Dissertation on

COMPARATIVE EVALUATION OF CLASSICAL SUBARACHNOID BLOCK, UNILATERAL SUBARACHNOID BLOCK AND LOW DOSE SUBARACHNOID BLOCK IN HIGH RISK PATIENTS UNDERGOING LOWER LIMB SURGERIES

Dissertation Submitted in partial fulfillment of

M.D. DEGREE EXAMINATION

BRANCH X – ANAESTHESIOLOGY

MADRAS MEDICAL COLLEGE, CHENNAI.

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI, TAMIL NADU

MARCH 2007

CERTIFICATE

This is to certify that the Dissertation "**COMPARATIVE EVALUATION OF CLASSICAL SUBARACHNOID BLOCK, UNILATERAL SUBARACHNOID BLOCK AND LOW DOSE SUBARACHNOID BLOCK IN HIGH RISK PATIENTS UNDERGOING LOWER LIMBSURGERIES**" presented herein by **Dr.M. GOMATHI** is an original work done in the Department of Anaesthesiology, Madras Medical College and Government General Hospital, Chennai for the award of Degree of M.D. (Branch X) Anaesthesiology during the academic period of 2004-2007.

Place:

Date:

Prof.Dr.Kalavathy Ponniraivan, B.Sc**,** MD.,
DEAN,
Madras Medical College & Hospital,
Chennai.

CERTIFICATE

This is to certify that the Dissertation "**COMPARATIVE EVALUATION OF CLASSICAL SUBARACHNOID BLOCK, UNILATERAL SUBARACHNOID BLOCK AND LOW DOSE SUBARACHNOID BLOCK IN HIGH RISK PATIENTS UNDERGOING LOWER LIMB SURGERIES**" presented herein by **Dr.M.GOMATHI** is an original work done in the Department of Anaesthesiology, Madras Medical College and Government General Hospital, Chennai for the award of Degree of M.D. (Branch X) Anaesthesiology under my guidance and supervision during the academic period of 2004-2007.

Place:

Date:

Prof.Dr.G.Sivarajan, MD., DA.,

Professor & HOD,
Department of Anesthesiology,
Madras Medical College & Hospital,
Chennai.

ACKNOWLEDGEMENT

I wish to express my sincere thanks to **Prof. Dr. Kalavathy Ponniraivan,** *MD*., Dean, Madras Medical College, Chennai for having kindly permitted me to utilize the hospital facilities to conduct this study.

I express my deep sense of gratitude to **Prof. Dr. G. Sivarajan,** *M.D., D.A*., Professor & Head of the Department of Anaesthesiology, Madras Medical College, Chennai for his constant encouragement and invaluable guidance.

I am very grateful **Prof. Dr. S. Gayathri,** *M.D., D.A*., and Additional Professor of anaesthesiology to for her patience and kind co-operation during the preparation of this dissertation.

My sincere thanks to **Prof. Dr. A. Thiruselvam,** *M.D., D.A*., Additional Professor of anaesthesiology, for his instructions and suggestions.

My sincere thanks to **Prof. Dr. Kamalini Sridharan,** *M.D., D.A*., Additional Professor of anaesthesiology, for her valuable suggestions and support.

My sincere thanks to my guide **Dr.T. Venkatachalam**, *M.D., D.A*., Registrar/ Lecturer, for his continuous supervision and able guidance throughout this work.

I thank all the Assistant Professors and Tutors for their able help, support and supervision during the course of the study.

I also express my thanks to all my colleagues for their co-operation and support for this study.

I will be failing in my duty if I do not express my heart felt gratitude to **Mr.M.G. Karthikeyan**, M.Sc., the Statistician, CIP Computers, Vellore for his patient guidance and expert advice in the statistical analysis of the study data.

I thank all the patients included in the study and their relatives, for their wholehearted co-operation in spite of their illness.

Last but not the least I would like to express my sincere gratitude to **Lord Almighty**.

DECLARATION

I hereby declare that dissertation entitled **"COMPARATIVE EVALUATION OF CLASSICAL SUBARACHNOID BLOCK, UNILATERAL SUBARACHNOID BLOCK AND LOW DOSE SUBARACHNOID BLOCK IN HIGH RISK PATIENTS UNDERGOING LOWER LIMB SURGERIES"** has been prepared by me under the guidance of **Prof.Dr.G.SIVARAJAN, M.D., D.A** Professor and Head of Department of Anaesthesiology, Madras Medical College, Chennai in partial fulfillment of the regulations for the award of the degree of M.D. (Anaesthesiology), examination to be held in March 2007.

This study was conducted at Madras Medical College and Government General Hospital, Chennai.

I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Date:

Place: Chennai. DR.M.GOMATHI.

TABLE OF CONTENTS

COMPARATIVE EVALUATION OF CLASSICAL SUBARACHNOID BLOCK, UNILATERAL SUBARACHNOID BLOCK AND LOW DOSE SUBARACHNOID BLOCK IN HIGH RISK PATIENTS UNDERGOING LOWER LIMB SURGERIES.

INTRODUCTION

It was in the year 1899 August Bier,used subarachnoid block and he gave first deliberate spinal anaethesia. Spinal anesthesia continued to be most common anesthetic technique because of its rapid onset, safety and simplicity. Even this relatively safe technique can have complication such as hypotension which a normal patient can tolerate but can be detrimental[9] to patients with haemodynamic instability. The safety improves if the block can be localized[15] to the area of surgery.

A special technique of spinal anaesthesia named spinal hemi block was described for one limb surgeries, which was named as spinal hemi analgesia. This is also known as unilateral spinal anaesthesia[7]. The distance between the left and right spinal roots is only 10-15 millimeter in the lumbar or lower thoracic level. Such a small distance should reasonably prevent from producing strictly unilateral block of the spinal nerve roots. However, various clinical reports suggested that using small doses of either hypo or hyperbaric [17,22,26] anesthetic solution injected at low speeds through directional needles in patients lying in the lateral decubitus [7, 16,20] position for 10-15 minutes results in preferential distribution of spinal anaesthesia towards the operated side, providing intense surgical block on that side[10, 16] .Even though the term unilateral spinal anaesthesia has been in vogue for a long time most of the research on this are recent. Even though performing spinal anaesthesia is technically easier, the complications which are usually expected like hypotension and bradycardia can be detrimental to this high risk group patients.

Ignored until the late twentieth century, now spinal cord has emerged as target of pain control. Drugs are given to provide intra operative anaesthesia and post-operative analgesia in various procedures. The discovery of the opioid receptors in the spinal cord led to the use of opioids [4] in the clinical practice for pain relief through Subarachnoid route.

Addition of fentanyl to bupivacaine is an established technique to reduce the dose of anaesthetic and to maintain heamodynamic stability[15]. However addition of fentanyl can change the baricity [5,27] of the local anaesthetic and can alter the effect of intended unilateral spinal analgesia.

The present randomized double blind study was designed to see if addition of fentanyl could reduce the dose of bupivacaine and maintain the unilateral nature of anaesthesia. This study was done to compare the efficacy of classical subarachnoid block, unilateral subarachnoid block,lowdose subarachnoid block in high risk patients undergoing lower limb surgeries.

AIM

To compare the efficacy of classical subarachnoid block using,0.5% bupivacaine ,unilateral spinal anesthesia using 0.5% bupivacaine and low dose spinal anesthesia using 0.5% bupivacaine 1.5 ml with 0.5 ml of fentanyl (25 micro grams) in high risk patients undergoing emergency unilateral lower limb surgeries based on the following parameters.

1. Feasibility of maintaining unilaterality of Subarachnoid block .
2. Haemodynamic stability in the peri-operative period .
3. Onset, Quality and duration of block.

ANATOMY OF SPINAL CORD

Intimate knowledge of the anatomy of the vertebral column and its contents is the key stone to successful, safe spinal anaesthesia, not only in terms of performance of lumbar puncture but also in terms of the spread of local anaesthetics in CSF and the level of anaesthesia involved.

The vertebral column comprising of 33 vertebrae has four curves. The cervical and lumbar curves are convex anteriorly; whereas the thoracic and sacral curves are convex posteriorly. The curves of the vertebral column have a significant influence on the spread of local anaesthetic in the subarachnoid space. In the supine position, the high points of the cervical and lumbar curves are at C5 and L5; the low points of the thoracic and sacral curves are at T5 and S2, respectively. The vertebral column is bound together by several ligaments, which give it stability and elasticity. They are Supraspinous ligament which is a strong fibrous cord that connects apices of the spinous processes from the sacrum to C7, where it is continued upward as the Ligamentum Nuchae. Interspinous ligament is a thin membranous ligament that connects spinous processes blending anteriorly with ligamentum flavum and posteriorly with supraspinous ligaments. Ligamentum flavum or the yellow ligament comprises yellow elastic fibres and connects adjacent lamina that run from the caudal edge of the vertebra above to the cephalad edge of the lamina below. Laterally, this ligament begins at the roots of the articular processes and extends posteriorly and medially to the point where the lamina joins to form the spinous process. Here the two components of the ligaments are united, thus covering the inter laminar space. The longitudinal ligaments (anterior and posterior) bind the vertebral bodies together.

Epidural space surrounds the spinal meninges and extends from the foramen magnum, where the dura is fused to the base of the skull to the sacral hiatus, which is covered sacrococcygeal ligament.

