A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES

A STUDY OF 60 CASES

DISSERTATION SUBMITTED FOR

DOCTOR OF MEDICINE

BRANCH X (ANAESTHESIOLOGY)

APRIL 2013

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

CHENNAI

TAMILNADU

BONAFIDE CERTIFICATE

This is to certify that this dissertation entitled **"A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES"** submitted by **Dr.K.G.PREM KUMAR** to the FACULTY OF ANAESTHESIOLOGY, The Tamilnadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement in the award of degree of M.D., Degree, Branch X – Anaesthesiology, for the April 2013 examination is a bonafide research work carried out by him under my direct supervision and guidance.

PROF. Dr.S.C.GANESH PRABU M.D, D.A,

Director,

Institute Of Anaesthesiology,

Madurai Medical College &

Govt. Rajaji Hospital,

Madurai.

DECLARATION

I, Dr.K.G.PREM KUMAR declare that the dissertation titled **"A COMPARATIVE STUDY OF BUPIVICAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES"** has been prepared by me. This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.D., Degree, Branch X – Anaesthesiology degree Examination to be held in April 2013. I also declare that this dissertation, in part or full was not submitted by me or any other to any other University or Board, either in India or abroad for any award, degree or diploma.

Place : Madurai

Date : **Dr. K.G.PREM KUMAR**

ACKNOWLEDGEMENT

I have great pleasure in expressing my deep sense of gratitude to **Prof.Dr. S.C.GANESH PRABU, M.D.,D.A.,** Professor and Director of the Institute Of Anaesthesiology, Government Rajaji Hospital and Madurai Medical College, Madurai for his kind encouragement and valuable guidance during the period of this study, with which this dissertation would not have materialized.

I would like to place on record my indebtedness to my Professors **Dr. T.THIRUNAVUKKARASU M.D., D.A., Dr.R.SHANMUGAM, M.D.,** and **Dr. A.PARAMASIVAN, M.D., DA**., **Prof. Dr. EVELYN ASIRVADHAM M.D.,** of the Institute of Anaesthesiology, Madurai Medical College, Madurai for their whole hearted help and support in doing this study.

I express my sincere thanks to **Dr.MOHAN, M.S., THE DEAN**, Madurai Medical College and Government Rajaji Hospital for permitting me to utilize the clinical materials of this hospital.

I express my profound thanks to assistant professor **Dr. PRATHEEBA DURAIRAJ, M.D., D.A.,** for her valuable suggestions and technical guidance in doing this study.

Lastly, I am conscious of my indebtedness to all my patients for their kind co-operation during the course of the study.

CONTENTS

INTRODUCTION

Regional anaesthesia is the method chosen for surgeries involving the lower abdomen and lower limb in children. It provides a good alternative to general anaesthesia. This technique is safe and cost effective in day care surgeries.

The first spinal anaesthesia was performed to August G. Bier by his assistant in 1898. This was followed by injection to his assistant Dr.Hildebrant. Dr.Bier noted ‘A strong blow with an iron hammer against the tibia was not felt as pain’ some twenty three minutes later.

The first planned spinal anaesthesia was performed by Bier, on 16th August 1898, by injection of 0.5% cocaine solution in a patient.

August Bier first performed the regional anaesthesia techniques in children way back in 1899. There are many publications about regional anaesthesia in children between 1909 and 1910. Bainbridge operated a three month old infant for strangulated hernia under subarachnoid block in 1900. Then between 1909 and 1910 there were many reports of about 200 cases of surgeries for lower abdomen being taken under subarachnoid block for children and infants by a British surgeon called Tyrell Gray.

The regional anaesthetic techniques for children and infants were reintroduced later in 1983 by Abajian et al under the American Society of Anesthesiologist Regional Anesthesia Breakfast Panel. But due to introduction of newer and potent muscle relaxants and volatile anaesthetic agents, the paediatric spinal anaesthesia did not become popular.

In recent years it is on the rise again because of increased awareness and knowledge on pharmacology, safe profile of the drugs, availability of dedicated equipments for regional anaesthetic techniques and good monitoring in children. Thus paediatric subarachnoid block may be the preferred method of anaesthesia for surgeries involving the lower abdomen and lower extremity where general anaesthesia is contraindicated.

The most common drugs used for spinal anaesthesia are Lignocaine and Bupivacaine. Lignocaine has faster onset and short duration of sensory and motor blockade and used for surgeries lasting for less than one and half hours. Lignocaine produces sudden and severe hypotension and bradycardia soon after block. It also produces transient neurological symptoms in a few patients.

Bupivacaine produces intermediate to long duration of sensory and motor blockade and thus is a good alternative to lignocaine in surgeries of longer duration. But the longer duration of motor blockade makes it unsuitable for ambulatory surgeries.

Ropivacaine provides an alternative to bupivacaine, with lesser duration of motor blockade. It has a good hemodynamic stability, with lesser systemic toxicity when compared to bupivacaine.

Hence this study is done to compare the efficacy of Bupivacaine and Ropivacaine in spinal anaesthesia in children.

AIM OF STUDY

The aim of this study is to evaluate the efficacy of Ropivacaine and Bupivacaine in spinal anaesthesia in children posted for infraumblical surgeries.

ANATOMY OF SUBARACHNOID SPACE

Subarachnoid block is a type of central neuraxial blockade, where temporary interruption of nerve transmission with in subarachnoid space is produced by injection of local anaesthetic solution into cerebrospinal fluid.

Applied anatomy

The vertebral column comprises of 33 vertebrae –

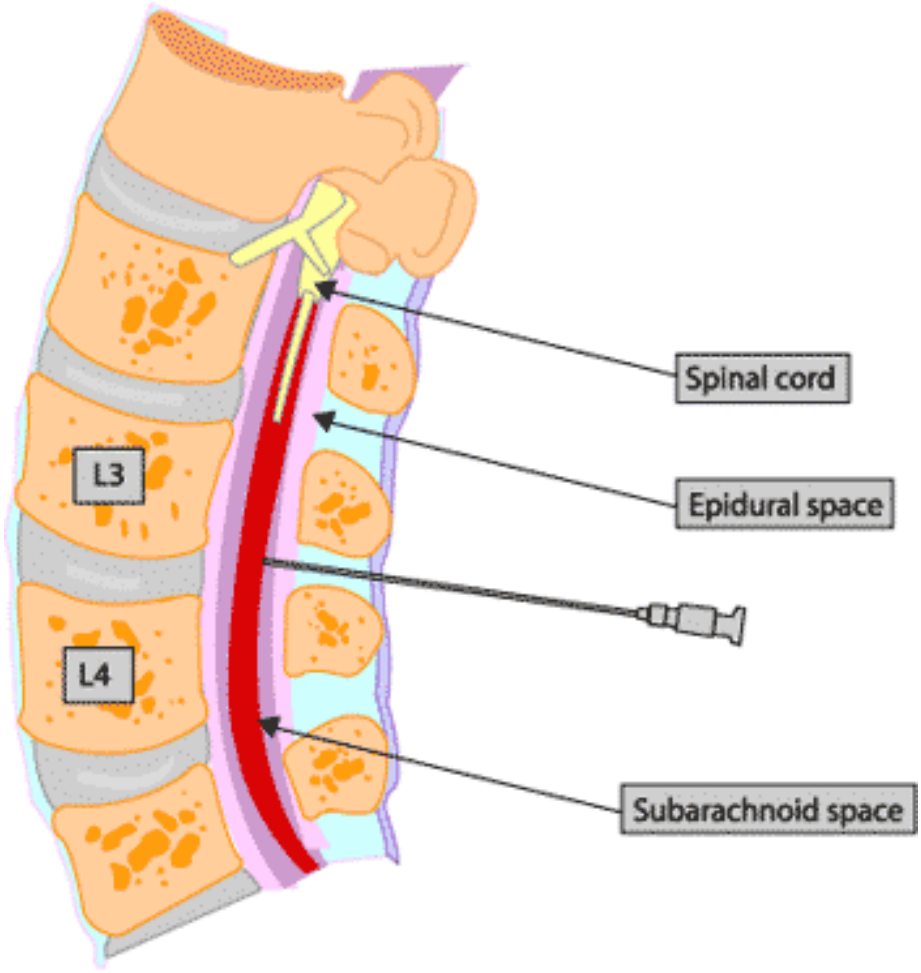
Cervical	7
Thoracic	12
Lumbar	5
Sacral	5
Coccygeal	4

Vertebral column has four curves

Cervical and Lumbar	-	convex anteriorly
Thoracic and Sacral	-	convex posteriorly

Each vertebra is composed of a body, pedicle and laminae and separated by intervertebral disc. The vertebral column is bound by ligaments.

ANATOMY OF SPINAL CORD



The structures which are pierced while performing lumbar puncture are

Skin

Subcutaneous tissue

Supraspinous ligament – connecting the tips of spinous process

Interspinous ligament – joins the spinous process together

Ligamentum flavum – running from lamina to lamina – yellow ligament

Duramater

Arachnoid membrane

Spinal cord

In adults it extends from medulla oblongata above to the upper border of first lumbar vertebrae below. It terminates as cauda equina, a leash of nerve roots.

There are 31 pairs of spinal nerves as follows

Cervical - 8

Thoracic - 12

Lumbar - 5

Sacral - 5

Coccygeal - 1

The spinal nerves are composed of anterior and posterior roots which unite in the inter vertebral foramina and form a nerve trunk. The dural sac extends upto the level of S2 in adults.

The coverings of spinal cord are

Piamater

Arachnoid membrane

Duramater

Blood supply:

It is from one anterior spinal artery, a branch of vertebral artery and a pair of posterior spinal arteries arising from the posterior inferior cerebellar arteries. Spinal cord also receives additional blood supply from the intercostal arteries arising in the thoracic level and lumbar arteries arising in the lumbar level. The largest of the radicular arteries is called ‘artery of Adamkiewicz’.

The spinal veins are formed by anterior and posterior plexuses. These plexuses drain into vertebral, azygous and lumbar veins.

Cerebrospinal fluid

CSF is an ultrafiltrate of the blood plasma. It is formed from choroid plexus of the lateral ventricles. It is a clear, colourless fluid. The total volume of CSF is 120- 150ml. It is distributed between the ventricles of brain, cranial and spinal subarachnoid spaces.

Composition of CSF:

Specific gravity	1.006
Pressure	60-80mm H_2O
PCO_2	48mmHg
Na^+	133-145 meq/l
Cl^-	15-20 mg/dl
Ca^{2+}	2-3 meq/l
Mg^+	2-2.5 mg/dl
PO^{4-}	1.6 mg/dl
Sugar	45-80 mg/dl
Protein	23-28 mg/dl
Lymphocytes	0-5 cells/cu.mm

Baricity:

Baricity of local anaesthetic drug is measured by a ratio of the density of local anaesthetic to the density of CSF at 37^{o} C. The baricity determines the spread of local anaesthetic solution in spinal subarachnoid space. Local anaesthetic can be isobaric, hypobaric or hyperbaric depending on the baricity of solution.

Hyperbaric - > 1.008gm/ml

Isobaric - 0.998 – 1.008

Hypobaric - < 0.998

	Density	Baricity
Water	0.9933	0.9933
CSF	1.0003	1.0000
Isobaric		
Lignocaine 2%	1.0004	1.0003
Bupivacaine 0.5%	0.9993	0.9990
Ropivacaine 0.5%	0.9995	0.9988
Hyperbaric		
Lignocaine 2% in dextrose 7.5%	1.0265	1.0265
Bupivacaine 0.5% in dextrose 8%	1.0210	1.0207

Hypobaric solutions being less dense than CSF rise against gravity and it leads to higher spread. Isobaric solutions being as dense as CSF remain at the level of injection. The cephalad movement is due to bulk movement of CSF in subarachnoid space. Hyperbaric solutions being denser than CSF follow gravity after injection. Thus the spread of drug is influenced by positioning after performing the subarachnoid block.

PHYSIOLOGY OF SUBARACHNOID BLOCK

Subarachnoid block is a temporary and reversible interruption of nerve transmission from the spinal cord by injecting local anaesthetics in subarachnoid space.

Factors influencing the height of blockade are

a. Site of injection
b. Angulation of needle
c. Barictiy of local anaesthetics
d. Dose of local anaesthetics
e. Position of patient during and after injection
f. Anatomic configuration of spinal column
g. Patient height (at extremes)
h. Volume of cerebrospinal fluid
i. Reduced CSF with increased intra abdominal pressure (eg. pregnancy)

Factors not influencing block height are

a. Weight of patient
b. Gender
c. Needle type
d. Rate of injection
e. Barbotage

f. Coughing and straining during injection

g. Vasoconstrictor addition

Effect on Cardiovascular system

The effect on cardiovascular system depends on various factors like the level of sympathetic blockade, hydration of the patient, and effect of vagal innervations. The most prominent effect is that of bradycardia and hypotension.

The factors producing hypotension in subarachnoid block are

a. Peripheral sympathetic blockade of T10-L2 fibers which leads to dilatation of post arteriolar capillaries and venodilatation. It produces increased venous capacitance, pooling of blood in lower extremities and decrease in venous return.
b. Adrenal medullary sympathetic block of T6-L1 level causes blockade of splanchnic nerves and pooling of blood in gut. Further it decreases the release of catecholamines which lead to decrease in heart rate and cardiac output.
c. Supine hypotension syndrome produced by compression of inferior vena cava and aorta by pregnant uterus or abdominal tumours.
d. Direct inhibition of cardioaccelerator fibers T1-T4 in case of high spinal.

The reflexes producing bradycardia in subarachnoid block are

a. BAINBRIDGE REFLEX: the cardio accelerator fibers get less efferent outflow due the decrease in venous return.
b. SINOATRIAL NODE STRETCH REFLEX : stretch receptors in the SA node respond proportionally to venous return
c. BEZOLD JARISCH REFLEX: stretching baroreceptors in inferoposterior wall of LV respond to increases in ventricular contractilty induced by reductions in preload and ventricular volume. Stretching baroreceptors paradoxically increase vagal output from vasomotor centre.

Effect on Nervous system

The Site of action is spinal nerve roots and it produces differential neural blockade as nerve fibres subserving different functions display varying sensitivity to local anesthetics. The order of blockade of fibers is autonomic fibers first followed by pain, temperature, touch, proprioception and skeletal muscle tone.

In subarachnoid block, the level of autonomic block is two segments higher than the level of sensory block, which are again two segments higher than the level of motor block. This type of block is called as *differential blocakade*. The segments where there is one type of block without others are

called as *zones of differential blockade*. The zones of differential blockade are produced due to various factors like, different diameter of axons, the number of nodes blocked, decremental conduction in nerve fibers and time available for diffusion. The local anaesthetic agents also have different affinity for different types of axons. This zone of differential blockade remains constant in extent during maintenance and regression of the level of anaesthesia when it wears off.

Effects on Respiratory system

There is no apparent effect on respiratory system when the block is maintained upto T4 level. The tidal volume, respiratory rate, minute ventilation and arterial oxygenation are well maintained. But in COPD patients there is decrease in these volumes as the intercostals are paralysed.

Apnea after spinal anaesthesia is due to following reasons

a. Medullary ischemia due to hypotension produced by subarachnoid block
b. High spinal blocking the C3,4,5 – phrenic nerves

Effect on GIT

Sympathetic blockade and parasympathetic over activity causes contracted gut with relaxed sphincters and thus increasing peristalsis. Nausea and vomiting is produced due to central hypoxia caused by hypotension. There

may be discomfort due to handling of viscera which also causes parasympathetic activation.

Effect of Liver and Kidneys

The hepatic blood flow is determined by blood pressure but maintained by hepatic arterial buffer system. The hepatic oxygen extraction is normal. The autoregulation in kidneys maintain the blood flow until the mean arterial pressure of 50mmHg.

Effect on Genitourinary system

The tone of ureter and bladder is not changed and sphincters are not relaxed. But urinary retention occurs in many patients. The penis is engorged due to venodilation. The tone of pregnant uterus is unchanged. There is no effect on uterine blood flow and progress of labour.

Metabolic and hormonal effect

It inhibits the stress response and decreases the release of blood sugar, cortisol, renin and aldosterone. It blocks the responses of nociceptive stimuli. Antidiuretic hormone release is also inhibited.

Thermoregulation

The vasodilatation produced by subarachnoid block causes hypothermia due to heat loss to cold environment.

VARIATIONS OF SUBARACHNOID BLOCK IN CHILDREN

Anatomy

The knowledge of anatomical differences in spinal cord in children helps us to provide safe and efficient spinal anaesthesia in children. The major differences are

a. The spinal cord terminates at level of lower border of L3 when compared to lower border of L1 in adults – so subarachnoid block is given at a lower space of L4-5 than L3-4 used in adults
b. The Tuffier's line joining the highest point of both iliac crest crosses at level of L4-5 or L5-S1 than that of adults where it crosses between L3-4 interspace.
c. The dural sac ends at level of S2 in adults and S4 in neonates – leads to more chances of injury.

Pharmacokinetics

Local anesthetic drugs are bound to a type of plasma protein called as α-1 acid glycoprotein (AAG). Children have lesser amount of plasma proteins. The plasma level is just 20% to 40% to that found in adults. The normal levels are obtained by a about 1 year. Thus the free fraction of local anaesthetic drug is higher due to low levels of α-1 acid glycoprotein. The higher level of unbound drug causes toxicity. Children have less clearance and increased elimination

time for local anaesthetics. These factors contribute to the increased risk of local anesthetic toxicity because of free drug circulating in plasma during regional techniques.

Developmental Differences

The myelination of nervous system is not fully developed until about 12 years of age. This incomplete myelination of nervous system leads to more penetration of local anaesthetic drug into nerve roots. The loose attachment of facial tissues around the nervous system also facilitates the uptake of local anaesthetic drug. Thus less amount of local anaesthetic drug can produce full block in children compared to adult and the level of block may also be more. The local anaesthetic drug as wears off more faster in children due to increased spread.

Cerebrospinal Fluid Volume

Cerebrospinal Fluid volume varies according to the patient age which bears considerable pharmacokinetic relations to drug used. The volume of cerebrospinal fluid in different age group is as follows

Neonates - 10ml/kg

Infants - 4ml/kg

Children - 3ml/kg

Adults - 1.5 to 2 ml/kg

The distribution of Cerebrospinal fluid between the cerebral and spinal circulation also varies with age. Children have about 50% of volume in spinal subarachnoid space compared to adults who have only 25% of total volume in spinal subarachnoid space. Thus larger volume of local anaesthetic drugs is needed for infants and children. Also the Cerebrospinal fluid hydrostatic pressure is lower in infants in the dorsal recumbent position. Thus progression of the needle during subarachnoid block must be slow to detect Cerebrospinal fluid reflux before the needle is advanced too far.

Hemodynamic effects

The incidence of hypotension and bradycardia following subarachnoid block is less due to poor development of sympathetic systems in neonates and children. But children more than 5 years of age may have similar effects to that of adults.

Post dural puncture headache

The incidence of headache following subarachnoid block is much less in children and the use of smaller and finer gauge needle may further decrease the incidence.

Post operative apnoea

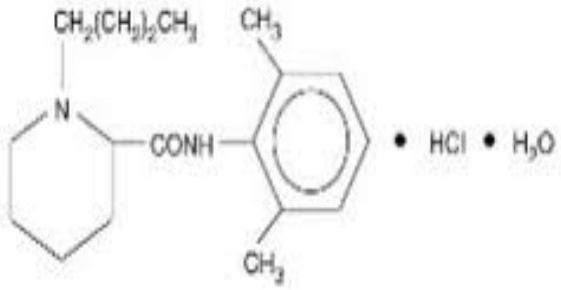
The regional anaesthesia technique does not decrease the occurence of apnoea in post operative period in neonates, though much lesser than that of general anaesthesia. The use of sedatives like ketamine during regional anaesthesia may increase the incidence of postoperative apnoea.

PHARMACOLOGY OF BUPIVACAINE

- Bupivacaine is the amino amide local anaesthetic.
- It is a derivative of Mepivacaine. The butyl group replaces the methyl group in the piperidine chain.
- Bupivacaine was first synthesized by Ekenstem.
- It was first used by Telivuo in 1963
- Bupivacaine is available as a raecemic mixture.
- Being a very stable compound , it can be autoclaved many times

PHYSICO CHEMICAL PROPERTIES

Chemically described as *d(1)-1-butyl-N-(2'6' dimethylphenyl) piperidine – 2- carboxamide.*



1. Molecular Weight : 288 (base)
2. Pka : 8.1

3. Protein binding : 95.6%
4. Plasma protein binding : 2 μgm/ml
5. Lipid solubility : 28
6. Partition coefficient : 27.5 (n-Haptane pH7.4 buffer)
7. Approximate anaesthetic duration : 175minutes
8. Elimination half life : 210 minutes
9. Toxic plasma concentration : more than 1.5microgram/ml

PHARMACOKINETIC PROPERTIES

Absorption

The plasma level of drug depends on the route and site of absorption. Also the richness of vessels at the site and presence of vasoconstrictors determine the rate of absorption. From the intrathecal route the drug is absorbed by nerve rootlets. Bupivacaine has higher lipid solubility and thus it easily penetrates the nervous and vascular tissues.

