A STUDY OF CLINICAL EFFECTS OF INTRA THECAL ROPIVACAINE AND ROPIVACAINE WITH DEXMEDETOMIDINE IN INGUINAL HERNIA CASES

A STUDY OF 60 CASES

DISSERTATION

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BRANCH X -ANAESTHESIOLOGY

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CERTIFICATE

This is to certify that this dissertation **"A STUDY OF CLINICAL EFFECTS OF INTRA THECAL ROPIVACAINE AND ROPIVACAINE WITH DEXMEDETOMIDINE IN INGUINAL HERNIA CASES"** presented herein by **Dr.R.SRINIVASAN, D.A.,** is an original work done in the Department Of Anaesthesiology, Tirunelveli Medical College Hospital, Tirunelveli for the award of Degree of M.D (Branch - X) Anaesthesiology under my direct supervision and guidance, during the academic period of 2011 – 2013.

DEAN

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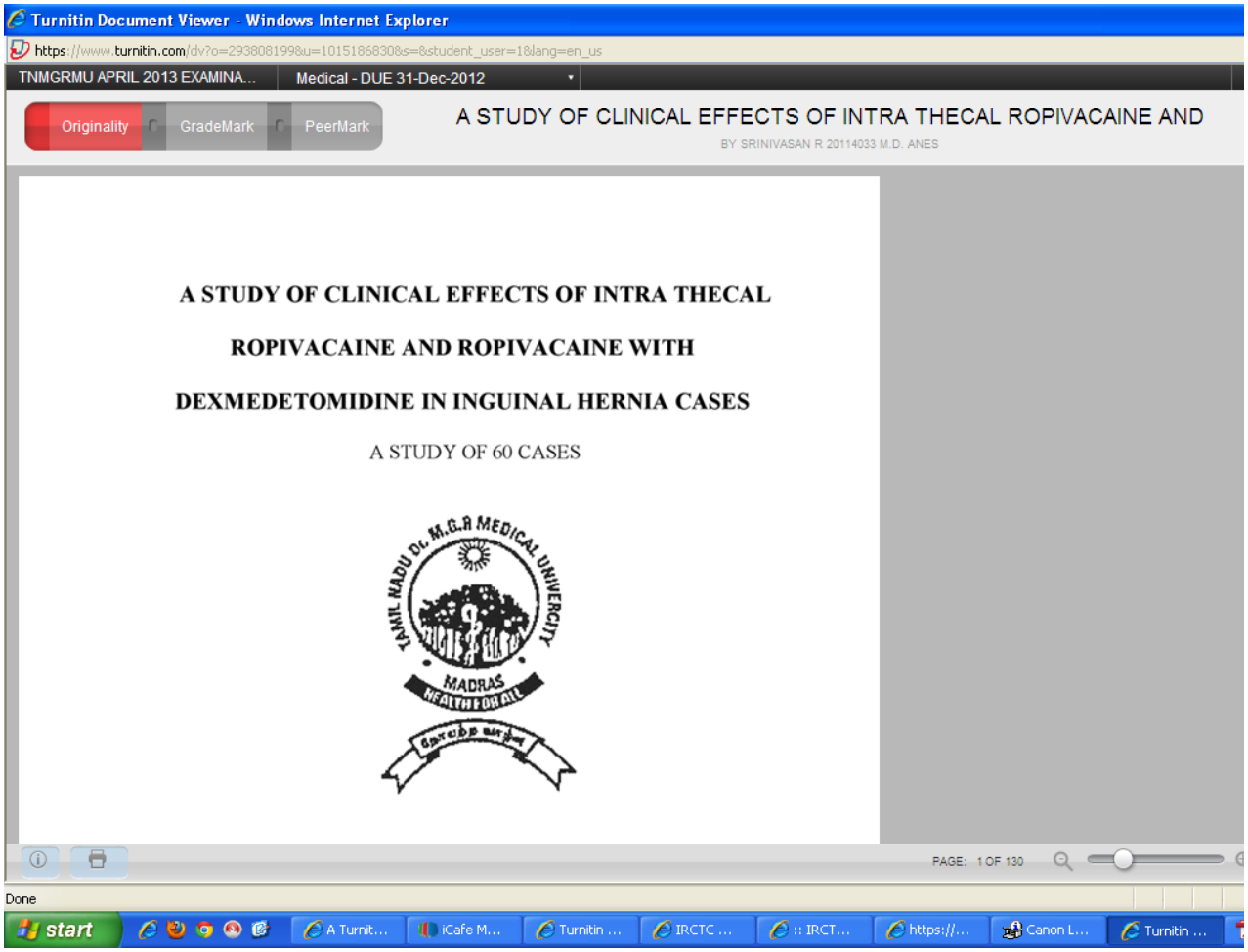
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DECLARATION

I, Dr.R.SRINIVASAN declare that the dissertation titled **"A STUDY OF CLINICAL EFFECTS OF INTRA THECAL ROPIVACAINE AND ROPIVACAINE WITH DEXMEDETOMIDINE IN INGUINAL HERNIA CASES"** has been prepared by me.

This is submitted to the Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.D. degree, Branch X (ANAESTHESIOLOGY) Degree Examination to be held in March 2013.

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CONTENTS

INTRODUCTION

It is always our first priority to select regional anesthesia in almost all procedures as much as possible. The subarachnoid block (or intra thecal) and epidural anaesthesia is a wonderful method of giving anaesthesia in lower abdominal and lower limb surgeries.

With the help of lignocaine and bupivacaine we are using spinal blockade for long time since its invention.

Lignocaine and Bupivacaine are the drugs used for long time. In this setting one of the newer drug Ropivacaine has emerged and which is available as only isobaric solution. It is used mainly for epidural, nerve plexus blocks. Now only it is available as 0.75% solution and most of us are not using it very much for subarachnoid block. That's why Ropivacaine was chosen as 0.75% intra thecal for my study. Dexmedetomidine is one of the newer drug very much used for sedation and to potentiate the effect of local anaesthetics.

AIM OF STUDY

To compare the clinical effects of intra thecal ropivacaine and ropivacaine with dexmedetomidine with respect to

1. Onset of sensory and motor blockade
2. Hemodynamic stability
3. Duration of sensory and motor blockade
4. Associated complications

HISTORY OF SPINAL ANAESTHESIA

First spinal anesthesia by J.Leonard corning 1855 – 1923, New york Neurologist in 1885. He accidentally pierced the dura while experimenting with cocaine on the spinal nerves of a dog. Later he deliberately repeated the intradural injection, called it spinal anesthesia and suggested it might be used in surgery.

Lumbar puncture standardized as a simple clinical procedure by Heinrich Irchacus Quinke (1842 -1922) of Kiel in Germany in 1891 and by Essex wynter (1860 – 1945) in England in the same year.

First planned spinal analgesia for surgery in man performed by August Bier (1861 – 1949) in August 1898 in Kiel when he injected 3ml of 0.5% cocaine solution into the 34 year old labourer. After using it on 6 patients he and his assistants each injected cocaine into others theca.

Adrenaline was used to increase duration to reduce toxicity of spinal analgesia in 1903.

Spinal analgesia was little used until Gaston Labats work in 1921. He used procaine crystals dissolved in cerebro spinal fluid together with barbotage and trendelenburg position. Meister discovered the analgesia properties of nubercaine in 1929 and it was used as hyperbaric solution by keyes and Mc Lelland of New york at 1980.

Howard Jones of London published his technique using hypobaric solution in 1930.

First amide local anesthetic lidocaine was synthesized by lofgren in 1943.

Bupivacaine was first used for intradural block in 1966.

In recent years there has been a steady increase in the popularity of spinal block for surgery.

In 1979, Albright published an alarming editorial which associated with long acting local anesthetics bupivacaine and etidocaine with cardiac arrest following regional anesthesia. Albright reported 6 cases of presumed accidental intra vascular injection of either bupivacaine or etidocaine which caused sudden ventricular arrhythmias occurring at the same time as severe convulsions.

Subsequently sporadic cases of maternal death resulting from accidental iv injection of 0.75% bupivacaine at the time of extradural injection for caesarian section were reported. In the UK 5 deaths were reported after i.v regional anesthesia. This sequence of events provided the impetus to develop a new local anesthetic drug.

Ropivacaine was introduced in clinical practice in 1996 and has consistently demonstrated an improved safety profiles over bupivacaine with a reduced CNS and cardio toxic profile.

Ropivacaine was approved for a new route of administration, intra thecal route in the European Union in Feb 2004.

In 1948 Raymond P.Ahlquist proposed the designation α and β adrenergic receptors and various subtypes of these two main classes have been characterized since then. Esmolol was introduced in 1985 as a short acting β_2 Antagonist that effectively control the heart rate during anesthesia. Labetalol a unique agent introduced in 1976 antagonises
α and β receptors.

The α_2 adrenergic agonists provide sedation, anxiolysis, hypnosis analgesia and sympatholysis. The initial impetus for the use of α_2 agonist in anaesthesia resulted from observation made in patients during anaesthesia who were receiving clonidine therapy. This was soon followed by a description of the MAC reduction of halothane by clonidine.

Dexmedetomidine is a more selective α_2 agonist with a 1600 greater selectivity for the α_2 receptor compared with α_1 receptor. It was introduced in clinical practice in the united states in 1999 and approved by the FDA only as a short term sedative for mechanically ventilated adult ICU patients.

Dexmedetomidine is now being used off label outside of the ICU in various settings including sedation and adjunct analgesia in the operating room, sedation in diagnostic procedures units and for other applications such as withdrawal detoxification amelioration in adult and paediatric patients.

To conduct a study on spinal anesthesia we must have through knowledge about the vertebral column, spinal cord anatomy and dermatomal distribution of nerves and physiology of the nerve function and detailed pharmacology, about the drugs which we use is obsolutely necessary to understand everything. Except strangulated inguinal hernia almost all inguinal hernias are done under regional subarachnoid block.

VERTEBRAL COLUMN

The bones of the vertebral canal are landmarks, identified both by the palpating fingers and the exploring needle by which the anesthetist performs spinal and epidural blocks. As well as being able to recognize these, landmarks, it is essential to be familiar with the feel of the inter vertebral ligaments as they yield to the advancing needle and to have intimate knowledge about the relationship of nervous tissue and dural sheath to the bony structures.

The vertebral column consists of 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 or 5 coccygeal vertebrae. The sacral and coccygeal vertebrae are fused in adult life.

The column has 4 curves of which thoracic and sacral are primary and are concave anteriorly therefore when the spine is fully flexed the cervical and lumbar curves are obliterated. In the supine position the 3rd lumbar vertebra marks the highest point of lumbar curve whereas the 5th thoracic is the lowest point of the dorsal curve. Kyphosis, lordosis, scoliosis and arthritis of the spine may upset the curve and make lumbar puncture difficult.

The direction of the spinous process determines the direction in which the spinal needle must be inserted. The spinous processes of the cervical, the first two thoracic and the last four lumbar vertebra are all practically horizontal and are therefore opposite the bodies of their respective vertebra.

The other spinous processes are inclined downwards and their tips being opposite the bodies of the vertebra next below; exception, tip of the first lumbar is opposite the inter vertebral disc. The 5th lumbar spine overhangs the lumbosacral inter space.

Some useful surface markings:

The vertebra prominens (spine of C7) is easily palpable. The tip of the spine of T7 is opposite the inferior angle of the scapula with the arms at the sides of the body.

The highest points of the iliac crests are usually on a line crossing the spine of L4 or the L3 L4 inter space. The tips of the spine of T7 is opposite the inferior angle of the scapula with the arms to the sides.

The dimples over the posterior superior iliac spines are on a line crossing the second, posterior sacral foramina and at this level the dural sac in the adult usually ends. The lower end of the spinal cord terminates at the level of the upper border of the body of L2.

THE VERTEBRAL CANAL

Bounded in front by the bodies of the vertebrae and inter vertebral discs, posteriorly by the laminae, ligamenta flava and the arch, which bears spinous processes and by ligaments between them called interspinous; laterally by the pedicles and laminae. Size and shape vary but is larger in cervical and lumbar regions.

Contents

1. Roots of spinal nerves
2. Spinal membranes with their enclosed cord and cerebrospinal fluid.
3. Structures : Vessels

   Fat

   Areolar tissue of extra dural space

The narrowest part is between T4 and T9. The stenosis of the vertebral canal may cause cord compression after central neural blockade. This may be intensified should there be extradural haemorrhage.

The spinal meninges:

Has 3 coverings

1. The dura mater
2. Arachnoid mater
3. Pia mater

The dura mater:

The dural coverings of the brain is a double membrane between the walls of which lie cerebral venous sinuses. The dura mater that encloses the cord consists of a continuation of the inner layer of the cerebral dura which is made up of dense fibrous tissue, the outer layer of cerebral dura terminates at foramen magnum where it merges with the periosteum enclosing the skull and is therefore represented by the periosteal lining of the vertebral canal.

The dural sac extends to the level of the 2nd segment of sacrum. Occationally if ends as high as L5 at other time if extends to S3. As a result of this it occationally possible to perform an inadvertant spinal tap (injection) during that course of a caudal injection. The dural sheath then continuous as the covering of the filum terminale to end by adhering to the periosteum on the back of the coccyx. The sac widens out in both cervical and lumbar regions corresponding to the cervical and lumbar enlargements of the cord. It lies rather loosely within the spinal canal buffered in the epidural fat, but it is attached at the following points to its bony surroundings.

a) Above to the edges of the foramen magnum and to the posterior aspect of the bodies of 2nd and 3rd cervical vertebrae.
b) Anteriorly, by the slender filaments of the fibrous tissue to the posterior longitudinal ligament.

c) Laterally, by prolongations along the dorsal and ventral root of nerves which fuse into the common sheath and which then blend with the epineurium of the resultant spinal nerves.

d) Inferiorly, by the terminale to the coccyx. However, the dural sac is completely free posteriorly.

The arachnoid mater:

This is a delicate mambrane which lines the dural sheath and which sends prolongations along each nerve roots. Above it is continuous with the cerebral arachnoid, which loosely invests brain and which dips into the longitudinal fissure between the cerebral hemispheres.

The pia mater:

It is the innermost one and it is a vascular connective tissue membrane that closely invests the brain and spinal cord and projects into their sulci and fissures. It is thickened anteriorly into the linea splendens along the length of the anterior median fissure. On either side it forms the ligamentum denticulatum, and series of triangular fibrous strands attached at their apices to the dural sheath. They are 21 in number and lie between the spinal nerves down to the gap between the 12^{th} thoracic and 1^{st} lumbar root. The lowermost denticulatum is bifid and is crossed by the 1^{st} lumbar nerve root. Inferiorly, the pia is continued downwards as the filum terminale, which pierces the lower head of the dural sac and then continuous to the coccyx with a covering sheath of dura.

The spaces related to the spinal meninges:

These are the

Sub arachnoid space

Subdural space

Epidural space

THE SUBARACHNOID (INTRA THECAL) SPACE contains the CSF. It is traversed by incomplete trabaculae, the posterior subarachnoid septum and the ligamentum denticulatum.

This space communicates with the tissue spaces around the vessels in the pia mater that accompany them as they penetrate into the cord. These continuations of the subarachnoid space have been described as breaking up into fine ramifications that surround individual nerve cells (the Virchow Robin spaces) and which have been considered as pathways by which a spinal anesthetic permeates the cord. It is debatable whether such spaces actually exist; they are probably artifact produced by syrinkage of the course of fixation of the historical material.

SUBDURAL SPACE is a potential space between dura and pia-arachnoid into which a catheter or local analgesic solution may track. It has no communications with the subarachnoid space.

EPIDURAL OR PERIDURAL SPACE:

Spinal dura mater represents meningeal layer of the dura mater of the brain. Epidural space is situated between the spinal dura and vertebral canal. Average diameter 0.5cm and widest in midline posteriorly in the lumbar region.