Spinal cord is protected by both bony vertebral column and three connective tissue coverings, the meninges. They are dura mater, arachnoid mater and piamater. The dura matter the outer most membrane, is a tough fibro elastic tube of fibers which run longitudinally.It can be described in two parts; the cranial and the spinal. The cranial dura consists of an outer layer that lines the skull and inner layer that invests brain and fold inward to form the falx cerebri. The two layers are closely united except where they enclose the great venous sinuses that drains the blood from the veins. At spinal level the outer layer continues down the vertebral canal as the periosteal lining. The inner layer continues caudally as the spinal dura or the theca.

Arachnoid matter is a middle of the three coverings of the brain and the spinal cord. It is a delicate non vascular membrane closely attached to the dura, nd , with it ,ends at the lower border of S2. There is a potential space between dura and arachnoid matter called the subdural space.

Pia matter is a delicate highly vascular membrane closely investing spinal cord and brain. It links to the surface of both these structures throughout their entire course. The space between arachnoid and the pia is thus called the subarachnoid space.

Spinal cord, continues above with the medulla oblongata, begins at the level of foramen magnum and ends below as the conus medullaris. At birth the cord ends at the level of L3 but rises to end in adult life at the lower border of L1.

Spinal nerves are 31 pairs which are symmetrically arranged and attached to the spinal cords by two roots.

Subarachnoid space, bounded internally by the Pia and externally by the arachnoid is filled with cerebrospinal fluid and contains numerous arachnoid trabeculae, which form a delicate, sponge like mass. This space has three divisions; the cranial, the spinal and the root surrounding the dorsal and ventral spinal nerve roots All of these components are in " free communication" with each other.

MECHANISM OF SPINAL ANESTHESIA

Injection of local anesthetics into the spinal CSF allows access to sites of action both within the spinal cord and the peripheral nerve roots.

With the dorsal and ventral horns, local anesthetics can exert sodium channel block and inhibit generation and propagation of electrical activity. Other spinal cord neuronal ion channels, such as calcium channels, are also important for efferent and efferent neural activity. Spinal administration of N-type calcium channel blocks results in hyper polarization of cell membranes resistant to electrical stimulation from nociceptive afferents and intense analgesia. Local anesthetics may have similar actions on neural calcium channels, which may contribute to analgesic actions of central neuraxis administered local anesthetics.

Multiple neurotransmitters are involved in nociception transmission in the dorsal horn of the spinal cord. Substance P is an important neurotransmitter that modulated nociception from C fibers and is released from presynaptic terminals of dorsal root ganglion cell. Administration of local anesthetics in concentration that occur after spinal and epidural anesthesia inhibits release of substance P , and also inhibits binding of substance P to the receptor in the central neuraxis in a noncompetitive fashion. Other inhibitory neurotransmitters that may be important for nociceptive processing in the spinal cord such a Gamma-aminobutyric acid are also affected by local anesthetics. Local anesthetics can potentiate effects of Gamma-aminobutyric acid by preventing uptake of clearance. These studies suggest spinal anesthesia can be partially mediated via complex interaction at neural synapses in addition to ion channel blockade and explain the ability of spinal anesthesia to reduce central temporal summation in humans.

Although spinal local anesthetics can block sodium channels and electrical conduction in spinal nerve roots, other mechanisms may also come into play.

FACTORS AFFECTING UNILATERAL SPINAL

Five main factors should be considered when trying to restrict spinal block to the operative side

1. The density of local anesthetic solution compared with CSF.
2. Patient position.
3. Speed of intrathecal injection,
4. Dose, Concentration, volume of the local anesthetic solution.
5. Design of spinal needles.

<u>1-The density of local anesthetic solution:</u>

The difference in the density between the CSF and the local anesthetic solution is the main factor that must be considered to restrict the spinal block. Both hypobaric[19,22] and hyperbaric[11,23] solutions have been used to restrict spinal block. How ever since the differences in baricity between the CSF and the anesthetic solution are wider for hyperbaric solutions than hypobaric ones, the use of anesthetic solution with density and baricity greater than the CSF often results in a more predictable distribution of nerve blockade.

2-Patient's Position:-

The position of the patient during and immediately after local anesthetic injection is known to influence the spread of intrathecal drugs. If we use an anesthetic solution either more or less dense than the cerebrospinal fluid it is theoretically possible to control the distribution of spinal block. Thus maintaining a lateral decubitus position for a certain period should allow restricting surgical anesthesia only at the operative side. However the optimal duration of lateral decubitus position is difficult to define, since it is largely influenced by the dose of local anesthetic injected. In fact, if large doses are (e.g.12-20 mg hyper baric bupivacaine) injected, clinically relevant migration of spinal block can be observed when position is changed even after 1 hour after injection[20]. On the contrary, if small doses of local anesthetic solution are used (5-8 mg hyperbaric bupivacaine) a 10-15 min period with lateral decubitus position may be adequate to prevent clinically relevant migration of surgical anesthesia after patients turned supine[7,21].

3-Speed of intrathecal injection:

Even if the injection rate seems to be of minor relevance for controlling the intrathecal spread of local anesthetic solutions, it should be considered that turbulence in the CSF produced by using high speed of injection[13,22] can increase the initial mixing between the anesthetic solution and the CSF itself, producing concentrations of local anesthetic solution in the nondependent part of the spinal canal high enough to block those myelinated nerve roots lying in the upper part of the spinal canal. This effect is probably due to the turbulence demonstrated in in-vitro studies when using high injection speed. These turbulencies lead to a rapid mixing of the local anesthetic solution with the CSF, producing a homogeneous mixture with reduced gradient of baricity as compared with the CSF, thus preventing from futher migration of local anesthetic solution. To minimize the incidence of Post Dural Puncture Headache, spinal needle size has been progressively reduced, and this should be considered when seeking for unilateral spinal block.

4-Dose/Concentration/Volume of the local anesthetic solution:

Concentration, Volume, and Dose of the local anesthetic solution injected into the spinal canal are strictly related, considering that the rationale of unilateral spinal anesthesia in obtaining a gradient of concentration between the dependent and nondependent sides of the spinal canal during the lateral decubitus position, in order to achieve a deeper block of the dependent than non-dependent nerve roots. Large variation in volume and concentration of the local anesthetic solution play a minor role on the intrathecal drug spread[7,14], while the total amount of local anesthetic molecules injected into the spinal canal seems to be the most important factor. Interaction between the injected anesthetic dose and volume of Lumbosacral cerebrospinal fluid is the primary determinant of sensory block extent and duration during spinal anesthesia.

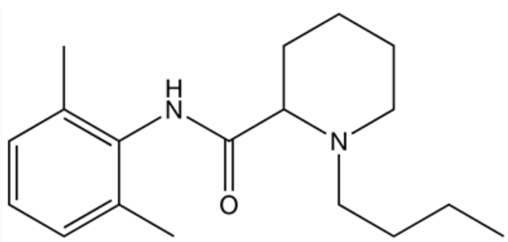
5-Spinal needle design:

Two main types of spinal needles are currently in clinical use, those with a pencil point, non-cutting tip (Whitacre-type or Sprotte type), and those with a cutting bevel tip (Quincke-Babcock type or Pitkin-type). It has been widely demonstrated that there is a clinically relevant reduction in post-dural puncture headache (PDPH) when non cutting rather than cutting needles are used, while no differences in spinal anesthesia success rate or back pain have been demonstrated. It has been demonstrated[18] that the use of low injection speed and whitacre-type needles provides a laminar flow which minimizes the mixing of local anesthetic solution with the CSF improving the control of intrathecal drug distribution[13], and providing a spinal anesthesia predominantly on the operated side[3].

PHARMACOLOGY OF BUPIVACAINE

Bupivacaime is an amide local anaeshetic, Synthesized by A.F.Ekenstam in 1957 and brought into clinical use in 1963.It is produced for clinical use in a racemic mixture, containing equal proportions of the 'S' and 'R' enantiomers. It is supplied for clinical uses as a hydrochride salt.

Chemical Structure of Bupivacaine



Description: 1 – Buty –N- (2-6-dimethylphenyl) -2- piperidine

Decarboxamide Hydrochloride monohydrate.

Physico-Chemical Profile

Molecular Weight (base) 288

pKa 8.1

Solubility in	
Alcohol	1 in 8
Water	1 in 25
Octanol / water partition	
Coefficient	High
Lipid Solubility	28
Plasma Protein Binding	95 %

Mechanism of Action

Bupivacaine exerts its effect by inhibition of sodium channels. It acts to block conduction in the nerves by decreasing or preventing the large transient increase in permeability of the cell membrane to sodium ions that follows depolarization of the membrane. Bupivacaine also reduces the permeability of the resting nerve membrane to potassium as well as sodium ions.

Pharmacodynamics

Bupivacaine by virtue of its pharmacological effects has a stabilizing action on all excitable membranes. In the central nervous system, stimulation can occur producing restlessness, tremors and convulsions in over dosage. Bupivacaine also causes a reduction of automaticity in the heart.

The clinical profile of nerve blockade prouced by Bupivacaine differts from that of Lignocane. It is 4 times more potent than Lignocaine but the onset of action is slower. The duration of action is considerably longer. The sensory block produced by Bupivacaine tends to be more marked than the motor block.

Pharmacokinetics

Bupivacaine is rapidy absorbed from the site of injection. The rate of rise in plasma Bupivacaine concentration and the peak plasma concentrations obtained depend on the route of administration. There is also some inter- individual variation and peak systemic concentrations may occur between 5 and 30 minutes after dministration. The addition of a vasoconstrictor delays absorption and results in lower plasma concentrations of Bupivacaine.