Distribution

About 80-95% of the total drug is bound to plasma protein especially alpha-1-acid glycoprotein. It has got a bimodal distribution phase containing a *rapid distribution phase* and *slow distribution phase.* In the rapid distribution phase the drug is first distributed to vascular tissues with a half life of about 2.7 minutes. Later in the slow distribution phase the drug is distributed to all tissues with a half life of about 28 minutes. The total half life involving the

biotransformation and excretion is about 3.5hours and the plasma clearance is about 0.47liters/minute.

Metabolism

The metabolism of bupivacaine takes place in liver. The metabolism begins with hydroxylation of the aromatic ring and removal of piperidine side chain. Thus it forms pipecolyxylidine derivatives. It is one eighth as toxic as bupivacaine and both compounds are excreted in urine. It also forms a more conjugated water soluble metabolite N-desbutyl bupivacaine. The conjugated form is freely excreted in urine. Bupivacaine undergoes extensive pulmonary extraction. The pulmonary extraction is inhibited by propranolol.

Elimination

Most of the drug and metabolites are excreted through the kidneys. 4 to 10% of the drug is excreted in unchanged form. The plasma clearance is about 0.47liters/minute.

Mechanism of action

Bupivacaine acts through the sodium channel blockade. It produces a non-depolarising type of blockade. It interferes with the transmembrane sodium channel thereby interfere with sodium ion transport. This delays the depolarization process and the channel remains in a state of persistent

repolarization. The drug probably acts at the level of nerve rootlets in the spinal cord, fine nerve filaments and the lateral and posterior part of spinal cord.

PHARMACODYNAMIC PROPERTIES

Effect on nervous system

Bupivacaine acts on both the A δ and C fibers. The higher lipid solubility of bupivacaine makes it fast acting and longer duration of block compared to ropivacaine. It causes profound motor block in high concentration. In low concentration it spares the motor fibers and produces sensory blockade. This property is useful for post operative analgesia. But the effect of motor blockade is more than that of ropivacaine. The addition of epinephrine does not alter the intensity or duration of block.

It causes both excitation and inhibition of the central nervous system. The toxic effects are manifested as tremors, convulsions, respiratory arrest and coma.

Effect of Cardiovascular system

It depends on the level of sympathetic blockade and number of segments blocked. It produces bradycardia and hypotension due to sympathetic blockade. High spinal block inhibits the cardio acceleratory fibers and produce cardiac arrest. The cardiotoxicity of bupivacaine is more than that of lignocaine. As

bupivacaine is more lipid soluble, it has more affinity towards myocardial fibers. Bupivacaine is a potent myocardial depressant. This effect is exacerbated with hypoxia, hypercarbia and by pregnancy. Ventricular arrythmias and fibrillation occur in toxic doses and are resistant to revival with bretyllium. Convulsions occur with plasma concentration of about 5.4microgram/ml.

Effect on respiratory system

There is no apparent change in respiratory function in normal doses. The tidal volume, respiratory rate and minute volume are maintained. In high spinals, it produces respiratory depression due to paralysis of intercostals and diaphragm.

Indications:

Surgical anaesthesia:

- Spinal anaesthesia
- Epidural anaesthesia
- Caudal anaesthesia
- Peripheral nerve block and infiltration anaesthesia

Pain management:

- Labour analgesia – intermittent bolus or continous infusion
- Post operative pain management – epidural infusion as
    - Intermittent bolus
    - Continous infusion
    - Patient controlled analgesia

Management of pain in children:

- Caudal anaesthesia
- Peripheral nerve blocks and infiltration anaesthesia.

Contraindications:

1. Known cases of allergic reactions to amide type of local anaesthetics
2. Intravenous regional anaesthesia (Bier's block).
3. Hemodynamic instability
4. Septicemia
5. Local site infection

Adverse effects

The adverse reactions to bupivacaine are related to excessive plasma levels which are caused by over dosage of drug used, unintentional intravascular injection and slow metabolic degradation of drug. The maximum effective dose (c max) is 0.7µgm/ml. The signs of toxicity begin to appear with doses of about 1.6µgm/ml. The toxicity ratio of Bupivacaine is about (c tox/c max) 2.3.

The various side effects produced are

- Central and peripheral nervous System – dyskinesia, hypokinesia, neuropathy, vertigo, tremors, paresis, neuropathy and coma. Convulsions are produced due to toxic level of drugs.
- Cardiovascular System – bradycardia , hypotension, vasovagal reaction, syncope, arrythmias, ventricular fibrillation
- Gastrointestinal System - nausea and vomiting, incontinence, tenesmus.
- Hearing and Vestibular - tinnitus, hearing abnormalities.
- Hepato - Biliary System – jaundice
- Musculoskeletal System – myalgia.
- Psychiatric Disorders - insomnia, confusion, amnesia, hallucination, nightmares.
- Urinary System Disorders- urinary incontinence.
- Skin Disorders - urticaria.
- Vascular - deep vein thrombosis, phlebitis, pulmonary embolism.

Availability

Bupivacaine is available in concentration of 0.25% and 0.5% solutions. It is available both as isobaric and hyperbaric solution. Hyperbaric solution is prepared by adding dextrose to the local anaesthetic solution. It is available in ampoules of 0.5% preservative free for spinal anaesthesia. It is available in vials of 0.25% and 0.5% with preservative for epidural and nerve blocks

Dosages

Spinal - 3 to 4 ml of 0.5% solution for adults

0.3 to 0.5mg/kg of 0.5% solution for children

Epidural - 15 to 20 ml of 0.5% or 0.25% solution

0.125% solution produces sensory block only

Caudal - 0.5ml/kg of 0.25% solution for sacral block

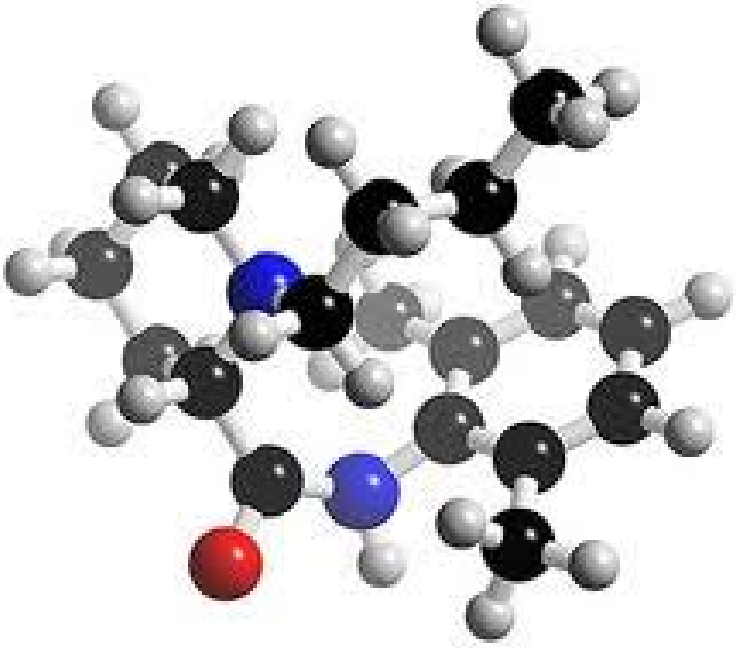
0.75ml/kg of 0.25% solution for lumbar block

1ml/kg of 0.25% solution for thoracic block

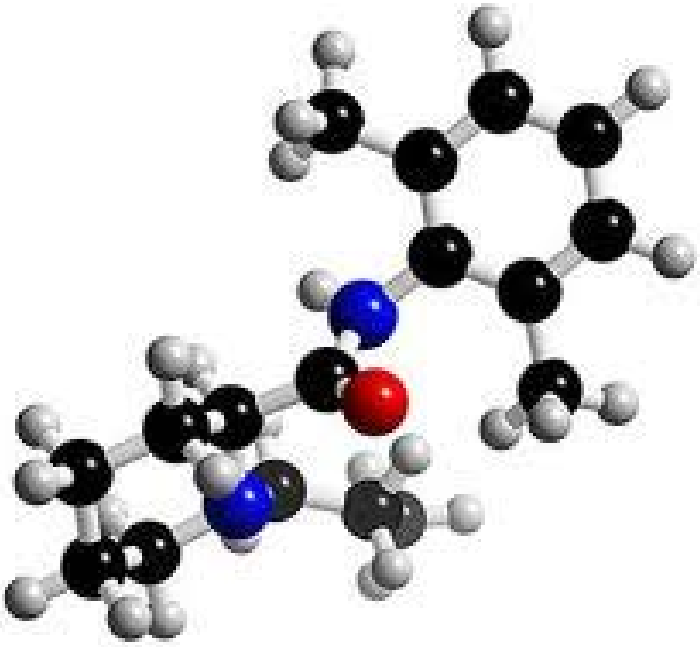
Peripheral nerve blocks – 15 to 20 ml of 0.25% solution

The toxic level is reached when more than 2mg/kg of drug volume is used.

3 D structure of Bupivacaine



3 D structure of Ropivcaine

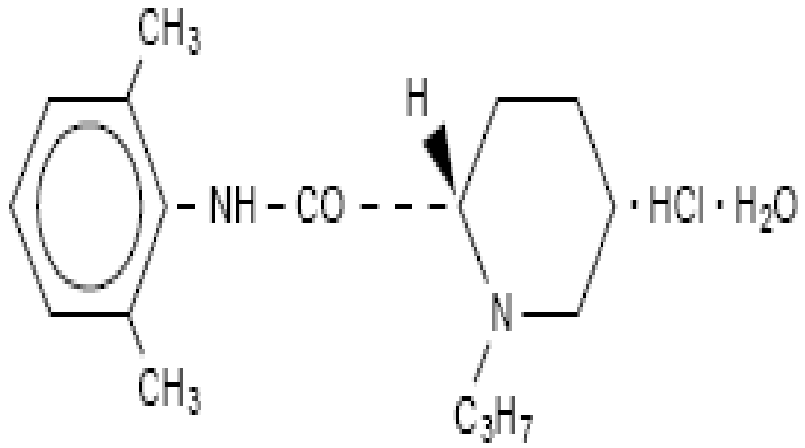


PHARMACOLOGY OF ROPIVACAINE

- Ropivacaine is the new amino amide local anaesthetic. It is a derivative of pipecoloxylidide.
- Pipecoloxylidide was first synthesized in 1957.
- Pipecoloxylidide are chiral drugs due to asymmetric carbon atoms and form two groups of S and R enantiomers.
- Ropivacaine is a pure S enantiomer with chiral purity of 99.5%
- Ropivacaine is prepared by alkylation of S enantiomer of dibenzoy-l-tartaric acid

Physiochemical properties:

Chemically defined as *S-(-)-1-propyl-2',6'-pipecoloxylidide hydrochloride monohydrate*



1. Molecular wt - 274
2. Pka - 8.07
3. pH - 7.4
4. Protein binding - 94%
5. Partition coefficient (lipid solubility) - 8.7

   It denotes the N heptanes buffer. This property of lower lipid solubility produces delayed and less binding to A delta fibers and less motor blockade.
6. Mean uptake ratio - 94
7. T1/2 - 111 minutes
8. Clearance - 10.3 L/minutes.

MECHANISM OF ACTION

Ropivacaine acts through inhibition of sodium channel. It inhibits the conduction of sodium ions through the channel and also potassium channel. Thus it inhibits the production and conduction of impulses across the nerve fibers. This type of block is reversible.

PHARMACOKINETIC PROPERTIES:

Absorption

The plasma concentration of ropivacaine is dependent on many factors like route by which it is given, dose of drug administered, concentration of drug

used, vascularity of the region and hemodynamic status of patient. It shows the biphasic absorption phase from the epidural space. The mean half life is 14 minutes in first phase and 4 hours in second phase. The rate limiting factor is the slow absorption from the epidural phase. Thus it has longer duration of action through the epidural route.

Distribution

The steady state plasma concentration after intravascular injection is about 59+7 liters in total volume of distribution. The protein bound fraction is about 94%. It mainly binds to α–1- acid glycoprotein. There is an increase in bound form of drug in post operative state due to increase in α-1-acid glycoprotein from stress response in surgery. This is especially so after continuous epidural infusion. Ropivacaine can easily cross the placenta and equilibrium is reached.

Metabolism

Most of the metabolism of ropivacaine occurs in liver. It is mainly metabolised by aromatic hydroxylation involving cytochrome P4501A to 3-hydroxy ropivacaine. About 37% of the total dose is excreted in urine. It is excreted in both free and conjugated form of 3-hydroxy ropivacaine. There is a low concentration of 3-hydroxy ropivacaine in the plasma. Another metabolite, 2-hydroxymethyl- ropivacaine has been identified but is not quantified in the

urine. 3-OH-ropivacaine and N-de-alkylated metabolite of ropivacaine are the major metabolites excreted in the urine. These are especially formed during the continous epidural infusion. There is no raecemerization between the S and R forms in the body.

Elimination

Ropivacaine is mainly eliminated through the kidney as various metabolites. Some about 86% of the total drug is excreted through the kidneys. The total clearance is about 387 ml/min. The mean half life is about 1.8 hours after intravascular injection and about 4.2 hours after epidural injection.

PHARMACODYNAMIC PROPERTIES:

Action on Nervous system

The type of blockade produced by ropivacaine depends upon the concentration of drug used. In low concentration it blocks both Aδ and C fibers which is more potent than that of equal concentration of bupivacaine. In high concentration, the blockade of Aδ fibers is less than that of bupivacaine while the blockade of C fibers is similar. The penetration of ropivacaine into myelin sheath is less due to low lipid solubility compared to bupivacaine. Thus it preferentially blocks C fibers than Aδ fibers. This causes less potent motor blockade.

The addition of epinephrine does not influence the type of blockade produced. In toxic doses, it causes initial excitation of nervous system manifesting as restlessness, tremor, and convulsions. Later it leads to depression of medullary centre and coma.

Effect on Cardiovascular system

The effects are mostly due to blockade of sympathetic fibers. There is decreased venous return and decreased heart rate which produces hypotension.

Effect on respiratory system

Ropivacaine does not have any marked effect on the respiratory system in normal doses. Higher doses leading to toxicity of drug produces respiratory depression secondary to medullary depressant effect.

INDICATIONS

Surgical anaesthesia:

- Spinal anaesthesia
- Epidural anaesthesia
- Caudal anaesthesia
- Peripheral nerve block and infiltration anaesthesia

Pain management:

- Labour analgesia – intermittent bolus or continous infusion

  more in walking epidurals

- Post operative pain management – epidural infusion as
  - Intermittent bolus
  - Continous infusion
  - Patient controlled analgesia

Management of pain in children:

- Caudal anaesthesia
- Peripheral nerve blocks and infiltration anaesthesia.

CONTRAINDICATIONS

1. Known cases of allergic reactions to amide type of local anaesthetics
2. Intravenous regional anaesthesia (Bier's block).
3. Obstetric Para cervical anaesthesia.
4. Hemodynamic instability
5. Septicemia
6. Local site infection

Adverse effects

The adverse reactions to ropivacaine are related to excessive plasma levels due to excess dosage, inadvertent intravascular injection and slow

metabolic degradation. The mean doses of plasma level when toxicity begin to occur are about 4.3 and 0.6 μg/ ml of total and free plasma concentrations respectively. The toxic levels are reached in cases of continuous epidural infusion as the drug is administered for long times.

The various possible side effects are:

- Cardiovascular System – bradycardia, hypotension, vasovagal reaction, syncope, arrhythmias. Due to low lipid solubility the cardiotoxic potential is less than that seen with bupivacaine.
- Central and peripheral nervous System – dyskinesia, hypokinesia, neuropathy, vertigo, tremors, paresis and coma
- Gastrointestinal System - nausea and vomiting, incontinence, tenesmus
- Hearing and Vestibular - tinnitus, hearing abnormalities
- Hepato - Biliary System – jaundice
- Musculoskeletal System – myalgia
- Psychiatric Disorders - insomnia, confusion, amnesia, hallucination, nightmares
- Urinary System Disorders- urinary incontinence
- Skin Disorders - urticaria
- Vascular - deep vein thrombosis, phlebitis, pulmonary embolism.

Availability

Ropivacaine is available in ampoules of isobaric solution in concentration of 0.2%, 0.5% and 0.75%. The solutions are prepared in preservative free form.

Dosages

Spinal - 3 to 4ml of 0.5% or 0.75% in adults

0.3 to 0.5mg/kg of 0.5% solution in children

Epidural - 15 to 20 ml of 0.2% or 0.5% solution

Caudal - 1ml/kg of 0.2% solution

Peripheral nerve block – 15 to 30 ml of 0.15% to 0.5%

MECHANISM OF ACTION OF LOCAL ANAESTHETICS

The local anaesthetics inhibit the conduction of impulses across the nerves by the following mechanism as defined by Carvino

The local anaesthetic drug exists in both charged and uncharged forms. The relative concentrations of the two forms are dependent on the pKa of the solution, pH of the site where injected. The positively charged cation form is the active form. It produces local anaesthetic action.

The uncharged base form is responsible for the diffusion across the liphophilic membranes across the cell. The drug acts from the inside of the cells on sodium ion channel. They occupy specific receptors on the inner side of sodium channel and inhibit the conduction of ions through them. Thus the cell remains in a state of persistent depolarization. This inhibits the propogation of action potential.

Other probable site of actions are

Channel narrowing and membrane expansion due to nonspecific absorption across the cell membrane

Unchanged base form diffuses across hydrophobic pathways of lipid membranes to reach specific receptor sites and protonation of drug to bind to inner opening of sodium channel.

The surface charge theory:

This theory is based on penetration of the axonal membrane by lipophilic portion of the local anaesthetic drug and neutralisation of axolemmal negative charges on surface by the positively charged terminal amino group of drug. The electronegativity of the external membrane is counteracted by the acquired positive charges. This results in increase in the transmembrane potential without altering much of the intracellular resting potential. This inhibits the conduction of nerve impulses from the normal areas to anaesthetized areas of the nerve membrane. Thus it produces a conduction block across the two portions. According to surface charge theory the active form of local anaesthetic drug is the charged form of drug.

REVIEW OF LITERATURE

1. *Anaesthesia analgesia journal* 2005, Vol 100, Pages 66 – 70

   Hannu Kokki MD, Merja Laisalmi, Matti Reinikainen, and Paula Ylonen.

   This study was conducted in 93 children aged 1 – 17 years scheduled for infraumblical surgeries. The children were divided into three groups of preschool age children (1-4yrs), school age children (5-11yrs) and adolescents (12-17yrs). All children were given Isobaric ropivacaine 0.5mg/kg in spinal anaesthesia. The parameters monitored were height of sensory block, regression of block by two segments, regression of block to T10, duration of sensory and motor block, rescue analgesia and time to discharge from PACU. Average height of block was T6- T8, 2 segment regression 40-130 min, regression of block to T10 was 90 min in average, the time of first recue analgesia was 130 min in average, time to discharge was 200 min in average. The mean height of block was lower in older children but the duration of sensory block was similar. Motor block developed with ropivacaine were less profound than that of bupivacaine and greater degree of separation of motor and sensory block was seen. Thus ropivacaine can be alternative to bupivacaine for spinal anaesthesia in children.

2. *Acta Anesthesiologica Belgia* 2008, Vol.59, Pages 65 -71

   Mantouvalou, S.Kalli and colleagues

   Compared the spinal characterics of spinal anaesthesia with 15mg of isobaric Ropivacaine, Bupivacaine, and Levobupivacaine for about 120 patients posted for lower abdominal surgeries. Ropivacaine had a delayed onset with less duration of sensory and motor blockade compared to bupivacaine and levobupivacaine. Bupivacaine group had a higher incidence of hypotension than both.

3. *Internet journal of anaesthesiology*, 2008, vol.17, No.1, Pages 1092-406

   V.Gupta , A.Metha, and colleagues

   Comparison of 15mg of isobaric bupivacaine, levobupivacaine and ropivacaine for spinal anaesthesia in patients posted for lower limb surgeries. The onset of sensory block was 4 minutes with bupivacaine and 5 minutes with ropivacaine. The onset of motor block was 5.5 minutes with bupivacaine compared to 6.5 minutes with ropivacaine. The ropivacaine group had a delayed onset of motor and sensory block than bupivacaine group. The average duration of sensory block was 140 minutes with ropivacaine group compared to 170 minutes with bupivacaine. The average duration of motor block was 130 minutes with ropivacaine compared to 170 minutes with bupivacaine. Thus recovery from motor and sensory block was faster in ropivacaine group. The

hemodynamic stability was better in ropivacaine group. Thus it was concluded that ropivacaine group produced spinal blockade of shorter duration with better hemodynamic stability and early ambulation of the patients than other groups.

