A Comparative Study Of 0.5% Levobupivacaine And 0.5% Bupivacaine In Spinal Anaesthesia In Geriatric Patients Undergoing Lower Limb Surgeries

by

DR.NAMRATA NAIR

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DR. VIJAYAKUMAR TK M.D

PROFESSOR

DEPARTMENT OF ANAESTHESIA

BLDE (DEEMED TO BE UNIVERSITY)

SHRI B. M. PATILMEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE

VIJAYAPUR – 586103

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LIST OF ABBREVIATIONS USED

%	Percentage of oxygen saturation
SPO2	Percentage of oxygen saturation
HR	Heart rate
MAP	Mean arterial pressure
RR	Respiratory rate
Mg	Milligrams
mL	Milliliters
CSF	Cerebrospinal fluid
C	Cervical
T	Thoracic
L	Lumbar
Hr	Hours
Mm	Millimeters
Cm	Centimeters
G	Gauge
Sec	Seconds
mV	Millivolts

Na^+	Sodium
t1/2	Half-life
CYP	Cytochrome P
Kg	Kilogram
Bw	Body weight
LAST	Local anaestheticsystemiun toxicity
µg	Micrograms
VAS	Visual Analog Scale
K^+	Potassium
A	Alpha
B	Beta
SD	Standard deviation
PDPH	Post dural puncture headache
i.v	Intravenous
Vdss	Volume of distribution at steady state
Mol	Mole

ABSTRACT

Introduction:

The geriatric population faces serious problems. When combined with the tendency for older population to have more unsteady balance and vision problems, it becomes a recipe for increased risk of fracture. Hemodynamic stability during peri-operative period is of paramount importance in such scenario and hence the technique of choice becomes neuraxial block to maintain hemodynamic stability namely heart rate, saturation, blood pressure and by avoiding hypotension, bradycardia etc.

Key Words:

Geriatric, Lower limb surgeries, Spinal anesthesia

Aim:

To compare the efficacy of 0.5% Bupivacaine and 0.5% Levobupivacaine in geriatric patients with regard to-

1. Time of onset of sensory blockade and maximum level of sensory blockade
2. Time to grade 4 motor blockade and time to 2 segment regression
3. Time to rescue analgesia, hemodynamic changes (RR,SPO_2,MAP,HR) and side effects if any

Methods:

A comparative study was conducted in the department of Anesthesia at _____ _____ Medical College Hospital and Research Centre, _____.

Ethical Committee permission- Taken

Informed written consent- Taken

Total of 120 geratric patients (above 60 years) scheduled for lower limb surgeries under spinal anesthesia divided into two groups.

Group B (BUPIVACAINE)

0.5 % hyperbaric Inj. Bupivacaine 3ml to 60 patients

Group L (LEVOBUPIVACAINE)

0.5 % hyperbaric Inj. Levobupivacaine 3ml to 60 patients

Test used were chi square test and unpaired t test.

Inclusion criteria :

1. Patients age group above 60 years.
2. Patients with ASA grade II and III.
3. Patients undergoing elective lower limb surgeries.

Exclusion criteria :

1. Patients having deformities of spine.
2. Patients having infection at the site of insertion of spinal needle.
3. Patients having bleeding disorders, coagulation abnormalities, raised Intra cranial pressure (ICP) and neurological deficits.

Results:

Time interval	Group B	Group L	P value
Heart rate	71.9 ± 6.4	75.7 ± 3.8	<0.001*
Mean Arterial Pressure	75.5 ± 6.0	73.0 ± 5.8	<0.02*
Respiratory rate	18.1 ± 1.6	19.7 ± 1.3	<0.001*
Time of onset of sensory block	2.4 ± 0.8	3.0 ± 0.8	<0.001*
Time to grade 4 motor blockade	10.7 ± 1.8	10.8 ± 1.5	0.872
Time to 2- segment regression	101.7 ± 7.2	104.3 ± 7.2	<0.046*
Time to rescue analgesia	147.0 ± 14.1	155.5 ± 15.0	<0.002*
Side effects like hypotension	35%- Yes 65%- No	8.3% - Yes 91.7%- No	<0.001*

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

Conclusion:

Increased incidence of intraoperative hypotension with bupivacaine suggests that levobupivacaine is a better drug in maintaining peri-operative hemodynamics in a geriatric patient undergoing lower limb orthopedic surgery.

TABLE OF CONTENTS

S. No.	Contents	Page No.
1	**Introduction**	1
2	**Aims and objectives**	2
3	**History**	3
4	**Anatomy of spinal cord**	5
5	**Physiology of neuraxial blockade**	23
6	**Pharmacology**	32
7	**Physiological changes in geriatric patients**	41
8	**Review of literature**	45
9	**Materials and methods**	52
10	**Results**	57
11	**Discussion**	80
12	**Summary**	87
13	**Conclusion**	88
14	**Bibliography**	89
15	**Annexure** Ethical clearance certificate Informed consent Case Proforma Key to Master chart Master chart	95-120

LIST OF FIGURES

Sl.No.	Figure	Page No.
1	Vertebral column	5
2	Lumbar vertebra	6
3	Lumbar vertebrae arrangement	7
4	Sagittal section of vertebra	9
5	Meninges of the spinal cord	9
6	Distribution of spinal nerves	12
7	Cross section of vertebra and spinal cord	13
8	Blood supply of spinal cord	15
9	Arterial supply of spinal cord	15
10	Nernst Equation	23
11	Chemical structure of bupivacaine	32
12	Chemical structure of levobupivacine	37
13	Distribution of age between study groups	59
14	Distribution of gender between study groups	60
15	Distribution of ASA Grade between study groups	61
16	Change in heart rate intraoperatively between study groups	62
17	Change in heart rate postoperatively between study groups	63
18	Change in mean arterial pressure intraoperatively between study groups	65

Sl.No.	Figure	Page No.
19	Change in mean arterial pressure postoperatively between study groups	66
20	Change in respiratory rate intraoperatively between study groups	68
21	Change in respiratory rate postoperatively between study groups	69
22	Change in SpO2 intraoperatively between study groups	71
23	Change in SpO2 postoperatively between study groups	72
24	Time of onset of sensory blockade between study groups	74
25	Time to reach highest level of sensory blockade between study groups	75
26	Time to obtain Grade 4 motor block between study groups	76
27	Time to reach 2 segment regression between study groups	77
28	Time to rescue analgesia between study groups	78
29	Hypotension between study groups	79

LIST OF TABLES

Sl. No.	Table	Page No.
1	Physiological changes due to ageing and their significance for Perioperative complications	41
2	Distribution of patients according to age group	59
3	Distribution of patients according to gender	60
4	Distribution of patients according to ASA Grade	61
5	Comparison of mean Heart Rate between Bupivacaine and Levobupivacaine Groups intraoperatively at different Time Intervals	62
6	Comparison of mean Heart Rate between Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals	63
7	Comparison of Mean Arterial Pressure between Bupivacaine and Levobupivacaine Groups intraoperatively at different Time Intervals	65
8	Comparison of Mean Arterial Pressure between Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals	66
9	Comparison of mean respiratory rate between Bupivacaine and Levobupivacaine Groups intraoperatively at different Time Intervals	68
10	Comparison of mean respiratory rate between Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals	69

11	Comparison of mean SpO2 between Bupivacaine and Levobupivacaine Groups intraoperatively at different time intervals	71
12	Comparison of mean SpO2 between Bupivacaine and Levobupivacaine Groups postoperatively at different time intervals	72
13	Comparison of mean time of onset of sensory blockade between Bupivacaine and Levobupivacaine Groups	74
14	Comparison of mean time to maximum level of sensory block between Bupivacaine and Levobupivacaine Groups	75
15	Comparison of mean time to grade 4 motor blockade between Bupivacaine and Levobupivacaine Groups	76
16	Comparison of mean time to 2 segment regression between Bupivacaine and Levobupivacaine Groups	77
17	Comparison of mean time to rescue analgesia between Bupivacaine and Levobupivacaine Groups	78
18	Distribution of patients according to complications(hypotension)	79

INTRODUCTION

The geriatric population faces serious problems as they age. Their bone mineral density decreases as they grow old. This is in particular a problem in post-menopausal women. Decreased mineral levels tend to translate into weaker and more brittle bones. When combined with the tendency for older adults to have more unsteady balance and vision problems, it becomes a recipe for increased risk of fractures. According to Population census 2011, there are nearly 104 million elderly persons (aged 60 years or above) in India; 51 million males and 53 million females.[1]

Anesthetic technique of choice for lower limb orthopedic surgeries is neuraxial blockade. A clinically precise and skillful anesthetic management of geriatric population requires in-depth knowledge of the numerous patho-physiological alterations and functional changes at this advanced age due to altered and more variable pharmacokinetics and pharmacodynamics and associated comorbidities.[2]

In elderly patients, neuraxial anesthetic blockade has a definite advantage over general anesthesia, as it reduces surgical stress by decreasing sympathetic efferent nerve activity and blocking nociceptive impulses from the operative site. Cardio-respiratory complications and overall morbidity and mortality are also minimised.[3] Evaluating the safety and efficiency of 0.5% levobupivacaine and 0.5% bupivacine (hyperbaric) in spinal anaesthesia for lower limb surgeries in geriatric patients, was the sole purpose of this study.

AIMS AND OBJECTIVES

To compare the efficacy of 0.5% Bupivacaine and 0.5% Levo Bupivacaine in geriatric patients with regard to

1. Time of onset of sensory blockade and maximum level of sensory blockade
2. Time to grade 4 motor blockade and time to 2 segment regression
3. Time to rescue analgesia, hemodynamic changes (RR,SPO_2,MAP,HR) and side effects if any

HISTORY

The first written account of the coca plant being used as a local anesthetic was by the Spanish Jesuit BernabeCobo (1582-1657), who, to relieve a toothache , chewed the plant and wrote about it in 1653.[4]

Albert Niemann (1834-1861) of Göttingen, Germany, who isolated the alkaloid from the dried leaves in 1856, gave the name cocaine to the active drug.[4,5,6,7]

A young house officer at the prestigious AllgemeinesKrankenhaus in Vienna, Sigmund Freud (1856-1939), had a unique interest in cocaine and tested the drug as a substitute for opioids.[4,7,8]

An intern, Carl Koller (1858-1944), was interested in producing local anesthesia for operations on the eye. Koller, with the help of Josef Brettauer (1835-1905), presented the three-page manuscript of topical cocaine analgesia, at the Ophthalmologic Congress in Heidelberg, Germany, on September 15, 1884.[4,7,8]

New applications for cocaine were quickly developed by American surgeons. Its efficacy in anesthetizing the trachea, rectum, nose, mouth, larynx and urethra was described in October 1884.[4,7]

NEURAXIAL BLOCK

The very first neuraxial block was performed 8 months after the demonstration of the local anesthetic properties of cocaine in Heidelberg. A neurologist, James Leonard Corning (1855-1923) learned the action of cocaine from observation of Halsted's work in the New York City.[4,5]

Corning, on October 12, 1885, injected a total of 120 mg of cocaine between the T_{11} and T_{12}spinous processes in a 45-year-old man and obtained loss of sensation of perineum andlegs [4,5]

This proved cocaine's action on the spinal cord and he suggested its use in certain cases of operations on the genitourinary system and spinal spasticity.[5]

SPINAL ANALGESIA

Leading internist in Kiel, Quincke HI (1842-1922), observed that the Dural sac, described by Cotugno D (1736-1822) in 1787, could be punctured, between the lumbar spinous processes, by inserting a needle.[1,2]

This was independently reported by Wynter W (1860-1945) of Leeds, England, in the same year.[4]

August Bier and his assistant Hildebrandt A (1868-1854), on August 15, 1898, used the Quincke method for entering the intrathecal space and injected between 5 and 15 mg of cocaine to produce spinal anesthesia in six cases for operations on the lower part of the body. They also reported the results of spinal anesthesia, in what has become one of the classic clinical papers.[4,7]

In 1899, Bier A published his celebrated paper on spinal anesthesia, under the title "Research on Cocainization of the Spinal Cord" ("VersucheuberCocainisirung des Ruckenmarkes").[7]

To enhance neuraxial analgesia, Matas appears to be among the first to attempts to use spinal opioids.[4,7]

The property of baricity was investigated by Arthur Barker, a London based surgeon, in 1907.[5,7]**.** Philadelphia surgeon, Lemmon WT, devised an apparatus for continuous spinal anesthesia in 1940.

ANATOMY OF SPINAL CORD

ANATOMY

A thorough understanding of the anatomy of the spine and the spinal cord is required for proficiency in epidural and spinal anesthesia. A mental image of the three-dimensional anatomy of deeper structures should be developed by the anesthesiologist. They must also be familiar with the surface anatomy of the spine and should also learn to appreciate the relationship between the vertebrae, the spinal nerves, cutaneous dermatomes and the spinal segment from which each spinal nerve arises.

VERTEBRAL COLUMN [9.10,11,12]

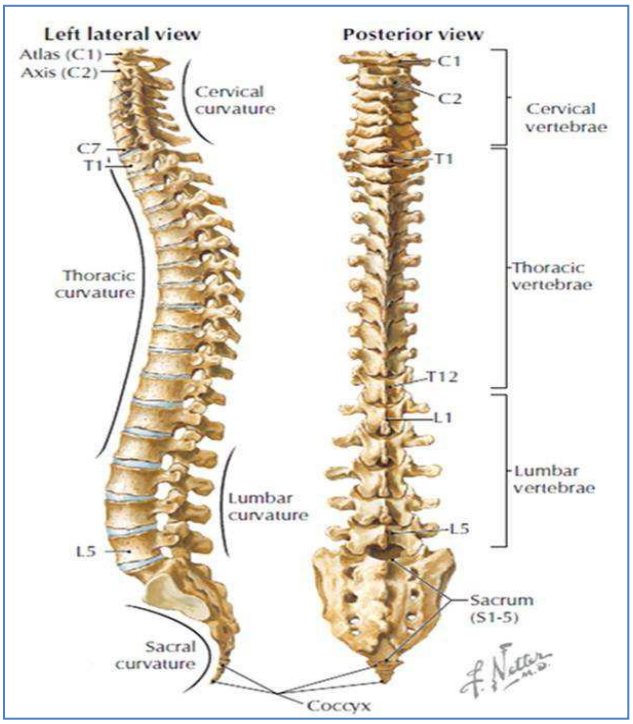


Fig.1 : Vertebral Column

The vertebral column consists of 33 vertebrae

- 7 cervical
- 12 thoracic
- 5 lumbar
- 5 fused sacral
- 4 fused coccygeal

In addition it consists of four curvatures

1. Cervical curve - convex anteriorly
2. Thoracic curves: convex posteriorly
3. Lumbar curve - convex anteriorly
4. Sacro-coccygeal - convex posteriorly

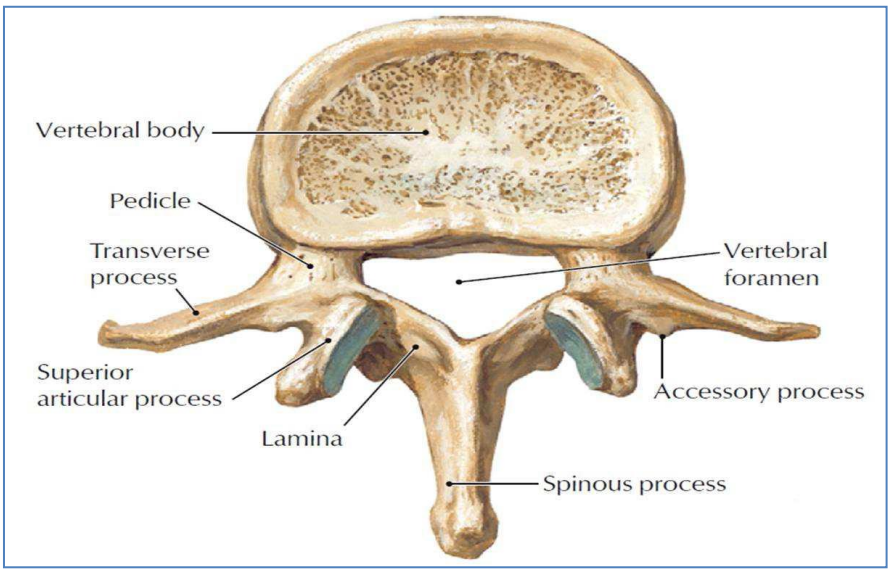


Fig.2 : Lumbar Vertebra

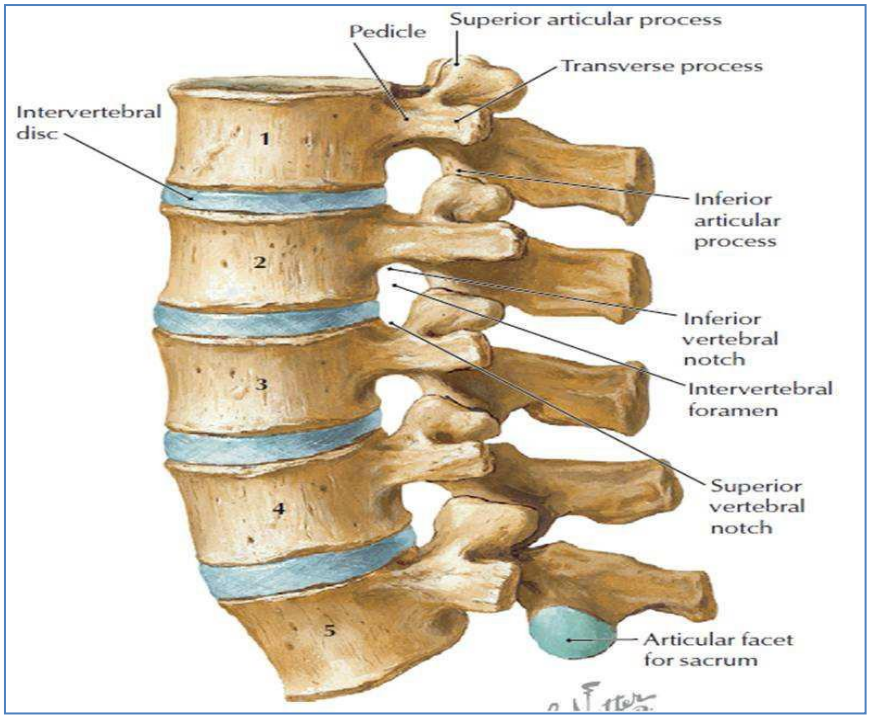


Fig.3 : Lumbar vertebrae arrangement[9,10,11,12]

The cervical, thoracic, and lumbar vertebrae (with the exception of C_1) consists of:

- A body which lies anteriorly.
- Two pedicles projecting posteriorly from the body
- Two laminae connecting the pedicles.

The above mentioned structures form the vertebral canal, which contains the spinal cord, spinal nerves and epidural space. The transverse processes project laterally and the spinous process that projects posteriorly, arise from the laminae which serve as sites for ligament and muscle attachments. The spinal nerves exit the vertebral canal through the superior and inferior vertebral notch present in the pedicle. The first cervical vertebra (“atlas”) differs from the rest in that it does not have a body or spinous process.

Ligaments [9,10,11,12]

The five ligaments stabilize the vertebral bodies and increase in size between the cervical and lumbar vertebrae. The supraspinous ligament runs between the tips of the spinous processes, from the sacrum to T_7. Ligamentumnuchae which attaches to the occipital protuberance at the base of the skull , is the continuation of this ligament above T_7. The interspinous ligament blends anteriorly with the ligamentumflavum and posteriorly with the supraspinous ligament and attaches between the spinous processes.

Epidural Space [9,10,11,12]

The epidural space lies between the spinal meninges and the sides of the vertebral canal, bounded cranially by the foramen magnum, caudally by the sacro-coccygeal ligament covering the sacral hiatus, posteriorly by both the ligamentumflavum and the vertebral lamina, anteriorly by the posterior longitudinal ligament and laterally by the vertebral pedicles. The epidural space communicates with the paravertebral space through intervertebral foramina and is not a closed space. Anteriorly the epidural space is shallowest, where the dura, may fuse with the posterior longitudinal ligament. Posteriorly the space is deepest. The space is intermittently obliterated by contact between the dura mater and the vertebral lamina or ligamentumflavum, hence its depth varies. Laterally, the epidural space is interrupted by the contact between the dura mater and the pedicles. Hence, discontinuous compartments are present in the epidural space which become continuous with an injection of liquid or air that opens up the space separating the compartments. Batson plexus is a rich network of valveless veins, seen rarely in the posterior epidural space but courses through the anterior and lateral portions of the epidural space. The extradural veins are anastomosed by epidural veins, the pelvic veins, intracranial veins and the azygous system.

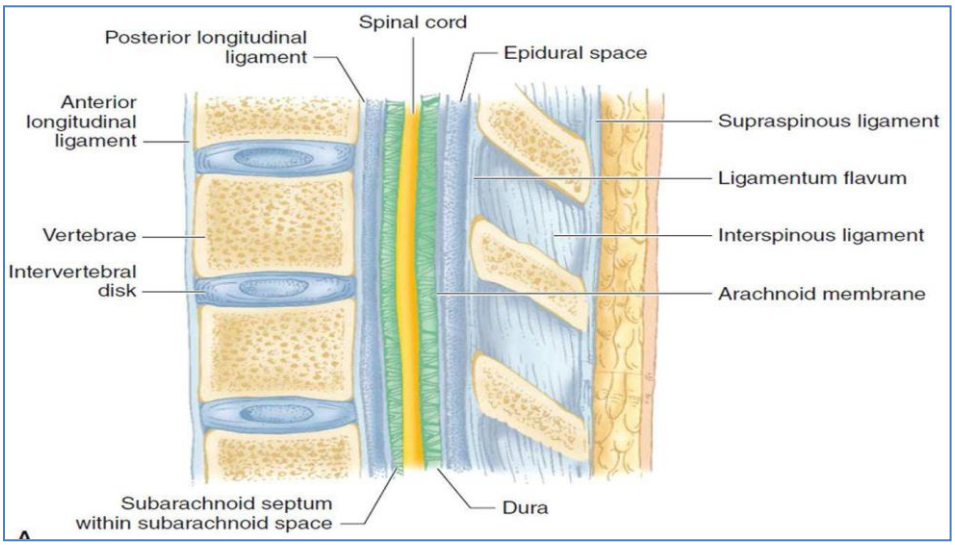


Fig.4 : Sagittal section of vertebrae showing structures to be pierced during neuraxial blockade

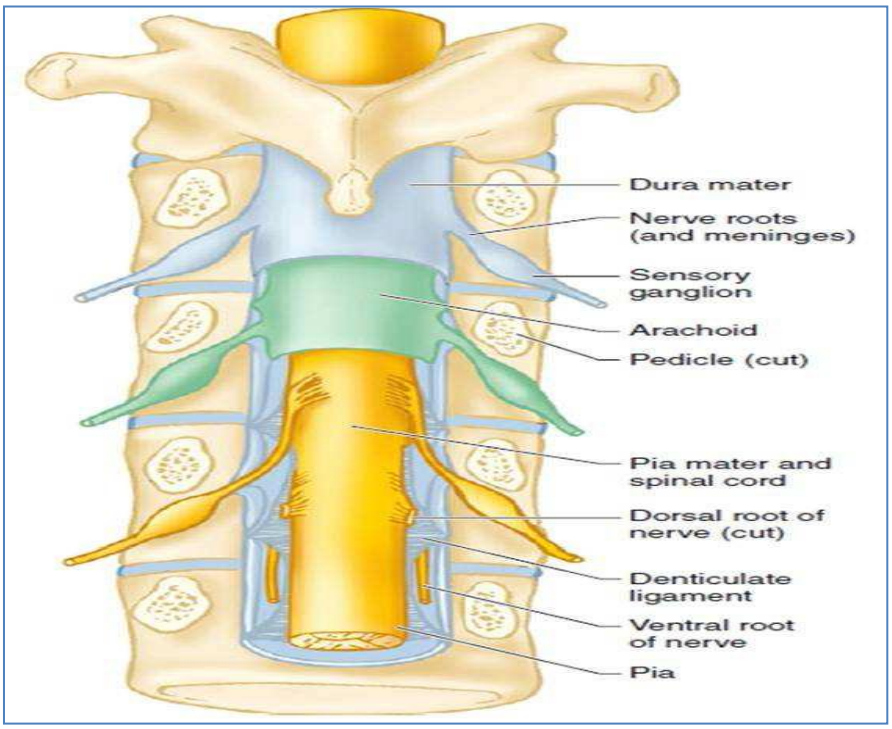


Fig.5 : Meninges of the spinal cord

Epidural Fat [9,10,11,12]

Fat is the most ubiquitous material in the epidural space, principally located in the lateral and posterior epidural space. The pharmacology and the pharmacokinetics of intrathecally and epidurally administered drugs are clinically influenced by the epidural fat. Despite the fact that a highly lipid-soluble local anesthetic like etidocaine is roughly seven times more potent than lidocaine in vitro, etidocaine is only approximately equipotent with lidocaine in the epidural space which is specifically explained by its sequestration in epidural fat.

