"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES: A RANDOMIZED COMPARATIVE STUDY."

Dissertation submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment for the award of the degree of

DOCTOR OF MEDICINE
IN
ANAESTHESIOLOGY
BRANCH X

INSTITUTE OF ANAESTHESIOLOGY AND CRITICAL CARE

MADRAS MEDICAL COLLEGE CHENNAI- 600003

APRIL 2020

REGISTRATION NO.201720017

CERTIFICATE OF THE GUIDE

This is to certify that the dissertation titled **"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES: A RANDOMIZED COMPARATIVE STUDY."** is a bonafide research work done by **Dr.K.VENKATESH** in partial fulfilment of the requirement for the degree of DOCTOR OF MEDICINE in Anaesthesiology.

Prof. Dr. ANURADHA SWAMINADHAN, M.D,D.A

Professor in Anaesthesiology,

Director, Institute of Anaesthesiology and Critical Care,

Madras Medical College, Chennai-3

Date:

Place: Chennai

CERTIFICATE

This is to certify that the dissertation titled, **"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES: A RANDOMIZED COMPARATIVE STUDY."** Submitted by **Dr.K.VENKATESH** in partial fulfilment for the award of the degree of **DOCTOR OF MEDICINE in Anaesthesiology** by The Tamilnadu Dr.M.G.R Medical University, Chennai is a bonafide record of work done by him in the **INSTITUTE OF ANAESTHESIOLOGY & CRITICAL CARE, Madras Medical College**, during the academic year 2017 -2020.

Prof.Dr.ANURADHA SWAMINATHAN, MD., DA.,
Professor and Director,
Institute of Anaesthesiology & Critical Care,
Madras Medical College,
Rajiv Gandhi Govt. General Hospital,
Chennai – 600003.

Prof.Dr. R. JAYANTHI, M.D., F.R.C.P. (Glasgow)
The Dean,
Madras Medical College,
Rajiv Gandhi Govt. General Hospital,
Chennai – 600003.

DECLARATION

I hereby declare that the dissertation titled, **"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES: A RANDOMIZED COMPARATIVE STUDY."** has been prepared by me under the guidance of **Prof. Dr. ANURADHA SWAMINATHAN, MD., DA., Director & Professor, INSTITUTE OF ANAESTHESIOLOGY AND CRITICAL CARE, MADRAS MEDICAL COLLEGE, CHENNAI** in partial fulfilment of the regulations for the award of the degree of **M.D (Anaesthesiology)**, examination to be held in May 2020. This study was conducted at **INSTITUTE OF ANAESTHESIOLOGY AND CRITICAL CARE, MADRAS MEDICAL COLLEGE, CHENNAI.**

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

Dr.K.VENKATESH

Date:

Place: Chennai

ACKNOWLEDGEMENT

I am extremely thankful to **Prof. Dr. R. JAYANTHI M.D., FRCP (Glasgow), Dean, Madras Medical College**, for her permission to carry out this study.

I am immensely grateful to **Prof. Dr. ANURADHA SWAMINATHAN, M.D., D.A., Director and Professor, Institute of Anaesthesiology and Critical Care**, for her concern, support, inspiration, meticulous guidance, expert advice and constant encouragement in doing and preparing this dissertation.

I am extremely thankful to my Assistant Professors **Dr. ASHOK KUMAR M.D., FIPM** and **Dr. A. GANESH M.D.** for their constant motivation and valuable suggestions in doing my study.

I am thankful to **Dr. N. DEEN MOHAMED ISMAIL MBBS, Dip (Orthopedics), MS, Director, Institute of Orthopedics and Traumatology** for permitting me to conduct this study in patients.

I am thankful to the Institutional Ethical Committee for their guidance and approval for this study.

I wish to thank all the faculty especially of Institute of Anaesthesiology and Critical Care for their aid and encouragement during the study.

I thank the staff nurses and theatre personnel, Madras Medical College, for their cooperation and assistance.

I am grateful to my family and friends for their moral support and encouragement.

Lastly I am greatly indebted and thankful to all the patients and their family members for willingly submitting themselves for this study.

ABBREVATIONS

OA	-	Osteoarthritis
TKA	-	Total knee Arthroplasty
THA	-	Total hip Arthroplasty
USG	-	Ultrasonography
LA	-	Local Anaesthetics
LB	-	Liposomal Bupivacaine
LIA	-	Local Infiltration Analgesia
ACB	-	Adductor Canal Block
VAS	-	Visual Analogue Scale
TUG	-	Timed Up and Go test
WDR	-	Wide Dynamic Range
ACC	-	Anterior Cingulate Cortex
IC	-	Insular Cortex
DI	-	Descending Inhibition pathway
DF	-	Descending Facilitation pathway
PAG	-	Periaqueductal grey
RVM	-	Rostral Ventromedial Medulla
LAST	-	Local Anaesthetics Systemic Toxicity
CPR	-	Cardio-Pulmonary Resuscitation
PCA	-	Patient Controlled Analgesia
FNB	-	Femoral Nerve Block
PAI	-	Peri-Articular Infiltration
POD	-	Post-Operative Day

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Osteoarthritis of knee is a common condition especially affecting the elderly population. Total Knee Arthroplasty (TKA) is the present gold standard treatment for management of severe OA Knee. As elderly population is increasing in our country TKA has become a common surgical procedure. TKA is associated with extensive tissue damage and excruciating pain. Good strategy for post-operative pain management without affecting the patient's ability to mobilise and minimal side effects of treatment is required for more rapid functional recovery, reduction in length of stay in the hospital. Recent study by Pinedo-Villanueva R et al [2] found 20% patients report chronic pain following TKA. Risk factors for chronic pain include poor management of pain in the intra-operative and acute post-operative period. So post-operative pain management is of paramount importance in patients undergoing TKA to reduce the incidence of chronic pain.

Opioid based post-operative pain management was the main stay of treatment. The wide spread usage of regional anaesthesia has reduced the post-operative opioid consumption and its adverse effects like post-operative nausea, vomiting, respiratory depression, opioid addiction and dependence. It has played a major positive role in effective post-operative pain management, early functional

recovery and reduced hospital stay. However epidural anaesthesia which was used in many institutions provided good pain control but adverse effects such as excessive motor block, total spinal, cauda equine syndrome and CNS infection due to indwelling catheter etc. limited its usage.

Femoral nerve block has shown to provide pain relief equivalent to epidural technique without the adverse effects associated with the central neuroaxial blockade [34]. Although femoral block provides effective analgesia, careful management is important to avoid significant motor blockade of Quadriceps which can inhibit rehabilitation and more rarely cause fall.

In recent times adductor canal block at the mid part of the thigh is being preferred over femoral nerve block at the groin with the benefit of maintain a sensory block for pain equivalent to femoral nerve block while minimizing motor nerve block to the Quadriceps mechanism thereby allowing early mobilisation.

Several centres around the world have adopted the use of local infiltration analgesia for TKA. The simplicity of the technique, as opposed to the advanced skills required for performing a peripheral nerve block, the limited time taken to perform LIA, as opposed to the 15–20 min often taken for performing a peripheral

nerve block and the apparent avoidance of motor block that can limit rehabilitation has lead increased to increased adoption of LIA. However there is lack of evidence if LIA technique provides sufficient analgesia at present. Injection of large volumes of local anaesthetic agents and other adjuvant drugs around the knee joint increases the risk of local anaesthetic associated systemic toxicity and studies need to be performed to examine these concerns.

The following study is designed to compare the efficacy of local infiltration analgesia and adductor canal block in patients undergoing knee surgeries.

2. AIMS AND OBJECTIVES

The aim of this randomized was to compare adductor canal block vs local infiltration analgesia on knee surgeries.

Primary objectives.

1. To assess postoperative pain using visual analogue scale pain score at 4, 12 and 24 hours.

Secondary objectives.

1. To evaluate the time to first rescue analgesic administration.
2. To assess the complications.
3. To assess the functional outcome using TUG test.

3. PHYSIOLOGY OF PAIN

Definition of pain

The definition of pain according to the International Association for the Study of Pain describes the complex nature of pain as an emotional, physical and psychological condition. Failure to appreciate the complex factors that affect the experience of pain and relying entirely on physical examination findings and laboratory tests may lead to misunderstanding and inadequate treatment of pain.

Pain receptors and their stimulation

Nociceptors are free nerve endings located in skin, muscle, bone, as well as in certain internal tissues, such as the periosteum, the arterial walls, the joint surfaces, and the falx and tentorium in the cranial vault and connective tissue with cell bodies located in the dorsal root ganglia. In contrast to most other sensory receptors of the body, pain receptors adapt very little and sometimes not at all.

Types of pain receptors

The pain receptors are distributed throughout the body. Mainly two kinds of receptors have been studied extensively. They are free nerve endings and opiate receptors.

a) **Free Nerve Endings -** The pain impulse is received by peripheral receptors of skin, namely, free nerve endings. These free nerve endings are the nociceptors. These nociceptors exhibit high response thresholds & persistent discharge to supra-threshold stimuli without rapid adaptation and are associated with small receptive fields and small afferent nerve fibre endings. Nociceptive pain occurs secondary to chemical, mechanical & thermal stimulation of A-delta & C-polymodal pain receptors, which are located in skin, bone, connective tissue, muscle & viscera by algogenic substances (histamine, bradykinin, substance P).

b) Opiate receptors - It has been found that pain produced by different injuries under different conditions in different people can be variable. There are several circuits that can modify pain. Only one circuit has been studied extensively wherein opioids are involved. The connecting circuit has links in the hypothalamus, midbrain and medulla and it selectively controls spinal pain transmission through a descending pathway. The discovery that opiates bind to neurons in the periaqueductal grey matter, substantia gelatinosa, the trigeminal nuclei, reticular formation and thalamus led to the hypothesis that endogenous substances with analgesic properties similar to the opiates exist. These substances were called endorphins. Endorphins are concerned in pain modulation through three principal mechanisms:

1. Descending pathways via the periaqueductal grey area of midbrain and raphe magnus nucleus
2. Substantia gelatinosa
3. Anterior pituitary gland

Nerve fibres involved in pain transmission

Nerve fibres involved in pain transmission are A-δ fibres and C fibres.

A-δ Fibres are small (1-4microns) in size, lightly myelinated and has a slow conducting velocity of 10-35 m/s. They respond to high threshold mechano-thermal receptors and carry sharp sensation of pain

C Fibres are small (0.5 – 1.5microns) in size, unmyelinated and has very slow conducting velocity of 0.5- 2 m/s. It is stimulated mostly by chemical stimuli but it also responds to all types of noxious stimuli. It requires a high intensity stimuli to trigger a response

Pain pathway

The nociceptive pathway is an afferent three-neuron dual ascending system, with descending modulation from the cortex, thalamus, and brainstem. Some fibres can ascend or descend in Lissauer's tract prior to terminating on neurons that

project to higher centres. Second-order neurons consist of nociceptive-specific and wide dynamic range (WDR) neurons. Nociceptive specific neurons constitute the neospinothalamic tract which mainly carry sharp pain transmitted by the A-δ fibres which reach Lamina I and V. The WDR neurons constitute the paleo spinothalamic tract which carry the slow pain transmitted by the C fibres which reach the Lamina I and II.

Nociceptive-specific neurons are located primarily in lamina I, respond only to noxious stimuli, and are thought to be involved in the sensory discriminative aspects of pain. WDR neurons are predominately located in laminae IV, V, and VI, respond to both non-noxious and noxious input, and are involved with the affective motivational component of pain. Axons of both nociceptive-specific and WDR neurons ascend the spinal cord via the dorsal column- medial lemniscus and the anterior lateral spinothalamic tract to synapse on third-order neurons in the contralateral thalamus, which then project to the somatosensory cortex where nociceptive input is perceived as pain.

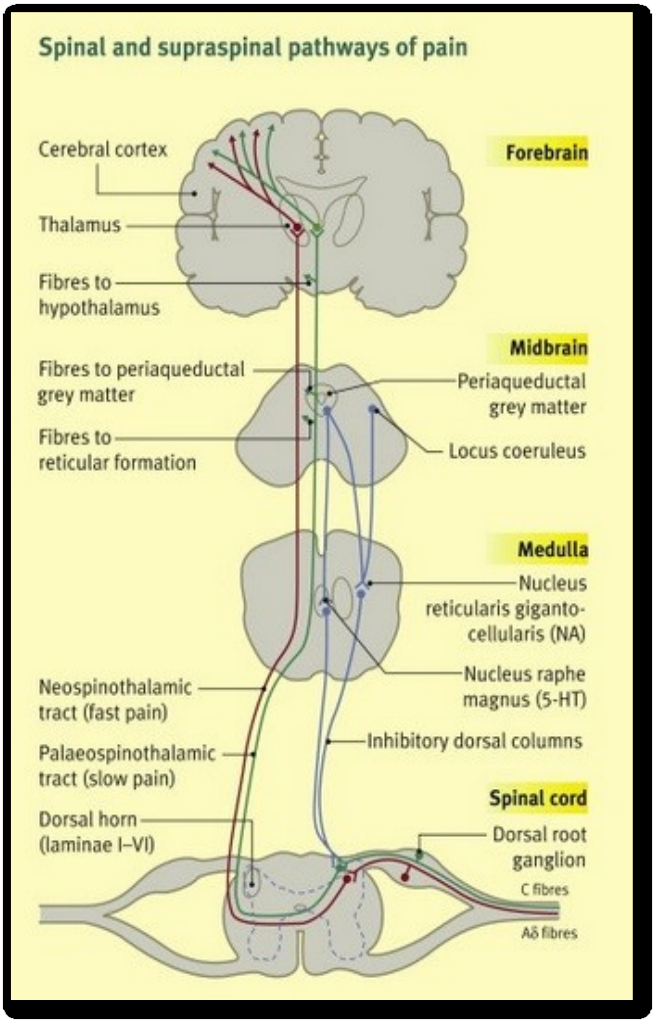


Fig: 1. Spinal and supraspinal pathways of pain

Ascending pathways of pain transmission

The major ascending pathways for pain include:

1. Spino-thalamic tract
2. Spino-bulbar projections
3. Spino-medullary tract

4. Spino-hypothalamic tract (ventral forebrain and hypothalamus).
5. Some indirect projections, such as spino-cervicothalamic pathway and the dorsal column system carry nociceptive information to the forebrain through the brainstem. .
6. Pathways arising from the trigeminal sensory nuclei of medulla process the nociceptive information from the facial structures.

Spino-thalamic tract is the major pathway involved in pain, temperature, and itch sensation. Spino-thalamic tract originates in the spinal dorsal horn neurons in lamina I, IV, V, VII and VIII. 10% to 15% of neuronal cells with projections extending through the Spino-thalamic tract is present on the ipsilateral side, with 85% to 90% on the contralateral side. The lateral spino-thalamic tract originates mainly from lamina I cells. The anterior spino-thalamic tract originates from laminae V and VII cells. In the lateral spino-thalamic tract, the axons from rostral body regions is located medially and the axons from caudal body regions are located laterally. The axons of spino-thalamic tract end in various well defined regions of the thalamus.

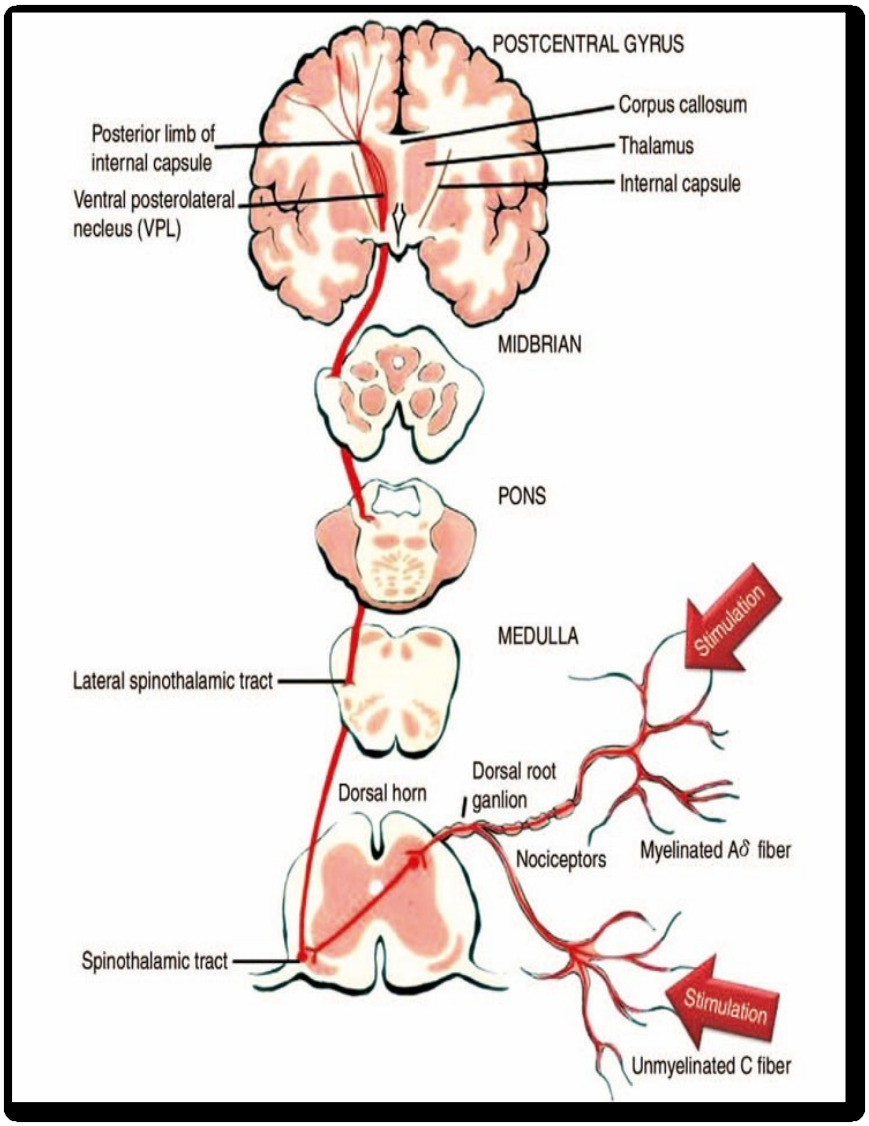


Fig: 2. Spinothalamic tract (Ascending pathway)

Spino-bulbar projections also originates from laminae I, V, and VII in the dorsal horn of spinal cord. Spinal projections to the medulla are bilateral. The spinal projections to the mesencephalon and pons have contralateral dominance.

Spino-bulbar projections terminate predominantly in parabrachial nucleus, catecholamine cell groups (A1-A7), brain stem reticular formation and PAG. The spino-hypothalamic tract arises from cells in laminae I, V, VII, and X bilaterally over the entire extent of the spinal cord. The spino-hypothalamic tract axons have connections with contralateral diencephalon. Decussation of the spinohypothalamic tract occur in the optic chiasma, and then it descends ipsilaterally through the hypothalamus and to the brainstem. The spino-hypothalamic tract is important for neuroendocrine, autonomic and emotional components of pain.

Supraspinal Modulation of Nociception

The most commonly activated regions during acute and chronic pain include anterior cingulate cortex (ACC), prefrontal cortex, insular cortex (IC), SI, SII, thalamus, and cerebellum. These regions of brain form a cortical and subcortical network, which are responsible for the emotional aspects of pain and the central modulation of pain perception. Somatosensory cortices like SI and SII are important for the perception of sensory features like the intensity and location of pain**.** Para limbic and limbic regions such as ACC and IC are important for the motivational and emotional aspects of pain. Anesthetized humans who are unaware of pain also exhibit significant pain-evoked activation of cerebellum, indicating

that pain-evoked cerebellar activity is important in regulation of afferent nociceptive activity than in the perception of pain.

