A Dissertation On

A COMPARATIVE STUDY OF ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK VERSUS SPINAL ANAESTHESIA FOR INGUINAL HERNIA REPAIR IN ADULTS

COIMBATORE MEDICAL COLLEGE HOSPITAL

Dissertation submitted in

Partial fulfilment of the regulations required for the award of

M.D. ANAESTHESIOLOGY

BRANCH-X

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

CHENNAI - 32, TAMIL NADU

APRIL - 2016

CERTIFICATE

This is to certify that the dissertation entitled, **" A COMPARATIVE STUDY OF ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK VERSUS SPINAL ANAESTHESIA FOR INGUINAL HERNIA REPAIR IN ADULTS"**, is a bonafide research work done by **DR.TAMALIKA DAS,** under my guidance during the academic year 2013 – 2016.

This has been submitted in partial fulfilment for the award of **M.D. Degree in Anaesthesiology (Branch – X)** by **The Tamilnadu Dr. M.G.R Medical University, Chennai – 600 032.**

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DECLARATION

I, **Dr. TAMALIKA DAS** solemnly declare that the dissertation entitled **"A COMPARATIVE STUDY OF ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK VERSUS SPINAL ANAESTHESIA FOR INGUINAL HERNIA REPAIR IN ADULTS"** was done by me at Coimbatore Medical College, during the period from July 2014 to August 2015 under the guidance and supervision of **Dr.K.SANTHA ARULMOZHI M.D.,DA.,** Professor and HOD, Department of Anaesthesiology, Coimbatore Medical College, Coimbatore.

This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University towards the partial fulfillment of the requirement for the award of M.D. Degree (Branch - X) in Anaesthesiology. I have not submitted this dissertation on any previous occasion to any University for the award of any degree.

Place:
Date:

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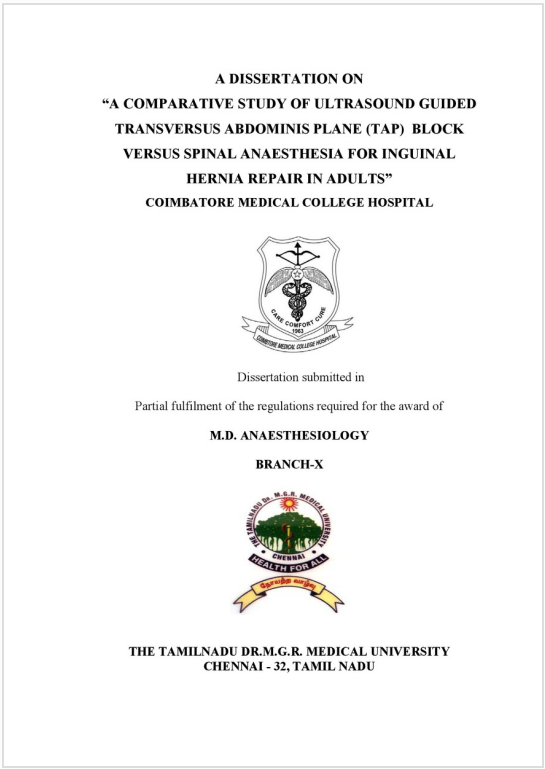

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INTRODUCTION

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Inguinal hernia repair is one of the most commonly performed surgeries worldwide[1]. A wide variety of anaesthetic techniques have been used for inguinal hernia repair such as local anaesthesia, spinal/epidural anaesthesia in conjunction with intravenous sedation and general anaesthesia[2]. Yet, there is no common consensus about the optimum mode of anaesthesia. The choice of anaesthesia for hernia repair depends on factors such as patient acceptance, duration and type of surgery – open/laparoscopic, bilateral, recurrent/strangulated hernia and anaesthetic considerations[3].

In Spinal Anaesthesia (subarachnoid block), local anaesthetic is deposited in the subarachnoid space and produces intense motor, sensory and sympathetic blockade. The widespread popularity of this techinique is due to the following advantages- an awake patient, decreased metabolic stress response to surgery, decreased blood loss, reduction in pulmonary complications and less post-operative pain. However, there are concerns regarding certain disadvantages such as undesirable hemodynamic responses such as hypotension, prolonged motor blockade, urinary retention and post-spinal headache[4].

The description of Transversus Abdominis plane (TAP) block was first done in 2001 by Dr. Rafi in Ireland, using lumbar triangle as an anatomic reference point[5], ultrasound technique later described by Hebbard in 2007. It is a regional anaesthetic technique in which local anaesthetic is deposited in between the two muscles - internal oblique and transversus abdominis muscles so that the T7-L1 nerves are blocked[5]. It does not provide analgesia to the visceral peritoneum of the anterolateral abdominal wall. This block has been used for post-operative analgesia following various surgeries such as appendicectomy, repair of hernia, caesarean section, hysterectomy, abdominoplasty and prostatectomy [6-8]. But there are a very few studies that have utilized TAP block as an anaesthetic technique. Though literature has reported the TAP block to be highly successful with very less risk of complications, TAP block remains underutilized and there is inertia regarding its adoption into clinical practice[9].

AIM OF THE STUDY

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The main aim of this study is to compare the efficacy of TAP block versus Spinal Anaesthesia to achieve an adequate anaesthesia, recovery profile, incidence of adverse effects and post-operative analgesia for inguinal hernia repair in adults.

OBJECTIVES

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- To evaluate the efficacy of ultrasound guided TAP block as an anaesthetic technique for inguinal hernia repair in adults, compared to Spinal Anaesthesia.
- To compare hemodynamic responses intra-operatively between ultrasound guided TAP block and Spinal Anaesthesia.
- To compare post-operative pain levels, side effects and recovery following TAP block and Spinal Anaesthesia.

SPINAL ANAESTHESIA

Definition:

In this technique, a local anaesthetic is deposited into the subarachnoid space resulting in temporary interruption of nerve transmission[10].

History:

The term ‘spinal anaesthesia’ was coined in 1885 by Leonard Corning, a Neurologist, who wanted to assess the action of cocaine for neurologic problems. Corning injected cocaine into a dog which produced transient hind limb paralysis. He then performed a neuraxial block using cocaine on a man. The first dose was administered without any effect, whereas after the second dose, the patient's legs “felt sleepy.” The man experienced impaired sensibility in his lower extremity after about 20 minutes. Although Corning did not describe escape of cerebrospinal fluid (CSF) in either case, it is likely that the dog had a spinal anaesthetic and the man had an epidural[11].

Augustus Bier, a German surgeon credited the merit for introducing spinal anaesthesia in 1899. Professor Bier permitted his assistant, Dr. Hildebrandt, to perform a lumbar puncture, but, after dural penetration, Hildebrandt could not fit the syringe to the needle and a large volume of the professor's spinal fluid escaped. They were about to abandon the study but

Hildebrandt volunteered to be the subject of a second attempt. Their persistence was rewarded with an astonishing success.

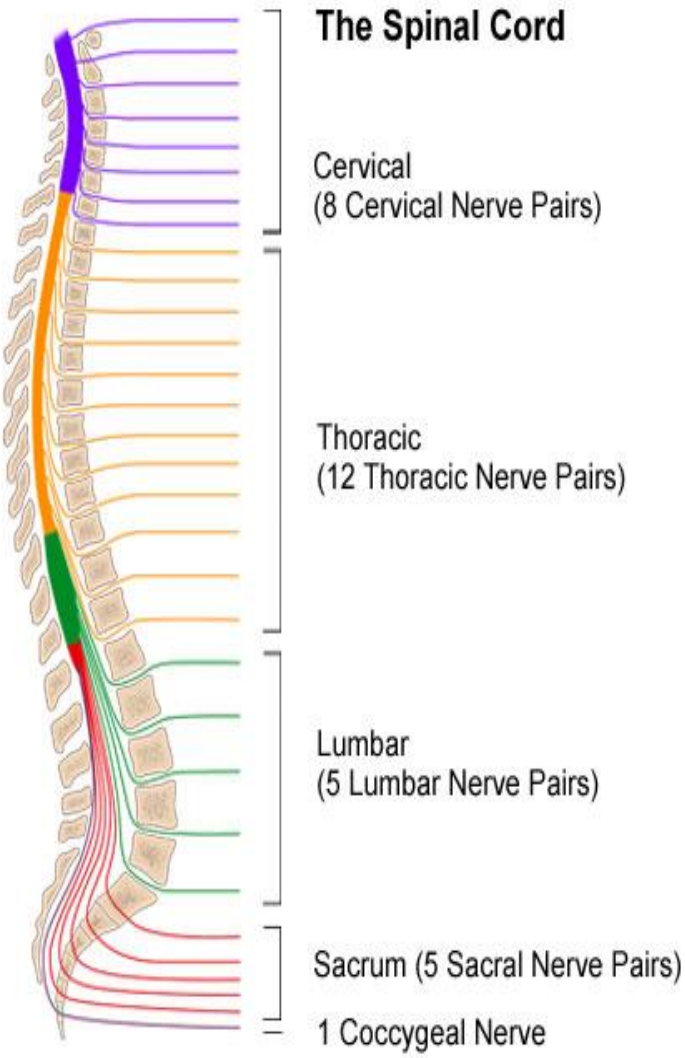
Twenty-three minutes after the spinal injection, Bier noted: “A strong blow with an iron hammer against the tibia was not felt as pain. After 25 minutes: Strong pressure and pulling on a testicle were not painful.”[11]

Anatomy:

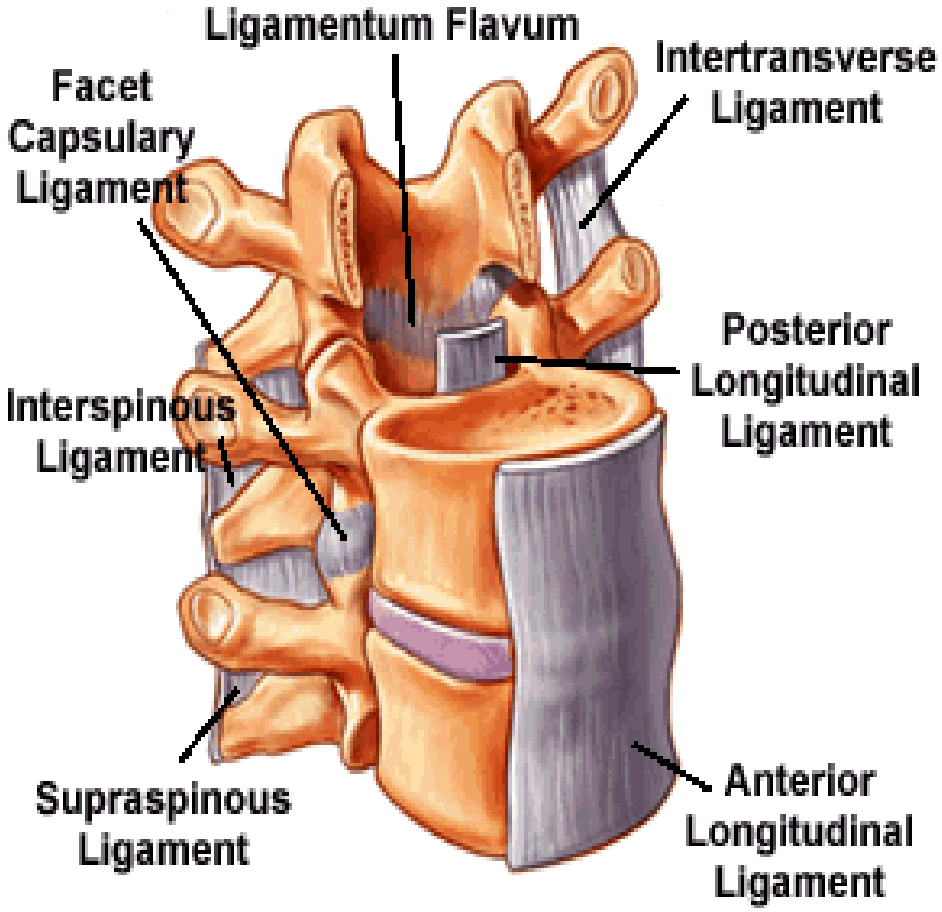
The spine is composed of the vertebral bones and fibrocartilaginous intervertebral discs. The main functions of the spine are to provide support structurally and protect the spinal cord and nerves. A pair of spinal nerves exit at each vertebral level.

Lumbar vertebrae have a large anterior cylindrical vertebral body. When stacked vertically, the hollow rings become the spinal canal in which the spinal cord and its coverings sit.

