receiving 20 ml of 0.75% Ropivacaine + 0.5 ml normal saline.

USG MACHINE

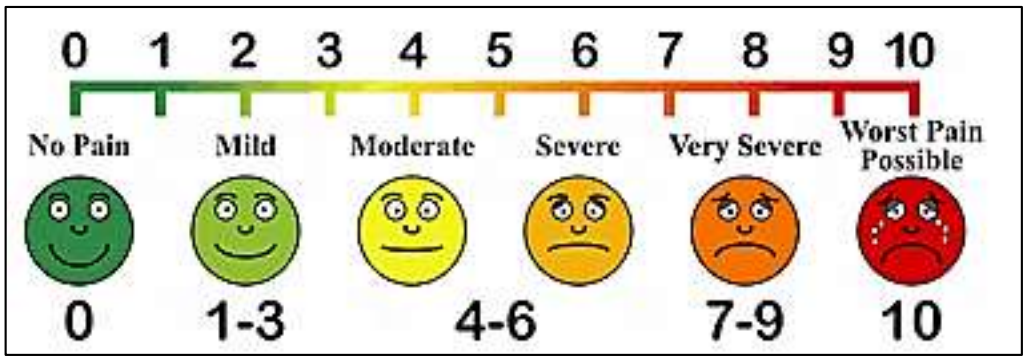
BRACHIAL PLEXUS



BRACHIAL PLEXUS AFTER DRUG ADMINISTRATION



VISUAL ANALOG SCALE



OUTCOME MEASURES:

SENSORY BLOCK: Sensory block is evaluated by pin prick stimulation at the areas supplied by the radial nerve, median nerve, ulnar nerve and musculocutaneous nerve. The assessment of sensory block documented for each nerve as:

a. Anaesthesia - score 2 (no pain, no touch sensation).
b. Analgesia - score 1 (no pain).
c. Pain - score 0 (feels pain).

MOTOR BLOCK: Motor block is assessed by modified Bromage scale.

0 – unable to move fingers

1 - able to move fingers only

2 – able to bend the wrist

3 – full flexion of the elbow

Sensory and Motor blockade are assessed every 2 minutes after completion of injection until 30 minutes and then every 30 minutes after the end of surgery until first 12 hours, there after hourly until the block had completely worn off.

DURATION OF BLOCK: The duration of sensory block is defined as the time interval between the onset of sensory block and the time by which patient complained of pain. The duration of motor block is defined as the time interval between the onset of motor block and complete recovery of motor function.

POSTOPERATIVE PAIN RELIEF : It is assessed by visual analogue scale. During postoperative period the patients are monitored for pain using VAS score every 30 minutes after the end of surgery until first 12 hours, there after hourly until the block had completely worn off. Rescue analgesic is given when pain score is VAS >3 cm.

VISUAL ANALOG SCALE:

0 – no pain.

10 – unbearable pain.

RESULTS

RESULTS

TABLE 1: DISTRIBUTION OF PATIENTS AMONG TWO GROUPS

GROUP	NUMBER	PERCENTAGE
ROPIVACINE+MGS04	20	50.0
ROPIVACINE+NS	20	50.0
TOTAL	40	100.0

TABLE 2: AGE AND WEIGHT DISTRIBUTION OF PATIENTS AMONG THE TWO GROUPS

VARIABLE	ROPIVACINE+MGS04	ROPIVACINE+NS
AGE IN YEARS	33.35±13.26	34.80±11.82
WEIGHT IN KG	57.55±5.15	58.45±4.47

CHART 1: AGE-WISE DISTRIBUTION OF PATIENTS AMONG THE TWO GROUPS

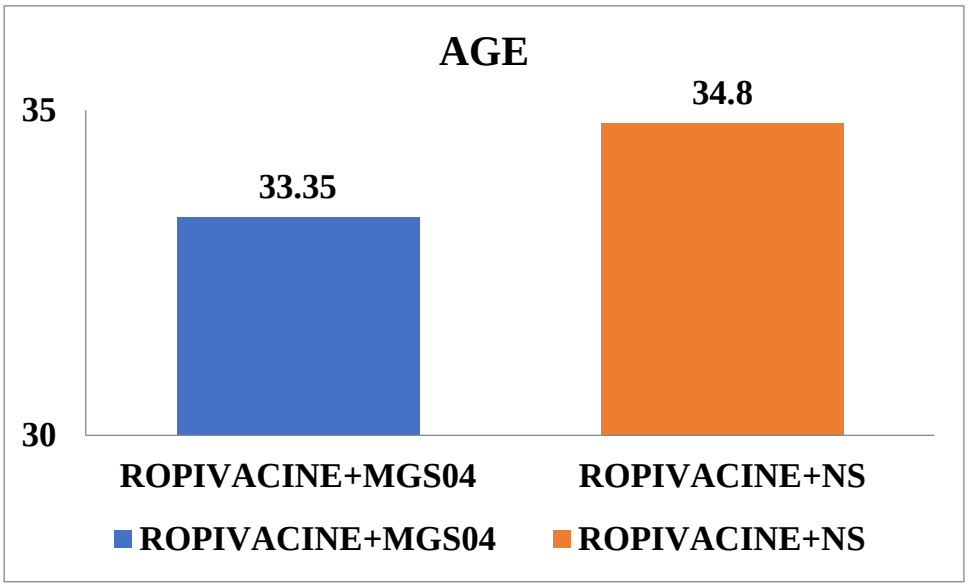


CHART 2: WEIGHT-WISE DISTRIBUTION OF PATIENTS AMONG THE TWO GROUPS

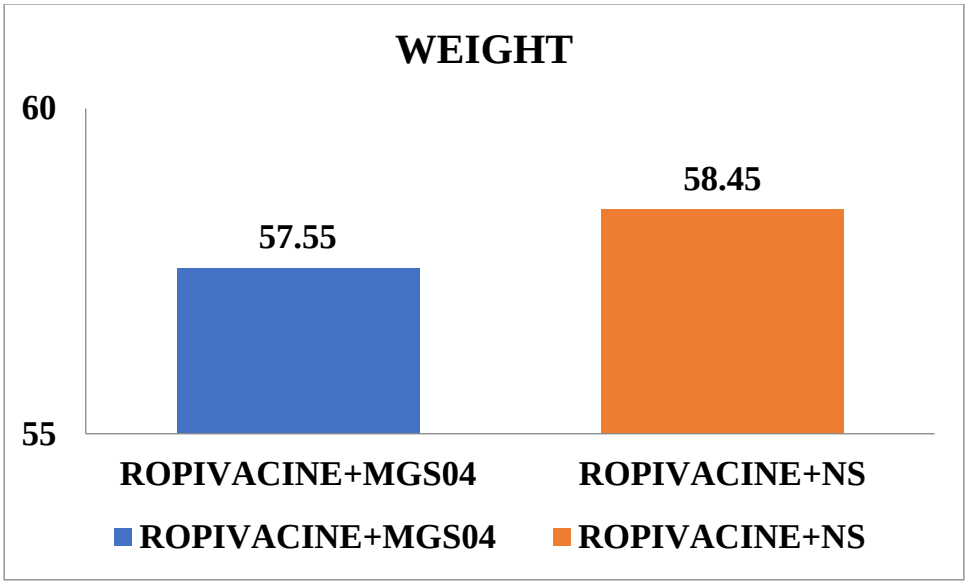


TABLE 3: GENDER AND WARD DISTRIBUTION OF PATIENTS AMONG VARIOUS DEPARTMENTS

VARIABLE		ROPIVACINE+MGS04		ROPIVACINE+NS	
		NO	%	NO	%
GENDER	MALE	15	75.0%	17	85.0%
	FEMALE	5	25.0%	3	15.0%
WARD	ORTHO	9	45.0%	7	35.0%
	PLASTIC	11	55.0%	13	65.0%