4. *Acta anaesthesiol Scandinavia* 2011,

   E. Marret, A. Thevinin et al

   This study compared between 0.5% bupivacaine and 0.5% ropivacaine in spinal anaesthesia for varicose vein stripping. The patients were allocated into spinal bupivacaine 10mg group and ropivacaine 10mg group with and without sufentanyl. The mean duration of sensory block was 68 minutes and 150 minutes with ropivacaine and bupivacaine respectively. The mean duration of motor block was 90 minutes and 180 minutes with ropivacaine and bupivacaine respectively. Thus ropivacaine had shorter duration of sensory and motor blockade. With this shorter duration of blockade ropivacaine is most suitable for ambulatory surgeries.

5. *Journal of clinical anaesthesiology* 2006, Vol.18, pages 521 – 525

   Neval Boztuz MD and collegues at turkey.

   Comparision between 15mg of isobaric ropivacaine and 7.5mg of isobaric bupivacaine in spinal anaesthesia for patients undergoing

ambulatory arthroscopic surgeries. The ropivacaine group had a delayed onset of motor and sensory block with faster recovery from the block. The level of maximum sensory block reached was less in ropivacaine group.

6. *British Journal of Anaesthesia* 2009, Vol.103, Pages 731-738

   G.Frowley, R.K.Smith, P.Ingelmo

   This study was conducted to compare the relative potency of ropivacaine, bupivacaine and levobupivacaine by minimum local anaesthetic concentration model. The ED50 and ED95 of each drug were determined by means of two phases of study. The phase I study involved a up-down sequential allocation model. The patient first received about 0.25ml/kg of drug first and further doses increased or decreased by 0.025ml/kg depending on the success or failure of the case. The minimum local anaesthetic concentration ED50 was determined by means of more than six positive or negative deflections. The phase II study involved dose escalation. The drug doses selected were 0.05ml/kg above ED50 doses. Dose response curve were plotted to derive ED95. The ED50 of bupivacaine, levobupivacaine and ropivacaine were 0.3mg/kg, 0.55mg/kg and 0.5mg/kg respectively. The ED95 of bupivacaine, levobupivacaine, and ropivacaine were 0.96mg/kg, 1.18mg/kg and 0.99mg/kg respectively. Thus ropivacaine had shorter duration of action than bupivacaine

7. *Anaesthesiology* 1999, vol.91, pages 1239 - 45

   Gautier PE, DE kock, Van steenberge A et al,Belgium

   Comparison of various doses of isobaric ropivacaine and bupivacaine in spinal anaesthesia for patients posted for various ambulatory surgeries. The doses compared are isobaric bupivacaine 8mg, isobaric ropivacaine 8mg, ropivacaine 10mg, ropivacaine 12mg and ropivacaine 14mg. The onset, offset and duration of sensory and motor block are studied. It was concluded that 12 mg of ropivacaine is equivalent to about 8 mg of bupivacaine.

8. *British Journal of Anaesthesiology* 2002, Vol.89, Pages 702-6

   Mc Namee D , Mc Clelland, A.M., and colleagues

   Comparison of isobaric ropivacaine 0.5% with bupivacaine 0.5% in spinal anaesthesia for patients posted for total hip arthroplasty. The onset of motor and sensory block was found to be equal of about 2 minutes. The duration of sensory blockade at T10 level was 3 hours in ropivacaine group and 3.4 hours in bupivacaine group. The duration of motor blockade was about 2.1 hours in ropivacaine group compared to 3.9 hours in bupivacaine group. The hemodynamic stability was comparable in both groups. Ropivacaine group had shorter duration of sensory and motor blockade than bupivacaine group. Thus ropivacaine can be better alternative to bupivacaine in ambulatory surgeries.

9. *Anaesthesia and analgesia* 2000, Vol.91, Pages 1457 – 60

   Mare Malinovsky MD, Jean, Florence Charles, ottman kick and colleagues

   Comparison of 15 mg of isobaric ropivacaine and 10mg of isobaric bupivacaine in spinal anaesthesia for patients posted for TURP or TURB. The maximum height of senory block achieved was T7 with bupivacaine and T9 with ropivacaine. The hemodynamic stability was comparable in both groups. But there was less analgesia in ropivacaine group.

10. *Indian journal of anaesthesia* 2006, Vol.46, Pages 445-448

    Dr.Anup Gogia, Dr.Ameeta sahni, Dr. Rama Nason, Dr. Rupa

    Comparison between hypobaric, isobaric and hyperbaric forms of bupivacaine in spinal anaesthesia for patients posted for total knee arthroplasty. The maximum level of sensory blockade achieved was higher in hyperbaric than hypobaric or isobaric groups.

11. *British journal of anaesthesia*, 2001, vol.87, Pages 743 – 747

    A.M.Clelland , Mc Nanee, L.Parts

    Comparison of various dosages of isobaric ropivacaine in spinal anaesthesia for patients posted for total hip arthroplasty. The doses selected were isobaric ropivacaine 0.75% and 1%. The onset of sensory block was 2 minutes in both groups. The median duration of sensory

block was longer in 1% of about 3.4hours compared to 3 hours in 0.75% group. The duration of motor block was significantly longer in 1% group when compared to 0.75% group.

12.*Anaesthesia and Analgesia* 2009, Vol.109, No.4, Pages 1331-1334

Ying Y.Lee, Warwick D Nang, Siu Y.Fong et al

This study was conducted to determine the median effective dose of bupivacaine, levobupivacaine and ropivacaine for lower limb surgeries. 75 patients were divided into three groups and dose of each drug was changed with up-down scale model. The initial dose was taken as 8mg and further drug dose was increased or decreased by 1mg depending on the failure and success of block. Success was defined as bilateral sensory block of about 20min at T10 dermatome. The ED50 of bupivacaine, levobupivacaine and ropivacaine were 5.5mg, 5.6mg and 8.4mg respectively. Thus ropivacaine produce shorter duration of sensory and motor block than bupivacaine or levobupivacaine.

13.*Anaesthesia and analgesia* 2005, Vol.101, Pages 77-82

Gianleuca Capellari MD, Georgio Aldehri MD, Georgio et al

This study was conducted to compare hyperbaric levobupivacaine and ropivacaine for knee arthroscopic surgery under subarachnoid block in day care setup. The patients were divided into three groups of 7.5mg of

0.5% ropivacaine, 5mg of 0.5% levobupivacaine and 7.5mg of 0.5% levobupivacaine in spinal anaesthesia. The time for complete resolution of block and fitness for home discharge were noted. The average time for complete resolution of block was 135 minutes with ropivacaine, which was shorter than 150 minutes in 5mg levobupivacaine or 160 minutes in 7.5mg levobupivacaine group. The average time to discharge was 197 minutes in ropivacaine group compared to 230minutes in levobupivacaine group. Thus ropivacaine is advantageous in ambulatory setup.

14. *British Journal of Anaesthesia* 2003, Vol.90, Pages 304-308

J.B.Whiteside, J.A.W.Wildsmith and D.Burke

This study was done to compare the hyperbaric ropivacaine 0.5% and hyperbaric bupivacaine 0.5% for spinal anaesthesia in elective lower abdominal surgery. The patients were divided into two groups and given either 0.5% ropivacaine 3ml or 0.5% bupivacaine in spinal anaesthesia. The mean onset of sensory block was 2 minutes in bupivacaine group compared to 5 minutes in ropivacaine group. The height of sensory block achieved was T5 with bupivacaine compared to T7 with ropivacaine. The mean duration of sensory block was 56.5minutes with ropivacaine compared to 118 minutes with bupivacaine. The patients in ropivacaine group could be mobilized in about 253 minutes in ropivacaine compared to 331 minutes in bupivacaine group. There was more incidence of

hypotension in bupivacaine group compared to ropivacaine. Thus ropivacaine produced shorter duration of spinal blockade with less hemodynamic stability. Ropivacaine is an ideal choice for outpatient surgeries.

MATERIALS AND METHODS

This study was a prospective randomized study conducted in Government Rajaji Hospital attached to Madurai Medical College.

After obtaining Ethical committee approval 60 children taken up for elective infraumblical surgeries under spinal anaesthesia were randomly allotted into two groups as follows

Group B – isobaric Bupivacaine 0.5%

Group R – isobaric Ropivacaine 0.5%

Inclusion Criteria

ASA I & II patients

Age: 7 – 12 years

Both sexes

Patients undergoing elective infraumblical surgeries.

Exclusion Criteria

Bleeding disorder

Known allergy to Local anaesthetic

Local site infection

Patient refusal

Patient with neurological deficit

Written informed consent was obtained from the parents of the patients before surgery. Premedication was avoided in these patients in order not to confound with the study. A large bore IV line was secured in the operating room and started with ringer lactate infusion. The patient was then placed in lateral decubitus position and was held firmly by the assistant. With sterile precautions, subarachnoid block was performed at L4 – L5 interspace using 25G Quinckie's needle. After confirming CSF with aspiration, local anaesthetic drug was injected according to the group allotted. The dosage of local anaesthetic drug was taken according to the weight of the patient as follows

< 5kg - 0.5mg/kg

5 -15kg – 0.4mg/kg

>15kg – 0.3mg/kg

The maximum dose was taken as 20mg

Parameters recorded:

1. ***Hemodynamic parameters***:
    a. Pulse rate, non invasive blood pressure and oxygen saturation were monitored every 2 minutes for the first 10 minutes, then every 5

minutes till first 60 min and every 15 minutes upto 90 minutes or till the surgery is over and then in recovery room

b. Any drop in mean arterial pressure 20% from baseline is taken as hypotension and ephedrine 3mg given

c. Any decrease in pulse rate less than 60/min was treated with atropine 0.04mg/kg.

2. ***Sensory Blockade***:

Sensory blockade was determined by pin prick along the mid axillary line at about a interval of 1 min until the level of block reached upto L1. The maximum height of the sensory blockade was noted.

Onset of sensory block was defined as the time taken from injection of drug to sensory block at L1 and offset of sensory block was determined by return of sensation at S5 dermatome. The duration of sensory block was determined by the time interval between onset and offset of sensory block.

3. ***Motor blockade***:

Motor block was determined by the modified Bromage score

0 - No motor loss

1 - unable to flex hip

2 – unable to flex knee joint

3 – unable to flex ankle joint

This is assessed at a gap of 1 minute till complete motor blockade develops. Onset of motor block was defined as the time taken from injection of drug to development of complete motor block (bromage score 3). Bromage score 0 is taken as complete recovery from motor block. The duration of motor block was determined by the time between onset and offset of motor block.

4. The highest dermatomal level of sensory block was noted.
5. The Time taken to achieve the highest dermatomal level was noted.
6. The Two segment regression time (ie., the time taken to decrease from maximum sensory level by two segments from initial level) was noted.
7. Quality of block was determined as adequate when no sedation or analgesia used, inadequate when there is need for additional analgesia, and as failed when converted to general anaesthesia. If analgesia was inadequate then fentanyl injection 1microgram/kg was given. If the regimen was switched to GA then the patient was excluded from the study.
8. Time of micturition was noted.
9. Duration of surgery was noted.

DATA ANALYSIS

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using **Epidemiological Information Package (EPI 2010)** developed by Centre for Disease Control, Atlanta. Using this software range, frequencies, percentages, means, standard deviations, chi square and 'p' values were calculated. Kruskul Wallis chi-square test was used to test the significance of difference between quantitative variables and Yate's chi square test for qualitative variables. A 'p' value less than 0.05 is taken to denote significant relationship.

OBSERVATION AND RESULTS

Table 1: Age distribution

Group	**Age in years**		
	Range	**Mean**	**SD**
Group B	7-12	8.97	1.33
Group R	7-12	8.7	1.39
p - value	0.418 Not significant		

The mean age are compared and it is found to be statistically not significant

Age distribution

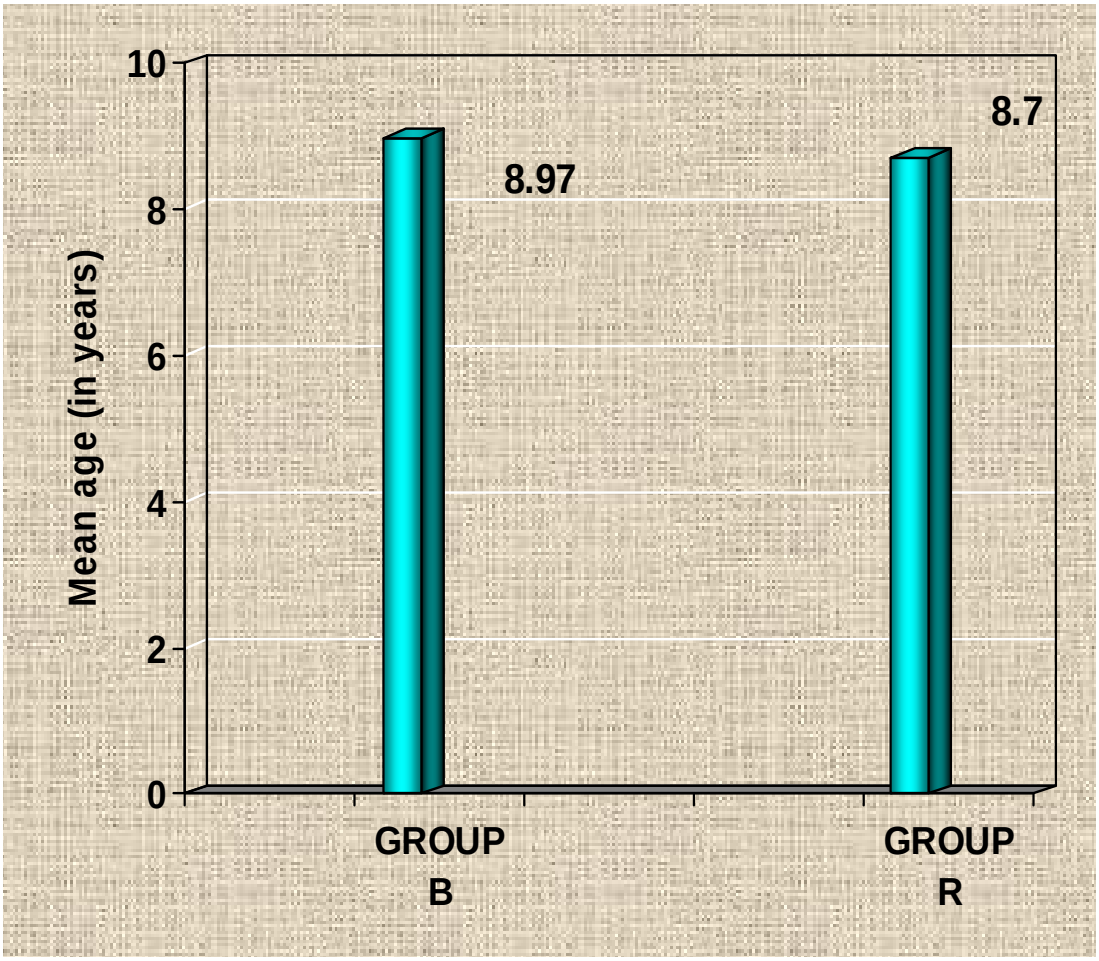


Table 2: Sex distribution

Group	**Sex**			
	Male		**Female**	
	No	**%**	**No**	**%**
Group B	27	90	3	10
Group R	26	86.7	4	13.3
p - value	0.5 Not significant			

The sex distribution are compared and it is found to be statistically not significant

Sex distribution

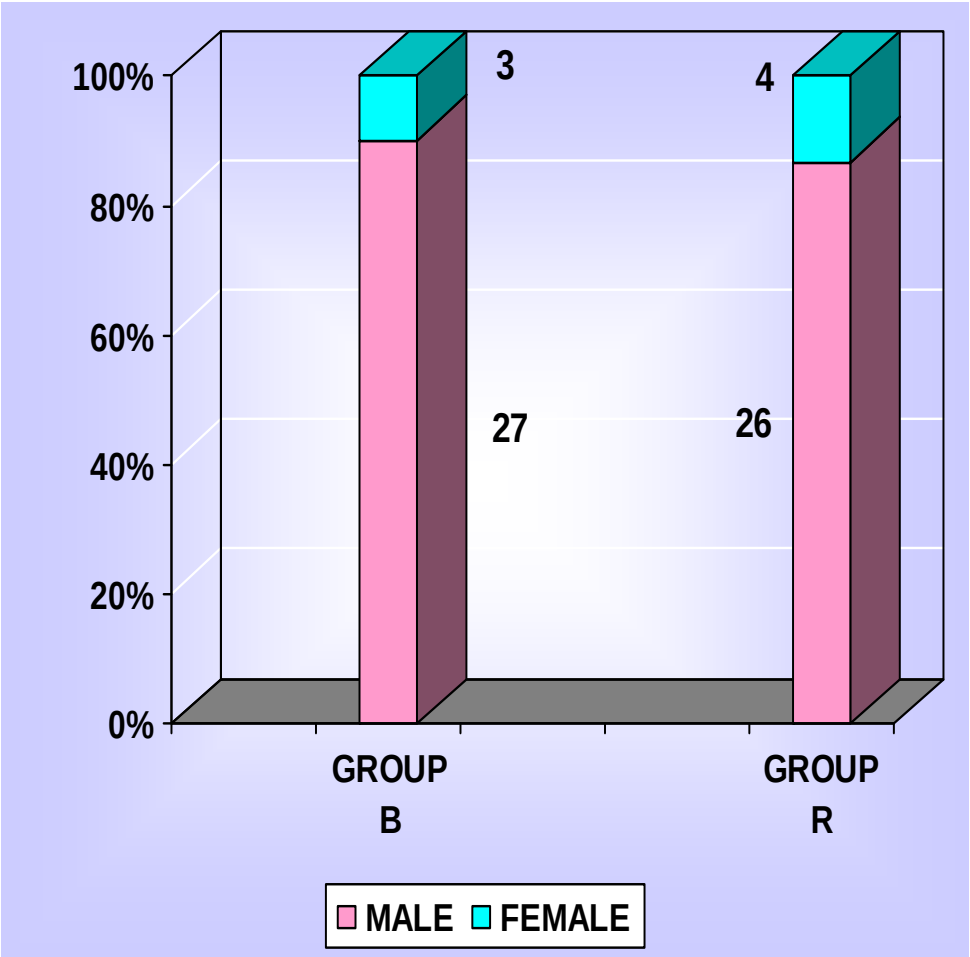


Table 3: Height / Weight

Group	**Height (in cms)**		**Weight (in kgs)**	
	Mean	**SD**	**Mean**	**SD**
Group B	110.2	8.3	15.87	2.76
Group R	108.6	10.6	16.57	2.79
p - value	0.3248 Not significant		0.3476 Not significant	

The height and weight are compared and found not to be statistically significant

Height / Weight

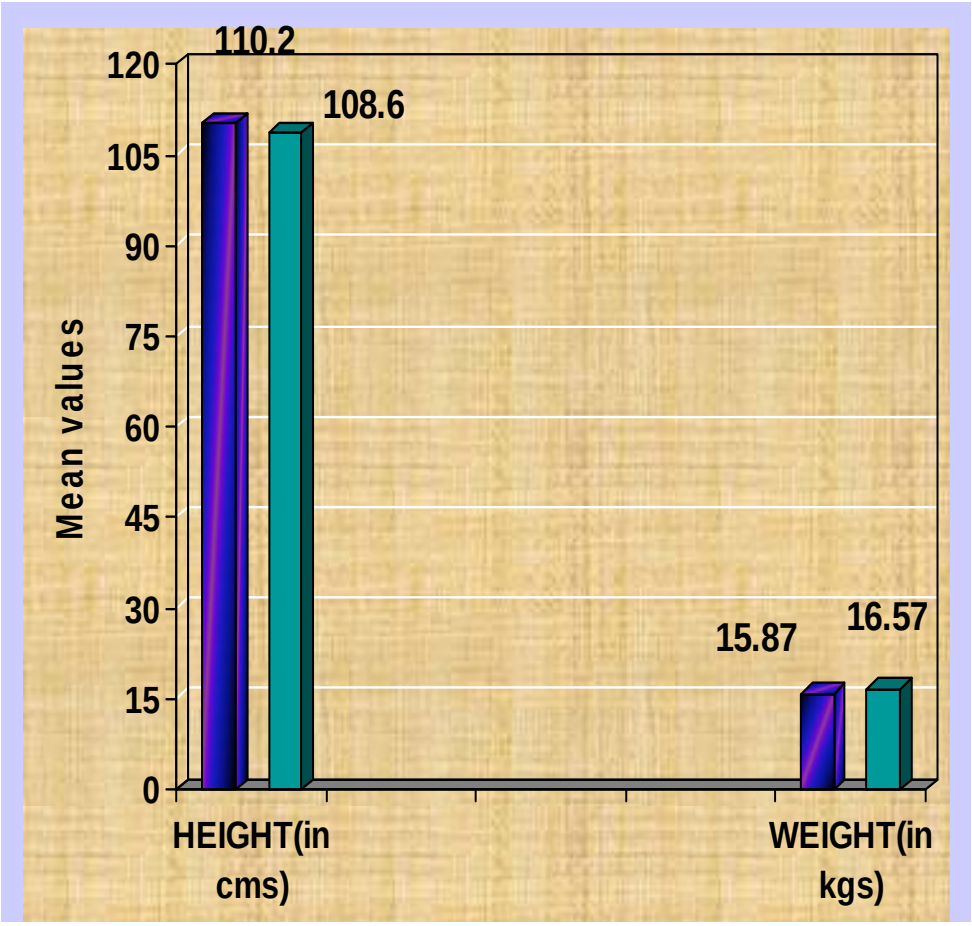


Table 4: ASA STATUS

Group	**ASA**			
	I		**II**	
	No	**%**	**No**	**%**
Group B	30	100	-	-
Group R	30	100	-	-