The spinal column normally forms a double C, being convex anteriorly in the cervical and lumbar regions.[12]



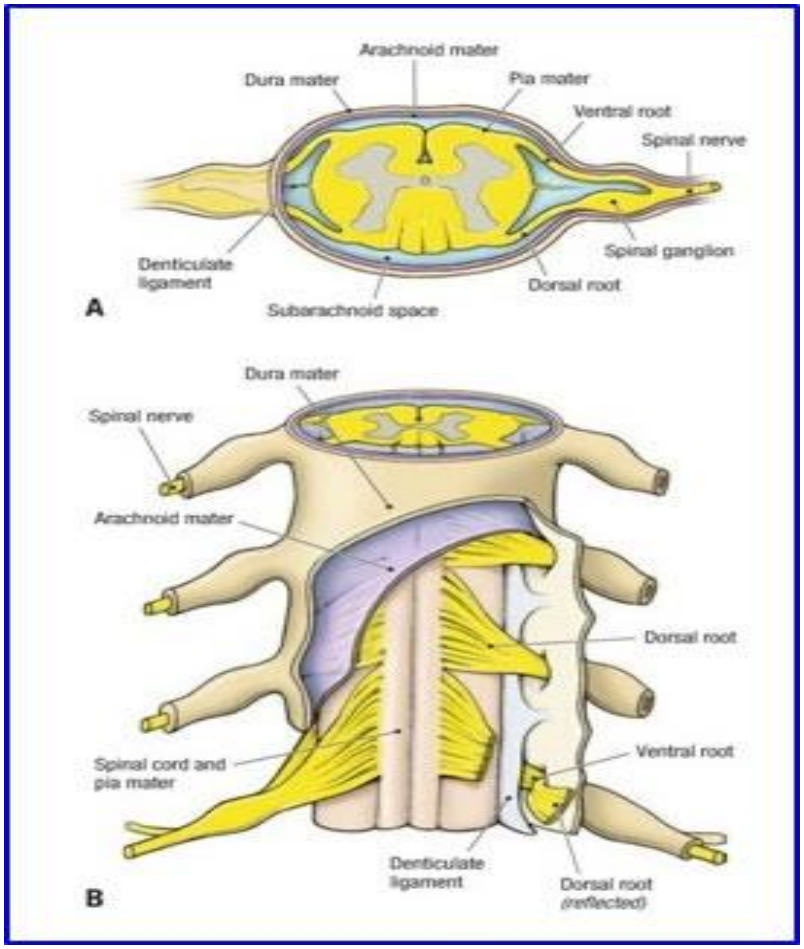
Ligamentous elements provide structural support and together with supporting muscles help maintain the unique shape. The anterior and posterior longitudinal ligaments provide support ventrally and the ligamentum flavum, interspinous ligament, and supraspinous ligament provide dorsal stability. Using the midline approach, a needle passes through these three dorsal ligaments and through an oval space between the bony lamina and spinous processes of adjacent vertebra[13] .



The spinal canal contains the spinal cord with its coverings , fatty tissue, and a venous plexus. The meninges are the pia mater, the arachnoid mater, and the dura mater; all are contiguous with their cranial counterparts. Cerebrospinal fluid (csf) is present in the subarachnoid space.

The extent of the spinal cord is from the foramen magnum to the level of L1 in adults, so it is safe to perform spinal anaesthesia below L2. In children, the spinal cord ends at L3 and moves up as they grow older.

A single anterior spinal artery and a pair of posterior spinal arteries supply the spinal cord and nerve roots[13].



Mechanism of action:

Local anaesthetics injected intrathecally bind mainly to the spinal nerve roots and also to the peripheral region of the spinal cord. Lesser amount of drug reaches the central region of spinal cord. Efferent motor and autonomic transmission is interrupted due to block of the anterior nerve fibers. Neural blockade of posterior nerve fibers blocks the somatic and visceral impulses[14].

Somatic blockade:

Spinal anaesthesia is achieved with a small dose and volume of local anaesthetic resulting in dense sensory and motor block. Smaller sympathetic fibers are more easily blocked than larger sensory and motor fibers. Due to large inter individual variability in nerve root size, interpatient differences in neuraxial block quality occur[14].

The clinical progression of differential nerve block from first blocked to last to be blocked is..

1. Autonomic fibers...sympathetic blockade occurs 2-6 segments higher than sensory block.
2. Sensory fibers
3. Motor fibers...motor block occurs 2-3 segments lower than sensory block.

The factors which contribute to differential nerve block are

1. The arrangement of fibers in a nerve bundle (core vs mantle)
2. Diameter of the nerve fibers
3. Inherent impulse activity of individual nerve fibers
4. Variability in spread of the agent
5. Effects on ion channels other than Na^+
6. Local anaesthetic drug.

Autonomic blockade:

Due to efferent autonomic transmission interruption, there is predominant sympathetic and lesser parasympathetic blockade. Sympathetic outflow is thoracolumbar, whereas parasympathetic outflow is craniosacral. Vagus nerve is not affected by neuraxial anaesthesia[14].

Physiologic effects:

Cardiovascular effects:

The effects are similar to the use of a combination of alpha1 and beta adrenergic blockers. Sympathectomy produces predominant venodilation due to the limited amount of smooth muscle in venules. Due to the vasodilation of arteries and arterioles, there is distribution of blood volume from the central compartment which result in slight decrease in myocardial contractility.

Reduction of cardiac output and systemic vascular resistance are the main causes of hypotension. Bradycardia may ocur due to a fall in right atrial filling or when the cardioaccelerator fibers from T1-T4[14] are affected.

The use of 5-10 degree head down tilt, Tredelenburg position and leg elevation are the first steps in case of low blood pressure. Oxygen is

necessary for the essential vital organs: the brain and myocardium. Crystaloids or colloids are effective in treatment of hypotension. Vasopressors (ephedrine, phenylephrine) are used for treatment of hypotension and bradycardia[15].

Respiratory effects:

Alterations in pulmonary function during neuraxial block are usually not significant in healthy patients. There is no change in tidal volume even during high spinal anaesthesia. Phrenic nerve block may not occur even with total spinal anesthesia as apnea often resolves with hemodynamic resuscitation, suggesting that brain stem hypoperfusion is responsible rather than phrenic nerve block.

Neuraxial block should be used cautiously in respiratory cripples because of paralysis of the respiratory muscles. The physiologic consideration related to muscle paralysis with neuraxial block should focus on the expiratory muscles as these muscles are important for effective coughing and clearing of secretions[14].

Deafferentation syndrome:

During high spinal anaesthesia, patients may complain of dyspnoea. This may be due to the loss of chest wall sensation. This is usually overcome by asking the patient to exhale forcefully and feel for the breath by keeping a hand near the mouth. It seems to provide reassurance[15].

Gastrointestinal effects:

20% of the patients may experience nausea and vomiting. This is due to gastrointestinal hyperperistalsis caused by predominant parasympathetic activity. This can provide excellent operative conditions for some laparoscopic procedures when used as an adjunct to general anesthesia. Hepatic blood flow will decrease with reductions in mean arterial pressure from any anesthetic technique[14].

Renal function:

Decrease in renal blood flow accompanies neuraxial blockade, which is not significant. If no urinary catheter is anticipated perioperatively, it is prudent to use the shortest acting and smallest amount of drug necessary for the surgical procedure and limit the amount of intravenous fluid administration (if possible). The patient should be

monitored for urinary retention to avoid bladder distention following neuraxial anesthesia[14].

Metabolic and endocrine effects:

Surgery produces a host of neuroendocrine responses by releasing various substances. Neuraxial block can effectively block this response. . By reducing catecholamine release, neuraxial blocks may decrease perioperative arrhythmias and possibly reduce the incidence of ischemia. To maximize this blunting of the neuroendocrine stress response, neuraxial block should precede incision and extend into the postoperative period[15].

Thermoregulatory effects:

The factors which contribute to hypothermia are

- Redistribution of heat from central to peripheral regions
- Loss of heat to the environment
- Inhibition of central thermoregulatory control.

Technique:

Preparation:

- Explain the procedure in short to the patient.

- Standard monitors to be attached.

- Secure an IV access with a large bore needle (20G/18G).

Equipment:

Various spinal needles are available, which can be classified according to the

1. *Size of the needle*

Sizes vary from 18-30 G. The feel of piercing each structure during spinal anaesthesia is better with larger gauge spinal needles, whereas complications related to CSF leaks are less in finer needles.

2. Shape of the spinal needle tip

There are two broad categories –

i) Cutting point spinal needles

ii) Non – cutting pencil point needle

The standard spinal needle consists of

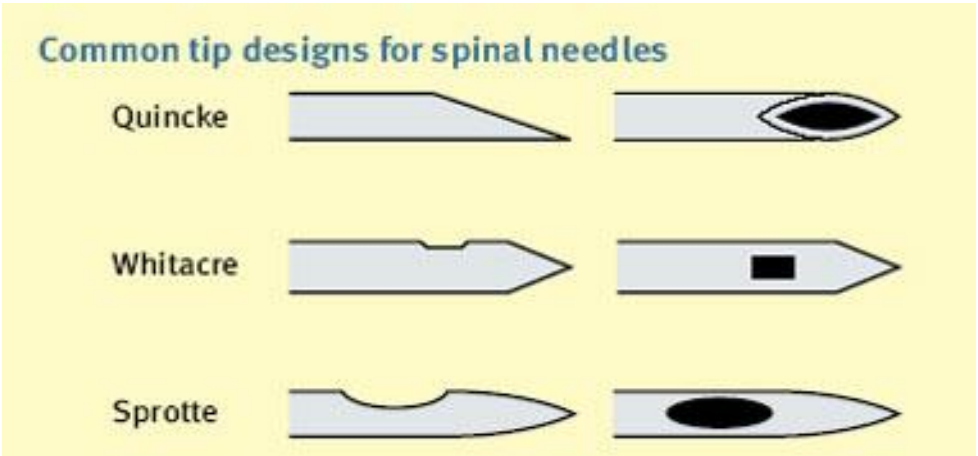
- hub
- shaft ending in a tip
- stylet

The standard shaft length of a spinal needle is 8 cm.

The Quincke - Babcock needle is considered to be the standard spinal needle. It has a small hub, medium length cutting bevel with a sharp point tip.

Other needles available are:

- Pitkin needle : It has a short bevel, cutting edges and rounded head.
- Greene needle: There are rounded, non cutting edges to the bevel which is of medium length.
- Sprotte needle : It has a solid pencil tip with a large lateral orifice whose diameter is equal to internal diameter of the needle.
- Whitacre needle: This is a pencil-point needle having a rounded tip, no cutting edges and the lateral orifice is 2 mm proximal to the tip



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Drugs:

Local Anaesthetic	Dose (mg)		Duration (min)	
	To T10	To T4	Plain	Epinephrine, 0.2 mg
'Bupivacaine '	8-10	12-20	1&1/2 hr-2 hrs	100-150
'Ropivacaine'	12-18	18-25	80-110	—

Mechanisms of drug spread:

Various factors have been found to affect the level of block after Spinal Anaesthesia. They are

Characteristics of the injected solution:

1. Baricity : Density of the local anaesthetic / Density of CSF.

There are three kinds of solutions-

- Hyperbaric – Baricity >1(dextrose is added)
- Isobaric – Baricity = 1
- Hypobaric – Baricity < 1

Gravity plays a role in the spread of hyper/hypobaric solutions.

2. Volume/dose/concentration All the three factors are interdependent.

3. Addition of other drugs:

Vasoconstrictors – prolong duration by reducing the absorption of drug into systemic circulation. The drug remains longer in the subarachnoid space and hence prolonged action.

Opioids – The addition of opioids with local anaesthetics has synergistic effect but this does not affect the motor block.

Technique:

1. Position of the patient:

The level of block is dependent on baricity of the local anaesthetic and position of the patient. Hyperbaric solutions tend to “sink down” whereas hypobaric solutions tend to “float”.

2. The level at which injection is done: Higher level of injection with plain solutions – greater spread.

3. Needle type:

The spread of anaesthesia may be influenced by using directional needles. The direction of needle aperture plays an important part in spread of the drug.

Technique of injection:

1. Site

2. Direction

3. Usage of barbotage

The term barbotage is derived from the French word “barboter” which means to “paddle up”. It means repeated aspirations of CSF and re-injection of the local anaesthetic[16].

4. Rate of injection – Rapid injections cause marked diffusion, thereby resulting in higher levels of block.

Spinal fluid characteristics:

The volume, density and pressure play a role.

Characteristics of the patient:

- Age – As the age increases, there is a reduction in conduction velocity, degeneration of axons, reduced number of fibers and reduced volume of CSF. Hence the dose has to be reduced in the elderly.

- Height – It plays an important role only when there is extreme variation.

- Weight – BMI has some effect on the spread of anaesthesia. In obese patients, due to the large abdominal mass, there may be reduced CSF volume and thus resulting in a larger spread of the anaesthetic.