CHART 3: GENDER DISTRIBUTION OF PATIENTS AMONG VARIOUS DEPARTMENTS

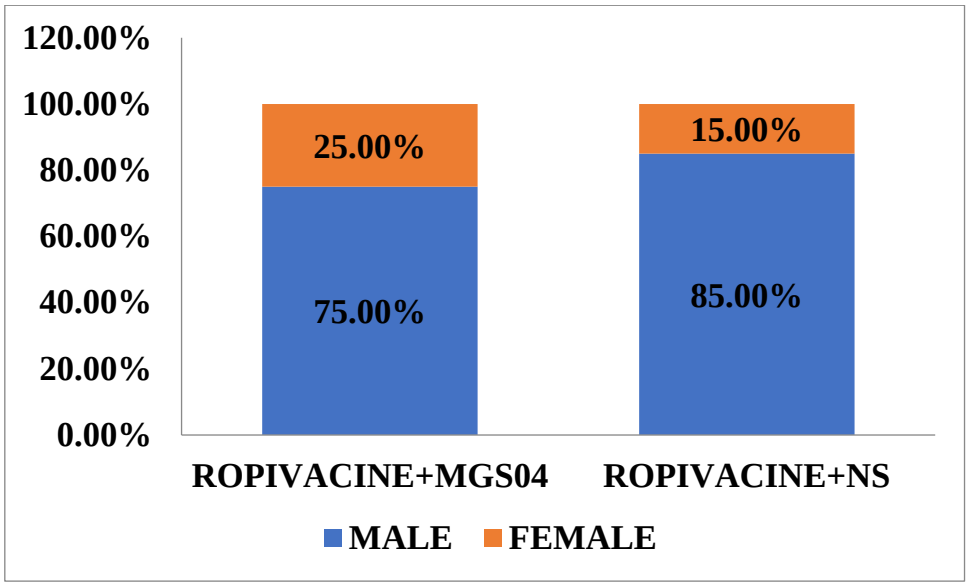


CHART 4: WARD DISTRIBUTION OF PATIENTS AMONG VARIOUS DEPARTMENTS

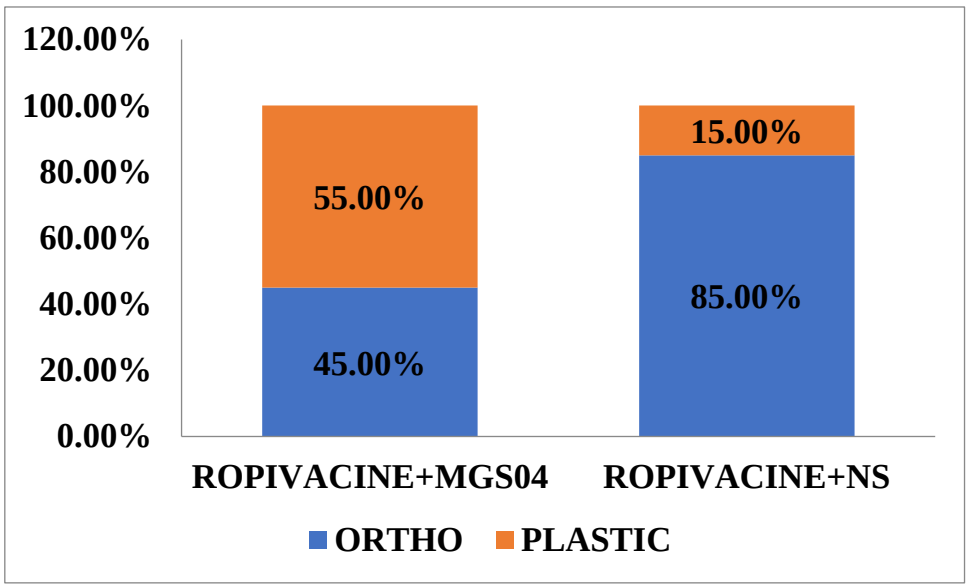


TABLE 4: DISTRIBUTION OF PATIENTS WITH DIFFERENT INJURIES AMONG TWO GROUPS

VARIABLE		ROPIVACINE+MGS04		ROPIVACINE+NS	
		NO	%	NO	%
Diagnosis	# BB FOREARM	4	20.0%	2	10.0%
	# RADIUS	4	20.0%	3	15.0%
	# ULNA	0	.0%	2	10.0%
	CONTRACTURE	2	10.0%	3	15.0%
	CRUSH INJURY	2	10.0%	1	5.0%
	FLEXOR INJURY	0	.0%	1	5.0%
	GALAZZEI #	1	5.0%	0	.0%
	R FOREARM INJURY	1	5.0%	0	.0%
	RAW AREA	5	25.0%	6	30.0%
	TENDON INJURY	1	5.0%	2	10.0%

CHART 5: DISTRIBUTION OF PATIENTS WITH DIFFERENT INJURIES AMONG TWO GROUPS

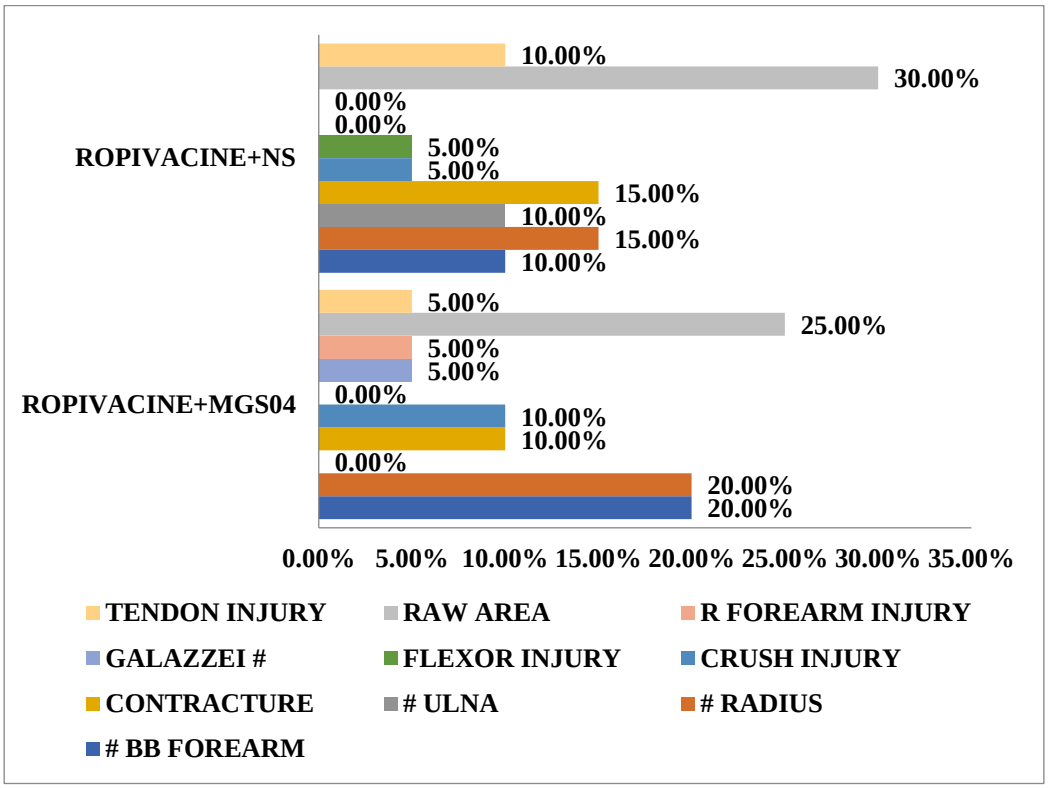


TABLE 5: DISTRIBUTION OF PATIENTS UNDERWENT DIFFERENT PROCEDURES AMONG THE TWO GROUPS

VARIABLE		ROPIVACINE+MGS04		ROPIVACINE+NS	
		NO	%	NO	%
PROCEDURE	DEBRIDEMENT	2	10.0%	1	5.0%
	EXPLORATION	1	5.0%	1	5.0%
	FLAP COVER	0	.0%	1	5.0%
	ORIF	9	45.0%	7	35.0%
	RELEASE	2	10.0%	2	10.0%
	REPAIR	1	5.0%	2	10.0%
	SSG	5	25.0%	6	30.0%