The ASA physical status is compared and found to be statistically not significant

ASA STATUS

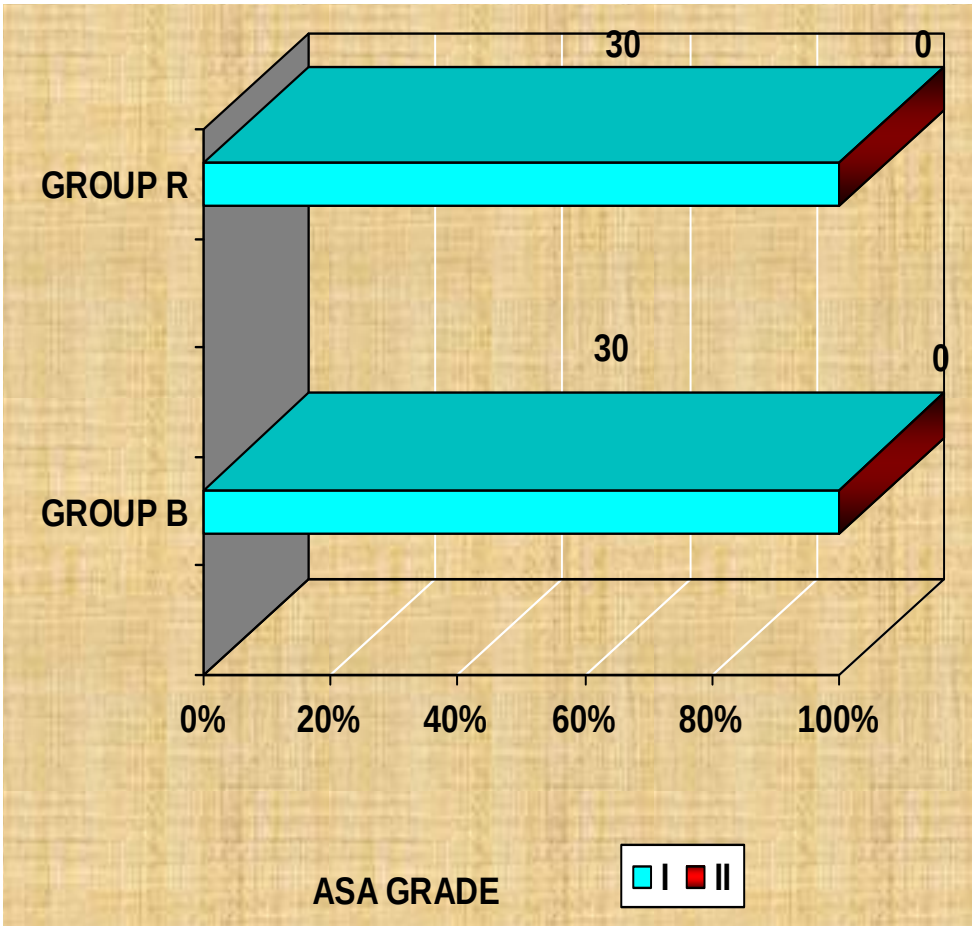


Table 5: Onset of sensory block

Group	**Onset of sensory block (in minutes)**		
	Range	**Mean**	**SD**
Group B	4-5	4.6	0.5
Group R	5-7	6.27	0.64
p - value	**0.0001 Significant**		

The onset of sensory block is delayed in ropivacaine group when compared to bupivacaine group and it is found to be statistically significant

Onset of sensory block

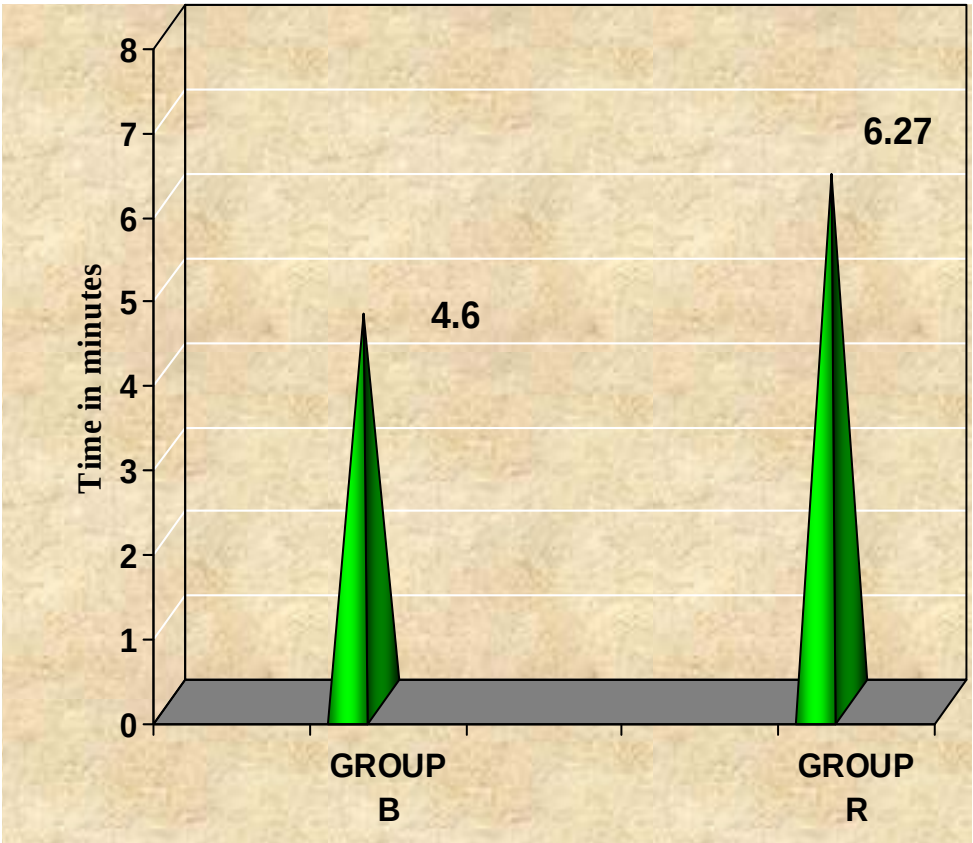


Table 6: Maximum height of sensory block

Maximum height of sensory block	Group B		Group R	
	No	%	No	%
T4	12	40	-	-
T5	16	53.3	-	-
T6	2	6.7	3	10
T7	-	-	19	63.3
T8	-	-	8	26.7
Total	30	100	30	100

The average level of maximum sensory block reached in ropivacaine group is T7, which is lower than that achieved in bupivacaine group of T5.

Maximum height of sensory block

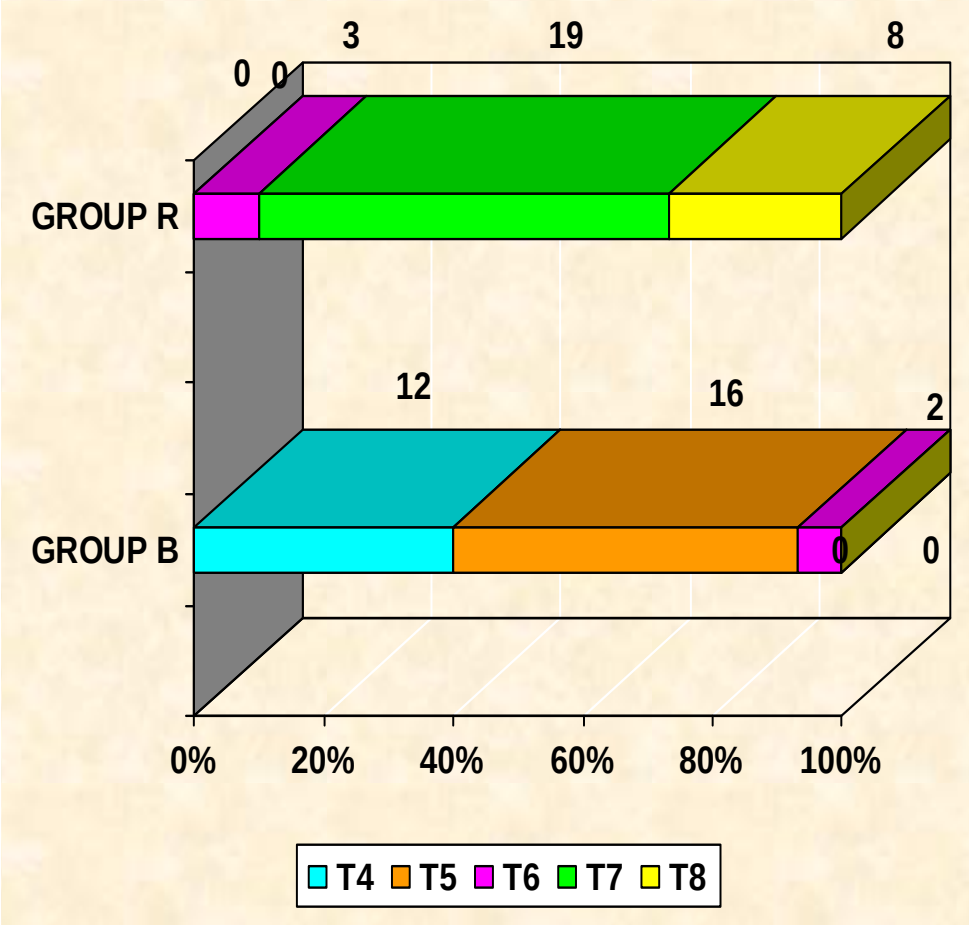


Table 7: Time taken for achieving maximum height of sensory block

Group	**Time taken for achieving maximum height of sensory block (in minutes)**		
	Range	**Mean**	**SD**
Group B	8-10	8.47	0.57
Group R	11-14	12.47	0.68
p - value	**0.0001** **Significant**		

The time taken to achieve the maximum height of sensory block is more in ropivacaine group compared to bupivacaine group and it is found to be statistically significant.

Time taken for achieving maximum height of sensory block

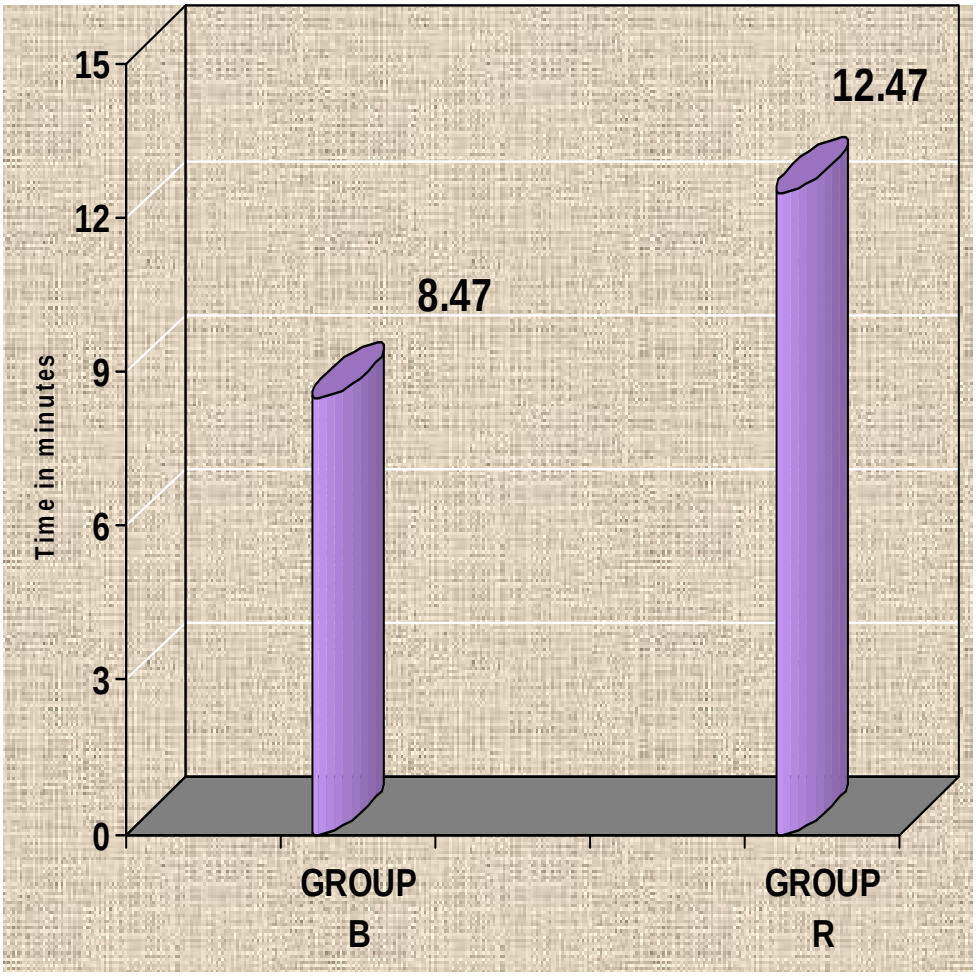


Table 8: Onset of motor block

Group	**Onset of motor block (in minutes)**		
	Range	**Mean**	**SD**
Group B	4-5	4.43	0.5
Group R	8-11	9.13	0.82
p - value	**0.0001** **Significant**		

The onset of motor block is delayed in ropivacaine group when compared to bupivacaine group and it is found to be statistically significant.

Onset of motor block

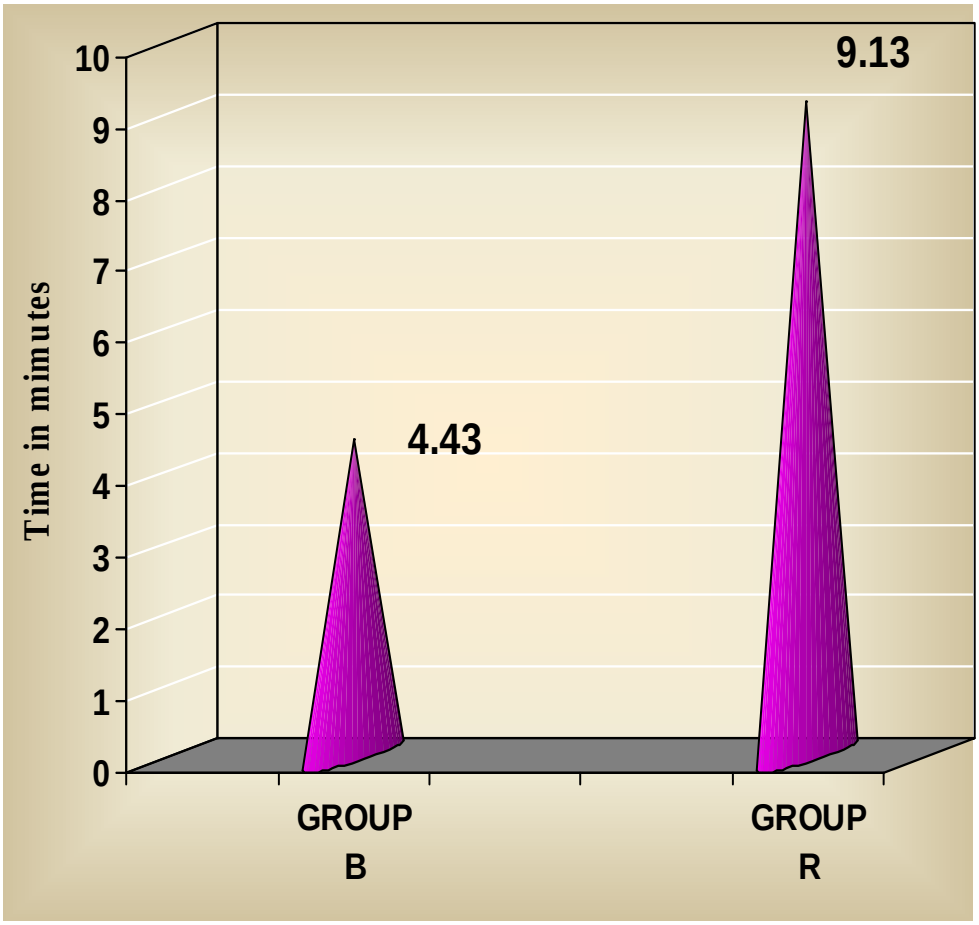


Table 9: Two segment regression time

Group	**Two segment regression time (in minutes)**		
	Range	**Mean**	**SD**
Group B	55-70	63.5	4.2
Group R	35-50	39.8	4.0
p - value	**0.0001** **Significant**		

The two segment regression time is faster in ropivacaine group when compared to be bupivacaine group and it is found to be stasistically significant

Two segment regression time

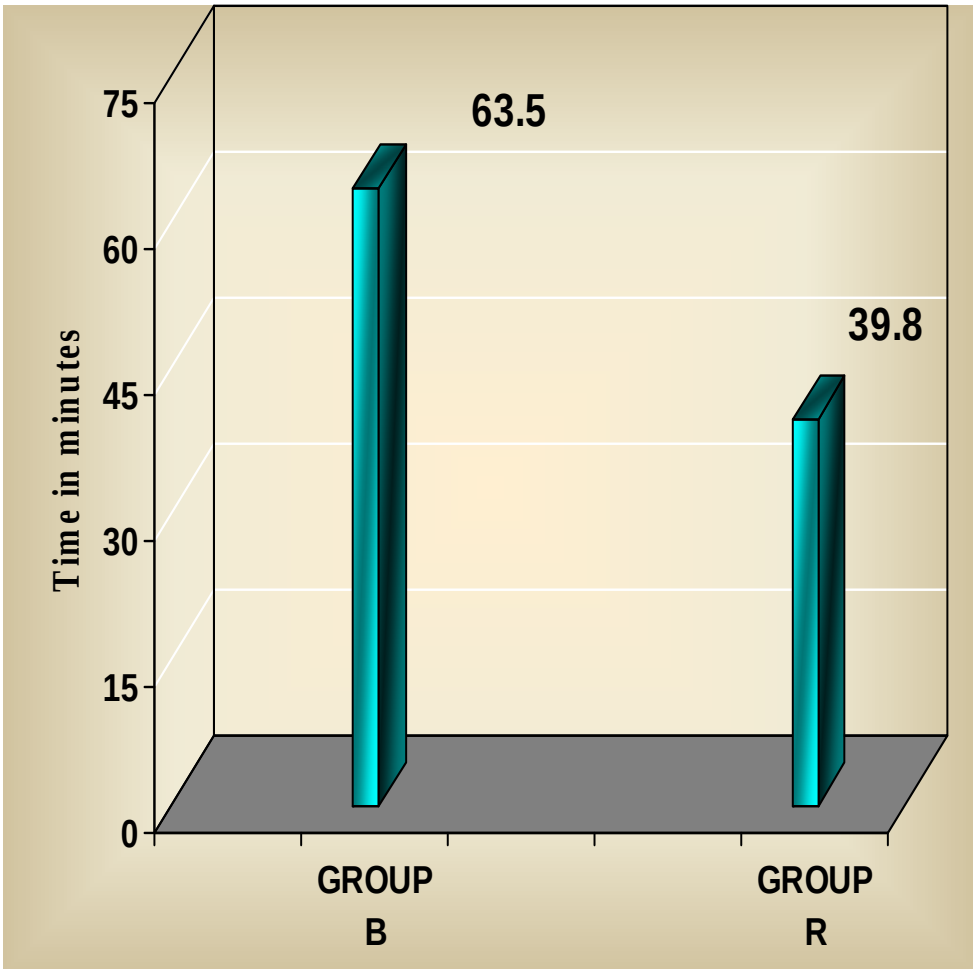


Table 10: Duration of sensory block

Group	**Duration of sensory block (in minutes)**		
	Range	**Mean**	**SD**
Group B	130-160	147.7	8.6
Group R	100-130	117.7	9.4
p - value	**0.0001 Significant**		