Meninges [9,10,11,12]

There are three protective membranes in the spinal meninges which are continuous with the cranial meninges. These are the dura mater, arachnoid mater, and pia mater.

Dura Mater [9,10,11,12]

The dura mater is the thickest and outermost meningeal tissue. The spinal dura mater begins at the foramen magnum, fuses with the periosteum of the skull and forms the cephalad border of the epidural space. Caudally, the duramater ends at approximately S_2, wherein it fuses with the filumterminale. At approximately the level of the intervertebral foramina, the duramater becomes continuous with the connective tissue of the epineurium and along the spinal nerve roots it extends laterally. The dura mater is composed of randomly arranged elastin fibers and collagen fibers which are arranged circumferentially and longitudinally.

The dura mater is largely acellular except for a layer of cells that forms the border between the arachnoid mater and dura mater. The inner surface of the dura mater abuts the arachnoid mater. There is a potential space between these two membranes called the subdural space.

Arachnoid Mater[9,10,11,12]

The arachnoid mater is avascular and delicate membrane composed of overlapping layers of flattened cells with connective tissue fibers running between the cellular layers. The drugs moving between the epidural space and the spinal cord have arachnoid mater as the principal anatomic barrier which possess specialized cellular connections. Arachnoid granulations is nothing but the arachnoid mater herniating through dura mater into the epidural space. This area also has the spinal nerve roots which traverse the dural membrane and the arachnoid membrane. The potential space between arachnoid mater and the pia mater called the subarachnoid space contains cerebrospinal fluid (CSF). The CSF in spinal space is in continuation with the cranial CSF, which explains why the drug injected into spinal CSF reaches th brain.

Pia Mater[9,10,11,12]

The layer adherent to the spinal cord, the pia mater, is composed of collagen within a thin layer of connective tissue cells. The pia mater is connected to the arachnoid mater by means of trabeculae. To make the spinal cord lie in direct communication with the CSF in subarachnoid space, there happens to be, at some places, fenestrations in the pia mater, which is not true with the arachnoid mater. Filumterminale is nothing but pia mater extending to the extreme tip of the spinal cord.

Cerebrospinal Fluid[9,10,11]

CSF is 99% water and is made up of plenty of molecules which includes electrolyte, protein, glucose, cyclic nucleotide, amino acid, neurotransmitter and neurotransmitter metabolites. CSF production happens at a rate of 20 to 25 mL/hr producing approximately 100 to 160 mL, which is entirely replaced every 6 hours. It observes a unidirectional flow in the subarachnoid space and is absorbed by the arachnoid villi in the superior sagittal sinus.

Characteristics and Composition of CSF

- Specific gravity - 1.003-1.009
- Vol. in spinal subarachnoid space - 20ml
- pH - 7.4-7.6
- Pressure – 110mm of water
- Protein - 200-400mg/L
- Glucose - 2.5-4.5mmol/L
- Chloride - 123-128mmol/L
- Sodium - 140-150mmol/L
- Bicarbonate - 25-30mmol/ L

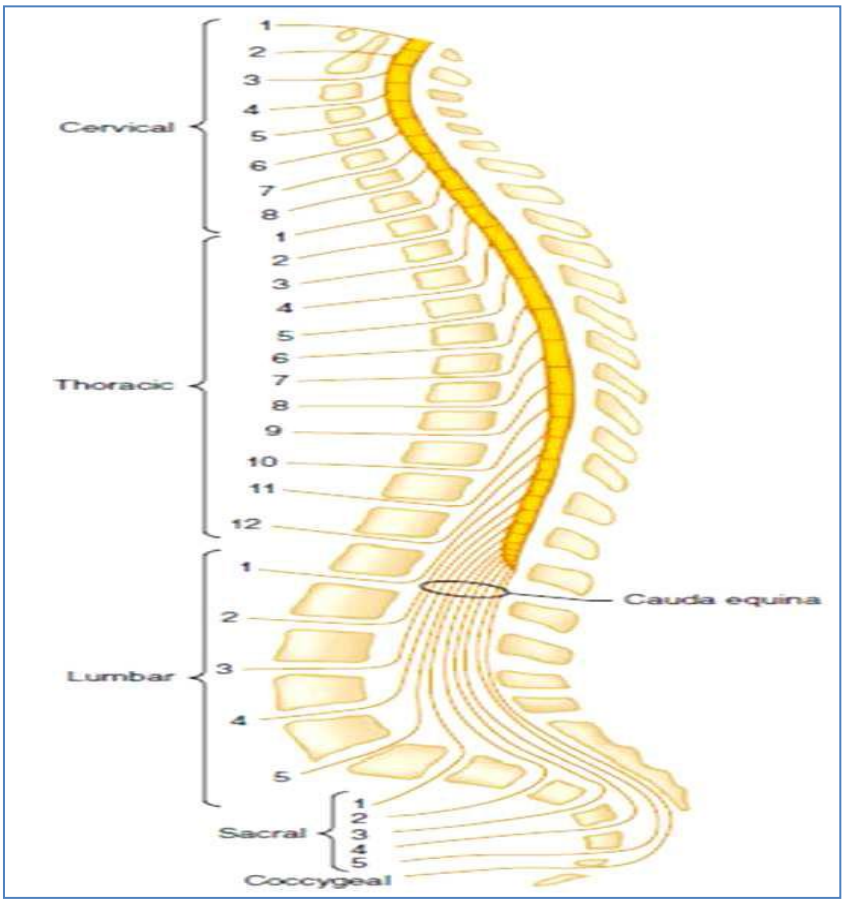


Fig.6 : Distribution of spinal nerves

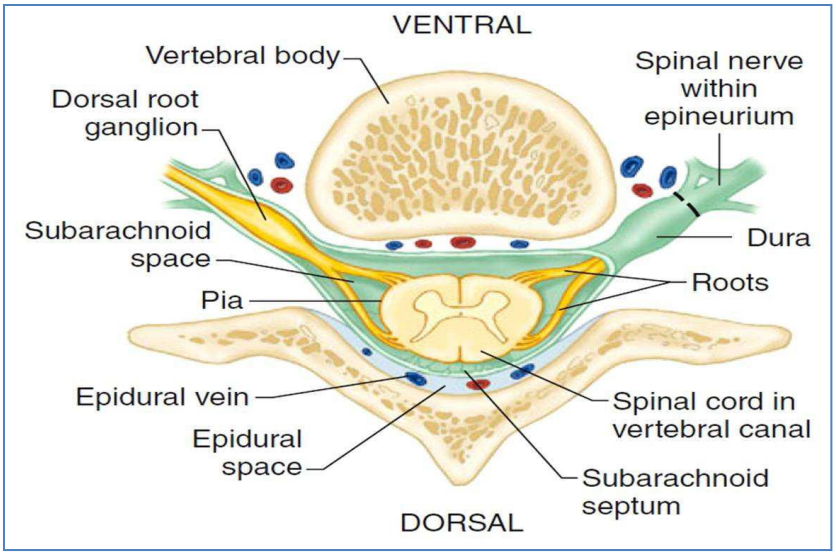


Fig.7 : Cross section of vertebra and spinal cord

Spinal Cord

The spinal cord has an extent from foramen magnum to the sacrum. The vertebral column tends to lengthen a little more than the spinal cord so as to end at the level of the second or third lumbar vertebra, at birth. Caudal tip of spinal cord typically lies at the level of the first lumbar vertebra, in adults. However, 10% of individuals may have a spinal cord spanning upto $L_{3,}$ while in 30% it may end as high as T_{12} level.

31 pairs of spinal nerves arise from the spinal cord, each composed of a posterior sensory root and an anterior motor root. The nerve roots are in turn composed of multiple rootlets. Rootlets of spinal nerves arise from a portion of spinal cord known as the cord segment. The skin areas all over the body are innervated by spinal nerves and their corresponding cord segments and such a distribution is referred to as a Dermatome.

Spinal cord segments from T_1 to L_2 levels contain cell bodies of preganglionic sympathetic neurons, within their intermediolateral gray matter. Caudaequina, is the term used collectively for those nerves that extend beyond the end of the spinal cord to their exit site.

Spinal Segment [9,10,11]

31 pairs of spinal nerves arise from the spinal cord, each composed of posterior sensory root and anterior motor root. Cord segment is the portion of the spinal cord that gives rise to a single spinal nerve. The skin areas all over the body are innervated by spinal nerves and their corresponding cord segments and such a distribution is referred to as a Dermatome. 31 pairs of spinal nerves are as follows.

- Cervical - 8
- Thoracic - 12
- Lumbar - 5
- Sacral - 5
- Coccygeal (rudimentary)

Spinal nerves

The posterior root and the anterior root fuse together to make a spinal nerve. Spinal cord segments from T_1 to L_2 levels contain axons of preganglionic sympathetic neurons, within their intermediolateral gray matter. The posterior root is larger than anterior and efferent impulses from whole body including the viscera pass these roots.

Pain, touch, temperature and deep sensation arising from bone joint, muscle and tendon is conveyed by each posterior root which has a ganglion.

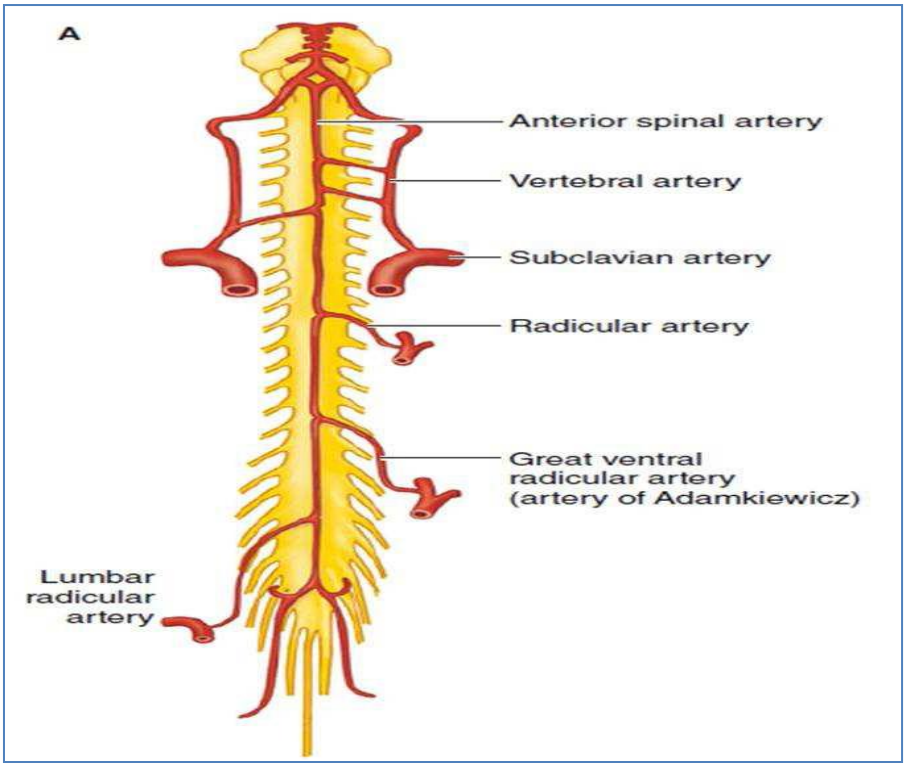


Fig. 8 : Blood supply of spinal cord

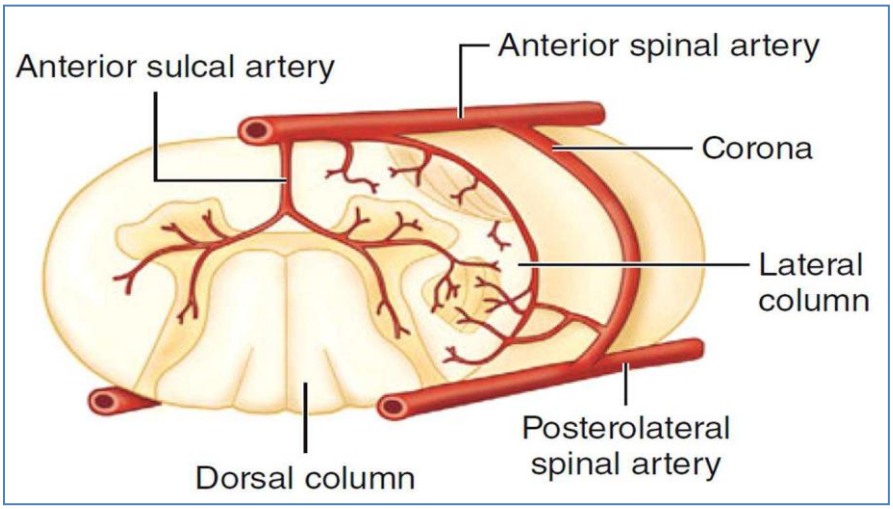


Fig. 9 : Arterial supply of spinal cord

Segmental levels

- Perineum S_1-S_4
- Inguinal region L_4
- Umbilicus T_{10}
- Sub costal T_{6-9}
- Nipple line T_4-T_5
- Second inter costal space T_2
- Clavicle C_{3-4}

The skin above the nipple receives double innervations from C_3 and C_4 and from $T_{2, 3, 4}$; so, there will be some sensation above the nipple line, even with a successful block to C8.

Blood supply of spinal cord [11]

Spinal cord and nerve roots derive their blood supply from a single anterior spinal artery and paired posterior spinal arteries. The anterior spinal artery arises from the vertebral artery at the base of the skull and courses down along the anterior surface of the cord. It supplies the anterior two-thirds, whereas the two posterior spinal arteries supply the posterior one-third of the cord. The posterior spinal arteries is derived from the posterior inferior cerebellar arteries and course down, medial to the dorsal nerve roots, along the dorsal surface of the cord. The lumbar arteries from abdomen and the intercostal arteries from thorax provide additional blood to the anterior and posterior spinal arteries. The aorta gives out a large radicular branch called the artery of Adamkiewicz, or arteriaradicularis magna, which is unilateral, mostly arising on the

left side and any injury to this artery may lead to anterior spinal artery syndrome . Blood supply to the anterior part of spinal cord and its lower two-thirds is majorly by this artery.

Venous drainage [11]

Venous drainage is through a plexus of anterior and posterior veins in the neck, lateral sacral veins in the pelvis, the azygous veins in the thorax and lumbar veins in the abdomen.

Technique [9,10,11]

Insertion of needle into the subarachnoid space leads to piercing of the following structures-

1. Skin
2. Subcutaneous tissue
3. Supraspinous ligament
4. Interspinous ligament
5. Ligamentumflavum
6. Areolar tissue or epidural space
7. Spinal dura matter

Needles [10]

Epidural and spinal needles are classified by the design of their tips. The Greene, Atraucan, and Quincke needles have beveled tips with cutting edges. The pencil tip needles have one or two apertures proximal to their tip. Examples of the same are whitacre, eldor, marx and sprotte spinal needles.When compared with bevel-tip

needles, the pencil-point needles require more force to insert but provide a better tactile "feel" of the various tissues encountered. In addition, the pencil point needles are not deflected whereas the needle is seen to be deflected from the intended path, as it passes through the tissue in cases of bevel tip needle.

Position [9,10,11]

For a successful spinal puncture, patient positioning is critical. Spinal needles are often inserted with the patient in the lateral decubitus position, However, both the sitting and prone jackknife positions offer advantages under specific circumstances. We must position the patient so as to rest his/her back at the edge of the table, such that the patient's hips and shoulders lie perpendicular. This in turn would prevent rotation of the spine.

With the help of an assistant, the patient's neck is flexed and the knees are pushed onto the chest helping to curve the lumbar spine outward, such that the spinous processes spread out which helps increase the size of the interlaminar foramen. Using the highest point on the iliac crests (an imaginary line between these two points crosses the body of L_5 or the L_4 to L_5 interspace) the desired interspace is chosen for needle insertion. Interspaces above L_2 to L_3 should be avoided as there are high chances of hitting the spinal cord with the needle. A skin marker may be used to mark the spinous processes flanking the desired interspace. This eliminates the need to re-identify the interspace after the patient is positioned and prepared.

Antiseptic solutions are very neurotoxic. Hence strict protocol to avoid contamination of spinal needles or local anesthetics should be followed. Antiseptic solutions with chlorhexidine–alcohol appear to better than 10% povidone–iodine as it prevents colonization of percutaneous catheters better. Currently, the American Society of

Regional Anesthesia recommends chlorhexidine for skin antisepsis prior to regional anesthesia procedures. Advantage is noticed with use of plastic fenestrated drapes as it improves the visualization and provides a clear idea whether the patient's spine is adequately flexed or not.

Midline Approach [9,10,11]

The skin overlying the desired interspace is infiltrated with a small amount of local anesthetic to prevent pain while inserting the spinal needle. Additional local anesthetic (1 to 2mL) is deposited to a depth of 1 to 2 inches, which helps in identifying the route for needle. Infiltrating local anesthetic prior to spinal in paramedian approach is unnecessary and causes pain to the patient and hence should be avoided. A 10-15 degree cephalad tilt is given to the needle while being inserted. A characteristic pop or give way sensation is felt as the ligament is pierced, to which the anesthetist must get used to, in order to differentiate a needle which is passing through a tough ligament from one which is advancing through less resistant muscles in the paraspinal region. Pencil tip needles make appreciation of the "pop", heard on dura penetration, easy, which helps to avoid unnecessary contact with the vertebral body. After inserting the needle correctly into space, the stylet is removed to see if CSF appears at the needle hub, it is then attached with a syringe filled with local anesthetic which is gently aspirated for CSF. This confirms that the drug is being injected into the subarachnoid space.

Paramedian Approach [9,10,11,12]

When the patient's spinal anatomy doesn't favor midline approach, as is seen in the cases with heavily calcified ligaments or when the patient is unable to flex the spine, lateral to median approach or the paramedian approach serves to be useful.

Lumbosacral Approach [9,10,11]

At the L_5 to S_1 interspace, which happens to be the largest interspinous space, paramedian approach chosen for subarachnoid or epidural anesthesia is known as the Taylor's approach or the lumbosacral approach, which appears to be useful in conditions wherein other approaches are not possible.

Contraindications to neuraxial blockade [9,10,11]

Absolute:

- Infection at the site of injection
- Patient refusal
- Coagulopathy or other bleeding diathesis
- Increased intracranial pressure
- Severe aortic stenosis
- Severe hypovolemia
- Severe mitral stenosis

Relative:

- Sepsis
- Uncooperative patient
- Preexisting neurological deficits
- Demyelinating lesions
- Severe spinal deformity
- Stenoticvalvular heart lesions
- Left ventricular outflow obstruction (hypertrophic obstructive cardiomyopathy)

Controversial:

- Prior back surgery at the site of injection
- Complicated surgery
- Major blood loss
- Maneuvers that compromise respiration
- Prolonged operation

Complications of neuraxial anesthesia [9,10,11,12]

- Adverse or exaggerated physiological responses
- Urinary retention
- Anterior spinal artery syndrome
- Horner's syndrome
- High block
- Total spinal anesthesia
- Cardiac arrest

Complications related to needle/catheter placement[11]

- Backache
- Dural puncture/leak
- Post-dural puncture headache
- Damage to nerve root
- Damage to spinal cord
- Caudaequina syndrome
- Severe bleeding
- Haematoma either intraspinal or epidural

- Misplacement of needle or catheter
- No effect or inadequate anesthesia
- Diplopia
- Tinnitus
- Neural injury
- Subdural block
- Inadvertent intravascular injection
- Catheter shearing/retention
- Inflammation
- Arachnoiditis
- Infection
- Meningitis
- Epidural abscess

Drug toxicity [9,10,11]

- Systemic local anesthetic toxicity
- Transient neurological symptoms
- Caudaequina syndrome

PHYSIOLOGY OF NEURAXIAL BLOCKADE

PHYSIOLOGY OF NERVE CONDUCTION [9,10,11]

Voltage difference of -60 to -90 mV is maintained between the cell's outside and intracellular medium, by the neural membrane. This is due to the fact that at rest, relative impermeability to Na^+ ions is seen but a selective permeability to the K^+ ions. An active pump, driven by energy dependent mechanism, the Na^+/K^+ pump, acts by using adenosine triphosphate as the source of energy and by sustaining the ion gradients driving this potential difference by expulsion of Na^+ from inside of the cell and taking up of K^+. The membrane happens to be comparatively permeable to K^+ ions, despite which, a 30:1 or 150 to 5 mm K^+ ratio is maintained between the intracellular and extracellular membranes. This is made to happen by maintaining an active removal ofpassively leaking K^+ across the membrane.

According to the Nernst equation, resting nerve tends to behave as a "K^+ electrode"

$$E_m \approx E_K = \left(\frac{-RT}{F}\right) \ln\left(\frac{[K^+]_i}{[K^+]_o}\right)$$

Fig. 10 : Nernst equation

- Em- potential across the membrane
- EK- equilibrium potential of potassium
- R- gas constant
- T- temperature (in Kelvin)
- [K+]i - potassium ion concentration inside the cell
- [K+]o - potassium ion concentration outside the cell
- F is Faraday's constant

The conductance of an ion is a measure of the membrane permeability to that ion and is reciprocal of its electrical resistance in the membrane. When there is a depolarizing stimulus, it results in a few of the voltage gated Na^+ channels becoming active. As and when the threshold potential occurs, the K^+ channels and all other channels are overwhelmed by the voltage gated Na+ channels resulting in an action potential. Due to a short lived increase in Na^+ conductance, an equilibrium potential is not attained, during an action potential, despite a membrane potential moving towards.

Sodium channels enter a closed state (inactivated state) for a couple of milliseconds before they return to resting state, wherein they eventually get. Influx of Na+ is limited by the reversing of membrane potential, which in turn reverses the electrical gradient direction. Voltage-gated K^+ channels happen to be the 3rd factor causing the membrane to repolarise. The opening is more prolonged and there is slow Na+ channel. The process of repolarisation is completed by the K+ efflux. The after hyperpolarization is explained by the slow return of the K^+ channels to the closed state followed by a return to the resting membrane potential. Thus, voltage-gated K^+ channels bring the action potential to an end and this causes closure of their gates through a negative feedback process[11]

PHYSIOLOGICAL EFFECTS OF NEURAXIAL BLOCKADE

Cardiovascular system [9]

- Decrease in heart rate
- Decrease in arterial blood pressure

The sympathectomy that accompanies the techniques depends on the height of the block. Typically it extends almost 2-6 dermatomes above sensory level with spinal anesthesia, and tends to be at the same level with epidural anesthesia. As a result of this sympathectomy, the venodilation tends to predominate the arterial

vasodialation(vascular smooth muscles have a high degree of autonomous tone) as a result of the huge venous blood and also because the venules have less smooth muscle.

After neuraxial block induced sympathectomy, total peripheral resistance should decrease only 15% - 18% in normovolemic healthy patients, if normal cardiac output is maintained, even with nearly total sympathectomy.[9]

The heart rate decreases due to blockade of the cardio-accelerator fibers arising from T_1 to T_4. The heart rate may also decrease because of a decrease in right atrial filling, which reduces outflow from intrinsic chronotropic stretch receptors located in the right atrium and great veins.**[9,10]**

Respiratory system [9,10]

Healthy patients show altered pulmonary variables during subarachnoid or epidural block. During high spinal anesthesia, tidal volume remains unchanged and there is a slight decrease in vital capacity due to reduction in expiratory reserve volume, which is less related to a reduction in functions of the diaphragm and more so because of paresis of muscles of the abdomen. This minimal impact on pulmonary function also holds true for elderly patients undergoing lumbar and thoracic epidural anesthesia.

The brainstem in the brain has various centres for respiration, which may be hypoperfused following subarachnoid block, which causes respiratory arrest rarely (shouldn't be confused with phrenic or inspiratory dysfunction for the arrest). This is supported by the complete disappearance of apnoea, post-resuscitation with drugs and intravenous fluids, which help in restoring the hemodynamic vitals of the patient. This would not have been the scenario if diaphragmatic paralysis due to local anesthetics in large quantities would have been the cause for apnoea. Lung variables depict slight

change or no change at all during epidural or spinal anesthesia whereas the hypercapnia induced ventilatoy responses are increased. Ventilatory functions may be impaired in higher-level block with intercostal and abdominal muscle paralysis.

Neuraxial block must be cautiously advocated in respiratory cripples because of the risk of paralysis of the respiratory muscles. Except for cases with severely compromised patients with respiratory failure, inspiratory muscle function during neuraxial blocks should be adequate to maintain ventilatory function. The physiologic consideration related to muscle paralysis with neuraxial block should focus on the expiratory muscles in these severely compromised patients as these muscles are important for clearing of intrapulmonary secretions and for effective coughing.