Boundaries are

- Foramen magnum superiorly
- Sacrococcygeal membrane inferiorly
- Lamina and ligaments posteriorly
- Posterior longitudinal ligament anteriorly
- Pedicles and inter vertebral foramina laterally

Contants:

Dural sac

Spinal nerve roots

Extradural plexus of veins

Spinal arteries

Lymphatics and fat

The plexus of veins have no valves and constitute the valveless vertebral plexus of BATSON. They connect pelvic veins below with the intra cranial veins above. They become distended with increased in intra abdominal pressure with IVC obstruction.

There are 58 inter vertebral foramen and their patency is important factor in controlling the height of analgesia. The shape of the space is triangular and a dorso median fold of membrane occationally divides the space into compartments which don't always communicate freely with each other. Such abnormalities may explain patchy analgesia.

The dura mater is attached to the margins of the foramen magnum. But this doesn't prevent the passage of analgesic drug to the cranial cavity. It ends at the lower border of the second lumbar vertebrae. Distance between the skin and extradural space is 4 – 5 cm. There is a negative pressure in the extradural space in only about 80% of patients.

The vertebral ligament bounding the canal

1. Supra spinous ligament between the tips of spinous processes C7 to sacrum.
2. Inter spinous ligament joining the spinous process together.
3. Ligamenta flava

   Running from lamina to lamina composed of yellow elastic fibres and it is thicker from above downwards.
4. Posterior longitudinal ligament

   On the posterior surface of vertebral body.
5. Anterior longitudinal ligament

   On the anterior surface of the vertebral body

Midline spinal puncture pierces the first three ligaments. In lateral approach only ligamenta flava are encountered.

THE SPINAL CORD

It is an elongated part of the nervous system which occupies upper 2/3 of the vertebral canal and is 45cm long. Extend from upper border of the atlas to the upper border of the 2nd lumbar vertebra and lower still in infarcts. It continuous as medulla oblongata upwards and ends in conus medullaris. The nerve toots which pass out transversely in early life become more oblique in direction in adults. They are bathed in CSF and will be affected by local analgesic solution injected in the lumbar area. Spinal cord is ensheathed by three membranes.

SPINAL SEGMENTS:

The cord is divided into segments by the pairs of spinal nerves, which arise from it. These pairs are 31 in number.

a) 8 Cervical

b) 12 thoracic

c) 5 lumbar

d) 5 sacral

e) 1 coccygeal

The nerve roots within the dura have no epineural sheaths and are easily affected by local analgesics. The cord is not transversely blocked by spinal analgesia.

Spinal nerves:

Anterior root is efferent and motor. Posterior root is larger than anterior and is largely sensory. Posterior root has a ganglion and conveys fibres of all sensation with automatic fibres.

Pain pathway in the spinal cord:

Pain and temperative fibres enter the posterior horn where they end around cells in the grey matter. Fibres then cross to cortra lateral side within three segments and ascend in the lateral spino thoracic tract to the thalamus. Tactile impulses ascend in the ventral spinothalamic tract to the thalamus. Deep or muscle sensory impulses ascend in the posterior columns and spinocerebellar tracts. Vibration impulses ascend in the posterior columns.

Anterior and posterior nerve roots within its sheath unite in the intervertebral foramen to form the main trunk which soon divide into anterior and posterior divisions.

Local analgesic drugs injected into the sub arachnoid space can soak along the nerve trunk for as much as 2cm beyond the inter vertebral foramen. Analgesic drugs affect autonomic, sensory and motor fibres in that order and fibres which block easily hold the drug longest and thus sensory block lasts longer than motor and usually ascends two segments higher up the cord than motor block.

Segmental levels:

Perineum	- S1 – S4
Inguinal region	- L1
Umbilicus	- T10
Sub costal arch	- T6 – T8
Nipple line	- T4 – T5
Second inter costal space	– T2
Clavicle	- C3 – C4

Segmental levels of spinal reflexes:

Epigastric	- T7 T8
Abdominal	- T9 - T12
Cremastric	- L1 L2
Plantar	- S1 S2

Blood supply of spinal cord:

It is supplied by 2 posterior spinal arteries which arise from posterior inferior cerebellar arteries and , anterior spinal artery which is formed by the branch of vertebral artery of each side.

Anterior spinal artery is reinforced by many anterior by which artery of ADAMKIEWICZ artery radicularis magna is very important which can enter anywhere between T5-L2 and usually (75%) it enters from left side. Damage to this artery by needle can lead to cord ischemia and paraplegia.

CEREBRO SPINAL FLUID

Source: From the choroid plexuses of the third, fourth and lateral ventricles by either secretion or dialysis.

Circulation: Otherwise called the third circulation. It forms a short circuit between the arterial and venous circulation. Fluids after formation enters into the lateral ventricles, passes through on each side, the foramen of MANRO to the third ventricle and then through the agueduct of SYLVIUS to fourth ventricle. Then fluid enters into the subarachnoid space through the central foramen of MAGENDIE and the lateral foramina of LUSCHKA and reaches cisterna magna. It baths whole of CNS and is absorbed into venous sinuses through the arachnoid villi.

Ordinary dose of analgesic drugs injected into the spinal subarachnoid space don't reach the fourth ventricle.

Physical characteristics:

Clear, colourless, slight opalescence due to globulin spe.gr.at 37^0c is 1003 – 1009.

The density is more dependent on the temperature and on the contained sodium, chloride and Co_2. Increased in DM, uremia and old age. 5 – 6 lymphocytes will be present and increase of cells indicates meningeal irritation. Quandity 110 – 150ml half of which is present in the cranium and half in the spinal canal.

Pressure: 100 – 200mm of H_2O in lateral position.

300 – 400mm of H_2O in vertical position.

Factors which increase the pressure are sleep, neoplasm, ↑ Co_2 tension, CCF and mediastinal tumours, straining and couging. Decreased in dehydration and with barbiturates. About 500 ml is secreted per day.

Chemical characteristics:

Alkaline

pH 7.6

Protein 24 – 40mg %

Sugar 45 – 80 mg percent

Sodium chloride 750 mg %

Urea 10 – 30 mg %

Bicorbonate 24 mg 1 litre

No antibodies present in the CSF and there is always chance for infection. Contains small amount of cholinesterase. After spinal anaesthesia albumin and globulin will increase and sugar decreases and magnesium increases than in blood.

Functions:

1. It is a fluid cushion to protect brain and spinal cord.
2. Regulates the volume of the cranial content.

3. It has a slight function in the metabolic exchanges of nervous tissue and may take the place of lymph. CSF amount is decreased in dehydration and after lumbar puncture.

Advantages of SAB over general anaesthesia:

- Cheaper
- Less risk of pulmonary aspiration
- Distribution of blood chemistry is minimal
- Less bleeding
- Decreased incidence of thrombo embolism

SYSTEMIC EFFECTS OF SPINAL ANAESTHESIA

Cardiovascular system:

Hypotention (1) due to venodilatation, by the symphathetic block (2) dilatation of postarteriolar capillaries (3) decreased cardiac output.

Decreased cardiac output due o decreased venous return, brady cardia.

Bradycardia due to

- decreased atrial pressure because of decreased veinous return (bainbridge reflex)
- Direct inhibition of cardio accelerator fibres (T1 to T4)

4. Paralysis of nerve supply to adrenal glands with consequently decreased catecholamine release.
5. Direct absorbtion of drug into the systemic circulation.
6. Compression of inferior vena cava & aorta by pregnant uterus, abdominal tumours (supine hypotension syndrome.

Nervous system:

Order of blocking nerve fibres.

- Autonomic preganglionic – β fibres
- Temperature fibres – cold before warm
- Pain-prick fibres
- Fibres conveying pain greater than pin prick
- Touch fibres

- Deep pressure fibres
- Somatic motor fibres
- Fibres conveying vibratory sense and proprioceptive impulses.

During recovery return of sensibility in the reverse order was assumed, but it has been suggested that symphathetic activity returns before sensation. The patient may complain of pain due to tourniquet and increased concentration of analgesic will avoid this. LA drugs mainly acts on here roots. Drug molecules removed from intradural space by absorbtion into the blood vessels. In intradural block, symphathetic fibres are blocked two to three segments higher than sensory fibres. The difference between sensory and motor block is slight.

Respiratory system:

Tidal volume, minute volume, arterial oxygen tension are well maintained in normal individuals but in patient of COPD whose expiration is dependent on abdominal muscles and can't bear loss of lower intercostals. There can be severe impairment of respiratory function if block is high enough to block abdominal and lower intercostals muscles.

Apnoea seen during spinal anaesthesia is usually due to severe hypotension causing medullary ischemia. Other causes of apnoea are

a) High spinal – block phrenic nerve
b) Total spinal – due to accidental intrathecal injection of large volume of drug during epidural.

c) Intra vascular injection and systemic toxicity.

Gastro intestinal system:

Symphathetic block and parasympathetic overactivity produces contracted bowel and relaxed sphincters. Peristalsis is increased. Nausea and vomiting due to hypotension, bile in stomach due to relaxed pyloric sphincter, handling of abdominal structures and psychological.

Genito urinary system:

Paralysed and engorged penis is one of the signs of successful block. Urinary retention is a very common post operative problem due to blocking of S234 fibres. Renal functions are not impaired unless mean arterial pressure falls below the critical pressure of kidney for autoregulation (which is 55mm of Hg).

Liver:

Hypotension can decrease liver blood flow but impairment is minimal.

Endocrine system:

- Stress response to surgery is inhibited.
- The response to insulin is augmented and there can be hypoglycemia.
- Usual increase in ADH during surgery is suppressed.

Thermoregulation:

Vasodilatation causes heat loss which is compensated by vasoconstriction above the block by shivering.

Local anaesthetics:

Classified into

Aminoesters and Aminoamides

Aminoesters causes high incidence of allergic reactions.

Aminoamides:

(e.g) lignocaine, bupivacaine, ropivacaine

- Metabolished primarily in the liver
- It has low incidence of allergic reactions
- Solutions are stable (not destroyed even by autoclaving)

Mechanism of action of LA:

Drug in non-ionized form penetrates the axonal membrance and inside it gets dissociated. This ionized form binds to receptor situated in sodium channel in inactivated state from inner side, blocking the channel and thus preventing depolarisation and hence action potential. LA enters at node of Ranvier.

SPINAL ANESTHESIA: (INTRATHECAL BLOCK)

It is otherwise called as sub arachnoid block and is one of the most commonly used technique.

One of the most important piece of equipment in the hand of the anaesthetist practicing regional anaesthesia is NEEDLE.

Following initial development of hypodermic needles by Francis Rynd of Dublin and others proved that regional anaesthesia of the extremities possible. Sep 15th 1884 is hailed as the birthdate of regional anaesthesia when Carlkoller demonstrated the anaesthetic properties of cocaine applied to the conjunctiva. While Koller's interest revolved around ophthalmic procedures, William Halsted experimented and proved that regional anaesthesia of the limbs was possible by means of injections into the brachial plexus and posterior tibial nerve. Corning is credited with the first needle designed for spinal anaesthesia. The needle was 3 ½ - 4 inches long and was made up of gold or platinum along with an introducer ½ inch in length. August Bier advocated large bore needles on the ground that these didn't require an introducer. However he was criticized on the ground that wide bore needles caused unnecessary trauma and pain to the patient.

Needles for spinal anaesthesia:

1. **Quincke bevel spinal needles**

Various needle were described from time to time but none of these

stood the test of time till Quincke needle was introduced into practice. This needle is popular even to this day which have a lower incidence of post dural puncture headache (PDPH). Quincke needle has a slanting bevel and a stillette, which is flush with the tip of the needle. This makes the entry of the needle very smooth and less painful.

2. <u>Pencil point spinal needles:</u>

Hast and Whitcre in 1951 introduced a solid end needle tapered to pencil point with an orifice on the side of the needle just proximal to the tip. This has non cutting bevels and spreads the dural fibres rather than cutting through them thereby minimizing the incidence of PDPH. The pencil point needles are the Whitcre needle or sprotte type difference between them being very slight. Whitcre needle has a conical tip with a rectangular side opening and with sharp edges. The Sprotte needle has a tapering end which is most blunt than the Whitcre needle tip. It has an oval lateral opening with smooth edge proximal to the tip. The side hole on the Whitcre needle is close enough to the needle tip to ensure an accurate delivery of the local anaethetic drug into the subarachnoid space. These pencil point needles are finebore needles require and introducer needle for insertion. The pencil point needles are gaining popularity although their use in India where economic considerations play and important role.

3. **Double hole pencil point needle (Eldor spinal needle)**

There will be faster flash back of CSF on dural puncture and the immediate dispersion of the injection is possible.

4. **Tip holed spinal needle:**

Also called ball pen needle. There have been very few users of this Needle, primarily because of the concern of tissue coring by the sharp edge of the needle.

There are dura cutting and dura separating needles.

Dura cutting:

Standard Quincke-Babcock needle comes in this group. The incidence of post dural puncture headache is high with these needle. But the needle is cheaper one.

Dura splitting:

These are pencil-tipped needles. (Whitcre, sprotte needles are the continuously available types, PDPH is less with this needle the problem is costly one.

Before going to the procedure for subarachnoid block it is essential to know about the drugs which we use .

PHARMACOLOGY OF LOCAL ANAESTHETIC DRUGS

Modern local analgesia began with the introduction of cocaine into medical practice in 1884. First used by CARLKOLLER for anaesthetizing cornea.

Local anaesthetics are classified on the basis of chemical structure and on the duration of action.

Based on chemical structure:

Chemically local anaesthetics are consist of a benzene ring separated from the tertiary amide either by ester (or) amide linkage. Based on this intermediate chain these are classified as aminoesters and aminoamides.

- Aminoesters:

  (e.g) procaine, chlorprocaine, tetracaine, benzocaine, cocaine

Features:

- Esters are metabolized by pseudocholinestrase except cocaine which is metabolized by liver.
- More incidence of allergic reactions.
- Solutions are unstable.

- Aminoamides

  (e.g) lignocaine, mepivacaine,

  Prilocaine, Bupivacaine

  Etidocaine, Ropivacaine

Amides are metabolized mainly in the liver. Lower incidence of allergic reactions is the main advantage. The solutions are stable one and they are not destroyed even by autoclaving.

Based on duration of action and potency

- Potency
  - Short duration, low potency

    Chloroprocaine

    Procaine
  - Inter mediate duration and potency

    Lignocaine

    Mepivacaine

    Prolocaine and cocaine
  - Long duration and high potency

    Bupivacine, Dibucaine, Ropivacaine

Among all chloroprocaine has shortest and dibucaine has the longest duration of action.

Commonly used drugs are lignocaine, bupivacaine, and ropivacaine.

STRUCTURE OF LA

LA drugs are water soluble salts of lipid soluble alkaloids and composed of aromatic ring and hydrophilic amide with a intermediate chain. There are 2 types of inter mediate chain ester and amide and depend upon that drugs are classified. Some change in chemical structure result in

pharmacological effect (eg) piperadine ring instead of tertiary amine we get mepivacaine result in increase in lipid solubility and duration of action. The addition of propyl or butyl group to the amine end of mapivacaine results in ropivacaine (or) bupivacaine respectively.

Bupivacaine exists in two forms called enantiomers which are mirror images of molecular structure (Levo, Dextro). Each has different pharmacodynamical and pharmocokinetic properties and potency and side effects.

NERVE ANATOMY AND FUNCTIONS

Nerves are conducting the signals from the CNS to peripheral nerve. Nerves consists of cell body, axon and presynaptic terminal. The spaces between the presynaptic terminal and the cell body of another nerve is called synaptic cleft, across which pass neurotransmitters norepinephrine (or) acetyl choline.

Nerve fibres classified into A & B & C depend upon their myelination and diameter and each has its own separate function. Small diameter axons are more susceptible to block than large diameter fibres, however myelinated fibres are more sensitive than non-myelinated. LA drugs by blocking the fibre at the node of Ranvier.

Resting membrane electrical potential of nerve fibres is -70 mV. Impulse generation by entry of sodium inside and potassium outside and repolarisation due to reversal of ion movement.

Site of action at molecular level

The nerve membrane is made up of a phospholipid bilayer. The globular proteins like sodium and potassium channels are situated in the membrane and is protruding through the lipid bilayer.