- Anatomy of the spine

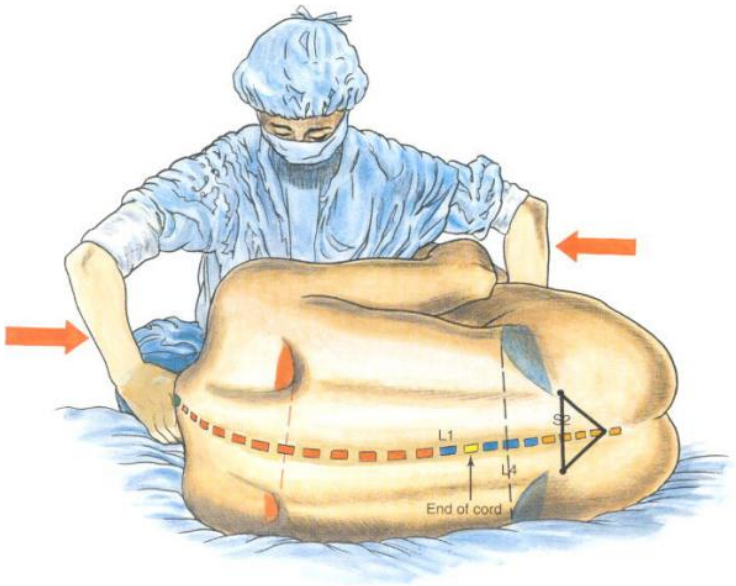
- Intra-abdominal pressure

- CSF volume

Position:

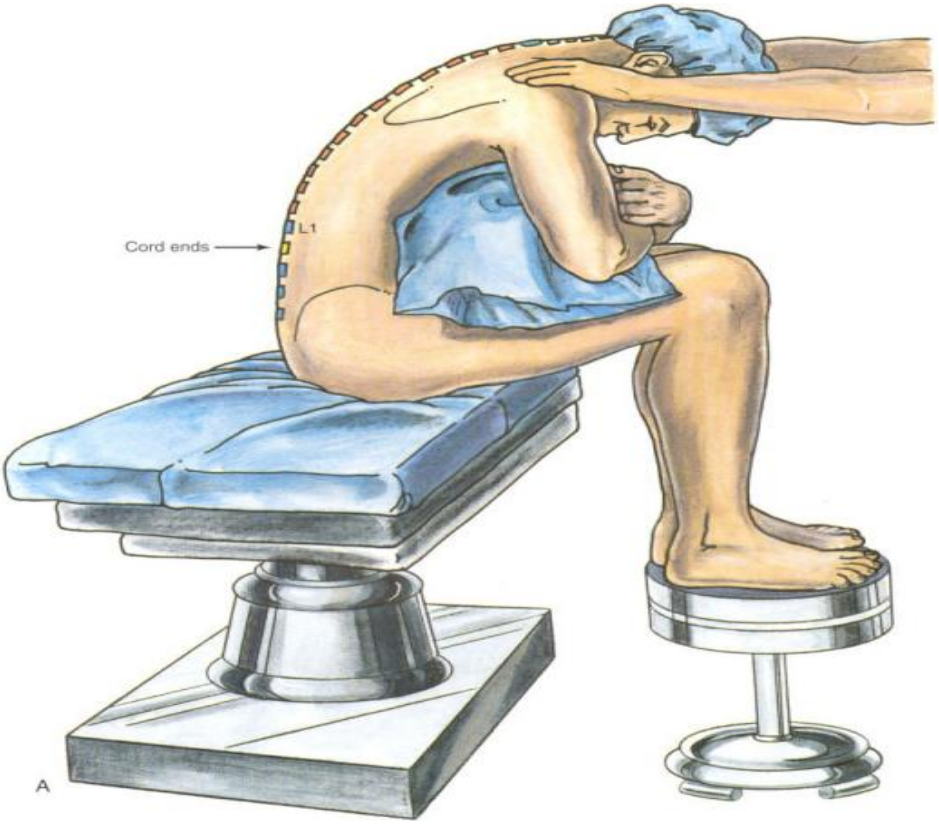
1. **Lateral decubitus with universal flexion :**

The patient should be positioned such that his back is parallel to the long axis of the OT table. Thighs are flexed up and neck is flexed forward (fetal positon). Head high/head low position may be done to take advantage of the baricity of the spinal LA[17].



2. **Sitting :**

The patient should be sitting up such that his back is parallel to the long axis of the OT table and his feet supported on a stool. His head to be flexed, arms to hold a pillow over the chest and he should arch his back to resemble the letter “C”. This will maximize the opening of the vertebral interspaces[17].



3. **Prone :**

The prone position is used when the patient will be in this position for the surgical procedure (rectal, perineal and lumbar procedures). Hypobaric LAs are administered. Patient positions self, lumbar lordosis should be minimized, a paramedian approach is often used.

Projection and puncture:

After proper positioning, strict aseptic measures have to be taken. The back should be painted with betadine, a povidone – iodine solution which should remain in contact with the skin for atleast 2 minutes , then wiped with dry gauze and draped. A line drawn between the highest points of either iliac crests, known as the Tuffier's line corresponds to either L4 vertebral body or L4-L5 interspace. There are two approaches for accessing the subarachnoid space:

1. Midline approach:

It offers two advantages –

1. Anatomic projection is only in two planes
2. It provides a relatively avascular plane.

- Local infiltration with 2 % plain lignocaine.

- Introduce the spinal needle in the midspace in 15-20 degree cephalad direction with bevel parallel to the longitudinal fibers of the dura.

- The structures pierced from dorsal to ventral are

  "Skin

  Subcutaneous tissue

  Supraspinous ligament

  Interspinous ligament

  Ligamentum flavum

  Dura"

  - As the ligamentum flavum and dura are traversed, there will be distinct "give way" or "pop" felt for each. After the second "give way", the needle is in the subarachnoid space. Once the CSF returns, steady the needle and attach the syringe with local anaesthetic. Gently aspirate CSF into the syringe.

  - Inject the spinal anaesthetic at the rate of 0.2 ml/second.

2. Paramedian approach:

- The advantage of this approach is that by placing the needle laterally, the anatomical limitation of the spinous process is avoided.

- Insert the spinal needle 1 cm laterally from the midline in the line of the midspace 10-15 degree off the sagittal plane. If the needle is inserted too far cephalad then lamina is encountered. As the needle is further advanced, the characteristic " give way" of dura is felt. Once CSF is obtained, continue in the same manner as the midline approach[18].

Contraindications for Spinal Anaesthesia :

Absolute:

- Patient's refusal
- Significant coagulopathy
- Raised intracranial pressure
- Infection at the site of puncture
- Valvular heart diseases – fixed output lesions/ stenotic lesions
- Severe untreated hypovolemia

Relative:

- Surgical scars
- Spinal deformities
- Sepsis
- Neurological deficits or demyelinating diseases
- Uncooperative patient

Controversial:

- Major blood loss
- Previous spinal surgery at the site of injection.

TRANSVERSUS ABDOMINIS PLANE BLOCK

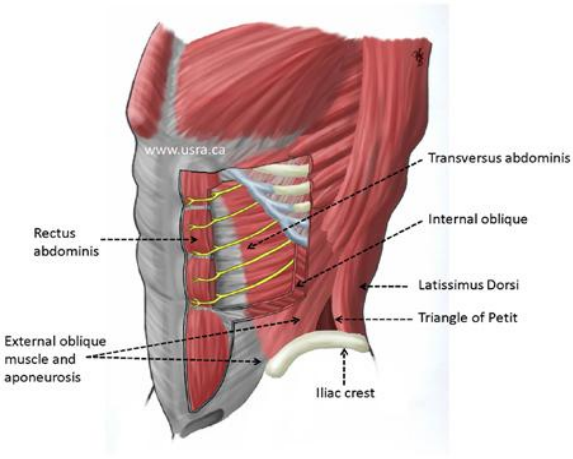
Abdominal surgical procedures cause substantial postoperative pain leading to prolonged recovery and significant morbidity. Epidural analgesia remains the gold standard but it interferes with early ambulation, carries risk of intravascular and intrathecal injection, infection and a small risk of epidural hematoma. Therefore blocks of nerves which course through the abdominal wall may be a good alternative[19].

TAP BLOCK:

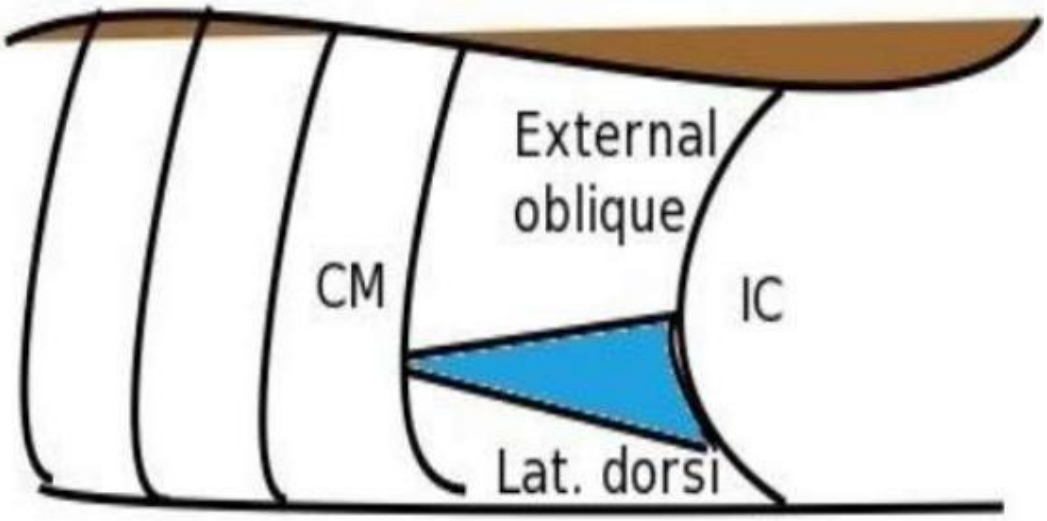
Anatomy:

The anterior abdominal wall is innervated by the anterior primary rami of the lower 7 thoracic nerves (T6-T12) and the first lumbar nerve (L1). After leaving the intervertebral foramina, these nerves pass over the vertebral transverse process and pierce the musculature of the anterior and lateral abdominal wall[20].

The muscles of the abdominal wall are the anterior rectus muscle medially, the external oblique, internal oblique and transversus abdominis muscles more laterally from superficial to deep. The linea semilunaris is present in between the rectus abdominis muscle and the 3 lateral muscles. The thoracolumbar nerves travel within a plane between the internal oblique and transversus abdominis muscles. The sensory nerves give a lateral cutaneous branch near the mid-axillary line and continue within the TAP plane to provide sensation to the abdominal wall upto the midline[(21,22)].



Lumbar triangle of Petit between external oblique muscle and latissmis dorsi.
CM: costal margin, **IC**: iliac crest.

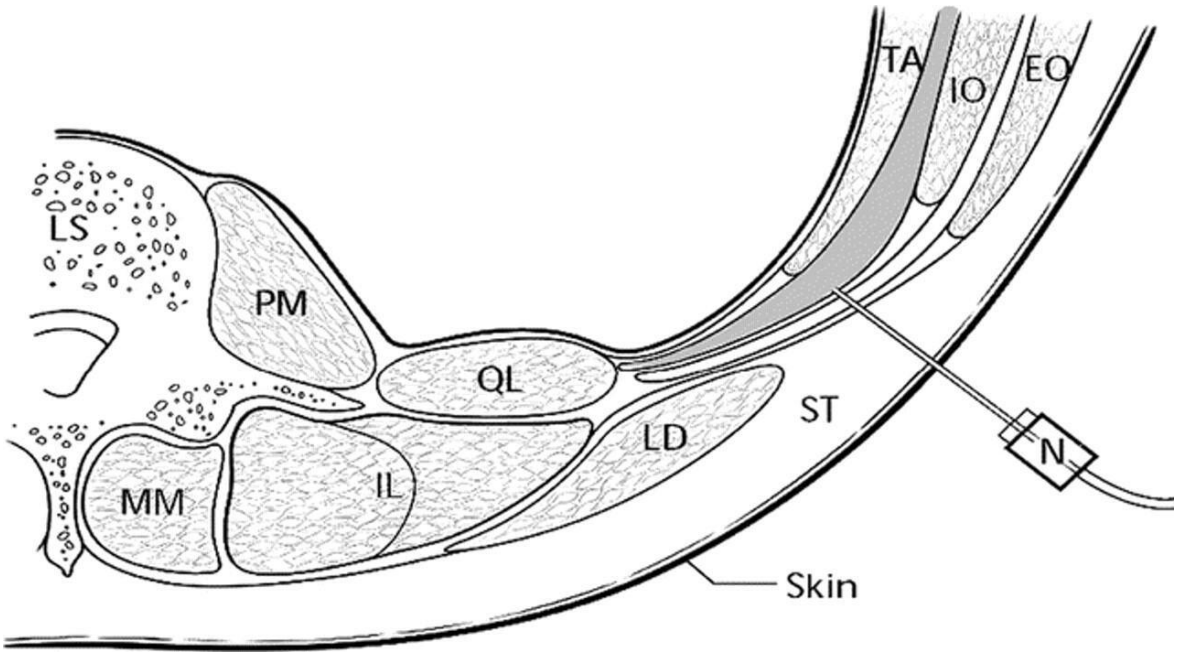


The Triangle of Petit is used as a landmark for injecting local anaesthetic into the TAP. The boundaries of the triangle are the lattisimus dorsi muscle posteriorly, external oblique muscle anteriorly and iliac crest inferiorly. The floor of the triangle is made up of extensions from both the internal and external oblique muscles[23,24,25].

Landmark technique:

The position of the patient is supine or slightly lateral. A blunt needle is inserted perpendicularly into the Triangle of Petit, above the iliac crest and posterior to the mid-axillary line[26].

The needle is advanced slightly anteriorly, when the first ‘pop’ is felt, which indicates passing through the external oblique fascia and then the second ‘pop’ is felt, indicating passage through the internal oblique fascia and entrance into the TAP. After negative aspiration, the local anaesthetic injection is given[27].