Gastrointestinal system [9,10]

20% patients after neuraxial blockade may have associated nausea and vomiting due unimpeded vagal activity leading to gastrointestinal hyperperistalsis. Nausea associated with high (T_5) subarachnoid anesthesia may be effectively treated with Atropine. This gastrointestinal hyperperistalsis has the benefit of providing excellent surgical conditions because of a contracted gut. An often-cited advantage of regional anesthesia in patients with compromised gastrointestinal function is that less physiologic impairment is possible as compared to general anesthesia. Nevertheless, it appears that if an intra-abdominal surgery is performed, the magnitude of decrease in hepatic blood flow parallels the site of surgery rather than the anesthetic technique which is chosen. The reduction in blood flow in the liver during spinal anesthesia equals the reduction in the mean arterial blood pressure (MAP). When epidural analgesia is continued into the postoperative period, there may be a protective effect on the gastric mucosa because the intramucosal pH is higher during postoperative epidural analgesia than during systemic analgesia.

Renal system [9,10]

The renal function has a real wide physiologic reserve. It is usually believed that the urinary retention in patients is caused by subarachnoid and epidural blocks, delaying discharge in outpatients and requiring catheterization in inpatients. A lower concentration of local anesthetic is sufficient for paralysis of bladder function than for paralysis of motor nerves to the lower extremities. After spinal anesthesia, it is prudent to avoid administration of excessive volumes of intravenous crystalloid solutions and to individualize the requirement in patients.

Endocrine system [10]

There are a number of metabolic and endocrine changes like oxygen consumption, raised catabolism of protein, increase in circulating catecholamines. Surgical stress response is the collective term for these endocrine–metabolic changes. Epidural and spinal anesthesia inhibit most of the endocrine and metabolic changes, mostly in lower extremity and lower abdomial procedures, seen due to stress response, which is initiated by blocking of afferent sensory information.

FACTORS POSTULATED TO AFFECT THE BLOCK HEIGHT[9,10,11]

Patient characteristics

- Age
- Height
- Weight
- Gender
- Intra-abdominal pressure
- Anatomic configuration of the spinal column
- Position

Technique of injection

- Site of injection
- Direction of injection (needle)
- Direction of bevel
- Use of barbotage
- Rate of injection

Characteristics of spinal fluid

- Volume
- Pressure (cough, strain, Valsalva maneuver)
- Density

Characteristics of the anesthetic solution

- Density
- Amount (mass)
- Concentration
- Temperature
- Volume
- Vasoconstrictors

FACTORS INFLUENCING BLOCK HEIGHT[9,10,11]

Controllable Factors:

- Dose (volume × concentration)
- Site of injection along the neuraxis
- Baricity of the local anesthetic solution
- Posture of the patient

Non-controllable Factors:

- Volume of cerebrospinal fluid
- Density of cerebrospinal fluid

FACTORS PROBABLY UNRELATED TO HEIGHT OF THE SPINALANAESTHETIC BLOCK[9,10,11]

- Added vasoconstrictor
- Coughing, straining, or bearing down (labor)
- Barbotage
- Rate of injection (except hypobaric)
- Needle bevel (except Whitacre needles)
- Gender
- Weight

Stout's principle for the spread of local anesthetic

The height achieved by the local anesthetic directly varies with:

- Concentration of the solution
- Speed of injection
- Specific gravity for hyperbaric solution
- Position of the patient for isobaric and hypobaric solutions
- Volume of fluid
- The height achieved by local anesthetic indirectly varies with
- Rapidity of the fixation
- CSF pressure

Baricity and patient position:

Baricity which is important in determining local anesthetic block height and spread, is derived by dividing the local anesthetic density by the CSF density. Isobaric solutions have density equal to that of CSF (1.0000). Hypobaric solutions have density less than CSF. Hyperbaric solutions are denser than CSF.

Baricity is important in that hyperbaric solutions flow to dependent regions, downward in CSF as a result of gravity in contrast to hypobaric solutions which tend to rise in CSF. Distribution of truly isobaric solutions is not affected by gravity.

Dose, volume and concentration:

These three are interdependent variables , it is not possible to change them individually without affecting the other variable

The fate of injected agents:

Soon after the injection of anesthetic agent into the subarachnoid space, there is fall in concentration. This is due to the following processes:

- Dilution and mixing in CSF
- Diffusion and distribution to neural tissues
- Uptake and fixation by neural tissues
- Vascular absorption and elimination through arachnoid villi
- Directly from capillary bed of parenchyma

Initially, soon after injection of the drug, concentration of drug rapidly decreases within 2-3 minutes due to dilution and mixing of drug with CSF. The rate or force of drug injection and to the volume of fluid in subarachnoid space are the factors affecting this.

SEQUENCE OF NERVE BLOCKADE BY LOCAL ANAESTHETICS [9,10,11]

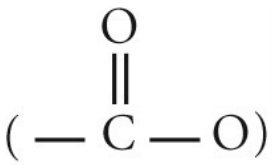
- flow
- Temperature fibers – cold followed by warmth
- Loss of temperature discrimination
- Tactile sensation loss
- Paralysis of the motor system
- Sense of pressure
- Pain fibers
- Proprioception and vibratory sense

The major determinant of physiologic responses to subarachnoid anesthesia is sympathetic blockade. Paralysis of these nerves may be as a result of the indirect effects of spinal anesthesia.

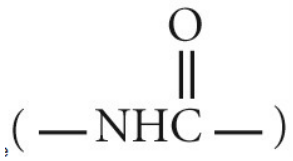
PHARMACOLOGY

Local anesthetics are chemical compounds which are capable of reversibly inhibiting the propagation of impulses in nerve cells. The key target of local anesthetics is the voltage-gated sodium channel. The binding is intracellular and is mediated by hydrophobic interactions.[13,14,15]

They are principally classified into:



Amino esters



Amino amides

Amino esters include procaine, chlorprocaine, tetracaine and aminoamides include lidocaine, prilocaine, mepivacaine, bupivacaine, levobupivacaine, etidocaine, ropivacaine.

BUPIVACAINE [13,14,15]

First synthesized by **Ehenstam** and his colleagues in**1957** and used clinically by **Telivuo in 1963** is at present acknowledged as one of the most suitable agent for epidural use in post-operative pain relief.

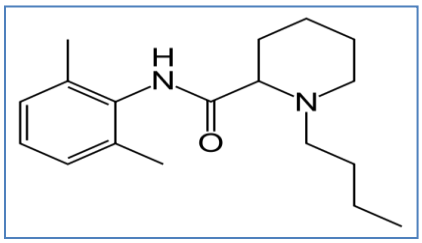


Fig. 11 : Chemical structure of bupivacaine

CHEMISTRY

Bupivacaine is 2 pepindine carboxamide1, butyl(2, 6 dimethyl) monohydrate of monohydrochloride with molecular weight of 324.9 pKa (8.1) similar to that of lignocaine (7.86) and a melting point of 258^0C. However bupivacaine, more bound to protein than lignocaine, possesses a greater degree of lipid solubility.

Clinical pharmacology:

Local anesthetics have a tendency to occlude the production and conduction of nerve impulses, by raising the electrical excitation threshold in the nerve, by impeding the nerve impulse transmission and by reducing the rate at which the action potential rises. Clinically, the order of loss of nerve function is as follows:

1. Loss of pain
2. Loss of temperature
3. Loss of touch
4. Loss of sense of proprioception
5. Loss of skeletal muscle tone

PHARMACOKINETICS

The absorption rate depends upon a number of factors like the concentration and total dose of drug administered, its vascularity, route and site of administration and also on the anesthetic solution(with or without adrenaline). There is rapid onset of action and long lasting anesthesia, with half-life in neonates 8.1 hrs and in adults 3.5±2.0 hrs. The anesthetic index of bupivacaine is similar to that of mepivacaine i.e. 3.0-4.0. The nerve penetrating power appears to be slow.

Based on the route of administration, local anesthetics are distributed to some extent to all body tissues with high concentration found in highly perfused organs such as brain, liver, lungs and heart. The elimination of drug from tissue depends upon its ability of binding. It is carried in the circulation to the liver wherein it is metabolized via conjugation with glucoronic acid hence patients with liver disease are likely to face the drug toxicity. Bupivacaine is mainly excreted by kidney (metabolite is 2, 6 pipecoloxylidine).

PHARMACODYNAMICS

The heart rate increases significantly at plasma concentrations of 1.0 to 2.0 mcg/ml and so does the mean arterial pressure. There is slight increase in the plasma nor-adrenaline levels, however, blood concentration of plasma cortisol, glucose and fatty acids do not show a significant change. However, the predominant effect seen at higher plasma concentration is vasodialation. Bupivacaine produces a direct myocardial depressant effect which causes progressive decrease(20%) in cardiac output at high plasma levels of more than 1.0mcg/ml. In addition, cardiac sympathetic nerve activity is inhibited by intravenous bupivacaine. It also has a definite beta adrenergic receptor blocking action and inhibits intestinal smooth muscle activity.

INDICATIONS

Bupivacaine in general is recommended for production of local or regional anesthesia by infiltration, sympathetic block, caudal or epidural block. It is specially indicated in those cases where induction of prolonged analgesia is desirable and necessary.

DOSAGE

The recommended concentration for various types of procedures is as follows:

Infiltration block: a concentration of 0.25% is used in healthy adults in volumes up to 70-80 ml with adrenaline.

Nerve block: the 0.25%-0.5% solution is usually used up to 5mg/kg volume. A 0.25% solution is satisfactory for small peripheral nerves.

Caudal block: for obstetric analgesia and perineal surgery, 20ml of 0.25% solution is effective. Similarly for lower extremity surgery and abdominal surgery up to 20 ml of 0.25% solution is satisfactory.

Subarachnoid block: Concentration of 0.5% bupivacaine is effective in a dose of 0.3mg/kg in adults.

Pediatrics: administration of bupivacaine is not recommended in children below 12 years of age due to limited experience in controlled clinical trials.

Contraindications:

- History of hypersensitivity to local anesthetics belonging to amide group.
- Patient who have inflammation and or sepsis in region of proposed infection.
- Should not be used in shock and heart block cases.
- Its use for intravascular anesthesia not recommended.
- Bupivacaine shouldn't be used in age group below 12 years and use of its any concentration is contraindicated in obstetrical paracervical block.

Drug interactions

1. Bupivacaine decreases the chronotropic effect of isoproterenol.
2. Administration of bupivacaine with adrenaline in patients receiving monoamine oxidase inhibitors or tricyclic antidepressants may produce severe, prolonged hypertension and should be avoided.

Adverse effects

Bupivacaine may present excessively in plasma due to inadvertent injection into the vessel leading to over dose and slow degradation. Unintentional subarachnoid injection of the drug during the intended performance of epidural, caudal block or nerve block near the vertebral column may result in apnea or under ventilation. Tolerance to bupivacaine may be diminished due to diseases wherein there is reduced protein synthesis, competition for binding sites with other drugs or acidosis.

Central nervous system (CNS) reaction:

CNS reactions may be in the form of depressive or excitatory episodes (depression usually occurs first, excitation tends to be transient), followed by drowsiness and visual changes like tinnitus, blurring of vision, discomfort or anxiousness resulting in convulsion and respiratory arrest eventually. Other CNS system effect may be nausea, vomiting, chills and constriction of pupil.

Cardiovascular effects:

Hypotension is due to respiratory paralysis, under ventilation, loss of sympathetic tone or may be even due to motor level extending cephalad, which may result in cardiac arrest secondary to high spinal, if left unaatended.

Therapeutic dose blood concentration result in minimal changes in excitability, refractoriness, cardiac transmission and venous return. Unintentional intravascular injection or high doses may lead to high plasma levels and related depression of myocardium, bradycardia, hypotension, decrease in cardiac output, heart-block and arrhythmias including ventricular fibrillation, ventricular tachycardia and cardiac arrest.

Allergic reactions:

Allergic reactions are rare and may occur due to sensitivity to bupivacaine. Compared to any other local anesthetic, bupivacaine causes more shivering. Erythema, angioneurotic edema, urticaria, excessive sweating, syncope and elevated temperature, have been described following the administration of bupivacaine.

LEVOBUPIVACAINE HYDROCHLORIDE [13,14,15]

Commercial preparation of bupivacaine is available in the form of racemic mixture (50:50) of 2 enantiomers, namely dextrobupivacaine(R (+) isomer) and levobupivacaine (S (−) isomer).

R isomer of bupivacaine (dextrobupivacaine) in comparison to S isomer (levobupivacaine, which has a safer pharmacological profile due to faster protein binding) is associated with more adverse effects (cardiovascular and central nervous system) after intravenous regional anesthesia or inadvertent intravascular injection.

Chemical Structure

[2S]1butylN[2,6‑ dimethylphenyl] piperidine2carboxamide) belongs to the family of n‑ alkyl substitute pipecoloxylidide and is an amino‑ amide local anesthetic drug.

Chemical formula: $C_{18}H_{28}N_2O$

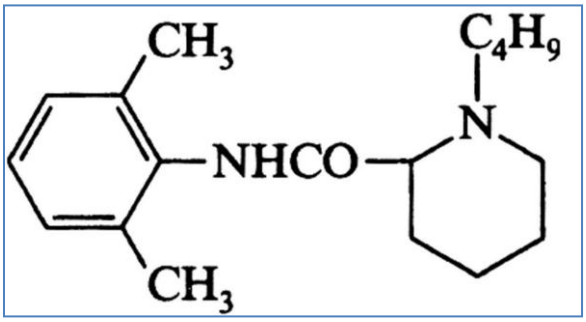


Fig.12 : Chemical structure of levobupivacaine

Physicochemical properties

- Molecular weight - 288.42772 g/mol
- Pka – 8.1
- Lipid solubility - 30
- Octanol/ buffer partition coefficient – 346.0
- Protein binding – >97%, mainly to α1-acid glycoprotein.
- Vdss – 54L
- t1/2 – 157 min
- Clearance – 0.32 L/min

Levobupivacaine is an amorphous, odorless, synthetic compound, its hydrochloride is available as solution without dextrose for intrathecal injection.

PHARMACOKINETICS

Absorption

The route of administration as well as the dose of levobupivacaine determines the plasma concentration following therapeutic administration as the absorption is dependent upon the vascularity of the tissue. The absorption is biphasic after epidural administration of levobupivacaine, in that a little quantity of drug is absorbed rapidly into the circulation and the remaining is absorbed slowly.

Distribution

Blood peak levels with epidural injection of levobupivacaine are seen after 30 minutes. Other body tissues may be affected by the free form of drug resulting in unwarranted adverse effects and manifestations. Larger levels of free drug may result due to proteindeficiency conditions (namely, under nutrition, nephritic syndrome etc.) which may bring about toxic effects even at low dosages.

Metabolism

In vitro studies using (14 C) levobupivacaine showed that cytochrome (CYP) CYP1A2 isoform and CYP3A4 isoform mediate the metabolism of levobupivacaine to inactive metabolites, 3‑ hydroxy levobupivacaine and desbutyllevobupivacaine, respectively. 3‑ hydroxy levobupivacaine appears to undergo further transformation to sulfide and glucuronide conjugates.

Elimination

Levobupivacaine is extensively metabolized by kidney (glucuronide and sulfate conjugates) with urinary excretion; no unchanged levobupivacaine detected in urine or feces. Levobupivacaine is essentially excreted with a mean total of about 95% being recovered in urine and faeces in 48 hours. Of this 95%, about 24% was in faeces while 71% was in urine.

Maximal dosage: is 2mg/kg body weight

Clinical uses

Levobupivacaine has been utilized in a number of procedures, mainly due to its low neurological and cardiovascular toxicity profile, namely

- Subarachnoid block
- Brachial plexus blocks
- Peripheral nerve block
- For local infiltrations
- Intraoperative anesthesia
- Labor analgesia
- Postoperative pain
- Acute and chronic pain
- Epidural anesthesia and analgesia

Adverse effects

- Cardiac toxicity
- CNS toxicity
- Hypotension (31%)
- Nausea (21%) and vomiting (14%)
- Headache (8%)
- Dizziness (5%)

Compared to bupivacaine, levobupivacaine shows lesser degree of CNS injury, rarely allergic reactions (ranging from urticaria to fatal anaphylactoid reactions) and cardiac toxicity.

Safety profile after unintended intravenous administration

Initially, for LAST, securing airway should be followed by lipid emulsion therapy.

PHYSIOLOGICAL CHANGES IN GERIATRIC PATIENTS

Progressive functional loss occurs in various organic systems and goes on accumulating over the years. Some of these changes are age-related and lead to specific perioperative risks.

Table 1 – Physiological changes due to aging and their significance for perioperative complications.

System	Change	Significance
General	↓ Total water and lean mass ↓ Thermoregulatory response	↑ Toxicity due to drugs ↑ Risk of hypothermia
Skin	↓ Capacity for epithelialization ↓ Blood flow	↑ Healing capacity ↑ Risk of scabbing
Cardiac	Fibrosis of sinus and conducting tissues Alteration of diastolic function ↓ Arterial compliance ↓ Baroreceptor response	↑ Risk of conduction disorders ↑ Risk of hypotension and direct congestive heart failure ↑ Systolic hypertension and left ventricular hypertrophy ↑ Risk of hypotension
Pulmonary	changes to ventilation mechanisms ↓ Response to hypercapnia ↓ Airway protection mechanism	↓ FCV, FEV1, PO2. Risk of sedative drugs ↑ Risk of aspiration/ infection
Renal	↓ Glomerular filtration rate ↓ Creatinine excretion rate ↓ Response to sodium deficiency ↓ Water and salt excretion capacity	↑ Drug half-life ↑ Risk of masked kidney failure ↑ Risk of volume depletion Volume and sodium overload
Immune	Involution of thymus ↓ T lymphocyte function	↑ Risk of infection
Hepatic	↓ Blood flow and microsomal oxidation	↑ Drug half-life
Endocrine	↓ Insulin secretion and action	Overload hyperglycemia and glucose intolerance
Others	Hyperplasia of the prostate	↑ Risk of urine retention

(Adapted from Francis J. Perioperative management of the older patient in principles of geriatric medicine and gerontology. In: Hazzard W, Bierman EL, Blass JP, Ettinger W Jr, Halter JB. editors. Geriatric Medicine & Gerontology. New York: McGraw-Hill; 1994).

AGE-RELATED CHANGES RELEVANT TO REGIONAL ANAESTHESIA [17]

With advancing age, both the peripheral and central nervous system degenerate. These changes may have an impact on the pharmacology of local anesthetic agents and on the neural block characteristics. A deterioration of myelin sheaths and connective tissue barriers, reduction in the number of neurons within the spinal cord, changes in the anatomical configuration of the thoracic and lumbar spine, slowed down peripheral nerve (motor nerves) transmission velocity, and possible reduction in the volume of cerebrospinal fluid, are contributory factors to modified characteristics of nerve block following neuraxial block.

As age advances, height of analgesia (spinal height) is seen to increase following lumbar and thoracic epidural with fixed dosage, mainly attributed to the ongoing sclerotic closing of intervertebral foramina. Elderly patients show typical reduction in β (beta) receptor affinity to adrenergic agonist and hence show a reduced response to adrenaline in test dose (to check for intravascular injection. [17]

Baricity of the solution decides the block extent post spinal anesthesia. [17]in elderly patients, isobaric solutions produce minimal effect on peak height of analgesia compared to hyperbaric solution which produce a quicker onset of motor block and a higher level of sensory block.

CLINICAL PROBLEMS

There may be a few difficulties faced with neuraxial anesthesia in oldage like inconvenience during spinal and epidural anesthesia. These difficulties are faced moreover due to the hardships witnessed during positioning the aged patients due to anatomic variations with age like rotation of curvature of spine. In elderly patients, calcification leads to a narrowed intervertebral foramen and regressive joint and disc

changes lead to a compressed and distorted epidural space. There is ossification of ligamentumflavum with age. Regional anesthesia in aged patients results in fall in body temperature, blood pressure and increased sensitivity to local anesthetics.

Hypotension

Dialatation of vessels with eventual fall in systemic vascular resistance, as a result of blocking of sympathetic flow during neuraxial block, results in fall in blood pressure. Incidence and adverse effect risk factors seen with spinal anesthesia were reported by Carpenter.[18] For the development of hypotension, increasing age and high levels of sensory anesthesia appeared to be the two main risk factors. Fall in heart rate and blood pressure was found to be associated with high leveled anesthesia (following epidural administration) in the old age patients. As age increases, there are many changes which happen in the body like arterioles undergoing structural alterations, reduction in cardiac reserve volumes and alterations in ANS. In elderly patients with limited cardiac reserve, marked hypotension may be especially harmful and preloading with fluids, either colloids or crystalloids wouldn't help allay fall in blood pressure. [19] Initial 5-10 minutes after the spinal administration, when the block is still extending, administration of intravenous fluids and ionotropes appear to be of use in treating the above mentioned adverse effects.

Hypothermia:

Geriatric patients, who undergo neuraxialblocks are at an increased risk of hypothermia because of their low basal body temperature which might not generate autonomic protective reflexes as a result of which there is a notable reduction in the threshold for thermoregulation following high spinal[20].

Sedation [21]

Elderly patients are more sensitive to benzodiazepines and these should be cautiously used in small doses with sufficient gap between increments while being used as a premedication in them. Compared to younger patients, propofol infusion for sedation, in the elderly patients, during spinal anesthesia resulted in a delayed recovery time as it produces hypnotic effects and shows EEG effects, to which the geriatric lot is way more sensitive, mandating long durations of observation in them.

Pharmacokinetics of local anesthetics

Extent and rate of absorption into the system and thereafter distribution and elimination of the drug following regional anesthesia depends on the variations in the body composition. Following a regional anesthetic, the pharmacodynamic or pharmacokinetic changes, which occur with increasing age, may alter the clinical profile of local anesthetics. Pharmacokinetic changes may, in part, be responsible for the observed changes in the clinical profile. In the elderly, absorption studies with various anesthetic drugs showed raised sensitivity unrelated to the deranged absorption through vessels.[22] Such clinical differences post neuraxial block is described by variations in anatomy and pharmacodynamics (and not the pharmokinetic variations) in the elderly.

REVIEW OF LITERATURE

Gautier et al (2003)[23] aimed to detect in patients undergoing Caesarean section, whether intrathecalropivacaine and levobupivacaine provided postoperative analgesia and anesthesia of similar quality to bupivacaine. Ninety parturient were enrolled and a combined spinal-epidural technique was used. Patients were randomly assigned to receive one of the following isobaric solutions: levobupivacaine 8 mg (n=30), bupivacaine 8 mg (n=30) or ropivacaine 12 mg (n=30), all combined with sufentanil 2.5 mg. Motor and sensory variations were seen. Successful anesthesia found in various groups. In comparison to levobupivacaine group, bupivacaine group was found to have more positive results, with greater analgesia and motor block. They concluded that, for cesarean section, a combination of bupivacaine with sufentanil is a superior option.

Casati et al (2004)[24] studied 60 patients taken for repair of the hernia sac, with unilateral subarachnoid anesthesia, with either of the drugs namely, levobupivacaine, bupivacaine or with ropivacaine (all 0.5% hyperbaric solutions) for outset time and success intraoperatively and found it to be equal in all three groups. The highest sensory blockade (operative and non-operative sides) happened to be T_8 and L_3 was seen following levobupivacaine, T_6 and L_3 following bupivacaine and T_5 and T_{11} following ropivacaine. There was nil difference seen in time for discharging patients home (least with levobupivacaine). Conclusion was made that 8mg of levobupivacaine or 12 mg of ropivacaine are acceptable alternatives to 8mg of bupivacaine when limiting spinal block at the operative side for inguinal hernia repair.

Vanna et al (2004)[25] investigated the safety and clinical efficacy of hyperbaric solution of racemic bupivacaine compared with isobaric solution of levobupivacaine in spinal anesthesia. They studied 70 patients undergoing elective transurethral endoscopic surgery who received either hyperbaric bupivacaine or isobaric levobupivacaine (0.5% solutions given intrathecally), and observed similarities among the two groups in context to various variables. They concluded that hyperbaric mixture of racemic bupivacaine, isobaric levobupivacaine are more or less similar when it comes to sensory block duration and time of outset.

Cappelleri et al (2005)[26] compared subarachnoid block initiated with levobupivacaine and ropivacaine(hyperbaric solutions), in ninety one patients posted for arthroscopic repair of the knee. Adequate unilateral sensory block, unilateral motor block, faster home discharge were noticed with levobupivacaineand ropivacaine (0.5% hyperbaric solutions) for arthroscopic repair of the knee.

Fattorini et al (2006)[27]observed 60 patients with 0.5% of bupivacaine and 0.5% of levobupivacaine in spinal anesthesia noticed no significant difference in either anesthetic potencies or postoperative pain and observed that levobupivacaine is more hemodynamically stable.

Thongrong et al (2007)[28] studied 70 patients aged 18-65 yrs. Of ASA I-II, scheduled for elective lower abdominal and lower extremity surgery under spinal anesthesia were enrolled. The patients were randomly allocated to two groups receiving either 0.5% isobaric racemic bupivacaine 3 ml. or 0.5%isobaric levobupivacaine3 ml. Vital signs, motor and sensory blockade were recorded, intraoperatively and postoperatively until the sensory and motor variables were back to normal and noticed insignificant variations among both the groups. The peak block

height with racemic bupivacaine group was T6, in the levobupivacaine was T11. They concluded that 0.5% isobaric racemic bupivacaine and 0.5% isobaric levobupivacaine showed equally effective potencies for spinal anesthesia, regard to both the onset time and duration of motor and sensory blockade.