Table. Nerve fiber types in mammalian nerve.[a]

Fiber Type	Function	Fiber Diameter (μm)	Conduction Velocity (m/s)	Spike Duration (ms)	Absolute Refractory Period (ms)
A					
α	Proprioception; somatic motor	12-20	70-120		
β	Touch, pressure	5-12	30-70	0.4-0.5	0.4-1
γ	Motor to muscle spindles	3-6	15-30		
δ	Pain, cold, touch	2-5	12-30		
B	Preganglionic autonomic	<3	3-15	1.2	1.2
C					
Dorsal root	Pain, temperature, some mechano-reception	0.4 – 1.2	0.5-2	2	2
Sympa thetic	Postganglionic sympathetic	0.3-1.3	0.7-2.3	2	2

Sodium channels

10 different types of Na^+ channels are identified. Binding of local anaesthetic at sites of voltage gated Na^+ channel prevents opening of channels and inhibits channel activation. LA drugs bind to channel pore and occlude the pathway.

Na^+ channel is bell shaped protein with four domains arranged around the central pore. Each domain consists of 6 α subunits (S1-S6). The short loops between S5 & S6 form the pore.

Potassium channels are tetramers with each of the four subunits forming part of the pore through which K^+ channels pass.

Action of LA drugs

LA drugs inhibit the peripheral nerve conduction by blocking Na^+ and K^+ channels. Binding of LA drugs more with open (or) inactivated channels than resting state or that dissociate slowly will cause more potent block. (eg) Bupivacaine. That will cause delay in recovery of cardiac Na^+ channels, prolong conduction and generate re-entry arrhythmias. Heart is more susceptible to more channel blockade by LA drug than peripheral nerves.

Cm- is the minimum concentration of local anaesthetic that will block nerve impulse conduction. Each anaesthetic has its own Cm.

Recent evidence says that LA drugs act on

- G.coupled receptor proteins.
- Muscarinic receptors.
- Endothelial nitric oxide.

Clinical pharmacology:

Potency:

Hydrophobicity is the deciding factor of intrinsic anaesthetic potency.

Onset of action:

Depends on number of factors like

(1) Dose and concentration

(eg) 0.25% Bupivacaine has show onset and 0.5% has accelerated onset of action.

(2) pKa

It is the pH at which LA drug is 50% ionized and 50% non ionized. Diffusion across the nerve fibre membrane decided by non – ionized fraction of the drug. The higher the pKa, the greater the ionized fraction in solution. LA drugs which has low value have a fast onset of action. Lignocaine has fast action (pKa 7.6) than bupivacaine (pKa 8.1).

This is the rationale of adding sodabicorbonate to local anaesthetic which increases pH and so more drug available in non ionized form.

(3) Type of nerve fibre:

Smaller axons, myelinated fibres are more sensitive to LA. So type B fibres are more easily blocked than type C fibres. So sequence of block is B → C → A and in functional terms it is autonomic → sensory → motor and the sequence of recovery is motor → sensory → autonomic. Among sensory fibres sequence of blockade is temperature → pain → touch → deep pressure → proprioceptain.

Frequency of nerve stimulation

A stimulated nerve will be blocked early.

Duration of action:

It depends on

1. Dose

   Increased dose increases duration.

2. Pharmocokinetic profile of drug

   It includes

   (i) Plasma protein binding

   Agents with high protein binding like bupivacaine has prolonged action. In the plasma amide LA drugs bind with α-acid glycoprotein, a high affinity limited-capacity protein and albumin, a low affinity large-capacity protein. Low protein will cause low protein bound fraction and increases the free fraction and increases the likelihood of toxic reactions. In critically ill patient hypoxia, hypercarbia, acidaemia increases free fraction and potentiate toxic effects.

   (ii) Metabolism:

   Esters are metabolized by pseudocholesterase and amides metabolized in liver by microsomal enzymes. Esters have short duration of action.

3. Addition of vasoconstrictors

   Vaso constrictors decrease the systemic absorbtion of local

anaesthetics in blood, so increases the concentration thereby increasing duration of action. Drugs used are

(a) Adrenaline

(b) Noradrenaline

(c) Felypressin

Intrinsic vasodilatory activity of lignocaine has influence on potency and duration of action. Bupivacaine and other newer drugs has biphasic vasoactive response. At low concentration will cause vacosonstriction and high concentration will cause vasodilatation. The cause for the LA drugs producing vasodilatation is nitric oxide release. Vasoconstrictors are should not be used for

- Ring block of fingers, toes, penis
- When inhalational agent halothane is used which sensitizes the heart to adrenaline.
- Myocardial ischiemic patients.
- Hyperthyroid patients.
- Severe hypertensives.
- IVRA (Biers block)

(4) Sodium bicarbonate:

Addition of sodium bicarbonate (1 ml of 8.4% solution to 10ml of lignocaine increases both onset and duration of action. Sodium bicarbonate increases the onset by making pH more alkaline so more drug is

available in unionized form. Later carbondioxide released from sodium bicarbonate metabolism enters intracellularly making the pH more acidic and making more drug to be available in ionized form thereby increasing the duration also.

So addition of sodium bicarbonate

- Enhances the onset of action
- Increases the duration of action
- Improves the quality of the block
- Decreases the pain of injection

Pharmacokinetics

Absorbtion: It depends on

- Site of injection. It is proportionate to the vascularity of the site of injection. Systemic absorbtion is highest after inter costal nerve block.
- Addition of vasoconstrictors. This is the most important factor. Addition of the vasoconstrictors increasing the margin of safety by decreasing the systemic absorbtion that is why maximum dose of xylocaine (lignocaine) with adrenaline is 7mg/kg while without adrenaline is 3mg/kg.

Distribution:

Tissue distribution is in proportion to the tissue : blood partition coefficient of the LA drug and the mass and perfusion of the tissue. The

plasma concentration of local anaesthetic is decided by distribution and clearance of the drug. Amide group of drugs are widely distributed in tissues than ester local anaethetics following systemic absorbtion.

Metabolism:

The ester group drugs are hydrolysed by pseudocholiesterase into the metabolite PABA which is a causative factor for the allergic reactions. Plasma half life is prolonged in atypical pseudo cholesterase. Amide group drugs metabolished in the liver by hydroxylation and dealkylation and willn't cause the PABA so less likely to get allergic reactions. Metabolized by cytochrome p450 and the enzyme activity depend upon the liver blood flow and usage of enzyme inhibitors.

Elimination:

Elimination half life mainly depends upon hepatic metabolism because renal excretion of unchanged drug is very minimal. In heart failure, distribution and clearance of the local anaesthetics are reduced.

Systemic effects and toxicity:

Toxicity is proportional to potency.

Cardio vascular system:

- Except cocaine all LA drugs are vasodilators in clinically used concentrations.
- Have negative inotropic action on the myocardium.

- These agents depress conducting system. It is manifested as initial tachycardia, hypertension followed by myocardial depression, bradycardia, hypotension, ventricular arrhythmias and cardiac arrest.
- Accidental invascular injection of high dosage of LA drugs causing blockade of Na^+, K^+, Ca^+, channels in the conduction systems in the CNS and CVS and causes acute collapse.

Treatment:

Lower head

100% oxygen

Intubation, ventilation

Intra venous fluids

Epinephrine

Cardiac massage

Cardiotoxicity of bupivacaine is much higher than that of lignocaine. Recent studies tell that ropivacaine, levo-bupivacaine are less likely to dwell on Na^+, K^+ channels and are less likely to impair myocardial electrical conduction and contractility. In animal studies they show increased threshold for convulsion and arrhythmias and resusitation after cardiovascular collapse is better with ropivacaine and levobupivacaine than bupivacaine.

CNS toxicity:

Typical sequence is initial excitation followed by depression of cerebral tissue (inhibitory neurons are more sensitive than excitatory neurons)

signs and symptoms are

- Circumoral numbness
- Dizziness, tongue parasthesia
- Visual and auditory disturbances
- Muscle twitching
- Tremors, convulsions followed by coma and death
- Treatment
    - Oxygen
    - IV propofol to control convulsions diazepam, thiopentone may be used
    - Lipid based solutions which reduces plasma levels.

Respiratory system:

- LA drugs depresses hypoxic drive
- Direct depression of medullary respiratory centre.

Immunologic:

Allergic reactions are common with esters. Reactions with amides due to its preservative methylparaben .

Local toxicity:

Produce nerve damage when directly injected into the nerve. When directly injected into the muscle it is myotoxic.

Factors affecting the Height of Block (i.e., Level of Block)

1. **Volume (dosage) of drug:** Greater the volume, higher the level of block.
2. **Baricity:** Baricity is the ratio of specific gravity of an agent at a specific temperature (body temperature) to specific gravity of CSF at same temperature. This is very important factor in determining the migration and eventual extent of block.
    - **Hyperbaric technique:** This is the most commonly used method. The outcome of hyperbaric spinal anaesthesia is governed by **position of the patient** during spinal anaesthesia and after injection till drug gets fixed to neuronal tissue, **which normally takes 10 to 15 minutes for xylocaine and 20 to 30 minutes for bupivacaine.**
    - **Unilateral spinal anaesthesia:** Spinal given in lateral position and patient remains in this position for 5 minutes, hyperbaric solution will produce block on one side only.

- **Hypobaric:** Agent used is **tetracaine** 0.3% which is **made by hypobaric by addition of sterile water.** It is useful in colorectal surgery and applied in prone position where head is lower than buttocks (**Jack knife position).** The drug will migrate caudally to block sacral dermatomes.
- **Isobaric:** The commonly used solution is **bupivacaine 0.5%.** The solution settles at the same level at which it is injected.

3. **Position of patient:** It is very important factor. If the Trendelenburg position is given (10 to 20 degree) the same volume will produce a much higher level of block.
4. **Intra-abdominal pressure:** Increase in intra abdominal pressure by ascites, pregnancy, abdominal tumours decreases the volume of subdural space and increases CSF pressure, producing higher block.
5. **Spinal curvature:** Spinal curvature by effecting the contour of subarachnoid space can affect the level of block.
6. **Patient factors:**
   a. **Age:** Old age persons have reduced spinal and epidural space. So higher level is expected.
   b. Obesity: Effects block by increasing intraabdominal pressure.
   c. Height: Taller persons have long spines so require more drug.

Factors Not Affecting the Height of Block

1. Sex: Dosage is same for both males and females.
2. Speed of injection.
3. Direction of needle.
4. **Barbotage:** It is the technique in which repeatedly. CSF is taken out and drug is injected.

Factors Affecting Duration of Block

1. Dose
2. Increased concentration.
3. Pharmacological profile of drug like protein binding, metabolism.
4. Type of the drug used. Bupivacaine has prolonged block than xylocaine.
5. Added vasoconstrictors: Although vasoconstrictors increase the duration by 10-50% but they should not be used for spinal anaesthesia as they can cause ischemia of cord.

PRELIMINARY MEDICATION

Inadequate premedication during spinal analgesia shows callous unconcern for the patient. It may also wreck the smoothness of an otherwise correct technical procedure.

In patients over 60 hyoscine may cause excitement and is better avoided. Patients who come to the theatre in an anxious state of mind should be helped by further intravenous doses of sedation.

Many anaesthetists prefer to give only light premedication, such as Atropin with sedative premedication.

The phenothiazine drugs give good pre-operative, together with prolonged post-operative sedation, but cause, in addition, hypotension which may require a pressor drug for its control.

Armamentarium

Sterilization is most important and the whole outfit should be dry sterilized by gamma radiation or autoclaved. All-glass syringes are ideal while plastic disposable syringes are excellent. Sterile distilled water must be regarded with suspicion unless it comes from a fresh, previously unopened container. Ampoules should not be stored in spirit or other antiseptic solution, as minute faults in the glass may result in contamination of the contents with untoward results. If the autoclave is used the hydrochloride salts of lignocaine, mepivacaine, and show no chemical change on gas chromatography. Boiling for five minutes in

water cannot be relied on to kill spores. Dry heat is not suitable for ordinary glass and metal syringes. Light and heavy cinchocaine solutions show decreased potency if autoclaved for more than two hours while amethocaine is rather less stable.

The lumbar puncture needle should be of fine gauge (22-26 gauge) and have a short bevel.

PREPARATION

Before starting regional anaesthesia we must be ready to deal with potential complications like total spinal, systemic toxicity following accidental intra venous injection of local anaesthetics. Hemo dynamic or airway sequelae. Regional anaesthesia done only where equipment and resuscitation drugs are available immediately includes IPPV with 100% oxygen, suction apparatus, airway equipment and drugs used in securing the airway and for supporting circulation. LMA and combitube should be available. Tilting table is the best one if the patient needs a trendelengburg position.

A large bored indwelling cannula is placed and around 500 – 100ml of lactated ringers solution is given 10 – 20 minutes before induction of the block. The hydration helps to prevent hypotension when symphathetic blockade develops. Infusion is maintained throughout the surgery and post operative period.

TECHNIQUE OF LUMBAR PUNCTURE FOR INTRADURAL BLOCK

The lumbar puncture must be done in good light on a table which can be tilted.

Lumbar puncture is contra-indicated in patients with papilloedema or cerebral oedema, especially as the result of tumours in the posterior fossa.

Puncture in Lateral Position. – The patient should be supported by a nurse and positioned as follows:

Back to be at edge of table and parallel to it.

Knees to be flexed on to abdomen.

Head to be brought down to knees.

Hips and shoulders to be vertical to table to avoid rotation of vertebral column. Sudden movement to be avoided. In unilateral operations patient should lie on diseased side when hyperbaric solutions, on the sound side when hypobaric solutions, are to be used. In the obese the median crease sags downwards sometimes as much as I in., so point of needle should be inserted above crease in these cases.

The line joining the highest points of the iliac crests crosses either the spine of the fourth lumbar vertebra or the interspace between L4 and L5. Precise identification of the lumbar spines may be impossible, but this does

not matter so long as the first lumbar interspace (and those above this level) are avoided. When the chosen interspace is located the intradermal needle is inserted after careful palpation, midway between the two spines, and a small weal of local analgesic solution is raised. The hands of the anaesthetist have been scrubbed up and he has donned a sterile gown and gloves. The back has been painted over a large area with antiseptic and towels arranged suitably. While the skin weal is taking effect, a syringe is filled with analgesic solution. A small incision is made in the skin with a large skin needle to prevent a tough skin from grasping the spinal needle tightly and to prevent a core of skin being carried into the intra – or extradural space with the lumbar puncture needle. Some prefer to use a Sise or a Rowbotham introducer as a cannula through which to introduce the spinal needle. The needle is then slowly pushed forwards parallel to the floor and at right – angles to the back, with its bevel in the plane to separate and not to divide the longitudinal fibres of the dura. If bone is met, withdraw and slightly alter direction either upwards or downwards. The extradural space can be identified in many cases if a drop of analgesic solution is left on the hub of the needle as it is pushed downwards: the negative pressure of the space causes the drop to be indrawn. From this point, the dura is only a millimeter or two away. When the dura is pierced a click can often be felt. A successful puncture is followed by a free flow of cerebrospinal fluid on withdrawal of the stillette. Flow must be free, not an occasional drop.

Rotation of needle and pushing it in an extra millimeter will often ensure a free flow. Blood-stained cerebrospinal fluid is of no importance and usually becomes clear after a few ml have leaked away. Withdrawal of pure blood shows that needle point is probably in a vein, and another puncture must be made. A dry tap is sometimes, but not always, due to failure to introduce the needle into the subarachnoid space.

Para-median approach easier than the lateral, but if latter is preferred, needle is inserted ½ in. from the midline directly opposite the centre of the interspace, and the needle is inserted at an angle of 25^0 to the midline. With this approach, flexion of the back is not so important, it is said to cause minimal pain, and tough ligaments are avoided, and so the sense of touch and needle control are more accurate. Sometimes it is successful when attempts using median approach have failed. In very fat patients bony landmarks may be impalpable, and in such cases it is a good plan to raise three weals in the midline 1cm. apart. If bone is struck when needle is inserted through one weal a successful puncture may be made if the others are used in turn. Another method to facilitate puncture in obese patients has been described, the needle entering the relatively large space between the fifth lumbar vertebra and the sacrum. A weal is raised o1cm. medial and 2.5 cm superior to the medial superior aspect of the posterior superior iliac spine: this point is 1.5cm lateral to the midpoint of the lumbosacral interspace and from it a needle is advanced 25^0 to the midline. This

approach may also be used for lumbar extradural blocks. If the needle touches a root of the cauda equine the patient will complain of pain, probably in the leg; usually no harm results from this, but if injection of the drug causes pain the position of the needle should be slightly altered. It shows that the needle point is within the vertebral canal and has pierced the ligamentum flavum. If failure results from puncture in one interspace it can often be made successfully if an adjacent interspace is used.