The mean duration of sensory block is shorter in ropivacaine group when compared to bupivacaine group and it is found to be statistically significant

Duration of sensory block

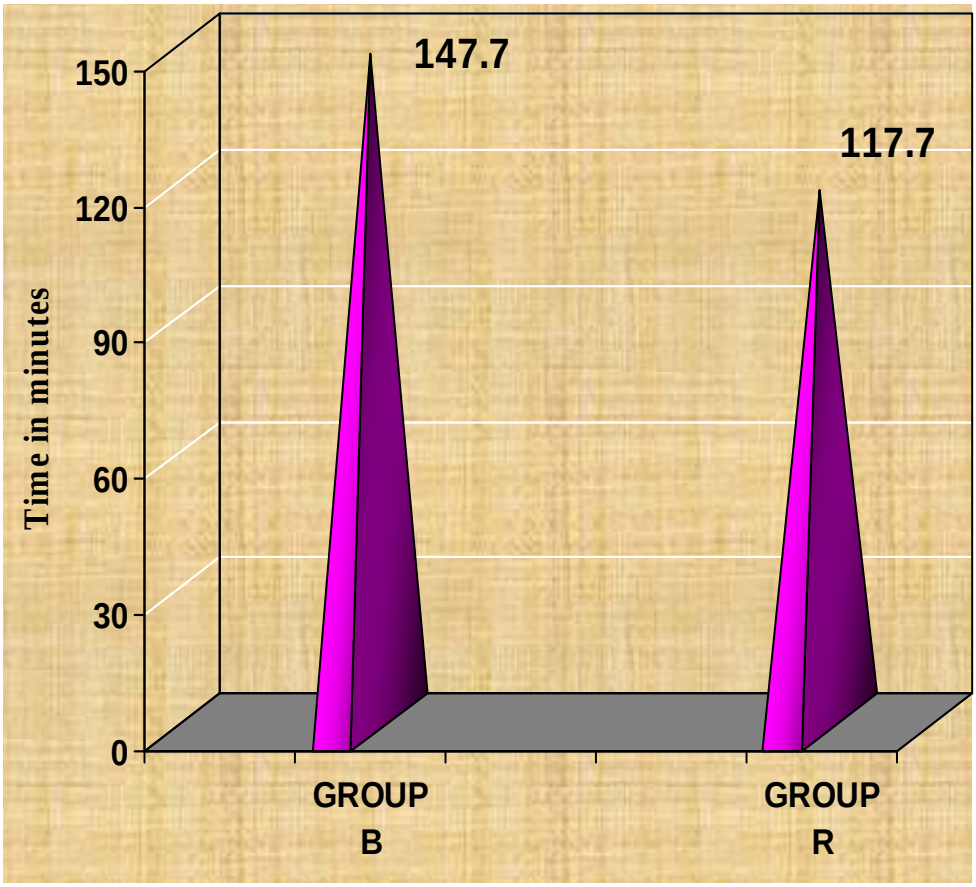


Table 11: Duration of motor block

Group	**Duration of motor block (in minutes)**		
	Range	**Mean**	**SD**
Group B	100-140	118.3	8.7
Group R	90-120	100	8.3
p - value	**0.0001** **Significant**		

The mean duration of motor block is shorter in ropivacaine group when compared to bupivacaine group and it is found to be statistically significant

Duration of motor block

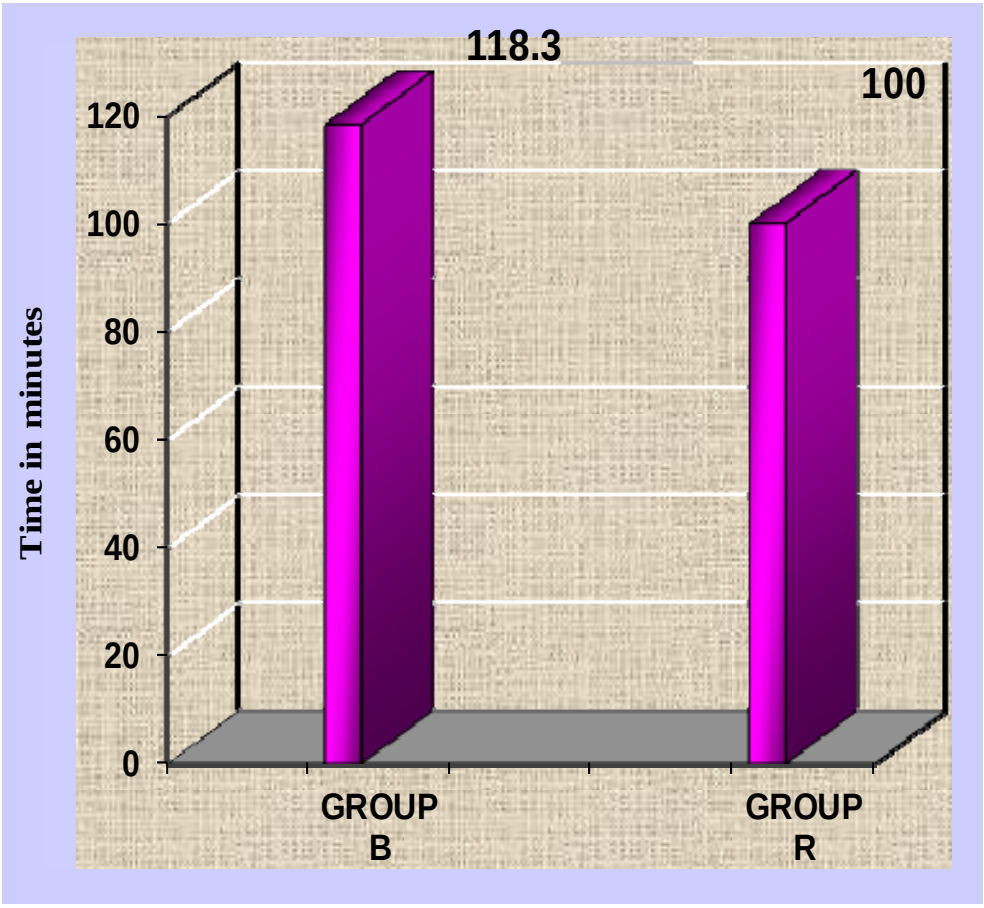


Table 12: Time of micturition

Group	**Time of micturition (in minutes)**		
	Range	**Mean**	**SD**
Group B	300-350	317	13.7
Group R	200-250	214	13.8
p - value	**0.0001** **Significant**		

The mean time of micturition is shorter in ropivacaine group when compared to bupivacaine group and it is found to be statistically significant.

Time of micturition

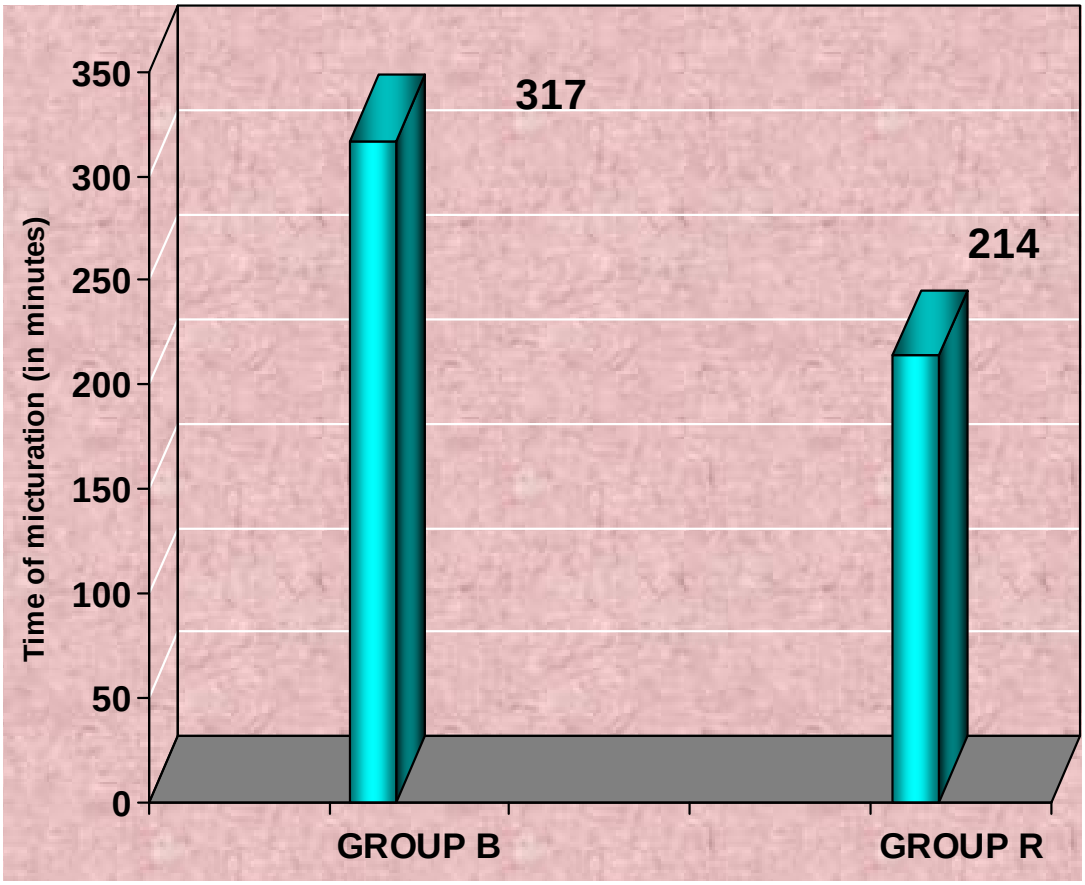


Table 13: Duration of surgery

Group	**Duration of surgery (in minutes)**		
	Range	**Mean**	**SD**
Group B	40-60	52	5.5
Group R	30-60	48.5	8.4
p - value	0.1219 Not significant		

The mean duration of surgery is not statistically significant between the ropivacaine and bupivacaine group.

Duration of surgery

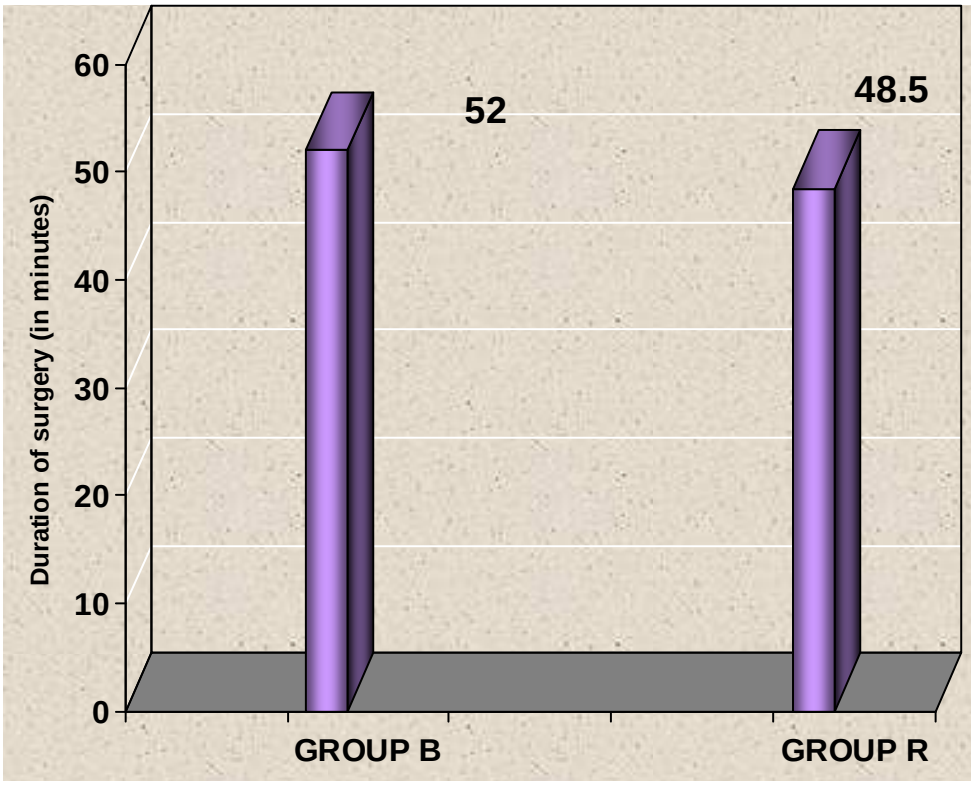


Table 14: Vasopressor / Atropine

Group	**Vasopressor**				**Atropine**			
	Yes		**No**		**Yes**		**No**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Group B	3	10	27	90	-	-	30	100
Group R	2	6.6	28	93.4	-	-	30	100
p - value	0.268 Not significant							

There is no statistically significant difference between the groups.

Table 15: Adequacy of block

Adequacy Block	**Group B**		**Group R**	
	No	**%**	**No**	**%**
Adequate	30	100	28	93.3
Inadequate	-	-	2	6.7
p - value	0.2458 Not significant			

The adequacy of block is not statistically significant between the ropivacaine and bupivacaine group.

Table 16: Changes in pulse rate

Pusle rate	Group B		Group R		p - value	Significance
	Mean	SD	Mean	SD		
Pre Op.	106.0	12.6	106.2	13.3	0.941	Not significant
2 minutes	108.3	12.3	110.9	14.2	0.3825	Not significant
4 minutes	106.2	13.2	110.4	14.3	0.2831	Not significant
6 minutes	103.5	12.5	105.4	14.3	0.5788	Not significant
8 minutes	106.8	13.0	106.7	15.2	0.9234	Not significant
10 minutes	108.3	13.6	110.1	13.7	0.615	Not significant
15 minutes	109.3	13.2	112.1	14.4	0.4242	Not significant
20 minutes	110.6	12.7	112.6	14.5	0.5343	Not significant
25 minutes	110.1	12.2	112.4	14.0	0.4327	Not significant
30 minutes	110.1	12.0	112.0	13.9	0.5688	Not significant
35 minutes	110.1	12.1	109.6	12.4	0.9058	Not significant
40 minutes	109.8	12.8	108.3	12.8	0.5295	Not significant
45 minutes	109.6	12.6	108.6	13.2	0.823	Not significant
50 minutes	109.2	13.1	108.9	13.6	0.9058	Not significant
55 minutes	107.4	12.0	107.9	13.8	0.8186	Not significant
60 minutes	107.1	11.7	105.6	12.6	0.549	Not significant
75 minutes	107.4	11.8	106	13.2	0.6359	Not significant
90 minutes	106.2	11.9	106.6	14.1	0.8591	Not significant

Changes in pulse rate

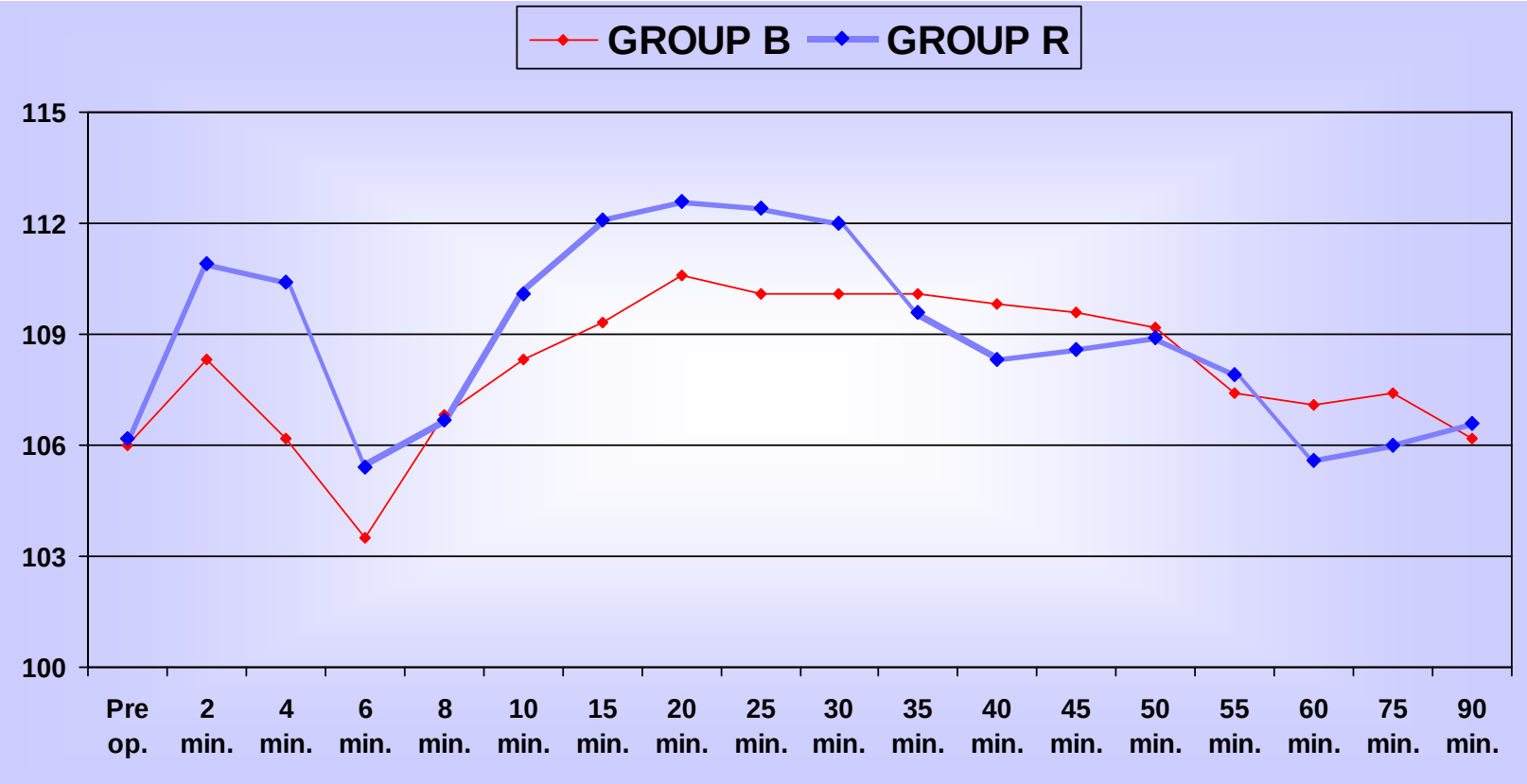


Table 17: Changes in SPO2

SPO2	Group B		Group R		p - value	Significance
	Mean	SD	Mean	SD		
Pre Op.	99.37	0.72	99.27	0.69	0.5279	Not significant
2 minutes	100	-	100	-	-	-
4 minutes	100	-	100	-	-	-
6 minutes	100	-	100	-	-	-
8 minutes	100	-	100	-	-	-
10 minutes	100	-	100	-	-	-
15 minutes	100	-	100	-	-	-
20 minutes	100	-	99.97	0.18	0.3173	Not significant
25 minutes	100	-	99.97	0.18	0.3173	Not significant
30 minutes	100	-	99.97	0.18	0.3173	Not significant
35 minutes	100	-	99.97	0.18	0.3173	Not significant
40 minutes	100	-	99.97	0.18	0.3173	Not significant
45 minutes	100	-	99.97	0.18	0.3173	Not significant
50 minutes	100	-	99.8	0.41	0.0605	Not significant
55 minutes	99.97	0.18	100	-	0.3173	Not significant
60 minutes	99.93	0.25	99.87	0.35	0.3934	Not significant
75 minutes	99.83	0.38	99.8	0.41	0.7408	Not significant
90 minutes	99.73	0.45	99.83	0.38	0.3512	Not significant