Pharmacokinetic Profile

Volume of distribution at steady state (Vdss)	72 litres
Clearance	0.47 1/mm
t ½	2.7 mm
t ½	28 mm
t ½	3.5hrs.

Metabolism

Possible pathways for metabolism of Bupivacaine include aromatic hydroxylation, N – dealkylation, amide hydrolysis and conjugation. Only the N dealkylated metabolite, N – desmethylbupivacaine has been measured in blood and urine after epidural and spinal administration. The degradation of Bupivacaine takes place in the liver. Renal disease is unlikely to after the kinetics of Bupivacaine to any great exetent. Less than 10 % of the drug is excrete unchanged in urine. The onset of action of Bupivacaine occurs 20 -30 minutes after peripheral nerve block and duration lasts for 8 -9 hours.

Clinical Applications

- Infiltration anaesthesia
- Peripheral nerve blocks
- Central neuraxial blocks (intrathecal, epidural and caudal)

Contraindications

- Paracervical block (in obstetrics)
- Know hypersensitivity to amide local anaesthetics
- Intravenous regional anasethesia (IVRA)

Preparations Available

- 0.25 %, 0.5 % solutions in 10 ml 20 ml vials.
- 5 mg /ml (0.5 %) Bupivavcaine and 80 mg dextrose for intrathecal injection (Baricity 1.027).

Recommended safe dose

Concentration used	Maximum permitted dose
0.125 % - 0.5 %	2 mg /kg body weight
0.75 % (not to be used in obstetric epidurals)	Max . over 4 hours – 150mg Max. during 24 hours – 400mg.
0.5 % plain / hyperbaric solution (intrathecal use)	20 mg

Adverse Reactions

Adverse reactions are associated mainly with excess plasma levels of the drug, which may be due to over dosage, unintentional intravascular injection or slow metabolic degradation.

CNS Reactions

Excitation characterized by restlessness, anxiety, dizziness, tinnitus, blurred vision or tremors were possible proceeding to convulsions, followed by drowsiness, unconsciousness and cardiac arrest.

Cardiovascular System Effects

Bupivacaine appears to be more cardiotoxic than Lidocaine and this relates to the action of Bupivacaine on cardiac sodium channels (fast in slow out agent) and physico-chemical properties like hig lipid solubility and high protein binding. Particularly at low pH. Accidental intravenous injection of Bupivacaine causes dysrhythmias, atrioventricular block, ventricular tachycardia and ventricular fibrillation. Pregnancy increases the sensitivity to cardiotoxic effects of Bupivacaine.

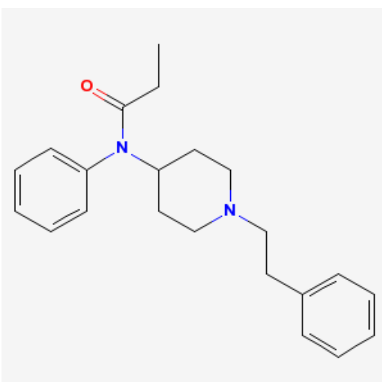
Allergic Reactions

Manifests as urticaria, Pruritis, angioneurotic edema etc. Cross sensitivity among members of amide type local anaesthetics has been reported.

PHARMACOLOGY OF FENTANYL

Fentanyl is a Phenylpiperidine – derivative, synthetic opioid agonist that is structurally related to Meperidine. As an analgesic, Fentanyl is 75 to 125 times more potent than Morphine.

Chemical structure



Molecular Weight: 336.471 g/mol

Molecular Formula: $C_{22}H_{28}N_2O$

Pharmacokinetics and physico-chemical properties

Fentanyl has a more rapid onset and shorter duration of action than Morphine. Effect –

Site equilibration time between blood and the brain for Fentanyl is 6.4 min. The greater potency and more rapid onset of action reflects the greater lipid solubility of Fentanyl compared with that of Morphine, Short duration of action of a single dose reflects its rapid redistribution to inactive tissues such as fat, skeletal muscle and lungs. Duration of analgesia is prolonged following multiple IV doses of following continuous infusion.

pKa – 8.4

% Un ionized at pH 7.4 -<10

Octanol / water partition coefficient – 813

% Bound to plasma protein -84

Diffusible fraction (%) – 1.5

t ½ α (min) 1-2

t ½ β (min) 10-30

t ½ γ (h) 2-4

Vde (L/kg)

Vdss (L/kg) 3-5

Clearance (ml/kg/mt) 10-20

Hepatic extraction ration 0.8 – 1.0

Metabolism

Fentanyl is extensively metabolized by N-demethylation producing Norfentanyl, which is structurally similar to Normeperidine . It is excreted by the kidneys and can be detected in the urine for 72 hours after a single IV dose of Fentanyl.

Routes of Administration

Oral Parenteral (IV/ IM) transmucosal transdermal, neuraxial (subarachnoid / epidural.)

Clinical Uses

Intravenous Fentanyl

- Low doses of Fentanyl 1 to 2 µgm/kg IV, are injected to provide analgesia.
- Fentanyl 2 to 20 µgm/kg IV administered as an adjuvant to inhaled anaesthetics in an attempt to blunt circulatory responses to.
- Direct laryngoscopy for intubation of trachea
- Sudden changes in the level of surgical stimulation
- Large doses of Fentanyl 50 to 150 ugm/kg IV have been used alone to Produce surgical anaesthesia. It has the advantage of stable haemodynamics due to the (a) lack of direct myocardial depressant effect (b) absence of histamine release and (c) suppression of stress responses to surgery.

Disadvantages

(a) Failure to prevent sympathetic nervous system responses to painful surgical stimulation at any dose (b) possible patient awareness , (c) postoperative depression of ventilation.

Side Effects:

Respiratory system: Persistent or recurrent depression of ventilation is a potential postoperative problem. Secondary peaks in plasma concentrations of Fentanyl from Sequesterated sites have been attributed.

Cardiovascular systerm: Markedly depresses carotid sinus baroreceptor reflex control of heart rate in neonate with 10 µgm/kg IV. Care should be taken in neonates because cardiac output is primarily heart rate dependent. Seizure activity following rapid administration Changes in somatosensory evoked potentials and electroencephalogram with doses> 30 µgm/kg IV.

Intracranial Pressure – modest increase (6 to 9 mm Hg) in ICP despite maintenance of an unchanged PaCo2 in head injury patients accompanied by decrease in mean arterial pressure and cerebral perfusion pressure.

Drug Interactions

Potentiates the effect of Midazolam and decrease the dose requirements of Propofol.

MATERIALS AND METHODS

The effect of lateral position on maintaining unilaterality of spinal anaesthesia and the effect of adding fentanyl to hyperbaric bupivacaine in achieving unilateral spinal anaethesia undergoing emergency lower limb surgeries on one limb was studied in 60 patients. The study was approved by the institutional research and ethics committee. The total number of patients are 60.They were divided into three groups.

Control Group - Received 2ml of 0.5% Bupivacaine and turned to Supine position immediately.

STUDY Group I - Received 1.5 ml of 0.5 % Bupivacaine with 25 µg(0.5 ml) Fentanyl and kept in lateral decubitus position for 10 mints and then turned supine.

STUDY Group II Received 2ml of 0.5 % Bupivacaine and kept in lateral decubitus position for 10 mints and then turned supine.

Inclusion Criteria

1. Patients between 18 to 80 years of age.
2. Patients belonging to ASA physical status III and IV
3. Undergoing emergency unilateral lower limb surgery.

Exclusion Criteria.

1. All Contra indication for central neuraxial block.
2. Patients who are not co-operative to positioning for subarachnoid block.
3. Patients with anomalies of the spinal column

Randomization

The patients were allocated into three groups by simple randomization using sealed envelope method.

Pre-operative preparation

The procedure was explained and the informed consent was obtained. When the patient reached the operating room monitors were attached which included electro cardiogram, noninvasive blood pressure and pulse oximetry.A wide bore cannula was inserted and the patient was pre loaded with 20 ml/kg of crystalloid solution. All base line vital parameters, were recorded.

The investigator was blinded to the drug as the study solution was prepared by an anesthesiologist who was not involved with the administration of spinal anaesthesia and in the monitoring of the patients. The procedure was done by the investigator on all patients to maintain uniformity of technique. Using 23gauge Quincke's spinal needle with the patient in lateral position (the side to be operated on as the dependent side) the drug was given after assuring free flow of CSF over 15 seconds. Patients were kept in the lateral position for 10 minutes after which the patient was positioned for surgery .Surgery was allowed to proceed

Assessment of the Patient and Recording of Data

The following variables were assessed and recorded in the operative and postoperative period. Heart rate, Systolic and Diastolic blood pressure was checked every three minutes and were recorded before the spinal and every five minutes for 60 minutes and in the recovery room and there after every 30 minutes till the time oral analgesic was given. Bradycardia was defined as heart rate less than 60/minute, and if the heart rate dropped below this, 0.6 mg of atropine was given intravenously. Hypotension was defined as drop in systolic blood pressure less than or equal to 30% which was treated with rapid infusion of crystalloid and / or 6mg of ephedrine was given intravenously, and repeated if necessary.

a. Side effects such as nausea, vomiting, and pruritus were recorded in the intra operative and post operative period.

b. Sensory blockade was assessed in the dependant as well as non- dependant limbs, Sensation was assessed using pin prick by a blinded observer. This was recorded every 5 minutes after positioning the patients for 60 minutes. The sensory levels were checked in the post operative period in the recovery room.

c. Motor blockade was assessed using Modified Bromage scale.