Puncture in the sitting position- Many workers find this easier than the lateral. Patient is placed across the table with his feet resting comfortably on a stool; spine should be flexed with chin pressed on to sternum. Flexion of the spine rather than flextion of the hips is the aim. Puncture in this position is required for Etherington Wilson's technique with hypobaric solutions, while it is convenient when block of the sacral roots by hyperbaric solutions is to be done, although this latter block can be done equally well if the puncture is made with the patient in the lateral position, provided that the caudal end of the patient is tipped downwards.

Puncture in the lumbar region requires no after-treatment other than a dab with antiseptic to the skin. Infection does not occur in the skin and subcutaneous tissues.

Injection of the analgesic drug

The prepared solution is drawn up in correct amount into a suitably graduated syringe. It is beneficial to rinse out the syringe first with some of

the solution, which is later discarded. When crystals are used, cerebrospinal fluid is allowed to drip into the ampoule, and, after solution has taken place, the fluid is re-injected. During injection, occasional aspiration of a small quantity of cerebrospinal fluid confirms that all of the solution reaches the subarachnoid space. The needle should remain in situ for a few seconds after injection to prevent leak of analgesic solution through the dural puncture hole.

If the height of analgesia is to be controlled by the time a patient remains tilted, leveling off should take place when sensory loss reaches two spinal segments below the desired level. This allows for a little spread with advancing time. For almost any work inside the abdominal cavity, except with the most gentle surgeons, analgesia should reach to the subcostal arch (T.6-8), so that the table can be leveled when analgesia reaches the umbilicus (T.10). Upper abdominal procedures require block to T_{2-5}. The cough test is useful in estimating height of analgesia. The patient is asked to cough: the relaxed part of the abdomen bulges out, and any segment not relaxed remains firm and rigid. Disappearance of the knee-jerks shows block at least up to L2.

Spinal intradural analgesia in non-surgical conditions

Therapeutic – Patient**s** with autonomic imbalance of the alimentary canal such as megacolon, etc. Relief of the condition by spinal block is an indication that sympathectomy may be helpful. The serial spinal technique

of Lemmon is excellent for this high block. In megacolon, block should reach to T.5. Patients with eclampsia are sometimes benefited by a high spinal block up T.8, which reduces their blood-pressure. Patients with acute pulmonary oedema due to left ventricular failure are said to have been successfully treated by spinal block, which produces a bloodless phlebotomy caused by vasomotor paralysis. The vasodilatation results in a decreased venous return to the right heart and hence to the lungs, relieving left ventricular failure. Renal anuria has been successfully treated by high spinal block, which results in dilatation of renal vessels and increased secretion of urine.

Reactionary haemorrhage from prostate bed has been stopped by spinal analgesia to S_1 which leaves intact the fibres producing vasoconstriction and contraction of the prostatic bed (L_1 and $_2$), blocking those fibres ($S_{2,3,4}$) causing dilatation of the vessels and prostatic capsule.

In cases of embolism of the lower extremity, continuous spinal analgesia has been successfully employed, a block to T_{10} removing the vasoconstrictor fibres from the whole leg. By this means, a block has been maintained for 50-60 hours. Continuous spinal analgesia lasting for fourteen days has been reported, and that without serious complications. In such cases, continuous extradural analgesia would be better. If, after many hours, an analgesic drug loses its effect, substitution of another drug should be tried.

For the treatment of paraplegic clonus in patients who have already lost sexual function and bladder control, 5-10ml of absolute alcohol should be injected, after 5ml of 5 per cent procaine solution. This also helps to establish the automatic bladder.

SPINAL ANALGESIA IN INTRACTABLE PAIN – Subarachnoid alcohol injection, which was recommended by Dogliotti in 1931 and by G.Todd in 1937, is sometimes helpful in incurable cases of malignant disease with severe pain below the groin and iliac crests, i.e., in the lumbar and sacral distribution. The patient is placed in the semi-prone position with diseased side uppermost and head tilted downwards. Alcohol (abdolute), which must be previously autoclaved, is injected between T_{11} and T_{12}, or T_{12} and L_1, the dose being 0.5ml. The semi-prone position ensures a greater effect on the posterior roots than on the anterior with this hypobaric solution. The position must be maintained for one hour. The beneficial effect may not be fully apparent for a week. About 10 per cent of patients get rectal or bladder disability, or weakness of the legs, but this is an improvement on the results after chordotomy. Headache may follow, but subarachnoid adhesions are not produced. The procedure may have to be repeated.

When sympathetic fibres alone need to be blocked, a weak analgesic solution can be used, e.g., 0.2 per cent procaine or 0.05 per cent amethocaine hydrochloride in distilled water which is hypobaric. A suitable dose of the

latter is 6-12 ml. (6-12mg) which usually gives a symphathetic block up to about T.8.

Hypothermic irrigation of the subarachnoid space has been used for the treatment of intractable pain, using 10ml of normal saline at 2-4^{0}C. The good effects may, however, be due to hyperosmolarity rather than hypothermia.

Intrathecal ammonium sulphate 6 per cent in buffered solution with a pH of 7.2 is said to block the C type fibres carrying pain impulses from root irritation by metastatic growths in the cord: 3.5ml of the 6 per cent solution should be mixed with cerebro spinal fluid and slowly re-injected.

Phenol (5 per cent) in glycerin and (7.5 per cent) in myodil have been injected intrathecally for the treatment of painful reflex spasms and spasticity. Not very effective in long-standing paraplegias with contractures. These injections may cause bowel and bladder disturbances and sensory loss and should be confined to bedridden patients. Both solutions are hyperbaric and careful positioning is necessary. Preliminary injection of a local analgesic or of a radio-opaque material will act as a guide to correct technique. The dose of the two solutions varies from 1 to 3 ml.

Diagnostic:

1. INTESTINAL OBSTRUCTION – can be differentiated into organic and functional by spinal analgesia; if functional, contraction of the gut, with relaxation of sphincters, results in passage of gas and faces within twenty minutes. Differential spinal block using 0.2 per cent procaine solution can be used. This concentration will give paralysis of the sympathetic fibres running to the splanchnics, without any sensory (or motor) effect. (Large-bowel nerve-supply : parasympathetic, vagi, and $S_{2,3,4}$-motor; sympathetic, T5 – L3 –inhibitory). Neither opiates nor atropine should be given to these patients, as both drugs inhibit the gut.

2. THROMBO-ANGIITIS OBLITERANS – If the vasoconstrictor fibres supplying the lower limbs which come from T10-L2 are blocked there is an increase in skin temperature of as much as 8^0C in normal legs and in the vasospastic types of this disease; in the the thrombotic types this increase does not take place and further surgery is not likely to be beneficial.

3. DIAGNOSIS OF THE CAUSE OF PAIN IN THE INFERIOR EXTREMITY, BACK, AND TRUNK – Injection at 10-min intervals of:

a. Ten ml of isotonic saline (placebo).

b. Ten ml of 0.2 per cent procaine in saline (sympathetic block).

c. Ten ml of 0.5 per cent procaine in saline (sensory block).

d. Ten ml of 1 per cent procaine in saline (motor block).

The changes produced are assessed and evaluated as an aid to diagnosis.

SPINAL INTRADURAL ANALGESIA IN CHILDREN

Risk of circulatory depression minimal because of elasticity of their cardiovascular systems. Puncture should be in L3-4 interspace because cord extends lower in children than in adults. Dosage for analgesia to T8 is 10 mg of procaine for each year; some prefer to use 1mg. procaine per lb of body-weight. For a newborn baby, 1-2ml of 1-1500 cinchocaine has been successfully used, injected through an intravenous needle. For pyloric stenosis in babies, 20mg of procaine in 1 ml cerebrospinal fluid. Specially indicated in shocking procedures, such as open operations on hip-joint; useful for operations in the presence of acute respiratory infection, intestinal distension, or a full stomach. Also in hot humid atmosphere, to prevent ether convulsions. Lack of co-operation is chief drawback, so premedication must be adequate. Small doses of morphine, repeated as necessary, make a good sedative. The technique is seldom employed in Britain.

COMPLICATIONS OF SPINAL ANAESTHESIA

Intraoperative

1. Hypotension: This is the most common complication. Mild hypotension do occur in almost all patients and significant hypotension (systolic BP <90 mm Hg) is seen in 1/3rd of the patients. Slight hypotension is beneficial in reducing the blood loss.

Treatment

Prophylactic: Preloading with 1 to 1.5 litres of crystalloid (Ringer lactate) or 500 ml of colloid (Haemaccel) (Colloids are preferred over crystalloids.

Curative

i. Head low position (Trendelenburg) to increase the venous return. Although the concern of Trendelenburg position is increased chances of high spinal and increased ICT but number of studies have proven that the beneficial effects overweigh these problems and secondly head low up to 15^0 does not significantly increase the level of block and ICT. So Trendelenburg upto 15^0 is still the very vital part of management for treatment of spinal hypotension.

ii. Fluids: Colloids are better than crystalloids.

iii. Vasopressors

Ephedrine: 2 to 6mg.

Mephenteramine

Methoxamine

iv. Inotropes (Dopamine, Dobutamine) : Hypotension after spinal is because of symphathetic blockade so sympathomimetic drugs (ephedrine, mephenteramine) are used in treatment. The inotrops do benefit only indirectly by improving the cardiac output.

v. Oxygen inhalation (to prevent hypoxia from hypotension)

2. Bradycardia

   Treatment : Intravenous atropine.

3. Respiratory paralysis (Apnea) : It is usually because of hypotension, so treat hypotension, it is because of high or total spinal then give intermittent positive pressure ventilation (IPPV) with bag and mask or intubation. Slight respiratory difficulty due to lower intercostals paralysis is treated by oxygenation and reassurance.

4. Nausea and vomiting: This is most commonly because of hypotension causing central hypoxia.

   Treatment

   - Treat hypotension
   - Oxygenation
   - Antiemetics

5. Difficulty in phonation: This is because of high spinal extending upto cervical level.

   Treatment: IPPV with bag and mask. Sometimes intubation may be required.

6. Restlessness, anxiety and apprehension: Hypoxia should be ruled out. Otherwise sedate and reassure may be patient.
7. Local anaesthetic toxicity: Due to intravascular injection. Treat symptomatically. If convulsions occur give diazepam, oxygenate and manage any cardiac arrhythmia.
8. Local anaesthetic toxicity: It is rare.
9. Cardiac arrest: It can be because of:
    - Severe hypotension
    - Total spinal / very high spinal.
    - Local anaesthetic toxicity/anaphylaxis.

    Immediate start the cardiopulmonary resuscitation.
10. Broken needle: Attempt the removal at once. If not possible get a portable X-ray and call for neurosurgeon.
11. Pain during injection.
12. Blood tap: It can occur because of puncture of epidural vein. The needle should be withdrawn and reinserted.

Postoperative

1. Urinary retention: It is due to blockade of S2,3,4, catheterization may be required.
2. Post spinal headache.

Clinical features:

It usually presents after 12-24 hours (corresponds to time when patient starts sitting after operation).

- Usually occipital but can be frontal also. May be associated with pain and stiffness in neck. It is throbbing and the typical presentation is that pain increases on sitting and relieved on lying down.
- External stimuli like strong light and noise aggravates the pain.
- Incidence: 3 to 30% (average 13%) it lasts for 7 to 10 days and is relieved in almost all cases in 3 weeks (complete healing of dural hole takes place in 3 weeks).

Aetiological factors

i. Single most important factor is needle size. Incidence with 16G needle may be 75% while with 25G needle it is 1 to 3%.

ii. Type of needle : Incidence is less with dural separating needle.

iii. Altitude: High incidence at high altitude.

iv. Type of patient: Patient with history of headaches are more prone for spinal headache.

v. Inadequate hydration.

vi. Pregnancy, female gender and young patients have more incidence.

vii. Incidence is less (statistical significance only) with paramedian approach and low glucose concentration of the drug.

Cause

- It is low pressure headache due to seepage of CSF from dural rent (hole) created by spinal needle. The loss may be around 10ml/hr. CSF leakage results in changes in hydrodynamics of brain causing traction on pain sensitive structures like dura, vessels, tentorium producing pain.

Treatment

Preventive:

i. Use of small bore needle.

ii. Adequate hydration.

iii. To avoid pillow for next 24 hours.

iv. If possible, lie in prone position.

v. Avoiding spinal in patient with history of head ache.

vi. Avoid sitting in post operative period.

Curative:

i. Ask the patient to lie supine in slight Trendelenburg position.

ii. Analgesics.

iii. Intravenous fluids (15ml/kg/hr) or oral fluids 3 litres/day. The aim of adequate hydration is to increase CSF production.

Most often headache is relieved by position, analgesics and adequate hydration.

iv. Abdominal binders.

v. Desmopressin: It is antidiuretic and retains fluid in body.

vi. Inhalation of 5 to 6% CO_2 in oxygen: CO_2 is cerebral vasodilator and will promote CSF production.

vii. Oral or intravenous caffeine: 500mg of caffeine in 1 litre of ringer lactate inhibits the vasospasm cycle in cerebral vessels.

viii. Epidural blood patch: 10 to 20 ml of autologous blood is given in the same epidural space in which spinal is given. Blood will clot and seal the rent. Ist blood patch is effective in treating headache in 95% patients and 2^{nd} blood patch in 99%. The blood patch should be applied only if other measures fail (15-20ml of blood is not likely to cause significant hematoma but can cause transient radiculopathy).

Other causes of headache after spinal anaesthesia:

- Meningeal irritation: Which is because of chemical meningitis or bacterial meningitis. Headache produced in meningitis is high pressure headache and is not related to postural changes.
- Queckenstedt's test is employed to differentiate between high pressure and low pressure headache. In this test applying pressure on jugular veins increases the headache in former and relieves in latter.

3. Paralysis of cranial nerves: All cranial nerves except 1st, 9th, 10th can be involved after spinal anaesthesia. Most commonly (90%) 6th nerve is involved (because of the longest course of 6th nerve).

Cause

- As a result of low CSF pressure, descent of pons and medulla can cause stretching of 6th nerve at the apex of petrous temporal bone.

Clinical features

- Paralysis appear after 3rd to 12th post operative day. Blurred vision, double vision, headache, photophobia are the symptoms.

Treatment:

Prophylactic:

- Vigorous hydration.
- Use of small bore needles.

Curative:

- Dark glasses with outer 1/3rd of glass to be made opaque.
- Muscle exercise.
- Adequate fluids

Recovery

- 50% cases recover in 1 month and most of the cases in 2 years. If recovery is not seen after 2 years surgical correction should be done.

4. Meningitis

a. Aseptic: Chemical meningitis because of antiseptic, solutions like betadine, starch powder from gloves, blood drops transported with spinal needle.
b. Infective: Usually due to Staphyloccous epidermidis, carried from skin along with needle.

   Treatment: Intravenous antibiotics.

5. Cauda equine syndrome: Due to direct injury to nerve fibres by trauma or by local anaesthetic. This is usually seen with continuous spinal with small bore catheters.

Clinical features

- Retention of urine, incontinence of faces, loss of sexual function, loss of sensation in perineal region.

Pathological lesion.

- Vacuolation of nerve fibres. Most of these cases recover spontaneously.

6. Chronic adhesive arachnoiditis: Chronic arachnoiditis can cause compression of spinal cord, impairing blood supply and causing cord ischaemia.
7. Paraplegia: Due to

- Epidural haematoma (traumatic spinal).
- Epidural abscess.
- Arachnoiditis.

- Cord ischemia.

  For epidural haematoma and abscess, neurosurgical intervention should be sought immediately.