CHART 6: DISTRIBUTION OF PATIENTS UNDERWENT DIFFERENT PROCEDURES AMONG THE TWO GROUPS

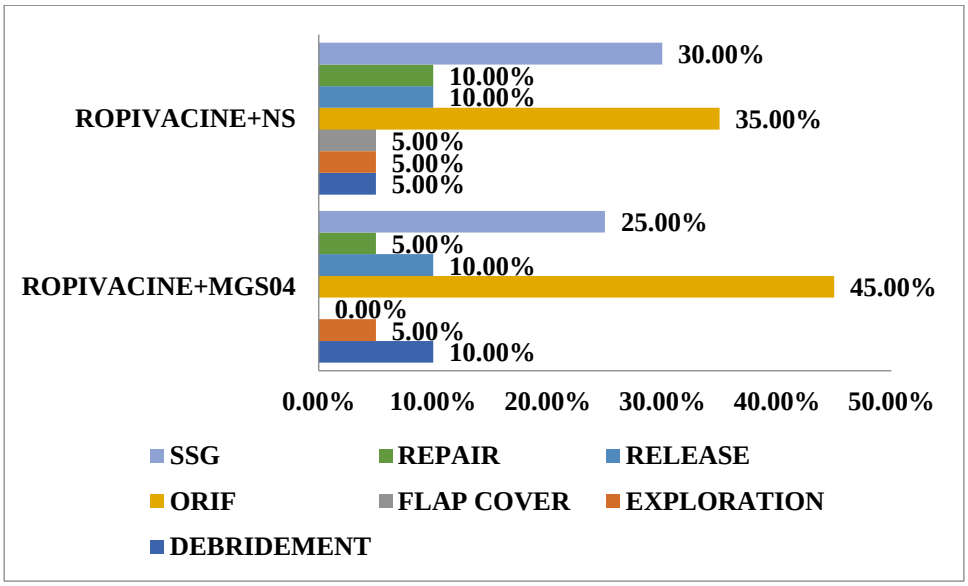


TABLE 6: ONSET OF SENSORY AND MOTOR BLOCK AMONG THE TWO GROUPS

VARIABLE	ROPIVACINE+MGS04	ROPIVACINE+NS	P VALUE
SENSORY ONSET	9.85±1.5.3	9.30±1.38	0.240
MOTOR ONSET	12.90±1.65	12.50±1.32	0.402

CHART 7: ONSET OF SENSORY BLOCK AMONG THE TWO GROUPS

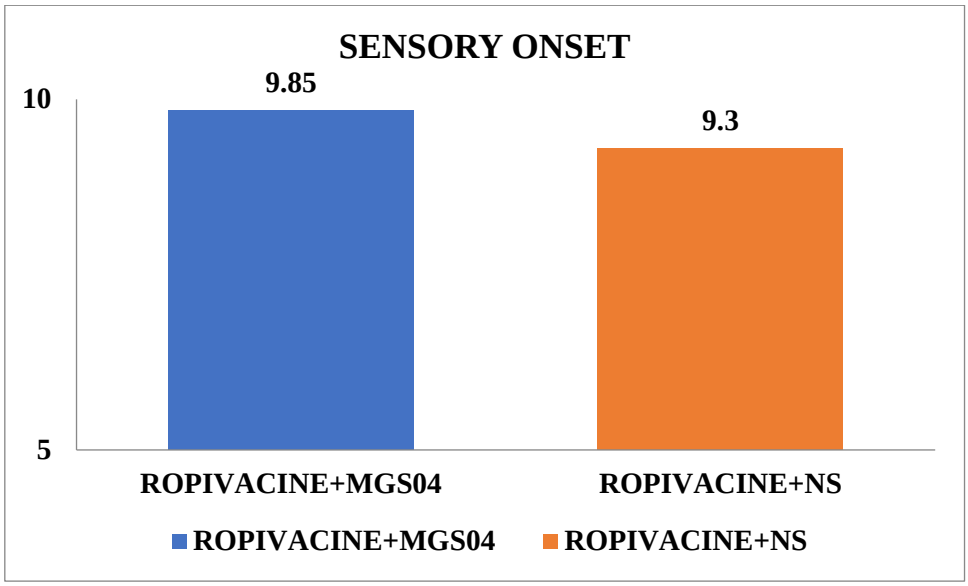


CHART 8: ONSET OF MOTOR BLOCK AMONG THE TWO GROUPS

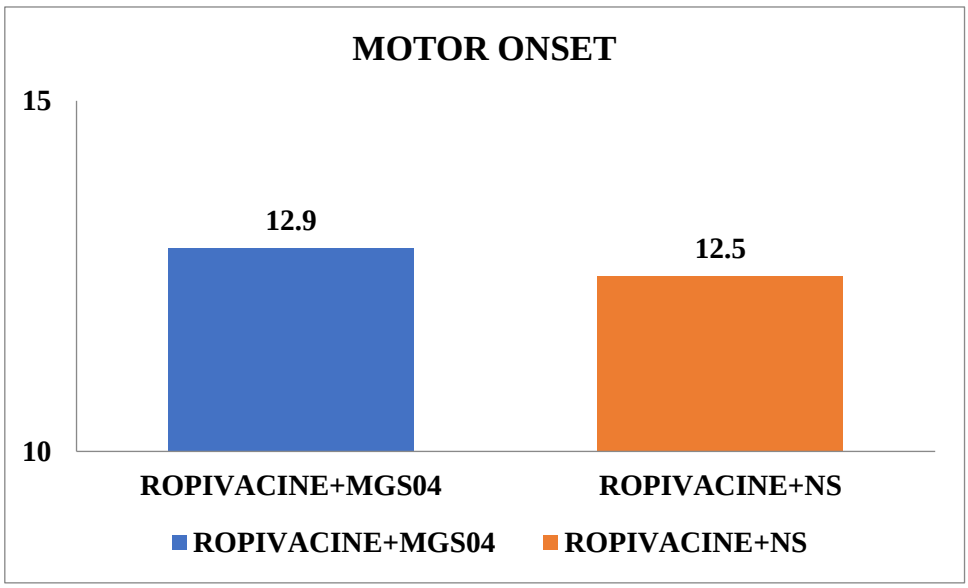


TABLE 7: DURATION OF SENSORY AND MOTOR BLOCKADE AND USE OF RESCUE ANALGESIC AMONG THE TWO GROUPS

DURATION	ROPIVACINE+MGS04	ROPIVACINE+NS	P VALUE
SENSORY	519.50±29.64	341.0±48.55	<0.001
MOTOR	422.70±21.24	270.60±37.88	<0.001
RESCUE ANALGESIC	618.50±27.00	401.50±57.33	<0.001