Changes in SPO2

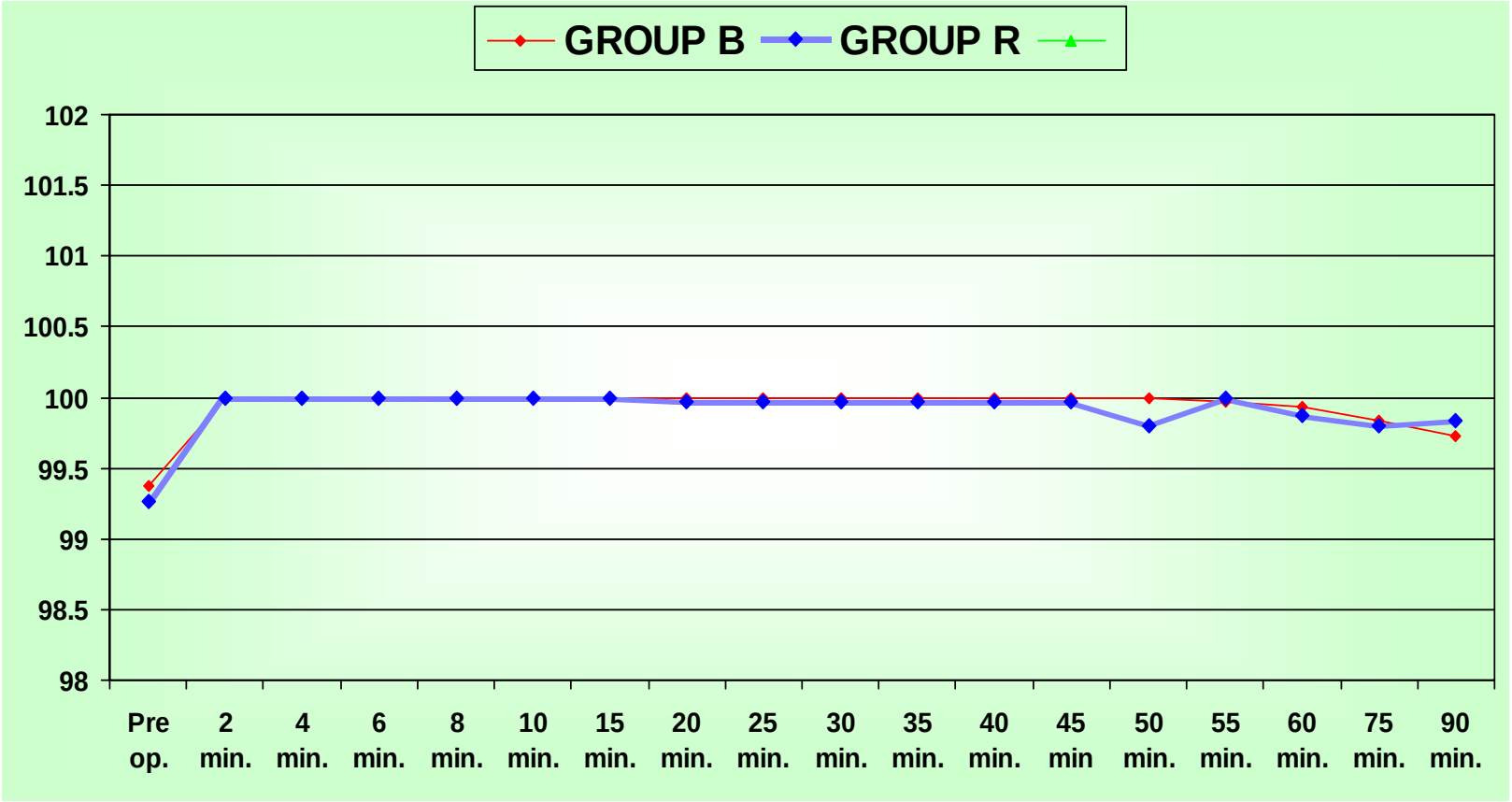


Table 18: Changes in systolic B.P

SBP at	Group B		Group R		p - value	Significance
	Mean	SD	Mean	SD		
Pre Op.	98.3	10.5	99.8	11.5	0.7588	Not significant
2 minutes	98.7	10.4	100.6	11.5	0.6334	Not significant
4 minutes	97.5	12.3	98.4	12.2	0.8875	Not significant
6 minutes	94.4	9.6	96	10.6	0.6696	Not significant
8 minutes	97.5	10.2	98.4	10.9	0.8349	Not significant
10 minutes	98.7	10.8	100	11.4	0.8342	Not significant
15 minutes	99.3	10.6	100.3	10.9	0.743	Not significant
20 minutes	97.8	10.1	99.9	11.0	0.4384	Not significant
25 minutes	99.6	11.0	100.1	11.5	0.9703	Not significant
30 minutes	97.9	11.0	99.5	11.3	0.5161	Not significant
35 minutes	99.2	10.9	100.2	11.0	0.8285	Not significant
40 minutes	98.9	10.9	100.3	11.0	0.4777	Not significant
45 minutes	99.2	10.6	100.4	11.2	0.8486	Not significant
50 minutes	100.1	11.5	100.8	11.4	0.8694	Not significant
55 minutes	100.0	11.7	101	12.2	0.9641	Not significant
60 minutes	99.9	0.3	99.8	0.3	0.3934	Not significant
75 minutes	99.0	10.9	100.6	11.0	0.5065	Not significant
90 minutes	98.7	10.8	100.1	11.0	0.596	Not significant

Changes in systolic B.P

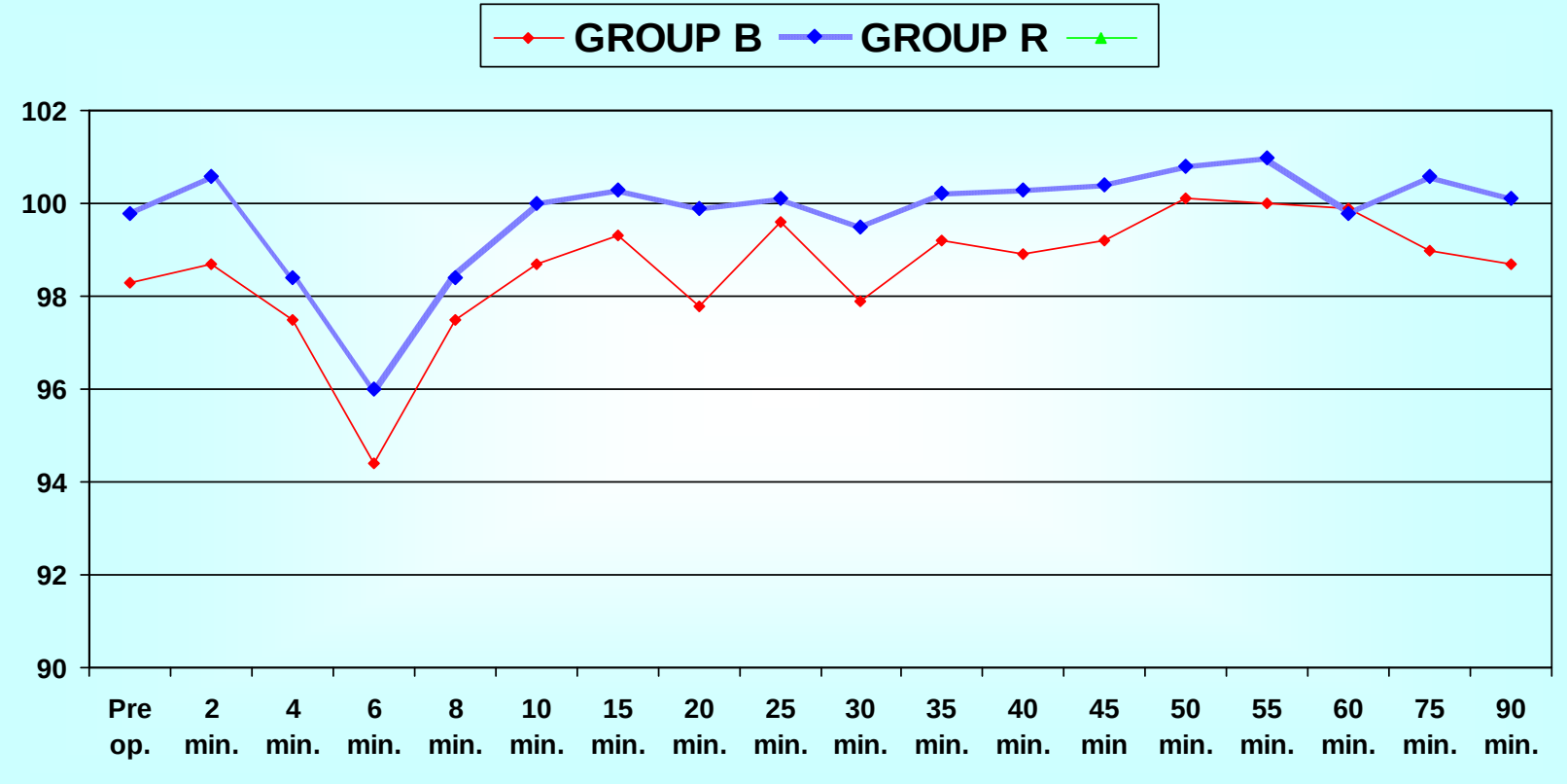
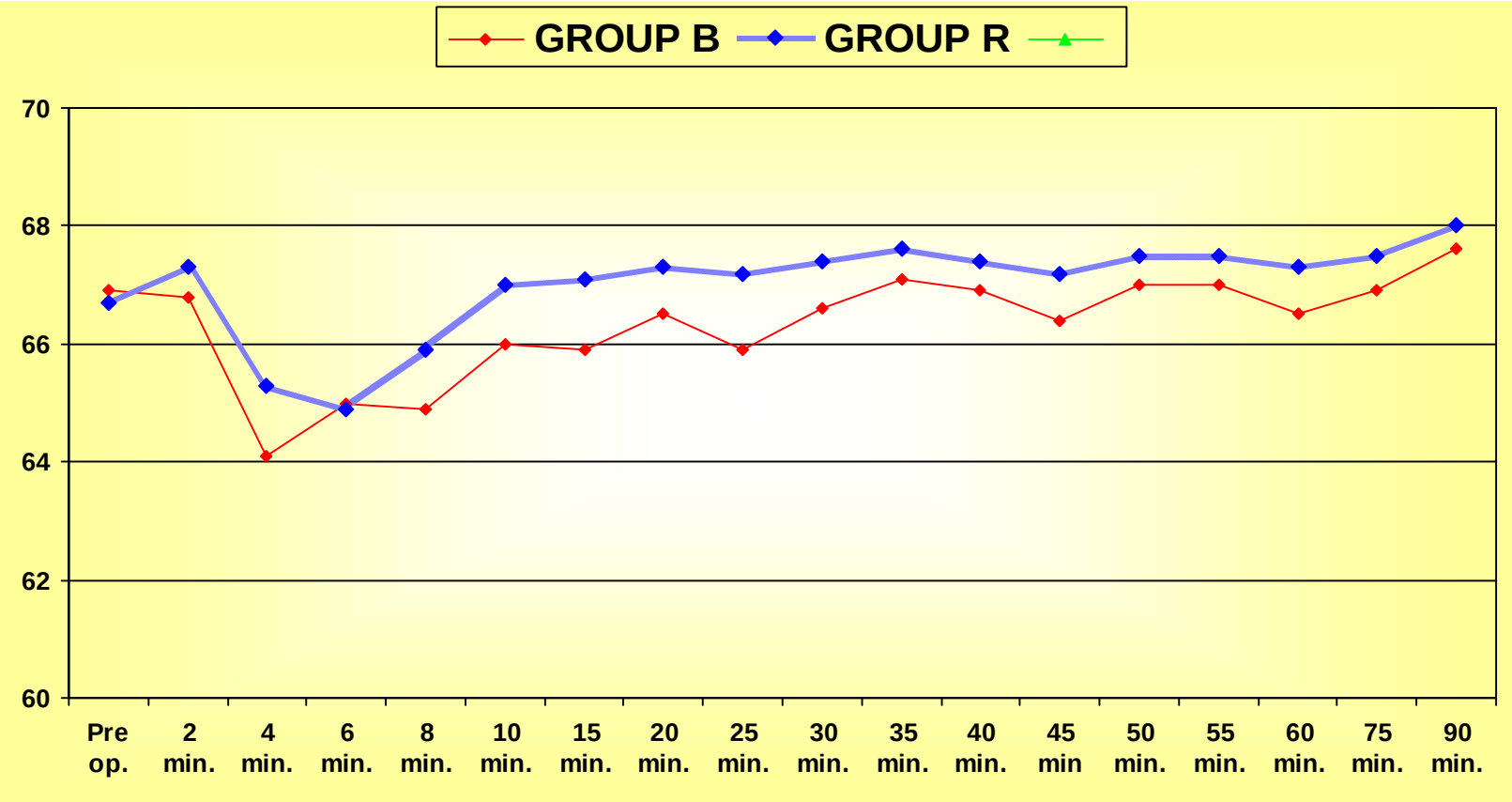


Table 19: Changes in diastolic B.P

DBP	Group B		Group R		p - value	Significance
	Mean	SD	Mean	SD		
Pre Op.	66.9	7.7	66.7	8.0	0.6949	Not significant
2 minutes	66.8	7.9	67.3	8.8	0.9641	Not significant
4 minutes	64.1	8.1	65.3	9.2	0.84	Not significant
6 minutes	65.0	6.9	64.9	7.5	0.6598	Not significant
8 minutes	64.9	7.7	65.9	8.3	0.5952	Not significant
10 minutes	66.0	8.1	67.0	8.1	0.5708	Not significant
15 minutes	65.9	7.8	67.1	8.3	0.5728	Not significant
20 minutes	66.5	7.7	67.3	7.8	0.6282	Not significant
25 minutes	65.9	13.8	67.2	11.9	0.3526	Not significant
30 minutes	66.6	8.3	67.4	8.1	0.6287	Not significant
35 minutes	67.1	8.3	67.6	8.1	0.9044	Not significant
40 minutes	66.9	7.7	67.4	7.8	0.9821	Not significant
45 minutes	66.4	7.1	67.2	7.2	0.9127	Not significant
50 minutes	67.0	7.9	67.5	8.0	0.9224	Not significant
55 minutes	67.0	6.9	67.5	7.9	0.7749	Not significant
60 minutes	66.5	8.1	67.3	8.3	0.7889	Not significant
75 minutes	66.9	8.0	67.5	7.9	0.7748	Not significant
90 minutes	67.6	8.2	68.0	7.9	0.8747	Not significant

Changes in diastolic B.P



DISCUSSION

Ropivacaine is introduced as an alternative to routinely used bupivacaine for surgeries of short duration especially in ambulatory setup. As the intensity of motor blockade is less in ropivacaine when compared to bupivacaine it is used in labour analgesia and post operative pain relief. The differential blockade produced by ropivacaine is an advantage in situations where we want to avoid the motor blockade, thereby we can ambulate the patient early in the post operative setup.

Ropivacaine is now available as an isobaric solution. Thus the distribution is not affected by gravity and level of blockade would be lesser than that of hyperbaric solution. Thus unnecessary high spinal blockade can be avoided. This also produces better hemodynamic stability.

The long duration of motor blockade with bupivacaine may be anxious to the parents though hemodynamically stable. Early ambulation of the patients relieves the anxiety of the parents and patients themselves. This is more useful in cases of surgeries lasting for short duration and patients can be discharged in the same day. Thus the drug is fit for ambulatory surgeries.

Hence this study was conducted to evaluate the efficacy of isobaric ropivacaine and bupivacaine in spinal anaesthesia in children posted for elective infraumblical surgeries.

Onset of sensory block:

According to this study, the average time taken for onset of sensory block is 6.2 minutes for ropivacaine group and 4.6 minutes for bupivacaine group. The lower lipid solubility character of ropivacaine is the cause for delayed onset of sensory block when compared to bupivacaine. This result is similar to that found in study conducted by V.Gupta, Mehta and colleagues where the onset of sensory block is delayed in ropivacaine group when compared to bupivacaine group.

Maximum height of sensory block:

According to the study, the maximum height of sensory block was T6 – T7 in ropivacaine group and T4-T5 in bupivacaine group. The maximum height of sensory block is less in ropivacaine group when compared to bupivacaine group. As less number of segments is blocked and also the level of block is lesser, it avoids cardiovascular and respiratory alterations. This is similar to that found in study by Marc Malinovskgy, Charles and Montouvalou and colleagues where a higher level of maximum height of sensory block is reached in case of bupivacaine group when compared to ropivacaine group.

Time taken to reach maximum height of sensory block:

According to this study the mean time taken to reach the maximum height of sensory block is about 12.4 in ropivacaine group and 8.4 in bupivacaine. The average time taken to reach the maximum height is more in case of ropivacaine group. This is similar to the study of Malinovsky, Florence Charles where the time taken to achieve the maximum height is delayed in case of ropivacaine group.

Two segment regression time

According to this study, the mean two segment regression time is about 39.8 minutes in ropivacaine group compared to that of about 63.5 minutes in case of bupivacaine group. This is similar to that of study conducted by Mantouvallou and colleagues where the two segment regression time is shorter in ropivacaine group.

Duration of sensory block:

According to this study, the mean duration of sensory block is about 117 minutes in ropivacaine group compared to 147 minutes in case of bupivacaine group. Thus the duration of sensory block is less in ropivacaine group. This is similar to that of study conducted by Metha and colleagues, Neval Boztuz and colleagues, Mantouvalou and colleagues. Early recovery of sensory block in case of ropivacaine makes the drug more suitable for ambulatory surgeries.

Onset of Motor Block:

According to this study, the average time taken for the onset of motor block is about 9.1 minutes in case of ropivacaine group compared to 4.4 minutes in case of bupivacaine group. Thus the onset of motor block is delayed in ropivacaine group. This is similar to the study found by Metha and colleagues, Neval Boztuz and colleagues, Mantouvalou and colleagues where the onset of motor block is delayed in ropivacaine group.

Duration of motor blockade:

According to this study, the mean duration of motor blockade is about 100 minutes in case of ropivacaine group and 118 minutes in case of bupivacaine group. Thus the duration of motor blockade is less in ropivacaine group. So the patients can be mobilized early in case of ropivacaine. This property makes it ideal for short surgeries and ambulatory surgeries. This is similar to study conducted by those of Metha and colleagues, Neval Boztuz and colleagues, Mantouvalou and colleagues where the duration of motor blockade is shorter in case of ropivacaine group.

Time taken for micturition:

According to this study, the mean time taken for micturition was about 214 minutes in case of ropivacaine group compared to about 317 minutes in case of bupivacaine group. This is similar to that study conducted by Neval

Boztuz and Zekiye and colleagues where the mean time of micturition is less in ropivacaine group. As the patient micturates earlier in case of ropivacaine, the patient meets the discharge criteria earlier. Thus ropivacaine is more useful in ambulatory surgeries.

Quality of Block:

According to this study, quality of block was adequate in both groups. This is similar to that of study conducted by McChelland and colleagues where the quality of block is adequate in both groups. Thus ropivacaine can be used as an alternative drug to bupivacaine in spinal anaesthesia.

Hemodynamic parameters:

a. ***Pulse rate*** :

   According to the study, there is no significant difference between the drop in pulse rate between both groups.

b. ***Blood Pressure***:

   According to the study, there is no significant difference between the drop in blood pressure between both groups.

c. ***Oxygen saturation***:

   According to the study, there is no significant difference between both groups as the saturation was maintained through out the surgery.

Thus ropivacaine proves to be good alternative to bupivacaine in case of infraumblical surgeries. Ropivacaine is more suitable for shorter duration of surgeries.

SUMMARY

This is a randomized controlled study involving 60 cases of children of age between 7 and 12 years posted for elective infraumblical surgeries under spinal anaeshesia. They are allotted into two groups, Group R receiving 0.5% ropivacaine and Group B receiving 0.5% bupivcaine. The following parameters are noted in the study periods. The onset of sensory block, maximum height of sensory block, time taken to reach the maximum height of sensory block, two segment regression time, onset of motor block, mean duration of sensory & motor block and quality of block. The hemodynamic parameters noted are pulse rate, systolic and diastolic blood pressure, oxygen saturation with pulse oximeters. The use of atropine and vasopressors are noted. Any complications during the study are also noted.

According to the study, there was significant delay in onset of sensory and motor block in ropivacaine group. There was earlier two segment regression time in ropivacaine group. There was earlier offset of sensory and motor block and time taken for micturition was earlier in ropivacaine group. The quality of block was adequate in both groups. The hemodynamic parameters were well maintained in both groups.

Thus ropivacaine provides a good alternative to bupivacaine in case of short duration of surgeries. It is more suitable in cases of ambulatory surgeries where the patients meet the discharge criteria earlier and can be discharged from the hospital.

CONCLUSION

Ropivacaine used for spinal anaesthesia in children has delayed onset of sensory and motor block. It also has faster offset of sensory and motor block with adequate quality of block compared to that of bupivacaine.

It is concluded that Ropivacaine can be used as a good alternative to Bupivacaine in case of shorter duration of surgeries especially in ambulatory setup.