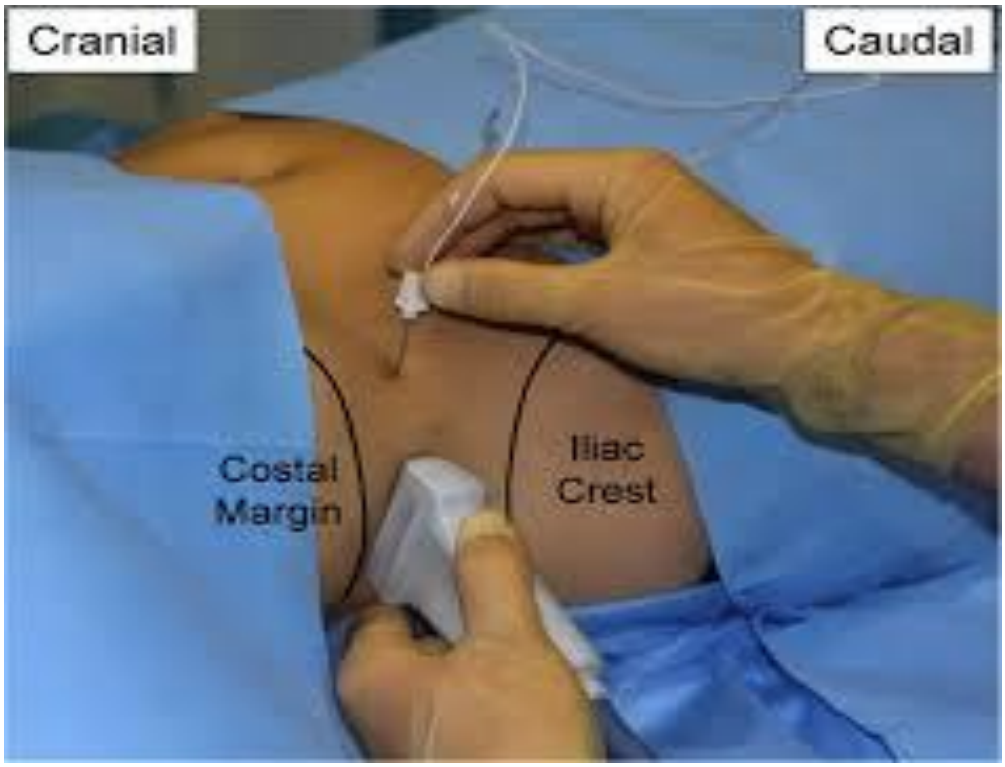
Ultrasound guided technique of TAP block:

There are two techniques

1. Subcostal approach
2. Posterior approach

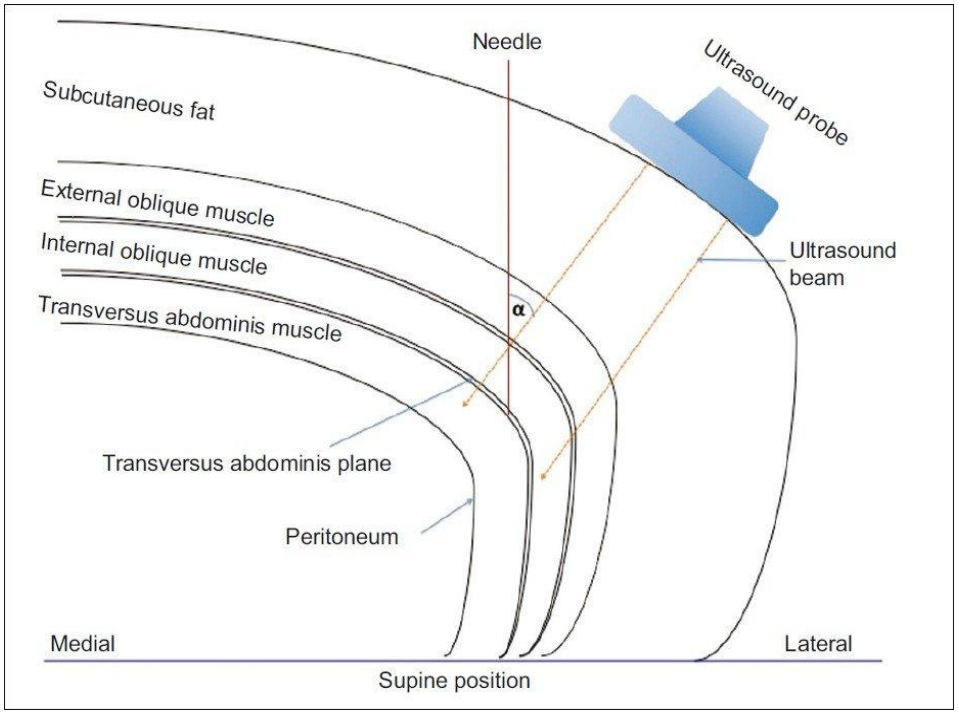
For the posterior approach, the patient may be in a supine or slightly lateral position. The probe is placed transversely in the horizontal plane along the lateral abdominal wall at the mid-axillary line, midway

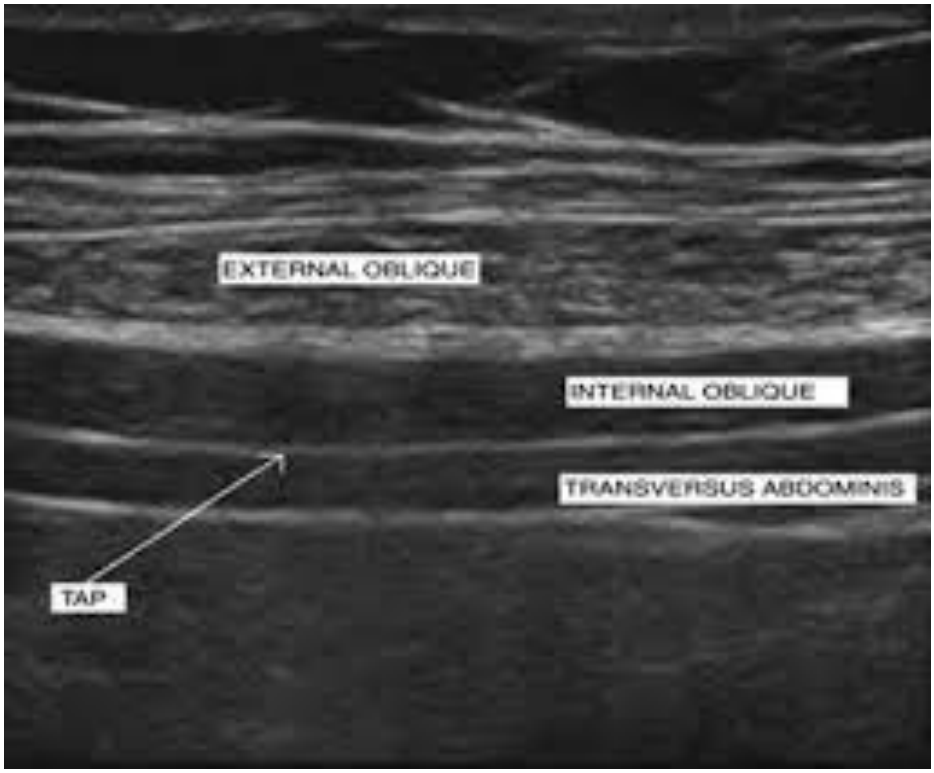
between the iliac crest and lower costal margin. At this level, the three muscles are easily distinguished. After obtaining an optimal Ultrasound view, a needle is inserted approximately 2-3 cm from the transducer in an antero- posterior direction[28-30].

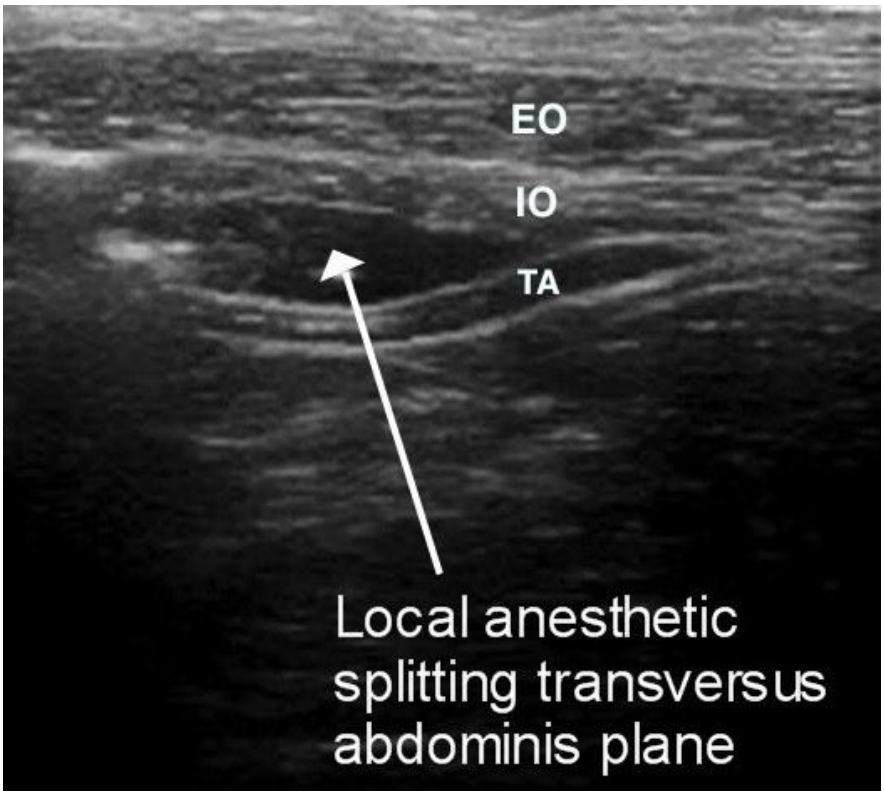


The needle is then advanced using an in- plane approach into the TAP. A small amount of local anaesthetic or normal saline is injected to confirm correct needle placement and then the remaining volume of local anaesthetic can be injected incrementally. The local anaesthetic appears

hypoechoic as it displaces the internal oblique superiorly and the transversus abdominis muscle inferiorly. This approach results in sensory block below the umbilicus.







When analgesia above the level of umbilicus is needed, a subcostal US guided block may be beneficial. In this block, the transducer is placed inferior and parallel to the costal margin, perpendicular to the abdominal wall and oblique to the sagittal plane[31].

Complications:

- Intravascular injection
- Local anaesthetic toxicity
- Infection
- Bleeding
- Neurologic injury
- Myonecrosis
- Block failure
- Injury to the internal visceral organs (eg. Liver, bowel)[32,33]

Contraindications:

- Peritonitis
- Acute abdomen[34,35]

BASIC PRINCIPLES OF ULTRASOUND

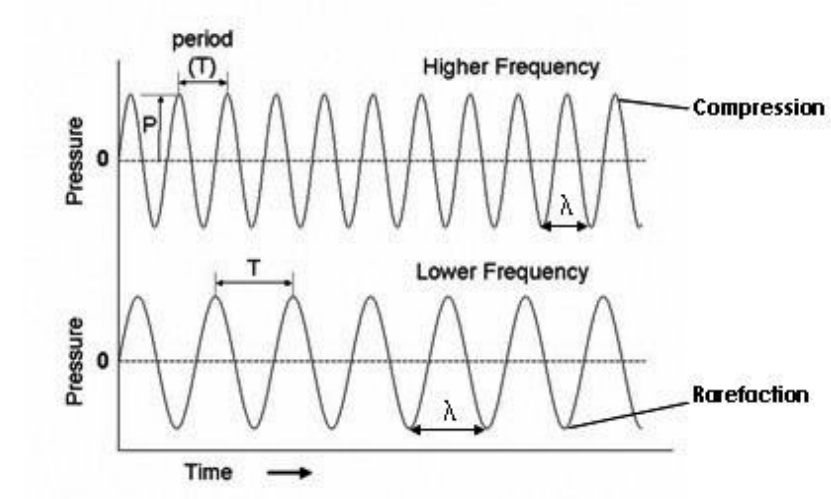
Introduction:

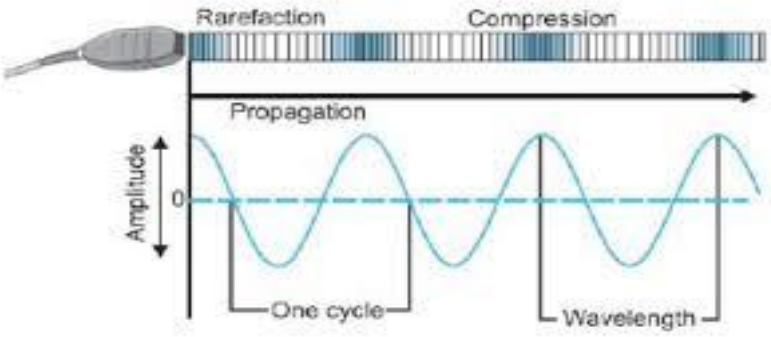
NM Denny and William Harrop-Griffiths wrote ***"Successful regional anaesthesia depends on deposition of the right drug, in the right dose, in the***

right place". To achieve this simplistic goal, practioners of regional anaesthesia used landmark techniques to begin with and later on, peripheral nerve stimulators. The advent of ultrasound, as a guidance tool, has redefined the practice of regional anaesthesia[32].