8. Spinal cord ischemia: It is due to
   - Severe prolonged hypotension.
   - Use of vasoconstrictors.
   - Epidural haematoma / abscess.
9. Local toxicity of local anaesthetics: Chloroprocaine can injure spinal cord and can cause paraplegia.
10. Anterior spinal artery syndrome: Epidural haematoma, abscess, epidermoid tumour (skin tissue carried with needle can cause epidermoid tumour), can lead to compression of anterior spinal artery causing anterior spinal artery syndrome manifested by motor deficit without involving posterior columns.
11. Intracranial complications: Can be
    - Subdural haematoma.
    - Cerebral uncus herniation.
    - Intracranial haemorrhage.

      These are due to changes in hydrodynamics of CSF.
12. Horner syndrome (with very high spinal anaesthesia).
13. Local anaesthetic toxicity / anaphylaxis.

14. Backache: Many patients report backache after spinal anaesthesis.

    Treatment : Reassurance and analgesia.

Contraindications:

Absolute

1. Raised intracranial tension: Coning can cause death if spinal is given to patients with raised ICT.
2. Patient refusal.
3. Severe hypovalemia (shock).
4. Patients on anticoagulants
5. Patients on thrombolytic / fibrinolytic therapy (spinal not given within 10 days of receiving these drugs).
6. Bleeding disorders / cogulopathy.

   In condition 4, 5, 6 there are very high chances of epidural haematoma and paraplegia.
7. Septicemia and bacterimia.
8. Infection at local site.

Relative

1. Fixed cardiac output lesions (AS, MS): These patients can not compensate for fall in cardiac output, so should not be given spinal (but epidural can be given).
2. Mild to moderate hypotension and hypovolemia.

3. Uncontrolled hypertension (these patients are very prone to go in hypotension).
4. Severe ischemia heart disease especially history of recent MI.
5. Heart blocks and patient on β blockers. Severe bradycardia can occur.
6. Patient on aspirin.
7. Patient on minidose heparin subcutaneously (patients on low molecular weight heparin IV should be avoided spinal as far as possible).
8. Spinal deformity: Technically difficult.
9. Previous spinal surgery.
10. Psychiatric disorders.
11. History of headaches.
12. Uncooperative patients.
13. GIT perforation: Parasympthetic overactivity increases peristalsis and can open the seal.
14. Neuropathies: Important from medicolegal point of view. If spinal is to be given in patient already having neurpathies it is mandatory to mention all the deficits in preanaesthetic sheet to avoid any litigation.
15. CNS disorders. Both infective and degenerative.
16. Resistant surgeon.

Spinal anaesthesia in children

- Should be given in lower space (L4-5).
- Preloading is not required as children less than 8 years are vitually free of haemodynamic side effects.
- Use of narcotics is contraindicated.
- Chances of systemic toxicity is high.

Opioids for intra thecal use

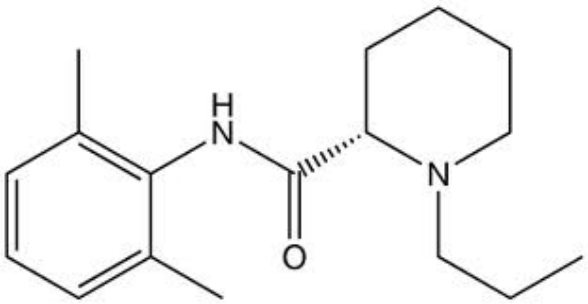
Produces only sensory effect but not preferred. Because of high chances of respiratory depression.

Morphin: 0.25mg. Onset is within 20 to 30 minutes and effect lasts for 4 to 6 hours.

Fentanyl: 25 µg. Onset in 5 to 10 minutes and effect lasts for 1 hour.

Intrathecal ketamine: Preservative free ketamine can be used for spinal but effect is short lasting and motor block is not seen.

ROPIVACAINE



History

Long acting local anaesthetic bupivacaine was released in 1965. Although bupivacaine has been the long acting local anaesthetic of choice for decades, when given accidentally it produces irreversible cardio vascular collapse. Cardio toxicity with bupivacaine often proves difficult (or) impossible to treat. Prolonged motor block is another drawback of Bupivacaine. Because of these problems newer agents were looked into and Ropivacaine was released in 1996 and only recently launched in India.

Pharmacology

It is amide group of local anaesthetic drug. It comes in the group of mepivacaine and bupivacaine. Instead of methyl group in mepivacaine ropivacaine has a propyl group and bupivacaine has a butyl group. Mepivacaine and bupivacaine is currently used clinically as a racemic mixture of enantiomers containing equal properties of 'S' and 'R' forms.

But ropivacaine is prepared from the alkylation of S-enantiomer of dibenzoil-L-tartaric acid.

Pure-S-enantiomer. It is available as a preservative free clear solution in ampoules or vials in concentration of 0.2%, 0.5% and 0.75%. The solution has pH of 4.6 with a pKa 8.1. It binds extensively with plasma proteins (mainly one & acid glycoprotein) metabolized mainly in the liver and excreted by the kidneys. It readily crosses the placenta. Pharmacodynamic parameters are similar to other amide agents. Like other local anaesthetic drugs Ropivacaine works by reversible inhibition of Na^+ ion influx in nerve fibres and thereby temporily stopping electrical conduction.

It is 10 times less lipid soluble than bupivacaine and hence less likely to penetrate large myelinated motor fibres. It has more selective action on A and C fibres as compared to A fibres. It has a less depression of cardiac conductivity and QRS interval. It is available as only isobaric solution.

Isobaric verses Hyperbaric

Density of a solution is the weight in gms of 1ml of that solution at 37^0C.

Specific gravity is the ratio of the density of the solution with the density of the water.

Baricity is the ratio comparing the density of the one solution to another.

To make a drug hypobaric to CSF it must be less dence than CSF i.e.1,0000

By adding water and warming the drug to 37^0C from 4^0C it becomes hypobaric.

Dose:

Upto 3mg per kg.

Based on patient.

Route of administration and type of surgery.

Contraindication:

Allergy to amide LA

Bier's block.

Uses:

Epidural / caudal block

Intra thecal block

Nerve block

Local infiltration

Local instillation

To establish a surgical anaesthesia through an epidural 10 – 20mls of 0.5% to 0.75% Ropivacaine is used depending on patient size and height of the block required. For postop and labour pain relief using an epidural 10mls/hr of 0.2%. Ropivacaine with fentanyl 2-4mg/ml can be used.

When used in epidural infusions 0.2% Ropivacaine is used for nerve blocks is fast with the motor block wearing off much earlier than compared to Bupivacaine.

It is available as only Isobaric solution. Spinal Ropivacaine (0.75%) 2.5 – 4mls with additives like Fentanyl and clonidine offers a reliable cardio stable anaesthesia of the lower abdomen and limbs. Speed of onset is slower compared to Bupivacaine.

For the same volume intra thecal, height of the block with isobaric Ropivacaine 0.75% is significantly lower as compared to hyperbaric Bupivacaine (0.5%) Addition of clonidine, Dexmedetomidine prolongs analgesia upto 16hrs (Beware Bradycardia).

Safety of Ropivacaine has been studied extensively. In a classic canine study (aroban 2001) open chested dogs were randomized to escalating infusion of Bupivacaine, levobupivacaine and Ropivacaine to the permit of cardiovascular collapse.

Unsuccessful resuscitation from Bupivacaine, levobupivacaine, Ropivacaine was 50%, 30% and 10%. Larger doses and blood concentrations of Ropivacaine was tolerated compared to Bupivacaine and levobupivacaine. Several studies and case reports have also established the safety of the Ropivacaine.

Ventricular arrhythmias and fatal ventricular fibrillation may occur more often after the rapid intra venous administration of large dose of bupivacaine.

The pregnant patient is more sensitive to cardiotoxic effects of bupivacaine. 0.75% bupivacaine is no longer recommended for use in obstetric anaesthesia.

There is no established role of antiarrhythmic drugs or traditional drugs in the setting of bupivacaine induced cardiac arrest. The first treatment for accidental intra vascular injection of overdose of anaesthetic are

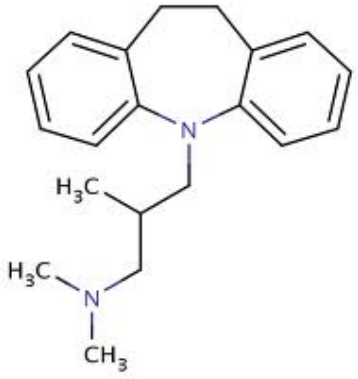
- Securing the airway
- Oxygenation, ventilation

DEXMEDETOMIDINE

α_2 receptors present in the sympathetic nerve endings and no adrenergic neurons in the central nervous system. Administration of α_2 agonist has been shown to have several beneficial action during the perioperative period. Clonidine is the α agonist which is used for long time.

Dexmedetomidine is the recently released IV anaesthetic. In December 1999, it was approved for the clinical practice. It is a highly selective α_2 receptor agonist that has been shown to have both sedative and analgesic effects in adults. It has an α_2 to α_1 receptor agonist ratio of 1600:1, which is 7-8 times higher than reported for clonidine. The ratio favors the sedation, anxiolytic action rather than the hemodynamic actions seen in the same class of α_2 receptor agonists such as clonidine.

Chemical structure of dexmedetomidine



Pharmacology:

It is available as injection form. If it is given it rapidly distributed, metabolized and excreted in urine and feces. It is 94% protein bound. The elimination half life of dexmedetomidine in 2-3hrs with CSHT 4 minutes after an infusion.

α receptors:

They are G-protein coupled receptors. It inhibits adenyl cyclase and modulation channels. Three types of α_2 receptors noted noted α_{2A}, α_{2B}, α_{2C}. α_{2B} & α_{2C} receptors are situated in the CNS and spinal cord. α_{2A} receptors are located in the periphery.

The overall response to the α_2 receptor agonist is sympatholysis, sedation, and antinociception.

CNS action:

Sedative and hypnotic

It acts on α_2 receptors situated in locus ceruleus in the CNS and spinal cord. Has limited respiratory depression providing wide margin of safety. This character is useful for daily wakeup test to asses the mental status and titration of dosage of sedation. It decreases the activity of the locus ceruleus and increases GABA and galamin release. It also decreases the histamine release in cortical and subcortical areas.

Their advantage is actions are reversible with antagonist.

Analgesic effect:

When given through intra thecal and epidural route it gives analgesic effect. It reduces blood pressure. It acts on spinal cord to produce analgesic effect. It reduces opioid requirement. Evidence based medicine says that it lowers neuro and histopathological damage during periods of cerebral ischiemia. It reduces excitating neurotransmitters and moderate actions of anti apoptotic protein. In craniotomies it is very well used because it has very minimal action on evoked potentials.

Respiration

It preserves ventilator response to hypercapnia and reduces histamine induced bronchoconstriction. Respiratory rate is increased and minute ventilation decrease in clinical concentrations.

CVS action:

- Decreases heart rate.
- ↓es peripheral vascular resistance
- ↓es cardiac output
- ↓es blood pressure

  It will increase Bp initially by vasoconstrictive response. Severe bradycardia reported and is easily reversible with atropine. It decreases myocardial O_2 consumption. Dry mouth is a one of its side effect.

Clinical uses:

- ICU sedation
- It decreases opioid requirement
- Hemodynamic stability is maintained in weaning patients
- Anxiolytic
- Used in alcohol withdrawl syndrome and drug withdrawl
- Gives adequate sedation without respiratory depression.

Uses in anaesthesia:

Used as a premedicant

- Reduces dosage of anaesthetic drugs like

  opioids and

  thropentone and

  volatile agents
- Reduces stress response to intubation
- Post operative shivering is reduced very much
- Has been used for monitored anaesthesia care.
- It is used as adjunct in subarachnoid block.
- Recent study reports say that it improves the quality of anaesthetic drug.
- ↓es intra and post operative analgesic requirement.

REVIEW OF LITERATURE

- S.Kurdi medhuri and kumara B.Anjali in J.Anaes clinical pharmacology 2010 Oct-Dec: 26(4) 564 telling that 0.75% Ropivacaine provides reliable, adequate and safe sensory and motor blockade.
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- Ragini Gupta et al Ind.J.Anaes 2011/vol 55/Issue 4 page 347-351.

  Say that addition of Dexmedetomidine with Ropivacaine. Prolongs duration of Analgesia.
- Ashrag Amin Mohamed et al. pain physician 2012; 15: 339-348, ISSN 1533 – 3159 tell that Dexmedetomidine improve quality and duration of post operative analgesia.
- G.E.KANAZI et al Acta Anaes. Scand 2006;50: 222-229 dexmedetomidine when added to intra thecal local analgesia produces prolongation of diameter of sensory and motor blockade and give hemodynamic stability.

- Yamashita A et al (18) Matsumoto M, Matsumoto S, Itoh M, Kawai K, Sakabe T.A compared the neurotoxic effects on the spinal cord of terracaine, lidocaine, bupivacaine, and ropivacaine administered intrathecally in rabbits reported no neurodeficit.
- Kalso et al (22) Reported that dexmedetomidine affecting to α_2 receptor agonists is 10 times compared to clonidine.
- Al-Ghanem et al (34) have reported the use of dexmedetomidine is associated with decrease in HR & BP.
- Yoshitomi et al (72) say that dexmedetomidine enhances the local anaesthetic action via an alpha-2A receptor.

MATERIALS AND METHODS

Study design: This was a randomized, prospective double blind comparative clinical study.

Randomization:

Simple randomized sampling was done by computer generated random numbers.

Sample size:

Sixty patients were studied.

Inclusion criteria:

- Age between 30 – 60 years and only male cases.
- ASA I & II cases
- Weight 40 – 65 kg
- Elective surgeries (Inguinal hernioplasty)

Exclusion criteria:

- Patient refusal
- Known allergy
- Coagulopathy
- Patient on β blockers
- Patient on long term analgesic therapy
- Patient on drugs which are known to interact with study drugs

Allocation

After obtaining Institutional Ethical committee Clearance and written informed consent, the patients were randomly allocated into 2 groups.

- Group 1 (30 patients)
- Group 2 (30 patients)

Spinal administration of drug mixture

1. Group 1 = 0.75% Isobaric Ropivacaine 3mls + 0.5ml normal saline (Total volume 3.5ml)
2. Group 2 = 0.75% Isobaric Ropivacaine 3ml + 5mcg (.05ml) dexmedetomidine in 0.45ml normal saline (Total volume 3.5ml)

Masking:

The anaesthesiologist who administered the drug and the observer were blinded to the study. Sterile syringes containing 3.5ml of total volume of the drug were loaded by another anaesthesiologist not participating in the study. The intra operative monitoring and post operative observation was done by the same anaesthesiologist who administered the drug, but was unaware of the contents of the syringes.

Preoperative evaluation:

1. History
2. Clinical examination
3. Airway assessment

4. Blood biochemistry

5. X ray chest

6. Electrocardiogram

Procedure:

Premedication:

The patients in both the groups were given inj.Glycopyrrolate 0.2mg and midazolam 2mg i.m. 45 min before surgery.

Patients were preloaded with Ringer's lactate – 15ml per kg.

The cases were started after checking the emergency drugs and equipment for resusitation.

30 cases from each group were taken up for study. In each group one case was converted to general anaesthesia because of failure of spinal block. That case was excluded from the study.

29 cases in each group were taken up for statistical analysis. Subarachnoid block was performed by using 25 g Quinkes needle with the patient in right lateral position at L3 L4 space. The study drug was administered according to allocated group. Ropivacaine 0.75% 3ml and 0.5ml normal saline in 30 cases and Ropivacaine 0.75% 3ml and 0.5ml normal saline with 5 microgram dexmedetomidine in 30 cases.

Immediately after performing the block patient were turned supine.

After the block pulse rate, BP and SPO_2 monitoring was done in 3, 5, 15, 30minutes then every 30 minutes. Onset of sensory block and level was seen by stillette of spinal needle by pinprick sensation. Onset of motor block was assessed by the Modified Bromage scale.