BIBLIOGRAPHY

1. Bayramlglu, H.ayaz, Bariskaner, Compare the effects on nerve conduction block: sensory specific site of action of ropivacaine when compared to bupivacaine: Methods find Exp, clinical pharmacology 2007, Vol.29(5): Pages 337.
2. Solomon E, Lenin H, Ben David et al, Bupivacaine for spinal anaesthesia in day care surgery: bupivacaine made isobaric by combining with saline: Anaesthesia and analgesia 1996: Vol. 83: Pages 716-21.
3. Brown et al., claimed to use an isobaric solution with a baricity of 1.0069 based on CSF measured by Levin et al in 1981.
4. Clincal anaesthesia by Paul G.Barash, Robert Stoelting, the level of sensory block achieved from isobaric bupivacaine is two dermatome less per interspace used.
5. Spinal, epidural and caudal anaesthesia in Miller R.D., Millers Anaesthesia 7th ed, New York: Elsevier Churcill Livingstone 2010, 1619-1637.
6. Regional anaesthesia in children, Miller R.D., Millers Anaesthesia 7th ed, New York: Elsevier Churcill Livingstone 2010, 2536-2537
7. P.imalango, K.R.Smith, G.Frawley: compared the potency between ropivacaine and bupivacaine in subarachnoid block, British journal of Anaesthesiology, 2009, vol.103, Pages 735-738.

8. Kavith jirtil, Rakhee Goyal, Subarachnoid block for children, Indian journal of Anaesthesia, 2010.
9. Dr.Prof. G.P.Dureja Revealing the facts, Neuraxial block.
10. Feldman, covino1998, The blocking tendency towards Aα and C fibers is more with ropivacaine.
11. Ropivacaine hydrochloride, Rapporteurs public paediatric assessment report for paediatric surgeries.
12. Melissa wheeler and Santhanam suresh : Practical paediatric regional anaesthesia, Anaesthesiology clinics of North America,2002, Vol.20.
13. Peterson M K, Fetter PD, Comparison of isobaric and hyperbaric solutions of ropivacaine for spinal anaesthesia: the sensory level reached is higher for hyperbaric solution than plain ropivacaine. British Journal of Anaesthesiology 2005: 94:107-11.
14. Kero M P, snall E V, comparison of intrathecal plain solutions containing ropivacaine 20 or 15mg versus bupivacaine 10mg; The major advantage of ropivacaine 15mg is faster motor recovery, suitable for day care surgeries, Anaesthesia – analgesia 2004, 99,713-717.
15. Zimmeman K, Heller A R. Varying the baricity of local anaesthetic drug with temperature, increase in temperature cause a decrease in density of local anaesthetics and addition of glucose increases the baricity. Anaesthesiology, 2006 Aug 105(2).

16. Geetha chowdry and Gaurav guitala, description of pharmacology and clinical effects of ropivacaine. Indian Journal of Anaesthesia, 2011, Vol.55,104-110.
17. Virshall Chandrasekar Ponde, Newer advances in regional techniques for children. Indian Journal of Anaesthesia, 2012, Vol.56, 470-8.
18. M.J. Coussins and P.O.Bridenbaugh – Neural blockade in clinical anaesthesia and management of pain 3 rd edition
19. Faulds B, Markaham A. The clinical uses and pharmacology of ropivacaine, Drugs 1996;52;429-49, Medline web of science.
20. Mc Leod GA. Variations in the baricity of solution used for spinal anaesthesia of ropivacaine and bupivacaine by addition of dextrose. BJA 2004 April 92(4): 547-51.
21. NYSORA : New York School of Regional Anesthesia, 2009 – 03- 16 – 26:12:00
22. Research journal of Pharmacology, ropivacaine Basic 4(1),1-4,2010.ISSN 1815 -9362,2010
23. Basic paediatric regional anaesthesia, Pages 119-123
24. Central neuraxial techniques, Paediatric anaesthesia 2012, Vol.22, Pages 56-67.
25. History of regional anaesthesia in children, Paediatric anaesthesia 2012, Vol.22, Pages 3-9.

26. Richardson and Wissler et al measured density in premenopausal, post menopausal and in men.
27. Solakovic, N, Compared the hemodynamic effects of hyperbaric and isobaric bupivacaine in spinal anaestheia. More stable with isobaric bupivacaine PMD; 20422816
28. Solakovic N. Level of sensory block and baricity of bupivacaine 0.5% in spinal anaesthesia. PMID:20645509
29. Dernedde M, Furlan D, Verbesselt R, Gepts E, Boogaerts JG. Grand mal convulsion after an accidental intravenous injection of ropivacaine. Anesth Analg 2004; 98(2): 521-3.
30. Warwick D, Ying Y.Lee, Hang K.chang. Ropivacaine is more suitable for surgeries involving the lower limb especially done in day care setup. Anaesthesia and analgesia, april 5, 2007.
31. Dominguez JJ, Morrison SG. The cardiac toxicity of ropivacaine, bupivacaine and levobupivacaine are compared with help of ECG. Anesthesia and Analgesia 2000 Jun; 90(6):1308-14.
32. Abraham I., Graf B. M., Kunst G, The steroselective and physiochemical properties of ropivacaine and bupivacaine form the basis for different cardiotoxic effects. Anesthesiology,96 (6), 1427-1434, 2002.
33. F.Reynolds, R.P.Griffin: The effects of 0.5% ropivacaine and 0.5% bupivacaine in regional anaesthesia for caesarian section are

compared. British Journal of Anaesthesia, 1995, Vol.74, Pages 512-516.

34. J.F.Luck, P.D.W.fettes and J.A.W.Wildsmith, The effects ropivacaine and bupivacaine in subarachnoid block for elective surgeries are compared.

STUDY PROFORMA

Name : Date :

Age : Sex :

IP No. : Ht : Wt:

ASA :

Diagnosis : Surgery:

Drug :

Premedication: Posture

Spinal Needle Gauge: Interspace:

Onset of sensory block	Max. Height Of sensory block	Time to Reach max. height	Onset of motor block	Time of two segment regression	Offset of sensory block at S5	Duration of motor block	Time of micturition

Hemodynamics

Time	Heart rate	NIBP	SPO2	Vasopressor	Atropine
Pre op					
2 min					
4 min					
6 min					
8 min					
10 min					
15 min					
20 min					
25 min					
30 min					
35 min					
40 min					

45 min					
50 min					
55 min					
60 min					
75 min					
90 min					

Duration of Surgery :

Duration of sensory block :

Duration of Motor block :

Quality of Block :

Time of Micturition :

If Ephedrine used, Dose :

If Atropine used, Dose :

Other complication :

MASTER CHART																					
Sl.No.	Name	IP No.	Surgery	Group	Age	Sex	Height	Weight	ASA	Onset of Sensory block	Max. Height of sensory block	Time to achieve max. ht.	Onset of Motor block	2 segment regression	Duration of senory block	Duration of motor block	Time of moicturition	Duration of surgery	Vasopressor	Atropine	adequacy of block
1	Suryaprakash	43515	R inguinal hernia	R	7	M	105	15	1	7	T8	12	10	45	120	110	250	30	NO	NO	adq
2	surendar	58147	urethroplasty	R	10	M	115	18	1	6	T7	14	9	50	120	100	240	40	NO	NO	adq
3	Dhanalakshm	48980	cystoscopy	R	8	F	100	14	1	6	T8	13	8	40	100	90	200	30	NO	NO	adq
4	subash	58637	L inguinal hernia	R	10	M	120	21	1	5	T7	14	10	40	110	90	230	40	NO	NO	adq
5	Alaguraja	58092	L inguinal hernia	R	10	M	124	21	1	6	T6	12	9	45	120	100	240	50	NO	NO	adq
6	Mohanraj	60896	appendicectomy	R	12	F	120	20	1	5	T7	11	10	40	130	100	230	55	NO	NO	adq
7	Vignesh	60116	cystoscopy	R	8	M	96	14	1	6	T7	13	9	45	130	110	220	50	NO	NO	adq
8	karthick	63042	R inguinal hernia	R	9	M	112	17	1	5	T8	12	11	40	110	90	210	40	NO	NO	adq
9	Kamlesh	60904	R inguinal hernia	R	7	M	104	15	1	6	T7	12	11	35	130	110	220	60	NO	NO	adq
10	syed ismail	67736	L inguinal hernia	R	9	M	110	18	1	7	T7	13	9	35	120	100	220	60	YES	NO	adq
11	Karuppasama	61009	appendicectomy	R	11	M	130	21	1	6	T7	12	10	40	120	110	230	50	NO	NO	in adq
12	Balamurugan	42112	R inguinal hernia	R	9	M	106	17	1	6	T7	12	9	40	110	90	200	50	NO	NO	adq
13	Anadraj	42633	L inguinal hernia	R	8	M	100	14	1	6	T8	13	9	35	100	90	210	40	NO	NO	adq
14	Praveenraj	44329	gatronemius bursa	R	8	M	102	14	1	6	T7	13	8	40	110	90	210	40	NO	NO	adq
15	Mohammed	44326	L inguinal hernia	R	7	M	98	13	1	7	T6	12	9	35	110	100	220	40	YES	NO	adq
16	Harikumar	44324	L inguinal hernia	R	10	M	126	20	1	7	T7	12	9	35	130	100	220	50	NO	NO	in adq
17	susaipraveen	44316	urethroplasty	R	9	M	105	16	1	7	T7	12	10	45	110	90	200	50	NO	NO	adq
18	arun	44856	R inguinal hernia	R	9	M	108	17	1	6	T8	13	8	40	120	100	200	55	NO	NO	adq
19	Mohanapriya	43736	colostmoy closure	R	8	F	100	14	1	6	T7	12	9	35	110	100	210	50	NO	NO	adq
20	sundarapandi	46974	R inguinal hernia	R	8	M	108	16	1	6	T7	13	9	40	120	110	210	55	NO	NO	adq
21	anandan	18707	R inguinal hernia	R	7	M	100	14	1	6	T7	12	9	40	130	110	210	50	NO	NO	adq
22	sudhakar	14457	L inguinal hernia	R	9	M	110	18	1	7	T6	12	8	45	130	120	200	55	NO	NO	adq
23	vinothkumar	17558	L inguinal hernia	R	11	M	130	22	1	7	T7	13	9	35	130	110	210	60	NO	NO	adq
24	suresh	44782	R inguinal hernia	R	10	M	124	20	1	6	T8	12	9	40	110	90	200	60	NO	NO	adq
25	durairaj	4738	R inguinal hernia	R	7	M	96	14	1	6	T7	12	10	40	110	100	210	50	NO	NO	adq
26	veeralagu	57576	R inguinal hernia	R	7	M	98	14	1	7	T8	13	9	45	110	90	200	50	NO	NO	adq
27	ramesh	508111	orchidopexy	R	8	M	102	15	1	7	T7	12	9	40	120	100	210	40	NO	NO	adq
28	pandeeswarar	1880	R inguinal hernia	R	8	M	100	14	1	7	T8	13	8	40	110	100	200	45	NO	NO	adq
29	janani	41006	appendicectomy	R	10	F	114	18	1	7	T7	13	9	35	130	100	210	60	NO	NO	adq
30	ammer	75421	R inguinal hernia	R	7	M	95	13	1	6	T7	12	8	35	120	100	200	50	NO	NO	adq

Sl.No.	Name	IP No.	Surgery	Group	Age	Sex	Height	Weight	ASA	Onset of Sensory block	Max. Height of sensory block	Time to achieve max. ht.	Onset of Motor block	2 segment regression	Duration of senory block	Duration of motor block	Time of moicturition	Duration of surgery	Vasopressor	Atropine	adequacy of block
31	arun	50498	L inguinal hernia	B	9	M	110	17	1	4	T6	10	4	70	150	140	350	40	NO	NO	adq
32	Veeramani	73453	L inguinal hernia	B	9	M	108	16	1	5	T5	9	5	70	160	130	340	50	NO	NO	adq
33	surendar	75690	R inguinal hernia	B	7	M	95	13	1	4	T5	8	4	60	150	120	300	55	NO	NO	adq
34	ajaynarayanan	75692	appendicectomy	B	10	M	118	19	1	4	T4	8	5	65	160	120	320	60	NO	NO	adq
35	ajithkumar	82913	R inguinal hernia	B	10	M	116	18	1	5	T4	9	5	60	160	130	320	55	YES	NO	adq
36	arunkumar	75692	L inguinal hernia	B	9	M	112	17	1	5	T5	9	4	60	150	130	340	60	NO	NO	adq
37	santhosh	16375	L inguinal hernia	B	8	M	108	15	1	4	T5	9	5	70	150	120	310	55	NO	NO	adq
38	baskar	16932	appendicectomy	B	9	M	114	16	1	5	T5	8	4	65	140	110	300	50	NO	NO	adq
39	Alaguraja	23739	appendicectomy	B	12	F	122	22	1	5	T4	8	4	70	160	110	310	60	NO	NO	adq
40	Suryaprakash	43515	R inguinal hernia	B	7	M	94	12	1	4	T4	9	4	60	130	110	300	50	NO	NO	adq
41	vigneshkumar	44860	R inguinal hernia	B	8	M	106	14	1	4	T5	8	5	60	140	110	310	60	NO	NO	adq
42	sameen	44876	R inguinal hernia	B	8	M	108	14	1	4	T4	8	4	60	150	100	300	50	NO	NO	adq
43	arjun	60905	L inguinal hernia	B	9	M	116	18	1	5	T4	9	4	60	140	110	320	50	NO	NO	adq
44	Alagu	80080	R inguinal hernia	B	9	M	114	18	1	5	T5	8	5	65	140	120	310	45	NO	NO	adq
45	vigneshwarn	61977	appendicectomy	B	11	M	122	21	1	5	T5	8	4	65	160	120	320	45	YES	NO	adq
46	santhosh	14572	R inguinal hernia	B	8	M	104	13	1	4	T5	9	4	60	140	110	320	40	NO	NO	adq
47	sirajudheen	47080	meatal stenosis	B	10	M	116	17	1	4	T4	8	5	65	150	120	330	55	NO	NO	adq
48	selvakumar	48165	R inguinal hernia	B	10	M	118	18	1	4	T5	8	4	65	160	120	310	50	NO	NO	adq
49	sikkandahar b	47703	urethroplasty	B	8	M	102	13	1	5	T4	8	5	55	140	110	300	50	NO	NO	adq
50	ilavarasan	49295	L inguinal hernia	B	9	M	114	17	1	5	T5	9	5	60	140	120	300	50	NO	NO	adq
51	karthick	49286	orchidopexy	B	7	M	95	12	1	5	T4	8	5	60	140	110	310	50	NO	NO	adq
52	alakar	49700	orchidopexy	B	9	M	115	17	1	5	T5	8	4	65	150	130	310	50	NO	NO	adq
53	selvam	4757	R inguinal hernia	B	11	M	120	20	1	4	T4	9	4	70	160	120	330	60	NO	NO	adq
54	raghunathan	45028	stricture urethera	B	10	M	116	16	1	5	T6	9	4	65	150	110	320	50	YES	NO	adq
55	Balamurugan	50328	R inguinal hernia	B	8	M	104	13	1	5	T5	8	5	65	140	120	320	55	NO	NO	adq
56	Balaguru	50818	R inguinal hernia	B	8	M	106	14	1	5	T5	9	4	60	140	110	310	50	NO	NO	adq
57	Manikandan	51283	R inguinal hernia	B	7	M	96	12	1	5	T4	8	4	60	140	120	320	55	NO	NO	adq
58	Priyadarshini	42135	cystoscopy	B	10	F	118	17	1	4	T4	8	5	65	150	130	330	50	NO	NO	adq
59	ramya	52073	hematoma vulva	B	11	F	116	15	1	5	T5	8	4	70	150	120	340	60	NO	NO	adq
60	akash	52812	urethroplasty	B	8	M	102	12	1	5	T5	9	5	60	140	120	310	50	NO	NO	adq

	PULSE RATE																		SPO2															
Sl.No.	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90MIN	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90MIN
1	110	120	124	130	122	126	128	130	128	124	120	116	118	126	118	112	110	112	99	100	100	100	100	100	100	100	99	99	100	100	100	99	100	100	99	100
2	96	110	118	120	114	98	96	114	112	114	108	102	100	96	98	98	97	95	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3	124	130	126	108	104	102	130	132	135	136	127	117	116	118	124	115	122	126	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4	94	98	94	88	86	102	111	105	103	99	95	96	96	98	99	94	92	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100
5	92	94	94	86	88	101	98	94	96	95	92	90	90	88	91	89	93	90	100	100	100	100	100	100	100	99	100	100	100	100	100	99	100	100	100	100
6	88	95	90	86	85	92	96	99	95	93	91	90	91	86	88	88	88	92	99	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100
7	116	124	129	115	118	123	128	124	126	127	119	125	121	123	127	119	123	120	99	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	99	100
8	118	125	130	120	124	125	130	130	121	122	119	118	120	121	117	119	123	120	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
9	125	130	131	122	129	125	121	126	130	124	122	120	123	127	123	119	121	125	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100
10	102	108	114	102	102	112	107	104	105	103	108	103	101	100	101	104	102	104	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
11	92	96	98	89	88	92	91	94	93	99	101	95	96	97	91	94	90	90	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
12	108	110	106	100	107	111	109	112	114	117	112	109	106	105	104	110	113	108	99	100	100	100	100	100	100	100	100	100	100	99	99	99	100	100	100	100
13	121	126	115	117	121	122	127	128	123	127	121	122	124	126	120	120	117	116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
14	116	119	108	109	116	115	119	121	125	119	118	116	114	112	110	111	117	115	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	99	100	100
15	123	124	125	119	116	120	124	126	121	126	124	122	125	127	129	121	122	124	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	89	88	94	87	92	91	95	94	99	101	95	93	95	97	99	93	92	90	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
17	92	96	99	98	95	99	98	93	100	96	99	95	97	99	94	92	90	91	99	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	99	
18	99	101	95	94	95	96	97	99	111	113	99	96	94	95	93	90	93	95	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
19	112	118	120	110	116	119	115	119	121	117	113	118	119	120	115	112	114	114	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	
20	118	122	116	112	120	122	118	116	115	113	108	112	118	117	119	111	107	108	98	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	99
21	120	127	124	120	126	128	129	126	128	130	131	127	125	123	125	121	122	126	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
22	105	103	110	104	103	109	111	114	107	106	103	105	107	108	107	103	101	102	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
23	85	88	89	81	80	88	92	91	85	83	88	85	88	89	90	91	93	88	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
24	90	94	100	92	96	97	99	101	96	95	97	93	90	96	90	88	89	86	99	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	99
25	115	119	121	114	119	124	122	120	121	117	120	118	114	116	113	112	112	115	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	
26	117	124	118	122	126	129	130	131	123	128	122	126	125	127	124	120	120	124	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
27	105	109	100	106	104	108	109	110	113	109	107	104	106	110	109	111	106	107	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
28	104	110	102	102	106	110	117	105	104	105	109	111	109	107	105	102	104	108	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	
29	86	89	88	84	80	88	85	87	89	93	95	99	98	92	88	84	85	89	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
30	125	130	133	126	122	130	131	134	133	129	126	125	122	122	127	125	122	127	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

	PULSE RATE																			SPO2																			
Sl.No.	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90MIN	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90MIN
31	106	104	100	108	103	101	98	105	105	109	104	105	104	103	104	105	103	108	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
32	102	105	101	98	105	103	106	110	111	106	104	104	106	108	103	105	105	106	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
33	126	130	121	120	131	132	129	122	128	130	132	136	134	130	127	125	128	124	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
34	84	88	87	82	81	88	92	94	93	97	99	100	97	93	89	85	86	88	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	92	96	94	88	94	95	93	96	99	101	102	96	94	95	97	95	99	94	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	108	112	114	105	102	109	112	116	109	105	106	104	102	103	107	105	106	104	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
37	115	117	110	110	119	121	118	112	116	113	117	119	120	121	119	115	112	117	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
38	107	106	110	104	105	103	109	112	115	117	110	114	116	117	111	107	109	105	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
39	86	88	85	81	88	89	93	96	95	90	88	87	88	85	89	91	93	89	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	99	100
40	125	127	130	123	128	129	132	127	125	126	122	126	126	128	124	122	120	122	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
41	115	118	120	114	113	120	122	125	121	118	123	122	122	121	120	122	125	119	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	111	118	112	110	117	118	121	119	116	115	120	121	120	117	118	116	112	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
43	104	108	100	103	109	112	106	109	110	113	115	119	117	113	116	118	111	107	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
44	108	107	101	100	109	111	107	109	115	117	111	107	106	105	107	109	106	104	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
45	90	93	88	89	94	96	99	97	94	99	101	97	96	99	95	94	98	94	99	100	100	100	100	100	100	100	100	100	100	100	99	100	100	99	100	99
46	118	119	120	117	119	115	114	118	120	122	125	120	120	121	117	116	118	114	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
47	96	99	101	95	97	95	98	99	101	96	95	97	96	94	93	95	91	94	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	99
48	92	96	100	94	99	94	94	97	95	98	100	97	98	96	92	95	94	96	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
49	117	110	115	117	114	113	118	120	121	119	116	118	117	115	117	119	116	112	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
50	106	108	100	107	110	113	109	108	105	108	106	107	108	108	105	104	107	105	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
51	124	122	128	120	122	126	128	130	127	126	125	129	125	121	117	118	120	122	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
52	102	104	98	104	109	110	103	104	107	106	108	107	106	110	105	104	106	103	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
53	93	92	88	85	90	94	96	97	94	96	98	99	100	100	101	96	95	97	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
54	100	102	97	99	101	94	95	93	94	99	100	97	98	99	96	95	98	94	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
55	117	119	110	112	116	120	121	122	117	116	119	114	112	113	111	116	118	110	99	100	100	100	100	100	100	100	100	100	100	100	99	100	99	100	100	100
56	112	114	107	102	110	115	116	120	122	116	118	119	118	121	117	115	112	119	98	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
57	122	127	128	120	122	127	130	133	128	129	127	124	122	128	122	120	125	125	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99
58	92	99	100	93	91	90	99	101	95	96	93	98	96	99	94	97	95	94	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
59	89	93	92	86	85	90	91	93	96	92	91	88	86	84	87	88	90	85	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
60	122	127	128	120	122	127	130	133	128	129	127	124	120	128	122	120	125	125	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99