    0- no motar block at any of three joints of lower limb including hip, knee and ankle.

1- Movement blocked at any one joint .

2- Movement block at any two joints .

3- Movement blocked at three joints .

Both the dependant as well as non dependant limbs were assessed for the motor blockade at 0, 5, 10, 15 and every 5 minutes after positioning the patient.

d. Post operatively analgesia was studied using visual analogue scale in the recovery room and in the ward every 30 minutes. In the 10 cm visual analogue scale 0 corresponds to no pain and 10 the "worst imaginable pain" when the pain score was 5 or more rescue analgesic was given.

STATISCAL METHOD

The data analysis was done using SPS SPC + Software. Comparison of the means between the groups was done by Student t-test or chi sqare test.

REVIEW OF LITERATURE

Our knowledge about spinal anesthesia has been greatly increased since Dr Bier injected local anesthetic mixture into spinal canal to provide surgical anesthesia. Spinal anesthesia is used for wide variety of surgical procedures, necessitating variable levels of sensory block. The ability of the anesthesiologist to predict the height of sensory blockade is essential to provide adequate anesthesia with minimal side effects. Many factors can influence the degree of spread of local anesthetic solutions, including patient characteristics, physical properties of the cerebrospinal fluid, injection technique, and the dose and physical properties of the injectate. The baricity of the solution (Ratio of the density of the solution to the density of CSF) is the primary determinant of the spread of solution after injection. Unilateral spinal anesthesia can be considered as a further special technique, with particular field of application and advantages in the world of spinal anesthesia.

Casati A, Fanelli G, AldegheriG et *al.,*[7] conducted randomized, double-blind study to evaluate if use of unilateral spinal block affects the incidence of hypotension during spinal anaesthesia in 120 patients undergoing lower limb surgery .The found in the unilateral group, 31 patients (52%) showed a unilateral loss of cold sensation and 48 patients (80%) had no motor block on the non dependent side for the duration of study, whereas all conventional patients had bilateral distribution of spinal block(P < .0001). The onset time and two and the two segment regression of sensory block on the dependent side were more rapid in the conventional group (18 + / - 7 minutes and 60 + / - 18 minutes) than in the unilateral group (22+/-8 minutes and 67+/- 19 minutes) (P<. 05 and P<0.05, respectively). The incidence of hypotension (SAP decrease >30 % from baseline) was higher in the conventional (22.4 %) than unilateral group (5%) (P<0.01%). The maximum percentages changes from baseline values of systolic arterial blood pressure and heart rate were greater in conventional group (-28% +/- 16% and 19% +/- 10%) than in unilateral group (-8%+/-16% and 12%+/-18%) (P<.0001 and P<.01respectively). Their conclusion was achieving an asymmetric distribution of spinal block by injecting a small dose of 0.5% hyperbaric bupivacaine through a whit acre spinal needle into patients placed in the lateral position for 15 min reduces the incidence of hypotension during spinal anesthesia.

Teckleburg – weier E, Quest F *et al.,*[26] done Propective studies to sea the effect of patient positioning on the spread of sensory blockade in hyperbaric and isobaric spinal anesthesia using bupivacaine. Besides the patient position other factor may influence the cephalad spread of sensory blockade such as baricity of local anesthetics, speed of injection, dose, volume, barbotage and size of needle Pashalidou found that after a supine position for five or ten minutes, followed by trendelenburg position for 5 to 10 min, there were differences in the increase of sensory blockade. Their conclusion was the mean spread of sensory blockade with isobaric bupivacaine was 16.95 % segments [T6] after the 20 degrees of trendelenburg position the spread of blockade was increased by 16.95 segments.

A casati, B Borghi[7] conducted a study to evaluate the effects of low dose hyperbaric bupivacaine for unilateral spinal anaesthesia in 60 patients undergoing lower limb surgeries. They were placed in lateral position with the side to be operated on dependent. They concluded highly concentrated solutions of hyperbaric bupivacine are not advantageous in obtaining a unilateral spinal anasethesia when a small anasethetic dose is injected slowly through a whitacre spinal needle.

Imbelloni LE, *et al.*,[15] did study on unilateral spinal anesthesia with low 0.5% hyperbaric bupivanaine in 30 patients with physical status of ASA III-IV and undergoing lower limb surgeries day concluded that 0.5% bupivacaine has provided unilaterallity. 20 min were enough for blockade installation. Major unilateral spinal anesthesia advantages are hemodynamic stability, patients satisfaction and faster recovery.

Kristiina *et al.,*[16] studied the efficacy of a low dose of plain or hyperbaric bupivacaine for unilateral spinal anesthesia in 60 patients. Drugs were administered at L2- L3 interspace with the patient in the lateral position. Patients remained in this position for 20 min before being turned supine for the operation. Spinal block was assessed by pinprick and modified Bromage scale. They concluded the spinal anesthesia in both groups are suitable alternatives for adult outpatient knee arthoscopies, but hyperbaric bupivacaine provides more unilateral spinal block.

Frank A et al[10] studied the influence of positioning on the quality of unilateral spinal anesthesia. Unilateral spinal anesthesia ("hemi-spinal") is theoretically associated with the advantages of fewer cardiovascular effects and longer duration of action while offering high density motor block of the extremity affected. They conducted prospective randomized study 60 patients received 2 ml of 4% hyperbaric mepivacaine intrathecally. Group I(n = 30) was returned into the supine position after 5 min in the lateral position, Goup II (n = 30) was kept in the lateral position for 15 min. Spread and subsequently offset of sensory and motor block were assessed separately for each side at predetermined time intervals pre - , intr -, and postoperatively. The mean cephalad spread of sensory block of the initially depended side was T6 after 15 min and T4 after 25 min. On the initially non-dependend side, the sensory block reached to T5 after 25 min.In the study group (hemi spinal) initial mean difference was equivalent to two segments. After 25 min there was no difference to the results in control group. They concluded hemi-spinal is an attractive concept, supposed to be associated with the advantages and the additional benefits of partially maintained sensation of one limb.

In 1961 **Tanasichuk**[25] and colleagues described a particular technique of spinal anesthesia in patients receiving one limb orthopedic surgery, which was named as spinal hemi analgesia. The distance between the left and right spinal nerve roots is only 10-15mm in the lumber or lower thoracic level, such a small distance should reasonably prevent from producing strictly unilateral block of spinal nerve roots. However, various clinical reports suggested that using small doses of either hypo or hyper baric anesthetic solutions injected at low speeds through directional needles in patients lying in the lateral decubitus position for 15-30 min, results in a preferential distribution of spinal anesthesia toward the operated side, providing surgical block on this side.

Guido Fanelli, Battista Borghi, Andrea Casati, Laura Bertini[9] did a study on behalf of the Italian study Group on unilateral Spinal anaesthesia done using the unilateral spinal technique in 100 patients. It showed a slower and more restricted spinal block in the dependent leg. It produced a more stable cardiovascular profile in patients with unilateral spinal with a decrease in the need for vasopressor to treat hypotension. Similar results have been reported in previous investigations, which demonstrated that unilateral spinal block reduced the haemodynamic effects of spinal anesthesia when small amount of small doses of hyperbaric bupivacaine 0.5% were used.

Tarasichuk *et al*.[25] reported that the most important advantage of unilateral spinal anesthesia is its haemodynamic stability, they reported that incidence of hypotension cases undergoing unilateral anesthesia was 18% , whereas it was 50% in patients undergoing bilateral spinal anaesthesia below tenth thoracic dermatome. They reported that hypotension was related to the age of the patients, preoperative physical status and the sensory level.

Fenelli G[9]**,** When deciding for an anesthetic technique, the most important issue should be the evaluation of the final outcome of the paient (mortality, morbidity, time to complete social recovery, etc), which can dramatically change the balance between risk and benefit of a certain technique. Unfortunately these outcomes are very difficult to evaluate and few information's are actually available on unilateral spinal anesthesia demonstrated in his study the cardiovascular advantages of unilateral spinal anesthesia might be particularly useful in elderly patient, with poor ASA physical status. It has been reported that older patients and those who are more ill are also more likely to be administered regional anesthesia, in these patients the use of a restricted spinal block could theoretically minimize the cardiovascular effects and might have some beneficial effects on patients management and preoperative morbidity.

M.M.Atallah,A.A.Shorrab,Y.M.Abdel Mageed *et a*[11] did a randomized study in 108 patients to see the efficacy of bupivacaine alone and bupivacaine with fentanyl in maintaining reliable neuraxial block,maintaining stable hemodymaics and good post operative analgesia and conculeded that bupivacaine with fentanyl will improve the quality of anesthesia

Battista Borghi, MD, Andrea Casati *et al.,*[2] did a randomized control study to compare unilateral and conventional bilateral bupivacaine spinal block in outpatients undergoing knee arthroscopy they found Sensory and motor blocks on operated limb were T9 (T12-T2) with a Bromage score 0/1/2/3; 0/2/0/45 in the unilateral group and T7 (T12-T1) with Bromage score 0/1/2/3/36 with bilateral block (P=0.026 and P=0.016, respectively. Vasopressor was required only in five bilateral patients (P=0.02). Two segment regression of sensory level and home discharge required 81 ± 25 min and 281 ± 83 min with bilateral block, and 99 ± 28 min and 264 ± 95 min with unilateral block respectively. There conclusion was seeking unilateral distribution of spinal anesthesia provided more profound and longer lasting block in the operated limb, less cardiovascular effects, and similar home discharge compared with bilateral spinal anaesthesia.