Luck et al (2008)[29]compared the clinical effects of hyperbaric bupivacaine for spinal anesthesia with those of similar preparations of levobupivacaine and ropivacaine. 60 ASA grade I–II patients undergoing elective surgery under spinal anesthesia were randomized to receive 3 ml of bupivacaine, levobupivacaine, or ropivacaine, each 0.5% and made hyperbaric by the addition of glucose 3% and assessed for the sensory and motor blocks. The level and duration of sensory block, intensity and duration of motor block, and time to mobilize and to micturate were also recorded. Observed that there were no significant differences between the groups with regard to the mean time to onset of sensory block at T10, the extent of spread, or mean time to maximum spread. Regression of sensory block in the ropivacaine group was more rapid as demonstrated by duration at T10, total duration of sensory block, more rapid recovery from motor block and shorter times to independent mobilization. There were no significant differences between the bupivacaine and the levobupivacaine groups. Concluded that hyperbaric ropivacaine provides reliable spinal anesthesia of shorter duration than bupivacaine or levobupivacaine, both of which are clinically indistinguishable. The recovery profile of ropivacaine may be useful where prompt mobilization is required

Erdil et al (2009)[30] did prospective randomized study between block span and hemodynamic changes seen in geriatric patients posted for transurethral prostate surgery, after subarachnoid administration of levobupivacaine and bupivacaine. 80 patients were taken up and given plain bupivacaine or levobupivacaine (both 0.5%

solutions) including 15 mcg fentanyl as an additive. They concluded that highest sensory blockade and peak motor blockade was faster achieved with bupivacaine. Patients receiving bupivacaine had fall in mean arterial pressure (MAP), 10-30 minutes post drug administration and higher incidence of nausea and vomiting. Thus, levobupivacaine was found to be a better option for subarachnoid block in geriatric lot on account of less adverse effects and good stability of vitals intraoperatively and postoperatively.

Frawley et al (2009)[31] compared 151 neonates in 2 phases for subarachnoid anesthesia (with levobupivacaine, bupivacaine and ropivacaine) and concluded that bupivacaine 0.5% and ropivacaine 0.5% are of equipotent dosing with 1mg/kg compared to levobupivacaine 1.2mg/kg.

Cuvas et al (2010) [32] did a comparative study of subarachnoid anesthesia with 0.5% levobupivacaine (with and without fentanyl) in transurethral resection. It was a prospective, randomized, double-blinded study and included 40 males, above 60 years of age, posted for the surgery. Findings of motor and sensory blockade, side effects, vitals of the patient were noted. Conclusion was made that levobupivacaine alone and in combination with fentanyl was effective and that adding fentanyl offered benefits of achieving motor blockade for a lesser span.

Erbay*et al* (2010)[33] studied 60 patients scheduled for urological procedure undergoing subarachnoid block with bupivacaine and levobupivacaine (hyperbaric solutions) with 25mcg fentanyl added to each group. The main focus was on the total time for the motor block to regress. They concluded that levobupivacaine was a superior choice in this setting.

Suthadsanavijit et al (2011)[34] compared clinical efficacy of intrathecalLevobupivacaine and Bupivacaine for elective cesarean section and concluded levobupivacaine is more hemodynamically stable compared to bupivacaine.

Guler*et al* **(2012)**[35] compared the clinical efficacy of spinal anesthesia for cesarean section in sixty females with bupivacaine and levobupivacaine (hyperbaric solutions) with 15mcg fentanyl as an additive. Conclusion was made that as motor blockade time was lesser with fewer adverse effects (fall in blood pressure, respiratory rate, heart rate, vomiting), levobupivacaine in combination with fentanyl would make a better alternative.

Subasi*et al* **(2012)**[36] compared intrathecal hyperbaric bupivacaine and levobupivacaine with fentanyl for caesarean section and concluded that the later has got shorter duration of motor blockade and allows early mobilization.

Celik et al (2013)[37] carried out a study wherein they compared the hemodynamic and anesthetic effects of intrathecally administered bupivacaine and levobupivacaine in combination with fentanyl in hip surgery. 60 patients of ASA class 1 or 2 were include and subarachnoid block was given with bupivacaine and levobupivacaine (0.5% solutions) with 10mcg fentanyl as an additive to each of them. Motor and sensory blockade levels were evaluated with recording of the hemodynamic data. They found similarities between both the groups. Conclusion was made that for surgeries requiring little motor blockade, a much better option would be to go with levobupivacaine.

Gozaydin et al (2014)[38] chose 40 patients undergoing hernia repair to study the difference between levobupivacaine and bupivacaine (hyperbaric solutions) for

subarachnoid administration. Peripheral oxygen saturation, blood pressure before and after surgery, motor and sensory blockade and complications were observed. Two groups were found out to be more or less similar. It was observed that levobupivacaine was similar to bupivacaine in terms of anaesthesia, analgesia, hemodynamic parameters and adverse effect profile but was superior in that it caused lower incidence of cardiovascular and neurological side effects.

Herrera *et al* (2014)[39] investigated hemodynamic impact of hyperbaric bupivacaine versus isobaric levobupivacaine in 120 patients posted for pelvic surgery under spinal block. This study was majorly conducted to observe and analyse the hemodynamic vitals of the patients (blood pressure, heart rate, lung variables, and lab investigations like hemoglobin based on partial oxygen saturation- spo2) and secondarily to understand the side effects following administration of these drugs. These stable vitals and goals were easily achieved after administration of levobupivacaine.

Prabha*et al* (2014) [40] compared the effects of intrathecal administration of levobupivacaine and fentanyl with bupivacaine and fentanyl in parturient posted for elective caesarean section. Patients were allocated randomly into two groups of 20 each. Group L received 8.75 mg of 0.5% isobaric levobupivacaine with 12.5mcg of fentanyl. Group B received 8.75 mg of 0.5% hyperbaric bupivacaine with 12.5 mcg of fentanyl. Spinal analgesia is the most preferred anesthetic for LSCS, since it provides rapid and easy induction, effective motor and sensory blockade and has no significant effects on the fetus. When compared to bupivacaine with fentanyl, levobupivacaine with fentanyl produces adequate levels of sensory blockade with less intensive motor blockade and also better hemodynamic stability. They concluded that 8.75 mg of 0.5% levobupivacaine combined with 12.5mcg fentanyl prolongs the sensory

blockade with slower onset and early regression of motor blockade and also maintains stable intraoperative hemodynamic parameters and decreases the incidence of adverse effects like hypotension and bradycardia. Duration of effective analgesia was comparable to bupivacaine. Hence we opine that levobupivacaine is a better alternative to bupivacaine for spinal anesthesia for LSCS.

MATERIALS AND METHODS

STUDY DESIGN

After receiving approval from the institutional research and ethical committee a comparative study was conducted on 120 geriatric patients undergoing elective lower limb surgeries under subarachnoid block at Department of Anaesthesiology, _____ Medical College, Hospital and Research Centre, _____. The study duration was from December 2017- August 2019

Inclusion criteria :

1. Patients age group above 60 years.
2. Patients with ASA grade II and III.
3. Patients undergoing elective lower limb surgeries.

Exclusion criteria :

1. Patients having deformities of spine.
2. Patients having infection at the site of insertion of spinal needle.
3. Patients having bleeding disorders, coagulation abnormalities, raised Intra cranial pressure (ICP) and neurological deficits.

PREANAESTHETIC EXAMINATION AND PREPARATION

The study protocol received ethical clearance from the institution. Pre-anesthetic checkup was performed one day prior to the surgery. Patients were evaluated with history, general physical examination, systemic examination of cardiovascular, respiratory, central nervous system and spine examination for deformity was also

performed. Investigations like haemogram, bleeding time, clotting time, blood glucose, blood urea, serum creatinine were done. ECG and Chest X-ray were done wherever necessary. Patient's weight, height were also recorded prior to surgery. All patients were kept nil orally for 6-8 hours. The procedure of spinal anesthesia was explained to the patients and written informed consent was obtained

PREMEDICATION

Patients were pre-medicated with Tab. Ranitidine 150mg, on the previous night of surgery. Each patient was preloaded with an I.V. infusion of 500ml of Ringer Lactate solution and 50mg I.V. Ranitidine, 30 min prior to surgery.

METHOD

120 patients were randomly divided into 2 groups of 60 each.

Group B

60 patients received 3 ml hyperbaric Inj. 0.5% bupivacaine intrathecally.

Group L

60 patients received 3 ml hyperbaric Inj. 0.5% levobupivacaineintrathecally

Preparation of Operating room

Anesthesia machine was checked and cock pit drill performed. Appropriate size endotracheal tubes, working laryngoscope with medium and large size blades, stylet, bougie, other emergency airway equipment and working suction apparatus were kept ready prior to the procedure.

After shifting the patient to operating room, patients were monitored for non-invasive blood pressure (NIBP), heart rate (HR) and percentage of oxygen saturation (SPO2).

Under all aseptic precautions, subarachnoid block was performed using a 25G Quincke needle, with the patient in the lateral or sitting position depending on the patients comfort, at the L_3-L_4 interspace. The study solution was administered slowly. Patient was repositioned gently to supine position without elevation of extremities and tested every 5 minutes until maximal spread of sensory block and then every 15 minutes during the surgery.

PARAMETERS EVALUATED

Sensory Blockade:

This was assessed by loss of sensation to alcohol cotton swab on each side and patients asked about the sensation.

a) Time to onset of sensory block: Defined as the time between injection of the drug to the time of loss of sensation at L_2 level
b) Time to maximum sensory block: Defined as the time to reach highest dermatomal level with loss of sensation.
c) Time to two segment regression: Defined as the time period to regain sensation at two dermatomes lower to the initial level of highest dermatome
d) Time to rescue analgesia: Defined as the time at which patient complained pain at the site of surgery intraoperatively or postoperatively

MOTOR BLOCKADE

The degree of motor block was assessed using “Bromage scale”. Motor blockade was assessed at 5 minutes and then for every 30 seconds till grade IV block was achieved. And then every 15 minutes until return of normal motor function.

Onset time for motor block: It is defined as the time between injection and grade IV block. Heart rate (HR), mean arterial pressure (MAP), percentage saturation of oxygen (SPO2) and respiratory rate (RR) were recorded every 5 minutes for the first 30 minutes and then every 1 hourly for 3 hours throughout the surgery.

Patients were considered hypotensive when their MAP decreased to <65 mmHg, and were treated with Inj. Ephedrine 5 mg I.V. dose titrated according to response. A decrease in the heart rate to < 50 bpm was treated with Inj. Atropine 0.3-0.6mg I.V.

Parameters recorded intraoperatively:

- Time of onset of sensory blockade.
- Time to maximum level of sensory blockade.
- Time to grade IV motor blockade.
- Time to 2 segment regression.
- Time to rescue analgesia.
- Percentage of oxygen saturation (SPO2).
- Heart rate (HR).
- Mean arterial pressure (MAP).
- Respiratory rate (RR).

BROMAGE SCALE

Grade motor activity:

1. Free movement of legs or feet.
2. Just able to flex knees with free movement of feet.
3. Unable to flex knees but with free movement of feet.
4. Unable to move legs or feet.

Complications such as nausea, vomiting and shivering were treated accordingly and the treatment given was recorded.

All the patients were kept under observation in the postoperative period for4 hrs and heart rate (HR), mean arterial pressure (MAP), percentage of oxygen saturation (SpO_2) and respiratory rate (RR) were recorded at interval of every 30 min till 4 hours. All the patients were assessed for pain at regular intervals and rescue analgesia was given accordingly.

RESULTS

120 patients were chosen for the study. 60 patients were assigned into each of the groups. Group B patients received 3ml hyperbaric 0.5% bupivacaine and Group L patients received 3ml hyperbaric 0.5% levobupivacaine.

STATISTICAL ANALYSIS

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

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

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

The subscript "c" stands for the degrees of freedom, "O" is observed value and E is expected value.

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

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

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

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

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

n_1 = number of subjects in sample 1

n_2 = number of subjects in sample 2

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

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

If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as statistically insignificant. Data were analyzed using SPSS software v.23.0. on Microsoft office 2007.

DEMOGRAPHIC DATA

Table No. 2

Distribution of patients according to age group

Paramaters	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
Age (yrs)	69.1	8.0	70.2	8.6	0.478

The above table shows the mean distribution of patients according to age group in both bupivacaine and levobupivacaine groups.

Majority of the patients in both the groups were in the age between 61-70 years.

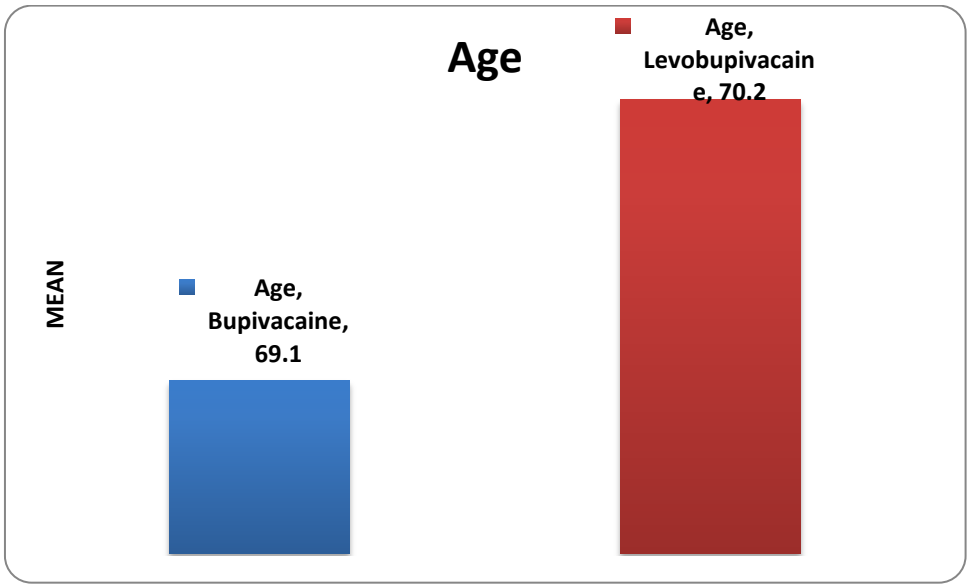


FIGURE 13 : DISTRIBUTION OF AGE BETWEEN STUDY GROUPS

Table No. 3

Distribution of patients according to gender

Gender	Bupivacaine		Levobupivacaine		p value
	N	%	N	%	
Male	38	63.3%	29	48.3%	0.098
Female	22	36.7%	31	51.7%	
Total	60	100.0%	60	100.0%	

The above table shows the distribution of patients according to gender in both bupivacaine and levobupivacaine groups.

In the bupivacaine group, there were 22 (36.7%) females and 38 (63.3%) males, while in the levobupivacainegroup, there were 31 (51.7%) females and 29 (48.3%) males.

In bupivacaine group, there was a male preponderance, while in the levobupivacaine group, there was near about equal distribution of males and females.

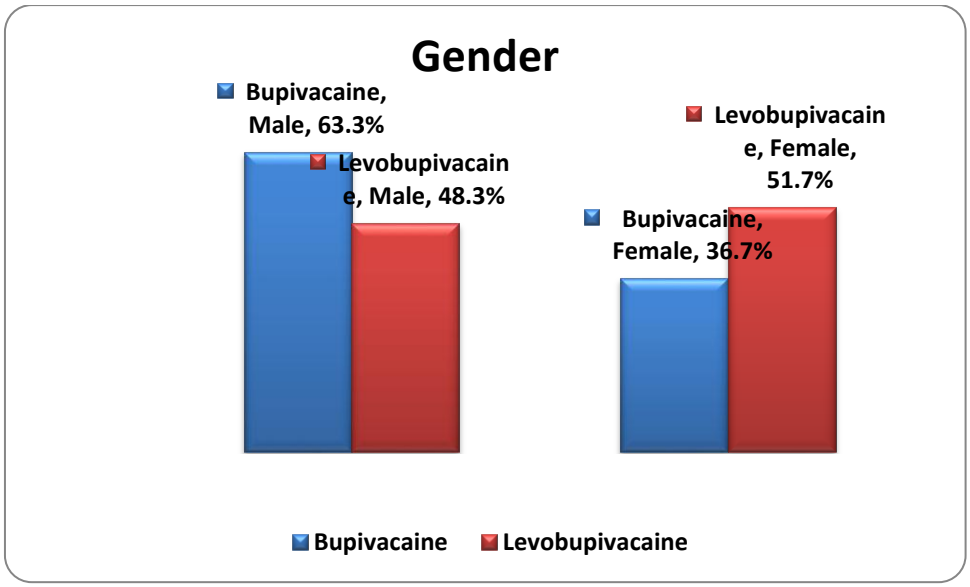


FIGURE 14: DISTRIBUTION OF GENDER BETWEEN STUDY GROUPS

Table No. 4

Distribution of patients according to ASA Grade

ASA GRADE	Bupivacaine		Levobupivacaine		p value
	N	%	N	%	
II	59	98.3%	55	91.7%	0.094
III	1	1.7%	5	8.3%	
Total	60	100.0%	60	100.0%	

The above table shows the distribution of patients according to ASA grading in both bupivacaine and levobupivacaine groups.

In the bupivacaine group, 59 (98.3%) patients were in ASA Grade II and 1 (1.7%) were in ASA Grade III.

In the levobupivacaine group, there were 55 (91.7%) patients in ASA Grade II, while 5 (8.3%) patients were in ASA Grade III.

Majority of the patients in both the group were in ASA Grade II.

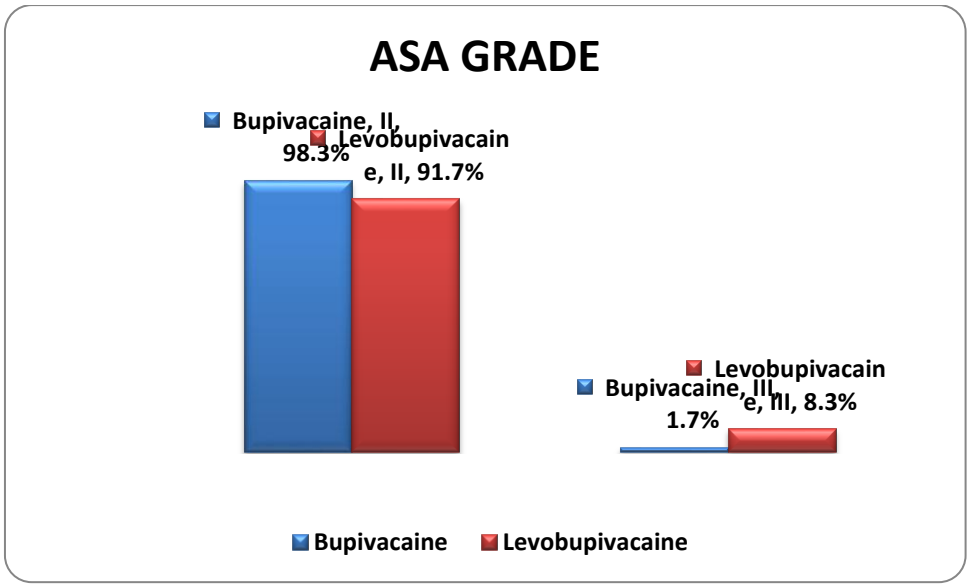


FIGURE 15: DISTRIBUTION OF ASA GRADE BETWEEN STUDY GROUPS

Table No. 5

Comparison of mean Heart Rate between

Bupivacaine and Levobupivacaine Groups intraoperatively at different Time

Intervals

Heart Rate Intraoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
5 min	76.7	10.8	79.8	6.4	0.053
10 min	78.7	10.2	82.0	7.7	0.048*
15 min	80.8	12.6	83.3	7.1	0.183
20 min	82.3	12.6	80.8	6.8	0.413
25 min	81.4	13.2	79.8	6.7	0.410
30 min	80.6	11.2	79.8	6.1	0.621
1 hour	80.7	11.1	81.6	6.5	0.575
2 hours	76.7	10.0	80.5	5.9	0.013*
3 hours	77.0	3.3	77.8	3.3	0.209

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

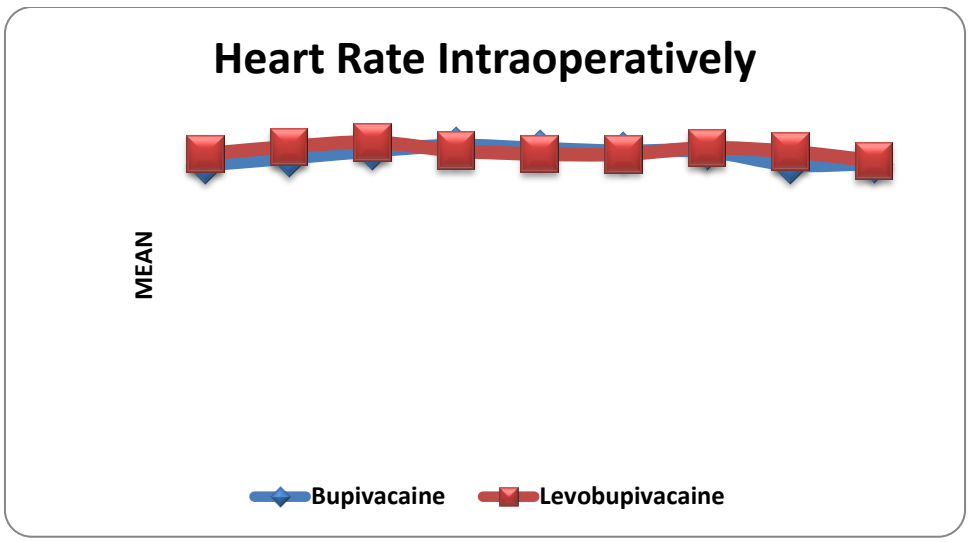


FIGURE 16: CHANGES IN HEART RATE INTRAOPERATIVELY

BETWEEN STUDY GROUPS

Table No. 6

Comparison of mean Heart Rate between

Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals

Heart Rate Postoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
30 min	73.4	7.6	74.0	5.3	0.627
1 hour	71.9	6.4	75.7	3.8	<0.001*
1.5 hour	72.8	7.4	72.3	6.6	0.687
2 hour	72.8	8.2	73.4	7.0	0.694
2.5 hour	73.6	8.0	73.4	7.9	0.863
3 hours	72.0	7.6	73.9	6.2	0.061
3.5 hour	72.8	6.1	73.4	6.9	0.636
4 hours	73.7	6.8	73.3	6.7	0.725

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

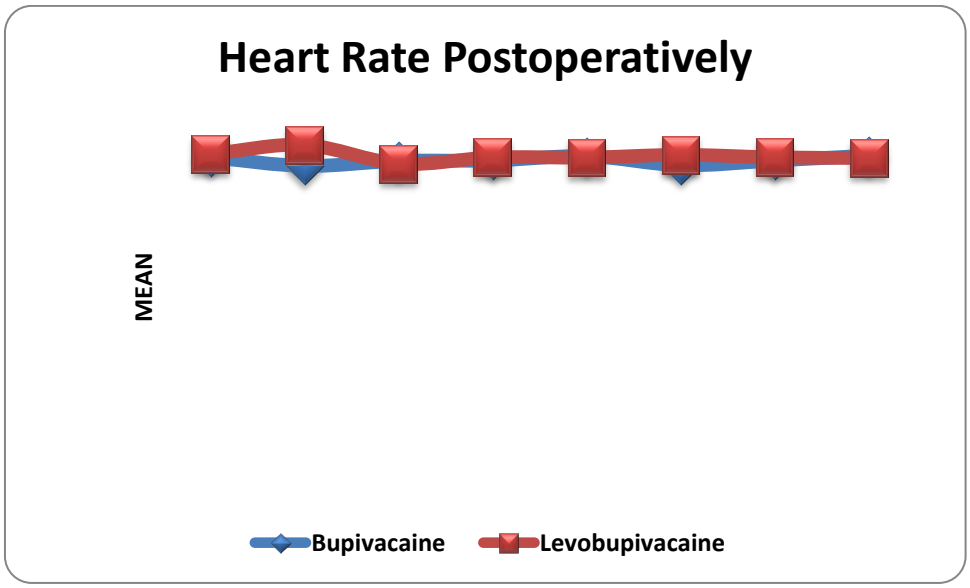


FIGURE 17: CHANGES IN HEART RATE POSTOPERATIVELY BETWEEN STUDY GROUPS

The above table shows the comparison of mean heart rate between bupivacaine and levobupivacaine groups at different time intervals.

In the bupivacaine group, there was a slight increase in mean heart rate from 5 min to 20 min intraoperatively, and then again it started falling till 3 hours when the mean heart rate was nearly comparable with that at 5 min. After 3 hours, there was a slight increase in heart rate till 4 hours. Postoperatively at 4 hours the mean heart rate was nearly same as that at baseline.

In the levobupivacaine group, there was slight increase in mean heart rate till 15 min and then again it started falling till 2 hours postoperatively. Heart rate again increasing from 2 hours 30 min postoperatively till 3 hours, then again started falling from 3 hours 30 min postoperatively till 4 hours postoperatively. At 4 hours postoperatively the mean heart rate was less in comparison to the baseline mean heart rate.