Descending Pathways of Pain Modulation

Descending pathways which originate from supra-spinal regions simultaneously suppress and promote nociceptive transmission through the dorsal horn. It is termed as Descending inhibition pathway (DI) and Descending facilitation pathway (DF). The periaqueductal grey (PAG) and the rostral ventromedial medulla (RVM) regions of the brainstem are the important brain regions responsible for descending pain modulation. The PAG neurons receive direct or indirect inputs predominantly from the nucleus accumbens, amygdala, hypothalamus and ascending nociceptive afferents from the dorsal horn. The RVM receives input from neuro-tensinergic neurons of the PAG and serotonin containing neurons of the dorsal raphe. Spinally projecting nor-adrenergic neurons of the pontine tegmentum has significant contribution in pain modulation. Electrical stimulation of these regions of descending pathway inhibit dorsal horn neurons mediated by spinal a2-adrenergic receptors and produces behavioural analgesia. There are parallel facilitatory and inhibitory output pathways to the spinal cord from RVM. There are three distinct types of neurons in the RVM:

1. neurons that discharge beginning just before the occurrence of withdrawal from noxious heat, known as On cells.
2. neurons that stop firing just prior to a withdrawal reflex , known as Off cells.
3. neurons that show no changes in activity when withdrawal reflexes occur, known as Neutral cells.

On cells have a facilitatory effect on nociception .Off cells have an inhibitory effect on nociception. Neutral cells are serotonergic neurons. The projections of neutral cells tonically release serotonin at the level of the dorsal horn and alter the action of other descending pain modulation systems through 5-HT3 receptor. The RVM-PAG system serves as one of the important brain sites responsible for opiate induced analgesia. In the RVM, κ opioid receptor are predominantly in the Off cells and μ opioid receptors are predominantly located in the On cells. The μ opioid receptor agonists, including morphine and other opioid analgesics, causes a direct postsynaptic hyperpolarization by increasing potassium conduction in RVM on cells. These agents also act pre synaptically to suppress GABAergic synaptic transmission. Activation of κ opioid receptors exhibit bidirectional pain modulation by either antagonism of μ opioid receptor–mediated analgesia or analgesia. Chronic opiate exposure produces emergence of functional δ opioid

receptors in RVM-PAG system, which exhibit δ opioid receptor mediated analgesia.

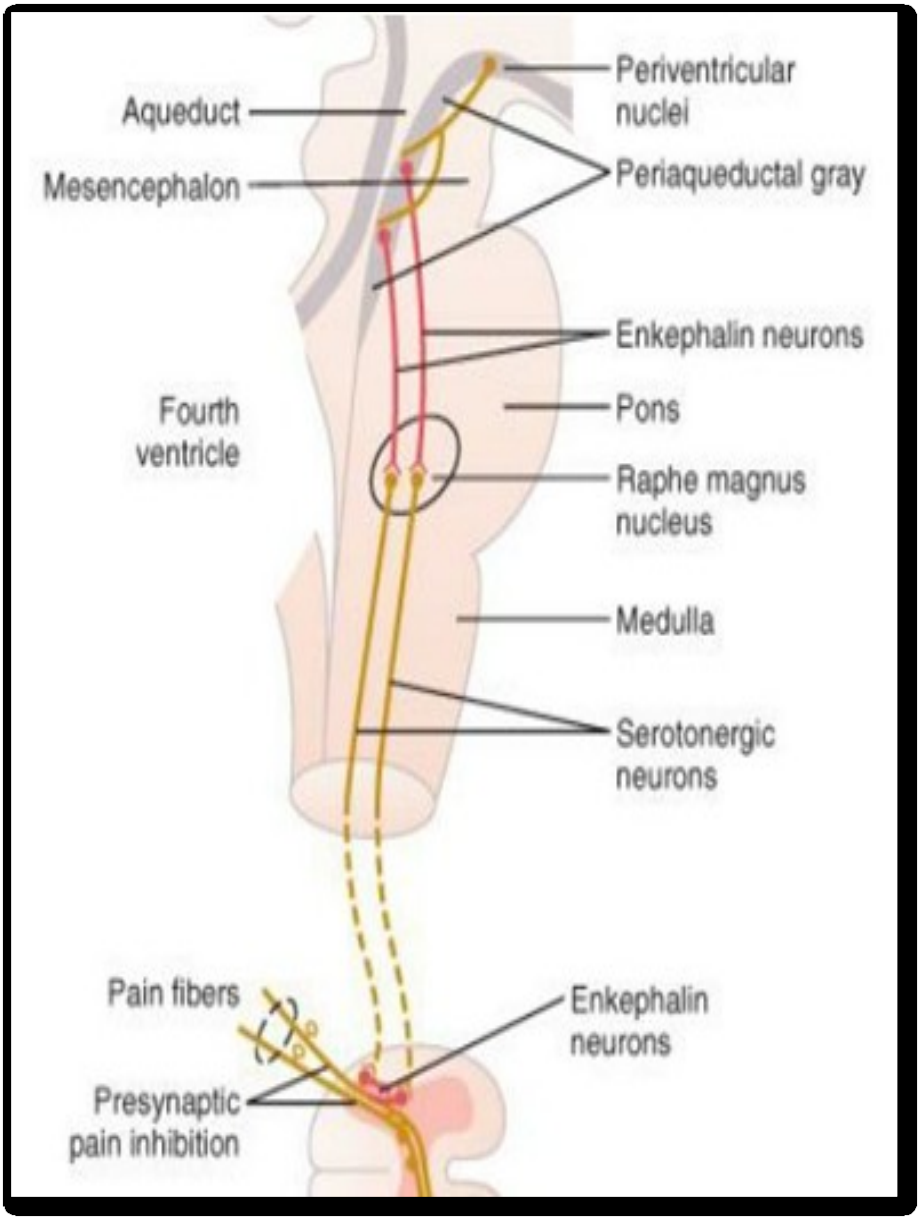


Fig: 3. Descending pain pathway

4. ANATOMY OF ADDUCTOR CANAL

The adductor canal is a narrow conical tunnel located in the thigh. It is also called as Hunter's canal or sub sartorial canal. It is 15cm long, extending from the apex of the femoral triangle to the adductor hiatus of the adductor magnus. The canal serves as a passageway from structures moving between the anterior thigh and posterior leg. It gives passage to the femoral vessels from femoral triangle to the popliteal fossa.

Borders of the Adductor canal

The adductor canal is triangular in cross section. Its boundaries are as follows. Anterolateral wall is formed by vastus medialis. Posterior wall (floor) is formed by adductor longus above and adductor magnus below. Medial wall (roof) is formed by a powerful fibrous membrane stretching across the anterolateral and posterior borders. The roof is overlapped by the Sartorius muscle. The apex of the adductor canal is formed by the adductor hiatus.

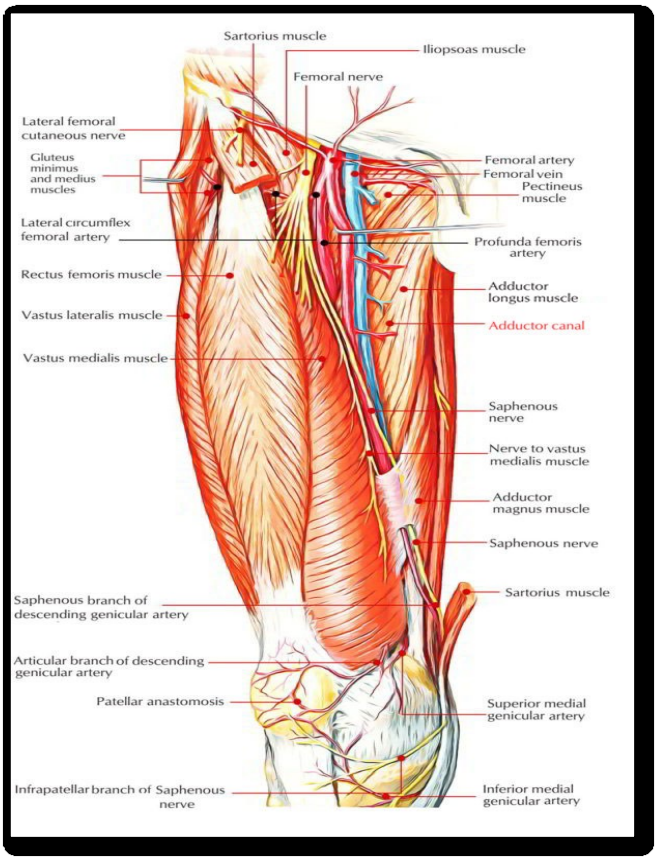


Fig: 4. Adductor canal with its contents

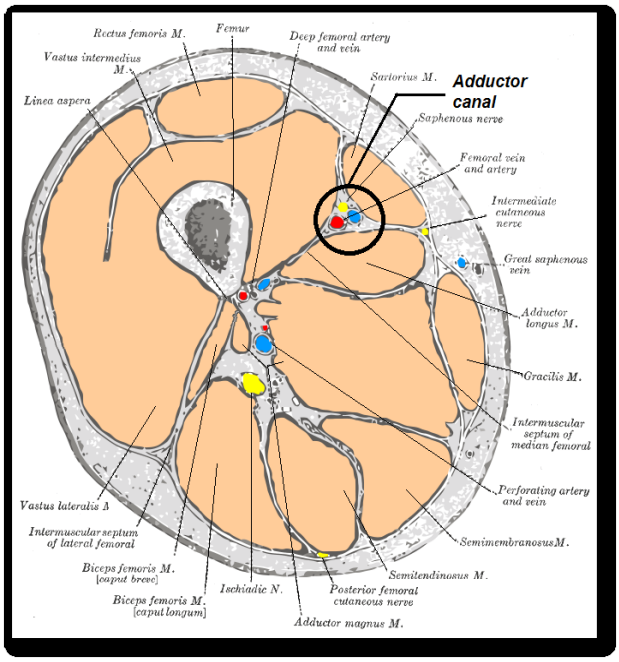


Fig: 5. Cross-sectional view of adductor canal

The Sub Sartorial plexus of nerves

The sub sartorial plexus of nerves is located on the roofing underneath the Sartorius. The plexus is composed by branches from the medial cutaneous nerve of the thigh, the saphenous nerve, the anterior section of the obturator nerve. It supplies the overlying fascia lata and the skin.

Contents of Adductor canal

The adductor canal serves as a passage way for structures moving between the anterior thigh and posterior leg, its content include

1. Femoral artery
2. Femoral vein
3. Nerve to the vastus medialis
4. Saphenous nerve (the largest cutaneous branch of the femoral nerve).
5. Anterior and posterior sections of the obturator nerve (occasional).
6. Descending genicular artery, a branch of the femoral artery, as the femoral artery and vein exit the canal, they become the popliteal artery and vein respectively.

Femoral Artery: The femoral artery enters the canal at the apex of the femoral triangle, traverses the entire length of the adductor canal, and leaves it by going

through the tendinous opening in the adductor magnus (adductor hiatus). Inside the canal it produces muscular branches and a descending genicular branch. The descending genicular artery appears before the femoral artery leaves the canal.

Femoral Vein: The femoral vein is located posterior to the femoral artery in the upper part and lateral to the artery in the lower part.

Saphenous nerve: The saphenous nerve is the longest cutaneous nerve of the body. It crosses the femoral artery anteriorly from lateral to medial side. It leaves the canal by piercing the fibrous roof. Just before leaving the canal it produces infrapatellar branch which pierces the Sartorius and joins the patellar plexus and supplies the pre-patellar skin.

Nerve to vastus medialis: The nerve to vastus medialis is the thickest muscular branch of the femoral nerve. It is located lateral to the femoral artery, and enters the vastus medialis in the upper part of the canal.

Posterior section of Obturator nerve: The posterior section of obturator nerve runs on the anterior outermost layer of the adductor magnus and ends by supplying the knee joint. The spiral course of the femoral vein and saphenous nerve with

regard to the femoral artery in the adductor canal is because of medial rotation of the lower limb during its development.

In the adductor canal block, local anaesthetic is administered in the adductor canal to block the saphenous nerve in isolation, or together with the nerve to the vastus medialis. The block can be used to provide sensory anaesthesia for procedures involving the distal thigh and femur, knee and lower leg on the medial side. The Sartorius and femoral artery are used as anatomical landmarks to locate the saphenous nerve.

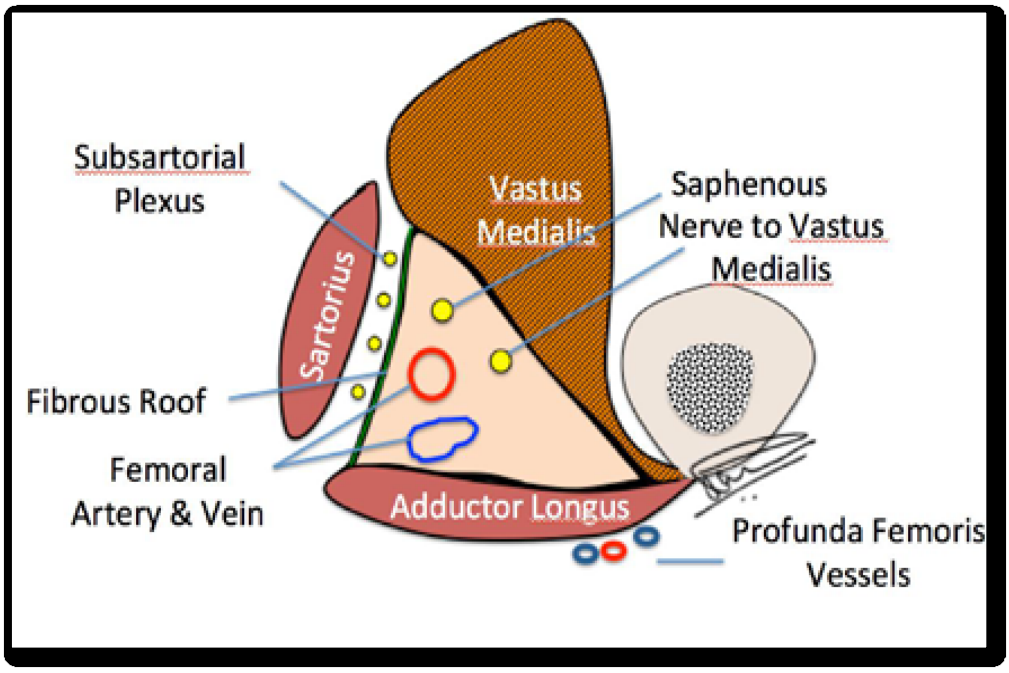


Fig: 6. Schematic representation of the contents of Adductor canal

5. NERVE SUPPLY OF KNEE JOINT

Knee joint is supplied by femoral nerve through its branches to vasti especially vastus medialis, sciatic nerve through genicular branches of tibial & common peroneal nerve, obturator nerve through its posterior division and infrapatellar branch of saphenous nerve.

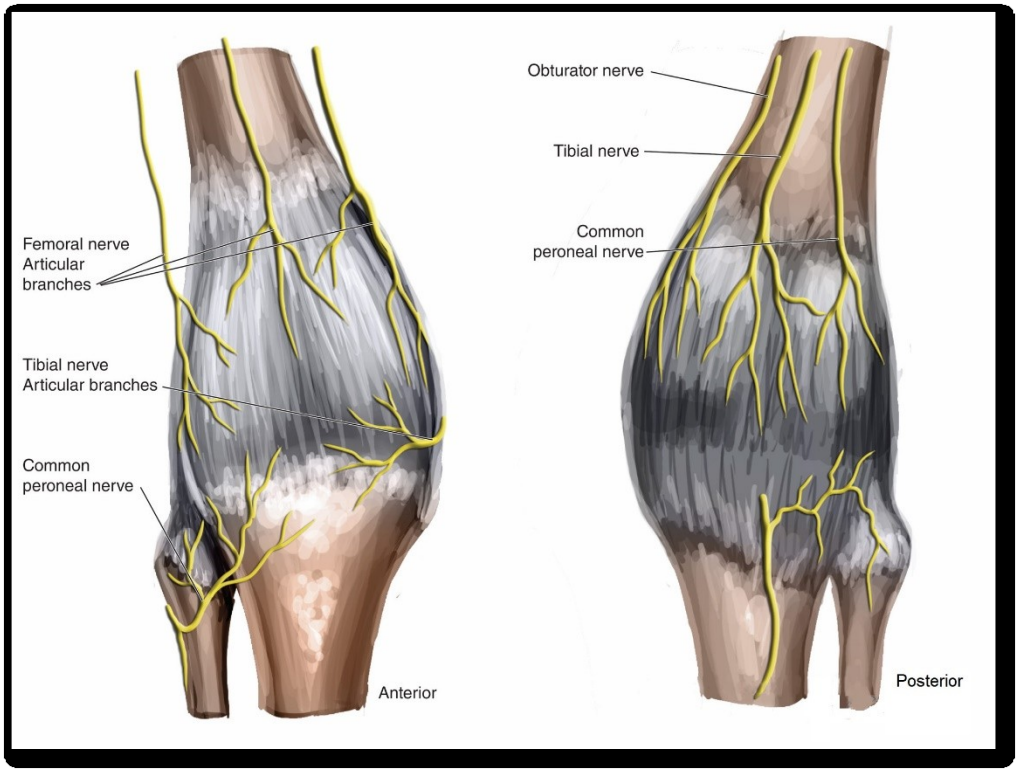


Fig: 7. Nerve supply of knee joint

\

6. PHARMACOLOGY OF LOCAL ANAESTHETICS

Chemical structure of local anaesthetics

Local anaesthetic consists of an aromatic part linked with tertiary amine via an intermediate chain. The aromatic part is fat soluble (lipophilic) while amine group is water soluble (hydrophilic). The intermediate chain contains either an ester (-CO-) or amide (NHC-) linkage on the basis of which local anaesthetics are classified as amides and esters. Bulkier the moiety in terminal amino group, more is the potency of the drug. The amine portion of LA can accept one proton (H+) and exist in charged form. In solution, local anaesthetic therefore exists as cationic and base form, the amount of each being determined by the pH of the solution.

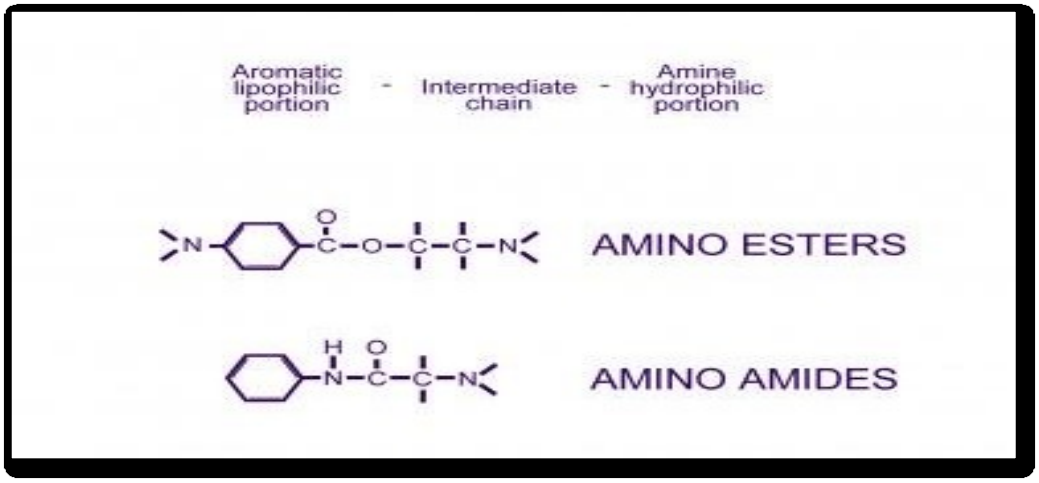
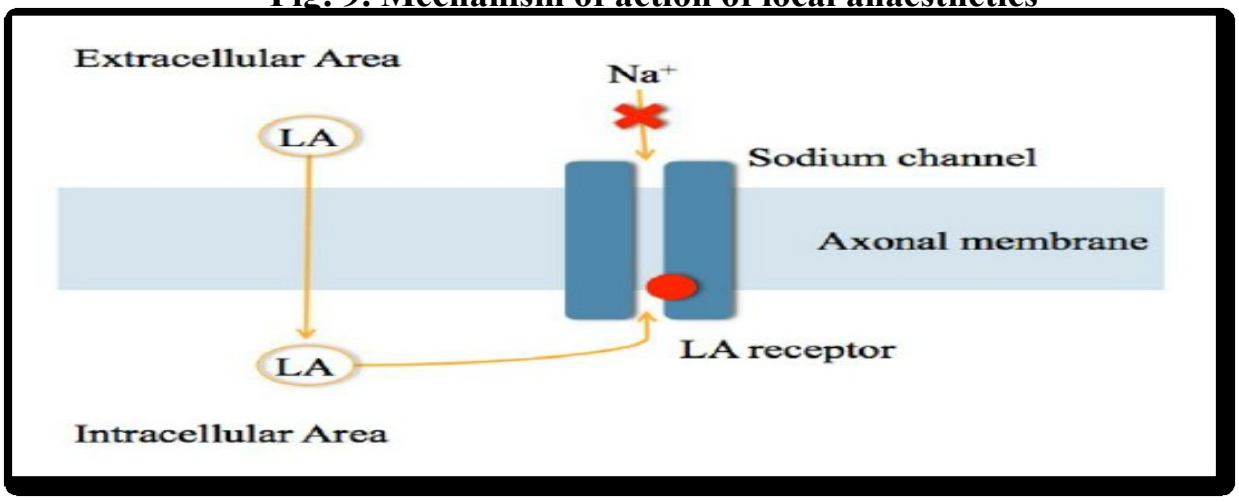


Fig: 8. Chemical structure of local anaesthetics

Mechanism of Action

Local anaesthetics act by reversible inhibition of Na^+ channels. It inhibits stimulated Na^+ channels more readily than resting Na^+ channels. This is called as phasic block and tonic block respectively. The modulated receptor hypothesis states that Na^+ channels pass through various states during membrane depolarization. They pass through the resting state (R), intermediate closed form (C) state , to reach an open form (O) state , and then close to reach an inactivated state (I). Local anaesthetics have greater affinity for Na^+ channels in the O and I forms than in the C and R forms. Therefore local anaesthetics binds to Na^+ channels of stimulated or active nerves more readily.