	SYSTOLIC BP																		DIASTOLIC BP																	
Sl.No.	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90 MIN	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90 MIN
1	90	88	88	90	94	90	92	90	90	90	94	92	94	94	90	90	90	90	60	56	54	56	58	60	60	62	58	62	64	60	62	60	62	60	62	64
2	110	112	104	108	110	114	110	114	112	112	110	110	112	116	114	112	110	110	70	74	76	74	74	76	70	70	72	72	76	70	70	70	70	70	70	72
3	90	90	88	86	90	84	88	90	90	88	86	88	88	90	90	90	90	90	60	60	54	58	56	58	60	62	60	60	60	62	62	60	62	60	60	60
4	116	118	114	110	112	116	112	112	114	110	114	114	110	112	114	114	112	112	74	76	76	74	72	74	74	72	74	72	76	76	74	74	74	74	74	74
5	114	118	114	116	112	112	114	116	110	112	116	114	114	114	114	112	114	114	70	74	72	72	70	72	70	70	70	74	74	72	72	72	70	74	74	72
6	120	114	120	110	116	122	124	120	124	120	120	120	122	124	126	122	120	120	84	80	82	80	80	84	84	84	82	82	84	84	84	84	84	82	84	84
7	90	88	84	80	86	88	92	90	90	88	90	90	90	92	88	86	88	90	60	60	56	56	60	60	60	62	60	58	60	58	58	58	60	60	60	60
8	92	94	90	88	92	94	96	92	92	90	92	90	90	90	90	92	94	92	64	64	60	60	58	60	60	62	62	60	60	64	64	64	62	62	64	62
9	88	90	84	88	90	92	88	88	88	86	88	90	90	90	92	92	90	88	60	58	56	58	60	60	60	58	58	58	58	58	60	60	62	60	60	60
10	92	94	92	90	94	94	94	92	96	92	92	92	94	94	94	92	92	94	64	66	64	64	62	60	60	62	62	62	64	64	62	62	64	62	60	62
11	122	124	120	116	118	120	124	122	124	122	120	120	120	120	124	126	122	122	84	80	84	76	80	80	80	82	82	84	85	88	88	88	88	90	88	86
12	94	96	92	90	88	92	94	94	92	92	94	92	92	90	90	94	92	94	62	64	60	60	62	62	60	62	60	64	62	64	62	62	60	60	60	64
13	96	96	90	92	94	94	96	96	92	92	90	92	92	92	90	94	96	96	62	60	60	58	64	64	64	62	64	64	62	62	62	62	64	64	64	66
14	92	92	90	88	94	94	96	94	94	94	94	96	96	90	94	94	94	94	64	60	58	58	60	62	62	64	64	64	64	62	64	64	64	62	62	62
15	90	92	88	85	90	92	92	90	94	92	92	94	94	94	92	92	90	90	60	58	58	60	62	62	62	64	64	62	60	60	60	62	60	60	60	60
16	114	118	120	112	114	114	112	110	114	114	114	112	116	118	120	118	116	116	78	80	74	74	76	78	78	76	18	80	80	74	76	78	76	78	76	78
17	108	108	110	102	100	104	104	104	108	110	108	106	104	104	108	108	110	106	74	78	70	76	78	80	82	78	78	76	76	74	76	76	76	76	74	76
18	110	110	104	100	102	106	106	106	102	104	104	106	106	104	106	106	104	102	74	76	70	70	76	76	76	76	78	74	74	74	74	74	76	76	76	78
19	92	94	88	90	88	92	94	92	94	94	96	90	90	92	94	92	94	90	64	66	60	60	62	64	60	60	60	62	62	64	64	64	64	62	64	64
20	94	98	90	88	90	94	96	96	96	94	92	94	94	94	94	94	97	96	62	66	60	58	64	64	64	62	62	62	64	64	64	64	62	62	62	64
21	90	88	86	92	94	94	94	92	90	90	90	90	92	92	92	94	96	94	58	56	56	58	54	60	60	62	60	60	60	62	62	62	60	62	60	60
22	108	110	106	100	106	106	104	104	102	102	104	104	104	106	106	108	106	104	76	78	78	70	70	76	78	78	78	80	74	74	74	74	74	76	74	76
23	114	110	116	108	114	114	112	112	115	116	116	120	120	118	118	116	118	116	76	80	76	74	76	70	76	78	76	76	76	74	74	76	76	74	76	74
24	106	106	108	100	106	108	108	106	110	106	110	112	112	110	108	108	106	106	72	74	68	72	74	74	72	74	72	72	72	74	74	74	74	76	76	78
25	88	90	88	86	90	90	90	90	88	90	92	90	90	90	90	90	92	90	60	58	58	60	62	60	60	62	62	62	60	60	60	60	60	60	62	64
26	90	92	88	86	84	88	88	90	90	92	92	94	94	96	94	92	92	92	58	60	60	58	54	58	58	58	58	60	60	60	60	60	60	62	62	62
27	92	92	94	90	88	90	92	92	92	94	94	94	94	94	94	94	92	92	60	60	60	62	58	62	64	62	62	62	64	64	62	62	62	62	64	64
28	90	90	94	88	92	94	92	92	92	92	94	94	96	96	94	94	94	92	60	60	60	60	62	60	62	60	60	62	64	62	62	64	64	62	62	62
29	114	116	110	110	116	118	116	120	118	118	116	114	112	116	118	116	116	118	74	78	80	70	76	74	76	74	76	76	72	76	74	74	74	72	72	72
30	88	90	92	90	88	90	90	92	90	90	92	94	92	92	92	92	90	92	58	60	60	62	58	60	60	62	64	60	60	62	60	60	60	60	62	60

	SYSTOLIC BP																		DIASTOLIC BP																	
Sl.No.	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90 MIN	preop	2min	4min	6min	8min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	75min	90 MIN
31	94	94	92	90	92	94	94	92	96	92	92	92	94	94	94	92	92	94	64	66	64	64	62	62	60	62	62	62	64	62	62	62	64	62	60	64
32	92	94	88	90	88	92	94	92	94	92	96	90	92	92	94	92	94	92	64	66	60	62	62	64	60	60	62	62	62	66	64	64	64	62	64	62
33	90	92	88	85	90	92	92	90	96	92	92	94	92	92	92	92	90	90	60	60	58	60	62	62	60	64	64	62	60	58	60	62	60	60	60	62
34	106	106	108	100	106	106	108	106	108	106	110	112	112	110	106	108	106	106	72	72	68	72	74	74	72	74	72	72	72	74	74	74	74	76	76	78
35	108	106	110	100	106	108	108	104	110	106	110	108	110	110	108	108	108	108	76	74	66	72	70	74	76	76	74	78	76	76	74	74	72	72	74	78
36	92	94	90	90	94	94	94	94	96	92	94	96	94	94	94	96	92	94	66	64	64	62	62	60	60	64	62	62	62	64	62	62	64	62	60	62
37	90	90	92	88	94	94	96	92	92	94	96	94	92	92	94	96	94	92	60	60	62	64	62	60	62	62	60	62	66	62	62	62	64	62	62	64
38	100	96	90	92	92	96	96	94	92	90	92	92	94	96	96	100	94	96	68	64	62	60	58	60	64	62	62	66	60	64	64	66	62	62	66	64
39	120	114	120	110	116	122	124	120	124	120	120	120	122	124	126	122	120	120	84	80	82	80	80	84	84	84	82	82	84	84	84	84	84	82	84	84
40	88	90	84	88	90	92	88	88	88	86	88	90	90	90	92	92	90	88	60	58	56	58	60	60	60	58	58	58	58	58	60	60	62	60	60	60
41	92	92	94	90	88	90	92	92	92	94	94	94	94	94	94	94	92	92	60	60	60	62	58	62	64	62	62	62	64	64	62	62	62	62	64	64
42	90	90	94	88	92	94	92	92	92	92	94	94	94	96	94	94	94	92	60	60	60	60	62	60	62	60	60	62	64	62	62	64	64	62	62	62
43	94	94	92	90	92	94	94	92	96	92	92	92	92	94	94	92	92	94	64	66	64	64	62	62	60	62	62	62	64	62	62	62	64	62	60	64
44	92	94	88	90	88	92	94	92	94	92	96	90	92	92	94	92	94	92	64	66	60	62	62	64	60	60	62	62	62	66	64	64	64	62	64	62
45	114	110	116	108	114	114	112	112	115	116	116	120	118	118	118	116	118	116	76	80	76	74	76	70	76	78	76	76	76	74	74	76	76	74	76	74
46	92	92	94	90	88	90	92	92	92	94	94	94	94	94	94	94	92	92	60	60	60	62	58	62	64	62	62	62	64	64	62	62	62	62	64	64
47	106	106	108	100	106	106	108	106	108	106	110	112	112	110	106	108	106	106	72	72	68	72	74	74	72	74	72	72	72	74	74	74	74	76	76	78
48	108	106	110	100	106	108	108	104	110	106	110	108	110	110	108	108	108	108	76	74	66	72	70	74	76	76	74	78	76	76	76	74	72	72	74	78
49	90	90	88	86	90	84	88	90	90	88	86	88	88	90	90	90	90	90	60	60	54	58	56	58	60	62	60	60	60	62	60	60	62	60	60	60
50	92	94	90	88	92	94	96	92	92	90	92	90	90	90	90	92	94	92	64	64	60	60	58	60	60	62	62	60	60	64	64	64	62	62	64	62
51	90	88	88	90	94	90	92	90	90	90	94	92	92	94	90	90	90	90	60	56	54	56	58	60	60	62	58	62	64	60	60	60	62	60	62	64
52	92	94	90	88	92	94	96	92	92	90	92	90	90	90	90	92	94	92	64	64	60	60	58	60	60	62	62	60	60	64	64	64	62	62	64	62
53	120	124	120	116	118	120	126	122	124	122	122	120	120	120	124	126	124	122	84	80	84	76	80	84	80	82	82	84	86	88	88	88	84	90	88	86
54	114	118	120	112	114	114	112	110	114	114	114	112	116	118	120	118	116	116	78	80	74	74	76	78	78	76	18	80	80	74	76	78	76	78	76	78
55	90	90	88	86	90	84	88	90	90	88	86	88	88	90	90	90	90	90	60	60	54	58	56	58	60	62	60	60	60	62	62	60	62	60	60	60
56	90	88	84	80	86	88	92	90	90	88	90	90	92	92	88	86	88	90	60	60	56	56	60	60	60	62	60	58	60	58	58	58	60	60	60	60
57	88	90	84	88	90	92	88	88	88	86	88	90	90	90	92	92	90	88	60	58	56	58	60	60	60	58	58	58	58	58	58	60	62	60	60	60
58	110	112	104	108	110	114	110	114	112	112	110	110	114	116	114	112	110	110	70	74	76	74	74	76	70	70	72	72	76	70	70	70	70	70	70	72
59	114	118	120	112	114	114	112	110	114	114	114	112	116	118	120	118	116	116	78	80	74	74	76	78	78	76	18	80	80	74	76	78	76	78	76	78
60	92	94	92	90	94	94	94	92	96	92	92	92	94	94	94	92	92	94	64	66	64	64	62	60	60	62	62	62	64	64	64	62	64	62	60	62

depart of Branch

Ref. No. 5336 /E4/3/2012

Govt. Rajaji Hospital,
Madurai.20. Dated: .08.2012

Institutional Review Board / Independent Ethics Committee.
Dr. N. Mohan, M.S., F.I.C.S., F.A.I.S.,
Dean, Madurai Medical College & 2521021 (Secy)
Govt Rajaji Hospital, Madurai 625020.
Convenor
grhethicssecy @gmail.com.

Sub: Establishment-Govt. Rajaji Hospital, aMadurai-20-
Ethics committee-Meeting Agenda-communicated-regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held at 11.00 Am to 1.00Pm on 28.06.2012 at the Dean Chamber, Govt. Rajaji Hospital, Madurai. The following members of the committee have been attended the meeting.

---

1. Dr.N.Vijayasankaran,M.ch(Uro.) 094-430-58793 0452-2584397	Sr.Consultant Urologist Madurai Kidney Centre, Sivagangai Road,Madurai	Chairman
2. Dr.P.K. Muthu Kumarasamy, M.D., 9843050911	Professor & H.O.D of Medical, Oncology(Retired)	Member Secretary
3. Dr.T.Meena,MD 094-437-74875	Professor of Physiology, Madurai Medical College	Member
4. Dr. S. Thamilarasi, M.D (Pharmacol)	Professor of pharmacology	
5.Dr.Moses K.Daniel MD(Gen.Medicine) 098-421-56066	Professor of Medicine Madurai Medical College	Member
6.Dr.M.Gobinath,MS(Gen.Surgery)	Professor of Surgery Madurai Medical College	Member
7.Dr.S. Dilshadh, MD(O&G) 9894053516	Professor of OP&Gyn Madurai Medical College	Member
8.Dr.S.Vadivel Murugan., M.D, 097-871-50040	Professor of Medicine Madurai Medical College	Member
9.Shri.M.Sridher,B.sc.B.L. 099-949-07400	Advocate, 2, Deputy collectors colony 4th street KK Nagar, Madurai-20.	Member
10.Shri.O.B.D.Bharat,B.sc., 094-437-14162	Businessman Plot No.588, K.K.Nagar,Madurai.20.	Member
11.Shri. S.sivakumar,M.A(Social) Mphil 093-444-84990	Sociologist, Plot No.51 F.F, K.K Nagar, Madurai.	Member

Following Projects were approved by the committee

Dr. Bharat 21/8/12

Sl. No	Name of P.G.	Course	Name of the Project	Remarks
1.	Dr. Premkumar. K.G	M.D Anaesth	Ropivacaine vs. bupivacaine for spinal anesthesia in children.	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. She/He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
3. She/He should not deviate for the area of the work for which applied for Ethical clearance.

She/He should inform the IEC immediately, in case of any adverse events pr Serious adverse reactions.

4. She/he should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and apply for if any Extension of time is required She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the word or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

DEAN 13.8.12
I/c

To
All the above members and Head of the Departments concerned.
All the Applicants.

DIRECTOR
INSTITUTE OF ANAESTHESIOLOGY
Madurai Medical College &
Govt. Rajaji Hospital
MADURAI-625020.

turnitin

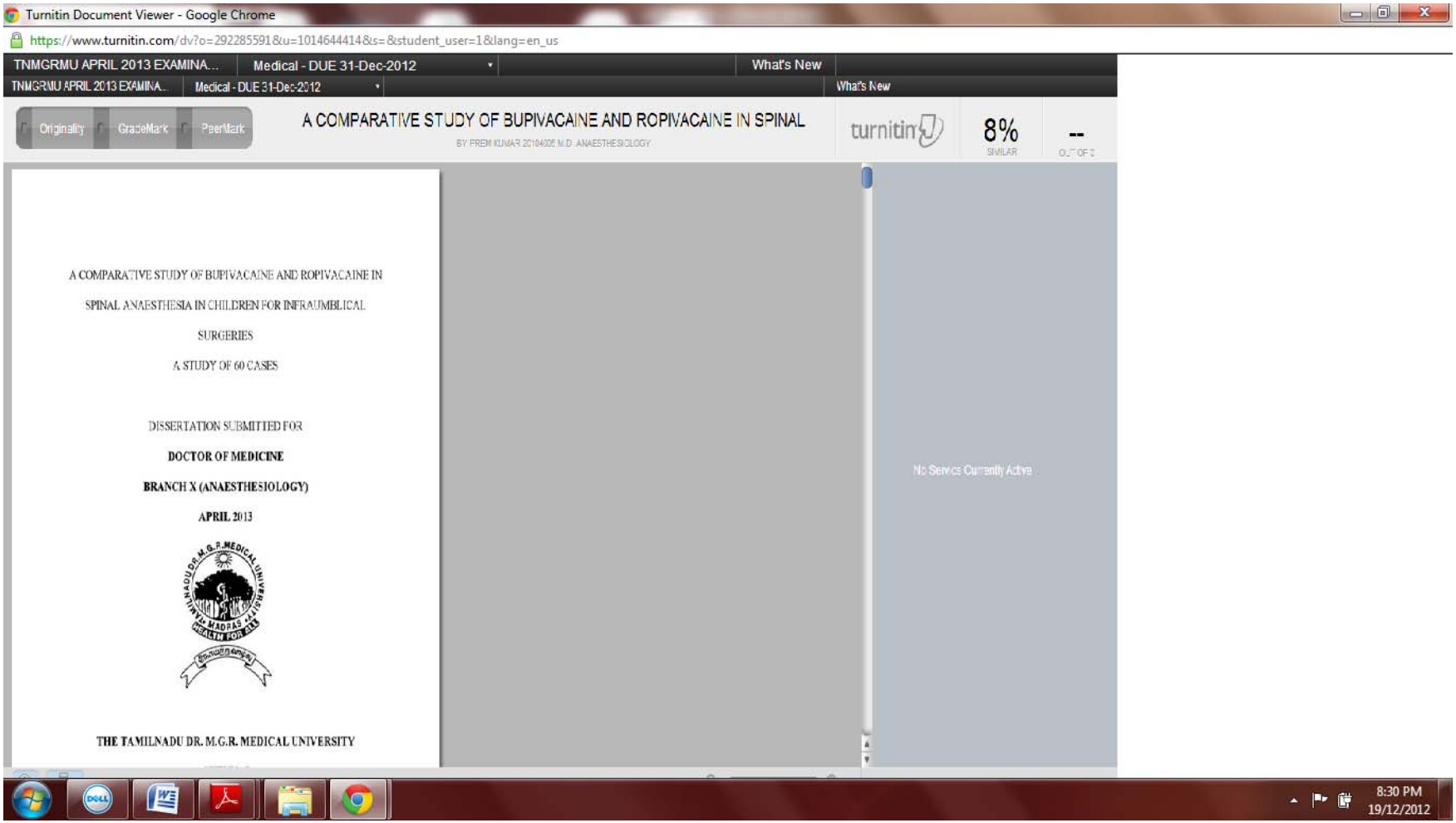
Your digital receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

Paper ID	292285591
Paper title	A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES
Assignment title	Medical
Author	Prem Kumar 20104005 M.D. Anaesthesiology
E-mail	drkgpremkumar@gmail.com
Submission time	18-Dec-2012 08:11PM
Total words	11279

First 100 words of your submission

A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES A STUDY OF 60 CASES DISSERTATION SUBMITTED FOR DOCTOR OF MEDICINE BRANCH X (ANAESTHESIOLOGY) APRIL 2013 THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY CHENNAI TAMILNADU BONAFIDE CERTIFICATE This is to certify that this dissertation entitled “A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL SURGERIES” submitted by Dr.K.G.PREM KUMAR to the FACULTY OF ANAESTHESIOLOGY, The Tamilnadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement in the award of degree of M.D., Degree Branch –X (ANAESTHESIOLOGY), for...


Turnitin Document Viewer - Google Chrome
https://www.turnitin.com/dv?o=292285591&u=1014644414&s=&student_user=1&lang=en_us
TNMGRMU APRIL 2013 EXAMINA...
Medical - DUE 31-Dec-2012
What's New
Originality
GradeMark
PeerMark
A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN SPINAL
BY PREM KUMAR 20104006 M.D. ANAESTHESIOLOGY
turnitin
8%
SIMILAR
A COMPARATIVE STUDY OF BUPIVACAINE AND ROPIVACAINE IN
SPINAL ANAESTHESIA IN CHILDREN FOR INFRAUMBLICAL
SURGERIES
A STUDY OF 60 CASES
DISSERTATION SUBMITTED FOR
DOCTOR OF MEDICINE
BRANCH X (ANAESTHESIOLOGY)
APRIL 2013
THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
No Service Currently Active
8:30 PM
19/12/2012