The basics of ultrasound:

- Any sound exceeding 20,000 Hz is ultrasound.
- Ultrasound is mechanical sound energy that is transmitted through a medium as a longitudinal wave with alternating areas of compression and rarefaction.
- Piezoelectric crystals that line the patient end of the transducer, upon stimulation by an electric charge, generate the ultrasound wave.
- Properties of ultrasound waves include frequency, wavelength, velocity and amplitude.





- As waves travel deeper into biological tissue, they are attenuated i.e. lose heat. Higher the frequency, more the attenuation, therefore lesser the penetration[32].

Tissue echogenecity:

- Bright image from the USG probe is labeled *hyperechoic*. Bone, diaphragm, gallstones and pericardium are examples of hyperechoic tissues.

- Weaker, diffuse reflections are labeled as *hypoechoic*. Solid organs are hypoechoic.

- No reflection is labeled as *anechoic*. Fluid and blood filled structures are anechoic[33].

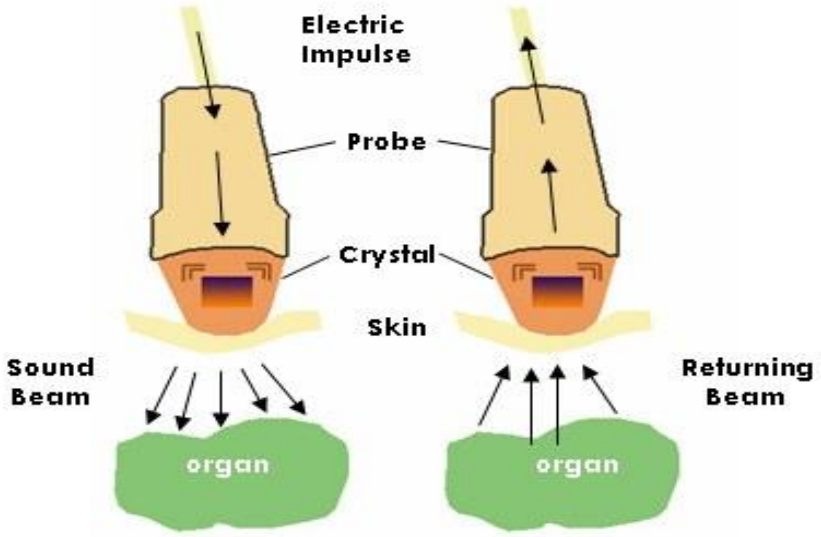
Transducer selection:

- A higher frequency (10-12 MHz) transducer is better suited to visualize superficial structures. These transducers have limited depth of penetration usually less than 4-5 cm[33].

- A lower frequency (less than 7 MHz) transducer is better for deeper structures.

- A transducer with a curvature has better field coverage than the straight one.

- The transducer, both emits the ultrasound beam, and receives the wave reflected from the imaged tissue, also called the "echo"[34].



- Resolution is the ability of the machine to differentiate two closely related structures as distinctly separate.
- Time Gain Compensation (TGC) amplifies returning echoes from deeper structures so as to present a homogenous image.
- Optimization of image includes

  Selection of the right transducer

  Adequate sterile gel

  Adjusting focus, gain and depth.
- Doppler is a principle that permits quantification of blood flow in vessels[33].
- Modes of imaging include

  A(Amplitude) mode – hardly used currently

  M(Motion) mode

  B(Brightness) mode – most commonly used.

In-plane approach:

- The needle is inserted few inches away from the transducer, both the needle and the transducer in the same plane.
- This technique is better for needle visualization as the entire needle including the tip can be visualized.

- As the tip of the needle is seen on the monitor, it is easy to deposit the local anaesthetic solution as close to the sheath as possible thereby reducing the requirement of large volume injections[35].

Out of plane approach:

- In this approach, the needle is advanced perpendicular to the USG probe making the needle visualization difficult.
- The best way to ascertain the position of the needle is by injecting a small volume of local anaesthetic solution and checking the spread on the monitor.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

- **Dimitrios et al** evaluated the efficacy of US guided Transversus Abdominis Plane (TAP) block with conscious sedation for inguinal hernia repair in 20 patients. The block was done using 20-25 ml of 0.5% ropivacaine. The time taken for the onset of block was 30 minutes. Out of the twenty patients, there was failure of block in only one patient, which was overcome by general anaesthesia. Post-operative analgesia was also good and there was need for additional analgesia in only 1 patient. Thus they concluded that US guided TAP block could be used as an anaesthetic method for inguinal hernia repair[36].

- **Mishra et al** used US guided TAP block in a elderly woman, with COPD, anaemia, type 1 respiratory failure, categorized as ASA-PS IV E ,diagnosed to have perforative peritonitis and was posted for emergency laparotomy. General anaesthesia or central neuraxial block was avoided as it would result in fatal complications and hence TAP block was selected as the sole anaesthetic technique. The block was performed using an aseptic ultrasound guided in-plane technique. After 30 min, the abdominal incision was carried out without pain. All the vital signs remained normal intraoperatively. Dexmedetomidine infusion helped in alleviating

the pain due to vagal stimulation. Her post-operative recovery was slow and she was discharged from hospital after14 days[37].

- **Gurkan et al** used US guided bilateral TAP block for repair of incisional hernia in a geriatric female with multiple co-morbities. The patient was also given IV fentanyl 50 mcg and IV midazolam 1mg. Intra-operative period was uneventful and the surgery was successfully completed[38].
- **Milone et al** conducted a case – control study on hundred and fifty male patients undergoing hernia repair. The cases received a combined Transversus Abdominis Plane block and local anaesthesia, whereas the control group received local anaesthesia alone. A higher percentage of patients in the control group (36%) were found to have adequate anaesthesia. Post –operative VAS scores were found to be significantly less in the group that received TAP block and local anaesthesia ($p=0.001$)[39].
- **Gultekin et al** did a prospective study on 200 patients scheduled to undergo inguinal hernia repair. The patients were randomized to receive either Spinal Anaesthesia or Local Anaesthesia. The post-operative VAS scores recorded at 4^{th}, 8^{th}, 12^{th} and 24^{th} hour were found to be less in the group that received local anaesthesia but it was not statistically significant. Complications were found to be more in the spinal anaesthesia group[40].

- **Zamani et al** conducted a comparative study of spinal anaesthesia and local anaesthesia on 60 patients for inguinal hernia repair. Post-operative pain scores lower in the local anesthesia group, which was found to be statistically significant ($p < 0.0001$). No difference was observed between the two groups in terms of duration of surgery, post-operative complications[41].

- **Jethva et al** did a comparative study of local anaesthesia vs spinal anaesthesia for inguinal hernia repair in 100 patients. About 14% of patients in the local anaesthesia group had discomfort intra-operatively. Post-operative analgesia was found to be better in the local anaesthesia group and also there were fewer complications compared to spinal anaesthesia. Ambulation and discharge time was earlier in local anaesthesia group[42].

- **Iqbal et al** did a study in 'Bahawal Victoria hospital ' which showed that the duration of hospital stay was less in the local anaesthesia group (1 day) compared to spinal anaesthesia group (3 days). The complications reported after spinal anaesthesia were urinary retention, headache and hypotension. The patients in local anaesthesia group reported wound infection and hematoma. Thus they found that local anaesthesia is a better alternative to spinal

anaesthesia in terms of patient comfort and complications post-operatively[56].

- A retrospective study was done by **Sanjay et al** in Ninewells hospital, UK which showed that the patients in local anaesthesia group were highly satisfied but had complications such as wound infection, hematoma and hydrocele. Also they required lesser analgesic doses in the intra-operative period and were ambulated early[43].

- A Comparative study of local versus spinal anaesthesia in 100 cases of inguinal hernia repair, done at Saraswati institute of medical sciences, Uttar Pradesh in 2010 by **Srivastava Arati, Sharma Shailja et al** reported that intra-op analgesia was equally good in both the groups and concluded that augmented LA results in increased day care surgery rates, lower post-operative analgesic requirements and fewer urinary problems[44].

- **Niraj et al** evaluated the post-op analgesia of TAP block vs epidural analgesia for abdominal surgery and found that TAP blocks resulted in hemodynamic stability, sparing of the sensory and motor blockade of the lower limbs and hence early ambulation[45].

MATERIALS AND METHODS

MATERIALS AND METHODS

Source of data:

100 adult patients aged 20 – 45 years scheduled for inguinal hernia repair at Government Coimbatore Medical College.

Study period:

August – 2014 to July - 2015

Study Design:

Prospective study

Study Subjects:

- Sample size : 100
- Inclusion criteria
  - ✓ Adults in the age group of 20 – 45 years with ASA physical status I and II with uncomplicated unilateral inguinal hernia (direct/indirect) admitted for elective open hernia repair.
- Exclusion criteria:

Co-morbid conditions such as

Uncontrolled diabetes mellitus,

Uncontrolled hypertension,

Ischaemic heart disease

Chronic lung disease,

Chronic renal failure

Obesity (BMI >= 30).

- ✓ Irreducible / Strangulated /recurrent Inguinal hernia
- ✓ Patients with known coagulopathy, infection at the site, allergy to local anaesthetics and whose BMI <= 18.5.
- ✓ Persons not capable of giving consent (psychiatric patients)
- ✓ Persons unwilling to undergo the study (who refused to consent)

Method of randomization:

- Sealed envelope method.

Materials required:

- **SPINAL ANAESTHESIA:**
  - ➢ Antiseptic (Betadine) for skin disinfection
  - ➢ Sterile drape

- 25 G Quincke spinal needle
- 5 ml syringe
- Bupivacaine ampoule (0.5% hyperbaric)
- Local anaesthetic – 2 % plain lignocaine

- **TAP BLOCK:**
  - Ultrasound machine with a high frequency probe (6-15 MHz)
  - Sterile probe cover
  - Antiseptic (betadine) for skin disinfection
  - Sterile ultrasound gel
  - Sterile gloves
  - Needle :10 cm needle, 20-21 gauge echogenic needle with 50 cm extension tubing
  - 20 ml syringe
  - 20 ml of local anaesthetic (0.5% bupivacaine).
  - Local anaesthetic – 2 % plain lignocaine

Methodology:

1. Institutional ethics committee approval obtained.
2. Informed written consent to be obtained.
3. 100 adults in the age 20- 45 years with ASA class I and II, scheduled for elective open inguinal hernia repair at Government Medical College and Hospital, Coimbatore will be enrolled for the study.
4. Patients will be randomized into two groups:

Group A	**Spinal Anaesthesia**
Group B	**USG guided TAP block**

5. Pre-operative anaesthetic assessment including history, physical examination and routine investigations to be done.
6. Monitoring of the patient to be done by Spo2, NIBP, and ECG.

Group A (Spinal Anaesthesia):

1. Patients to be placed in a lateral decubitous position.
2. Spinal anaesthesia to be performed using midline approach.
3. Local infiltration with 2 % plain lignocaine at the site of injection.
4. Under aseptic precautions, using 25 G Quincke spinal needle, 3.5 cc of 0.5% hyperbaric bupivacaine to be injected at L3 – L4 space.
5. The patient to be then placed in supine position.
6. Pain sensation to be assessed using pin-prick test every 2 min to know the dermatome level achieved.
7. Patients will be considered ready for surgery when there would be complete loss of sensation to pin- prick at the operation site.

Group B (TAP block):

1. To perform ultrasound guided TAP block, patient has to be placed in supine position.
2. After local infiltration with 2 % plain lignocaine at the site of needle entry, with aseptic precautions, the probe is placed transversely in the mid-axillary line mid-way between the lower costal margin and iliac crest.
3. The three muscles are visualised from above downwards – external oblique, internal oblique and transversus abdominis.

4. A 50 to 100 mm, 20-21 gauge echogenic needle is introduced and then advanced until it reaches the TAP plane.
5. When the plane is reached, 2 ml of saline is injected to confirm correct needle placement in the plane and then 20 ml of local anaesthetic 0.5 % bupivacaine will be injected.

- The patients in both group A and B to be given a dose of intravenous midazolam 0.05 mg/kg and fentanyl 1-2 mcg/kg to alleviate anxiety and make them comfortable during the surgery.
- The patients in group B to be given additional infiltration with 5 ml of local anaesthetic-2 % lignocaine when the sac is dissected and also around the pubic tubercle.

Parameters to be assessed:

1. Demographic profile – age and sex of the patients to be noted.
2. Changes in hemodynamic responses such as heart rate and mean arterial pressure to be recorded before and after the block in both the groups at 10 min intervals till the end of surgery.

   Hypotension defined as more than 20 % decrease in mean arterial pressure within the first 20 minutes after anaesthesia.

   Bradycardia defined as a heart rate less than 60/min.
3. Time of achievement of surgical anaesthesia,

4. dermatome level at the beginning and end of surgery,
5. Motor block at the beginning and end of surgery using Modified Bromage scale.