Fig: 9. Mechanism of action of local anaesthetics



Local anaesthetics have two binding sites on the Na^+ channel. One site is present near the channel pore and is responsible for phasic block. Binding and unbinding at

this site is slow. The second site is present on the inner aspect of the channel in the hydrophobic centre of the membrane. Binding and unbinding at this site is relatively rapid.

Pharmacokinetics

I. Absorption:

The systemic absorption of local anaesthetics is determined by

- *Site of injection*: Absorption depends upon vascularity of the area. Intravenous > Tracheal > Intercostal > Paracervical > Caudal > Lumbar epidural > Brachial plexus> subarachnoid > Subcutaneous.
- *Presence or absence of Vasoconstrictor*: Epinephrine by reducing local blood flow will reduce absorption from the site of injection. Some drugs have an inherent vasoconstrictor action.
- *Pharmacologic profile of the agent:*
    a. The degree of protein binding in the tissues- as only free drug is available for uptake by the vasculature.
    b. The fat solubility-as the amount of drug dissolved in fat is not available for absorption.
    c. Vasoactivity- drugs that cause vasoconstriction will delay absorption.

d. PKa of the drug- It determines the degree of ionization at tissue pH and thus proportion available to cross lipid bilayer.

II. Distribution:

Initial rapid disappearance of the drug from systemic circulation occurs due to distribution to highly perfused organs (brain, lungs, liver, kidney, heart). Lungs play a major role in extraction of LAs once the drug passes through pulmonary vasculature. Propranolol interferes with extraction of bupivacaine by lungs. The ensuing slow disappearance of the drug occurs due to distribution to less perfused tissues (skeletal muscles and gut). Skeletal muscles act as the greatest reservoir for LA agents because of large mass. High lipid solubility facilitates tissue uptake of the drug while plasma protein binding property tends to retain LA in blood.

III. Metabolism:

The metabolism of local anaesthetic agent is a function of chemical linkage present in its intermediate chain. Ester local anaesthetics undergo hydrolysis by pseudo cholinesterase into water soluble metabolites and is excreted by kidney. Pseudo cholinesterase is absent in CSF so termination of an ester local anaesthetic once injected intra thecally depends on absorption in blood.

PABA is one such common metabolite which has a tendency to cause allergic reaction. Amide local anaesthetics undergo enzyme degradation in the liver and is excreted by kidneys.

Factors affecting Pharmacokinetics

1. Age: infants have decreased levels of α1 acid glycoprotein which is the major local anaesthetic binding protein. This results in higher free drug concentration for equivalent mg/kg doses. Moreover children do not mount premonitory signs of local anaesthetic toxicity. Special precaution is warranted while using prolonged infusions of LAs in paediatric population.

2. Low cardiac output states: All the conditions associated (e.g. hypovolemic shock, heart failure), with decreased cardiac output will lead to decreased hepatic blood flow. Hepatic metabolism of amide drugs is hampered and their action prolonged. Blood levels are higher than anticipated.

3. Pregnancy: Pregnant patients show increased sensitivity for LAs probably due to prolonged increase in progesterone levels.

4. Poor Nutrition: Cachexic patients have low α1 acid glycoprotein levels and so more free drug is available to cross blood brain barrier. Toxicity appears at lower doses.

BUPIVACAINE PHARMACOLOGY

Bupivacaine is formed by the addition of butyl group to the piperidine nitrogen of mepivacaine. It belongs to the amide class of local anaesthetics. It was first synthesized by A.F.Ekenstam in 1957 and was clinically used for the first time in 1963. It is available as a racemic mixture with both S & R enantiomers in equal amounts. Chemical structure of bupivacaine is 1-Butyl N-(2, 6 dimethyl phenyl)-2 piperidine decarboxamide hydrochloride monohydrate.

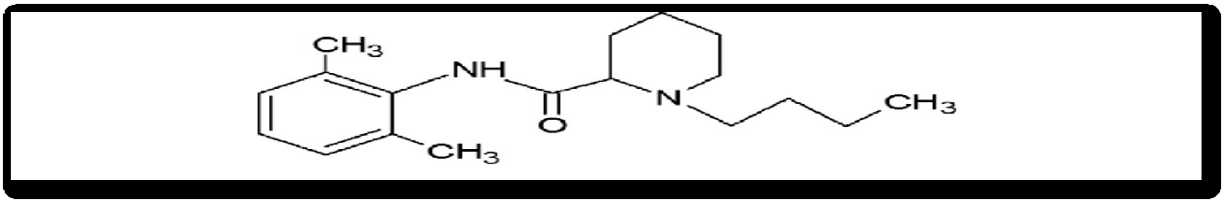


Fig: 10. Chemical structure of Bupivacaine

Bupivacaine is a long acting local anaesthetic agent with high potency. It crosses both blood brain barrier and placenta. It is highly protein bounding and is also lipid soluble in nature.

Mechanism of action

Bupivacaine acts by binding to alpha subunit of the sodium channel to produce conduction blockade. It decreases the permeability of sodium ions across the cell membranes which is responsible for depolarization of the membranes,

thereby blocking nerve conduction. It also reduces the permeability of potassium ions across the resting nerve membranes and thereby producing a stabilizing all excitable membranes.

Pharmacokinetics

The systemic absorption of bupivacaine depends on the route of administration, dose and concentration of drug, vascularity of the tissue, and the presence or absence of epinephrine in the preparation. It has an onset of action of 1-17 min and duration of action of 2-9 hours depending on the dose and route of administration. It has a half-life of 8.1 hours in neonates and 2.7 hours in adults. It is metabolized in the liver and is excreted by kidneys.

Medical uses of Bupivacaine

Bupivacaine is used in peripheral nerve blocks, sympathetic nerve blocks, local infiltration, epidural and caudal blocks. When used in combination with epinephrine it helps prevent systemic absorption and extend the duration of action. It is the most commonly used local anaesthetic in postoperative pain management and in epidural anaesthesia during labour.

Adverse drug reactions

1. Allergy reactions such as Pruritus, Angioedema, Urticaria, Accidental intravascular injection.
2. Cardiac side effects include hypotension, arrhythmias, ventricular tachycardia, ventricular fibrillation, atrioventricular block. Pregnant patients are more prone for the cardio toxic effects of bupivacaine. It depresses automaticity and contractility of heart.
3. CNS side effects include tinnitus, vertigo, circumoral numbness, metallic taste, confusion, drowsiness, light headedness, dizziness, muscle twitches slurred speech, seizures, coma.

It is contraindicated in patients with known hypersensitivity reactions to amide local anaesthetics. It is also contraindicated in intravenous regional anaesthesia and obstetrical paracervical blocks because of potential risk of tourniquet failure and systemic absorption of the drug which might result in cardiac arrest.

Liposomal Bupivacaine:

The liposome Bupivacaine formulation is a blend of a small amount of extra liposomal Bupivacaine and liposome encapsulated Bupivacaine. The extra liposomal component allows for rapid release and onset of action. The liposome encapsulated component allows Bupivacaine release over a longer period of time.

Liposomal Bupivacaine use in children is currently under study and is not approved yet. If approved, it can be used for pain management in children who need prolonged regional blockade without using indwelling catheters.

Pharmacologic treatment of Local Anaesthetic Systemic Toxicity (LAST)

The management of cardiac arrest resulting from local anaesthetic systemic toxicity is different from management of other cardiac arrest scenarios.

American Society of Regional Anaesthesia and Pain medicine Recommendations for the management of LAST are as follows:

1. Stop injecting local anaesthetic.
2. Get help.
3. Consider lipid emulsion therapy at the first sign of a serious LAST event.
4. Call for the LAST Rescue Kit.
5. Alert the nearest cardiopulmonary bypass team — resuscitation may be prolonged.
6. Airway management - Ventilate with 100% oxygen / avoid hyperventilation / advanced airway device if necessary.
7. Control seizures, Benzodiazepines are preferred.
8. Avoid large doses of propofol, especially in hemodynamically unstable patients.

9. Treat hypotension and bradycardia- If pulseless, start CPR.
10. Continue monitoring.
11. At least 4-6 hours after a cardiovascular event.
12. Or, at least 2 hours after a limited CNS event.
13. Do not exceed 12 mL/kg lipid emulsion (particularly important in the small adult or child).
14. Much smaller doses are typically needed for LAST treatment.

7. BASICS OF ULTRASOUND

Ultrasound denotes mechanical pressure waves with frequencies greater than 20,000 Hz (beyond the audible range). A medium is needed for ultrasound propagation to happen. In animals ultrasonic energy is transmitted in the form of longitudinal waves, as is in fluids. The piezoelectric transducer can both receive and emit ultrasound waves. The piezoelectric transducer can change electrical signals into mechanical waves and can also change mechanical pressure into electrical signals. Ultrasound waves are transmitted at an average speed of 1540 meters per second.

Ultrasound waves interact with tissues in various ways, they can be partially absorbed by the tissue and their energy is converted into heat.

Ultrasound waves is either reflected or scattered when they pass through the tissue. These reflected or scattered echoes are received by the transducer and is the source of the diagnostic information. The echoes are analysed with regard to their site of origin (time–distance principle), and with regard to their intensity. This information is used to construct a two-dimensional image. Only a small part of the ultrasound is reflected at each interface, and most of the ultrasound is transmitted to deeper tissues. Bones, foreign bodies and gas cause a very strong reflection resulting in acoustic shadow thus no information can be obtained from regions behind these obstacles. The ultrasound attenuation should be corrected by

amplifying echoes as a function of distance from the transducer in order to get a homogeneous display of the echoes. In spite of this amplification, attenuation seriously limits the depth of penetration of higher frequencies.

The ultrasonic field is a geometric description of the region encompassed by the ultrasound beam. There are two main sectors, the far field and the near field (interference field) which is located between the ultrasound transducer and the focus. The beam intensity decreases continuously with distance from the centre as a result of this the lateral boundary of the ultrasound field is not sharp. The lateral resolution depends on the diameter of the ultrasound beam, the smaller the diameter the better is the resolution. Therefore the resolution is best in the focal area. In modern ultrasound technique the ultrasound beams are focused electronically enabling the clinician to focus on the region of interest. The axial resolution depends on the length of the emitted ultrasound pulses and finally on the wave length (i.e.) frequency.

The higher the frequency the better is the resolution. But higher the frequency higher is the attenuation in the tissues resulting in a limited penetration depth. So, for small and superficial parts high frequency transducers (5–10MHz)

should be used whereas for the abdomen or in late pregnancy, transducers with lower frequencies should be used.

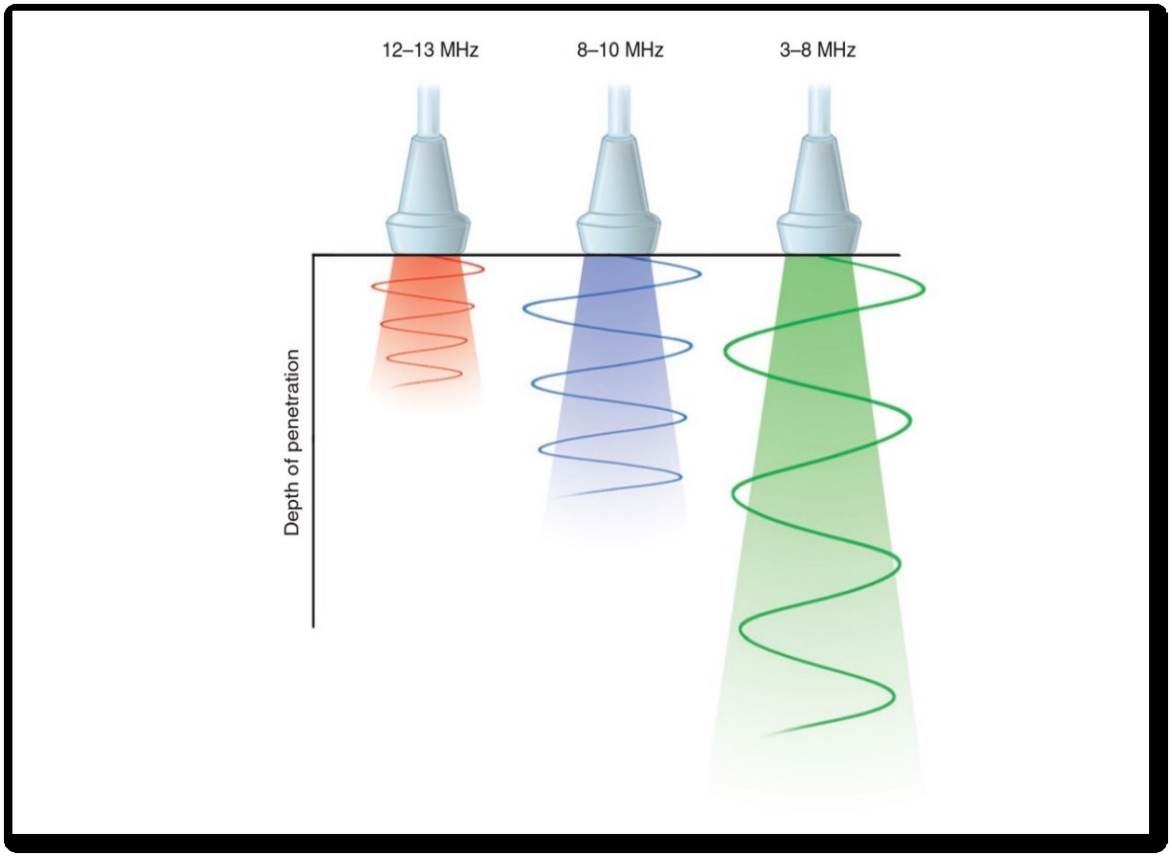


Fig: 11. Relationship of probe frequency and depth penetration

Imaging Techniques

Imaging techniques include A-scan**,** M-scan**,** B-scan and Doppler techniques. A-scan (amplitude modulation) is a one-dimensional technique. The echoes received are displayed as vertical deflections. B-scan (brightness modulation) is a technique in which the echo amplitude is depicted as dots of varying brightness (grey scale). It is arranged successively in one plane to form a

two-dimensional image. The image is built up by mechanically or electronically regulated scanning in a fraction of a second. In real time, the image rate of more than 15 per second enables an impression of permanent imaging during the examination**.** M-scan also referred to as TM-scan is used to display motion like parts of the heart. The echoes produced by a stationary ultrasound beam are recorded continuously.

Doppler techniques use the Doppler effect as an additional source of information. If the ultrasound waves are reflected by an interface moving away from transducer or toward it, the reflected frequency will be lower or higher respectively than the transmitted frequency. The difference between the emitted and received frequencies is proportional to the velocity of the moving reflector. This is called as the Doppler effect and the difference is called the Doppler frequency or Doppler shift. There are various Doppler techniques

1. *Continuous wave Doppler*: In this the transducer is divided in two parts: one crystal transmits ultrasound and the other crystal receives the echoes. It does not provide any information about the distance of the reflectors but provides information only about the velocity, at which the reflector (the blood stream) moves.

2. *Pulsed Doppler*: Ultrasound is emitted in very short pulses. The echoes reaching the transducer between the pulses in a specific time interval are received and analysed. In this way, the movement of the reflectors in a particular distance is displayed and analysed. The echoes, received in a definite time distance are analysed. The colour coded information about the flow direction enables the differentiation between arteries and veins.

3. *Colour-Doppler and power-Doppler techniques* are used as duplex techniques integrated in the B-scan image. The echoes arising from tissue are displayed as bright spots (grey-scale technique). The echoes from moving reflectors are analysed by the Doppler technique separately, but displayed in the same image "color-coded". Colour-Doppler imaging is based on the mean Doppler frequency shift of the scatterers. The different colours indicate the direction of the blood flow. Disadvantages of this technique are their angle dependency, especially in the abdomen, and the aliasing artefact. The power Doppler technique is based on the total integrated power of the Doppler signal. This Doppler technique is more sensitive in detecting small vessels and slow flow and is angle independent. However it does not give information about the direction of the flow.

Ultrasound in Peripheral nerve blocks.

Ultrasound guided peripheral nerve blocks has two fundamental aspects. It involves imaging of structures in the plane of section including the target nerve and subsequently guiding the needle. Recognising of three dimensional anatomic structures or two dimensional image requires training in the technology and sono-anatomy pattern recognition. Certain basic principles of optimizing an ultrasound image are applicable to all nerve blocks. To optimize sono-anatomy visualization following steps have to be adhered.

1. Choose appropriate transducer frequency.
2. Understand underlying anatomic relationships.
3. Apply varying degree of pressure with transducer.
4. Align transducer with underlying nerve target.
5. Rotate transducer to fine tune image.
6. Tilt the transducer to optimize the image.

Ultrasound guided needling: Ultrasound guided needling can be done either by direct ultrasound guidance or indirect ultrasound guidance.

Indirect Ultrasound guidance: The target structure is localized before puncturing using ultrasound. The skin is marked, the depth and angle of the needle course are

estimated. Imaging is then completed and the needle is directed toward the target tissue. It helps when the landmarks are difficult to palpate or identify or when they are distorted. However it is appropriate only when neither precise needle placement nor avoidance of collateral structures apart from the target is mandatory.

Direct ultrasound guidance: Ultrasound is used to identify the target structure. Afterwards it is used to visualize the needle in real time as it pierces through the tissues and collateral structures can be avoided. Real-time scanning techniques create a rapid series of images, which are displayed sequentially to depict motion giving a real-time, two-dimensional image of a three-dimensional structure.

Needle placement techniques

There are two approaches in needle placement. They are In-plane needle approach and Out of plane needle approach.

In-plane approach

The needle is inserted parallel to the ultrasound beam and the shaft of the needle is visualized as an echogenic white line. Alignment of the ultrasound beam and the needle in this approach is important. The target structure is usually placed

to one side in the ultrasound field, and the needle is advanced from the other side towards the target, usually at an angle of 45° or less.