Table No. 7

Comparison of mean Mean Arterial Pressure between

Bupivacaine and Levobupivacaineintraoperatively at different Time Intervals

MAP Intraoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
5 min	61.9	9.8	67.0	7.7	0.002*
10 min	57.7	13.7	61.3	8.7	0.091
15 min	56.3	12.4	60.1	8.5	0.054
20 min	59.1	7.0	62.3	6.6	0.011*
25 min	62.2	6.9	66.5	6.2	0.001*
30 min	64.7	5.0	69.0	5.0	<0.001*
1 hour	70.9	6.5	69.5	5.9	0.222
2 hours	72.8	5.2	72.3	6.2	0.670
3 hours	77.5	3.9	77.0	3.8	0.536

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

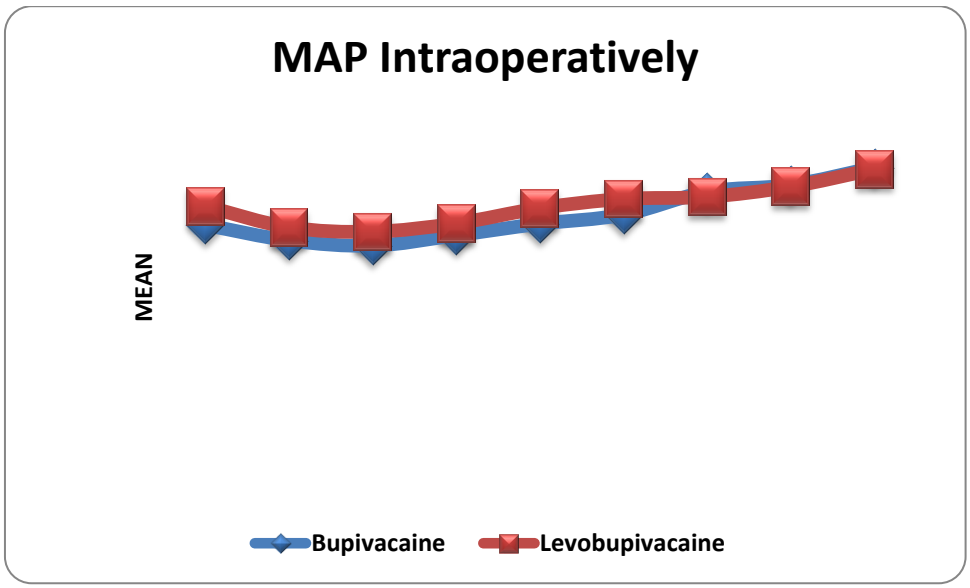


FIGURE 18: CHANGE IN MAP INTRAOPERATIVELY BETWEEN STUDY GROUPS

Table No. 8

Comparison of mean Mean Arterial Pressure between Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals

MAP Postoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
30 min	73.5	5.5	74.6	4.6	0.219
1 hour	74.3	6.4	75.2	4.7	0.345
1.5 hour	76.3	5.2	75.1	5.3	0.208
2 hour	75.5	6.0	73.0	5.8	0.022*
2.5 hour	76.2	8.7	76.6	4.2	0.739
3 hours	71.9	6.5	72.1	6.2	0.875
3.5 hour	75.7	4.4	75.9	4.6	0.808
4 hours	75.6	5.1	74.7	5.5	0.401

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

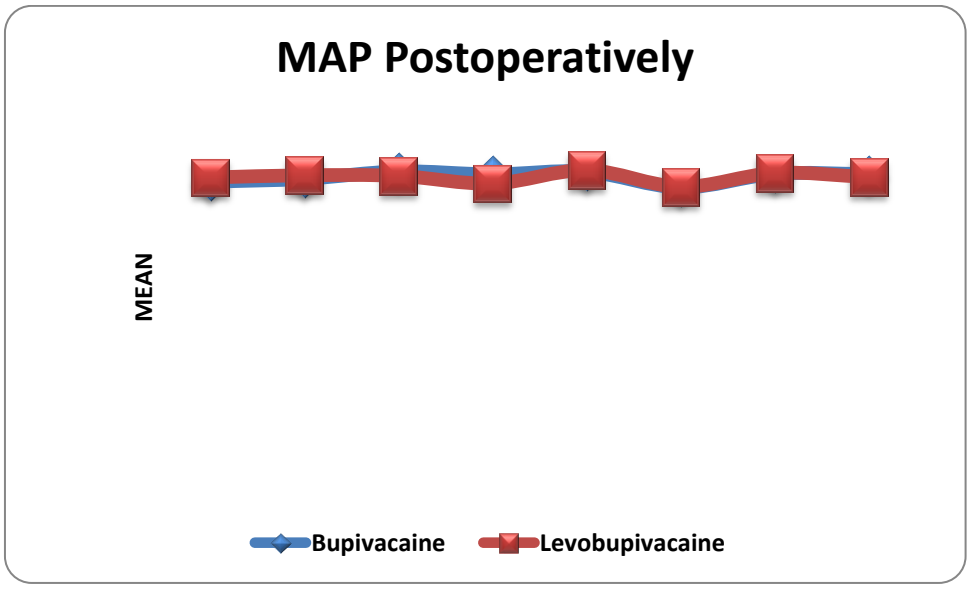


FIGURE 19: CHANGE IN MAP POSTOPERATIVELY BETWEEN STUDY GROUPS

The above table shows the mean mean arterial pressure comparison between the bupivacaine and levobupivacaine groups at different time intervals.

In the bupivacaine group, there was a fall in mean arterial pressure till 20 min, and then it started rising till 3 hours intraoperatively. Again there was a fall at 30 min postoperatively and then rise from 1 hour postoperatively till 3 hours 30 min postoperatively. There was a slight fall at 4 hours postoperatively. At 4 hours postoperatively, the mean mean arterial pressure was much higher in comparison to that at 5 min.

In the levobupivacaine group, there was a fall in mean arterial pressure till 15 min, then it started rising till 3 hours intraoperatively. There was a fall at 30 min postoperatively, then increase from 1 hour postoperatively till 2 hours 30 min postoperatively. Then a fall at 3 hours postoperatively and then a rise at 3 hours 30 min postoperatively and then a slight fall at 4 hours postoperatively. At 4 hours postoperatively, the mean mean arterial pressure was much higher than that at 5 min.

Table No. 9

Comparison of mean Respiratory Rate between Bupivacaine and Levobupivacaine Groups intraoperatively at different Time Intervals

Respiratory Rate Intraoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
5 min	19.1	1.5	18.6	1.3	0.044*
10 min	19.6	1.7	19.5	1.3	0.719
15 min	20.0	1.9	19.5	1.4	0.076
20 min	20.3	2.0	19.8	1.2	0.108
25 min	20.6	2.2	20.1	1.6	0.213
30 min	21.0	2.9	20.2	2.1	0.102
1 hour	20.4	1.9	20.4	1.6	0.959
2 hours	20.6	1.6	20.3	1.9	0.273
3 hours	20.2	1.0	20.3	1.3	0.534

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

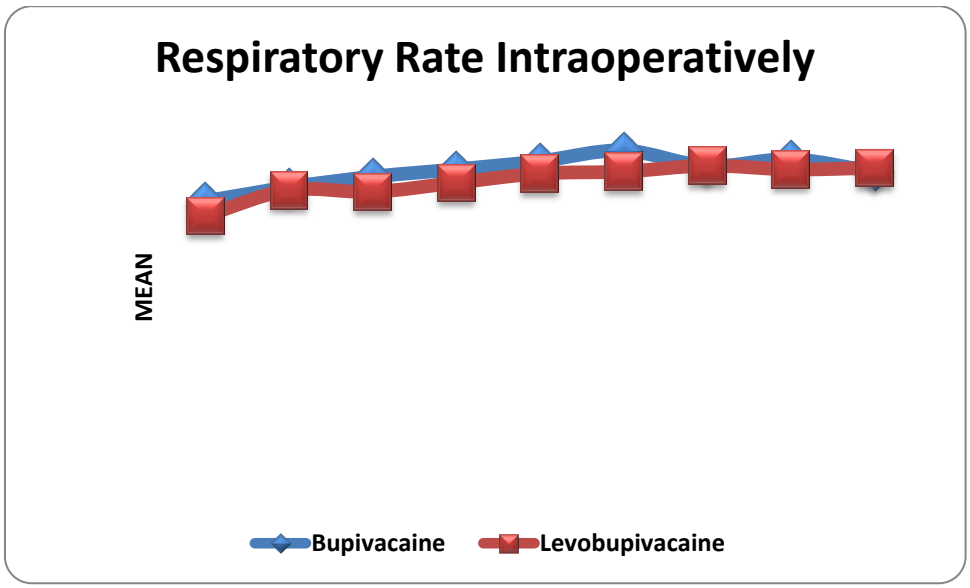


FIGURE 20: CHANGE IN RESPIRATORY RATE INTRAOPERATIVELY BETWEEN STUDY GROUPS

Table No. 10

Comparison of mean Respiratory Rate between

Bupivacaine and Levobupivacaine Groups postoperatively at different Time

Intervals

Respiratory Rate Postoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
30 min	18.1	1.6	19.7	1.3	<0.001*
1 hour	18.9	1.9	18.9	1.7	0.920
1.5 hour	19.0	2.3	20.0	1.6	0.007*
2 hour	19.9	1.7	19.8	2.0	0.844
2.5 hour	20.2	1.8	20.4	2.0	0.732
3 hours	18.5	2.0	18.2	1.9	0.401
3.5 hour	19.0	2.3	19.3	1.9	0.513
4 hours	19.2	2.1	19.4	2.0	0.628

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

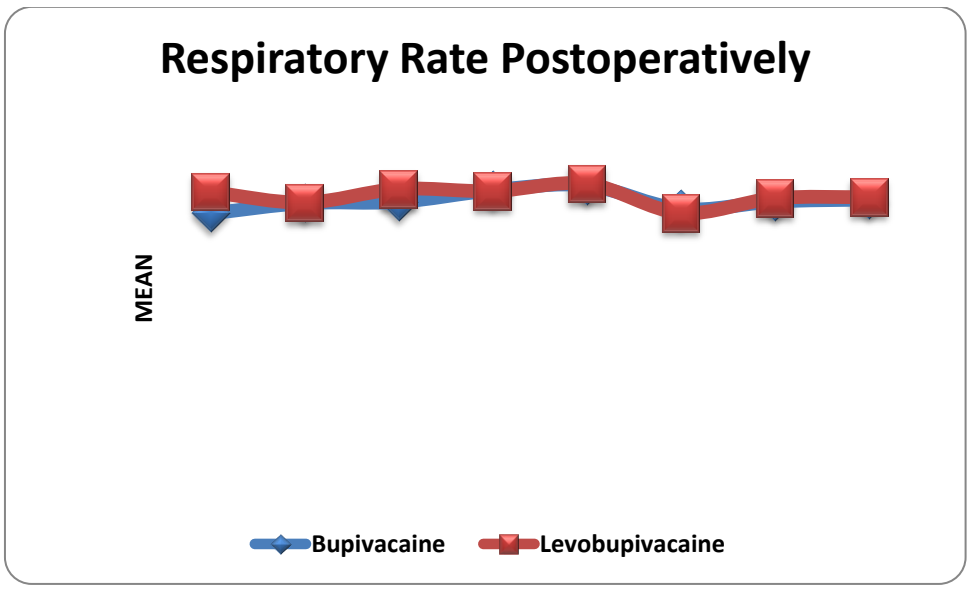


FIGURE 21: CHANGE IN RESPIRATORY RATE POSTOPERATIVELY

BETWEEN STUDY GROUPS

The above table shows the comparison of mean respiratory rate between the bupivacaine and levobupivacaine groups.

In the bupivacaine group, there was an increase in mean respiratory rate from 5 min till 3 hours intraoperatively. Then a fall at 30 min postoperatively, then again a rise from 1 hour postoperatively till 2 hours 30 min, then a fall at 3 hours postoperatively and then again a rise at 3 hours 30 min postoperatively, then a slight fall at 4 hours postoperatively. The mean respiratory rate at 4 hours postoperatively was slightly higher than that at 5 min.

In the levobupivacaine group, there was an increase in respiratory rate till 3 hours intraoperatively. Then a fall at 30 min postoperatively, then a rise from 1 hour postoperatively till 2 hours 30 min postoperatively, and then a fall at 3 hours postoperatively, then a rise at 3 hours 30 min postoperatively and then a very slightly fall at 4 hours postoperatively. The mean respiratory rate at 4 hours postoperative was slightly higher than that at 5 min.

Table No. 11

Comparison of mean SpO_2 between

Bupivacaine and Levobupivacaine Groups intraoperativelyat different Time

Intervals

SpO2 Intraoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
5 min	99.7	0.6	99.8	0.8	0.699
10 min	99.7	0.7	99.8	0.8	0.389
15 min	99.5	0.9	99.8	0.9	0.066
20 min	99.7	0.7	99.8	0.6	0.215
25 min	99.6	0.9	99.7	0.7	0.486
30 min	99.6	0.7	99.9	0.4	0.009*
1 hour	99.4	0.8	99.4	0.9	0.918
2 hours	99.8	0.5	99.8	0.5	0.435
3 hours	99.4	0.9	99.6	0.8	0.209

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

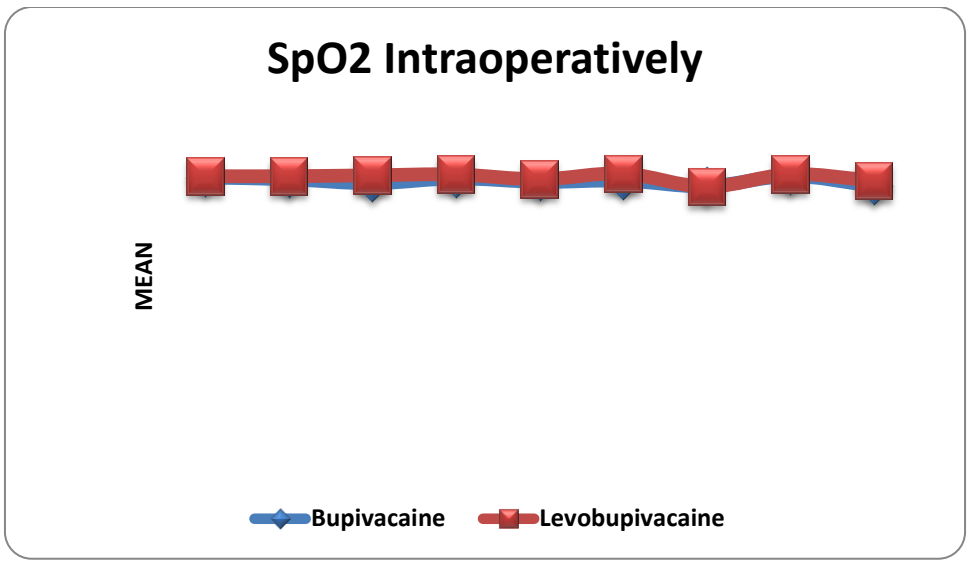


FIGURE 22: CHANGE IN SpO2 INTRAOPERATIVELY BETWEEN STUDY GROUPS

Table No. 12

Comparison of mean SpO_2 between

Bupivacaine and Levobupivacaine Groups postoperatively at different Time Intervals

SpO2 Postoperatively	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
30 min	99.5	0.6	99.4	0.9	0.470
1 hour	99.6	0.6	100.0	0.2	<0.001*
1.5 hour	99.8	0.5	99.9	0.3	0.052
2 hour	99.6	0.6	99.9	0.4	0.004*
2.5 hour	99.7	0.6	99.9	0.4	0.033*
3 hours	99.6	0.7	99.4	0.7	0.158
3.5 hour	99.5	0.7	99.5	0.7	0.791
4 hours	99.3	0.8	99.5	0.8	0.440

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

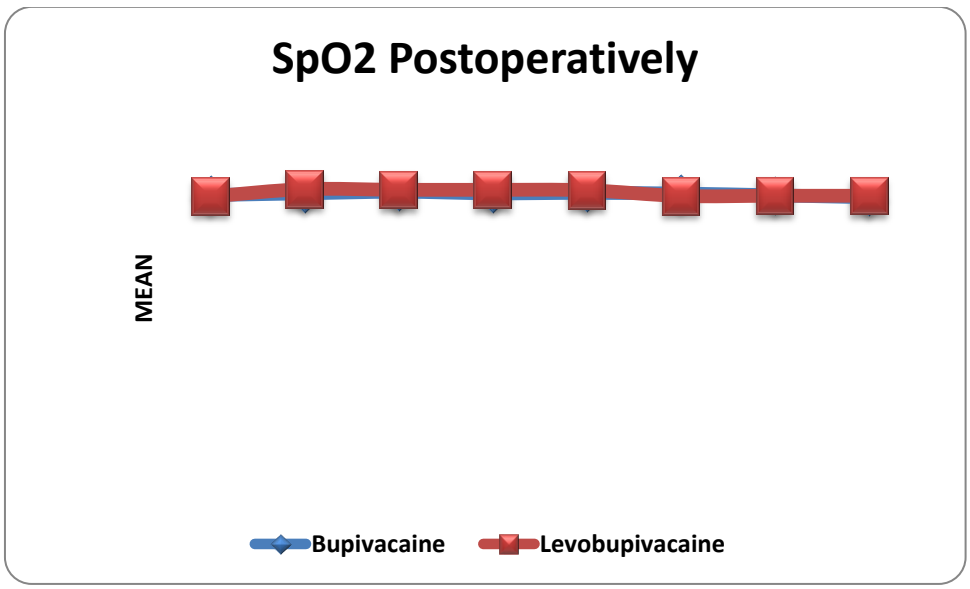


FIGURE 23: CHANGE IN SpO2 POSTOPERATIVELY BETWEEN STUDY GROUPS

The above table shows the comparison of mean SpO2 between the bupivacaine and levobupivacaine groups at different time intervals.

In the bupivacaine group, there was no major change in the SpO2 till 4 hours postoperatively from that at 5 min. At 4 hours postoperatively, the mean SpO2 was nearly similar to that at 5 min.

In the levobupivacaine group also, there was no major change in the SpO2 till 4 hours postoperatively from that at 5 min. At 4 hours postoperatively, the mean SpO2 was nearly similar to that at 5 min.

Table No. 13

Comparison of mean time of onset of sensory blockade between Bupivacaine and Levobupivacaine Groups

Time of onset of sensory block	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
	2.4	0.8	3.0	0.8	<0.001*

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

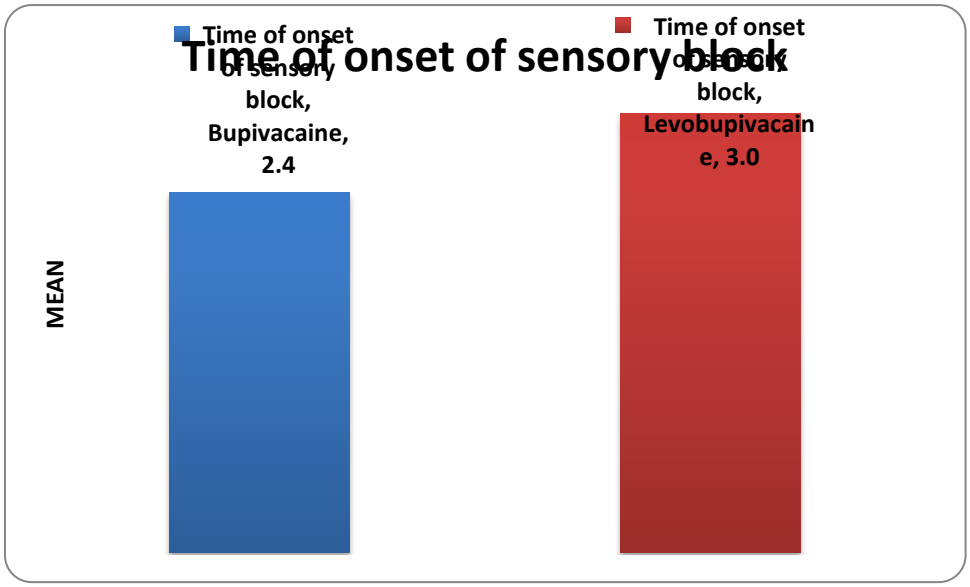


FIGURE 24: TIME OF ONSET OF SENSORY BLOCK BETWEEN STUDY GROUPS

The above table shows the comparison of mean time of onset of sensory blockade between the bupivacaine and levobupivacaine groups.

The mean time of onset of sensory blockade in bupivacaine group was 2.4 ± 0.8 min, while in the levobupivacaine group it was 3 ± 0.8 min.

Table No. 14

Comparison of mean time to maximum level of sensory block between Bupivacaine and Levobupivacaine Groups

Time to reach highest level of sensory blockade	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
	7.0	1.3	7.4	1.6	0.127

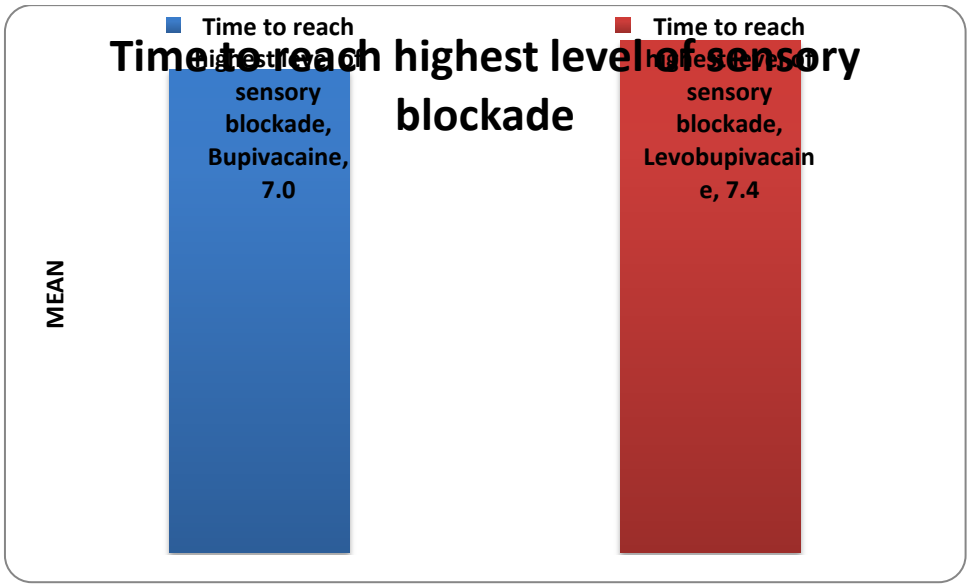


FIGURE 25: TIME TO REACH HIGHEST LEVEL OF SENSORY BLOCKADE BETWEEN STUDY GROUPS

The above table shows the comparison of mean time to maximum level of sensory block between the bupivacaine and levobupivacaine groups.

The mean time to maximum level of sensory block in bupivacaine group was 6.86 ± 1.37 min, while in the levobupivacaine group it was 7.16 ± 1.59 min.

Table No. 15

Comparison of mean time to grade 4 motor blockade between Bupivacaine and Levobupivacaine Groups

Time to obtain grade 4 motor block (Bromage Scale)	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
	10.7	1.8	10.8	1.5	0.872

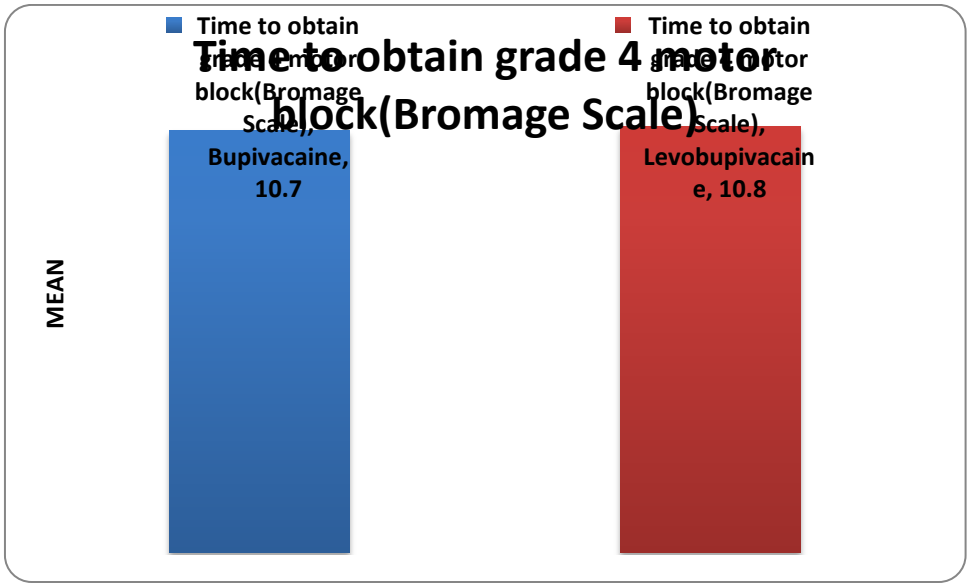


FIGURE 26: TIME TO OBTAIN GRADE 4 MOTOR BLOCK BETWEEN STUDY GROUPS

The above table shows the comparison of mean time to grade 4 motor blockade between the bupivacaine and levobupivacaine groups.