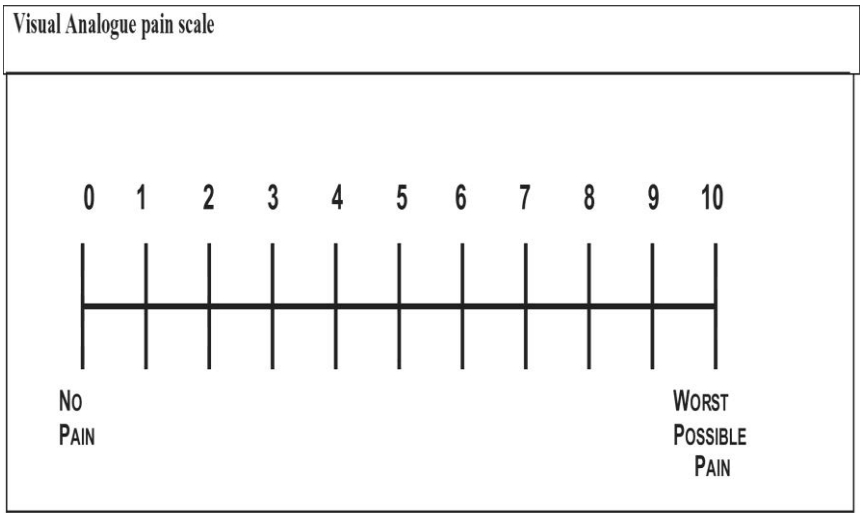
MODIFIED BROMAGE SCALE

0	No motor block	No block (0 %)
1	Can flex knee, move foot, but cannot raise leg	Partial (33 %)
2	Can move foot only	Almost complete (66 %)
3	Cannot move foot or knee	Complete (100 %)

6. onset of perception of discomfort,
7. duration of surgery
8. At the end of surgery, patients to be shifted to PACU (Post Anaesthesia Care Unit), where the pain level of the patients would be assessed using the "Visual Analog Scale(VAS)" at 3,6, 12 ,24 and 48 hrs post-operatively both at rest and during movement.

Visual Analog Scale :

This scale uses a score from 0 to 10 on a line, where 0 indicates no pain and 10 indicates the most severe pain experienced and the patient will be asked to indicate his/her level of pain on the pain scale.



- ✓ Patients also to be questioned regarding side effects such as
- ✓ nausea,
- ✓ vomiting,
- ✓ Headache,
- ✓ Urinary retention,

  Ambulation.

STATISTICAL ANALYSIS:

Statistical analysis will be done using "SPSS version 16 (Statistical Package for Social Sciences) software" for Windows and p value < 0.05 will be considered as statistically significant.

OBSERVATION AND RESULTS

OBSERVATION AND RESULTS

In the present study, 100 ASA I and II patients scheduled to undergo elective inguinal hernia repair were randomized to receive one of the two techniques - Ultrasound guided TAP block or Spinal Anaesthesia. They were compared in view of adequate anaesthesia, hemodynamic changes, post-operative analgesia and adverse effects.

All the data were collected, tabulated and expressed as mean +/- standard deviation. Appropriate statistical analysis was conducted. If the ‘p’ value is between 0.000 to 0.010 , it is considered to be significant at level 1(highly significant). If the ‘p’ value is between 0.011 to 0.050, it is considered to be significant at level 5 (significant). If the ‘p’ value is between 0.051 to 1.000, then it is considered insignificant at level 5 (not significant).

The compiled results are depicted below:

TABLE 1 : DEMOGRAPHIC PROFILE – AGE DISTRIBUTION

	Group	N	Mean ± SD	P Value
AGE Group	**Spinal**	50	37.78 ± 9.1	.672 **Not significant**
	TAP	50	41.04 ± 5.4	

Table 1 shows that the mean age in group Spinal Anaesthesia is 37.78 ± 9.1 and the mean age in group TAP block is 41.04 ± 5.4. The P value is > 0.05 and hence, it is not statistically significant.

AGE DISTRIBUTION

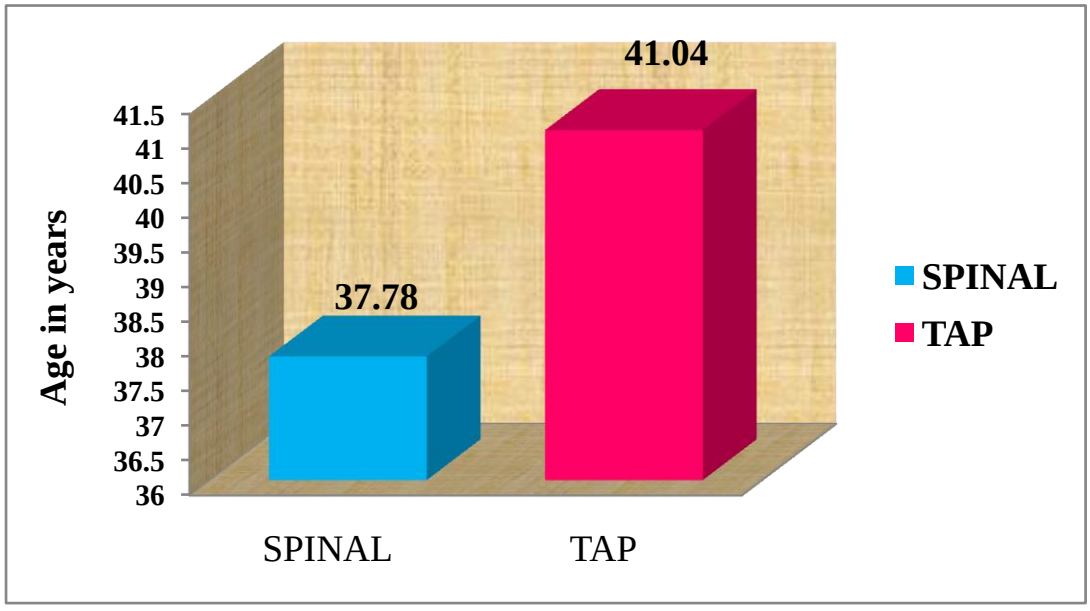


TABLE 2 : DEMOGRAPHIC PROFILE – GENDER DISTRIBUTION

GENDER	Spinal	TAP
MALE	46 (92 %)	49 (98 %)
FEMALE	4 (8 %)	1 (2 %)

Table 2 shows that in Spinal Anaesthesia group, 46 % were males and 8 % were females and in TAP block group, 98 % were males and 2 % were females.

GENDER DISTRIBUTION

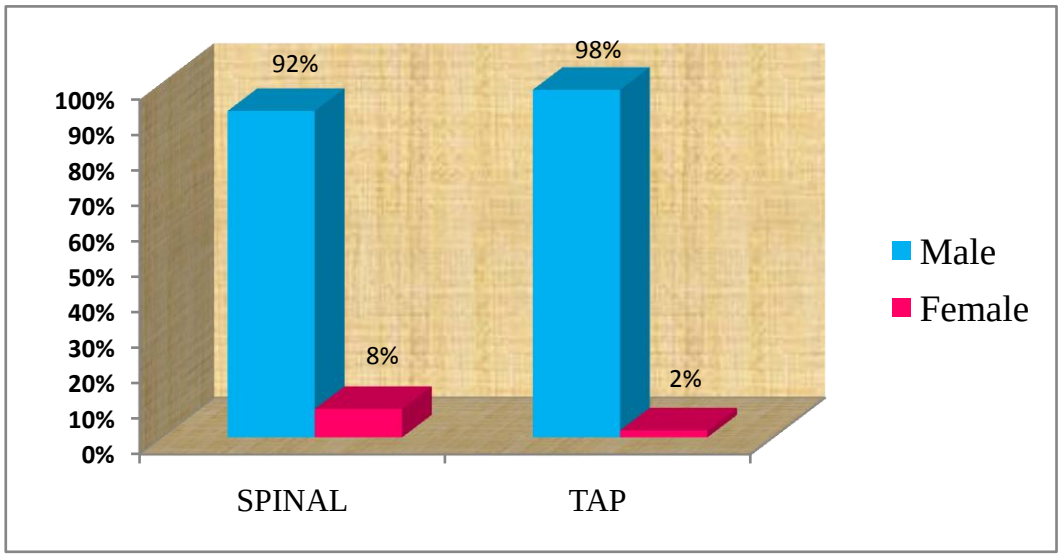


TABLE 3 : TYPE OF HERNIA

GROUP	Indirect	Direct	Right	Left
Spinal	35 (70%)	15(30%)	36(72%)	14(28%)
TAP	34(68%)	16(32%)	35(70%)	15(30%)

Table 3 shows that in Spinal anaesthesia group, 70 % had indirect hernia, 30 % had direct hernia, 72 % had right sided hernia and 28 % had left sided hernia. In TAP block group 68 % had indirect hernia, 32 % had direct hernia, 70 % had right sided hernia and 30 % had left sided hernia.

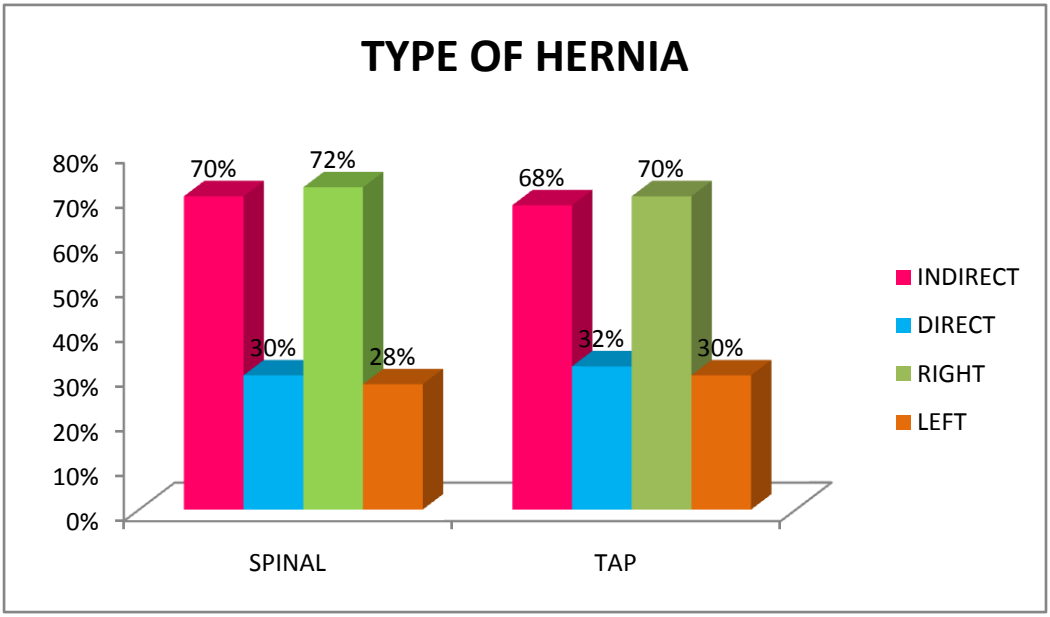


TABLE 4 : TIME TAKEN TO PERFORM THE TECHNIQUE

		N	Mean ± SD	P Value
Time taken to perform the technique	**Spinal**	50	5.28±.497	.000 **Significant**
	TAP	50	10.36±1.711	

Table 4 shows that the mean time taken to perform spinal anaesthesia is 5.28±.497 and for TAP block is 10.36±1.711. The p value is 0.000 which is highly significant.

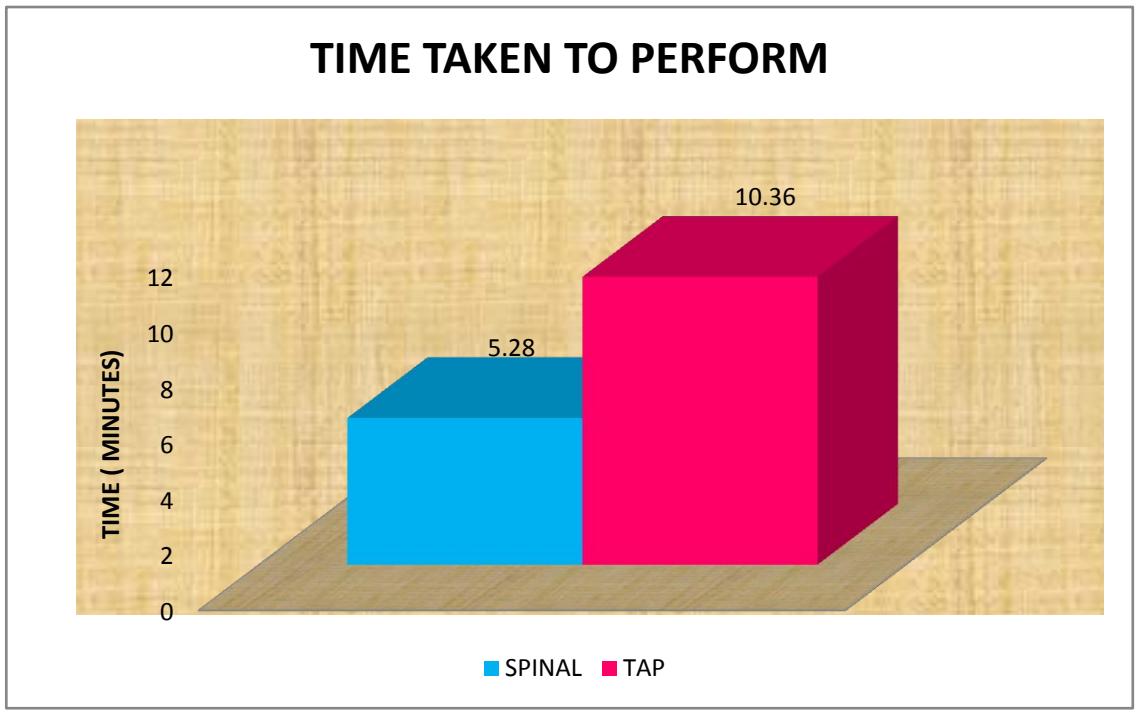


TABLE 5 : ACHIEVEMENT OF SURGICAL ANAESTHESIA

		N	Mean±SD	P Value
Achievement of surgical anaesthesia	**SPINAL**	50	11.92±.2.5	.045 **Significant**
	TAP	50	20.19±3.4	

Table 5 shows that the mean time of achievement of surgical anaesthesia after spinal anaesthesia is 11.92±.2.5 and for TAP block is 20.19±3.4. The p value is less than 0.05 and hence it is significant.