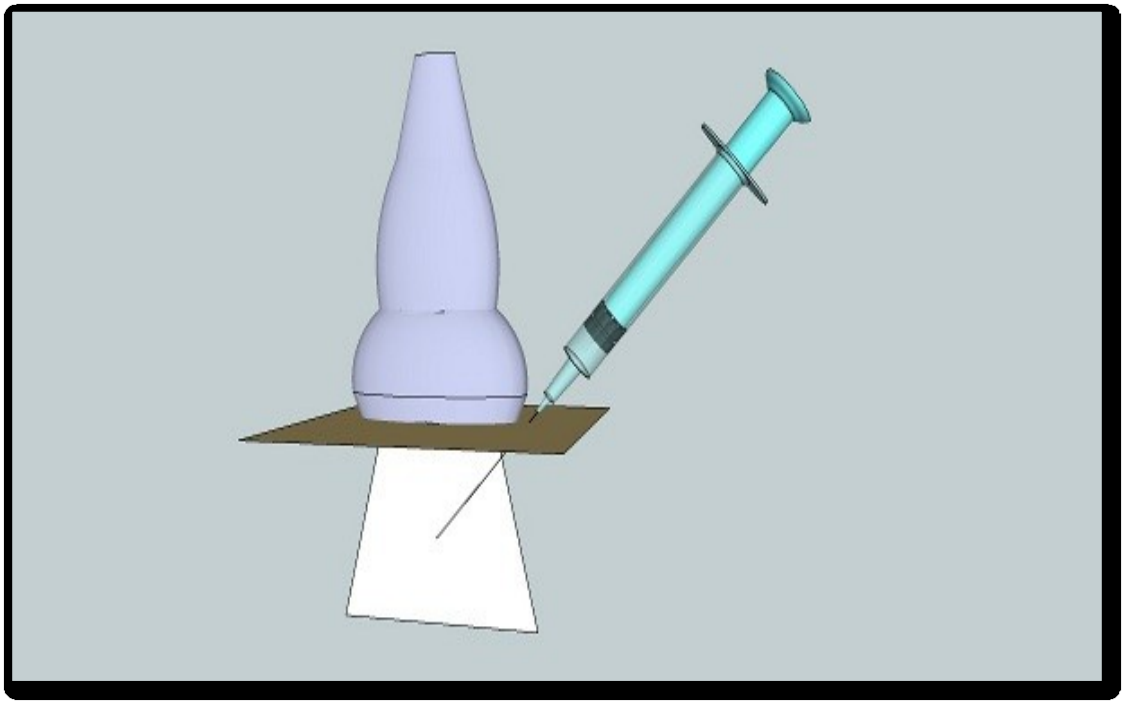


Fig: 12. In-plane approach

Out-of-plane needle approach

The needle is introduced perpendicular to the plane of the ultrasound beam. Vessels and nerves are viewed in cross section, enabling adjacent structures to be visualized easily but this approach gives poorer visualization of the needle because the angle of approach of the needle is more parallel to the ultrasound beam and also short segment of the needle is only visible.

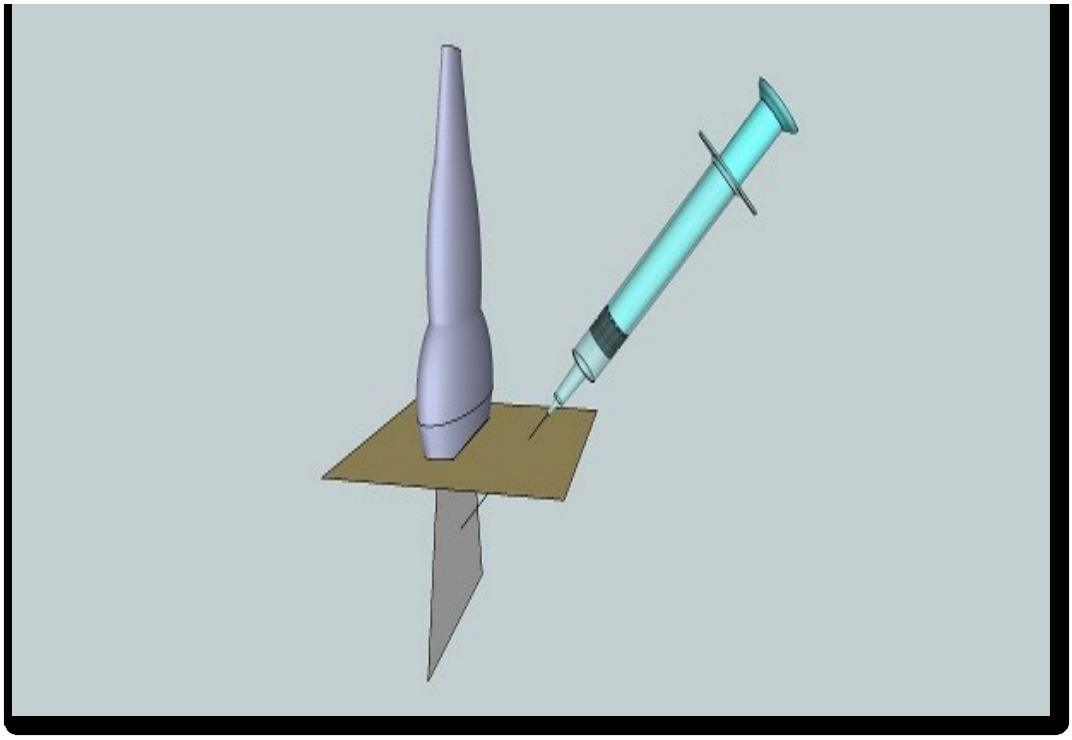


Fig: 13. Out of plane approach

There are two techniques that can be used to aid correct needle placement, i.e., the small-volume injection test (hydro dissection) and the walk-down method. In the small-volume injection test what is thought to be the needle tip is centered in the ultrasound image and small amount of a clear solution is injected. It enhances the view of the needle tip by producing a bigger difference of echo density between the needle tip and the injected solution, as opposed to the difference between the surrounding echogenic tissue and the needle tip.

The walk-down method is used with the out-of-plane approach and it uses the ultrasound to determine the depth of the target structure. The puncture site is selected to be of equal distance from the probe as the target depth. The needle is then inserted at a shallow angle and advanced until the tip is visualized. Then the needle is advanced at progressively steeper angles until the target is reached at approximately 45°. Geometrically, at 45° the needle, ultrasound beam and skin forms an isosceles right angle triangle with the depth equal to the distance from the probe. Inserting the needle at a steeper angle of about 75° to the probe in the out-of-plane approach is also a technique advocated by many. Visualization of the needle tip is better with steeper angles in this technique.

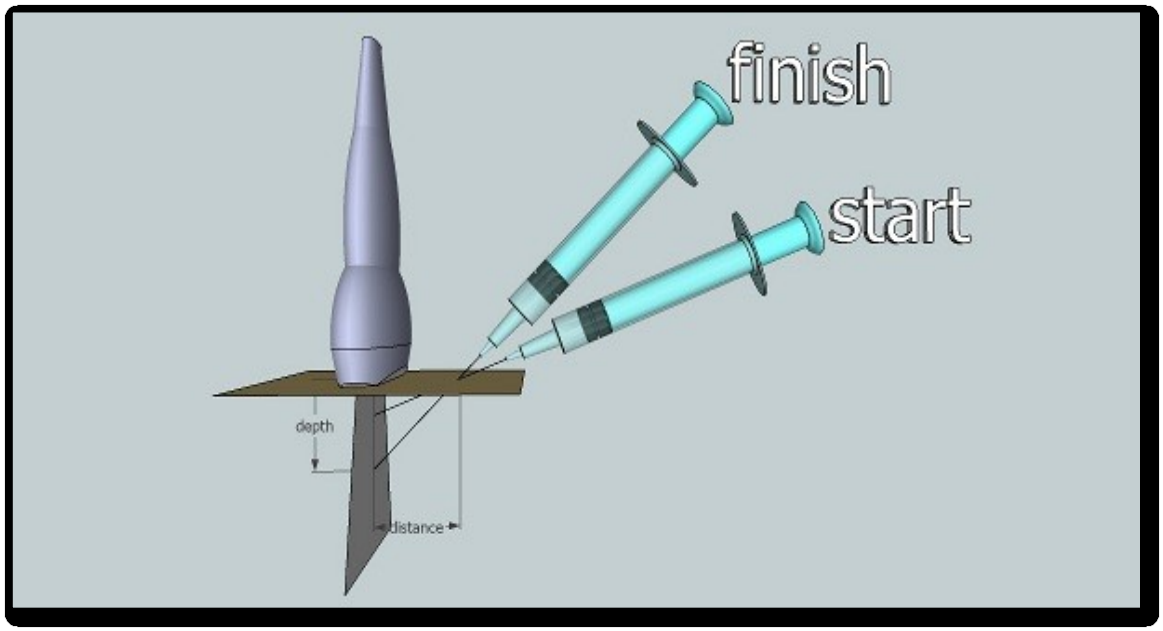


Fig: 14. Walk down method of needling

Methods of improving ultrasound needling techniques

- Larger needles are more easily visualized than smaller needles.
- Directing the ultrasound beam perpendicular to the needle rather than parallel to it.
- The use of styleted needles if possible decreases reverberation artifact.
- Filling the needle with a clear solution rather than air.
- Introducing the needle with its bevel either pointing towards the ultrasound probe or away from it. The relatively rougher bevel results in more ultrasound scatter, enhancing the tip.
- Tissue movement: introducing the needle in a short "in-and-out, side-to side" motion causes deflection of the adjacent soft tissues and makes the trajectory of the needle more discernible.
- Hydrolocation: injecting a small amount of a clear solution can enhance the visibility of the needle tip.

Using special needles with increased echogenicity increases ultrasound reflection at the interface between needles and tissues. Needle with special echogenic markings near the tip of the needle that appear as bright dots on the screen are available. Newer needles have a stylet with a piezoelectric crystal at the tip to

receive the ultrasound beam. The stylet is wired to the ultrasound machine, which is configured to display the piezoelectric tip in bright red color.

American Society of Regional Anaesthesia and Pain Medicine Recommendations for performing an ultrasound guided regional blocks are as follows

1. Visualize key landmark structures, including muscles, fascia, blood vessels and bone.
2. Identify the nerves or plexus on short-axis imaging, with the depth set 1 cm deep to the target structures.
3. Confirm normal anatomy or recognize anatomic variation(s).
4. Plan for the safest and most effective needle approach.
5. Use the aseptic needle insertion technique.
6. Follow the needle under real-time visualization as it is advanced toward the target.
7. Consider a secondary confirmation technique, such as nerve stimulation.
8. When the needle tip is presumed to be in the correct position, inject a small volume of a test solution.
9. Make necessary needle adjustments to obtain optimal perineural spread of local anaesthetic.
10. Maintain traditional safety guidelines of frequent aspiration, monitoring, patient response and assessment of resistance to injection.

8. ADDUCTOR CANAL BLOCK

The adductor canal also called as sub-sartorial block is a largely motor sparing block, anaesthetizing the femoral nerve after most of its motor branches to quadriceps have already exited, providing analgesia and anaesthesia intraoperatively and postoperatively for surgeries to the anterior part of the knee like patellar surgery, knee arthroscopy, MCL and ACL reconstruction.

Applied Anatomy

The femoral nerve passes through the femoral canal and lies beneath the Sartorius muscle. It enters an aponeurotic intermuscular tunnel in the middle third of the medial side of the thigh called Adductor canal or Hunter's canal. Approximately two thirds down the thigh, femoral vessels pass through the adductor hiatus. They change course and become deeper, indicating the end of the canal and the point at which the nerves that supply quadriceps exit. Few of the sensory articular nerve branches exits proximal to the Adductor canal therefore, an Adductor canal block may provide inferior anaesthesia for knee surgery compared to a classical femoral nerve block. The Adductor canal block is considered a purely sensory block, with the motor branches to the quadriceps exiting more proximally,

however proximal spread of large volumes of local anaesthetic may cause some motor blockade of vastus medialis and difficulty in ambulation.

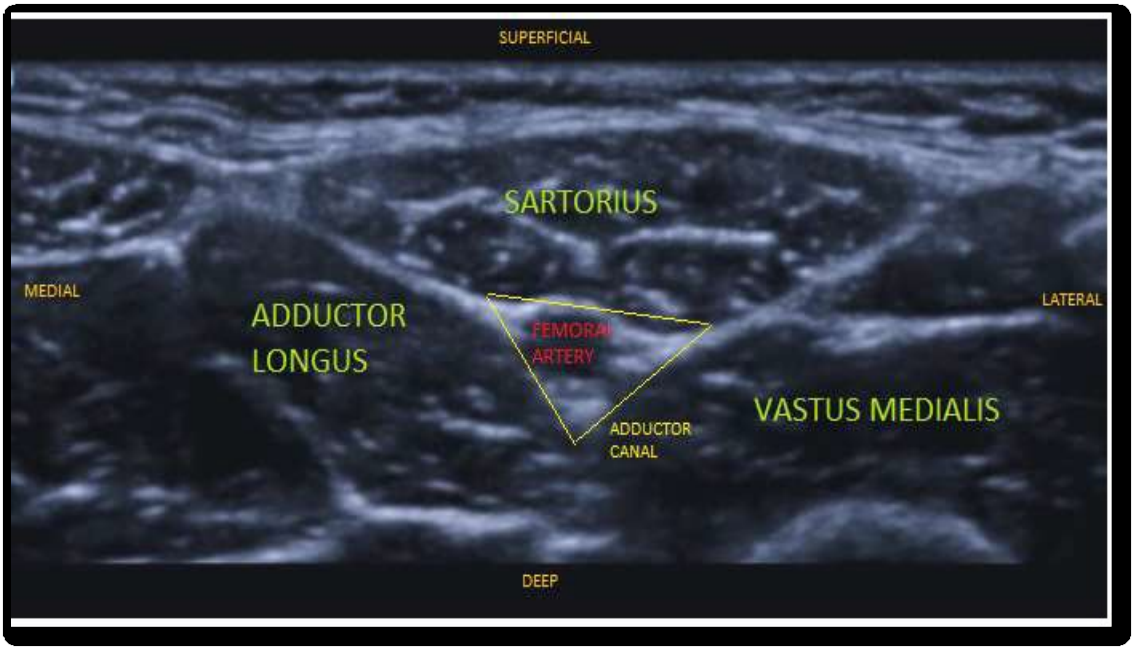


Fig: 15. Sonoanatomy of adductor canal

Technique

The patient is placed in supine position with the knee slightly flexed and externally rotated. The ultrasound machine, operator, insertion site and ultrasound machine are positioned in such a way that they lie in series thus improving ergonomics and chance of success. 6-12 MHz frequency linear probe is placed axially at the level of the central mid-thigh, visualising the femur. The probe is slid medially until the femoral artery becomes visible with the boat shaped Sartorius muscle above it. The depth is adjusted so that the femoral artery and Adductor

canal lie in the centre of the screen. The femoral artery is traced to the point at which the artery divides posteriorly ultimately becoming the popliteal artery. The optimal position for insertion is immediately proximal to the adductor hiatus. The nerves are visualized anterolateral to the artery. The needle is inserted from lateral to medial using an in plane technique. This is achieved via a steep angle traversing Sartorius, or more horizontally, by piercing vastus medialis and travelling perpendicular to the ultrasound beam.

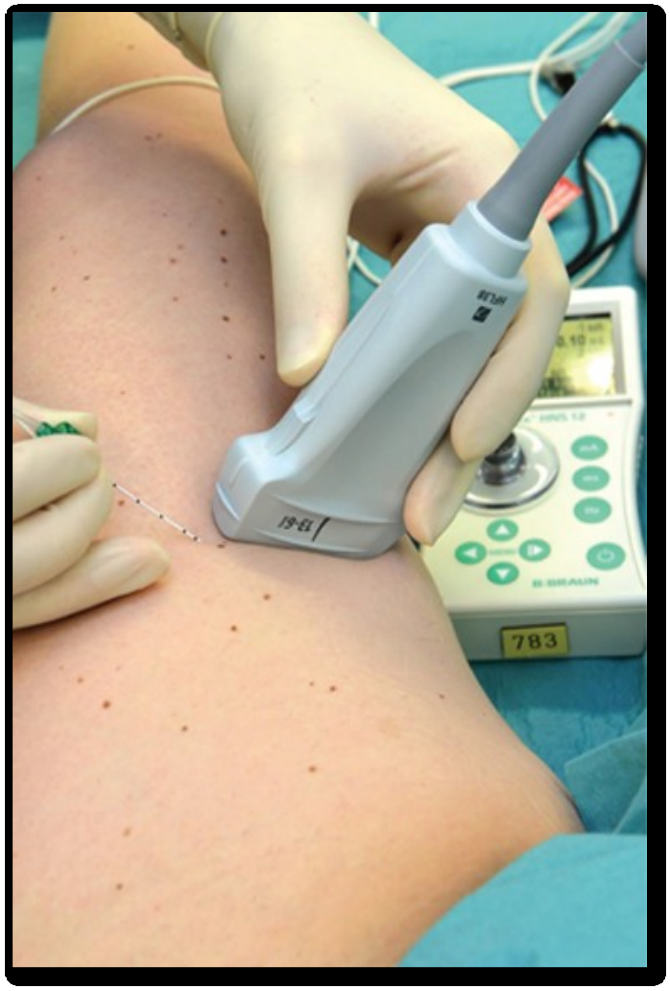


Fig: 16. Probe placement and needle insertion in adductor canal block

Once the needle enters the Adductor canal, the needle tip is made to lie immediately lateral to the femoral artery. An aspiration test is performed and then a test dose of 0.5% Bupivacaine is injected, ensuring spread around the nerve. If the nerve is not visible, the needle tip is positioned superficial to the artery and the local anaesthetic agent spread around the artery is ensured. Once the correct position has been confirmed, the total volume of 0.5% Bupivacaine (3mg/kg- upto 20 ml) is deposited, aspirating frequently to rule out intravascular injection.

Complications of Adductor canal block

1. Motor block of anterior thigh
2. Block failure
3. Nerve Injury
4. Arterial puncture, bleeding, bruising
5. Intra vascular injection/ Local Anaesthetic Systemic Toxicity
6. Infection

9. REVIEW OF LITERATURE

1. **Joseph D. Lamplot et al** [35] conducted a prospective randomized controlled trial to analyse the effects of a multimodal analgesic regimen on postoperative pain, function, adverse effects and satisfaction compared to patient-controlled analgesia (PCA) in patients undergoing TKA. Thirty-six patients undergoing TKA were randomized to receive either peri-articular injection before wound closure (30 cc 0.5% bupivacaine, 10 mg $MgSO_4$, and 15 mg ketorolac) and multimodal analgesics (oxycodone, tramadol, ketorolac; narcotics as needed) or hydromorphone PCA. The multimodal group had lower VAS scores, fewer adverse effects, lower narcotic usage, higher satisfaction scores and earlier times to physical therapy milestones. Multimodal pain management protocol decreases narcotic usage, improves pain scores, increases satisfaction and enhances early recovery.

2. **Davies AF et al** [36] conducted a prospective randomized control study in Sixty patients undergoing unilateral knee replacement who were randomly grouped to receive either a lumbar epidural infusion or combined single-shot femoral (3-in-1) and sciatic blocks (combined blocks). All patients received standard general anaesthesia. In both groups, pain on movement was well controlled at discharge from recovery and 6 h postoperatively but increased

at 24 and 48 h. VAS pain scores with the combined blocks were significantly lower at 24 h (P=0.004). Total morphine usage was low in both groups: median epidural group 17 mg (8-32) versus combined blocks 13 mg (7.8-27.5). Patient satisfaction was high in both groups. Perioperative blood loss and rehabilitation indices were also similar. It was concluded that combined femoral (3-in-1) and sciatic blocks offer a practical alternative to epidural analgesia for unilateral knee replacements.

3. **Parvataneni HK et al** [37] compared peri-articular local anaesthetic infiltration with patient controlled analgesia with or without femoral nerve block for post-operative pain relief, recovery of functional milestone and overall satisfaction among patients undergoing THA & TKA. Among THA group significantly lower pain scores and higher overall satisfaction were noted than the control group. Among TKA group no difference in pain score was noted. Both group noted decrease in narcotic consumption.