Helsinki[12] did a prospective randomized study in 60 patients undergoing out patients knee arthroscopy to find out whether the speed of intratheacal injection and lateral position facilitates unilateral distribution of spinal anaesthesia. They compared the effects of playing and hyperbaric bupivacaine in attempting to obtained unilateral spinal anaesthesia for patients undergoing knee arthroscopy. Spinal block was assessed by pin prick and modified Bromage scale and compared between the dependent and non dependent limb. There was a significant difference between the dependent and non dependent limbs at all times but a more unilateral block was achieved with hyperbaric bupivacaine. They concluded that hyperbarick bupivacaine was better than the plane bupivacaine in maintaining unilaterality.

Kuusniemi KS, Pihlajamaki KK, Pitkanen MT[17] did a randomized study whether the speed of injection and lateral position low dose of anaesthetic solution pencil point needle facilitated the production of unilateral spinal anaesthesia. Spinal block was assessed using pin prick and modified Bromage scale there was a significant difference between the dependent and non dependent limbs at all times but a more unilateral block was achieved with hyperbaric bupivacaine. They concluded that hyperbarick bupivacaine was better than the plain bupivacaine in maintaining unilaterality.

Clinton Z. Kakazu et *al*.,[8]did a randomized double blind study on five different bupivacaine concentrations diluted with fentanyl.A hand held refractometer with an accuracy of 0.001 was used to measure specific gravity. he concluded that addition of fentanyl alters baricity and hence increases the height of blockade

RESULTS

Demographic Data

There were 60 patients in this study. Each group consisted of 20 patients. Patients characteristic for age, sex, height were comparable in all three groups. This is shown in Table I, Table II and Table III.

Table I. The distribution of patients according to age were similar in all three groups

Age (Years)	Number of Patients		
	Control Group	Study Group I	Study Group II
17-26	3	1	1
26-36	3	1	1
37-46	7	2	4
47-56	3	5	4
57-66	4	11	10

P- Values control group I and Group II = 0.879 (Not significant)

P- Values control group I and Group II = 0.486 (Not significant)

Table II Depicts the distribution of males and females in all three groups were similar.

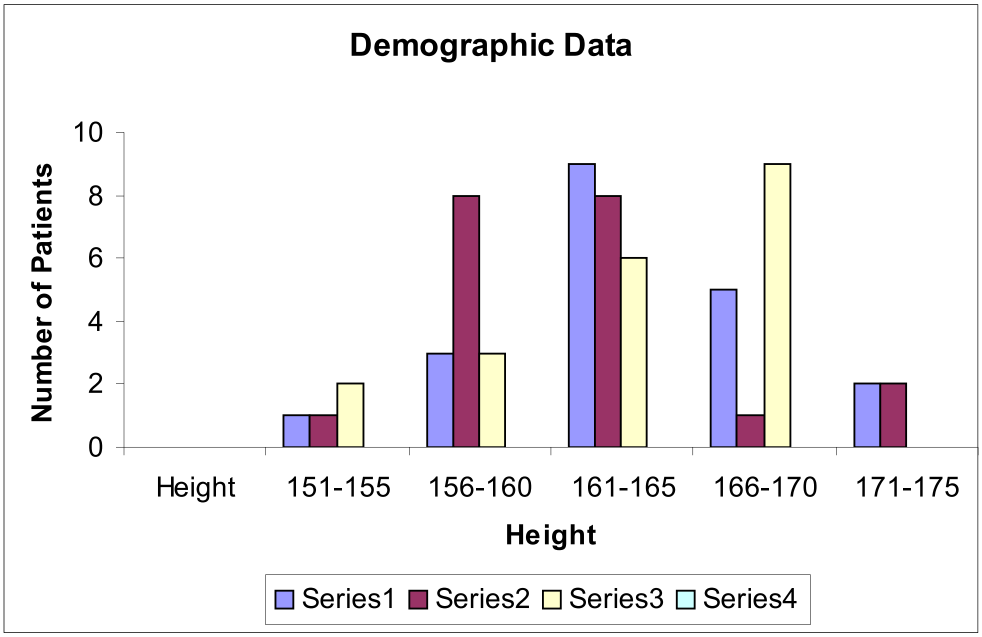
Sex	**No of Patients**			
	Control	Study Group I	Study Group II	P value of control and study Group I & 0.675(NS) P value of control and study Group II & 0.25(NS)*
Female	8 (40%)	10 (50%)	7 (35 %)	
Male	12 (60%)	10 (50%)	13 (65%)	

* NS –Not Significant

Table III. Distributions of Height in all three Groups Studied were similar.

Height	**Control Group**	**Study Group 1**	**Study Group II**
151 – 165	1	1	2
156-160	3	8	3
161 –165	9	8	6
166 –170	5	1	9
171 – 175	2	2	0
Total	20	20	20

The demographic data reveals that all 3 groups are comparable on height, weight and sex ratios. There is no statistically significant difference between the groups with regard to demographic data.



Haemodynamics (Heart Rate,Blood pressure)

Haemodynamics (Heart Rate)

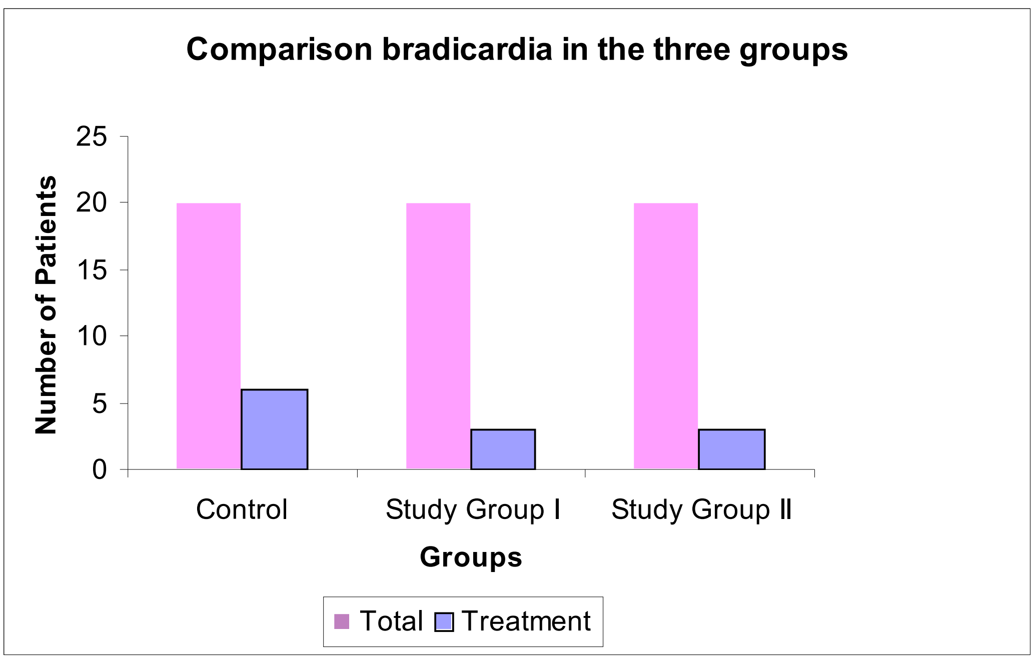
Table IV shows the comparison of heart in the three groups.

Groups	Control Group	Study Group I	Group II
Total	20	20	20
Bradycardia with treatment	6	3	3
Percentage	30	15	15

P = 0.02 (statistically significant)

Bradycardia – Heart rate < 60 beats /min

Heart rate comparison revealed that the occurrence of bradycardia requiring treatment was more in control group (30%) versus the study group I (15%) and study group II (15%). This difference was found to be statistically significant. Unilateral spinal and low dose final with bupivacaine with fentanyl produced haemodynamic stability as evidence by decreased incidence of bradycardia compared to that of control group.



Haemodynamics (Blood pressure)

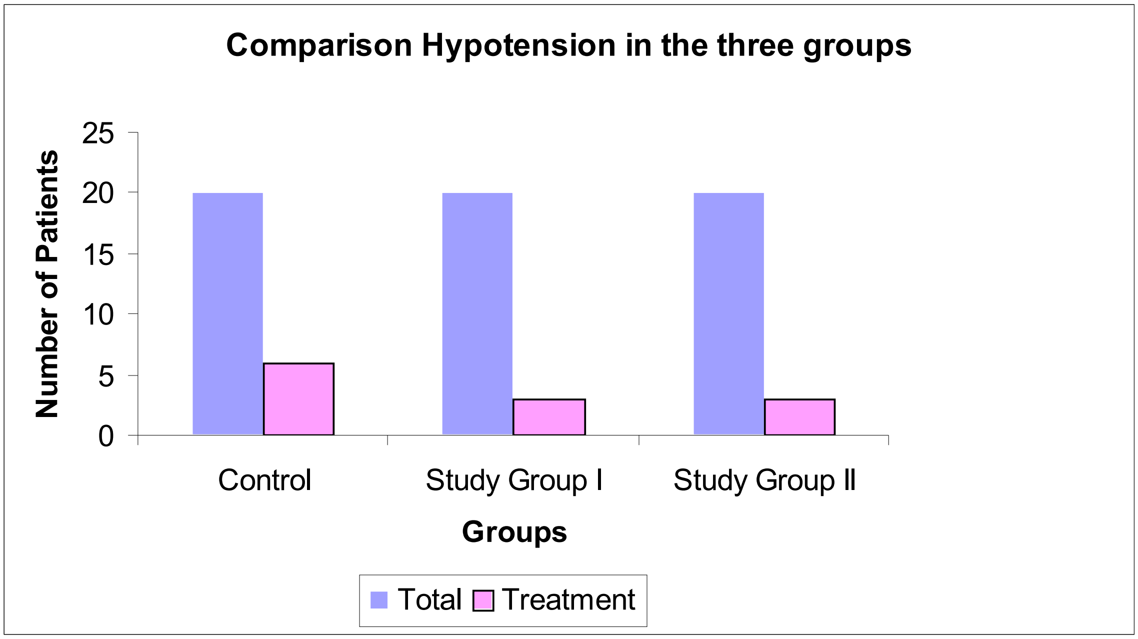
Table – V shows the comparison of Hypotension in the three groups.