Intra venous fluids was given intra operatively and post operatively about 100 – 150ml per hour. Sensory level T7 – T8 was achieved in all cases that was adequate for doing hernia surgery.

Supplimental oxygen was given by mask throughout the surgery in all the cases.

Ephedrine was given when more than 20% fall in baseline systolic blood pressure. Atropine was given when pulse rate less than 60 per minute. It was required in group 2 cases.

Post operatively patients were kept in recovery room for 4 hours and then shifted to the ward.

Two segment regression and S_2 segment regression time were noted. Duration of analgesia was taken when visual analogue scale score more than 4 and motor duration was taken when modified bromage scale 'O' i.e. full power.

Rescue analgesia given time was noted for analgesia duration. Patients were observed for 2 post operative days for complications. One patient developed headache and relieved by giving intra venous fluids.

OBSERVATION AND RESULTS

"A STUDY OF CLINICAL EFFECTS OF INTRATHECAL ROPVACAINE AND ROPVACAINEWITH DEXMEDETOMDINEIN INGUINAL HERNIA CASES"

Statistical Analysis:

The two groups were matched according to their base line characteristics of continuous variables by Students' independent 't' test. And the categorical variables between two group were matched by χ^2 (Chi-square) test. The on set sensory block, motor block and rescue of analgesia and motor block duration were compared between two groups. The analysis and interpretations were performed by IBM SPSS statistics 20. The P- values lessthan 0.05 ($P< 0.05$) were defined as statistically significant in two tailed test.

Results and observation:

Matching of the two groups;

The two groups were matched in respect of their demographic characteristics such as age and weight. The base line clinical variables such as ASA grade, Pulse rate, SBP, DBP, Sensory and Motor block were matched between the two groups.

Table-1. Matching of age between two groups.

Age (years)	Ropivacaine =1		Ropivacaine and Dexmed=2	
	No	%	No	%
30-39	10	34.5	5	17.2.
40-49	6	20.7	17	58.6
50-59	13	44.8	7	24.2
Total	29	100.0	29	100.0
Mean±SD	45.1±8.6		45.0±4.9	
Significance	t=0.019, df=56 and P>0.05			

Table-1. Matching of age between two groups.

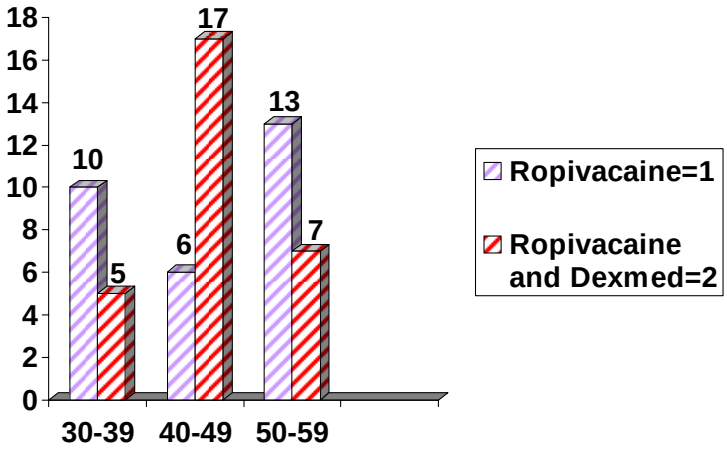


Table-2. Matching of Weight between two groups.

Weight (Kg)	Ropivacaine =1		Ropivacaine and Dexmed=2	
	No	%	No	%
40-45	1	3.4	2	6.9
45-50	11	37.9	13	44.8
50-55	6	20.7	12	41.4
55-60	7	24.2	0	0.0
60-65	4	13.8	2	6.9
Total	29	100.0	29	100.0
Mean ± SD	51.3±5.3		49.6±4.0	
Significance	t=1.396, df=56 and P>0.05			

The two groups were not significantly differed in respect of their mean ages (45.1±8.6 = 45.0±4.9). Similarly they were also not significantly differed between the mean weights of two groups (51.3±5.3≈49.6±4.0 and P>0.05).

Table-2. Matching of Weight between two groups.

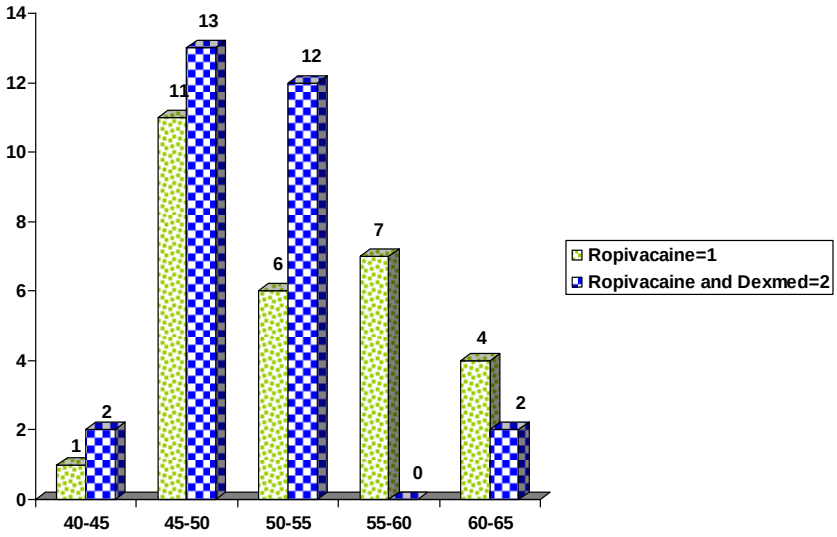


Table-3.Matching of base line PR, SBP and DBP between two groups.

Variables	Ropivacaine =1		Ropivacaine and Dexmed=2		Difference b/w means	't'	df	Signi
	Mean	SD	Mean	SD				
PR	86.9	8.9	84.5	9.3	2.4	1.010	56	P>0.05
SBP	121.3	8.3	120.3	5.9	1.0	0.547	56	P>0.05
DBP	78.6	4.4	79.3	2.6	0.7	0.727	56	P>0.05

The base line PR, SBP, and DBP were matched and shown in the above table-3. The mean PRs between the two groups were not statistically significant (86.9±8.9 ≈ 84.5±9.3 and P>0.05). The mean SBPs between the two groups were not statistically significant (121.3±8.3 ≈ 120.3±5.9 and P>0.05).). The mean DBPs between the two groups were not statistically significant (78.6±4.4 ≈ 79.3±2.6 and P>0.05).

Table-4. Matching of sensory level between two groups.

Sensory level	Groups			χ^2	Df	Signi
	1	2	Total			
T7	6	10	16	1.381	1	P>0.05
T8	23	19	42			
Total	29	29	58			

The above table states the base line sensory block between the two groups. The two groups were not significantly differed between them (P>0.05).

Table-4. Matching of sensory level between two groups.

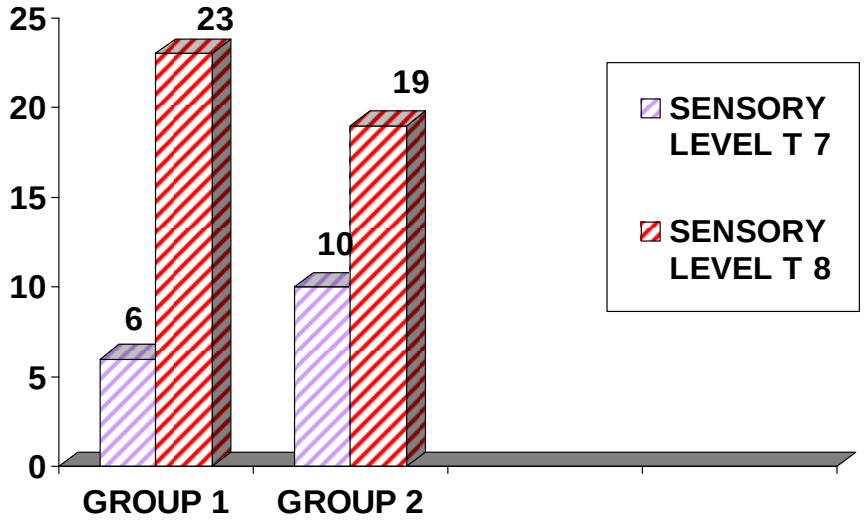


Table-5. Matching of ASA Grade between two groups.

ASA grade	Groups			χ^2	df	Signi
	1	2	Total			
I	25	26	51	0.162	1	P>0.05
II	4	3	7			
Total	29	29	58			

The above table -5 describes the base line ASA grade between the two groups. The two groups were not significantly differed between them (P>0.05).

The two groups namely Ropivacaine (1) and Ropivacaine and Dexmedetomidine (2) were not significantly differed at base line and hence they were comparable during and after surgery. Two groups Motor blocks at base was 3 in both groups.

Comparison of two groups during and after surgery:

The two groups were compared during and after surgery to study the effectiveness of two drugs at different intervals in respect of sensory and motor blocks on set.

Table-6.On set of Sensory blocks (T10) and Motor blocks(2) between two groups.

Blocks	Group-1(Mts)		Group-2(Mts)		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
Sensory	8.0	1.8	5.58	3.56	2.42	3.31	56	P<0.005
Motor	10.14	5.2	5.37	3.6	4.77	5.30	56	P<0.001

The mean on set of sensory blocks between the two groups was statistically significant (P<0.005). The mean on set of Motor blocks between the two groups was statistically significant (P<0.001).

Table-7. Comparison of Pulse rate at different interval between the two groups.

Intervals	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
3 Mts	91.8	13.8	92.0	13.5	0.2	0.058	56	P>0.05
6 Mts	89.3	13.7	83.4	12.9	5.9	1.680	56	P>0.05
15 Mts	79.8	14.4	75.0	17.2	4.9	1.176	56	P>0.05
30 Mts	81.1	12.8	76.9	14.3	4.2	1.180	56	P>0.05
1 Hr	82.0	9.0	81.1	5.2	09	0.397	56	P>0.05
2 Hrs	86.3	103	83.9	7.3	2.4	1029	56	P>0.05
4 Hrs	113.6	9.0	89.8	8.0	23.8	10.469	56	P<0.001
8 Hrs	107.2	7.3	112.3	11.3	5.1	2.072	56	P<0.05

The above table-7 shows the pulse rate at different interval starting from 3 minutes to 8 hours. From 3 minutes to 2 hours there was no significant difference between the two groups. At 4 hours the pulse rate among the group 1 subjects was significantly greater than the group 2 and the same was attributed to the risk of rescue analgesia. At 8 hours the pulse rate was greater in group 2 due to the above reason.

Table-8. Comparison of SBP at different interval between the two groups.

Intervals	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
3 Mts	121.4	9.8	120.5	6.8	0.9	0.404	56	P>0.05
6 Mts	118.9	8.6	115.2	4.2	3.7	2.097	56	P>0.05
15 Mts	111.9	10.1	108.8	1.9	3.1	1.625	56	P>0.05
30 Mts	109.0	9.7	106.8	2.7	2.3	1.212	56	P>0.05
1 Hr	111.2	6.2	109.5	2.5	1.7	1.386	56	P>0.05
2 Hrs	112.5	5.7	113.9	4.5	1.4	1.075	56	P>0.05
4 Hrs	128.3	4.9	114.7	4.0	13.6	11.568	56	P<0.001
8 Hrs	117.4	5.6	128.9	5.0	11.5	8.232	56	P<0.05

The above table-8 shows the SBPat different interval starting from 3 minutes to 8 hours. From 3 minutes to 2 hours there was no significant difference between the two groups. At 4 hours the pulse rate among the group 1 subjects was significantly greater than the group 2 and the same was attributed to the risk of rescue analgesia. At 8 hours the pulse rate was greater in group 2 due to the abovereason.

Table-9. Comparison of DBP at different interval between the two groups.

Intervals	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
3 Mts	77.2	7.0	76.9	5.4.	0.3	0.209	56	P>0.05
6 Mts	75.5	6.9	76.6	4.8	1.0	0.664	56	P>0.05
15 Mts	70.0	7.6	70.0	0.0	0.0	0.0	56	P>0.05
30 Mts	71.0	6.6	66.6	4.8	4.4	2.898	56	P>0.05
1 Hr	69.7	4.9	69.7	1.8	0.1	.071	56	P>0.05
2 Hrs	70.4	4.4	73.1	4.7	2.7	2.235	56	P>0.05
4 Hrs	78.4	7.4	73.1	4.7	5.3	3.244	56	P<0.001
8 Hrs	73.0	6.1	83.4	4.8	10.4	7.214	56	P<0.05

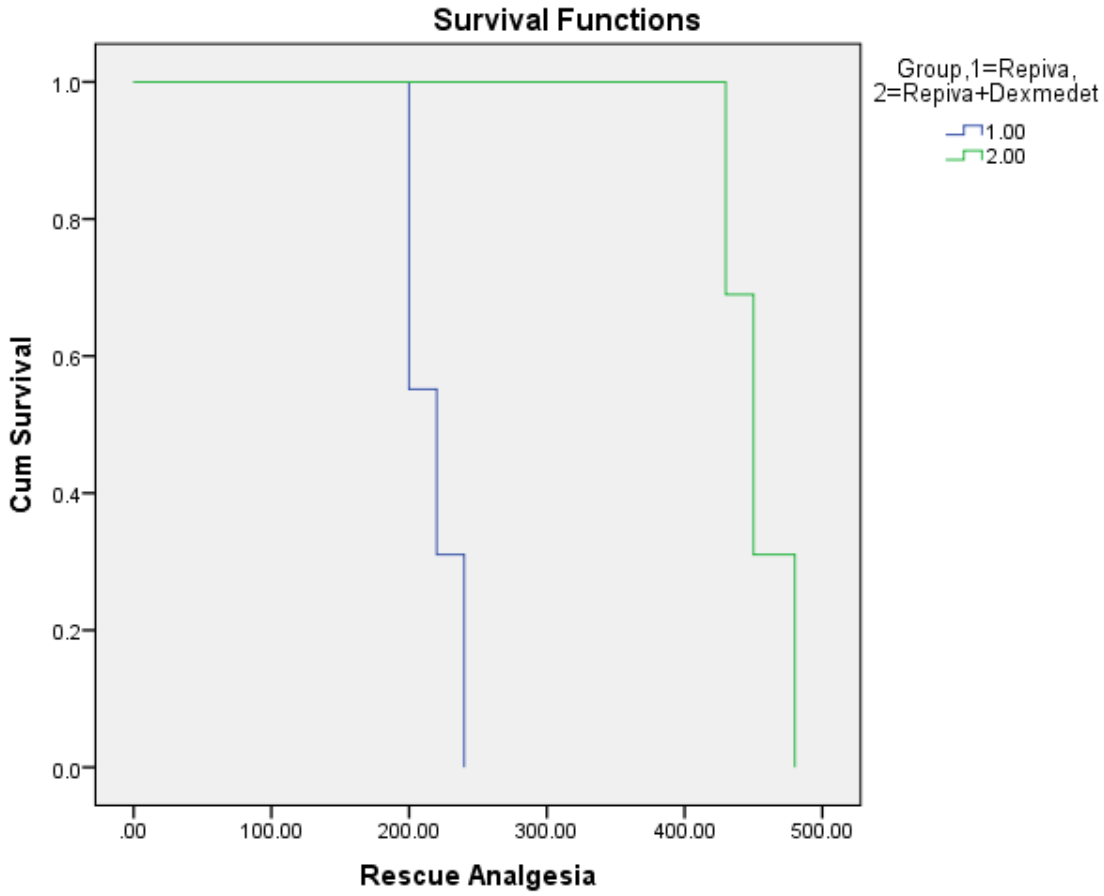
The above table- shows the DBP at different interval starting from 3 minutes to 8 hours. From 3 minutes to 1 hour there was no significant difference between the two groups. At 4 hours the pulse rate among the group 1 subjects was significantly greater than the group 2 and the same was attributed to the risk of rescue analgesia. At 8 hours the pulse rate was greater in group 2 due to the above reason.

Table- 10. Comparison of Rescue analgesia between two groups.