4. **David H. Kim et al** [38] conducted a prospective randomized controlled trial to compare the post-operative analgesia, opioid consumption and quadriceps femoris strength of adductor canal block (ACB) with femoral nerve block (FNB) in patients undergoing total knee arthroplasty. Forty-six patients

received ACB; 47 patients received FNB. At 6 to 8 h post anaesthesia, ACB patients had significantly higher median dynamometer readings versus FNB patients, but was not inferior to FNB with regard to Numeric Rating Scale pain scores (1.0 [0.0, 3.5] ACB vs. 0.0 [0.0, 1.0] FNB; P = 0.019), or to opioid consumption (32.2 [22.4, 47.5] ACB vs. 26.6 [19.6, 49.0]; P = 0.0115). At 24 and 48 h post anaesthesia, there was no significant statistical difference in dynamometer results, pain scores, or opioid use between the two groups. At 6 to 8 h post anaesthesia, the ACB, compared with the FNB, exhibited early relative sparing of quadriceps strength and was not inferior in both providing analgesia and opioid intake.

5. **Q.J. Tong et al** [3] did comparative study of adductor canal block with local infiltration analgesia in total knee arthroplasty to determine which technique provides better post-operative analgesia and enabling early post-operative rehabilitation. Statistically significant reduction of 24 hour post-operative Morphine consumption was seen in patient group who received ACB with no statistically significant difference in resting & dynamic pain scores, 30 seconds chair stand test and TUG test which measures the functional strength of quadriceps femoris.

6. **Mathew. J. Grosso et al** [5] did comparative study of Adductor Canal block with periarticular Bupivacaine injection for total knee arthroplasty. The mean VAS pain score & opioid consumption on POD 1 and POD 3 was significantly higher in the ACB group than the PAI alone and PAI + ACB group. There was no statistical difference in Opioid consumption between the patients treated with PAI alone and those who received ACB + PAI.

7. **Henning Lykke Andersen et al** [39] conducted double-blind randomized controlled trial in 40 patients to compare the combination of a saphenous nerve block with single-dose LIA with LIA alone in patients undergoing TKA. Worst pain scores during movement on the day of surgery were significantly lower in the ropivacaine group VAS score, 3 [0–7] vs 5.5 [0–10]; $P < 0.050$), as well as pain at rest (visual analogue scale, 2 [0–8] vs 4 [0–8]; $P = 0.032$). Breakthrough pain occurred later in the ropivacaine group (10.5 [range, 0.5–48] hours vs 3.4 [range, 0.5–24] hours; $P = 0.011$). All patients in the ropivacaine group were able to ambulate on the day of surgery versus 13 patients in the control group ($P = 0.004$). Fewer patients had sleep disturbance on the first postoperative night in the ropivacaine group ($P = 0.038$). No differences in morphine consumption was noted. The

combination of a saphenous nerve block with single-dose LIA offered better pain relief on the day of surgery than LIA alone.

8. **W. Kampitak et al** [4] conducted a randomized controlled trial to compare Adductor Canal Block versus Local Infiltration Analgesia on Postoperative Pain and Functional Outcome after Total Knee Arthroplasty. Median total morphine consumption over 24 and 48 postoperative hours of ACB group were significantly less than LIA (6/10 mg vs 13/25 mg, p, 0.008 and 0.001, respectively). Similarly, ACB group had significantly lower VAS at postoperative 6, 12 and 18 hours, VAS at ambulation on postoperative (POD) 1-3, better TUG tests on POD 2 and during POD 3 than those of LIA group. However, quadriceps strength and patient satisfaction were not different between both groups. It was concluded that patients undergoing TKA with single-injection ACB required less postoperative opioids than those with LIA. Furthermore, multimodal analgesia using ACB provided better postoperative analgesia, as well as performance-based activities, than those with LIA.

9. **Phillips J et al** [40] conducted a retrospective study of 86 patients who received the LB mixture + ACB, and 86 historical controls who received non-liposomal bupivacaine and femoral nerve block to determine

postoperative opioid requirements, pain scores, and functional outcomes in patients undergoing total knee arthroplasty. Compared with controls, patients in the LB mixture group were more likely to require minimal assistance or better when going from a sitting to a standing position by postoperative day 1 (POD; 99% vs 81%, P = 0.0001) and POD 2 (90% vs 77%, P = 0.0212). There were no differences between groups with regard to discharge disposition or safety outcomes. The LB mixture was effective in reducing opioid use and improving functional outcomes compared with historical controls.

10. **Sankineani SR et al** [41] conducted a comparative study of adductor canal block and IPACK block (interspace between the popliteal artery and the capsule of the posterior knee) with adductor canal block alone after total knee arthroplasty. VAS score showed significantly ($p < 0.005$) better values in ACB + IPACK group compared to the ACB group. The mean ROM of knee and ambulation distance also showed significantly better values in ACB + IPACK group compared to the ACB group. It was concluded that ACB + IPACK is a promising technique that offers improved pain management in the immediate postoperative period without affecting the motor function around the knee joint resulting in better ROM and ambulation compared to ACB alone.

10. MATERIALS AND METHODS

This study was conducted on 60 patients presenting for knee surgeries at Rajiv Gandhi Government General Hospital attached to Madras Medical College, Chennai after the approval of Institution Ethics committee over a period of 6 months during October 2018 – March 2019. Patients were described about the procedure in detail and informed consent was obtained in writing.

Study design

This was a randomized prospective, comparative study. Randomization was carried out by allocating the patients to either adductor canal block (Group 1) or local infiltration analgesia (Group 2) using random numbers generated by computer. Patients were divided into groups of 30 each.

Group 1- USG guided adductor canal block

Group2- Local infiltration analgesia

Sample size

$$n = 2(z\alpha + z\beta)^2 \sigma^2/d^2$$

σ = combination of SD $Z\alpha$ = 1.96 at 95% confidence level

$Z\beta$ = 0.84 at 80% Power d = Mean difference between groups

Inclusion criteria:

- Age - 18 years to 75 years
- ASA - I, II.
- Surgery - Elective knee surgeries
- Patients who give valid informed consent

Exclusion criteria:

- Patients not satisfying inclusion criteria
- Patients with advanced respiratory and cardiac insufficiency, history of major neurological deficits in operated limb.
- Allergy to local anaesthetics or opioids.
- Cemented arthroplasty, revision arthroplasty
- Local infection, bleeding tendency due to anticoagulant therapy
- Lack of written informed consent
- Renal failure, preoperative DVT, chronic pain requiring opioid medication.
- Patient with previous history of lower limb surgery.

Pre-anaesthetic evaluation

During pre-anaesthetic assessment detailed history was obtained and complete physical examination was carried out. Complete blood count, Blood grouping & typing, ECG, renal function test, Random Blood Sugar and chest X-ray were done. Baseline TUG test to measure the functional outcome was carried out. Patients not fulfilling the inclusion criteria were excluded from the study.

Materials

The following equipments and drugs were kept ready for the conduct of anaesthesia

Equipments

1. Anaesthesia workstation
2. AMBU bag
3. Multichannel monitor
4. Laryngoscope with all sizes of blades
5. Endotracheal tubes of size 6mm to 8.5mm ID
6. Oropharyngeal airways
7. Laryngeal mask airway size 3 & 4
8. Suction apparatus

9. Bain circuit
10. Oxygen source
11. Ultrasound machine with high frequency (6-12 MHz) Linear probe
12. Sevoflurane vaporizer
13. 25G Quincke's needle
14. 18G and 22G IV cannula
15. Sterile gauze pads
16. Syringes (2ml,5ml, 10ml)
17. Sterile drapes

Drugs

1. Povidone iodine solution
2. Surgical spirit
3. Inj. 2% Lignocaine
4. Inj. 0.5% Hyperbaric Bupivacaine
5. Inj. 0.5% Bupivacaine

Monitors

1. ECG
2. Pulse Oximetry
3. Non-invasive blood pressure

4. Blood loss
5. Fluids administered
6. Urine Output
7. Temperature

Emergency drugs

1. Inj. Adrenaline
2. Inj. Atropine
3. Inj. Dopamine
4. Inj. Hydrocortisone
5. Inj. Nitroglycerine
6. Inj. Ephedrine
7. Inj. Furosemide
8. Inj. Deriphylline

PROCEDURE

All the patients subjected to the study were examined in our pre-anaesthetic assessment clinic. Patients who satisfied the inclusion criteria were only included in the study. Informed consent was obtained from the patient in writing. Patients were allocated into 2 groups randomly comprising of 30 patients each.

Randomization was carried out using computer generated numbers by allocating the patients either to group 1 (ultrasound guided adductor canal block) or group 2 (local infiltration analgesia). Preoperatively patients were given Tab. Metoclopramide 10mg, Tab. Alprazolam 0.5mg and Tab. Ranitidine 150mg and on the night before surgery. As per the standard guidelines patient were kept nil per oral. On the day of surgery patients were shifted to the premedication room. Intravenous line was secured using 18G IV cannula and Ringer Lactate was started at the rate of 2ml/kg/hr. NIBP, ECG, SPO_2 , temperature monitors were connected and baseline values were recorded when the patient arrived in the operating room. Laryngoscope with all size blades, AMBU BAG, appropriate size endotracheal tubes, Laryngeal Mask airways, Oropharyngeal airway and all the emergency drugs were kept ready. Anaesthesia work station was checked for normal functioning. All patients in the study received spinal anaesthesia with hyperbaric bupivacaine (0.5%) using 25G Quincke's needle while the subjects where lying lateral with the operating side being in the dependent position. After assessing the level of block TKA was done using a standard surgical method and use of thigh tourniquet. At the end of the procedure the patients were given either local infiltration analgesia or USG guided adductor canal block based on groups allocated by random numbers.

Group 1 (USG guided adductor canal block)

Immediately after the completion of surgery, under all aseptic precautions 6-12 MHz USG probe was placed transversely on the antero-medial aspect of mid--thigh to obtain a short axis view of the adductor canal. The needle tip is placed just anterior to the femoral artery deep to the Sartorius muscle by in plane technique and 0.5% bupivacaine (3mg/kg- upto 20ml) is deposited until its spread around the artery is confirmed with ultrasound visualization.

Group 2 (Local infiltration analgesia):

Intra-operatively the local infiltration analgesia group received local infiltration of 0.5% bupivacaine (3mg/kg), 5mg morphine, and adrenaline 200mcg in a total volume of 50 ml by the surgeon.

OUTCOMES MEASURED

Primary Outcome:

Assessment of postoperative pain using visual analogue scale pain score

Secondary outcome:

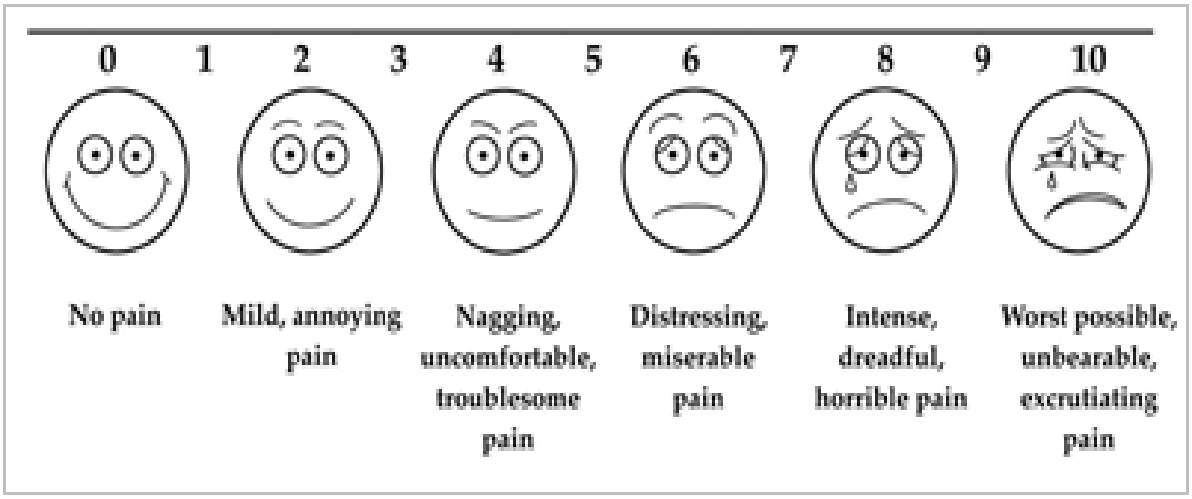
1. To evaluate the time to first rescue analgesic administration.
2. To assess complications.
3. To assess the functional outcome using TUG test.

Primary Outcome Measures

Postoperative pain was assessed at 4, 12 and 24 hours from the time of administration of the block using visual analogue scale pain score.

Visual Analogue Score

The pain VAS is a continuous scale comprised of horizontal (HVAS) or vertical (VVAS) line or a usually 10 centimetres (100 mm) in length, anchored by 2 verbal descriptors, one for each symptom extreme. For pain intensity, the scale is most commonly anchored by "worst imaginable pain" (score of 100 [100- mm scale]) and "no pain" (score of 0). To avoid clustering of scores around a preferred numeric value, and verbal descriptors and numbers at intermediate points are not recommended.



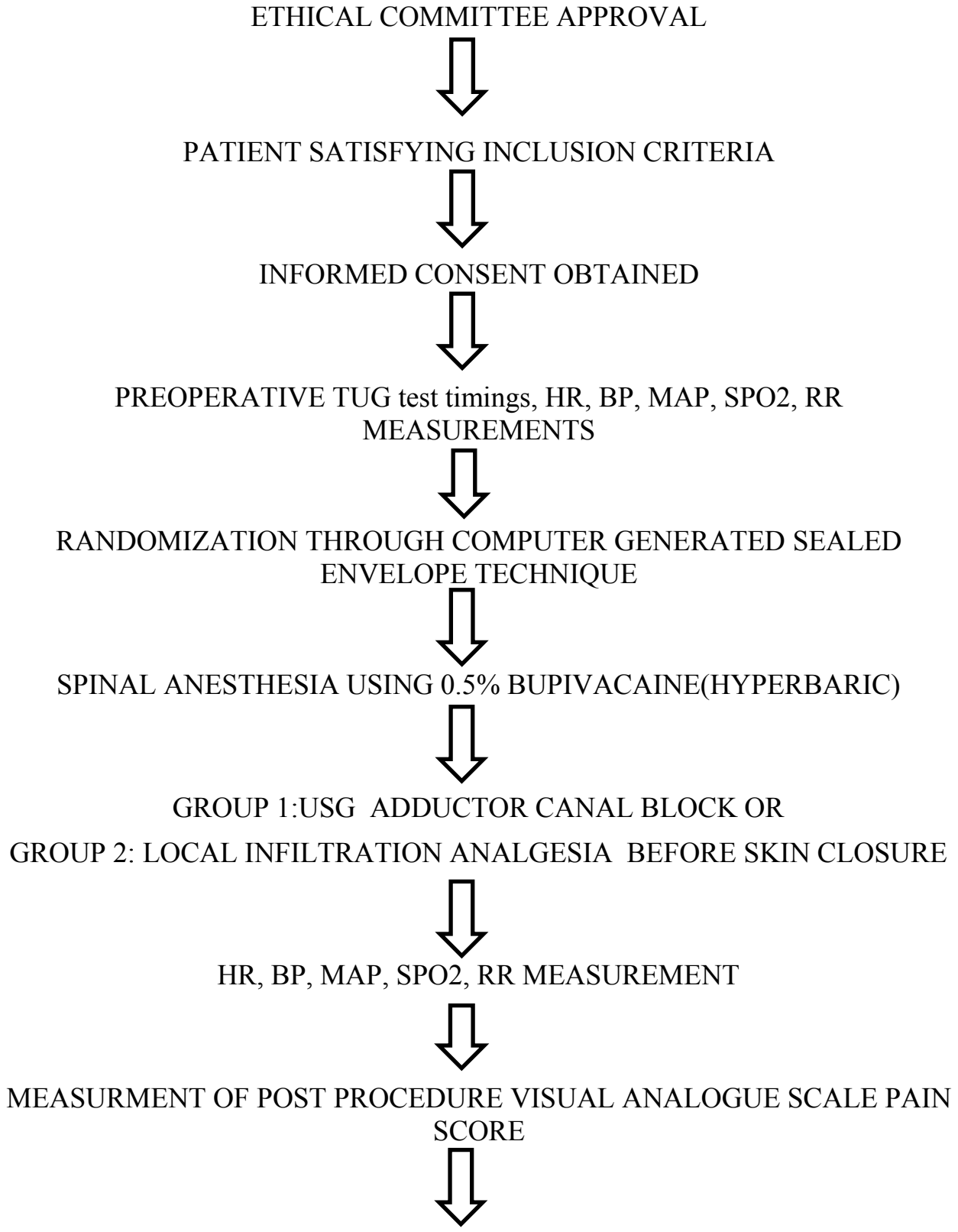
Secondary outcome measures:

a) **Time to first rescue analgesia:** Rescue analgesia of injection Tramadol 100 mg was given intramuscularly when the postoperative pain scores as measured by visual analogue scale is greater than or equal to 4.

b) **Assess for complications:** Patients were observed for signs of complications such as nausea, vomiting and excessive sedation. *Nausea* was defined as the unpleasant sensation associated with awareness of the urge to vomit. *Vomiting* was defined as the forceful expulsion of gastric contents from the mouth. The presence or absence of nausea and number of episodes of vomiting (more than 10ml) were recorded. *The level of sedation* was assessed on a 4 point scale (0 = no sedation, 1 = light, 2 = moderate, 3 = severe).

c) **Assess functional outcome:** Patients functional outcome was assessed using TUG test at 24 hours (i.e. - the time taken for each subject to get up from a seated position on the chair, walk 3 meters away from chair before returning to it).

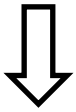
METHODOLOGY



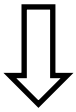
MEASUREMENT OF STUDY OUTCOME

- SIDE EFFECTS
- TO EVALUATE THE REQUIREMENT OF SYSTEMIC ANALGESICS
- TO ASSESS FUNCTIONAL OUTCOME – TUG SCORE

DATA COMPILATION



STATISTICAL ANALYSIS



CONCLUSION

11. OBSERVATON, RESULTS AND ANALYSIS

This study was conducted at MMC – Rajiv Gandhi Government General Hospital, Chennai from October 2018 to March 2019 for a period of six months on 60 patients belonging to ASA PS I & II who underwent TKA, to compare postoperative pain relief between Ultrasound-guided adductor canal block and local infiltration analgesia.

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent groups (ACB & LIA) the unpaired t-test and the Mann-Whitney U test was used. To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value .05 is considered as significant level.