Groups	Control group	Study group I	Study group II
Total	20	20	20
Hypotension with treatment	6	3	3
Percentage	30	15	15

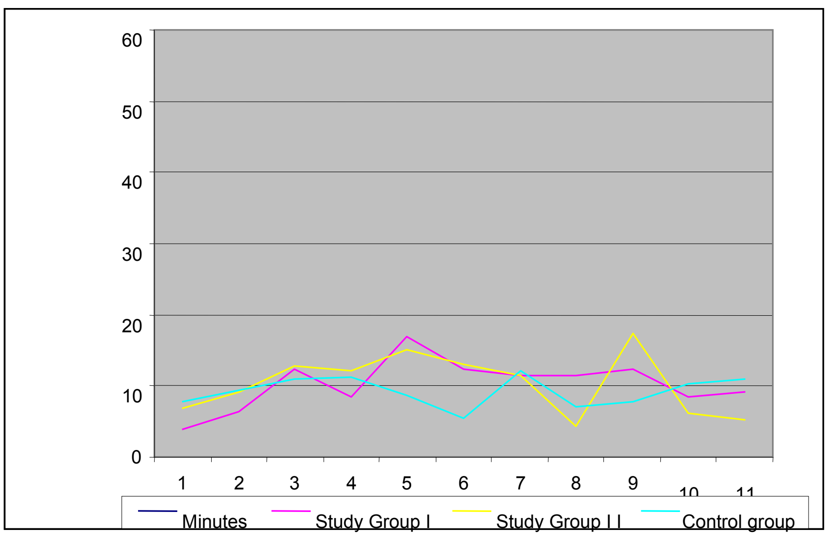
P = 0.02 (statistically significant)

Hypotension – Systolic drop of blood pressure more than30 %

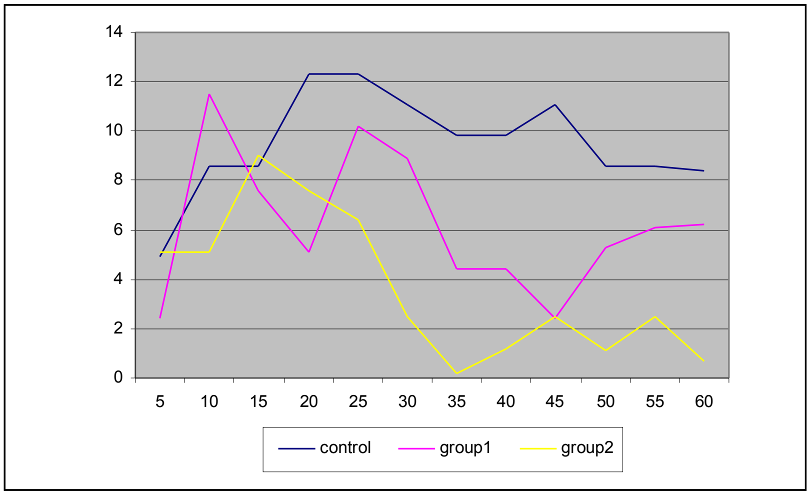
Hypotension comparison revealed that the occurrence of hypotension requiring treatment was more in control group (30%) versus the study group I (15%) and study group II (15%). This difference was found to be statistically significant. Unilateral spinal and low dose final with bupivacaine with fentanyl produced haemodynamic stability as evidence by decreased incidence of bradycardia compared to that of control group.



Percentage variation of systolic blood pressure in the groups studied



Percentage variation of diastolic blood pressure in the groups studied



Motor Blockade

Table VI Shows comparison of motor blockade in all three groups

	Dependent					Non-dependent			
At 15 minutes	Bromage Scale	0	1	2	3	0	1	2	3
	Control group	0	0	3	17	0	1	4	15
	Study group 1	1	0	7	12	6	7	2	5
	Study group 2	2	0	7	11	8	2	4	6
At 30 minutes	Control group	0	0	3	17	0	1	4	15
	Study group 1	1	0	7	12	4	7	3	6
	Study group 2	2	0	7	11	6	3	3	8
60 minutes	Control group	0	0	0	20	0	2	6	12
	Study group 1	0	0	8	12	4	5	3	8
	Study group 2	0	0	8	12	6	2	4	8

An analysis of motor blockade in the 3 groups showed that unilateral spinal block and low dose spinal block introduced lesser degree of motor blockade when compared to the classical

Subarachnoid Block group. This difference was found to be statistically significant.

MOTOR BLOCKADE

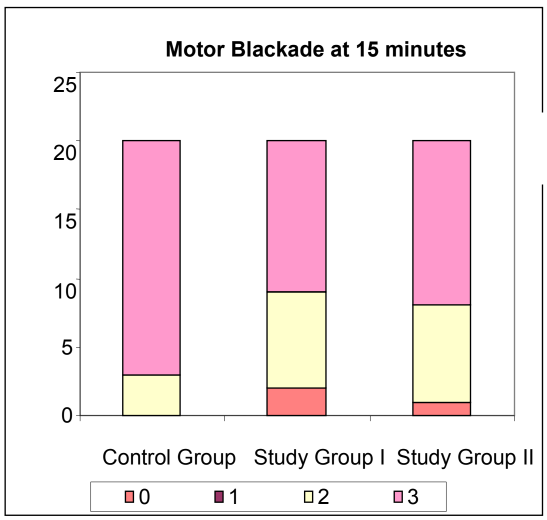
Motor Blockade at 15 minutes Dependent

Motor Blockade at 15 minutes Non Dependent

Bromage	Control Group	Study Group I	Study Group II
0	0	2	1
1	0	0	0
2	3	7	7
3	17	11	12

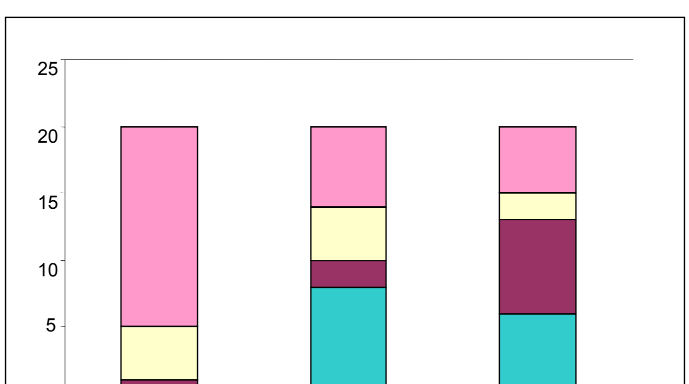
	Control Group	Study group I	Study Group II
0	0	8	6
1	1	2	7
2	4	4	2
3	15	6	5

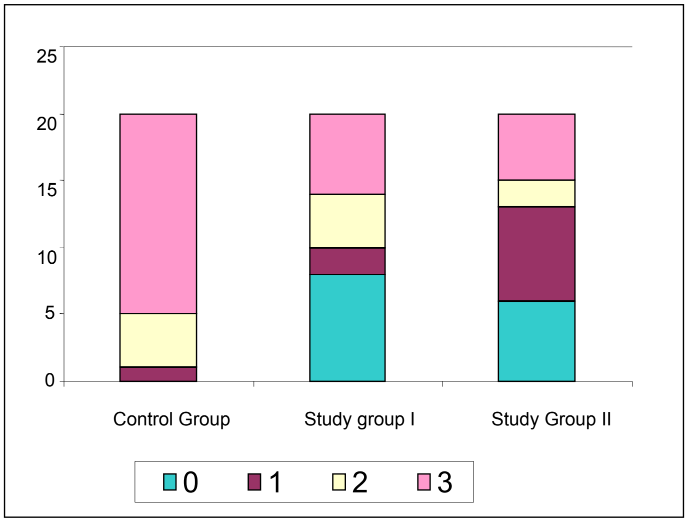
MOTOR BLOCKADE AT 15 MINUTES



DEPENDENT

NON-DEPENDENT





MOTOR BLOCKADE

Motor Blockade at 60 minutes

Dependent

Motor Blockade at 60 minutes

Non Dependent

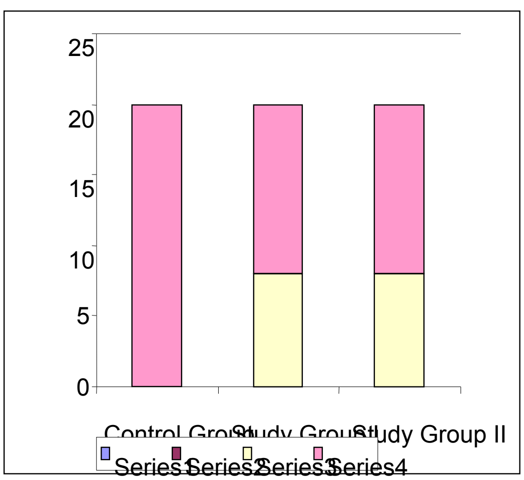
Bromage	Control Group	Study Group I	Study Group II
0	0	0	0
1	0	0	0
2	0	8	8
3	20	12	12