CHART 9: DURATION OF SENSORY BLOCKADE AMONG THE TWO GROUPS

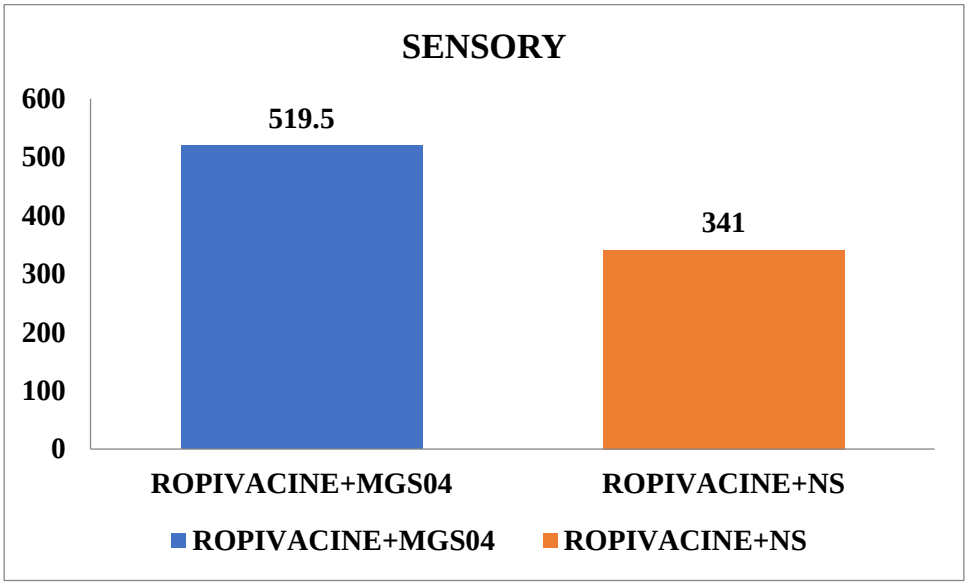


CHART 10: DURATION OF MOTOR BLOCKADE AMONG THE TWO GROUPS

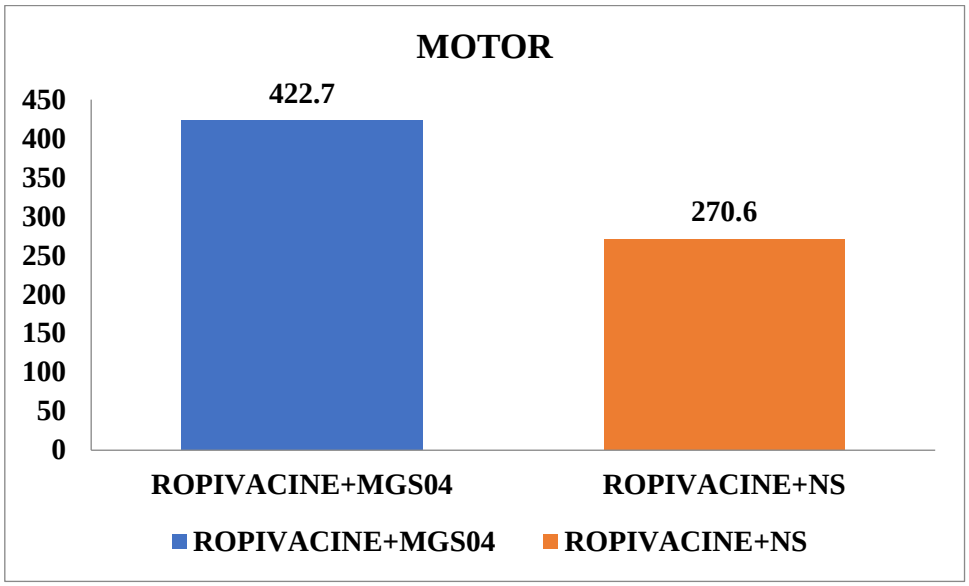


CHART 11: USE OF RESCUE ANALGESIC AMONG THE TWO GROUPS

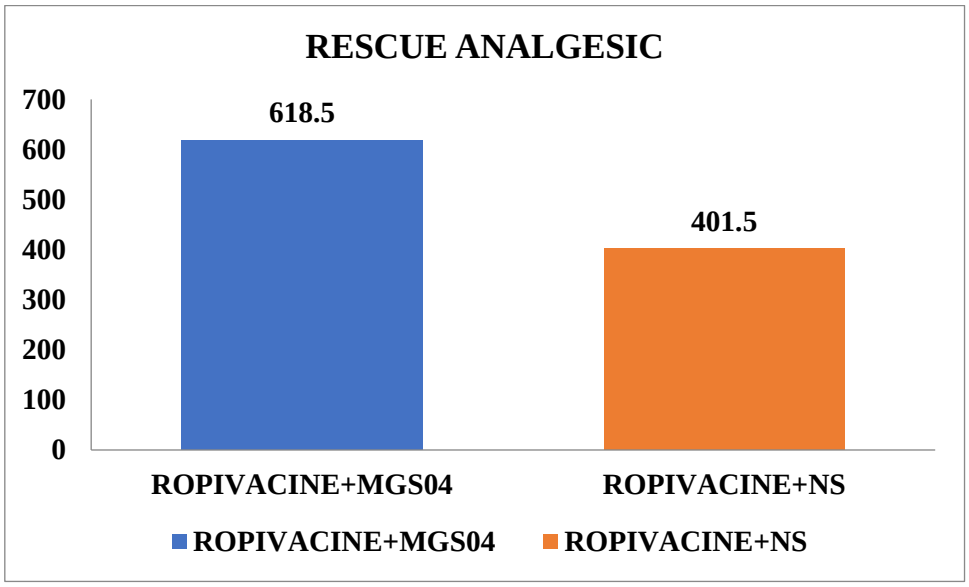


TABLE 8: DISTRIBUTION OF VARIOUS VITAL SIGNS AMONG TWO GROUPS

VITALS	ROPIVACINE+MGS04	ROPIVACINE+NS	P VALUE
SBP	122.75±5.14	124.30±4.82	0.332
DBP	81.10±6.47	80.30±6.23	0.693
PULSE	81.00±0.49	79.80±6.99	0.648
SPO2	99.65±0.49	99.70±0.47	0.744