DEMOGRAPHIC PROFILE

I. Age distribution

Comparison between Age (yrs.) with Groups						
			Groups		Total	P-value
			ACB	LIA		
AGE(yrs.)	Upto 40 yrs.	Count	4	2	6	0.799 #
		%	13.3%	6.7%	10.0%	
	41 - 50 yrs.	Count	3	4	7	
		%	10.0%	13.3%	11.7%	
	51 - 60 yrs.	Count	12	14	26	
		%	40.0%	46.7%	43.3%	
	Above 60 yrs.	Count	11	10	21	
		%	36.7%	33.3%	35.0%	
Total		Count	30	30	60	
		%	100.0%	100.0%	100.0%	

Table: 1. Age distribution between groups

P-value is 0.799 which is not statistically significant

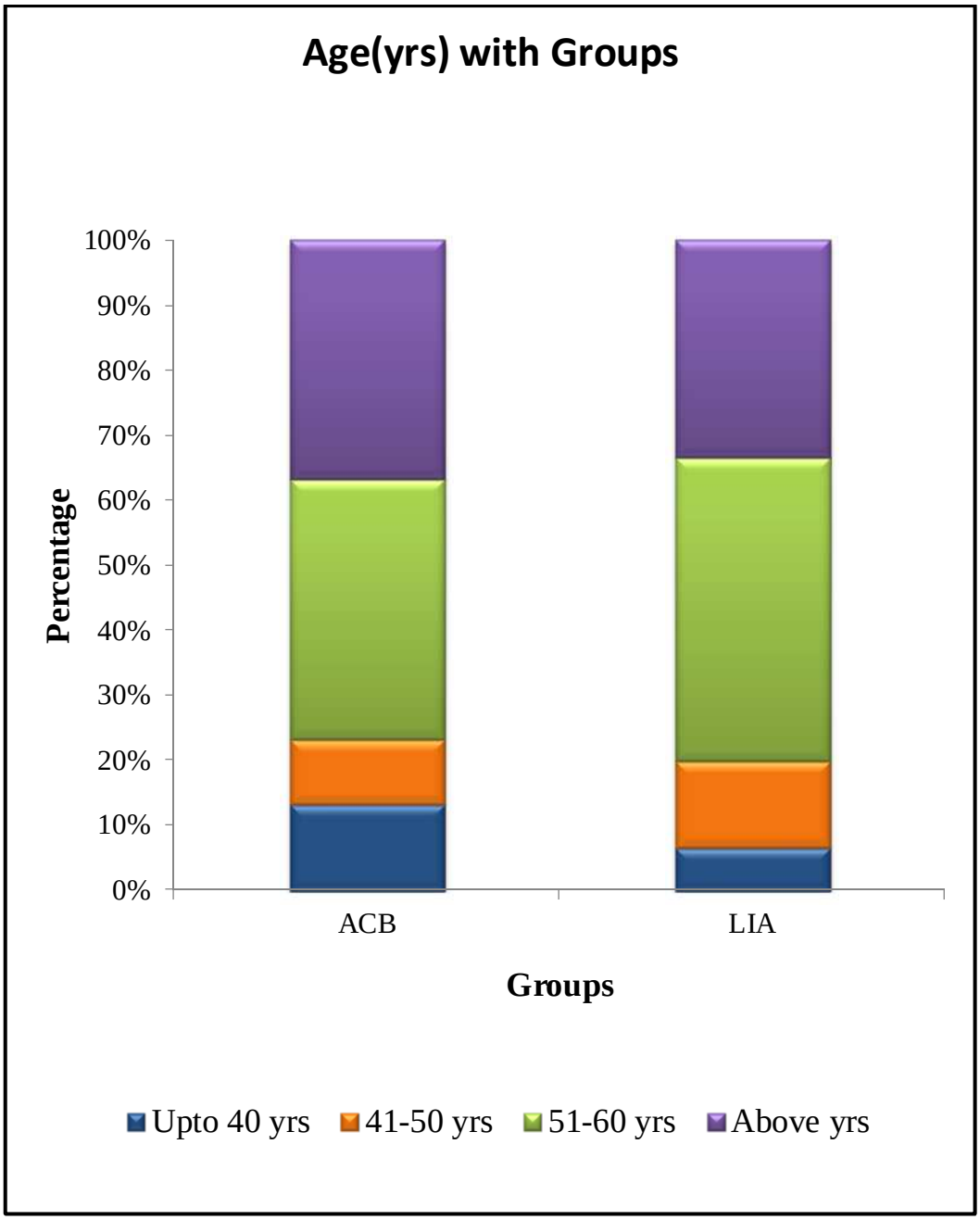


Fig: 17. Graphical representation of age distribution between two groups

II. Gender Distribution

Comparison between Gender with Groups						
			Groups		Total	P-value
			ACB	LIA		
SEX	Female	Count	17	14	31	0.606 #
		%	56.7%	46.7%	51.7%	
	Male	Count	13	16	29	
		%	43.3%	53.3%	48.3%	
Total		Count	30	30	60	
		%	100.0%	100.0%	100.0%	

Table: 2. Gender distribution between Groups

P-value is 0.606 which is not statistically significant.

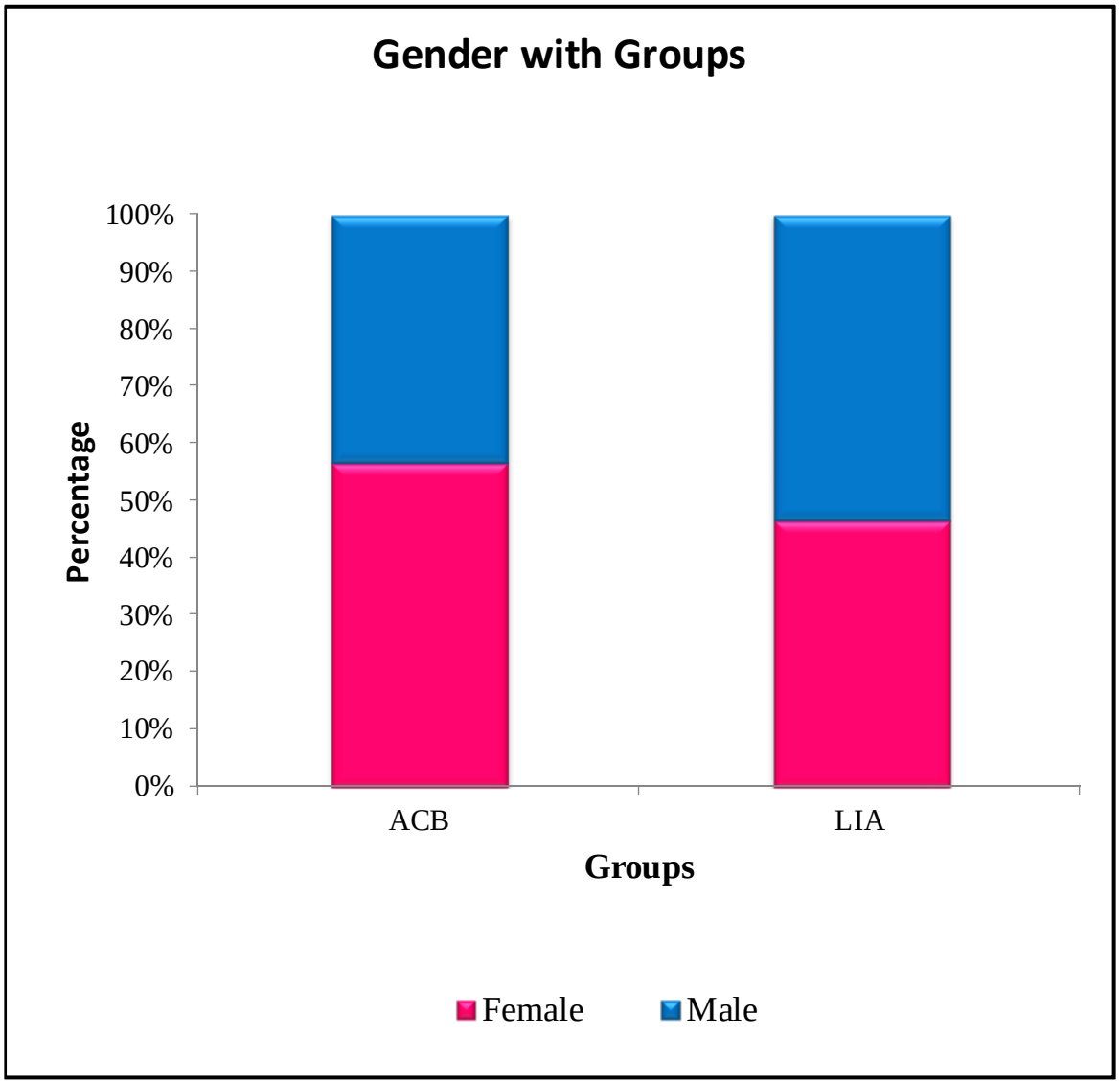


Fig: 18. Graphical representation of gender distribution between two groups

III. ASA PS distribution

Comparison between ASA PS with Groups						
			Groups		Total	P-value
			ACB	LIA		
ASA PS	I	Count	16	13	29	0.606 #
		%	53.3%	43.3%	48.3%	
	II	Count	14	17	31	
		%	46.7%	56.7%	51.7%	
Total		Count	30	30	60	
		%	100.0%	100.0%	100.0%	

Table: 3. ASA PS status distribution between groups

P-value is 0.606 which is not statistically significant.

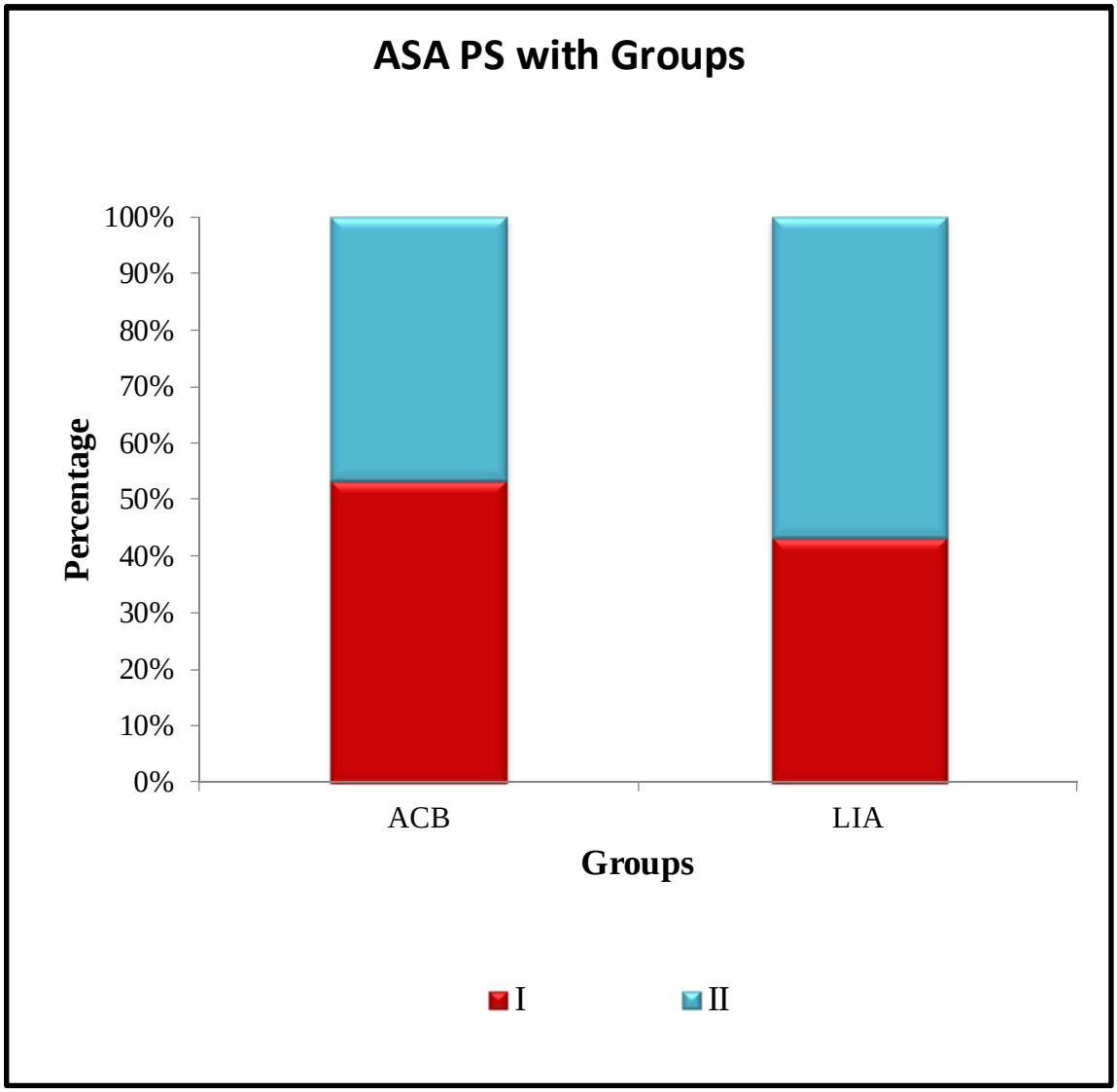


Fig: 19. Graphical representation of ASA PS status distribution between two groups

IV. Weight distribution

Comparison of Weight(Kg) between groups					
Groups		**N**	**Mean**	**S.D**	**P-value**
WEIGHT	**ACB**	30	63.67	3.92	0.349 #
	LIA	30	64.67	4.27	

Table: 4. Weight distribution between groups

P-value is 0.349 which is not statistically significant

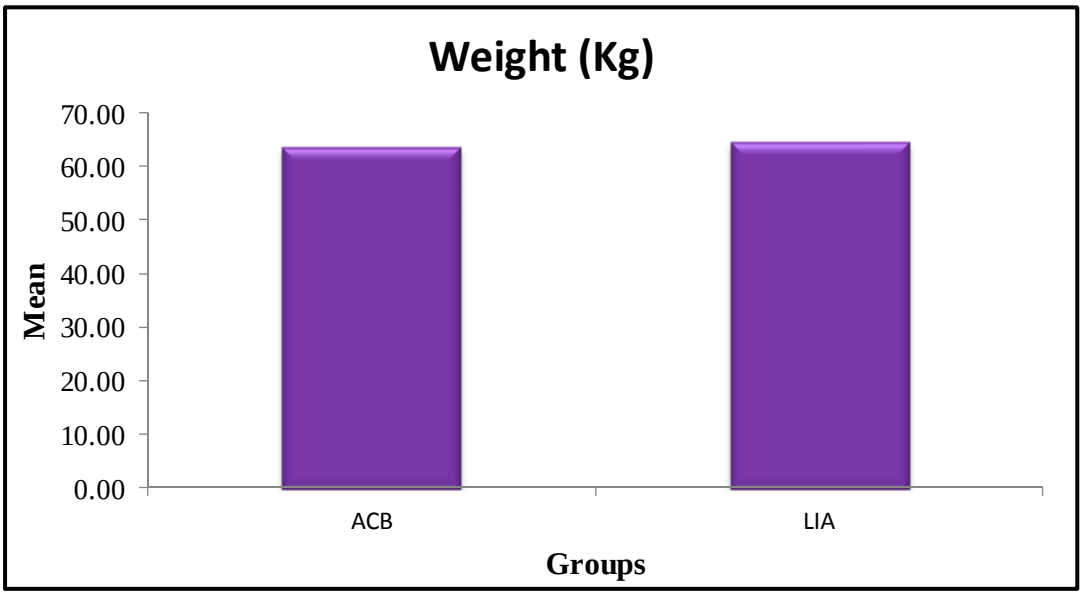


Fig: 20. Graphical representation of weight distribution between two groups

STUDY VARIABLES

I. Visual analogue score

Comparison of VAS by Mann-Whitney Test					
Groups		**N**	**Mean**	**S.D**	**P-value**
VAS 4 hour	**ACB**	30	1.00	1.46	0.637 #
	LIA	30	1.13	1.46	
VAS 12hour	**ACB**	30	2.33	1.75	0.194 #
	LIA	30	3.00	1.88	
VAS 24hour	**ACB**	30	4.07	2.49	0.028 *
	LIA	30	5.27	1.34	

Table: 5. Comparison of VAS pain score (4, 12, 24 hours) between two groups

A. VAS pain score at 4 hours

Mean VAS score at 4 hours in ultrasound ACB group was 1.00 and 1.13 in LIA group. P value was 0.637 which was not statistically significant.

B. VAS pain score at 12 hours

Mean VAS score at 12 hours in ultrasound ACB group was 2.33 and 3.00 in LIA. P value was 0.194 which was not statistically significant.

C. VAS pain score at 24 hours

Mean VAS score at 24 hours in ultrasound ACB group was 4.07 and 5.27 in LIA. P value was 0.028 which was statistically significant.

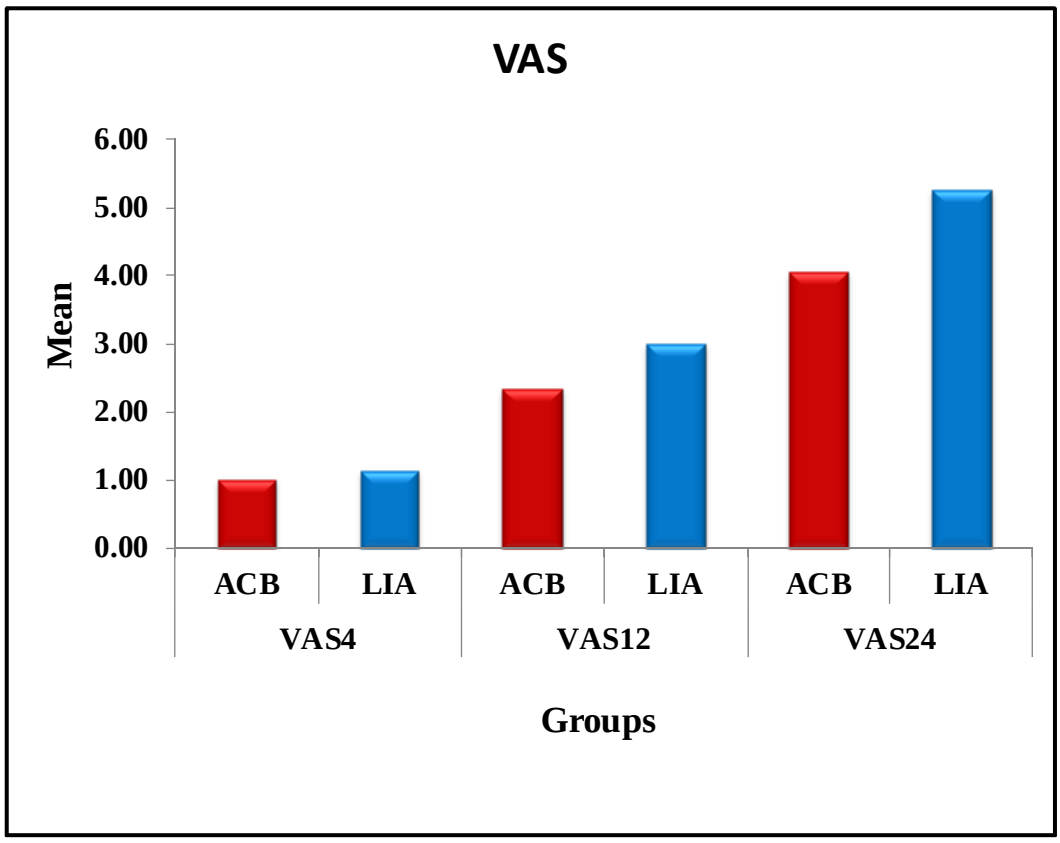


Fig: 21. Graphical representation of VAS pain scores at 4, 12, 24 hours of both groups

II. Time of Rescue Analgesia

Comparison of Time of Rescue Analgesia (Hours) by Unpaired t-Test					
Groups		**N**	**Mean**	**S.D**	**P-value**
TIME OF RA(hours)	**ACB**	30	16.83	6.45	0.005 **
	LIA	30	12.67	4.23	

Table: 6. Comparison of Time of Rescue Analgesia between two groups

P-value is 0.005 which is statistically highly significant

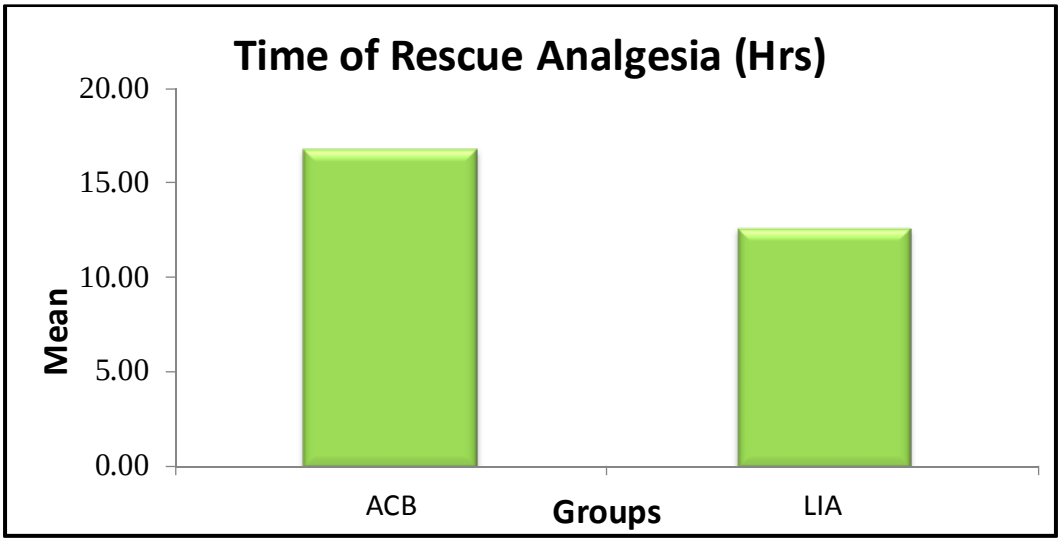


Fig: 22. Graphical representation of time of rescue analgesia of both groups

III. Complications

There were no complications noticed in any of the patients in of both groups.