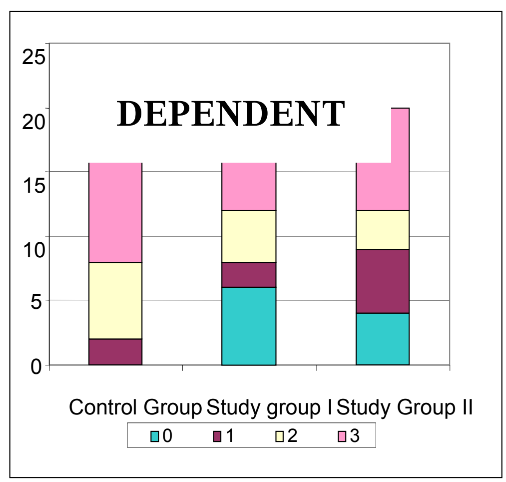
	Control Group	Study group I	Study Group II
0	0	6	4
1	2	2	5
2	6	4	3
3	12	8	8

An analysis of motor blockade in the 3 groups showed that unilateral spinal block and low dose spinal block introduced lesser degree of motor blockade when compared to the classical Subarachnoid block group. This difference was found to be statistically significant.

In the study group 1 and 2 the onset of motor blockade was faster and the degree of motor blockade was more in the dependant limb when compared to the nondependent limb. This difference was also found to be statistically significant.

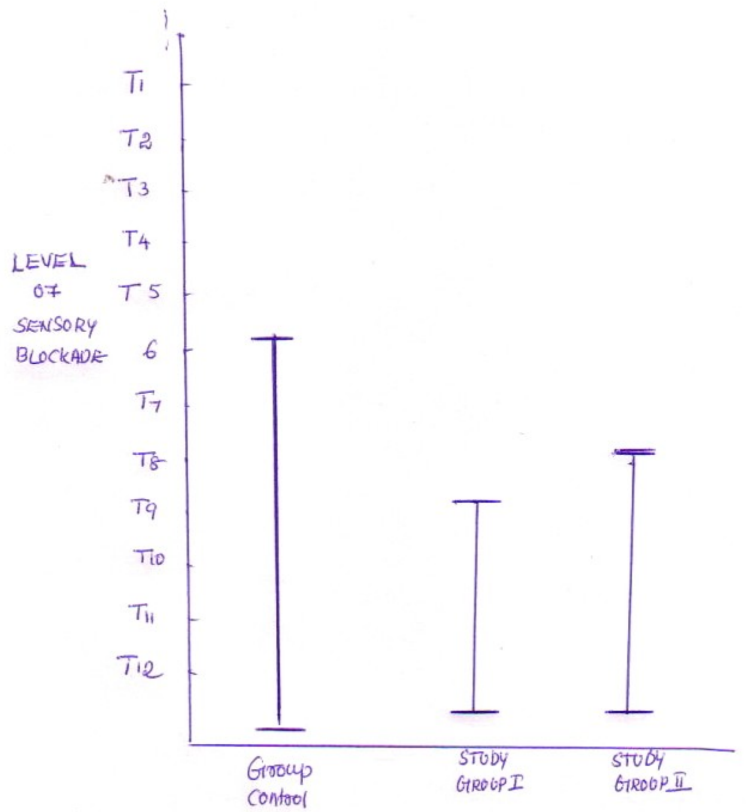
MOTOR BLOCKADE AT 60 MINUTES





NON-DEPENDENT

SENSORY BLOCKADE



The level of block in control group extended between T_6 to L_1. In the study group I the block extended between T_9 – T_{12}. In the study group II the block extended between T_8 and T12. The median level of block was between T_9 – T_{10} in all 3 groups.

There was no statistical difference in the level of sensory blockade.There was also no statistical difference in the onset time, two space regression times between the groups.

DISCUSSION

This prospective randomized study was done in 60 high risk patients of ASA III and IV category with co morbid factors and potential for haemodynamic instability were drafted into the study. The practicality of producing a unilateral spinal block and in ability to reduce haemodynamic instability was studied. The ability of a low dose bupivacaine subarachnoid block in combination with fentanyl in maintaining a unilateral spinal block and its ability to decrease haemodynamic alteration was also studied.

UNILATERAL SPINAL ANAESTHESIA

After performance of Subarachnoid block in the lateral position (operated limb kept dependant), patients were maintained in the lateral position for 15 minutes before turning them supine.

In this study the onset time for loss of pin prick sensation at T_{10} in both the limbs was similar between 5 to 7 minutes. This was similar to the onset time of block with classical subarachnoid technique. **Caseti A, Fanelli G**[7] et al found onset times in dependant limb to be more rapid when compared to non-dependant limb. In this study we were not able to demonstrate any obvious difference in onset times.

SENSORY BLOCK AND ONSET TIME

In this study the sensory block had a wide variation in the upper level of block between the dependant and non dependant limb at 15 minutes. But with the passage of time this difference was narrowed or obliterated. But in all the 3 groups.

The median level of block was between $T_9 - T_{10}$ in all 3 groups. The level of block in control group extended between T_6 to L_1. In the study group I the block extended between $T_9 - T_{12}$. In the study group II the block extended between T_8 and T_{12}.

A Casati, G. Fanelli[7] et al in their study demonstrated a difference in maximum sensory block achieved between the 2 limbs. On the dependant limb the block extended between L_1 to T_2 with a mean of T10 and on the non dependent limb extended between T_6 to L_2 with a mean of T_{12}.

In our study there was no statistical difference in level of sensory blockade between the dependant and non dependant leg. The initial difference observed between the 2 limbs due to maintenance of lateral position is lost to a great extent on assumption of the supine position.

Motor Block

An analysis of motor blockade in the 3 groups showed that unilateral spinal block and low dose spinal block introduced lesser degree of motor blockade when compared to the classical Subarachnoid block group. This difference was found to be statistically significant.

In the study group 1 and 2 the onset of motor blockade was faster and the degree of motor blockade was more in the dependant limb when compared to the nondependent limb.

This difference was also found to be statistically significant.

B**attista Borghi**[2] et al found that sensory block in dependent was T9 in unilateral block and T7 in bilateral block. In our study there was no statistically significant difference in sensory block between the 2 limbs with average sensory blocks in both limbs being T10.

Borghi[2] et al also demonstrated a difference in motor block between the dependant and non dependant limbs. They recorded a Bromage score of 0/1/2/3 of 0/2/3/45 in unilateral group in the dependant limb and Bromage score of 0/1/2/3/36 in the classical subarachnoid block.

In our study we recorded a Bromage scale on the operated limb with classical sub arachnoid block 0/1/2/3 as 0/0/3/17. There was no difference between the 2 limbs.

In study group I on the dependent limb Bromage score were 2/0/7/11 and in the non dependent limb 8/2/4/6.

In the study group II the dependent limb had bromage score of 1/0/7/12 and in the non dependent limb had score of 6/7/2/5. These difference were statistically significant and they concur with findings recorded in the study of Borghi et al.

Two Space Regression

Casati A, Fanelli G[7] in their study demonstrated more rapid two spacre regression of sensory block on the dependent limb when compared to the non – dependent limb. In our study we were unable to demonstrate any statistically significant difference between the three groups studied and also between the dependent and non dependent.

HAEMODYNAMIC STABILITY AND COMPLICATIONS

In our study haemodynamic stability as evidenced by systolic blood pressure, diastolic blood pressure and mean arterial blood pressure was comparable between study group I and II.. Three patients had hypotension of more than 30% from base line values that required treatment. Control group had higher incidence of both hypotension and bradycardia with 6 patients requiring treatment with vasopressors,and fluids(crystalloid/colloids) for both these complications.

Casati Fanelli[7] et al reported a higher incidence of hypotension in classical group (22.4%) than unilateral group (5%). The change in systolic blood was -28% ± 16% in classical group and -8% ± 11% in unilateral group. Heart rate variation in their study was -19% ± 10% in classical group and -12% ± 18% in unilateral group.

In our study classical group showed greater fall in blood pressure and heart rate than the unilateral group. Study group I and II had lesser incidence of haemodynamic problems. These differences were also found to be statistically significant.

MOTOR BLOCKADE

Analysis of motor block was done using Modified Bromage Scale both in the dependent and non dependent limb exclusively.

The control group had maximum degree of motor blockade with 17/20 patients having grade 3 motor blockade in both limbs. Study group I had grade III motor blockade in 11/20 patients and the study group II had motor blockade of 3 in 12/20 patients. From this study it was found that the unilateral spinal and low dose spinal anaesthesia decrease the degree of motor blockade which was statistically significant analysis was done to see if there is any difference in the degree of motor blockade between the two limbs (dependent vs non dependent, where applicable). Comparisons were made at 15, 30 and 60 minutes interval. Grade II and III of modified Bromage scale were considered as significant motor blockade of limb. Based on these parameters the following observations were made.