CHART 12: DISTRIBUTION OF SBP AMONG TWO GROUPS

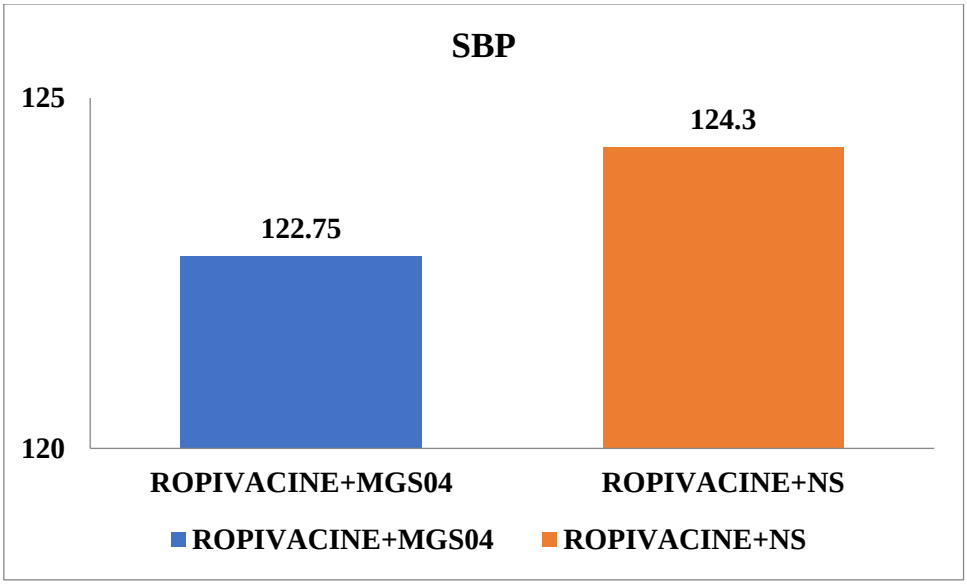


CHART 13: DISTRIBUTION OF DBP AMONG TWO GROUPS

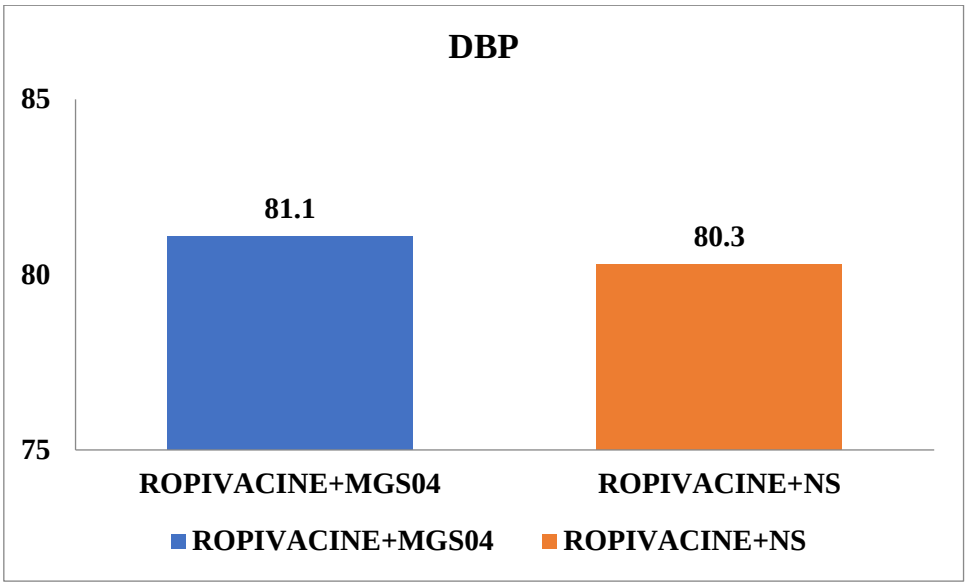


CHART 14: DISTRIBUTION OF SPO2 AMONG TWO GROUPS

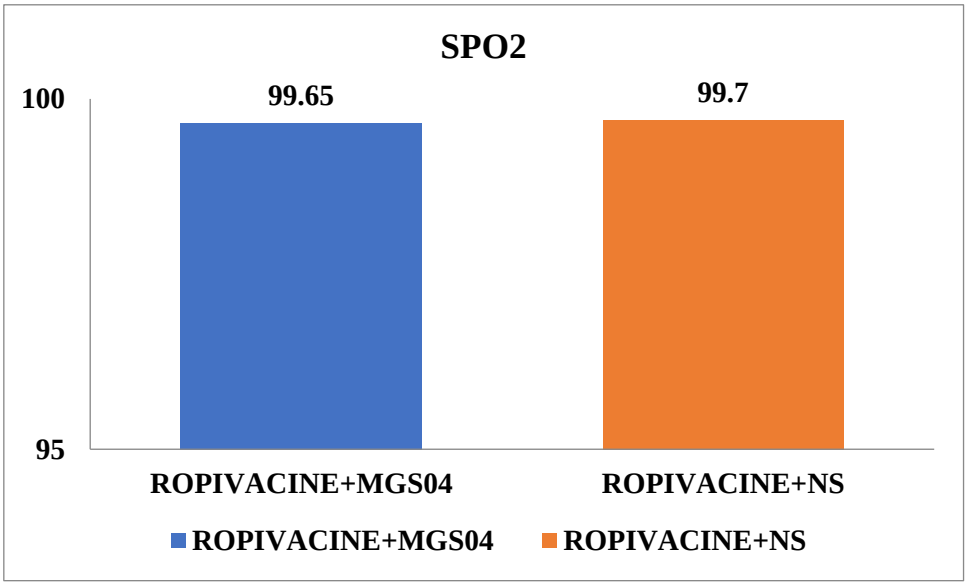


CHART 15: DISTRIBUTION OF PULSE AMONG TWO GROUPS

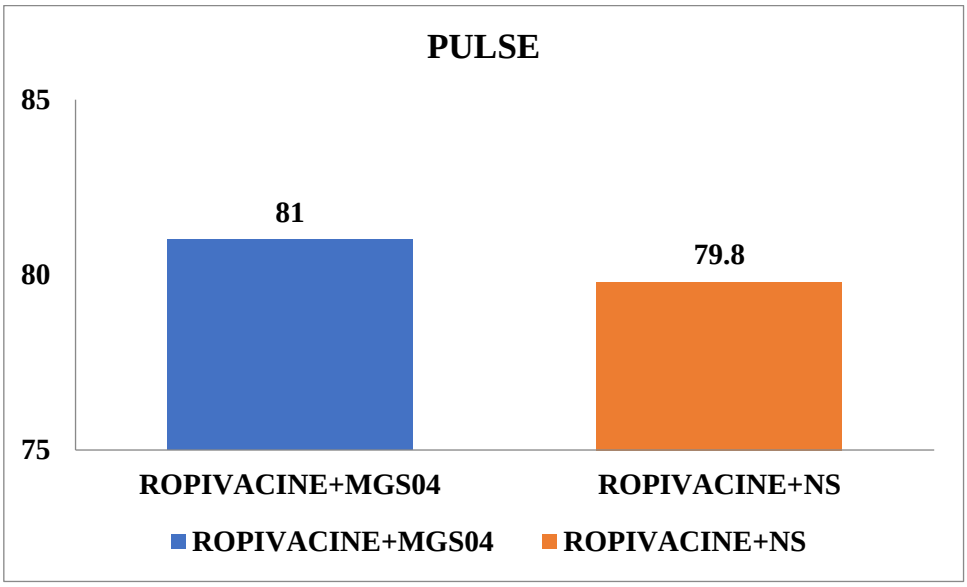


TABLE :9 ANALGESIC USAGE FOR 24 HOURS AND VAS AT VARIOUS TIME INTERVALS AMONG TWO GROUPS

VARIABLES	ROPIVACINE+MGS04	ROPIVACINE+NS	P VALUE
ANALGESIC USAGE FOR 24 HOURS	150±0.0	210±30.78	<0.001
VAS AT 6HRS	0.0±0.0	1.25±0.79	<0.001
VAS AT 9HRS	0.95±0.22	3.0±0.0	<0.001
VAS AT 12HRS	3.0±0.0	3.0±0.0	NA

CHART 16 ANALGESIC USAGE FOR 24 HOURS AMONG TWO GROUPS

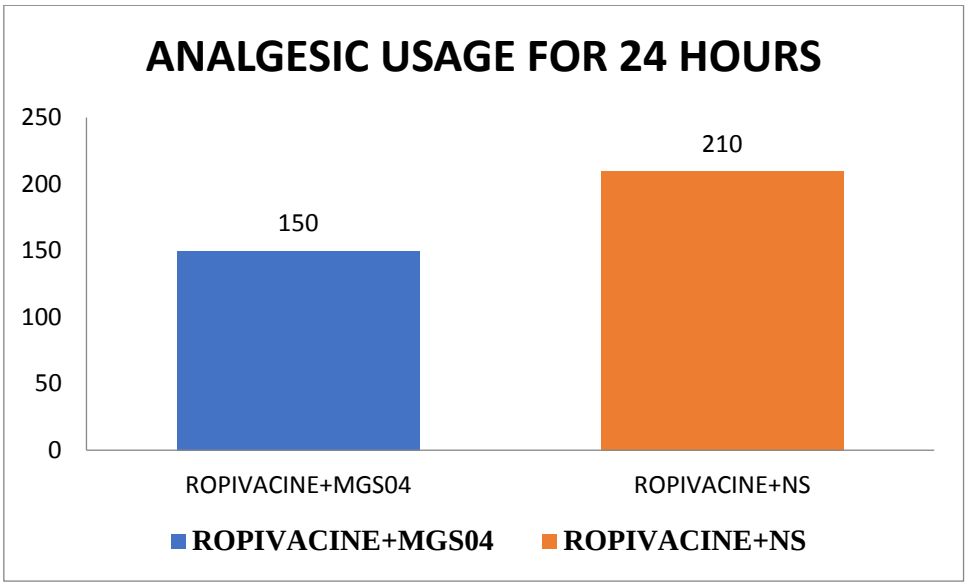
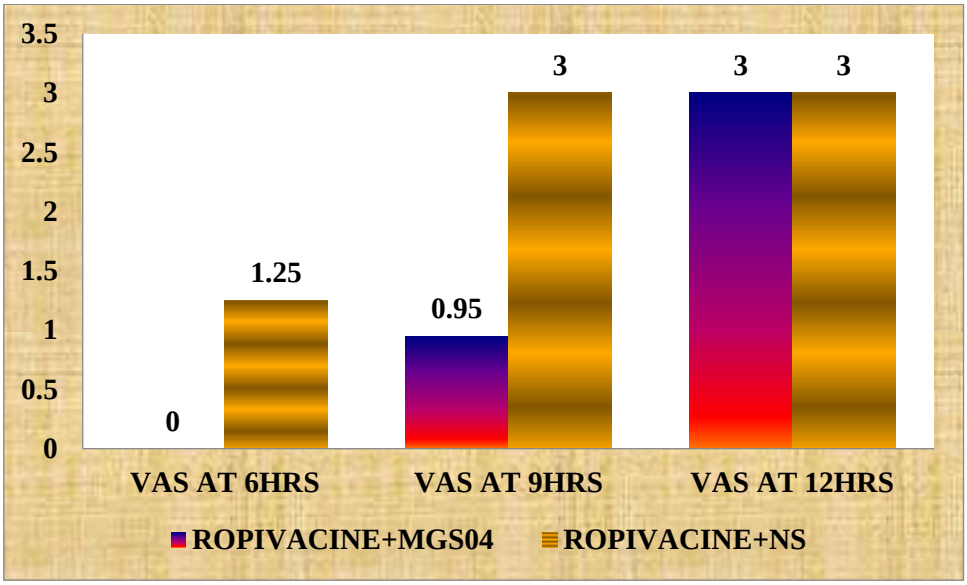


CHART 17: VAS AT VARIOUS TIME INTERVALS AMONG TWO GROUPS



OBSERVATION AND RESULTS:

A prospective, randomized, comparative study was conducted in the Department of Anaesthesiology, Coimbatore Medical College Hospital, Coimbatore on 40 patients aged 20 to 60 years posted for upper limb surgeries to study the efficacy of magnesium sulphate as an adjuvant to Ropivacaine for ultrasound guided supraclavicular brachial plexus block. There was no clinical or statistically significant difference in the demographic profile of patients in both the groups. But it was evident that prolonged duration of sensory and motor block was found among patients who were given magnesium sulphate with ropivacaine for ultrasound guided supraclavicular brachial plexus blockade.