IV. TUG test timings

TUG test comparison between the groups by Unpaired t-test					
Groups		**N**	**Mean**	**S.D**	**P-value**
Pre-op	**ACB**	30	19.17	2.135	0.533 #
	LIA	30	18.63	2.822	
Post-op 24 hours	**ACB**	30	117.87	8.328	0.291 #
	LIA	30	120.37	9.771	

Table: 7. Comparison of per-op and post-op TUG test timings between two groups

P-value of post-op TUG score is 0.291 which is not statistically significant

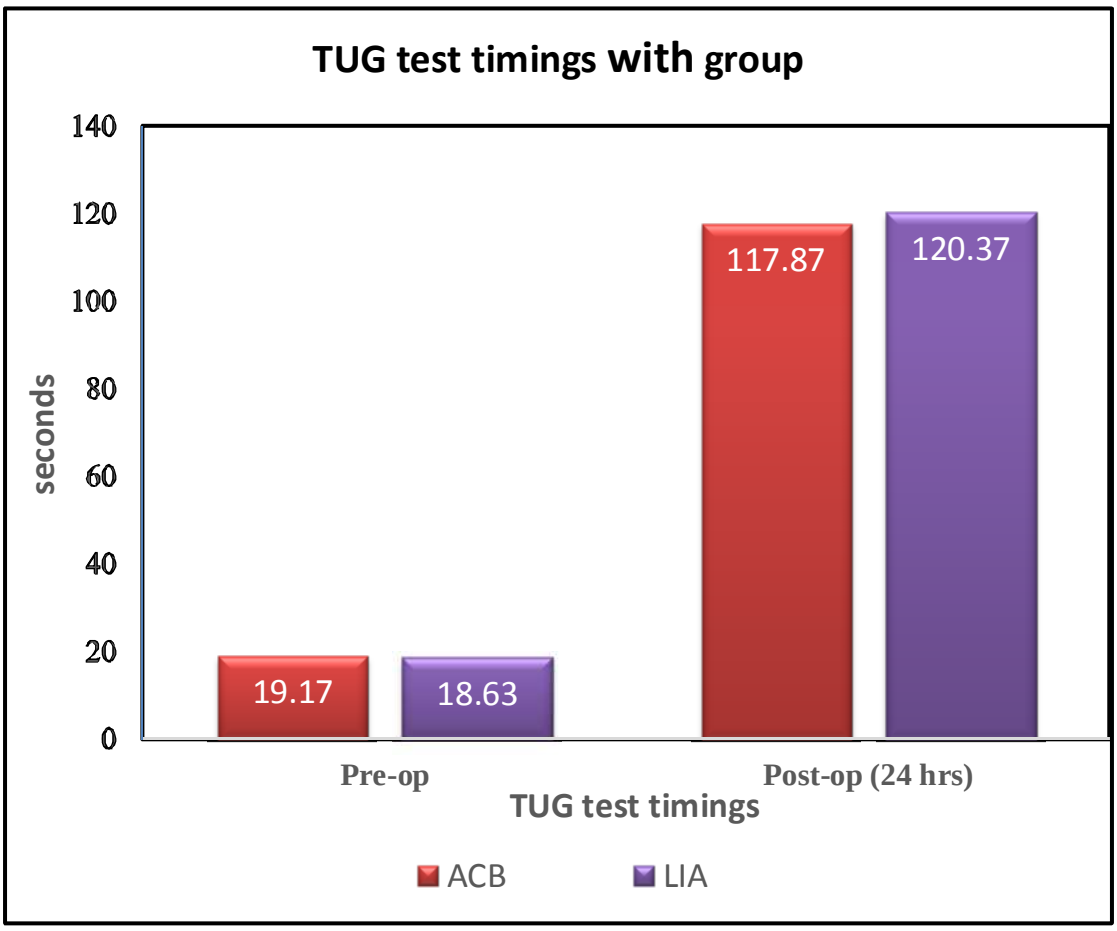


Fig: 23 Graphical representation of TUG test timings

(pre-op & 24 hours post-op) of both groups.

12. DISCUSSION

Postoperative pain is often overlooked with up to 70% of patients reporting moderate to severe pain following surgery. Pain control is of prime importance in improving the quality of patient care. Regional nerve block techniques offer superior postoperative pain relief and facilitates early ambulation and discharge. Ultrasound guided blocks enables accurate placement of needle thereby improving the success rate and it also reduces the complications due to inadvertent injury to vital structures in landmark based techniques.

Acute postoperative pain following Total Knee Arthroplasty is maximum during the first 24 hours. Various modalities have been adopted to reduce this post-operative pain with NSAIDs, parenteral opioids, central neuraxial analgesia, femoral nerve block, ACB and LIA with varying results. Among these techniques ACB block and LIA are effective and easy to perform with least complications.

While there are few studies [3-5] comparing ultrasound guided ACB block with LIA for postoperative pain relief and functional outcome, the results of those studies have contrasting inferences.

We conducted this randomized prospective study to compare the efficacy of USG guided ACB block with local infiltration analgesia in providing postoperative pain relief and improving functional outcomes in patients undergoing total knee arthroplasty done under spinal anaesthesia. In this study we planned to test the hypothesis that USG guided ACB block would provide superior postoperative analgesia without having any negative impact on the functional outcome in comparison with local infiltration analgesia.

We compared the VAS pain scores between USG guided ACB block and local infiltration analgesia over a period of 24 hours. In addition time to first rescue analgesia, Timed Up to Go test time and complications associated with the procedure were evaluated between the two groups. Sample size selected was 60.As far as the inclusion criteria was concerned, 60 patients between the ages of 18-75 years were selected. As far as ASA physical status was concerned, ASA PS I & II patients were included in the study. Patients who were excluded from the study were, patients with advanced cardiac and respiratory insufficiency, history of major neurological deficits in operated limb, allergy to local anaesthetics or opioids, local infection, bleeding tendency due to anticoagulant therapy, patient refusal, renal failure, preoperative DVT and chronic pain requiring opioid medication.

Patients from both the groups were analysed for the demographic profile. Patients mean age and standard deviation were comparable between the two groups. The gender distribution and mean weight were similar between the two groups and the P-value computed using student-t-test was insignificant. So the demographic profile as computed by student-t-test and chi-square test were comparable between the groups. ASA status were similar in both groups. All patients in the study were given spinal anaesthesia. After assessing the level of block TKA was done using a standard surgical method and use of thigh tourniquet. At the end of the procedure the patients were given either local infiltration analgesia or USG guided adductor canal block based on groups allocated by random numbers.

Group 1 patients received USG guided ACB block using 0.5% Bupivacaine (3mg/kg – upto 20ml). Group 2 patients were given local infiltration of 0.5% bupivacaine (3mg/kg), 5mg morphine, and adrenaline 200mcg in a total volume of 50 ml by the surgeon. The primary outcome measure that was compared between the groups, was the pain scores graded by visual analogue scores. The VAS scores were graded on a 0-10 cm scale. VAS scores were noted at 4, 12 and 24 hours post-operatively from the time of block. The mean VAS scores measured at 4 hours (Group 1 – 1.00 and Group 2 - 1.13) and 12 hours (Group 1 – 2.33 and

Group 2 – 3.00) were comparable between both the groups. The P-value (0.637 & 0.194) calculated was statistically not significant. But the mean VAS score measured at 24 hours (Group 1 – 4.07 and Group 2 – 5.27) with P-value of 0.028 which was statistically significant. Hence USG guided ACB block was superior to local infiltration analgesia in providing better long lasting analgesia, especially at 24 hours.

One of the secondary outcomes measured was the time to first rescue analgesia. Rescue analgesia was given on patients demand as per the patient's requirement. Rescue analgesia was given when VAS scores were greater than or equal to 4. Injection ondansetron 4mg was given before administering injection Tramadol 100mg IV. The mean time for rescue analgesia in group 1 (USG guided ACB) was 16.83 hours and in group 2 (local infiltration analgesia) was 12.67 hours with P- value of 0.005 which was highly significant. Hence USG guided ACB block provides analgesia for longer duration in the postoperative period compared to local infiltration analgesia.

The next secondary outcome measured was assessment of complications both groups. No complications were observed in both groups.

Other secondary outcome measured was TUG test timings. The mean TUG test time in group 1 (USG guided ACB) was 117.87 seconds and in group 2 (local infiltration analgesia) was 120.37 with P-value of 0.291 which was not significant. Hence USG guided ACB block has comparable recovery of functional outcome with that of local infiltration analgesia.

In our study, we observed that USG guided ACB block provided superior analgesia at 24 hours and the time to first rescue analgesia was prolonged than local infiltration analgesia without having a negative impact on the functional outcome which was similar to Q.J. Tong et al[3] and W. Kampitak et al[4] studies which concluded that USG guided ACB block provided better post-operative analgesia in terms of reduced morphine consumption in the first 24 hours and 48 hours than local infiltration analgesia without having negative impact on the functional outcome in TKA patients.

This was in contrast to the MJ Grosso et al [5] study which concluded that mean VAS pain score & opioid consumption on POD 1 and POD 3 was significantly higher in the ACB group than the PAI alone and PAI + ACB group.

13. SUMMARY

Osteoarthritis of knee is a common condition and TKA is the gold standard treatment. Post-operative pain management is of paramount importance in patients undergoing TKA to reduce the post-operative morbidity. At present LIA and ACB are the two most commonly used modes of management. This study was conducted to compare these two techniques on factors such as efficacy, time for rescue analgesia, complications and their impact on functional outcome.

The following observations were made

- Mean VAS pain score at 4 hours and 12 hours in the post-operative period were similar between ACB and LIA group and was statistically insignificant.
- Mean VAS pain score of ACB group at 24 hours in the post-operative period was significantly lower than the corresponding mean VAS pain score of LIA group which was statistically significant.
- Mean time of rescue analgesia was considerably higher in the ACB group than LIA group which was statistically significant.
- Mean TUG test timings were similar between ACB and LIA group which was statistically insignificant.

14. CONCLUSION

In our randomized study of comparison between ultrasound guided adductor canal block and local infiltration analgesia in knee surgeries, to assess the analgesic efficacy in postoperative period we conclude that post-operative pain relief at 4 hours and 12 hours, the functional outcome were comparable in both groups, but in the USG guided Adductor Canal block group there was better pain relief at 24 hours post-operatively and the need for first rescue analgesia was delayed.

15. BIBLIOBRAPHY

1. Chan EY, Fransen M, Parker DA, Assam PN, Chua N. Femoral nerve blocks for acute postoperative pain after knee replacement surgery. Cochrane Database Syst Rev 2014.
2. Pinedo-Villanueva R, Khalid S, Wylde V, Gooberman-Hill R, Soni A, Judge A. Identifying individuals with chronic pain after knee replacement: a population-cohort, cluster-analysis of Oxford knee scores in 128,145 patients from the English National Health Service.
3. Tong QJ, Lim YC, Tham HM. Comparing adductor canal block with local infiltration analgesia in total knee arthroplasty: A prospective, blinded and randomized clinical trial.
4. Kampitak W, Tanavalee A, Ngarmukos S, Amarase C, Songthamwat B, Boonshua A. Comparison of Adductor Canal Block versus Local Infiltration Analgesia on Postoperative Pain and Functional Outcome after Total Knee Arthroplasty: A Randomized Controlled Trial**.**
5. Grosso MJ, Murtaugh T, Lakra A, Brown AR, Maniker RB, Cooper HJ, Macaulay W, Shah RP, Geller JA Adductor Canal Block Compared with Periarticular Bupivacaine Injection for Total Knee Arthroplasty: A Prospective Randomized Trial.

6. Ilfeld BM, Duke KB, Donohue MC. The association between lower extremity continuous peripheral nerve blocks and patient falls after knee and hip arthroplasty. Anesth Analg 2010;111:1552–4.

7. Jaeger P, Grevstad U, Henningsen MH, Gottschau B, Mathiesen O, Dahl JB. Effect of adductor-canal-blockade on established, severe post-operative pain after total knee arthroplasty: a randomised study. Acta Anaesthesiol Scand 2012;56:1013–9.

8. Jenstrup MT, Jaeger P, Lund J, Fomsgaard JS, Bache S, Mathiesen O, et al. Effects of adductor-canal-blockade on pain and ambulation after total knee arthroplasty: a randomized study. Acta Anaesthesiol Scand 2012;56:357–64.

9. Jaeger P, Nielsen ZJ, Henningsen MH, Hilsted KL, Mathiesen O, Dahl JB. Adductor canal block versus femoral nerve block and quadriceps strength: a randomized, double-blind, placebo-controlled, crossover study in healthy volunteers. Anesthesiology 2013;118:409–15.

10. Jaeger P, Zaric D, Fomsgaard JS, Hilsted KL, Bjerregaard J, Gyrn J, et al. Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty: a randomized, double-blind study. Reg Anesth Pain Med 2013;38:526–32.

11. Kehlet H, Andersen LO. Local infiltration analgesia in joint replacement: the evidence and recommendations for clinical practice. Acta Anaesthesiol Scand 2011;55:778–84.

12. Essving P, Axelsson K, Kjellberg J, Wallgren O, Gupta A, Lundin A. Reduced hospital stay, morphine consumption, and pain intensity with local infiltration analgesia after unicompartmental knee arthroplasty. Acta Orthop 2009; 80:213–9.

13. Andersen LO, Husted H, Otte KS, Kristensen BB, Kehlet H. High-volume infiltration analgesia in total knee arthroplasty: a randomized, double-blind, placebo-controlled trial. Acta Anaesthesiol Scand 2008;52:1331–5.

14. Niemelainen M, Kalliovalkama J, Aho AJ, Moilanen T, Eskelinen A. Single peri- articular local infiltration analgesia reduces opiate consumption until 48 hours after total knee arthroplasty. A randomized placebo-controlled trial involving 56 patients. Acta Orthop 2014;85:614–9.

15. Carli F, Clemente A, Asenjo JF, Kim DJ, Mistraletti G, Gomarasca M, et al. Analgesia and functional outcome after total knee arthroplasty: periarticular infiltration vs continuous femoral nerve block. Br J Anaesth 2010;105:185–95.

16. Tripuraneni KR, Woolson ST, Giori NJ. Local infiltration analgesia in TKA patients reduces length of stay and postoperative pain scores. Orthopedics 2011;34:173.

17. Mei S, Jin S, Chen Z, Ding X, Zhao X, Li Q. Analgesia for total knee arthroplasty: a meta-analysis comparing local infiltration and femoral nerve block. Clinics (Sao Paulo) 2015;70:648–53.

18. Gill SD, de Morton NA, Mc Burney H. An investigation of the validity of six measures of physical function in people awaiting joint replacement surgery of the hip or knee. Clin Rehabil 2012;26:945–51.

19. Yeung TS, Wessel J, Stratford PW, MacDermid JC. The timed up and go test for use on an inpatient orthopaedic rehabilitation ward. J Orthop Sports Phys Ther 2008;38(7):410.

20. Affas F, Nygards EB, Stiller CO, Wretenberg P, Olofsson C. Pain control after total knee arthroplasty: a randomized trial comparing local infiltration anesthesia and continuous femoral block. Acta Orthop 2011;82:441–7.

21. Andersen LO, Kehlet H. Analgesic efficacy of local infiltration analgesia in hip and knee arthroplasty: a systematic review. Br J Anaesth 2014;113:360–74.

22. Toftdahl K, Nikolajsen L, Haraldsted V, Madsen F, Tonnesen EK, Soballe K.Comparison of peri- and intraarticular analgesia with femoral nerve block

after total knee arthroplasty: a randomized clinical trial. Acta Orthop 2007;78:172–9.

23. Fan L, Zhu C, Zan P, Yu X, Liu J, Sun Q, et al. The comparison of local infiltration analgesia with peripheral nerve block following total knee arthroplasty (TKA): a systematic review with meta-analysis. J Arthroplast 2015;30:1664–71.

24. Perret M, Fletcher P, Firth L, Yates P. Comparison of patient outcomes in periarticular and intraarticular local anaesthetic infiltration techniques in total knee arthroplasty. J Orthop Surg Res 2015;10(119).

25. Spreng UJ, Dahl V, Hjall A, Fagerland MW, Raeder J. High-volume local infiltration analgesia combined with intravenous or local ketorolac + morphine compared with epidural analgesia after total knee arthroplasty. Br J Anaesth 2010;105:675–82.

26. Garcia JB, Barbosa Neto JO, Vasconcelos JW, Ferro LS, Silva RC. Analgesic efficacy of the intra-articular administration of high doses of morphine in patients undergoing total knee arthroplasty. Rev Bras Anestesiol 2010;60:1–12.

27. Andersen KV, Nikolajsen L, Haraldsted V, Odgaard A, Soballe K. Local infiltration analgesia for total knee arthroplasty: should ketorolac be added? Br J Anaesth 2013;111:242–8.

28. Affas F, Eksborg S, Wretenberg P, Olofsson C, Stephanson N, Stiller CO. Plasma concentration of ketorolac after local infiltration analgesia in hip arthroplasty. Acta Anaesthesiol Scand 2014;58:1140–5.

29. Dennis DA, Kittelson AJ, Yang CC, Miner TM, Kim RH, Stevens-Lapsley JE. Does tourniquet use in TKA affect recovery of lower extremity strength and function? A randomized trial. Clin Orthop Relat Res 2016;474:69–77.

30. Liu D, Graham D, Gillies K, Gillies RM. Effects of tourniquet use on quadriceps function and pain in total knee arthroplasty. Knee Surg Relat Res 2014;26:207–13.

31. Shah NA, Jain NP, Panchal KA. Adductor canal blockade following total knee arthroplasty-continuous or single shot technique? Role in postoperative analgesia, ambulation ability and early functional recovery: a randomized controlled trial. J Arthroplast 2015;30:1476–81.

32. Ng HP, Cheong KF, Lim A, Lim J, Puhaindran ME. Intraoperative single shot “3-in- 1” femoral nerve block with ropivacaine 0.25%, ropivacaine 0.5% or bupivacaine 0.25% provides comparable 48-hr analgesia after unilateral total knee replacement. Can J Anaesth 2001;48:1102–8.

33. Wong WY, Bjorn S, Strid JM, Borglum J, Bendtsen TF. Defining the location of the adductor canal using ultrasound. Reg Anesth Pain Med 2017;42:241–5.

34. Suma Vishwanatha and Sandhya Kalappa. Continuous Femoral Nerve Blockade versus Epidural Analgesia for Postoperative Pain Relief in Knee Surgeries: A Randomized Controlled Study.

35. Lamplot JD, Wagner ER, Manning DW. Multimodal pain management in total knee arthroplasty: a prospective randomized controlled trial.

36. Davies AF, Segar EP, Murdoch J, Wright DE, Wilson IH. Epidural infusion or combined femoral and sciatic nerve blocks as perioperative analgesia for knee arthroplasty.

37. Parvataneni HK1, Shah VP, Howard H, Cole N, Ranawat AS, Ranawat CS.Controlling pain after total hip and knee arthroplasty using a multimodal protocol with local periarticular injections: a prospective randomized study.