Variable	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
Rescue analgesia	217.2	17.5	453.1	20.2	235.2	47.525	56	P<0.001

The above table -10 shows the analgesia of two groups The mean analgesia of group 2 was 453.1±20.2 and group 1 was 217.2 ± 17.5. The group 2 patients had longer duration of analgesia than the group 1 patients. (453.1±20.2>217.2 ± 17 and P<0.001).

Survival of Analgesia between two groups



The above Figure illustrates the significance of longer duration of analgesia of group-2 than the group-1.

Table-11. Comparison of two segment regression and S2 regression between the Groups.

Variable	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
2 segment regression	89.0	18.2	131.7	11.4	42.8	10.735	56	P<0.001
S2 regression	243.1	20.2	297.9	25.3	54.8	9.128	56	P<0.001

The above table -11 shows the two segment regression and S2 regression of two groups. The mean two segment regression of group 2 was 131.7±18.2 and group 1 was 89.0 ± 18.2. The group 2 patients had longer duration of two segment regression than the group 1 patients (131.7± 11.4>89.0±18.2 and P< 0.001). Similarly, S2 regression was also significantly greater in group -2 than in group-1 (297.9±25.3 > 243.1±20.2 and P< 0.001).

Table12 Comparison between two groups in Motor block duration in hours

Variable	Group-1		Group-2		Difference b/w means	't'	df	Sig.
	Mean	SD	Mean	SD				
Motor Duration	2.63	0.41	3.94	0.38	1.31	0.02	56	P>0.05

The above table shows motor block durations between two groups. In Group -2 patients had long duration of blockade ($3.94 \pm 0.38 > 2.63 \pm 0.41$ $P > 0.05$)

DISCUSSION

Sub arachnoid block is a simple, frequently used technique which provides very effective analgesia in lower abdominal surgeries and lower limb surgeries. Ropivacaine is a newer drug with a more safety margin with reduced risk of cardiotoxicity. Dexmedetomidine is an α_2 agonist which is very much used nowadays as an additive with local anaesthetics. It gives intra operative and post operative analgesia with a single dose of sub arachnoid block. This study was done keeping this point in mind. Moreover it is devoid of opioid side effects, but may produce sedation, bradycardia, hypotension.

Onset of sensory and motor block was early in group II patients than group I (group II $5.58 \pm 3.56 > 8.0 \pm 1.8$ in group I) with the 'P' value < 0.05.

Bradycardia and hypotention are the known features of subarachnoid block. In this study in group II patients out of 29 patients 2 patients were developed bradycardia with hypotention and they required atropine and ephedrine.

No patients have developed any nausea or vomiting in both groups. But in group II, patients were free of anxiety and comfortable. Both groups didn't require any sedation intra operatively.

Post operatively group II patients had delayed two segment regression and S2 segment regression, than group I patients. ('P' value < 0.001).

It was observedthat motor block duration was more with group II patients than group I ('P' value > 0.05).

It was noted that time of getting rescue analgesia was very much delayed in group II than group I ('P' value <0.001).

SUMMARY

It was found that intrathecal ropivacaine in this study produces T7 – T8 level of sensory blockade with adequate motor blockade for hernia surgery and patients were hemodynamically stable.

With group 2 patients early onset of sensory and motor blockade and delayed recovery from sensory blockade and motor blockade noted with the risk of getting bradycardia and hypotention. But patients were more comfortable (free of anxiety) in this group 2 than group 1.

Only one patient developed PDPH which was relieved by intra venous fluids.

CONCLUSION

Ropivacaine is a newer ideal, safe anaesthetic of choice for intra thecal use in inguinal hernia surgery cases, (ASA I & II) and by adding dexmedetomidine we get prolongation of analgesia.

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PROFORMA

A STUDY OF CLINICAL EFFECTS OF INTRATHECAL ROPIVACAINE & ROPIVACAINE + DEXMEDETOMIDINE IN INGUINAL HERNIA CASES

NAME DATE AGE SEX WARD

SURGEON ANAESTHESIOLOGIST

ASA GRADE STUDY GROUP A / B

PRE OPERATIVE CONDITION:

PR BP Hb% BT.CT

Blood Sugar Urea Creatinine Chest X-Ray

ECG CVS RS Airway

Blood Grouping:

ANAESTHETIC PLAN

PRE LOADING:

SUB ARACHNOID BLOCK:

Drug:

Dossage:

Needle:

Position:

Level:

No of Attempts:

ASSESSMENT OF LEVEL OF BLOCK

Autonomic level:

Sensory level:

Motor Blockade:

Modified Bromage Scale: **0** **1** **2** **3**

SPINAL DERMATOMOL LEVEL OF BLACKADE TIME

Time	Sensory	Motor
3MTS		
5MTS		
10MTS		
15MTS		
30MTS		
45MTS		
60MTS		
80MTS		
100MTS		
120MTS		

TIME	PR	BP	SPO2	RR	GI Symptom	Sedation	Pruritus	VAS
3MTS								
5MTS								
10MTS								
15MTS								
30MTS								
45MTS								
60MTS								
80MTS								
100MTS								
120MTS								

POST OPERATIVE

VAS for Analgesia Assessement

Motor MBS

Time	BP	PR	Analgesia		Motor Blockade	

TIMING OF RESCUE ANALGESIA	
Duration of Analgesia:	

TWO SEGMENT REGRESSION TIME:

S2 SEGMENT REGRESSION TIME:

STUDY GROUP

(A) INTRATHECAL ROPIVACAINE
0.75% 3ml + 0.5ml of NS

(B) INTRATHECAL ROPIVACAINE
0.75% 3ml + 0.5ml of NS with 5 Microgram of

dexmedetomidine

1. AUTONOMIC LEVEL TESTED BY APPLICATION OF SPIRIT
2. SENSORY LEVE PIN PRICK SENSATION
BLUNTED NEEDLE /
3. MODIFIED BROMAGE SCALE FOR MOTOR BLOCKADE

0 Full Power

1 Unable to straighten the leg
Just able to Flex knees

2 Foot Movement only.

3 Loss of power – No movement

VISUAL ANALOG SCALE

1	2	3	4	5	6	7	8	9	10

VERBAL RATING SCALE

0 None

1 Mild

2 Moderate

3 Severe

4 Very severe Intolerable Pain

MASTER CHART

Group,1=Repiva,2=Repiva+Dexmedet	Sl.No	Age	Weight	TSA	BaPR	BaSBP	BaSBP	Senblo	Mot	Sentime	Senlev	MotTime	Motlev	PR3Mits	PR6Mits	PR15Mits	PR30Mits
1	1	36	48	I	100	120	80	T8	3	9	T8	12	2	100	96	92	96
1	2	56	46	I	100	120	80	T8	3	9	T8	3	2	100	96	92	96
1	3	50	50	I	70	100	60	T8	3	6	T8	12	2	68	66	60	80
1	4	50	58	I	94	130	80	T8	3	9	T7	3	2	90	80	64	80
1	5	50	55	I	80	130	80	T8	3	3	T8	12	2	90	96	80	78
1	6	38	48	I	100	120	80	T7	3	9	T8	12	2	96	86	68	76
1	7	52	56	I	108	120	80	T8	3	9	T8	9	2	108	108	104	102
1	8	48	50	II	70	100	80	T8	3	6	T8	9	2	68	66	60	60
1	9	38	55	I	108	120	80	T8	3	9	T7	12	2	90	96	80	78
1	10	56	46	II	106	120	80	T8	3	9	T8	12	2	90	96	84	88
1	11	50	56	I	100	130	80	T8	3	9	T8	6	2	96	86	64	68
1	12	52	60	II	78	130	80	T8	3	6	T8	6	2	72	78	86	90
1	13	40	44	I	100	130	80	T7	3	9	T8	9	2	110	106	100	98
1	14	48	50	I	72	120	80	T8	3	6	T8	6	2	70	68	64	68
1	15	36	50	I	90	120	80	T8	3	9	T8	9	2	110	106	102	96
1	16	40	45	I	90	120	80	T7	3	6	T7	12	2	90	94	64	68
1	17	32	60	I	90	130	80	T8	3	9	T8	12	2	90	90	80	68
1	18	32	60	I	96	120	80	T8	3	9	T8	12	2	90	88	82	86
1	19	55	48	I	90	120	80	T8	3	6	T8	6	2	92	80	66	70
1	20	38	48	II	110	128	80	T8	3	9	T8	9	2	110	106	100	102
1	21	58	45	I	96	120	80	T7	3	9	T7	9	2	78	74	68	64
1	22	50	60	I	96	120	80	T8	3	9	T7	9	2	78	74	68	68

1	23	52	56	I	110	130	80	T8	3	3	T8	12	2	108	100	98	96
1	24	36	55	I	90	120	80	T8	3	9	T8	12	2	100	102	82	76
1	25	34	52	I	80	110	70	T8	3	9	T8	9	2	90	86	80	80
1	26	48	48	I	80	110	70	T8	3	9	T8	6	2	68	66	60	64
1	27	32	50	I	90	120	80	T8	3	9	T7	12	2	110	106	98	96
1	28	42	45	I	108	130	80	T7	3	9	T8	6	2	108	108	90	86
1	29	58	45	I	100	130	80	T7	3	9	T8	9	2	92	86	80	74
2	1	45	50	I	80	120	80	T7	3	3	T7	6	2	76	70	60	64
2	2	44	54	I	80	120	80	T8	3	3	T8	3	2	108	100	98	96
2	3	46	48	I	80	120	80	T7	3	3	T8	6	2	76	70	60	64
2	4	48	44	I	80	120	80	T8	3	3	T8	3	2	108	100	98	96
2	5	38	45	I	80	120	80	T8	3	3	T7	3	2	108	100	98	96
2	6	54	50	I	82	130	80	T7	3	3	T8	6	2	76	70	60	64
2	7	39	44	I	80	112	80	T7	3	6	T7	6	2	76	70	60	64
2	8	44	45	I	80	112	80	T8	3	6	T8	3	2	108	100	98	96
2	9	40	52	II	76	116	80	T7	3	6	T8	6	2	76	70	60	64
2	10	40	48	I	76	116	80	T7	3	6	T7	6	2	76	70	60	64
2	11	47	49	I	80	120	80	T8	3	6	T8	3	2	108	100	98	96
2	12	48	48	I	80	120	80	T7	3	6	T8	6	2	76	70	60	55
2	13	52	48	I	92	130	80	T8	3	9	T8	3	2	92	80	66	70
2	14	45	45	II	80	120	80	T8	3	3	T8	6	2	108	100	98	96
2	15	48	60	I	80	120	80	T8	3	3	T7	3	2	108	100	98	96
2	16	50	50	I	80	120	80	T8	3	3	T8	3	2	108	100	98	96
2	17	44	52	I	76	116	80	T7	3	9	T8	6	2	76	70	60	64
2	18	47	48	I	80	120	80	T8	3	9	T8	3	2	108	100	98	96
2	19	38	52	I	92	130	80	T8	3	6	T7	6	2	92	80	66	70
2	20	38	48	I	76	116	80	T7	3	6	T7	3	2	76	70	60	64

2	21	50	50	I	76	110	80	T7	3	6	T8	3	2	76	70	60	54
2	22	33	48	I	76	110	70	T8	3	9	T8	6	2	108	100	98	96
2	23	45	50	I	92	120	70	T8	3	3	T8	3	2	92	80	66	70
2	24	50	60	I	92	130	80	T8	3	3	T7	3	2	92	80	66	70
2	25	47	48	I	100	120	80	T8	3	3	T8	6	2	92	80	66	70
2	26	42	45	I	98	120	80	T8	3	9	T7	3	2	92	80	66	70
2	27	50	52	II	106	120	80	T8	3	6	T8	12	2	92	80	66	70
2	28	50	54	I	108	130	80	T8	3	6	T8	12	2	92	80	66	70
2	29	44	52	I	92	130	80	T8	3	6	T7	12	2	92	80	66	70

MASTER CHART

Group,1=Repiva,2=Repiva+Dexmedet	Sl.No	Age	Weight	TSA	Ba PR	Ba SBP	Ba SBP	Sen blo	Mot	Sen time	Sen lev	Mot Time	Mot lev	PR 3 Mits
1	1	36	48	I	100	120	80	T8	3	9	T8	12	2	100
1	2	56	46	I	100	120	80	T8	3	9	T8	3	2	100
1	3	50	50	I	70	100	60	T8	3	6	T8	12	2	68
1	4	50	58	I	94	130	80	T8	3	9	T7	3	2	90
1	5	50	55	I	80	130	80	T8	3	3	T8	12	2	90
1	6	38	48	I	100	120	80	T7	3	9	T8	12	2	96
1	7	52	56	I	108	120	80	T8	3	9	T8	9	2	108
1	8	48	50	II	70	100	80	T8	3	6	T8	9	2	68
1	9	38	55	I	108	120	80	T8	3	9	T7	12	2	90
1	10	56	46	II	106	120	80	T8	3	9	T8	12	2	90
1	11	50	56	I	100	130	80	T8	3	9	T8	6	2	96
1	12	52	60	II	78	130	80	T8	3	6	T8	6	2	72
1	13	40	44	I	100	130	80	T7	3	9	T8	9	2	110
1	14	48	50	I	72	120	80	T8	3	6	T8	6	2	70
1	15	36	50	I	90	120	80	T8	3	9	T8	9	2	110
1	16	40	45	I	90	120	80	T7	3	6	T7	12	2	90
1	17	32	60	I	90	130	80	T8	3	9	T8	12	2	90
1	18	32	60	I	96	120	80	T8	3	9	T8	12	2	90
1	19	55	48	I	90	120	80	T8	3	6	T8	6	2	92
1	20	38	48	II	110	128	80	T8	3	9	T8	9	2	110
1	21	58	45	I	96	120	80	T7	3	9	T7	9	2	78
1	22	50	60	I	96	120	80	T8	3	9	T7	9	2	78
1	23	52	56	I	110	130	80	T8	3	3	T8	12	2	108
1	24	36	55	I	90	120	80	T8	3	9	T8	12	2	100
1	25	34	52	I	80	110	70	T8	3	9	T8	9	2	90
1	26	48	48	I	80	110	70	T8	3	9	T8	6	2	68
1	27	32	50	I	90	120	80	T8	3	9	T7	12	2	110
1	28	42	45	I	108	130	80	T7	3	9	T8	6	2	108
1	29	58	45	I	100	130	80	T7	3	9	T8	9	2	92

2	1	45	50	I	80	120	80	T7	3	3	T7	6	2	76
2	2	44	54	I	80	120	80	T8	3	3	T8	3	2	108
2	3	46	48	I	80	120	80	T7	3	3	T8	6	2	76
2	4	48	44	I	80	120	80	T8	3	3	T8	3	2	108
2	5	38	45	I	80	120	80	T8	3	3	T7	3	2	108
2	6	54	50	I	82	130	80	T7	3	3	T8	6	2	76
2	7	39	44	I	80	112	80	T7	3	6	T7	6	2	76
2	8	44	45	I	80	112	80	T8	3	6	T8	3	2	108
2	9	40	52	II	76	116	80	T7	3	6	T8	6	2	76
2	10	40	48	I	76	116	80	T7	3	6	T7	6	2	76
2	11	47	49	I	80	120	80	T8	3	6	T8	3	2	108
2	12	48	48	I	80	120	80	T7	3	6	T8	6	2	76
2	13	52	48	I	92	130	80	T8	3	9	T8	3	2	92
2	14	45	45	II	80	120	80	T8	3	3	T8	6	2	108
2	15	48	60	I	80	120	80	T8	3	3	T7	3	2	108
2	16	50	50	I	80	120	80	T8	3	3	T8	3	2	108
2	17	44	52	I	76	116	80	T7	3	9	T8	6	2	76
2	18	47	48	I	80	120	80	T8	3	9	T8	3	2	108
2	19	38	52	I	92	130	80	T8	3	6	T7	6	2	92
2	20	38	48	I	76	116	80	T7	3	6	T7	3	2	76
2	21	50	50	I	76	110	80	T7	3	6	T8	3	2	76
2	22	33	48	I	76	110	70	T8	3	9	T8	6	2	108
2	23	45	50	I	92	120	70	T8	3	3	T8	3	2	92
2	24	50	60	I	92	130	80	T8	3	3	T7	3	2	92
2	25	47	48	I	100	120	80	T8	3	3	T8	6	2	92
2	26	42	45	I	98	120	80	T8	3	9	T7	3	2	92
2	27	50	52	II	106	120	80	T8	3	6	T8	12	2	92
2	28	50	54	I	108	130	80	T8	3	6	T8	12	2	92
2	29	44	52	I	92	130	80	T8	3	6	T7	12	2	92