Table 1 shows the total no of cases studied for ultrasound guided supraclavicular brachial plexus block. A total of 40 cases(100%) were divided into two groups, group I and group II each containing 20(50%) patients. Group I was given ropivacaine with magnesium sulphate and group II was given ropivacaine with normal saline.

Table 2 shows the mean age in years among the two groups. The mean age among the group I was 33.35±13.26 and among group II was 34.80±11.82. **Table 2** also shows the distribution of weight among the two groups. The mean weight in group I, was 57.55±5.15 years and in group II, was 58.45±4.47 years.

Table 3 shows the gender distribution of patients among the two groups. In group I, 15 were male patients which contributes to 75% and 5 were female patients which contributes to 25%. In group II, 17 were male patients which contributes to 85% and 3 were female patients which contributes to 15%.

Table 3 also shows the distribution of patients among orthopaedic and plastic surgery wards. In group I among the 20 patients, 9 cases were from the orthopaedic ward which contributes to about 45% and 11 cases were from the plastic surgery ward which contributes to about 55%, for a total of 100%. In group II among the 20 patients, 7 patients were from the orthopaedic ward which contributes to about 35% and 13 patients were from the plastic surgery ward which contributes to 65%, with a total of 100%.

Table 4 shows the distribution of various cases among the two groups. In group I, there were 4 cases of #BB Forearm which contributes to 20%, 4 cases of #Radius which contributes to 20%, 2 cases of Contracture which contributes to 10%, 2 cases of Crush injury which contributes to 10%, 1 case of Galazzei # which contributes to 5%, 1 case of Forearm injury which contributes to 5%, 5 cases of Raw area which contributes to 25% and 1 case of Tendon injury which contributes to 5%. A total of all the cases gives 100%.

In group II, there were 2 cases of #BB Forearm which contributes to 10%, 3 cases of # Radius which contributes to 15%, 2 cases of # Ulna which contributes to 10%, 3 cases of Contracture which contributes to 15%, 1 case of Crush injury which contributes to 5%, 1 case of Flexor injury which contributes to 5%, 6 cases of Raw area which contributes to 30% and 2 cases of Tendon injury which contributes to 10%, with a total of 100%.

Table 5 shows the distribution of various procedures among the two groups. In group I, 2 cases had undergone wound debridement which contributes to 10%, 1 case of wound exploration which contributes to 5%, 9 cases of ORIF which contributes to 45%, 2 cases of Contracture release which contributes to 10%, 1 case of Wound repair which contributes to 5%, 5 cases of SSG which contributes to 25%, with a total of 100%.

In group II, 1 cases had undergone wound debridement which contributes to 5%, 1 case of Flap cover which contributes to 5%, 1 case of wound exploration which contributes to 5%, 7 cases of ORIF which contributes to 35%, 2 cases of Contracture release which contributes to 10%, 2 case of Wound repair which contributes to 10%, 6 cases of SSG which contributes to 30%, with a total of 100%.

Table 6 shows the onset of motor and sensory blockade among the two groups. In group I, the mean onset of sensory blockade was 9.85±1.53 mins and in group II, the mean onset of sensory blockade was 9.30±1.38 mins. The P value was 0.240 which is statistically insignificant. In group I, the mean onset of motor blockade was 12.90±1.65 mins and in group II, the mean onset of motor blockade was 12.50±1.32 mins. The P value was 0.402 and is statistically insignificant.

Table 7 shows the duration of sensory and motor blockade among the two groups. In group I, the mean duration of sensory blockade was 519.50±29.64 mins and in group II, the mean duration of sensory blockade was 341.0±48.55 mins. The P value was found to be <0.001 and is statistically significant.

In group I, the mean duration of motor blockade was 422.70±21.24 mins and in group II, the mean duration of motor blockade was 270.60±37.88 mins The P value was found to be <0.001 and is statistically significant.

In group I, the time at which rescue analgesic given was 618.50±27.00 mins and in group II, the time at which rescue analgesic given was 401.50±57.33 mins and the P value was <0.001 and is statistically significant.

Table 8 shows the mean values of vital parameters like systolic BP, diastolic BP, Pulse and $SP0_2$ among the two groups.

In group I, the mean systolic BP was 122.75±5.14 mmHg and in group II, the mean systolic BP was 124.30±4.82 mmHg with a P value was 0.332 which is statistically insignificant.

In group I, the mean diastolic BP was 81.10±6.47 mmHg and in group II, the mean diastolic BP was 80.30±6.23 mmHg and the P value was 0.693 which is statistically insignificant.

In group I, the mean pulse rate was 81.00±0.49 bpm and in group II, the mean pulse rate was 79.80±6.99 bpm and the P value was 0.648 which was statistically insignificant.

In group I, the mean $SP0_2$ was 99.65±0.49 percentage and in group II, the mean $SP0_2$ was 99.70±0.47 percentage and the P value was 0.744, which is statistically insignificant.

Table 9 shows the usage of rescue analgesic for 24 hours and the VAS score at 6, 9 12 hours and among the two groups.

The rescue analgesic usage for 24 hours in group I, was 150±0.0 mg of Inj. Diclofenac sodium and the rescue analgesic usage for 24 hours

in group II, was 210±30.78 mg of Inj. Diclofenac sodium and the P value was found to be <0.001 which is statistically significant.

The VAS score at 6 hours in group I, was 0.0±0.0 and the VAS score at 6 hours in group II, was 1.25±0.79 and the P value was <0.001, which is statistically significant. The VAS score at 6 hours in group I, was also shows that those patients did not have pain.

The VAS score at 9 hours in group I, was 0.95±0.22 and the VAS score at 9 hours in group II, was 3.0±0.0 and the P value was <0.001, P value was <0.001, which is statistically significant.

The VAS score at 12 hours in group I, was 3.0±0.0 and the VAS score at 12 hours in group II, was 3.0±0.0 and the P value was not applicable, since the values are the same.

DISCUSSION

DISCUSSION:

Regional anaesthesia allows the patient to remain conscious and can avoid airway manipulation and ventilation management, less interference with the vital centres and fewer side effects. This has made regional anaesthesia, the choice of anaesthesia, especially for patients with wide range of comorbidities. In the last decade, image guided peripheral nerve block with ultrasound has become the norm of anaesthesiologists.

To increase the efficacy of peripheral nerve blocks, various adjuvants have been added. In our study, ropivacaine was used along with an adjuvant magnesium sulphate in supraclavicular brachial plexus block under ultrasound guidance.

This study involves a total of 40 patients, ASA I AND II, aged 20 - 60 years, admitted for various upper limb surgeries. After obtaining the institutional ethical committee clearance, patients were randomized into two groups, i.e, group I received ropivacaine with magnesium sulphate and group II received ropivacaine with plain normal saline. The onset and the duration of sensory and motor blockade, any hemodynamic changes intraoperatively and complications perioperatively were noted.

DEMOGRAPHIC DATA:

The age distribution among the study participants was found to be 33.35 ± 13.26 in group I, and 34.80 ± 11.82 in group II, which was found to be statistically insignificant. The sex distribution among the patients and ASA status of the patients also showed no statistically significant

difference among the two groups as assessed by the chi square test. The weight distribution among the patients was 57.55 ± 5.15 in group I, and 58.45 ± 4.47 in group II, which was also found to be statistically insignificant. Therefore our study groups were equally matched demographically.

HEMODYNAMIC VARIABLES:

Variables like the heart rate, systolic blood pressure, diastolic blood pressure and oxygen saturation were noted. Before the block and after the block, every 5 minutes for the first half an hour and then every 15 minutes till the end of the surgery. They showed no statistically significant difference.

Similarly, Arunkumar Alarasan et al [70] ,in 2016, in his study of dexamethasone in low volume supraclavicular brachial plexus block consisting of 60 patients randomized in two groups – group D - received 20 ml 0.5% bupivacaine and 8 mg dexamethasone and group C received 20 ml 0.5% bupivacaine and 2 ml of saline. It was found that there was no hemodynamic complications and few side effects. Our study showed the same results.

ONSET OF SENSORY BLOCK:

In group I, the mean onset of sensory blockade was 9.85±1.53 minutes and in group II, the mean onset of sensory blockade was 9.30±1.38 minutes. There was a minimal difference between the two groups which was statistically insignificant.

Similar to our study, Taneja P et al, also showed a minimal difference in the onset of sensory block where they used magnesium sulphate as an adjuvant to ropivacaine, but there was no statistical significance between the two groups($p>0.005$) [12].