The mean time to grade 4 motor blockade in bupivacaine group was 10.70 ± 1.96 min, while in the levobupivacaine group it was 10.64 ± 1.60 min.

Table No. 16

Comparison of mean time to 2 segment regression between Bupivacaine and Levobupivacaine Groups

Time to reach 2-segments regression	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
	101.7	7.2	104.3	7.2	0.046*

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

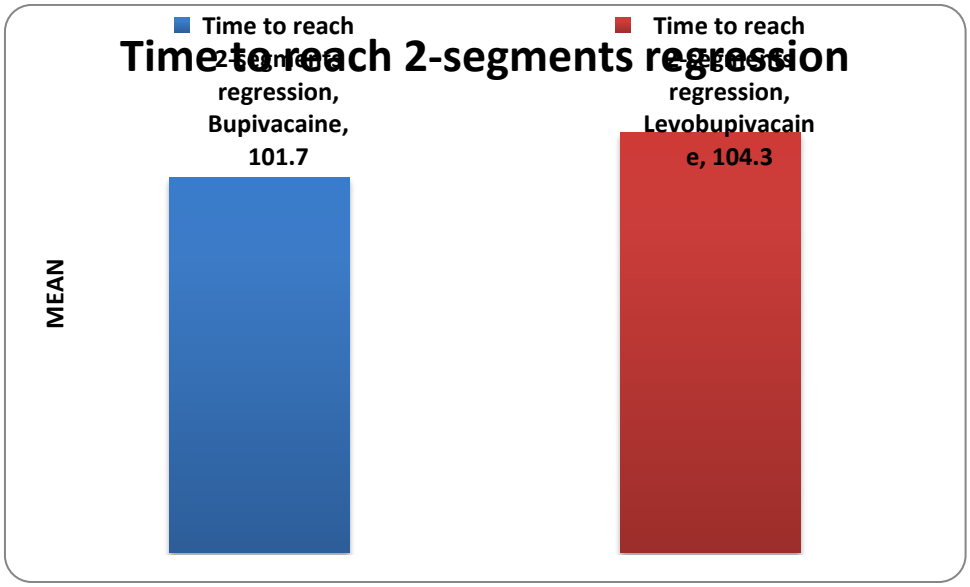


FIGURE 27: TIME TO REACH 2-SEGMENTS REGRESSION BETWEEN STUDY GROUPS

The above table shows the comparison of mean time to 2 segment regression between the bupivacaine and levobupivacaine groups.

The mean time to 2 segment regression in bupivacaine group was 101.36 ± 7.76 min, while in the levobupivacaine group it was 104.76 ± 7.62 min.

Table No. 17

Comparison of mean time to rescue analgesia between

Bupivacaine and Levobupivacaine Groups

Time to rescue analgesia	Bupivacaine		Levobupivacaine		p value
	Mean	SD	Mean	SD	
	147.0	14.1	155.5	15.0	0.002*

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

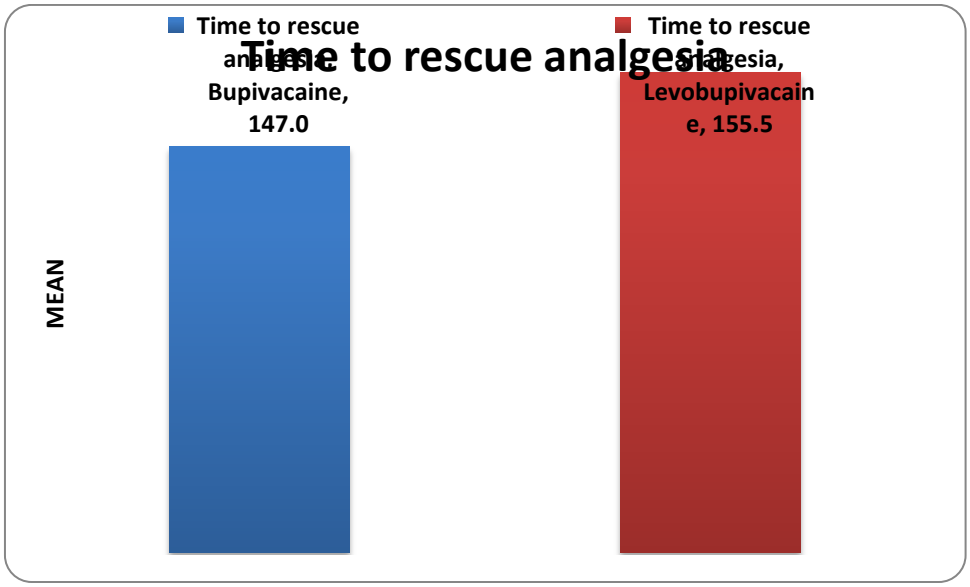


FIGURE 28: TIME TO RESCUE ANALGESIA BETWEEN STUDY GROUPS

The above table shows the comparison of mean time to rescue analgesia between the bupivacaine and levobupivacaine groups.

The mean time to rescue analgesia in bupivacaine group was 146.22 ± 15.46 min, while in the levobupivacaine group it was 152.04 ± 14.88 min.

Table No. 18

Distribution of patients according to hypotension

Hypotension	Bupivacaine		Levobupivacaine		p value
	N	%	N	%	
YES	21	35.0%	5	8.3%	<0.001*
NO	39	65.0%	55	91.7%	
Total	60	100.0%	60	100.0%	

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

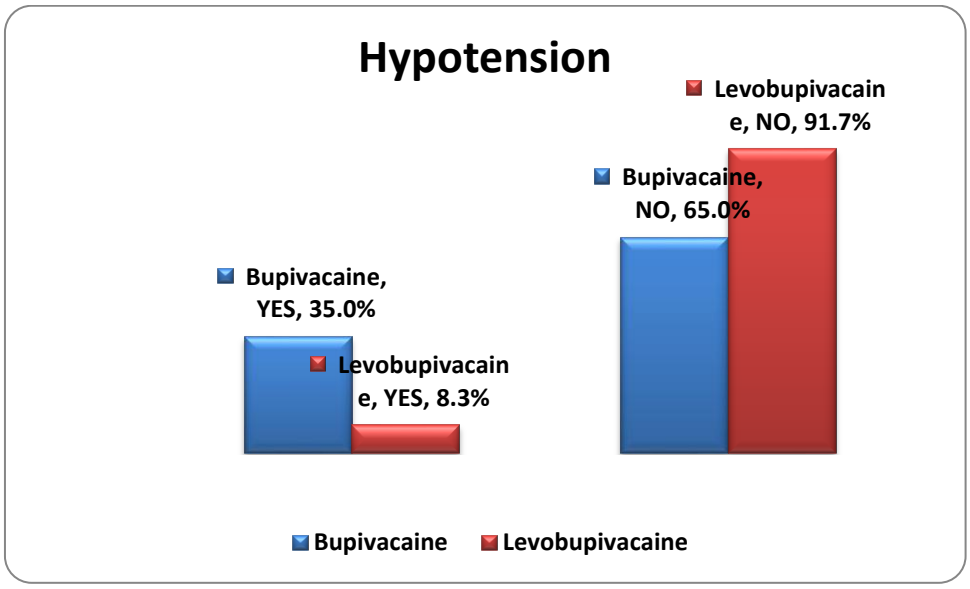


FIGURE 29: HYPOTENSION BETWEEN STUDY GROUPS

The above table shows the distribution of patients as per hypotension in bupivacaine and levobupivacaine groups.

In the bupivacaine group, 21 (35%) patients had hypotension, while in the levobupivacaine group 5 (8.3%) patients had hypotension.

DISCUSSION

Lower limb fractures are most commonly seen in geriatric population like neck of femur fracture or shaft of femur fracture etc. Various factors such as altered cognitive function, neuromuscular degeneration, reduced bone mineral density and environmental factors are responsible for trivial injury in geriatrics. Surgical fixation of fracture is the definitive treatment. Ageing is a universal and progressive physiological phenomenon clinically characterized by degenerative changes in both the structure and the functional capacity of organs and tissues.

In general, geriatric patients are more sensitive to anesthetic agents. Less medication is usually required to achieve a desired clinical effect, and drug effect is often prolonged. The most important outcome and overall objective of peri-operative care of geriatric population, is to speed recovery and avoid functional decline. Spinal anesthesia is a widely used anesthetic technique for lower limb surgery in the elderly. Spinal anesthesia is often preferred for its efficacy, rapidity, minimal effect on mental status, reduction of blood loss, and protection against thrombo-embolic complications. But risk of severe and prolonged hypotension is associated with spinal anesthesia. This is due to the rapid extension of the sympathetic block, hindering cardiovascular adaptation and causing significant morbidity and mortality.

This study largely focuses on the relative potencies, systemic effects, particularly cardiovascular system and the relative degree of sensory and motor blockade with bupivacaine and levobupivacaine in geriatric patients who are undergoing lower limb surgeries.

This study designated the patients into two groups, i.e.

- The B group - Bupivacaine group and
- The L group – Levobupivacaine group

DEMOGRAPHIC DATA

Majority of the patients in both the groups were in the age group of 61-70 years.

Majority of the patients in both the groups were in ASA Grade II.

COMPARISON OF MEANTIME OF ONSET OF SENSORY BLOCKADE

In present study the time for sensory block to reach the L2 level were shorter in the bupivacaine group, difference was found to be statistically significant with P value < 0.05.

This study is comparable with study of **Erdil***et al***.**[30] which compared the effect of intrathecallevobupivacaine and bupivacaine in 80 elderly patients and showed mean onset time for sensory blockade at T10 dermatome was about 6.4 minute and 7.8 minute for bupivacaine and levobupivacaine respectively with P value < 0.05.

Our study also showed the P value of <0.05 which is highly significant

Celiketal[37] studied the effectiveness of bupivacaine and levobupivacaine in hip surgery which showed no significant difference in onset time of sensory blockade. This study was conducted in age group between 18-65 yrs with low dose of drug.

Casati et al[24] studied the effectiveness of bupivacaine, levobupivacaine and ropivacaine for unilateral spinal anesthesia for inguinal hernioplasty which showed there was no significant difference in onset time of sensory blockade between these drugs.

Overall in our study time of sensory blockade was almost similar in bupivacaine and levobupivacaine groups.

COMPARISON OF MEAN TIME TO MAXIMUM LEVEL OF SENSORY BLOCKADE

This study observes that there is no significant difference between the two groups as far as overall attainment of highest dermatomal level of sensory blockade with p value >0.05

Erdilet al[30]which compared the effect of intrathecallevobupivacaine and bupivacaine in the elderly showed the mean time to maximal level of sensory blockade is significantly shorter in the bupivacaine group compared to levobupivacaine group with P value <0.05.

Thongrong et al[28] conducted study in the patients scheduled for elective lower abdominal and lower extremities surgery with similar spinal doses like our study and found that there is no significant difference in two groups in quality of sensory blockade (P value > 0.05) although they used isobaric levobupivacaine.

Erbay et al[33]also observed that the time taken for maximum sensory blockade were similar in both groups.

COMPARISON OF MEAN TIME TO GRADE IV MOTOR BLOCKADE

This study showed that the mean time to grade 4 motor blockade in bupivacaine group was 10.70 ± 1.8 min, while in the levobupivacaine group it was 10.8 ± 1.5 min.

The difference was found to be statistically not significant (P > 0.05), thus, time to grade 4 motor blockade was comparable in both the groups.

Thongrong et al[28]conducted study in the patients scheduled for elective lower abdominal and lower extremities surgery with similar spinal doses like our study and found that there is no significant difference in two groups in quality of motor blockade (P value> 0.05) with isobaric bupivacaine.

COMPARISON OF MEAN TIME TO TWO SEGMENTS REGRESSION

The study shows that the mean time to two segments regression in bupivacaine group was 101.70 ± 7.2 min, while in the levobupivacaine group it was 104.3 ± 7.2 min.

The difference was found to be statistically significant (P < 0.05), with a higher time for two segments regression in levobupivacaine group in comparison to bupivacaine group.

The study conducted by **Erdil et al**[30] for the comparison of effects of levobupivacaine and bupivacaine in elderly observed that the time taken for the two segment regression was 78.3 for bupivacaine and 80.3 for levobupivacaine with p value >0.05.But in our study we found the two segment regression was higher for levobupivacaine than bupivacaine. This difference may be due to the difference in the drug dosages in both the studies.

COMPARISON OF MEAN TIME TO RESCUE ANALGESIA

This study shows that the mean time to rescue analgesia in bupivacaine group was 147.0 ± 14.1 min, while in the levobupivacaine group it was 155.5 ± 15.0 min.

The difference was found to be statistically significant (P <0.05), thus, time to rescue analgesia in was earlier in bupivacaine group than in levobupivacaine group.

Erbay*et al* (2010)[33] studied 60 patients scheduled for urological procedure undergoing subarachnoid block with bupivacaine and levobupivacaine (hyperbaric

solutions) and similar to our study found that the requirement for analgesia was earlier in Group Bupivacaine (305+/-50 min) than in Group Levobupivacaine (389+/-146 min), (P=0.004).

COMPARISON OF COMPLICATIONS

This study shows that in the bupivacaine group, 21 (35%) patients had hypotension, while in the levobupivacaine group, 5 (8.3%) patients had hypotension.

In bupivacaine group, there was higher number of hypotension seen in comparison to levobupivacaine group.

Guler*et al* (2012)[35] compared the clinical efficacy of spinal anesthesia for cesarean section in sixty females with bupivacaine and levobupivacaine (hyperbaric solutions). Conclusion was made that as motor blockade time was lesser with fewer adverse effects (fall in blood pressure, heart rate, vomiting), levobupivacaine would make a better alternative, which is similar to the finding in our study.

Overall hypotension was most common complication seen with bupivacaine.

COMPARISON OF MEAN HEART RATE

When mean heart rate was compared between the two groups, the mean heart rate was found to be comparable at all the time intervals ($P > 0.05$), except at 2 hours intraoperatively, when it was statistically significant ($P < 0.05$), with a higher heart rate in levobupivacaine group in comparison to bupivacaine group.

Vanna et al[25] study showed that there is no significant difference in heart rate in the intraoperative period with bupivacaine and levobupivacaine group.

Fattorinietal[27]compared bupivacaine with levobupivacaine and concluded that there is no significant difference observed in intraoperative heart rate.

COMPARISON OF MEAN ARTERIAL PRESSURE

This study showed that the mean arterial pressure between the two groups at different time intervals, was statistically significant (P<0.05) at 5 min, 20 min, 25 min and 30 min, with a higher mean arterial pressure in levobupivacaine group in comparison to bupivacaine group.

Erdil et al[30] studied the effects of intrathecallevobupivacaine and bupivacaine in the elderly and concluded that MAP was significantly lower in group bupivacaine than levobupivacaine with P value <0.05

Fattorinietal[27] compared bupivacaine with levobupivacaine and concluded that there is no significant difference in intraoperative Mean Arterial Pressure. They used isobaric solution in their study

COMPARISON OF MEAN RESPIRATORY RATE

This study showed that there is significant difference observed in both groups with respect to respiratory rate at 5min intraoperatively and 30min and 1 hour postoperatively, with P value <0.05, with a higher respiratory rate in levobupivacaine group.

Guler*et al* (2012)[35] compared the clinical efficacy of spinal anesthesia for cesarean section in sixty females with bupivacaine and levobupivacaine (hyperbaric solutions). Conclusion was made that as motor blockade time was lesser with fewer adverse effects (fall in blood pressure, respiratory rate, heart rate, vomiting), levobupivacaine would make a better alternative, similar to the findings in our study.

COMPARISON OF MEAN SpO_2

This study showed there was statistically significant difference in mean spo2 at 30min intraoperatively and at 1 hour and 3 hours postoperatively, with p value < 0.05, with higher spo2 levels in levobupivacaine group.

Herrera *et al* (2014)[39] investigated hemodynamic impact of hyperbaric bupivacaine versus isobaric levobupivacaine in 120 patients posted for pelvic surgery under spinal block. This study was majorly conducted to observe and analyse the hemodynamic vitals of the patients (blood pressure, heart rate, lung variables, and lab investigations like hemoglobin based on partial oxygen saturation- spo2) and secondarily to understand the side effects following administration of these drugs. These stable vitals and goals were easily achieved after administration of levobupivacaine, which were similar to the findings in our study.

SUMMARY

A comparative study was conducted involving 120 patients belonging to ASA grade II and III undergoing elective lower limb surgeries. They were randomly divided into two groups of 60 each with age group above 60 yrs. They were designated as group B and group L. Group B received 3 ml 0.5% hyperbaric bupivacaine and Group L received 3 ml 0.5% hyperbaric levobupivacaine. Patients were pre-medicated with Tab. Ranitidine 150mg, on the previous night of surgery. Each patient was preloaded with an I.V. infusion of 500ml of Ringer Lactate solution and 50mg I.V. Ranitidine, 30 min prior to surgery. Following institution of subarachnoid block under aseptic precautions, sensory characteristics such as onset of sensory blockade, time to maximum sensory blockade and time to two segments regression were recorded. Motor characteristics such as time to grade 4 motor blockade were recorded. Monitoring of pulse oximetry, respiratory rate, heart rate, mean arterial pressure, partial oxygen saturation (spo2) were noted at 5 minutes interval for 30 minutes, thereafter hourly until the end of the surgery. Postoperatively the same parameters were recorded for the first 4 hours for every 30 minutes.

Demographic characteristics of both the groups were comparable. It was observed that onset of sensory blockade was earlier in bupivacaine as compared to levobupivacaine group, and most of the parameters were comparable between two groups. Duration of 2 segment regression was faster in bupivacaine group and requirement of rescue analgesia was earlier in bupivacaine group, compared to levobupivacaine group. In the present study HR, RR, MAP and SPO2 were lower with bupivacaine, when compared to levobupivacaine. Higher incidence of hypotension was also observed in bupivacaine group.

CONCLUSION

From the results obtained from this study, we conclude that even though there was no major statistically significant difference between the efficacy of levobupivacaine and bupivacaine when used in a volume of 3 ml for spinal anesthesia with respect to:

1. Time of onset of sensory blockade
2. Time to maximum level of sensory blockade
3. Time to grade 4 motor blockade
4. Time to 2 segment regression
5. Time to rescue analgesia
6. Hemodynamic change (RR, SPO2, MAP, HR)
7. Side effects like hypotension

But the increased incidence of intraoperative hypotension with bupivacaine suggests that levobupivacaine is a better drug in maintaining peri-operative hemodynamics in a geriatric patient undergoing lower limb orthopedic surgery.

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ANNEXURES

ETHICAL CLARANCE CERTIFICATE

INFORMED CONSENT FORM

TITLE OF THE PROJECT: "A COMPARATIVE STUDY OF 0.5% LEVOBUPIVACAINE AND 0.5% BUPIVACAINE IN SPINAL ANAESTHESIA IN GERIATRIC PATIENTS UNDERGOING LOWER LIMB SURGERIES"

PRINCIPAL INVESTIGATOR : **Dr. _____**

Department of Anaesthesiology,

Email: namratanair07@gmail.com

PG GUIDE : **Dr._____**

Professor,

Department of Anaesthesiology,

_____

Medical College, Hospital & Research Centre, _____

I have been informed that this study is **"A COMPARATIVE STUDY OF 0.5% LEVOBUPIVACAINE AND 0.5% BUPIVACAINE IN SPINAL ANAESTHESIA IN GERIATRIC PATIENTS UNDERGOING LOWER LIMB SURGERIES"**. I have been explained about this study in the language which I understand. I have been explained about the reason for doing this study and selecting me/my ward as a subject for this study. I have been told that my participation in the above study is voluntary and I am aware that I can opt out of the study at any time

without having to give any reasons for doing so. I am also informed that my refusal to participate in this study will not affect my treatment by any means.

I agree to participate in the above study and cooperate fully. I agree to follow the Doctor's instructions about my treatment to the best of my ability.

CONFIDENTIALITY:

I understand that medical information produced by this study will become a part of this Hospital records and will be subjected to the confidentiality and privacy regulation of this hospital. Information of a sensitive, personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code key connecting name to numbers will be kept in a separate secure location.

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

REQUEST FOR MORE INFORMATION:

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

If during this study, or later, I wish to discuss my participation or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me and that a copy of this consent form will be given to me for my careful reading.

REFUSAL OR WITHDRAWL OF PARTICIPATION:

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

I also understand that Dr. _____ Nair will terminate my participation in this study at any time after she has explained the reasons for doing so and has helped arrange for my continued care by my own physician or therapist.

INJURY STATEMENT:

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

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

I have been explained about the purpose of this research, the procedures required and the possible risks and benefits, in my own language.

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

Patient's Signature: Witness Signature

Name : Name :

Date : Date :

Dr. _____ **Dr. _____**

(Guide) (Investigator)

PROFORMA

PROFORMA

STUDY- **"A COMPARATIVE STUDY OF 0.5% LEVOBUPIVACAINE AND 0.5% BUPIVACAINE IN SPINAL ANAESTHESIA IN GERIATRIC PATIENTS UNDERGOING LOWER LIMB SURGERIES"."**

Name of the patient : I.P. No. :

Age : Sex: M/F

Weight : Date of Admission:

Diagnosis:

Consent taken for study: Y/N

Group allocated : L/B

Pre anaestheticevaluation :

Chief complaints :

Past History :

a) Presence of any comorbid condition - Diabetes/ Hypertension/ Ischemic heart disease/ Cerebrovascular accident / Asthma/ Epilepsy/ Bleeding disorder/ Drug allergy/ any other .

b) Drug Therapy

c) H/o previous anaestheticexposure :

Family History:

General Physical Examination:

- General condition :
- Pallor / Icterus / Cyanosis / Clubbing / Lympadenopathy / Pedal edema.
- Temperature:
- Pulse rate:
- Respiratory rate:
- Blood Pressure :

Mallampatigrade :

Systemic Examination :

- Cardiovascular system
- Respiratory system
- Central nervous system
- Others

Investigations :

- Complete blood picture
- Total Leucocyte count :
- Differential count :
- Platelet count :
- Random Blood sugar :
- Urine routine:
- ECG:
- Chest X ray:
- Any other :

ASA Grade :

Diagnosis

ANAESTHESIA PROTOCOL :

Premedication :

Patients will be pre-medicated with Tab. Ranitidine 150mg, on the previous night of the surgery. Each patient will be preloaded with an I.V. infusion of 500ml of Ringer Lactate solution and 50 mg I.V Ranitidine, 30 min prior to surgery.