Control Group

This group showed no statistically significant difference in motor blockade between the limbs. Establishment and regression of motor blockade as recorded at 15 mins and 60 mins also were matched between the two limbs.

Study Group I

This group showed a statistically significant difference in motor blockade between the two limbs at 15 mins. Significant motor blockade in dependant limb was 17/20 and in non dependent limb was 10/20. At 60 mins significant motor blockade in the dependent limb was 20/20 and in the non dependent limb was 12/20.

Study Group II

This group showed statistically significant motor block on dependent limb 19/20 versus the non dependent limb 7/20 at 15 minutes. This reflects that onset time is faster and denser in the dependent limbs. At 60 mins the dependent limb had significant motor blockade of 20/20 while in the non dependent limb motor blockade was 11/20. So as the time elapsed the differential blockade obtained between the two limbs seems to have reduced probably reflecting slow spread of local anaesthetics to the non dependent limb also on assumption of supine position.

The mechanism and distribution of motor blockade in study group I and II were comparable and same principle of unilaterality of block operating in both the groups.

Sensory Block

a) Sensory blockade was assessed in the dependant as well as non- dependant limbs, Sensation was assessed using pin prick by a blinded observer. This was recorded every 5 minutes after positioning the patients upto 60 minutes. The sensory levels were checked in the post operative period in the recovery room.

In control group the sensory block extended between T6 – T12 with median being T9-T10. The study group I the block extended between T9 - T12 with the median of T10. In the study group II the block extended between T8 – T12 with the median of T10. This was not statistically significant. Four out of forty patients in the unilateral group (Study group I and II) had no sensory loss in the non dependent limbs. It was also not statistically significant.

b) **Onset time for 2 space regression**

There was no difference in onset time between the 3 groups with average onset time of 5 to 7 mins for abolition of pin prick sensation at T10 level there was no difference in 2 space regressions times between the 3 groups and also between the dependent limb and non dependent limb in the 3 groups.

SUMMARY

This prospective randomized study was done to compare the efficacy of classical subarachnoid block using 0.5% bupivacaine, unilateral spinal anesthesia using 0.5% bupivacaine and low dose spinal anesthesia using 0.5% bupivacaine 1.5 ml with 0.5 ml of fentanyl (25 micro grams) in sixty high risk patients undergoing emergency unilateral lower limb surgeries.

This study yielded the following results

1) Unilateral spinal anaesthesia can be produced by using small volume of hyperbaric local anaesthetic , slow injection of drugs and maintaining the patient in lateral position with the operated limb being dependant.
2) Unilateral spinal anaesthesia produces higher level of sensory block on dependant limb when compared to non-dependant limb.
3) Unilateral spinal anaesthesia produces higher level and greater degree of motor block on dependant when compared to non-dependant limb.
4) Unilateral spinal anaesthesia is more haemodynamically stable in high risk sick patients when compared to classical subarachnoid block.
5) Classical Subarachnoid block produces more haemodynamic complications (hypotension and bradycardia) which requires treatment..

6) Low dose Bupivacaine with Fentanyl subarachnoid block may lead to alteration in baricity / specific gravity of the solution. This however does not decrease the differential blockade between the two limbs.

7) The low dose Bupivacaine with Fentanyl Subarachnoid block is a more haemodynamically stable option in high risk patients.

8) The onset time and time for two space regression is not different among the three groups.

9) The biggest limitation to the production of unilateral subarachnoid block is the inability of the patients to lie in the lateral position for 10 minutes.

10) Time consideration for production of unilateral Subarachnoid block may be a restraining factor in emergency surgeries. The patient should be maintained strictly in lateral position with the limb to be operated kept dependant for at least 15 minutes to achieve unilateral block.

CONCLUSION

From this study we can conclude that in high risk patients undergoing emergency unilateral lower limb surgeries.

1) Unilateral low dose Subarachnoid block offers better haemodynamic stability during the intra-operative period.

2) The onset, quality and duration of block matches those produced by classical subarachnoid block.

3) It is possible to produce unilateral subarachnoid block by maintaining patients in lateral position for 10 minutes.

BIBLIOGRAPHY

1) Atallah MM, Shorrab AA, Abdel Mageed YM, and A.D. Low – dose bupivacaine

2) Spinal anaesthesia for percutaneous nephrolithotomy; the suitability and imapact of adding intrathecal fentanyl 2006 ; 50 ; 798.

3) Borghi B, Fanelli G, Cappelleri G, Casati A Borghi B, Cedrati V and Torri G. Low dose Hyperbaric bupivacaine for unilateral spinal anaesthesia.

4) Brooker RF, Butterworth JF , et al. Treatment of hypotension after hyperbaric tetracaine spinal aneshthesia. Anesthesiology 1997; 86; 797 - 805.

5) Carr DB, Cousins MJ. Spinal route of analgesia, Opioids and future options. Ins; Cousins MJ. Bridenbaugh PO, Eds. Neral Blockade in clinical anesthesia and management of pain. 3rd ed. Philadelphia; Lippincott – Raven, 1998;915-975.

6) Chambers, WA Edstrim , HH , and Scott, DB , effect of baricity on spinal anaesthesia with bupivacaine Br.J.Anaesth, 53 1981 53; 279.

7) Carpenter RL, Liu S S.et al. Lumbosacral CSF volume is the primary determinant of sensory block extent and duration during spinal anesthesia. Anesthesiology 1998; 89 ; 24 -9.

8) Casati A, Fenelli G, etal. Effects of speed of intrathecal injection on unilateral spinal block .

Minerva Anesth.1999; 65; 5-10.

9) Clinton Z , Kakazu, Chingmuh L and Mc Donald JS. Addition Fentanyl alters the barcity of hyperbaric spinal bupivacine . Anesthesiology 2004; 101 ; A1071.

10) Fanelli G, Torri G, Bilateral Versus unilateral selective subarachnoid anesthesia ; cardiovascular homeostasis. Br J Anaesthesia.1996; 76 ; A242.

11) Frank A, Schuster M and Biscoping J. Influence of positioning on the quality of unilateral spinal anesthesia.*Reg Anesth Pain Med.* 2000 ; 25 (6) ; 605 – 610.

12) Gentili ME, Mamalle JC, et al. Combination of low dose bupivacaine and clonidine for unilateral spinal anesthesia in arthroscopy knee surgery. Reg Anesth 1995; 20 ; 169 – 70.

13) Hel sinki, Finland hyperbaric bupivacaine for unilateral spinal block.Reg Anesthisia Pain medicince 2000 ; 25:605-610.

14) Holman S J, Robinson R A, et al. Hyperbaric Dye solution Distribution characteristics after pencut point needle injection in a spinal cord model Anesthesiology 1997 ; 86 ; 966 – 73.

15) Harbhel Singh, Jay Yang - Intrathecal Fentanyl prolongs sensory bupivacaine spinal block. Can J Anesth.1995/42 : 11/987 -91.

16) Imbelloni, Unilateral spinal anaesthesia with low0.5% hyperbaric bupivacaine dose.Rev.Bras.Anaesth.Vol.54.september 2004.

17) Kristiina S, Kuusniemi MD, Kalevi K, Pihlajamaki and Mikko TP. A low dose of plain or hyperbaric bupivacaine for unilateral spinal anes *Anasthesiol Intensivmed Notfallmed Schmerzther*. 2002; 37(11) ; 659 – 654

18) Kuusniemi KS, Pihlajamaki KK and Pitkanen MT. A low dose of plain or hyperbaric . Bupivacaine for unilateral spinal anesthesia. *Reg Anesth Pain Med* 2004; 29 (1); 17-22.

19) Neigh JL, Kane PB, Smith TC, Effects of speed and direction of injection on the level and duration of spinal anesthesia. Anesth Anal.1970; 49 ; 912-8.

20) Pitkanen M.Slow injection of 0.5% plain bupivacaine increases level. Reg Anesth.1992 ; 17/26: 35-38.

21) Povey H M R, Jacobsen J, et al. Subarachnoid analgesia with hyperbaric 0.5% bupivacaine : effect of a 60min period of sitting. Acta Anaesthesiol Scand 1989; 33; 295-7.

22) Pitkanen M.Slow injection of 0.5% plain bupivacaine increases level. Reg Anesth.1992 ; 17/26: 35-38.

23) Serpell MG, Gray W. Flow dynamics through spinal needles. Anesthsia 1997; 52:229-36.

24) Stienstra R, Gielen M, Kroon J W, van Poorten F. The influence of temperature and speed of injection on the distribution of a solution containing bupivacaine and methylene blue in a spinal canal model.Reg Anesth 1990; 15: 6-11.

25) Spener S,Liu MD- Current Issue in spinal anesthesia. Anesthesiology ; 2001 ; 94 : 886 -88.

26) Tanasichuk MA, ShultzEA, etal. Spinal Hemianalgesia, an evaluation of a method and its applicability. Anesthesiology 1961,22:74-85.

27) Tecklenburg WE , Quest F, Nolte H and Meyer J. The effect of patient positioning on the spread of sensory blockade in hyperbaric and isobaric spinal anesthesia using bupivacaine.

28) Whiteside JB , Burke and Wildsmith AW . Spinal anaesthesia with ropivacaine 5mg ml in glucose 10 mg ml or 50mg ml. *Brt Jour Anesth* 2001; 86(2) 241-244.