38. David H. Kim, M.D.; Yi Lin, M.D., Ph.D.; Enrique A. Goytizolo, M.D.; Richard L. Kahn, M.D.; Daniel B. Maalouf, M.D., M.P.H. Adductor Canal Block *versus* Femoral Nerve Block for Total Knee Arthroplasty: A Prospective, Randomized, Controlled Trial.

39. Henning Lykke Andersen, MD, Jens Gyrn, MD, Lars Moller, MD, Bodil Christensen, RN and Dusanka Zaric, MD, PhD. Continuous Saphenous Nerve Block as Supplement to Single-Dose Local Infiltration Analgesia for Postoperative Pain Management After Total Knee Arthroplasty.

40. Phillips J, Doshi A. Effects of Liposomal Bupivacaine with Adductor Canal Block on Pain and Functional Outcomes in Patients Undergoing Total Knee Arthroplasty.

41. Sankineani SR, Reddy ARC, Eachempati KK, Jangale A, Gurava Reddy AV Comparison of adductor canal block and IPACK block (interspace between the popliteal artery and the capsule of the posterior knee) with adductor canal block alone after total knee arthroplasty: a prospective control trial on pain and knee function in immediate postoperative period.

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.K.VENKATESH
I Year, MD (Anaesthesiology) Post Graduate,
Madras Medical College
Chennai – 600003.

Dear **Dr.** K.VENKATESH,

The Institutional Ethics Committee has considered your request and approved your study titled **"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES": A RANDOMIZED COMPARITIVE STUDY - NO:43052018**

The following members of Ethics Committee were present in the meeting held on **15.05.2018** conducted at Madras Medical College, Chennai 3

1. Prof.P.V.Jayashankar	:Chairperson
2. Prof.R.Narayana Babu,MD.,DCH., Dean,MMC,Ch-3	: Deputy Chairperson
3. Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4. Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
5. Prof.S.Mayilvahanan,MD,Director. Inst. of Int.Med,MMC. Ch-3	: Member
6. Prof.A.Pandiya Raj,Director, Inst. of Gen.Surgery,MMC	: Member
7. Prof.Shanthy Gunasingh, Directoe Inst.of Social Obstetrics, KGH	: Member
8. Prof.Rema Chandramohan,Prof.of Paediatrics,ICH.Chennai	: Member
9. Prof. Susila, Director. Inst. of Pharmacology,MMC,Ch-3	: Member
10.Prof.K.Ramadevi,MD., Director, Inst. of Bio-Chemistry,MMC,Ch-3	: Member
11.Prof.Bharathi Vidya Jayanthi,Director, Inst. of Pathology,MMC,Ch-3	: Member
12.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
13.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist
14.Thiru K.Ranjith, Ch- 91	: Lay Person

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

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary – Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

URKUND

Urkund Analysis Result

Analysed Document:	Venki ACB vs LIA Urkund.docx (D58238415)
Submitted:	11/4/2019 3:38:00 PM
Submitted By:	kempul4946@gmail.com
Significance:	24 %

Sources included in the report:

Thesis 5.11.18.docx (D43830863)
Final - corrected @16 Nov..docx (D44131879)
copy(2) 27.11.18 with plagiarism correction.docx (D44609013)
27.11.18.docx (D44597196)
copy 27.11.18 with plagiarism correction.docx (D44604873)
ALL FILES (2).docx (D43040602)
sakthi abirami thesis final copy.docx (D42444292)
thesis 1.docx (D31047042)
PELAGRISED REVISED.docx (D57177870)
PELAGRISED REVISED.docx (D56547412)
THESIS 1.docx (D42727358)
https://link.springer.com/article/10.1007/s00590-018-2218-7
https://journals.lww.com/md-journal/FullText/2017/09220/Adductor_canal_block_with_local_infiltrative.42.aspx
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5617724/
https://www.ncbi.nlm.nih.gov/pubmed/29725506
https://www.ncbi.nlm.nih.gov/pubmed/24401769
https://journals.lww.com/md-journal/Fulltext/2015/12010/Single_Shot_Adductor_Canal_Block_for_Postoperative.26.aspx
https://www.researchgate.net/publication/324898619_Comparison_of_adductor_canal_block_and_IPACK_block_interspace_between_the_popliteal_artery_and_the_capsule_of_the_posterior_knee_with_adductor_canal_block_alone_after_total_knee_arthroplasty_a_prospec
https://read.qxmd.com/keyword/27787/5
https://read.qxmd.com/shared-collection/13759
https://www.ncbi.nlm.nih.gov/pubmed/29721648
https://www.sciencedirect.com/science/article/pii/S0952818017311145
https://bmcanesthesiol.biomedcentral.com/articles/10.1186/s12871-019-0787-6
https://www.researchgate.net/publication/51551997_Local_Infiltration_Analgesia_Versus_Intrathecal_Morphine_for_Postoperative_Pain_Management_After_Total_Knee_Arthroplasty_A_Randomized_Controlled_Trial

PLAGIARISM CERTIFICATE

This is to certify that this dissertation work titled **"COMPARISON OF ADDUCTOR CANAL BLOCK VERSUS LOCAL INFILTRATION ANALGESIA IN KNEE SURGERIES: A RANDOMIZED COMPARATIVE STUDY."** of the candidate **Dr. K.VENKATESH** with registration number 201720017 for the award of **M.D. ANAESTHESIOLOGY** in the branch of X. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains all the pages from introduction to conclusion and the result shows 24% of plagiarism in the dissertation.

Guide & Supervisor sign with seal

INFORMATION TO PARTICIPANTS

Investigator : Dr. K.VENKATESH

Name of the Participant:

TITLE: "Comparison of Adductor Canal Block Versus Local Infiltration Analgesia in knee surgeries"

You are invited to take part in this research study. We have got approval from the IEC. You are asked to participate because you satisfy the eligibility criteria. We want to compare between Adductor Canal Block Versus Local Infiltration Analgesia in knee surgeries

What is the Purpose of the Research? :

To compare Adductor Canal Block Vs Local Infiltration Analgesia in knee surgeries

1. Post-operative visual analogue scale pain score
2. To evaluate the requirement of systemic analgesics
3. To assess side effects in both the methods.
4. To assess the functional outcome using TUG test.

The Study Design:

Total of 60 patients presenting for knee surgeries were randomly assigned as two groups.

Group 1- USG guided Adductor canal block

Group2- local infiltration analgesia

Benefits:

To assess the quality of analgesia, requirement of systemic analgesics in the post - operative period.

Discomforts and risks:

Arterial hypotension, respiratory depression, nausea/vomiting, enuresis.

This intervention has been shown to be well tolerated as shown by previous studies. And if you do not want to participate you will have alternative of setting the standard treatment and your safety is our prime concern.

Time :

Date :

Place :

Signature / Thumb
Impression of Patient
Patient Name:

Signature of the Investigator : _____

Name of the Investigator : _____

PATIENT CONSENT FORM

TITLE: "Comparison of Adductor Canal Block Versus Local Infiltration Analgesia in knee surgeries"

STUDY CENTRE: Institute of Anaesthesiology and Critical care,
Madras Medical College, Chennai

PARTICIANT NAME:

I.P. NO: AGE: SEX:

I confirm that I have understood the purpose of the procedure for the above study.I have an opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complication that may occur during the procedure. I understand that my participation in the study in voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the Ethics Committee will not need my permission to look at my health records both in the respective current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties of published, unless as required under the law. I agree not to restrict the use of any or results that arise from the study.

I hereby consent to participate in the study COMPARISON OF

SIGNATURE OF THE PARTICIPANT

DATE:
PLACE:

NAME OF THE INVESTIGATOR

நோயாளி தகவல் தாள்

ஆராய்ச்சி தலைப்பு :

□ட்டு அறுவை சிகிச்சைகளில் உள்ளிழுப்பு கால்வாய் உணர்வு நீக்கம் மற்றும □ட்டு வலிநிவாரணி ஊடுருவல் ஊசி ஆகியவற்றின் வலிநிவாரண திறனை ஒப்பிடுதல்.

ஆய்வு நடத்தப்படும் இடம் : மயக்கவியல் மற்றும் தீவிர சிகிச்சைப்பிரிவு
ராஜீவ் காந்தி அரசு பொது மருத்துவமனை
சென்னை மருத்துவக் கல்லூரி, சென்னை.

பங்குபெறுபவரின் பெயர் :

பங்கு பெறுபவரின் எண் :

நோயாளி தகவல் தாள் :

உங்களை இந்த ஆராய்ச்சியில் பங்கு கொள்ள அழைக்கிறோம். நாங்கள் உங்களுக்கு கொடுக்கும் இந்த படிவத்தில் உள்ள விவரங்களை கொண்டு நீங்கள் இந்த ஆராய்ச்சிக்கு உட்படலாமா அல்லது நிராகரிக்கலாமா என்பதை நீங்களே முடிவு செய்யலாம். மேலும் உங்களின் சந்தேகங்களையும் எங்களிடம் கேட்கலாம். நீங்கள் எங்கள் ஆராய்ச்சிக்கு தகுதி உள்ளவராகும் பட்சத்தில், சென்னை ராஜீவ் காந்தி அரசு பொது மருத்துவமனையில் நடைபெறும் இந்த ஆராய்ச்சியல் உங்களை பங்கெடுத்துக்கொள்ள செய்வோம்.

ஆராய்ச்சியின் நோக்கம்:

□ட்டு அறுவை சிகிச்சைகள் தண்டுவடம் வழி உணர்வு நீக்கம் (Spinal Anaesthesia) அல்லது முழு மயக்கம் (General Anaesthesia) கொடுத்து மேற்கொள்ளப்படும், அறுவை சிகிச்சைக்கு பின் அதிகமான வலி ஏற்படும். அதனை போக்க அதிகமான அளவில் வலி நிவாரணிகள் தேவைப்பட வாய்ப்புள்ளது. இந்த ஆராய்ச்சியில் □ட்டு அறுவை சிகிச்சையினால் ஏற்படும் வலியினை போக்க உள்ளிருப்பு கால்வாய் உணர்வு நீக்கம் (Adductor Canal Block) மற்றும் □ட்டு வலி நிவாரணி ஊடுருவல் ஊசி (Local Infiltration Analgesia) ஆகியவற்றில் வலி நிவாரண திறனை ஒப்பிடுவதே இந்த ஆய்வின் நோக்கமாகும்.

இந்த முறையான ஆய்வு ஏற்கனவே பல இடங்களில் நடத்தப்பட்டுள்ளது. மேலும் இதன் பாதுகாப்பு உறுதிசெய்யப்பட்டுள்ளது. நீங்கள் இந்த ஆய்வில் பங்குகொள்ள விரும்பவில்லை என்றால் எப்போதும் உபயோகிக்கப்படும் மருந்தே கொடுக்கப்படும். உங்கள் பாதுகாப்பே எங்களின் முக்கிய நோக்கம்.

இந்த ஆய்வு சம்பந்தமாக எல்லா புள்ளி விவரங்கள் மற்றும் நோயாளிகளின் விவரங்கள் ரகசியமாக வைக்கப்படும். இந்த ஆய்வு சம்பந்தப்பட் எல்லா பரிசோதனைகள், மருந்துகள் மற்றும் மருத்துவ சேவைகள் அனைத்தும் நோயாளிகளுக்கு இலவசமாக வழங்கப்படும்.

ஆய்வாளரின் பெயர்

பங்குகொள்பவரின் /
பாதுகாவலரின் பெயர்

ஆய்வாளரின் கையொப்பம்

பங்குபெறுபவரின்
கையொப்பம் /

கட்டை விரல் ரேகை

<u>ஆராய்ச்சி ஒப்புதல் படிவம்</u>

<u>ஆராய்ச்சி தலைப்பு :</u>

□ட்டு அறுவை சிகிச்சைகளில் உள்ளிழுப்பு கால்வாய் உணர்வு நீக்கம் மற்றும □ட்டு வலிநிவாரணி ஊடுருவல் ஊசி ஆகியவற்றின் வலிநிவாரண திறனை ஒப்பிடுதல்.

ஆராய்ச்சி நிலையம் : மயக்கவியல் துறை,
இராஜீவ் காந்தி அரசு பொது மருத்துவமனை மற்றும்
சென்னை மருத்துவக் கல்லூரி, சென்னை - 600 003.

பங்கு பெறுபவரின் பெயர் : உறவுமுறை :

பங்கு பெறுபவரின் எண். :

பங்கு பெறுபவர் இதனை (✓) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களைப் பெறவும் வாய்ப்பளிக்கப்பட்டது. ☐

நான் இவ்ஆய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்தக் காரணத்தினாலோ எந்தக் கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்ஆய்வில் இருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்மந்தமாகவோ, இதை சார்ந்த மேலும் ஆய்வு மேற்கொள்ளும்போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன். ☐

இந்த ஆய்வின் □லம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும் அதைப் பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன். ☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்குக் கொடுக்கப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். ☐

பங்கேற்பவரின் கையொப்பம்..... இடம்..... தேதி
கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம்.....

ஆய்வாளரின் கையொப்பம்..... இடம்..... தேதி

ஆய்வாளரின் பெயர்.....

PROFORMA

DATE: ROLL NO:

NAME:

AGE: SEX: IP NO:

DIAGNOSIS:

SURGICAL PROCEDURE DONE:

Ht: CVS: HB:

Wt: RS:

PRE OP ASSESSMENT:

HISTORY: Any Co-morbid illness

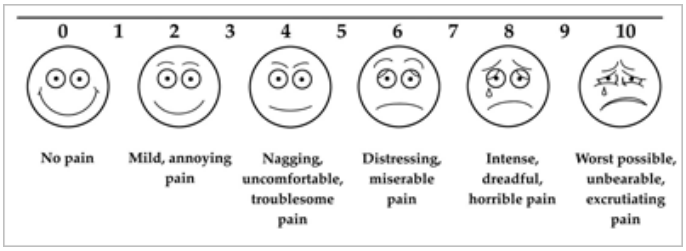
H/O previous surgeries

APPROACH:

MEASURES OF STUDY OUTCOME:

1. Post-operative visual analogue scale pain score

VISUAL ANALOG SCALE at 24 hours postoperatively



2. Time to rescue analgesia:
3. Side effects :
4. TUG test timing:

COMPLICATIONS DURING PROCEDURE:

MASTER CHART

ACB Group – Master chart													
S.No	PATIENTS NAME	AGE (yr)	SEX	IP No	WEIGHT (kg)	ASAPS	POST OP VAS Score			TIME OF RESCUE ANALGESIA (hrs.)	TUG test (seconds)		COMPLICATIONS
							4hrs	12 hrs	24hrs		Pre OP	Post OP	
1	Dilli	54	M	103037	60	II	0	0	6	16	22	113	NIL
2	Chelapandi	54	M	106342	67	I	2	4	8	10	21	120	NIL
3	Gopi	24	M	105375	63	I	0	2	6	18	20	115	NIL
4	Kalyani	54	F	106932	64	II	2	4	8	11	20	122	NIL
5	Kannan	45	M	110751	70	II	0	0	2	24	17	107	NIL
6	Jyothi	63	F	111093	62	II	0	0	0	24	22	110	NIL
7	Shanaz Begam	65	F	114873	65	I	2	4	8	10	19	121	NIL
8	Ashtalakshmi	63	F	115766	63	I	0	2	6	18	20	125	NIL
9	Vasantha	71	F	118352	67	I	2	4	6	10	17	110	NIL
10	Dhanalakshmi	37	F	121032	70	II	0	2	2	19	18	104	NIL
11	Paneerselvam	70	M	121766	69	II	0	0	0	24	17	127	NIL
12	Durairaj	53	M	121130	64	I	4	6	8	2	19	107	NIL
13	Sushila	58	F	122992	60	II	0	2	4	20	16	126	NIL
14	Natrajan	63	M	126134	61	II	0	0	4	20	21	119	NIL
15	Pandiammal	68	F	128378	59	I	2	2	4	18	24	133	NIL
16	Mahendran	60	M	132752	57	I	2	4	4	10	18	129	NIL
17	Amirtham	67	F	135362	62	II	0	2	2	18	20	125	NIL
18	Kanagammal	65	F	142272	60	I	2	2	4	18	16	104	NIL
19	Kannan	48	M	143946	65	II	2	4	4	11	19	117	NIL
20	Jayalakshmi	55	F	144272	68	I	0	0	0	24	17	115	NIL
21	Chitra	22	F	145899	61	I	0	2	2	20	18	124	NIL
22	Vasantha	67	F	146770	66	II	2	4	4	12	23	131	NIL
23	Govindaraj	57	M	146922	67	II	0	2	4	20	20	121	NIL
24	Dhanalakshmi	55	F	147119	60	I	0	2	2	24	22	127	NIL
25	Silamban	58	M	147538	64	II	0	0	2	24	18	117	NIL
26	Krishnaraj	34	M	147630	70	I	0	2	2	24	19	118	NIL
27	Narayani	63	F	148092	59	I	0	4	4	12	17	105	NIL
28	Francis	60	M	148570	69	I	2	2	6	18	20	122	NIL
29	Radhidevi	48	F	150276	58	I	6	6	8	2	19	109	NIL
30	Sulochana	53	F	150467	60	II	0	2	2	24	16	113	NIL

LIA Group - Master chart

S.No	PATIENTS NAME	AGE (yrs.)	SEX	IP No	WEIGHT (kg)	ASA PS	POST OP VAS Score			TIME OF RESCUE ANALGESIA (hrs)	TUG test (seconds)		COMPLICATIONS
							4 hrs	12 hrs.	24 hrs		Pre OP	Post OP	
1	Rajendran	60	M	103167	64	II	0	2	4	16	16	104	NIL
2	Jayalakshmi	61	F	106246	65	II	0	2	4	19	20	129	NIL
3	Inbakumar	62	M	105567	60	I	2	4	6	8	18	115	NIL
4	Umarani	40	F	106978	54	I	0	2	6	19	19	124	NIL
5	Natrajan	51	M	110856	65	I	0	0	4	19	18	131	NIL
6	Karpagavalli	36	F	111198	70	II	6	8	8	3	25	140	NIL
7	Nagarathinam	58	M	115245	69	II	2	4	6	10	19	121	NIL
8	Savithri	73	F	115794	68	II	0	2	4	13	24	135	NIL
9	Sarasammal	60	F	117124	67	II	0	2	4	16	21	117	NIL
10	Valli	63	F	120562	61	I	2	6	6	9	18	118	NIL
11	Chelladurai	60	M	121451	62	I	0	0	4	15	15	105	NIL
12	Loganathan	60	M	121976	68	II	2	4	8	10	16	122	NIL
13	John Kennedy	46	M	124607	59	I	4	4	6	4	18	109	NIL
14	Rajavelu	69	M	126555	66	II	0	2	4	14	17	113	NIL
15	Swaminathan	62	M	128475	64	I	2	4	6	11	21	120	NIL
16	Mary	57	F	132386	74	II	2	6	6	9	20	115	NIL
17	Rajammal	63	F	135174	62	I	0	2	4	15	15	122	NIL
18	Sekhar	57	M	142233	67	II	2	4	8	10	16	107	NIL
19	Baskar	64	M	143165	66	II	2	4	6	9	13	110	NIL
20	Lakshmi	52	F	144376	60	I	0	2	4	15	14	121	NIL
21	Radhakrishnan	50	M	145754	57	I	0	2	6	15	17	125	NIL
22	Vijaya	57	F	146121	69	II	2	6	6	8	18	110	NIL
23	Kaniammal	50	F	146953	70	II	0	2	4	16	19	104	NIL
24	Mayili	55	F	147247	63	I	0	2	6	15	20	132	NIL
25	Ponnan	59	M	147585	61	I	2	4	6	10	22	130	NIL
26	Ibrahim	57	M	147918	65	II	0	0	4	16	17	126	NIL
27	Muniaammal	70	F	148243	64	I	2	4	6	10	19	119	NIL
28	Krishnamurthy	65	M	148797	68	II	0	2	4	15	22	133	NIL
29	Kannan	55	M	150802	67	II	2	2	4	13	21	129	NIL
30	Shameem Banu	43	F	150976	65	II	0	2	4	18	21	125	NIL