RECOVERY CHARACTERISTICS :

Awareness of procedure: Y/N

Any nausea or vomiting: Y/N

Orientation to time, place and person:

Adverse effects, if any:

Signature of Anaesthesiologist

Name:

Designation:

MASTERCHART

S. No.	NAME	Age	Gender	ASA GRADE	Group	Heart Rate																
						5 min	10 min	15 min	20 min	25 min	30 min	1 hour	2 hours	3 hours	30 min	1 hour	1:30min	2 hour	2:30min	3 hours	3:30min	4 hours
1	Parappa	65	M	II	BP	78	80	88	90	95	88	81	78	66	72	69	68	65	66	65	71	70
2	Gangabai	70	F	II	BP	68	70	78	85	88	82	79	78	65	66	70	69	68	69	67	68	70
3	Kallawa	70	F	II	BP	71	78	85	88	90	85	84	90	70	71	80	68	65	70	72	71	74
4	Pomu	65	M	II	BP	55	68	62	65	68	70	69	69	65	68	67	68	66	69	68	67	68
5	Nagendra	73	M	II	BP	72	77	80	88	82	80	78	82	80	68	70	72	74	74	78	68	71
6	Rukmabai	80	F	II	BP	110	115	118	120	106	99	84	90	67	82	79	80	85	83	82	81	84
7	Irasangapp	63	M	II	BP	72	75	80	81	75	72	68	67	72	66	63	72	65	67	62	70	68
8	Yallappa	60	M	III	BP	68	70	65	62	60	63	65	64	70	65	70	70	72	70	68	69	68
9	Parvati	70	F	II	BP	68	70	72	73	68	70	70	68	65	70	67	65	67	65	62	62	65
10	Sugalabai	80	F	II	BP	75	78	80	85	90	88	90	75	64	68	65	64	68	65	67	67	69
11	Lachawwa	80	F	II	BP	88	90	95	100	98	102	98	101	79	78	80	79	78	80	75	78	79
12	Malkappa	80	M	II	BP	90	92	104	98	97	100	100	103	85	86	80	85	90	92	88	84	82
13	Dharmabai	60	F	II	BP	90	85	88	84	82	80	82	84	80	82	80	80	85	84	80	80	78
14	Chanabasappa	62	M	II	BP	75	70	72	70	68	65	68	68	65	68	75	65	72	70	70	78	77
15	Yamanappa	70	M	II	BP	88	78	75	80	73	72	80	85	88	87	75	88	88	85	88	80	85
16	Gurawwa	65	F	II	BP	68	65	62	63	60	65	72	67	66	80	82	85	78	79	72	84	83
17	Revanappa	68	M	II	BP	70	68	65	69	70	72	67	70	65	80	68	77	78	80	72	72	70
18	Mathurabai	78	F	II	BP	80	85	88	82	78	77	85	75	70	88	82	85	86	89	82	78	89
19	Sharabayya	65	M	II	BP	90	91	102	104	108	102	102	91	75	920	80	81	83	86	82	80	84
20	Bhimraya	80	M	II	BP	72	80	88	78	77	75	60	77	91	67	70	74	71	68	72	72	70
21	Shrishail	60	M	II	BP	78	80	88	90	95	88	81	79	77	72	69	69	65	66	63	71	72
22	Gurubai	70	F	II	BP	68	70	78	85	85	82	79	76	76	66	70	71	68	73	67	67	75
23	Nagappa	68	M	II	BP	71	78	85	88	90	85	84	75	67	71	80	68	65	70	72	71	74
24	Danabai	60	F	II	BP	54	68	62	67	68	70	69	70	72	66	67	68	66	69	68	70	68
25	Mallappa	70	M	II	BP	75	77	80	86	82	80	78	81	82	68	73	72	73	74	80	68	71
26	Siddanagou	60	M	II	BP	109	114	113	104	106	99	86	89	79	82	79	80	85	86	82	81	87
27	Huvanna	60	M	II	BP	72	75	80	81	75	72	68	67	72	66	63	72	65	67	62	70	68
28	Shivappa	60	M	II	BP	67	70	63	62	60	63	65	64	70	67	70	70	73	70	68	69	70
29	Ningappa	75	M	II	BP	70	70	72	72	68	70	70	69	75	73	67	65	67	65	62	68	67
30	Tipanna	63	M	II	BP	77	75	80	85	90	88	90	78	91	68	68	68	68	65	67	67	69
31	Shivappa	68	M	II	BP	89	90	99	102	98	102	98	98	77	75	82	80	78	80	75	78	79
32	Mahesh	64	M	II	BP	88	92	102	98	97	99	100	100	85	85	80	86	90	92	88	85	83

33	Suresh	60	M	II	BP	90	85	88	84	82	80	82	84	82	82	80	80	85	84	80	80	78
34	Shrishail	75	M	II	BP	74	70	72	70	65	68	72	68	68	68	75	65	72	70	70	78	77
35	Yamanaww	75	F	II	BP	85	78	75	80	73	74	80	85	87	87	75	88	87	85	88	80	84
36	Shetawwa	75	F	II	BP	69	67	62	63	66	65	73	67	80	80	82	85	78	79	72	88	83
37	Sidappa	75	M	II	BP	74	68	65	70	73	72	67	70	80	80	68	79	78	80	72	76	70
38	Nabisab	86	M	II	BP	82	85	87	82	78	77	85	75	87	87	82	85	86	89	82	78	89
39	Shantawwa	70	F	II	BP	92	91	102	103	108	102	99	91	91	88	80	81	83	86	82	80	84
40	Malabai	74	F	II	BP	76	80	87	78	77	75	60	77	70	69	71	74	71	68	72	72	70
41	Sangawwa	60	F	II	BP	78	83	87	90	95	87	83	78	91	72	67	68	65	66	65	74	70
42	Shardamm	90	F	II	BP	66	70	77	85	88	83	79	78	76	66	70	69	68	69	69	68	70
43	Dharmanna	78	M	II	BP	71	78	85	88	90	85	84	75	82	71	80	68	65	70	72	71	74
44	Ningangou	72	M	II	BP	56	68	67	65	68	70	69	69	72	70	67	68	66	69	68	67	65
45	Daulsab	60	M	II	BP	76	72	80	88	82	80	78	82	80	68	70	72	74	74	73	68	71
46	Gangappa	60	M	II	BP	98	103	99	110	106	99	84	90	82	87	79	82	85	83	86	83	86
47	Nemu	60	M	II	BP	72	76	80	81	75	72	68	67	72	66	63	72	65	67	62	70	68
48	Mallikarjun	60	M	II	BP	68	70	65	62	60	63	65	64	74	65	70	70	72	70	68	69	68
49	Tukaram	75	M	II	BP	68	70	72	73	68	70	70	68	69	70	67	65	67	65	62	62	65
50	Jakamma	70	F	II	BP	75	78	80	85	90	88	90	75	75	68	65	64	68	65	67	67	69
51	Sushilabai	78	F	II	BP	78	80	82	84	88	87	92	75	71	70	66	64	68	66	68	67	69
52	Gurubai	60	F	II	BP	78	80	80	85	88	88	91	75	70	71	65	64	68	68	66	71	70
53	Guruning	60	M	II	BP	78	80	80	88	68	88	88	74	70	68	66	70	66	70	66	72	68
54	Gurubai	80	F	II	BP	77	77	72	86	66	78	84	65	72	66	65	64	65	68	68	66	70
55	Sangappa	62	M	II	BP	76	76	77	77	70	72	98	66	71	74	66	66	68	66	65	74	71
56	Laxmibai	60	F	II	BP	69	76	76	75	72	70	90	75	72	72	63	60	68	70	62	70	70
57	Kantappa	60	M	II	BP	70	77	72	72	80	88	90	77	70	70	67	68	65	69	74	68	68
58	Abdul	72	M	II	BP	80	76	70	70	88	80	92	78	72	69	60	70	62	68	68	70	69
59	Shivbal	75	M	II	BP	82	80	80	80	85	82	94	68	71	70	70	75	60	75	75	66	70
60	Dhansingh	80	M	II	BP	75	82	80	80	88	87	84	66	74	68	72	66	78	70	70	70	70
1	Datanna	60	M	II	LBP	80	89	88	85	82	80	78	75	85	70	71	71	68	70	70	74	74
2	Basavantap	60	M	II	LBP	86	88	85	81	82	79	92	89	82	65	72	68	69	71	65	66	70
3	Ishwaramm	85	F	III	LBP	80	88	90	81	82	87	94	75	68	72	85	71	68	70	70	76	74
4	Roopa	85	F	II	LBP	92	95	88	85	88	84	88	89	87	67	70	67	68	65	68	67	70
5	Mallappa	60	M	II	LBP	75	72	78	71	68	69	72	74	80	70	69	68	72	74	78	68	71
6	Basappa	82	M	II	LBP	82	83	88	79	78	80	80	80	80	83	77	81	80	82	86	81	84
7	Mahadevi	60	F	II	LBP	88	87	90	90	88	83	86	90	87	76	80	70	72	68	66	84	66
8	Ishwarappa	70	M	III	LBP	68	70	71	78	80	75	76	74	84	67	71	69	70	71	68	69	68
9	Chandram	60	M	II	LBP	82	83	86	80	79	75	82	81	74	73	73	62	65	68	62	62	65
10	Satewwa	80	F	II	LBP	75	82	83	80	81	88	78	81	69	76	69	67	64	69	67	67	69
11	Ningappa	65	M	III	LBP	75	78	68	69	65	69	75	70	75	74	75	78	79	82	72	88	76
12	Ranabai	60	F	II	LBP	67	70	72	73	70	74	78	80	74	74	74	84	85	88	86	84	82

13	Sunanda	79	F	III	LBP	89	85	80	82	83	80	79	82	84	84	80	80	80	84	80	80	78
14	Ladamma	70	F	II	LBP	85	95	100	104	99	97	94	88	82	73	75	78	65	70	70	78	77
15	Basappa	66	M	II	LBP	72	80	88	89	82	78	81	86	68	83	75	80	88	85	86	80	86
16	Sheshgiri	82	M	II	LBP	80	82	86	78	75	72	70	68	70	78	82	84	85	79	72	86	82
17	Kasavva	70	F	II	LBP	72	68	78	76	79	77	75	82	68	75	73	72	77	82	72	72	70
18	Shantamm	65	F	II	LBP	76	72	70	68	72	78	78	71	72	79	78	78	85	89	84	78	89
19	Neelawwa	70	F	II	LBP	78	79	78	80	81	82	85	81	85	86	80	80	81	86	82	80	86
20	Lakshmam	75	F	II	LBP	92	90	88	85	70	80	87	80	82	70	81	72	74	68	82	72	70
21	Dhansingh	60	M	II	LBP	82	89	86	82	85	82	74	75	68	72	73	71	69	70	82	71	72
22	Jagadeva	75	M	II	LBP	86	88	85	81	82	79	92	89	87	73	78	67	71	72	82	70	75
23	Bagawwa	65	F	II	LBP	81	88	88	86	89	87	94	75	80	73	75	71	68	72	82	72	76
24	Shivawwa	61	M	II	LBP	92	95	88	85	88	84	88	89	80	74	73	70	68	69	82	70	68
25	Mahadev	62	M	II	LBP	79	72	78	76	68	69	73	74	87	73	72	68	72	74	82	68	71
26	Boramma	90	F	II	LBP	89	83	84	79	75	80	83	80	80	82	77	81	80	86	86	81	66
27	Bavasab	64	M	II	LBP	88	87	90	90	88	83	86	90	80	73	79	70	72	69	82	74	68
28	Sidamma	60	F	II	LBP	67	70	75	78	80	75	76	78	87	70	75	69	70	70	82	69	70
29	Laxmibai	70	F	II	LBP	82	83	86	80	79	75	82	81	77	73	72	68	65	69	84	68	67
30	Sugalabai	75	F	II	LBP	76	82	83	86	85	88	78	81	80	78	70	67	68	65	82	67	70
31	Tamanappa	80	M	II	LBP	80	78	68	69	73	69	75	74	80	75	74	78	80	80	86	78	79
32	Basamma	65	F	II	LBP	67	70	72	73	70	74	78	80	87	73	75	85	86	88	82	84	83
33	Indirabai	80	F	II	LBP	87	85	85	82	83	80	80	82	75	82	80	80	80	84	82	80	76
34	Kashimsab	65	M	II	LBP	85	95	100	104	99	97	94	88	85	72	75	78	65	73	82	78	77
35	Laxman	75	M	II	LBP	78	88	88	89	82	78	81	86	75	73	75	80	88	83	82	80	84
36	Sharanaww	60	F	II	LBP	80	82	86	78	75	72	70	68	70	81	74	88	85	77	80	88	82
37	Satish	60	M	II	LBP	73	68	88	76	79	77	75	82	75	83	73	76	79	81	82	86	70
38	Yallappa	70	M	II	LBP	76	72	70	68	72	74	78	71	73	77	82	78	85	89	82	78	89
39	Madiwalap	70	M	II	LBP	77	79	80	80	81	82	85	81	74	84	83	80	81	86	82	80	84
40	Chidanand	62	M	II	LBP	87	90	88	82	77	80	87	80	73	81	78	72	74	70	86	72	70
41	Chandabee	80	F	II	LBP	80	89	88	85	82	80	78	75	82	72	73	74	68	69	82	72	70
42	Indubai	80	F	II	LBP	86	88	85	81	82	79	92	89	83	74	78	68	69	70	88	68	72
43	Kusumbai	78	F	II	LBP	78	87	90	83	82	87	94	75	78	69	80	71	68	71	82	71	74
44	Tirumalara	72	M	II	LBP	88	93	88	85	88	84	88	89	73	71	74	67	68	73	80	66	66
45	Revubai	70	F	II	LBP	75	72	78	71	68	69	72	74	78	67	70	68	72	72	82	68	71
46	Umabai	75	F	II	LBP	84	89	88	79	78	80	87	80	80	83	79	83	82	78	82	85	86
47	Gurubai	60	F	II	LBP	89	90	92	88	92	83	86	90	74	69	68	70	72	66	82	70	68
48	Savathrawa	85	F	II	LBP	68	70	71	78	80	75	76	74	73	70	70	69	70	71	82	69	68
49	Dadasingh	72	M	II	LBP	82	83	86	80	79	75	82	81	82	72	75	62	65	69	82	62	64
50	Hamu	65	M	II	LBP	75	82	83	80	81	88	78	81	83	73	74	67	64	63	84	62	70
51	Somalu	75	M	II	LBP	74	82	80	77	80	82	80	82	78	76	78	68	66	66	88	66	66
52	Chandabee	60	F	II	LBP	77	88	83	78	78	80	82	83	73	77	80	68	70	60	84	67	67

53	Shakuntala	80	F	II	LBP	80	78	86	80	78	88	87	80	78	74	78	70	72	64	83	68	68
54	Shakuntala	75	F	II	LBP	76	70	76	82	80	78	88	78	80	70	76	66	70	65	80	70	70
55	Sopanna	60	F	II	LBP	76	76	78	85	75	79	80	78	77	66	77	68	68	66	82	68	72
56	Husen	60	M	II	LBP	78	77	87	78	76	80	80	88	78	68	78	67	68	66	88	70	68
57	Parsappa	85	M	II	LBP	77	88	88	80	80	81	78	80	80	67	80	62	66	67	80	68	69
58	Shivappa	75	M	III	LBP	84	80	87	82	80	88	76	80	76	69	76	60	70	60	80	68	70
59	Dandappa	64	M	II	LBP	80	78	85	78	78	78	76	78	76	66	76	64	78	73	82	70	68
60	Parvataww	65	F	II	LBP	76	78	76	80	78	80	80	80	85	70	76	66	76	65	80	70	66

S. No.	Group	MAP																
		5 min	10 min	15 min	20 min	25 min	30 min	1 hour	2 hours	3 hours	30 min	1 hour	1:30min	2 hours	2:30min	3 hours	3:30min	4 hours
1	BP	60	45	48	55	60	65	78	80	70	75	74	72	70	73	70	76	78
2	BP	65	62	58	55	65	70	74	72	75	72	68	70	72	73	68	78	69
3	BP	58	57	52	54	58	60	73	72	70	68	78	80	81	83	74	78	74
4	BP	60	48	50	55	56	60	69	70	73	69	68	68	69	68	70	68	70
5	BP	70	60	55	60	68	69	75	73	78	78	77	76	75	77	65	76	75
6	BP	103	116	106	77	81	76	82	87	74	85	85	87	85	90	88	81	88
7	BP	60	55	45	56	60	65	72	77	75	77	73	80	78	75	78	78	77
8	BP	60	58	55	60	65	68	72	78	80	77	84	78	80	82	82	78	77
9	BP	50	45	48	52	55	60	65	72	75	73	71	75	71	72	70	76	77
10	BP	56	50	55	58	57	65	75	70	75	67	70	74	70	68	72	74	73
11	BP	55	45	40	55	56	60	70	68	75	70	68	72	73	70	60	70	71
12	BP	60	44	45	50	55	60	68	75	82	78	79	79	78	99	80	79	78
13	BP	62	61	60	62	60	58	60	65	76	72	82	84	87	88	62	82	80
14	BP	55	60	65	62	61	58	62	70	83	69	68	78	72	74	65	71	70
15	BP	70	60	55	58	60	62	68	70	88	80	88	84	85	90	77	80	83
16	BP	55	58	60	62	58	63	68	72	70	75	70	68	67	68	68	70	68
17	BP	55	58	60	62	68	65	72	69	70	65	64	72	78	70	65	67	70
18	BP	55	58	60	62	63	64	72	68	73	78	75	83	84	85	75	81	82
19	BP	63	44	58	55	55	56	49	62	77	74	82	81	84	87	72	83	85
20	BP	60	45	47	65	68	72	70	70	70	70	68	71	72	70	70	75	70
21	BP	70	47	48	54	60	65	76	82	77	76	74	72	72	70	70	75	78
22	BP	65	63	58	55	64	70	72	74	75	73	68	70	72	73	68	78	69
23	BP	58	57	52	54	58	60	73	72	78	68	78	80	81	83	74	78	74
24	BP	66	45	54	55	56	60	69	70	78	72	70	67	69	68	70	68	72
25	BP	72	60	55	62	68	69	75	73	78	81	77	76	76	77	65	76	75
26	BP	90	110	106	77	81	78	85	85	78	86	87	87	86	90	88	81	88
27	BP	60	55	45	56	60	65	72	77	78	77	73	80	78	75	78	78	77

28	BP	65	58	55	60	67	70	72	78	83	79	84	78	80	82	82	77	79
29	BP	48	45	48	52	55	63	65	74	78	74	71	75	71	72	70	77	74
30	BP	56	50	55	58	57	65	75	70	78	67	70	74	70	68	72	74	73
31	BP	51	45	40	55	54	62	72	68	78	70	68	72	73	70	60	72	71
32	BP	60	47	45	50	56	60	68	75	74	78	79	79	78	99	78	79	78
33	BP	62	61	60	62	60	58	60	65	78	72	82	84	87	88	62	82	80
34	BP	54	60	64	62	61	58	62	70	75	69	64	78	72	75	65	71	70
35	BP	72	60	55	58	60	62	68	70	75	88	88	84	85	90	76	80	81
36	BP	57	58	60	62	58	63	68	72	75	76	70	68	67	68	68	70	68
37	BP	53	58	65	62	68	65	72	69	75	68	64	72	78	70	62	67	70
38	BP	52	58	60	65	63	64	72	69	76	75	75	83	84	85	75	81	82
39	BP	63	65	58	55	68	56	49	62	80	74	82	81	84	87	72	83	85
40	BP	65	45	47	65	68	72	70	70	70	70	77	71	72	70	70	75	70
41	BP	64	45	50	55	60	65	79	80	80	75	74	72	70	73	72	78	78
42	BP	67	62	58	56	65	70	74	72	75	72	68	70	72	73	68	78	69
43	BP	58	57	52	54	58	60	73	72	82	68	78	80	81	83	74	78	74
44	BP	62	48	50	55	56	60	69	70	83	74	68	68	69	68	70	69	70
45	BP	68	60	53	63	70	69	75	73	78	80	77	76	75	77	65	76	75
46	BP	95	98	99	96	81	76	82	87	88	87	85	87	85	90	88	81	88
47	BP	63	55	45	55	60	65	72	78	70	77	73	80	78	75	78	78	74
48	BP	60	58	55	60	65	68	72	78	80	77	84	78	80	82	82	78	77
49	BP	50	45	48	52	55	60	65	72	70	73	71	75	71	72	70	76	77
50	BP	56	50	55	58	57	65	75	70	73	67	70	74	70	68	72	74	73
51	BP	55	50	55	57	58	66	75	75	74	66	70	77	72	68	70	75	72
52	BP	53	52	55	57	57	66	76	74	77	68	69	78	70	66	68	76	77
53	BP	60	58	50	60	70	65	78	74	77	68	70	75	72	70	66	77	78
54	BP	68	56	58	64	58	68	77	70	77	66	75	77	70	78	72	78	76
55	BP	55	70	54	62	68	62	76	74	78	70	78	74	78	74	78	74	70
56	BP	64	68	65	58	69	60	75	74	78	72	74	70	66	65	74	70	77
57	BP	54	66	52	56	52	70	65	70	78	78	71	80	68	68	74	68	76
58	BP	63	64	58	57	57	72	70	75	78	75	70	75	70	69	74	74	74
59	BP	66	66	59	58	78	65	68	70	78	66	69	74	72	66	78	70	75
60	BP	62	58	54	59	68	68	70	70	77	65	69	74	74	66	66	68	74
1	LBP	65	49	54	59	67	76	74	79	75	68	75	78	72	76	76	80	76
2	LBP	63	62	55	55	66	69	70	70	75	71	70	69	70	78	68	78	69
3	LBP	60	57	53	56	62	66	70	72	75	78	79	74	72	78	74	80	76
4	LBP	55	64	56	55	55	68	68	68	75	68	67	70	72	68	68	68	70
5	LBP	75	63	60	60	69	72	77	72	76	77	75	75	80	76	65	76	75
6	LBP	90	88	89	77	75	73	83	84	77	82	80	88	84	81	88	81	86
7	LBP	65	55	55	57	65	67	68	75	77	76	74	77	80	78	76	80	77

8	LBP	68	58	68	60	66	71	75	74	78	81	78	77	78	78	82	78	77
9	LBP	55	48	55	53	65	67	68	70	78	74	75	77	71	76	70	74	77
10	LBP	58	56	54	58	63	74	68	72	78	70	75	73	68	74	74	74	70
11	LBP	52	69	56	55	56	69	65	73	78	73	70	71	62	70	60	72	71
12	LBP	67	72	58	50	58	65	72	70	78	75	78	78	81	79	80	79	76
13	LBP	69	75	63	65	65	67	58	63	78	78	81	80	68	82	64	82	80
14	LBP	67	74	67	70	69	68	60	65	73	70	72	70	68	71	65	71	70
15	LBP	65	63	59	68	70	77	70	72	78	82	77	83	88	80	78	84	82
16	LBP	67	66	63	64	69	74	60	70	75	68	72	68	70	70	68	70	68
17	LBP	64	64	62	74	75	71	70	70	78	67	65	70	70	67	65	68	70
18	LBP	62	58	65	70	77	72	70	73	78	78	80	82	72	81	75	81	84
19	LBP	65	53	68	63	56	67	57	56	78	78	86	85	70	83	74	84	85
20	LBP	67	45	54	69	70	74	75	68	80	72	70	70	72	75	70	75	70
21	LBP	76	66	53	58	60	74	74	80	80	68	75	78	72	75	70	78	76
22	LBP	68	63	58	60	64	68	74	76	82	71	70	69	70	78	68	78	69
23	LBP	55	57	52	56	58	60	70	72	83	78	79	74	72	78	76	76	70
24	LBP	67	52	57	59	56	67	70	72	88	68	67	72	72	68	70	68	72
25	LBP	69	60	55	70	69	70	77	73	70	77	79	75	80	76	69	70	72
26	LBP	80	90	88	75	81	75	83	84	70	82	80	88	84	81	86	81	88
27	LBP	69	55	56	65	65	65	68	75	73	76	74	77	80	78	78	76	77
28	LBP	72	58	57	67	67	70	75	76	74	81	78	79	78	77	84	77	76
29	LBP	55	57	49	65	58	63	68	70	78	74	75	74	71	77	68	76	74
30	LBP	62	55	57	54	57	65	68	72	75	70	75	73	68	74	72	74	73
31	LBP	55	49	45	58	55	62	65	70	75	73	70	71	63	72	64	72	74
32	LBP	65	54	49	58	56	60	73	74	75	75	78	78	81	79	78	76	78
33	LBP	68	55	67	66	60	87	58	63	75	78	81	80	68	82	62	82	80
34	LBP	63	67	62	59	67	58	60	65	74	70	72	70	70	71	68	70	68
35	LBP	68	68	63	65	65	62	70	72	76	82	79	81	88	80	76	80	81
36	LBP	62	64	65	63	70	70	60	70	82	68	76	68	70	70	66	70	66
37	LBP	64	67	68	69	73	69	68	70	77	67	65	70	67	67	62	66	70
38	LBP	70	65	65	62	75	65	71	72	88	78	80	82	72	81	76	81	80
39	LBP	69	56	62	58	70	56	57	56	77	78	88	85	70	83	72	82	85
40	LBP	69	52	56	67	72	72	75	68	78	72	70	70	72	75	68	75	68
41	LBP	68	56	59	58	69	65	74	79	78	68	75	78	74	78	70	78	78
42	LBP	75	67	60	54	68	70	70	70	78	71	70	69	70	78	68	76	69
43	LBP	72	64	55	67	69	67	70	72	78	78	79	74	72	78	72	78	72
44	LBP	69	55	57	67	65	68	68	68	78	68	67	70	72	69	70	69	70
45	LBP	70	65	54	65	70	73	77	72	78	77	75	75	80	76	66	76	75
46	LBP	88	79	92	87	81	79	83	84	78	82	80	88	84	81	86	81	86
47	LBP	75	65	52	58	66	67	68	75	78	76	74	74	80	78	78	78	74

48	LBP	80	60	57	65	69	72	75	74	80	81	78	77	78	78	80	78	77
49	LBP	58	48	55	55	70	67	68	70	78	74	75	77	71	76	70	74	77
50	LBP	55	52	57	60	59	69	68	72	80	70	75	73	68	74	74	74	70
51	LBP	60	60	66	62	66	70	70	60	78	78	78	73	70	76	70	76	77
52	LBP	62	66	60	64	68	72	68	68	78	76	72	74	72	78	74	74	78
53	LBP	65	68	58	59	65	70	72	76	78	76	76	77	68	80	76	78	70
54	LBP	76	56	58	58	66	67	67	78	78	70	73	76	70	82	68	78	76
55	LBP	75	66	60	56	70	68	66	80	80	72	79	73	68	78	78	68	68
56	LBP	77	60	62	60	72	70	70	86	80	76	71	70	70	76	76	69	69
57	LBP	60	62	60	62	69	69	68	78	82	81	75	68	68	79	68	81	70
58	LBP	70	58	65	66	68	70	66	74	83	80	80	70	70	80	69	68	65
59	LBP	72	60	59	64	70	72	70	79	76	76	76	69	66	82	70	78	78
60	LBP	66	60	60	60	71	68	72	76	88	76	76	70	72	78	70	76	79