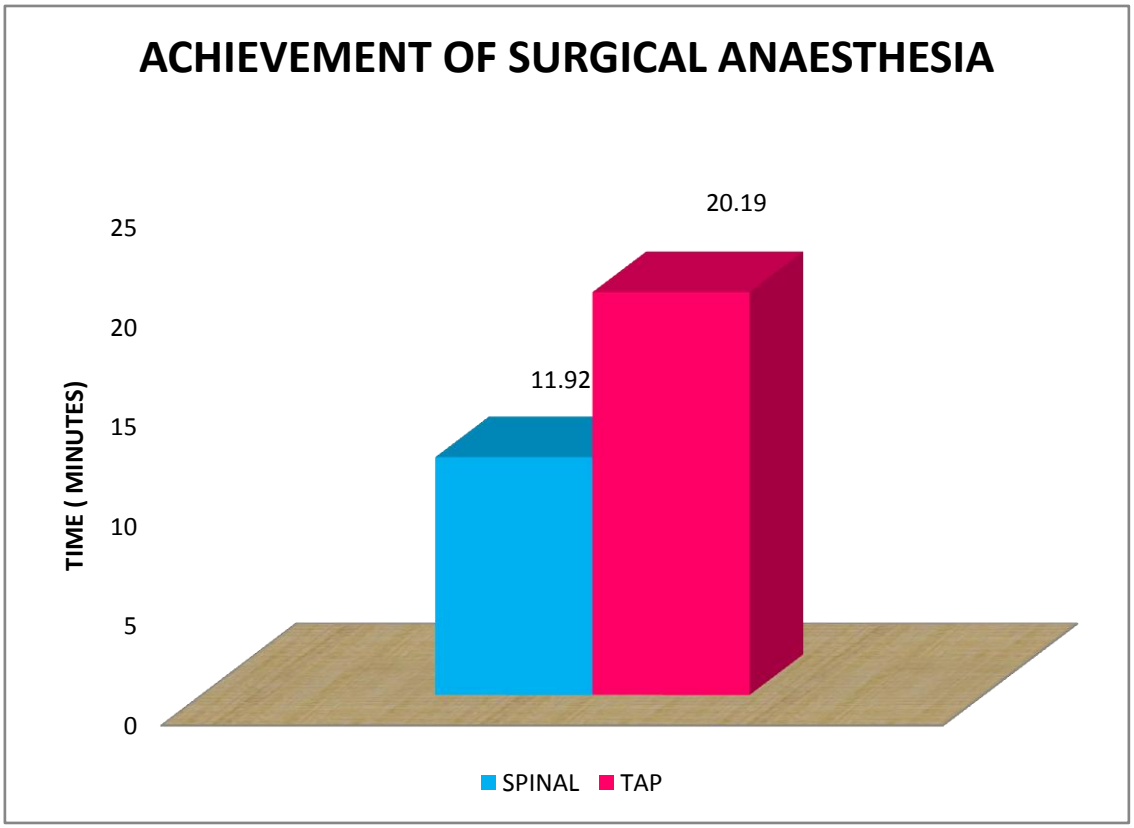


TABLE 6 : DERMATOME LEVEL

Dermatome level	Spinal	TAP
T4	3 (6 %)	
T6	39 (78 %)	
T8	8 (16 %)	
T10		44 (88 %)
T11		6 (12 %)

Table 6 shows that in Spinal anaesthesia group, 6 % had T4, 78 % had T6 and 16 % had T8. In TAP block, 88 % had T10 and 12 % had T11.

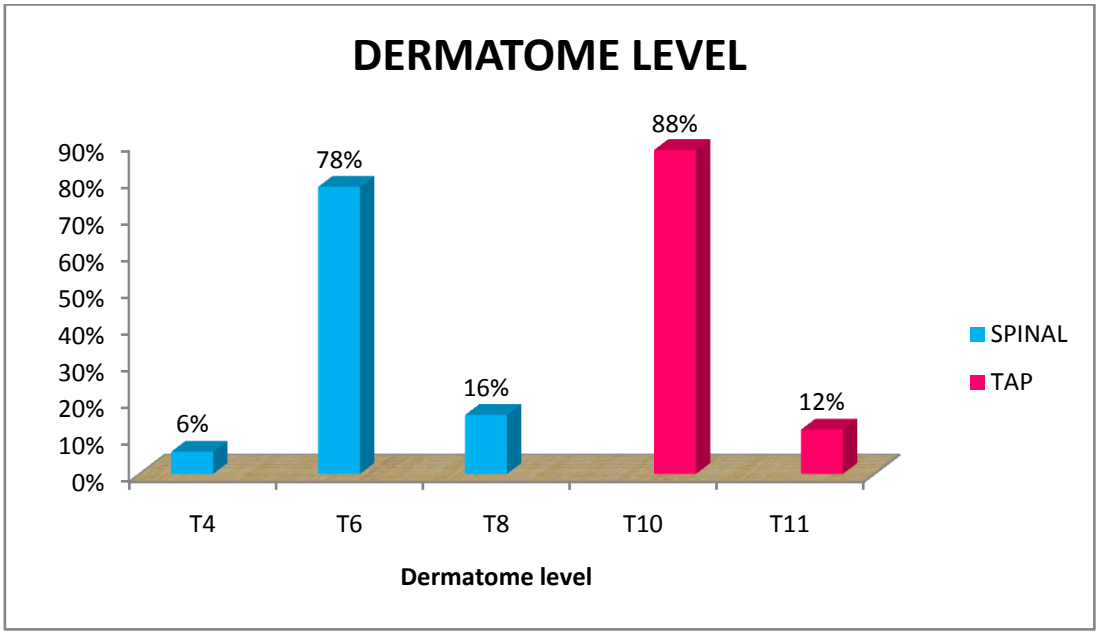


TABLE 7 : MOTOR BLOCK

Modified Bromage score	Spinal	TAP
0		50 (100 %)
1		
2	20 (40 %)	
3	30 (60 %)	

Table 7 shows that in spinal anaesthesia, 40% had a modified Bromage score of 2 and 60% had a score of 3. In TAP block, 100% had a score of 0.

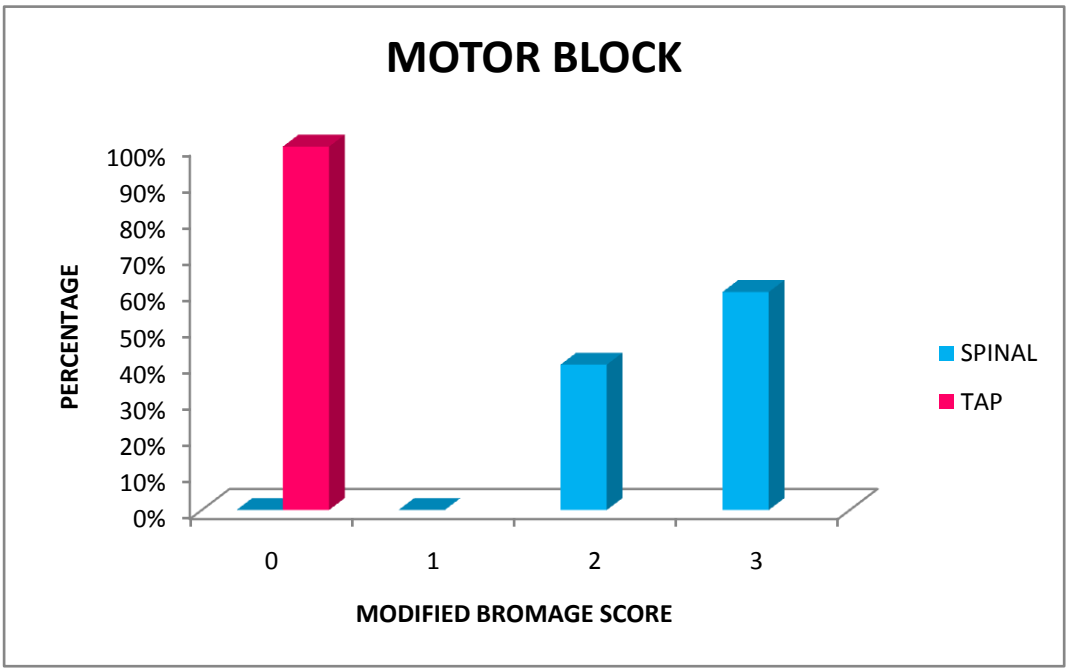


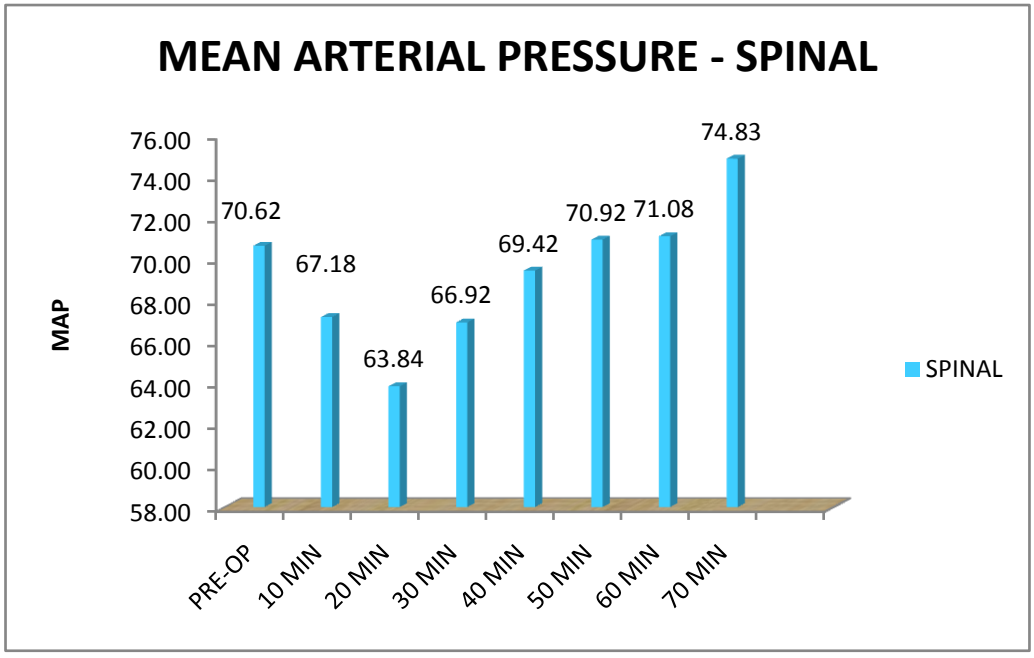
TABLE 8 : MEAN ARTERIAL PRESSURE

		N	Mean±SD	P Value
Pre op	**Spinal**	50	70.62±8.276	.582
	TAP	50	72.12±9.737	
10 minutes	**Spinal**	50	67.18±9.699	.000
	TAP	50	70.94±8.328	
20 minutes	**Spinal**	50	63.84±9.358	.000
	TAP	50	72.56±8.548	
30 minutes	**Spinal**	50	66.92±6.854	.000
	TAP	50	72.32±8.267	
40 minutes	**Spinal**	50	69.42±8.574	.555
	TAP	50	72.42±8.692	
50 minutes	**Spinal**	50	70.92±8.703	.698
	TAP	50	68.72±7.998	
60 minutes	**Spinal**	50	71.08±8.568	.690
	TAP	50	68.49±8.755	
70 minutes	**Spinal**	50	71.08±8.568	.852
	TAP	50	73.71±8.118	

Table 8 shows that the mean arterial pressure during Spinal anaesthesia during pre-op, 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes and 70 minutes is 70.62±8.276, 67.18±9.699 , 63.84±9.358, 66.92±6.854, 69.42±8.574 , 70.92±8.703, 71.08±8.568 and 73.71±8.118 respectively.

In TAP block group, the mean arterial pressure during pre-op, 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes and 70 minutes is 72.12±9.737, 70.94±8.328, 72.56±8.548, 72.32±8.267, 69.42±8.574, 68.72±7.998, 68.49±8.755 and 73.71±8.118 respectively.

Statistical analysis reveals a p value of 0.582, 0.000, 0.00, 0, 0.000, 0.555, 0.698, 0.690 and 0.852 at pre-op, 10 minute, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes and 70 minutes respectively. The p value is significant at 10 minutes, 20 minutes and 30 minutes.