PR 6 Mits	PR 15 Mits	PR 30Mits	PR 1HR	PR 2HR	PR 4HR	PR 8HR	SBP3 Mts	SBP6 Mts	SBP15 Mts	SBP30 Mts	SBP 1 Hr	SBP 2 Hr	SBP 4 Hr
96	92	96	92	90	120	110	120	120	110	120	116	112	128
96	92	96	92	90	120	110	120	120	110	120	116	112	128
66	60	80	86	80	118	108	100	106	80	90	110	120	130
80	64	80	82	82	116	110	120	120	110	112	110	112	136
96	80	78	78	98	126	116	120	110	110	118	120	118	126
86	68	76	76	80	116	114	130	126	112	120	122	118	136
108	104	102	104	110	112	108	130	130	110	110	108	108	126
66	60	60	70	86	118	100	100	106	120	108	110	110	130
96	80	78	78	98	126	116	120	110	108	120	120	118	126
96	84	88	80	80	126	110	120	110	90	92	100	110	130
86	64	68	76	100	116	108	126	126	120	108	112	114	130
78	86	90	90	92	100	108	112	112	108	110	112	106	126
106	100	98	84	90	126	116	130	126	126	120	118	110	126
68	64	68	68	66	86	86	110	108	106	104	102	108	120
106	102	96	90	84	110	100	128	130	126	118	118	116	120
94	64	68	70	74	100	106	120	120	110	110	108	116	130
90	80	68	90	100	110	100	130	130	120	100	110	110	120
88	82	86	86	96	116	116	130	130	110	100	102	100	130
80	66	70	72	72	100	104	120	120	110	110	110	110	140
106	100	102	96	94	108	102	128	130	132	110	110	110	120
74	68	64	68	70	116	108	112	112	108	110	112	116	130
74	68	68	68	70	114	108	114	112	108	110	112	116	130
100	98	96	86	84	112	100	130	130	116	80	106	106	126
102	82	76	82	88	112	106	130	120	110	110	112	114	130
86	80	80	82	84	118	120	130	116	110	110	110	114	128
66	60	64	80	90	122	114	100	102	110	114	120	126	126
106	98	96	86	84	112	100	130	126	124	118	110	112	130
108	90	86	86	80	110	96	130	120	120	110	114	120	136
86	80	74	80	90	108	108	130	120	110	100	96	100	126

70	60	64	70	74	82	110	116	116	110	106	110	118	110
100	98	96	86	90	100	126	118	110	110	106	108	108	114
70	60	64	70	74	82	114	116	116	110	100	108	118	110
100	98	96	86	90	100	126	118	110	110	106	108	108	114
100	98	96	86	90	100	126	118	110	110	106	108	108	114
70	60	64	70	74	82	112	116	116	110	104	100	118	110
70	60	64	70	74	82	110	110	116	110	100	110	118	110
100	98	96	86	90	100	126	108	110	110	106	108	108	114
70	60	64	70	74	82	112	116	116	110	106	110	118	116
70	60	64	70	74	82	112	116	116	110	106	110	118	110
100	98	96	86	90	100	120	118	110	110	106	108	108	114
70	60	55	70	74	82	112	116	116	110	106	110	118	110
80	66	70	88	88	88	96	130	120	106	110	112	116	120
100	98	96	86	90	100	126	118	110	110	106	108	108	114
100	98	96	86	90	100	126	118	110	110	106	108	108	114
100	98	96	86	90	100	126	118	110	110	106	108	108	114
70	60	64	70	74	82	112	116	116	110	108	110	118	110
100	98	96	86	90	100	126	118	110	110	106	108	108	114
80	66	70	88	88	88	100	130	120	106	110	112	116	120
70	60	64	70	74	82	112	116	116	110	106	110	118	110
70	60	54	70	74	82	112	116	116	110	104	110	118	110
100	98	96	86	90	100	126	118	110	110	106	108	108	114
80	66	70	88	88	88	100	130	120	106	110	112	116	120
80	66	70	88	88	88	100	130	120	106	110	112	116	120
80	66	70	88	88	88	100	130	120	106	110	112	116	120
80	66	70	88	88	88	100	130	120	106	110	112	116	120
80	66	70	88	88	88	100	130	120	106	110	112	116	120
80	66	70	88	88	80	90	130	120	106	110	112	116	120
80	66	70	88	88	88	100	130	120	106	110	112	116	120

SBP 8 Hr	DBP3 Mts	DBP6 Mts	DBP15 Mts	DBP30 Mts	DBP 1 Hr	DBP 2 Hr	DBP 4 Hr	DBP 8 Hr	Analg Dura Mts	VAS lev	2 seg reg Mts	S2 Reg Mts
126	80	80	70	80	70	70	80	82	240	4	80	240
126	80	80	70	80	70	70	80	82	240	5	80	240
110	60	60	60	60	70	80	90	70	200	6	60	220
120	80	80	70	70	70	70	90	80	240	4	80	240
118	80	70	70	70	70	70	70	60	200	5	80	270
120	80	80	70	70	70	68	90	80	240	6	80	220
106	80	80	70	70	70	70	70	70	220	4	120	240
110	60	60	60	70	70	70	90	74	200	5	80	270
118	80	70	70	80	70	70	70	60	200	6	80	220
110	80	80	60	60	60	70	80	70	200	4	80	240
118	80	80	80	70	70	76	80	70	240	4	80	270
120	80	70	60	70	70	70	70	70	200	4	100	220
120	80	80	80	80	80	70	80	70	220	4	120	240
110	70	70	60	68	62	70	80	70	200	5	80	270
118	80	80	80	80	70	70	70	70	220	6	120	220
120	80	80	80	70	70	70	80	70	240	4	80	240
130	80	80	70	70	70	70	80	80	200	4	80	270
120	80	80	70	70	70	60	80	80	200	4	80	220
122	80	80	80	80	80	80	90	80	240	4	80	240
120	80	80	80	80	70	70	70	70	220	5	120	270
112	70	70	60	66	70	70	72	70	200	6	100	220
112	70	70	60	64	70	70	72	70	200	4	100	240
116	80	80	80	60	70	70	70	70	220	4	120	270
116	90	80	70	70	70	72	80	80	240	4	80	220
108	80	70	70	60	60	66	70	80	200	4	80	240
120	60	60	60	70	80	80	70	70	220	5	60	270
120	80	80	80	80	70	70	80	70	220	6	120	220
118	80	80	70	70	70	70	90	80	240	5	80	240
120	80	80	70	70	60	60	80	70	200	6	80	270

150	80	80	70	60	70	70	70	80	450	4	120	300
126	70	70	70	70	70	70	70	80	430	5	140	270
130	80	80	70	60	60	70	70	80	450	4	120	270
126	70	70	70	70	70	70	70	80	430	6	140	240
126	70	70	70	70	70	70	70	80	430	4	140	270
130	80	80	70	60	70	70	70	80	450	4	120	330
130	80	80	70	60	70	70	70	90	450	4	120	300
126	70	70	70	70	70	70	70	80	430	4	100	330
130	80	80	70	60	70	70	70	80	450	5	120	300
130	80	80	70	60	70	70	70	80	450	4	120	330
120	70	70	70	70	70	70	70	80	430	4	140	300
130	80	80	70	60	70	70	70	80	450	6	120	330
130	80	80	70	70	70	80	80	90	480	4	140	330
120	70	70	70	70	70	70	70	80	430	4	140	300
126	70	70	70	70	70	70	70	80	430	4	140	330
126	70	70	70	70	70	70	70	80	430	8	140	270
130	80	80	70	60	70	70	70	80	450	4	120	300
126	70	70	70	70	70	70	70	80	430	4	140	330
130	80	80	70	70	70	80	80	90	480	4	140	300
130	80	80	70	60	70	70	70	80	450	5	120	330
130	80	80	70	60	70	70	70	80	450	4	120	300
126	70	70	70	70	70	70	70	80	450	4	140	270
130	80	80	70	70	70	80	80	90	480	6	140	300
130	90	80	70	70	70	80	80	90	480	4	140	270
130	80	80	70	70	70	80	80	90	480	4	140	300
130	80	80	70	70	70	80	80	90	480	7	140	270
130	80	80	70	70	70	80	80	90	480	4	140	300
130	80	80	70	70	70	80	80	90	480	4	140	270
130	80	80	70	70	70	80	80	90	480	7	140	300

MOTOR BLOCKADE - DURATION

Group I	3 Mts	6 Mts	15 Mts	30 Mts	1 Hr	1.30 Hrs	2 Hrs	2.30 Hrs	3 Hrs	3.30 Hrs	4 Hrs	4.30 Hrs	5 Hrs
1	2	2	3	3	3	2	2	0	0	0	0	0	0
2	2	2	2	3	3	3	2	2	1	0	0	0	0
3	2	2	3	3	3	2	2	1	0	0	0	0	0
4	2	3	3	3	3	3	2	1	1	0	0	0	0
5	1	1	2	3	2	1	1	1	0	0	0	0	0
6	2	2	2	3	3	3	2	0	0	0	0	0	0
7	0	1	2	2	3	3	2	1	1	0	0	0	0
8	0	2	2	3	3	2	1	1	0	0	0	0	0
9	0	1	2	2	3	3	2	0	0	0	0	0	0
10	0	2	3	3	3	2	2	0	0	0	0	0	0
11	0	2	3	3	2	2	1	1	0	0	0	0	0
12	0	1	2	2	2	2	1	1	1	0	0	0	0
13	0	2	2	3	2	2	1	1	0	0	0	0	0
14	0	1	2	2	3	2	2	0	0	0	0	0	0
15	0	1	2	2	3	2	2	0	0	0	0	0	0
16	0	1	2	2	3	2	2	1	0	0	0	0	0
17	0	1	2	2	3	3	2	2	1	0	0	0	0
18	0	0	2	2	3	2	2	0	0	0	0	0	0
19	0	2	3	3	3	2	2	1	0	0	0	0	0
20	1	2	2	3	3	2	2	1	1	0	0	0	0
21	0	1	2	3	2	2	2	1	0	0	0	0	0
22	0	0	2	3	3	2	2	0	0	0	0	0	0
23	0	0	2	2	3	3	2	1	0	0	0	0	0
24	1	2	2	3	3	2	2	1	1	0	0	0	0
25	0	0	2	3	2	2	2	2	0	0	0	0	0
26	1	2	2	3	3	3	3	2	0	0	0	0	0
27	0	0	2	3	3	3	2	0	0	0	0	0	0
28	0	2	2	3	3	3	2	1	0	0	0	0	0
29	0	1	2	2	3	3	3	2	2	0	0	0	0

Group II													
1	1	2	2	3	3	3	3	3	2	1	0	0	0
2	2	2	2	2	2	2	2	2	2	1	0	0	0
3	1	2	2	3	3	2	2	2	2	1	1	0	0
4	1	2	2	2	3	3	3	2	1	1	0	0	0
5	2	2	3	3	3	3	2	2	1	1	1	0	0
6	1	2	3	3	3	2	2	2	1	1	0	0	0
7	0	1	2	3	3	3	3	2	1	1	1	0	0
8	2	2	3	3	3	3	3	3	2	2	0	0	0
9	1	2	2	2	2	3	3	2	2	1	1	0	0
10	2	2	3	3	3	2	2	1	1	1	0	0	0
11	2	2	3	3	3	3	2	2	1	1	1	0	0
12	2	2	3	3	3	3	2	2	2	1	1	0	0
13	1	2	2	2	3	3	3	2	2	1	1	0	0
14	0	2	2	2	2	3	3	2	2	2	0	0	0
15	0	1	2	2	3	3	3	2	1	1	1	0	0
16	2	2	2	2	3	3	2	2	2	2	2	0	0
17	2	3	3	3	3	3	3	3	3	3	0	0	0
18	1	2	2	2	2	3	3	2	2	1	1	0	0
19	1	2	2	2	3	3	2	2	1	1	0	0	0
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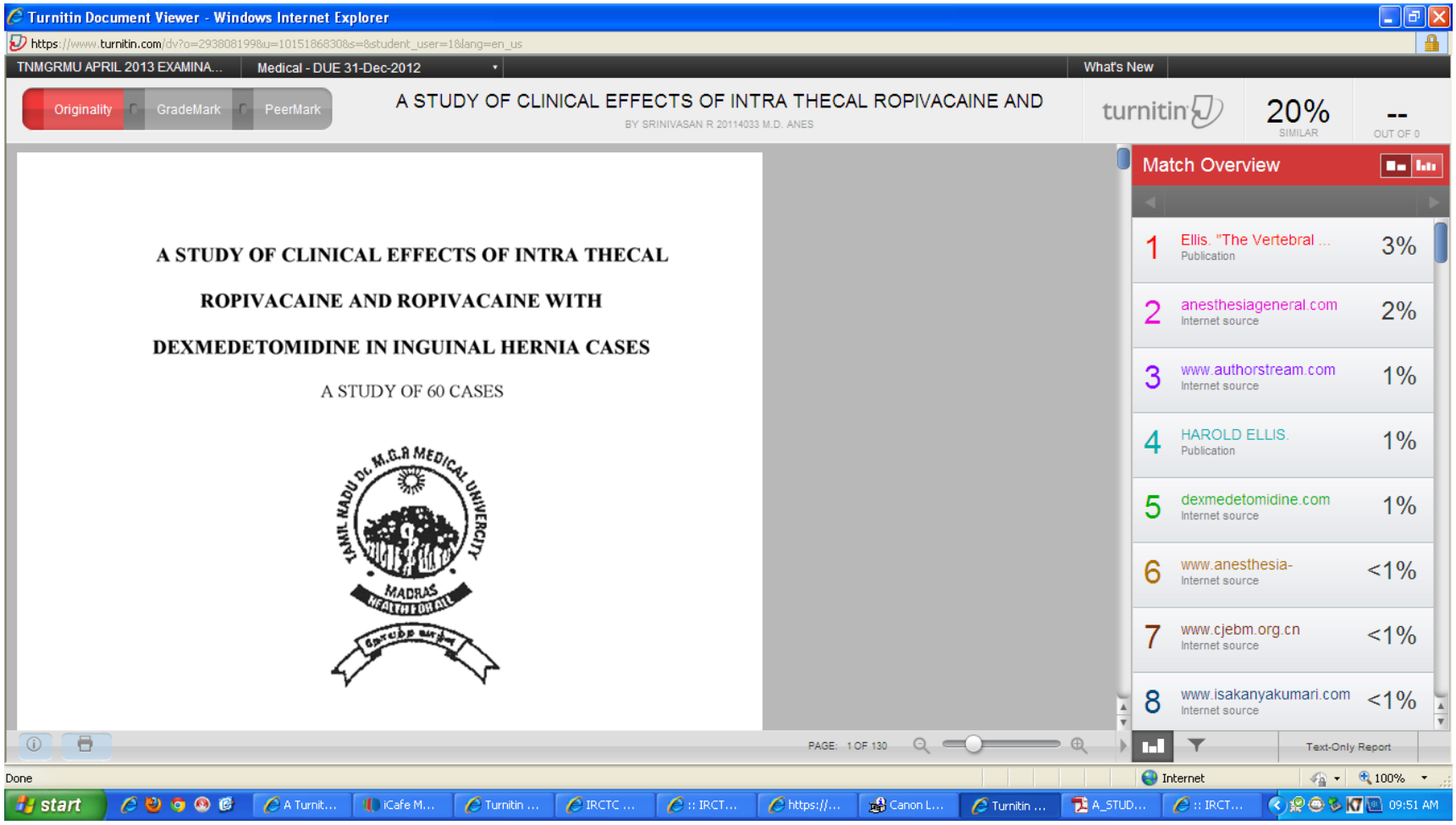
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