S. No.	Group	Respiratory Rate (RR)																
		5 min	10 min	15 min	20 min	25 min	30 min	1 hour	2 hours	3 hours	30 min	1 hour	1:30min	2 hours	2:30min	3 hours	3:30min	4 hours
1	BP	18	20	21	19	20	22	21	24	23	19	21	18	19	18	17	16	17
2	BP	18	20	19	20	22	21	19	21	21	18	19	20	22	23	16	21	22
3	BP	18	19	18	17	20	21	19	21	18	18	19	19	18	19	16	19	18
4	BP	19	20	21	22	23	24	21	21	19	18	19	20	21	22	21	21	19
5	BP	18	19	20	19	18	17	18	18	20	18	18	20	21	20	17	21	22
6	BP	18	20	20	18	18	17	17	22	19	16	17	16	18	18	16	18	17
7	BP	18	19	21	22	23	19	22	22	19	19	19	18	20	22	17	18	20
8	BP	21	22	23	21	20	25	23	21	19	16	19	19	18	17	19	19	17
9	BP	20	18	17	19	18	20	21	19	19	19	18	17	18	19	19	20	18
10	BP	19	20	18	21	22	28	22	21	19	16	18	19	20	21	18	17	18
11	BP	21	22	24	25	0	23	21	22	20	18	18	19	18	19	19	20	21
12	BP	22	22	23	24	25	21	23	23	21	18	18	18	18	19	22	18	17
13	BP	15	14	16	14	13	15	16	16	20	16	17	14	18	20	16	15	17
14	BP	18	20	21	22	21	20	20	22	21	18	18	18	19	20	20	23	19
15	BP	18	18	19	20	20	18	21	20	23	19	17	23	21	22	21	21	22
16	BP	18	19	20	20	22	24	25	20	23	20	23	22	21	20	20	20	19
17	BP	18	20	19	22	21	20	20	21	18	22	22	24	22	21	20	24	25
18	BP	18	19	20	21	20	22	19	21	19	21	24	22	23	24	19	21	19
19	BP	23	25	24	22	21	23	23	19	20	18	17	17	18	20	12	16	18
20	BP	18	17	18	19	20	21	19	19	20	19	22	23	24	23	17	21	22
21	BP	19	20	20	19	21	22	22	23	20	19	21	19	19	20	17	19	17

22	BP	20	20	19	21	22	21	19	21	21	19	19	21	22	23	16	21	22
23	BP	18	19	18	17	20	21	19	21	20	18	19	19	18	19	16	19	18
24	BP	19	20	21	22	23	20	21	20	20	20	19	20	21	21	21	21	20
25	BP	18	19	20	20	18	19	18	20	20	18	18	20	21	20	17	21	22
26	BP	18	20	20	20	18	19	20	22	20	19	17	16	18	18	20	18	17
27	BP	18	19	21	22	23	19	22	22	20	19	19	18	20	22	17	18	20
28	BP	20	22	23	22	20	22	20	21	19	18	19	20	18	17	19	19	17
29	BP	20	18	19	19	18	20	21	19	20	19	18	17	18	19	19	20	18
30	BP	19	20	18	21	22	28	22	21	21	16	18	19	20	21	18	17	18
31	BP	20	22	20	22	20	23	21	22	21	18	18	19	18	19	19	20	21
32	BP	21	22	23	22	23	21	23	23	19	18	18	18	18	19	22	18	17
33	BP	15	14	16	14	13	15	16	16	21	16	17	14	18	20	16	15	17
34	BP	18	20	21	22	21	20	20	22	19	18	18	18	19	20	20	23	19
35	BP	20	18	19	20	20	18	21	20	19	19	17	23	21	22	21	21	22
36	BP	18	19	20	20	22	24	25	20	19	20	23	22	21	20	20	20	19
37	BP	19	20	19	22	21	20	20	21	20	22	22	24	22	21	20	24	25
38	BP	18	19	20	21	20	22	19	21	20	21	24	22	23	24	19	21	19
39	BP	22	21	24	22	21	23	23	19	21	18	17	17	18	20	19	16	18
40	BP	18	17	18	19	20	21	19	19	20	19	22	23	24	23	17	21	22
41	BP	19	20	21	20	20	22	21	24	21	19	21	18	19	18	21	19	18
42	BP	20	20	19	20	22	21	19	21	21	18	19	20	22	23	16	21	22
43	BP	18	19	18	17	20	21	19	21	21	18	19	19	18	19	16	19	18
44	BP	20	20	21	22	23	24	21	21	21	18	19	20	21	22	21	21	19
45	BP	18	19	20	19	18	17	18	18	20	18	18	20	21	20	17	21	22
46	BP	20	20	21	18	18	17	20	22	23	16	17	16	18	18	16	18	17
47	BP	18	19	21	22	23	19	22	22	23	19	19	18	20	22	19	18	20
48	BP	21	22	23	21	20	25	23	21	19	16	19	19	18	17	19	19	17
49	BP	20	18	17	19	18	20	21	19	18	19	18	17	18	19	19	20	18
50	BP	19	20	18	21	22	28	22	21	19	16	18	19	20	21	18	17	18
51	BP	20	20	19	22	23	28	21	21	19	15	18	18	21	20	18	16	17
52	BP	21	21	18	21	20	19	20	21	20	16	18	17	20	21	18	17	18
53	BP	22	20	19	22	22	18	19	19	20	18	19	16	21	20	17	16	20
54	BP	20	20	18	21	21	19	18	22	20	19	16	18	20	21	19	17	21
55	BP	18	19	21	18	20	20	20	21	20	16	16	20	22	17	21	14	19
56	BP	19	18	22	19	22	22	21	21	20	18	18	19	18	19	17	17	21
57	BP	21	20	23	19	23	21	22	20	20	16	18	19	19	21	21	16	18
58	BP	20	19	19	21	24	20	19	19	20	18	17	18	20	22	18	16	17
59	BP	20	21	20	20	21	19	18	20	18	19	21	17	21	20	21	18	18
60	BP	19	20	21	20	20	18	18	19	20	15	20	16	21	19	20	20	17
1	LBP	19	18	20	21	19	21	21	19	19	20	22	19	17	20	18	16	18

2	LBP	18	19	18	20	21	19	19	17	19	19	18	21	22	20	17	21	22
3	LBP	17	20	21	19	20	17	20	21	19	19	20	21	22	23	16	19	18
4	LBP	18	20	19	20	21	25	21	23	20	19	18	21	20	22	21	20	18
5	LBP	18	19	20	21	19	18	18	22	20	21	19	22	21	21	16	21	20
6	LBP	18	20	20	19	22	18	21	22	20	20	18	21	22	23	16	16	18
7	LBP	20	19	20	21	22	20	22	21	20	21	18	21	19	22	17	18	20
8	LBP	19	21	21	20	22	22	23	21	20	22	18	18	21	21	18	19	17
9	LBP	17	18	21	20	20	21	21	20	21	20	17	21	18	20	19	19	18
10	LBP	18	20	17	18	19	20	22	21	20	18	19	18	20	21	18	17	20
11	LBP	16	22	21	22	20	22	21	21	20	21	16	21	22	19	19	20	21
12	LBP	20	22	20	19	17	21	19	22	20	20	19	19	18	17	22	18	18
13	LBP	18	19	19	20	19	14	18	18	20	22	16	23	24	25	16	16	17
14	LBP	18	20	19	20	19	18	20	21	20	20	19	18	19	17	19	22	19
15	LBP	17	18	21	20	18	19	21	21	21	22	18	17	18	18	21	21	22
16	LBP	18	19	17	19	18	22	25	22	23	19	22	21	16	17	20	20	18
17	LBP	18	20	20	21	22	22	20	16	21	21	21	19	18	19	20	22	25
18	LBP	19	19	16	18	17	17	19	19	19	22	23	18	17	18	19	21	19
19	LBP	20	21	20	21	22	24	20	22	21	20	18	21	22	20	14	16	18
20	LBP	18	17	20	21	21	20	19	19	21	21	21	18	19	20	17	22	22
21	LBP	18	20	20	21	19	21	22	19	21	19	20	19	17	20	17	19	18
22	LBP	21	20	18	20	21	19	19	17	21	20	20	21	22	20	16	21	22
23	LBP	20	19	21	19	20	17	19	-	21	19	20	21	22	23	16	18	18
24	LBP	19	20	19	20	21	25	21	23	23	19	18	21	20	22	21	21	20
25	LBP	18	19	20	21	19	20	18	22	23	20	19	22	21	21	18	21	22
26	LBP	20	20	20	19	22	18	20	22	18	19	18	21	22	23	20	18	17
27	LBP	19	19	20	21	22	20	21	21	19	18	18	21	19	22	17	19	20
28	LBP	18	22	21	20	22	22	20	21	19	21	18	18	21	21	19	19	17
29	LBP	19	18	21	20	20	21	21	20	21	20	17	21	18	20	19	20	17
30	LBP	18	20	17	18	19	20	22	21	19	18	19	18	20	21	18	17	18
31	LBP	20	22	21	22	20	22	21	21	19	21	16	21	22	19	19	20	21
32	LBP	18	22	20	19	17	21	22	22	19	19	19	19	18	17	22	19	17
33	LBP	21	18	19	20	19	20	16	18	20	19	16	23	24	25	16	15	17
34	LBP	18	20	19	20	19	18	20	21	20	20	19	18	19	17	20	22	19
35	LBP	20	18	21	20	18	19	21	21	20	22	18	17	18	18	21	21	22
36	LBP	19	19	17	19	18	22	25	22	23	19	22	21	16	17	21	20	19
37	LBP	20	20	20	21	22	22	21	16	20	21	21	19	18	19	20	23	25
38	LBP	19	19	16	18	17	17	19	19	19	22	23	18	17	18	19	21	19
39	LBP	18	21	20	21	22	21	23	22	20	17	18	21	22	20	19	17	18
40	LBP	18	17	20	21	21	20	19	19	20	20	21	18	19	20	17	21	22
41	LBP	18	19	20	21	19	22	21	19	20	20	22	19	17	20	21	17	18

42	LBP	20	20	18	20	21	19	20	17	20	19	18	21	22	20	16	21	22
43	LBP	19	19	21	19	20	19	19	21	20	19	20	21	22	23	16	18	18
44	LBP	18	20	19	20	21	21	21	23	20	21	18	21	20	22	21	21	19
45	LBP	20	18	20	21	19	18	20	22	21	19	19	22	21	21	17	21	22
46	LBP	21	20	20	19	22	18	20	22	21	20	18	21	22	23	15	18	17
47	LBP	15	19	20	21	22	20	22	21	21	20	18	21	19	22	19	18	20
48	LBP	18	22	21	20	22	22	19	21	21	17	18	18	21	21	19	18	17
49	LBP	20	18	21	20	20	21	21	20	21	20	17	21	18	20	19	20	18
50	LBP	18	20	17	18	19	20	22	21	21	18	19	18	20	21	16	17	17
51	LBP	20	20	17	18	20	20	19	22	20	20	19	22	18	21	19	20	18
52	LBP	18	19	18	19	21	21	18	23	21	17	20	21	19	23	17	21	17
53	LBP	17	18	20	20	22	25	21	21	21	18	21	21	20	21	18	18	20
54	LBP	15	20	21	21	23	22	20	21	21	21	18	18	18	20	17	17	22
55	LBP	19	18	18	18	21	21	22	19	21	20	17	18	21	19	17	18	18
56	LBP	21	20	19	19	22	20	20	18	21	17	17	21	22	18	19	21	19
57	LBP	17	20	20	20	20	19	21	19	21	18	18	18	21	21	16	21	22
58	LBP	17	20	19	17	18	19	19	17	21	19	21	20	20	21	17	20	21
59	LBP	19	17	18	18	19	17	19	19	21	20	20	19	18	20	16	18	21
60	LBP	20	20	20	18	20	22	20	16	23	21	18	21	19	18	16	17	19

		SpO2																
S. No.	Group	5 min	10 min	15 min	20 min	25 min	30 min	1 hour	2 hours	3 hours	30 min	1 hour	1:30min	2 hours	2:30min	3 hours	3:30min	4 hours
1	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
2	BP	100	100	100	100	100	100	100	100	100	100	100	100	99	99	100	98	99
3	BP	100	100	100	100	100	100	100	99	98	100	100	100	100	100	100	100	100
4	BP	99	99	99	100	99	99	99	99	98	99	99	99	98	99	98	99	98
5	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6	BP	100	100	100	100	100	100	100	100	98	99	100	99	100	100	100	99	99
7	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
8	BP	100	100	99	100	100	100	99	100	100	99	100	100	100	100	100	100	100
9	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
10	BP	100	100	100	100	98	99	98	100	100	100	99	100	99	99	99	99	99
11	BP	98	99	96	99	99	98	98	100	100	98	99	99	100	100	99	100	99
12	BP	100	100	98	99	100	100	98	99	100	99	100	100	99	100	99	98	99
13	BP	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	99	99
14	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
15	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

17	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
18	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
19	BP	100	98	98	100	98	100	100	100	100	99	100	100	99	99	100	100	99
20	BP	99	99	98	98	100	99	98	99	98	99	99	100	100	100	99	99	97
21	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
22	BP	100	100	100	100	100	100	100	100	100	100	99	100	99	100	100	98	99
23	BP	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	100	100
24	BP	99	99	99	99	99	99	99	99	100	99	100	99	100	99	98	99	98
25	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	BP	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	99	99
27	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
28	BP	100	100	99	100	100	100	99	100	100	99	100	100	100	100	100	100	100
29	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
30	BP	100	100	100	99	98	99	98	100	100	100	99	99	99	99	99	99	99
31	BP	98	99	98	99	99	98	98	100	100	98	100	100	100	98	99	99	98
32	BP	100	100	98	99	100	100	98	100	98	99	100	99	99	100	99	98	99
33	BP	100	100	100	100	100	100	100	100	98	99	99	100	100	100	100	99	99
34	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
35	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
37	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
38	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
39	BP	100	98	98	100	98	100	100	100	100	99	100	99	99	99	100	100	99
40	BP	99	99	98	100	100	99	98	99	98	99	99	100	100	100	99	99	97
41	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	BP	100	100	100	100	100	100	100	100	100	100	100	99	100	100	100	98	99
43	BP	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	100	100
44	BP	99	99	99	99	99	99	99	100	100	99	99	100	99	99	98	99	98
45	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
46	BP	100	100	100	100	100	100	100	100	100	99	100	99	100	100	100	99	99
47	BP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
48	BP	100	100	99	98	100	100	99	100	100	99	100	100	100	100	100	100	100
49	BP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
50	BP	100	100	100	100	98	99	98	99	98	100	99	100	100	99	99	99	99
51	BP	100	99	100	98	100	99	99	100	98	100	98	100	99	99	100	100	99
52	BP	99	98	99	99	100	99	98	99	100	99	99	100	99	99	100	99	100
53	BP	99	98	99	99	100	99	98	99	100	99	98	100	98	99	100	100	100
54	BP	98	98	98	98	98	98	99	100	100	100	98	99	99	100	98	99	99
55	BP	100	99	100	98	96	98	98	99	100	98	99	100	100	100	99	98	98
56	BP	101	100	99	98	98	99	98	98	100	98	100	100	99	99	99	99	98

57	BP	99	100	100	100	98	98	100	98	100	99	100	100	98	98	98	98	98
58	BP	98	100	99	100	100	100	98	100	98	99	98	98	100	98	98	100	100
59	BP	98	98	100	102	100	100	100	100	100	99	99	98	99	99	100	100	99
60	BP	100	100	100	100	98	98	99	100	98	100	99	99	98	100	100	100	99
1	LBP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100
2	LBP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	100	100	99
3	LBP	100	100	100	100	100	100	100	99	98	100	100	100	100	100	100	100	100
4	LBP	100	100	100	100	99	100	99	100	100	98	100	100	100	100	100	99	98
5	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6	LBP	100	100	100	100	100	100	100	100	100	98	100	100	100	100	100	99	99
7	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
8	LBP	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100	100	100
9	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10	LBP	100	100	100	100	98	100	99	100	100	100	100	100	100	100	99	99	100
11	LBP	100	100	100	100	99	100	99	100	100	98	100	100	100	100	99	100	100
12	LBP	100	100	100	100	100	100	99	100	100	98	100	100	100	100	98	98	100
13	LBP	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	99	99
14	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
15	LBP	96	98	100	99	100	99	100	99	100	100	100	100	100	100	100	100	100
16	LBP	99	96	95	97	100	99	100	98	98	100	99	99	100	99	99	100	100
17	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	100
18	LBP	100	100	100	100	100	100	100	100	100	100	100	99	99	98	100	100	100
19	LBP	100	100	100	100	98	100	97	100	100	99	100	100	100	100	100	98	99
20	LBP	100	100	100	100	100	100	97	100	100	98	100	100	100	100	99	99	97
21	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100
22	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	99
23	LBP	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	99	100
24	LBP	100	100	100	100	99	100	99	100	100	98	100	100	100	100	98	99	98
25	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	LBP	100	100	100	100	100	100	100	100	100	98	100	100	100	100	100	99	99
27	LBP	100	100	100	100	100	100	100	100	98	100	100	100	100	100	99	100	100
28	LBP	100	100	100	100	100	100	98	100	98	100	100	100	100	100	100	100	100
29	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	100	100
30	LBP	100	100	100	100	98	100	99	100	98	100	100	100	100	100	99	99	99
31	LBP	100	100	100	100	99	100	99	100	98	98	100	100	100	100	99	99	98
32	LBP	100	100	100	100	100	100	99	100	98	98	100	100	100	100	99	100	99
33	LBP	100	100	100	100	100	100	100	100	98	99	100	100	100	100	99	99	100
34	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	LBP	96	98	100	99	100	99	100	99	100	100	100	100	100	100	100	99	100
36	LBP	99	96	95	97	100	99	100	99	98	100	99	99	100	99	100	100	100

37	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100
38	LBP	100	100	100	100	100	100	100	100	100	100	100	99	99	98	98	99	100
39	LBP	100	100	100	100	98	100	97	100	100	99	100	100	100	100	100	100	99
40	LBP	100	100	100	100	100	100	97	100	100	98	100	100	100	100	99	100	97
41	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	98	99
43	LBP	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	100	100
44	LBP	100	100	100	100	99	100	99	100	100	98	100	100	100	100	98	100	98
45	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100
46	LBP	100	100	100	100	100	100	100	100	100	98	100	100	100	100	100	99	99
47	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
48	LBP	100	100	100	100	100	100	98	100	100	100	100	100	100	100	100	99	100
49	LBP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	98	100	100
50	LBP	100	100	100	100	98	100	99	100	100	100	100	100	100	100	99	99	100
51	LBP	99	100	100	100	99	100	99	100	100	100	100	99	99	100	98	99	100
52	LBP	99	100	100	100	100	100	98	100	100	98	100	100	100	100	98	100	100
53	LBP	100	100	100	99	100	99	99	99	100	99	100	100	98	99	99	100	99
54	LBP	100	100	99	100	100	100	98	100	100	100	100	100	100	100	100	100	98
55	LBP	99	99	100	100	98	98	100	98	100	100	100	99	100	100	99	100	100
56	LBP	100	100	100	100	99	100	100	100	100	100	99	100	100	100	100	98	98
57	LBP	100	99	100	100	98	100	98	100	100	98	100	100	99	100	100	99	99
58	LBP	100	100	100	100	100	99	99	99	100	99	100	100	100	99	99	100	100
59	LBP	99	100	99	100	100	100	100	100	100	98	100	100	100	100	100	100	98
60	LBP	100	100	100	99	100	100	99	100	100	100	100	100	100	100	100	100	100

S. No.	Group	Time of onset of sensory block	Time to reach highest level of sensory blockade	Time to obtain grade 4 motor block(Bromage Scale)	Time to reach 2-segments regression	Time to rescue analgesia	Complications
1	BP	2	8	10	105	160	Hypotension
2	BP	2	6	11	110	150	No
3	BP	3	9	9	98	160	Hypotension
4	BP	3	8	10	100	150	Hypotension
5	BP	3	7	10	110	150	No
6	BP	3	5	12	90	150	No
7	BP	3	8	15	105	120	Hypotension
8	BP	2	9	12	98	125	No
9	BP	2	6	10	100	130	Hypotension
10	BP	1	8	10	105	130	Hypotension
11	BP	2	6	10	103	140	Hypotension

12	BP	3	5	7	93	180	Hypotension
13	BP	2	5	7	85	180	No
14	BP	2	6	10	95	150	No
15	BP	2	4	8	106	155	No
16	BP	3	6	11	93	160	No
17	BP	2	5	12	103	160	No
18	BP	2	7	10	110	150	No
19	BP	3	6	10	97	147	Hypotension
20	BP	2	7	9	103	145	Hypotension
21	BP	4	9	10	110	145	Hypotension
22	BP	2	6	13	113	150	No
23	BP	3	9	10	99	99	No
24	BP	2	7	12	110	150	Hypotension
25	BP	4	6	9	87	145	No
26	BP	2	5	14	90	130	No
27	BP	3	8	15	105	120	No
28	BP	2	9	12	98	125	No
29	BP	1	5	15	100	130	Hypotension
30	BP	4	8	10	100	130	Hypotension
31	BP	2	6	10	92	134	No
32	BP	3	5	7	98	155	Hypotension
33	BP	2	6	8	102	146	No
34	BP	4	7	11	89	143	No
35	BP	2	8	13	103	145	No
36	BP	3	6	11	103	155	No
37	BP	2	7	12	110	140	No
38	BP	1	7	11	105	160	No
39	BP	3	6	10	110	165	Hypotension
40	BP	3	7	9	125	152	Hypotension
41	BP	2	8	12	105	160	Hypotension
42	BP	2	7	11	108	145	No
43	BP	3	9	10	104	160	No
44	BP	3	8	11	110	154	Hypotension
45	BP	2	7	9	97	167	No
46	BP	3	8	10	93	160	No
47	BP	3	6	15	105	140	No
48	BP	2	9	12	99	154	No
49	BP	2	5	10	89	130	Hypotension
50	BP	4	8	10	100	130	No
51	BP	3	7	11	99	132	No

52	BP	2	8	12	105	130	No
53	BP	2	8	10	104	148	No
54	BP	1	9	11	99	162	No
55	BP	2	7	12	104	148	No
56	BP	3	8	12	105	145	Hypotension
57	BP	2	6	11	107	150	No
58	BP	1	8	9	100	140	No
59	BP	2	7	9	102	165	No
60	BP	3	9	10	108	166	No
1	LBP	3	8	10	110	170	No
2	LBP	4	10	10	120	160	No
3	LBP	3	7	7	95	140	Hypotension
4	LBP	4	8	8	110	157	No
5	LBP	2	6	11	105	140	No
6	LBP	3	10	13	95	160	No
7	LBP	4	8	11	105	130	No
8	LBP	4	10	12	98	125	No
9	LBP	3	9	11	105	140	Hypotension
10	LBP	5	10	10	105	120	-
11	LBP	2	7	9	110	140	No
12	LBP	4	6	12	103	170	NO
13	LBP	2	7	11	95	180	No
14	LBP	2	9	10	95	160	No
15	LBP	3	6	11	106	140	No
16	LBP	3	9	9	96	160	No
17	LBP	2	7	10	103	170	No
18	LBP	3	6	13	110	155	No
19	LBP	3	5	12	93	145	No
20	LBP	2	8	9	103	155	Hypotension
21	LBP	2	9	10	110	145	No
22	LBP	4	8	12	113	150	No
23	LBP	3	8	11	99	130	Hypotension
24	LBP	3	6	9	110	160	No
25	LBP	3	5	10	97	155	No
26	LBP	3	6	11	93	130	No
27	LBP	2	8	12	120	150	No
28	LBP	2	6	14	98	125	No
29	LBP	4	5	12	110	140	No
30	LBP	2	5	10	100	150	No
31	LBP	3	6	11	104	134	No

32	LBP	2	4	10	112	155	No
33	LBP	4	6	8	102	146	No
34	LBP	2	5	9	103	160	No
35	LBP	3	7	10	97	170	No
36	LBP	4	6	8	113	165	No
37	LBP	2	9	11	110	167	No
38	LBP	4	8	12	99	165	No
39	LBP	2	7	10	110	170	No
40	LBP	3	6	12	125	155	Hypotension
41	LBP	2	7	9	103	180	No
42	LBP	4	9	9	99	145	No
43	LBP	3	6	10	108	160	No
44	LBP	3	10	13	115	156	No
45	LBP	4	7	10	95	165	No
46	LBP	3	6	12	117	163	No
47	LBP	3	5	9	105	140	NO
48	LBP	2	8	14	99	154	NO
49	LBP	2	6	13	110	170	No
50	LBP	3	8	12	100	170	No
51	LBP	2	8	12	105	170	No
52	LBP	3	7	11	100	167	No
53	LBP	4	8	10	110	165	No
54	LBP	3	9	10	98	160	No
55	LBP	4	10	11	99	178	No
56	LBP	2	10	12	100	180	No
57	LBP	2	8	10	100	160	No
58	LBP	3	10	13	105	168	No
59	LBP	4	9	12	105	166	No
60	LBP	4	8	12	100	176	No