Khezri et al[38] , Malleeswaran et al [39] , and Ekmecki et al [40] , also observed similar results while performing a comparative study between levobupivacaine with magnesium sulphate and plain levobupivacaine in femoral nerve block though it was statistically insignificant.

In contrast, Ritu Baloda et al [41] , in 2016, in his comparative study of supraclavicular brachial plexus block with or without dexamethasone as an adjuvant to 0.5% levobupivacaine found out that, among his 60 patients, 30 patients received dexamethasone had faster onset of sensory and motor block with prolonged duration of the block.

ONSET OF MOTOR BLOCK:

The mean onset of motor block was 12.90 ± 1.65 minutes in group I, and 12.50 ± 1.65 minutes in group II, among the two groups, and the difference was minimal, which was statistically insignificant.

Similar to our study, various studies conducted by Nath et al [42], found that the addition of magnesium did not cause statistically significant onset of motor blockade.

Similar results were observed by Khezri et al [38], and Malleeswaran et al [39], Ekmecki et al [40], while performing femoral nerve block, found minimal delay in the onset of motor block in the levobupivacaine,

magnesium group than in the levobupivacaine group which was statistically insignificant.

DURATION OF SENSORY BLOCK:

In our study we found that the mean duration of sensory block was 519.50 ± 29.64 minutes in group I, and the mean duration of sensory block was 341.0 ± 48.55 minutes in group II, and the difference was found to be statistically significant between the two groups.

Similarly, in a study conducted by Kasthuri et al in 2014 [43], the mean duration of sensory block in the magnesium group was 456.21 minutes, where the prolonged duration is attributed to the use of magnesium sulphate.

Lee et al [44], also had similar results where the mean duration of sensory block with bupivacaine, epinephrine and magnesium sulphate was 600.60 minutes.

Malleeswaran et al [39], conducted a study using bupivacaine, fentanyl and magnesium where the mean duration of sensory block prolonged in the magnesium group, compared to the other group.

Dileep gupta et al [8], observed similar results using ropivacaine and magnesium sulphate, where the mean duration of sensory block was 491 ± 100.22 minutes.

Similar findings were made by Hamed et al [48], where the duration of analgesia was significantly longer in magnesium sulphate group 558.00 ± 48.08 minutes. Reddy et al [57], had significant results in the duration of

magnesium sulphate group of about 855 ± 73.66 minutes which was statistically highly significant ($p<0.0001$).

The prolonged duration of sensory block is attributed to the addition of magnesium sulphate as an adjuvant to local anaesthetics. Magnesium sulphate is a promising adjuvant administered perineurally. Magnesium as an adjuvant enhances the analgesic properties of established analgesics. The primary hypothesis for the analgesic properties of magnesium on peripheral nerves is surface charge theory. Akutagawa et al [62], showed that modulation of the external magnesium ion concentration bathing a nerve bundle resulted in enhancement of the nerve blockade due to local anaesthetics. Mert et al [64], reported that a high concentration of divalent ions (Mg^{2+} and $Ca^{2+)}$ attracted by the negative charges of the outer membrane surface affected Na^{+} channel gating and could cause hyperpolarization. If the nerve fibre is hyperpolarized, it is more difficult to achieve the threshold level, and it then results in nerve conduction block. Another possible mechanism for the analgesic action of magnesium is the voltage dependent antagonism of NMDA receptors, leading to the prevention of central sensitization from peripheral nociceptive stimulation and a decrease in the acute pain after tissue injury.

DURATION OF MOTOR BLOCK:

In our study, the mean duration of motor block was 422.70 ± 21.24 minutes in group I, and 270.60 ± 37.88 minutes in group II and was found to be statistically significant.

Reza Akhondzade et al [65], also had similar results when they used magnesium as an adjuvant to lidocaine in supraclavicular brachial plexus block, increased the duration of motor block, between the two groups.

Haghighi et al [67] in 2014, investigated the effect of magnesium in axillary brachial plexus block when added to lidocaine in upper limb surgeries, and reported that the addition of magnesium sulphate to lidocaine significantly increased the duration of motor block in comparison with the use of lidocaine alone.

THE USAGE OF RESCUE ANALGESIC AND VAS SCORE:

The rescue analgesic usage for 24 hours in group I, was 150 ± 0.0 mg of Inj. Diclofenac sodium and the rescue analgesic usage for 24 hours in group II, was 210 ± 30.78 mg of Inj. Diclofenac sodium and was statistically significant. The usage of rescue analgesic was lesser in the magnesium group which is attributed to the prolonged duration of sensory block by magnesium.

Kasthuri et al [43], showed similar results, where the magnesium group required lesser number of diclofenac injections in first 24 hours of postoperative period than in the other group.

This findings correlates with the studies of Lee et al [44], where they found that 16 patients of bupivacaine plus normal saline group required IV Meperidine 0.5 mg/kg as rescue analgesic, whereas 14 patients in magnesium plus bupivacaine group required same drug as rescue

analgesic, but the result was not statistically significant. Reduced requirement of analgesic in the magnesium group is certainly due to prolonged duration of sensory block.

The VAS score at 6 hours in group I, was 0.0 ± 0.0 and the VAS score at 6 hours in group II, was 1.25 ± 0.79 and was statistically significant.

The VAS score at 9 hours in group I, was 0.95 ± 0.22 and the VAS score at 9 hours in group II, was 3.0 ± 0.0 and was statistically significant.

Dileep Gupta also observed similar results in the VAS score and rescue analgesic was administered at VAS score >4.

COMPLICATIONS:

There were no complications found in both the groups either during the surgery or for the first 24 hours after surgery. Our results are comparable with that of similar study conducted by Arunkumar Alarasan et al, where no complications were noted . however we could not follow up the patients for a longer period to note any delayed complications.

The dose of magnesium used in this study was based on the data from Gunduz et al [68], who showed that addition of the addition of magnesium sulphate 250 mg provided a pronounced prolongation of the duration of sensory and motor blocks. However we did not find a report associated with evidence of dose- responsiveness related to magnesium administered perineurally. This is an area that may warrant further

investigation. The safety of perineural adjuvants has recently been the subject of debate that centres on the potential for neurotoxicity of the adjuvant drug itself or any co-administered preservatives.

SUMMARY

SUMMARY

A randomized controlled study was conducted among patients admitted to CMC hospital for elective upper limb surgeries and were allotted into two groups, 20 in each group and the study was conducted from January 2019 to August 2019.

PRIMARY OBJECTIVE:

To evaluate the effect of addition of magnesium sulphate to ropivacaine in ultrasound guided supraclavicular blocks in terms of duration of sensory and motor blockade.

SECONDARY OBJECTIVES:

1. To assess the duration of postoperative pain relief by Visual analogue scale and the time to first rescue analgesic.
2. To assess the onset of sensory & motor blockade.
3. To evaluate the hemodynamic stability and complications.

METHODS:

Informed consent taken from the patients.

Supraclavicular block was performed under ultrasound guidance with the study drugs.

Onset and duration of sensory and motor block, postoperative pain relief, VAS score, hemodynamic changes and perioperative complications were assessed.

- It was found that the primary objective of the study ; duration of the sensory and motor block were prolonged with ropivacaine and magnesium sulphate when compared to plain ropivacaine.
- Post operative analgesia was significantly prolonged in magnesium sulphate group, which was assessed by the VAS score.
- It was also found in the study that there is minimal delay in the onset of motor and sensory blockade, which was statistically insignificant.
- Other secondary objectives like hemodynamic variables and perioperative complications did not show any statistically significant difference among the two groups.

CONCLUSION

CONCLUSION

Supraclavicular approach to the brachial plexus is popularly used for upper limb surgeries**.** The plexus is compactly arranged here, thus providing more complete and consistent block. To prolong the duration of analgesia in order to avail maximum benefit of single shot blocks, various adjuvants have been added to local anaesthetics.

Magnesium sulphate is a promising adjuvant administered perineurally. To overcome the failure of blocks and to prevent the complications, ultrasound guidance was used. The addition of magnesium has proved to be a better adjuvant in this study, since it prolonged the duration of sensory and motor blockade significantly.

Hence magnesium sulphate added to local anaesthetics for ultrasound guided supraclavicular brachial plexus block provides better postoperative analgesia.

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ANNEXURES

STATEMENT OF CONSENT

I, _____, do hereby volunteer and consent to participate in this study being conducted by Dr.M.Prasanna Kumar , I have read and understood the consent form (or) it has been read and explained to me thoroughly. I am fully aware of the study details as well as aware that I may ask questions to him at any time.

Signature / Left Thumb Impression of the patient

Station: Coimbatore

Date:

Signature / Left Thumb Impressionand Name of the witness

Station: Coimbatore

Date:

ஒப்புதல் படிவம்

மரு. பிரசன்ன குமார். மா அவர்கள், மயக்கவியல் துறை , கோவை மருத்துவக்கல்லூரி, பரிசோதனை நடத்த சம்மதம் அளிக்கிறேன். இந்த ஆய்வின் செய்முறை மற்றும் இது தொடர்பான அனைத்து விளக்கங்களையும் கேட்டுக்கொண்டு, எனது சந்தேகங்களையும் தெளிவுபடுத்திக்கொண்டேன் என்பதையும் தெரிவித்துக்கொள்கிறேன். இந்த ஆய்வில் என் விவரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதையும் தெரிவித்துக்கொள்கிறேன்.

கையொப்பம்

NAME:	AGE/SEX:	IP NO:	WARD:
DIAGNOSIS:	PROCEDURE:		

	1 Hour					2 Hour		3 Hour		4 Hour		5 Hour		6 Hour	7 Hour	8 Hour	9 Hour	10 Hour	11 Hour
	0 min	5 min	15 min	30 min	60 min	90 min	120 min	150 min	180 min	210 min	240 min	270 min	300 min						
1. Onset of sensory block																			
2. Onset of motor block																			
3. Duration of Sensory block																			
4. Duration ofmotor block																			
5. Visual analog scale																			
6. Systolic BP																			
7. Diastolic BP																			
8. Pulse Rate																			
9. SPO2																			
10. Complications if any																			

											12 Hour		

MASTER CHART

MASTERCHART

s.no	pt name	age	sex	ward	wt	diagnosis	procedure	group	onset of sensory	onset of motor	duration of sensory	duration of motor	VAS-6hr	VAS-9 hr	VAS-12 hr	rescue analgesic	total analg 24hrs	mean sysBP	mean dia BP	PULSE	SP02
1	karupasamy	21	M	PLASTIC	55	r forearm injury	exploration	I	13	16	590	474	0	0	3	660	150	113	74	98	99
2	indrani	35	f	PLASTIC	52	raw area	ssg	I	12	15	550	440	0	1	3	630	150	124	78	82	99
3	ravi	27	m	PLASTIC	60	contracture	release	I	10	13	520	430	0	1	3	600	150	118	72	86	100
4	suresh babu	28	m	PLASTIC	60	raw area	flap cover	II	11	14	360	290	1	3	3	470	150	122	74	78	100
5	vijayan	47	m	PLASTIC	65	raw area	ssg	II	12	15	360	270	1	3	3	420	225	128	72	82	99
6	satish	22	m	PLASTIC	58	raw area	ssg	II	11	14	370	280	1	3	3	430	225	126	68	84	100
7	moorthy	23	m	PLASTIC	56	raw area	ssg	II	10	12	410	300	0	3	3	480	150	114	80	88	100
8	jenifer	26	f	PLASTIC	50	flexor injury	exploration	II	8	11	420	370	0	3	3	500	150	124	82	78	100
9	gunasekar	33	m	PLASTIC	63	tendon injury	repair	II	8	11	430	300	0	3	3	510	150	126	78	74	100
10	sangari	24	f	PLASTIC	53	raw area	ssg	I	9	12	540	420	0	1	3	620	150	128	86	96	99
11	ansar ali	23	m	PLASTIC	56	crush injury	debridement	II	10	12	360	286	1	3	3	410	225	122	88	90	100
12	renuka	20	f	PLASTIC	50	contracture	release	I	11	13	520	430	0	1	3	600	150	128	92	94	100
13	saravanan	29	m	PLASTIC	57	tendon injury	repair	II	10	13	370	300	1	3	3	420	225	132	88	96	99
14	suresh	38	m	PLASTIC	64	raw area	ssg	I	11	14	580	430	0	1	3	690	150	126	88	90	99
15	rajendran	60	m	PLASTIC	63	raw area	ssg	II	10	14	370	300	1	3	3	410	225	124	86	88	100
16	thirumani	55	m	PLASTIC	64	tendon injury	repair	I	12	16	540	420	0	1	3	660	150	128	74	92	100
17	eswari	38	f	PLASTIC	58	contracture	ssg	II	8	12	390	290	0	3	3	440	225	124	72	80	100
18	vishnu	25	m	PLASTIC	59	raw area	ssg	I	8	11	520	410	0	1	3	600	150	128	88	86	99
19	satish kumar	28	m	PLASTIC	56	L raw area	ssg	I	8	12	510	420	0	1	3	600	150	124	82	74	100
20	Vijayan	26	m	PLASTIC	55	flexion contractu	release	II	10	14	300	240	2	3	3	370	225	116	80	74	99
21	nagaraj	36	m	PLASTIC	64	f2 contracture	release	II	8	11	290	230	2	3	3	340	225	128	84	76	100
22	ravi	28	m	PLASTIC	57	crush injury	debridement	I	9	12	500	420	0	1	3	620	150	124	88	86	100
23	raju	32	m	PLASTIC	55	raw area	ssg	II	9	12	280	220	2	3	3	320	225	128	84	78	99
24	vijayan	29	m	PLASTIC	64	crush injury	debridement	I	11	14	480	360	0	1	3	590	150	118	74	72	100
25	selvaraj	47	m	ORTHO	66	BB # forearm	ORIF	I	9	11	500	420	0	1	3	620	150	128	84	82	99
26	chinnapappa	60	f	ORTHO	55	# radius	ORIF	I	11	14	490	420	0	1	3	570	150	118	80	74	100
27	rajkumar	29	m	ORTHO	54	# BB forearm	ORIF	II	8	11	280	230	2	3	3	320	225	126	84	72	100
28	manikandan	22	m	ORTHO	53	# ulna	ORIF	II	8	12	290	220	2	3	3	340	225	128	86	74	100
29	ramkumar	20	m	ORTHO	50	# BB forearm	ORIF	I	9	12	520	430	0	1	3	630	150	122	84	70	100
30	vellingiri	44	m	ORTHO	60	# ulna	ORIF	II	10	13	310	280	2	3	3	370	225	124	74	82	99
31	manikandan	28	m	ORTHO	56	# radius	ORIF	II	8	11	310	270	2	3	3	380	225	128	86	78	99
32	saradha	50	f	ORTHO	54	# radius	ORIF	I	9	12	510	420	0	1	3	620	150	120	84	72	100
33	mohammed	23	m	ORTHO	58	# BB forearm	ORIF	I	8	11	480	390	0	1	3	600	150	118	70	74	99
34	murugan	21	m	ORTHO	53	Galazzei #	ORIF	I	9	12	490	430	0	1	3	610	150	126	84	72	100
35	natar	45	f	ORTHO	60	# radius	ORIF	II	7	11	310	270	2	3	3	370	225	114	72	70	100
36	Pannerselvam	45	m	ORTHO	68	# radius	ORIF	II	9	13	310	216	2	3	3	360	225	128	86	84	100
37	selvam	37	m	ORTHO	63	# radius	ORIF	I	11	15	500	430	0	1	3	610	150	112	72	74	100
38	sathyalingam	23	m	ORTHO	54	# BB forearm	ORIF	I	8	11	520	430	0	1	3	620	150	124	82	72	100
39	Shanmugam	56	m	ORTHO	64	# radius	ORIF	I	9	12	530	430	0	1	3	620	150	128	86	74	100
40	chinna kutty	60	m	ORTHO	58	# BB forearm	ORIF	II	11	14	300	250	1	3	3	370	225	124	82	70	100

KEY TO MASTERCHART

M	: MALE
F	: FEMALE
PLASTIC	: PLASTIC SURGERY WARD
ORTHO	: ORTHOPEDIC WARD
Pt	: PATIENT
WT	: WEIGHT
VAS	: VISUAL ANALOG SCALE
SYS BP	: SYSTOLIC BLOOD PRESSUERE
DIA BP	: DIASTOLIC BLOOD PRESSURE
SPO2	: OXYGEN SATURATION