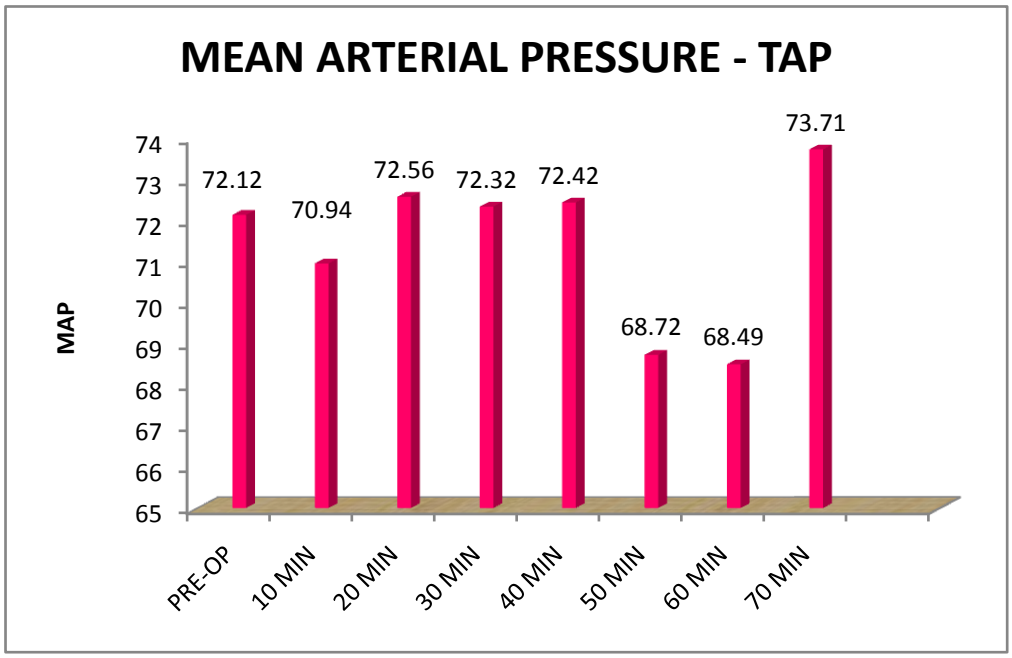

MEAN ARTERIAL PRESSURE - TAP
MAP
74
73
72
71
70
69
68
67
66
65
72.12
70.94
72.56
72.32
72.42
68.72
68.49
73.71
PRE-OP
10 MIN
20 MIN
30 MIN
40 MIN
50 MIN
60 MIN
70 MIN

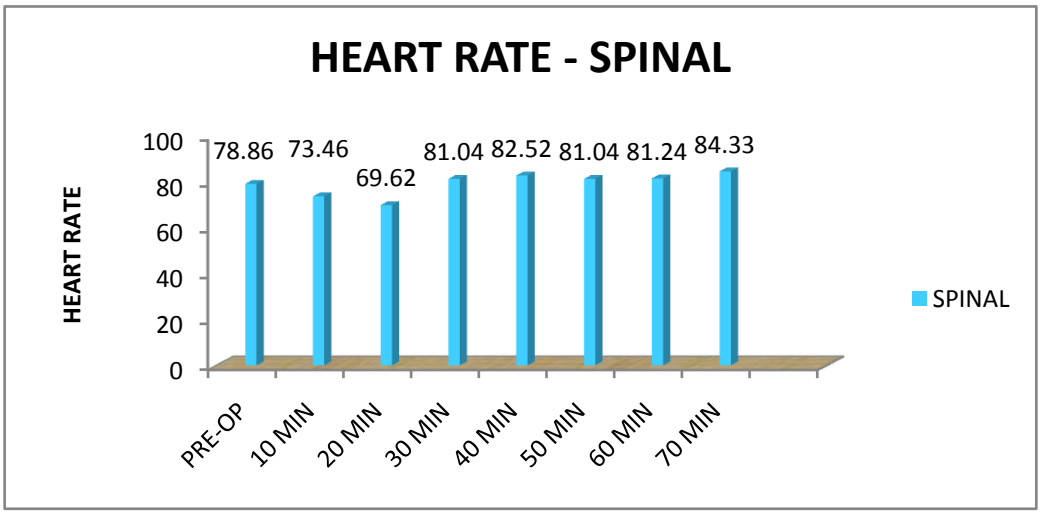
TABLE 9 : HEART RATE

		N	Mean±SD	P Value
Pre op	**Spinal**	50	78.86±8.094	.330
	TAP	50	78.44±7.086	
10 minutes	**Spinal**	50	73.46±7.274	.000
	TAP	50	81.60±8.020	
20 minutes	**Spinal**	50	69.62±9.185	.000
	TAP	50	80.58±7.640	
30 minutes	**Spinal**	50	81.04±7.348	.628
	TAP	50	75.16±7.742	
40 minutes	**Spinal**	50	82.52±7.172	.446
	TAP	50	76.36±6.353	
50 minutes	**Spinal**	50	81.04±7.348	.205
	TAP	50	75.36±7.188	
60 minutes	**Spinal**	50	81.24±6.625	.303
	TAP	50	76.02±6.370	
70 minutes	**Spinal**	50	84.33±9.070	.499
	TAP	50	78.43±6.655	

Table 9 shows that the mean heart rate after spinal anaesthesia during pre-op, 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes and 70 minutes is 78.86±8.094, 73.46±7.274, 69.62±9.185, 81.04±7.348, 82.52±7.172 , 81.04±7.348, 81.24±6.625 and 84.33±9.070 respectively.

The mean heart rate after TAP block during pre-op, 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes and 70 minutes is 78.44±7.086, 81.60±8.020, 80.58±7.640, 75.16±7.742, 76.36±6.353, 75.36±7.188, 76.02±6.370 and 78.43±6.655 respectively.

The p value is significant at 10 minutes and 20 minutes.



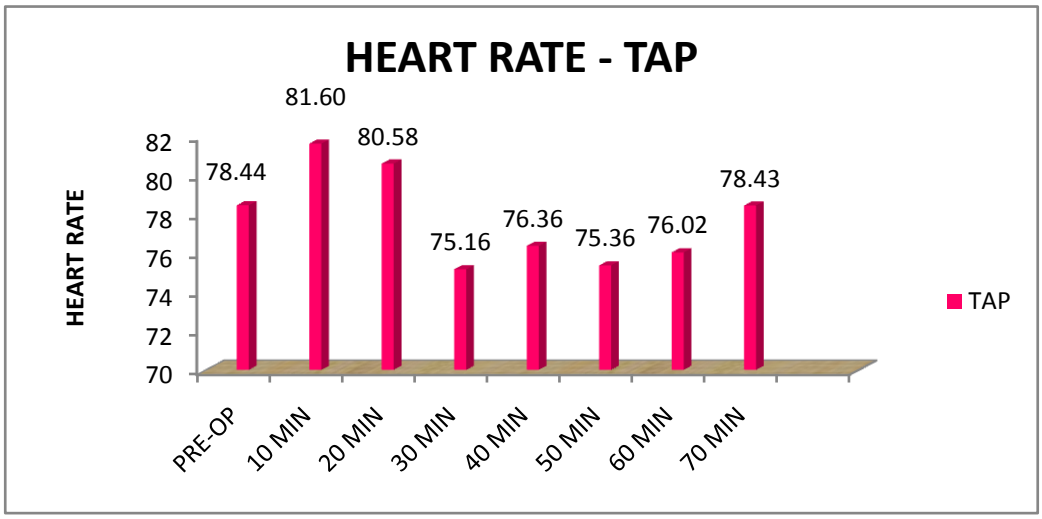


TABLE 10 : SUCCESS OF THE BLOCK

GROUP	Success	Failure	P value
Spinal	50 (100 %)		0.003
TAP	42 (84 %)	8 (16 %)	**Significant**

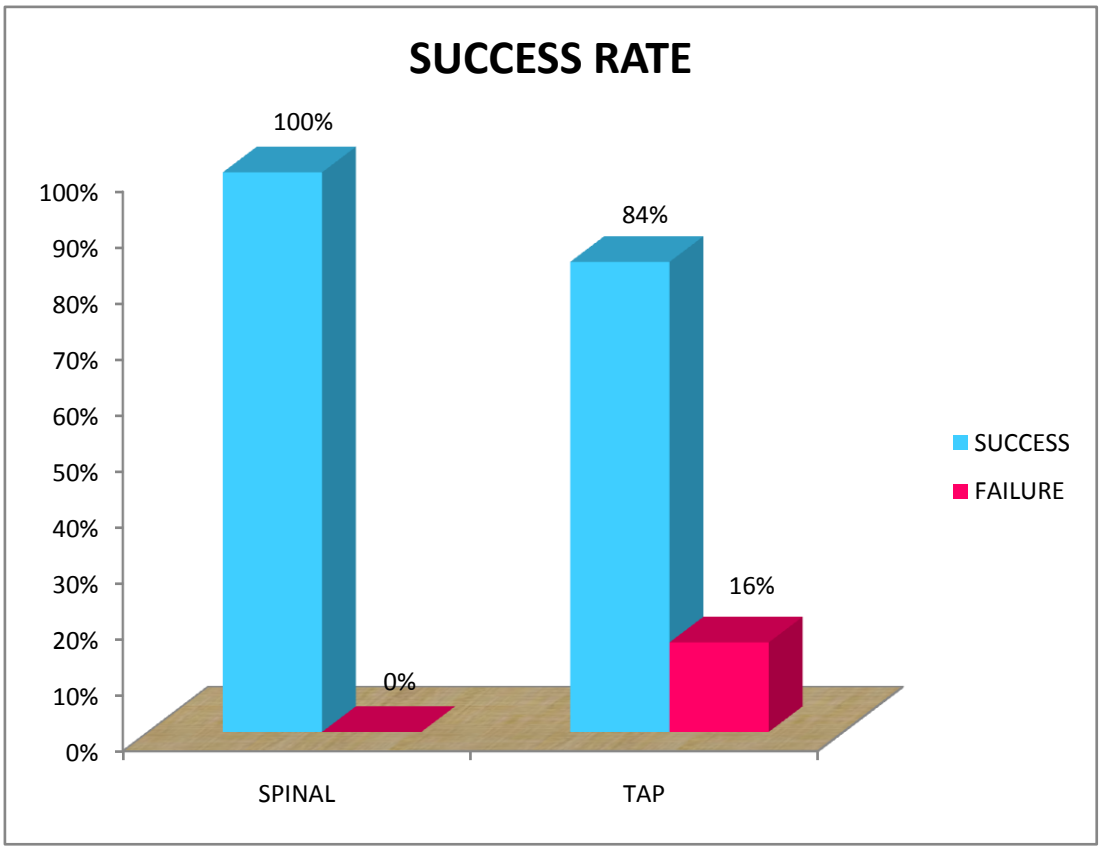
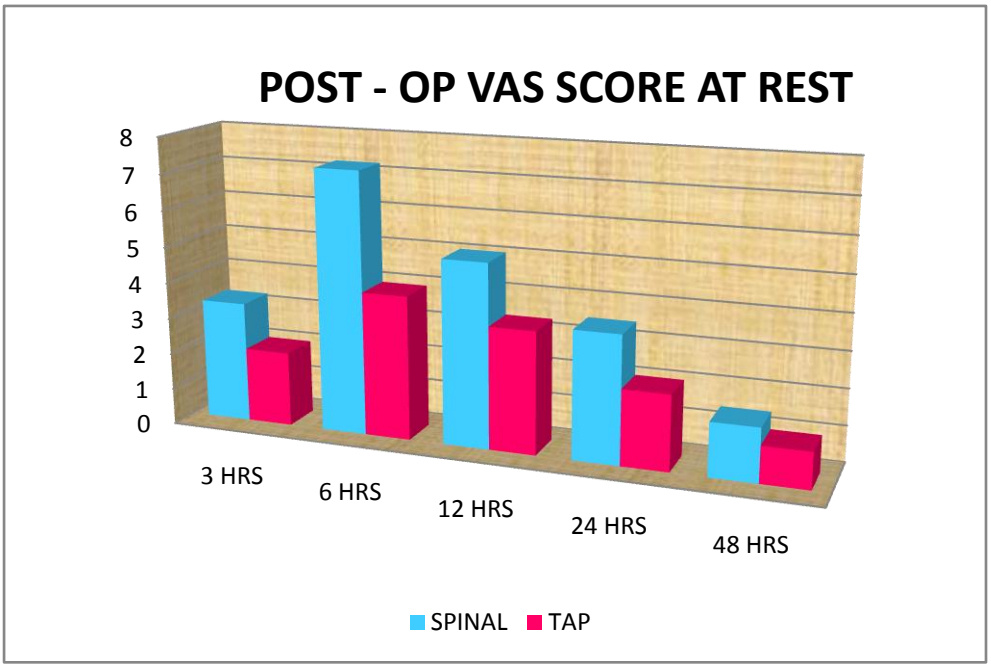


TABLE 11 : VAS SCORE AT REST

		N	Mean±SD	P Value
3 hrs	**SPINAL**	50	3.34±1.6	.008
	TAP	50	2.06±2.4	
6 hrs	**SPINAL**	50	7.26±.4	.000
	TAP	50	3.98±1.9	
12 hrs	**SPINAL**	50	5.08±.6	.030
	TAP	50	3.38±.6	
24 hrs	**SPINAL**	50	3.52±.7	.000
	TAP	50	2.08±.5	
48 hrs	**SPINAL**	50	1.48±.6	.932
	TAP	50	1.01±.4	


POST - OP VAS SCORE AT REST
8
7
6
5
4
3
2
1
0
3 HRS
6 HRS
12 HRS
24 HRS
48 HRS
SPINAL
TAP

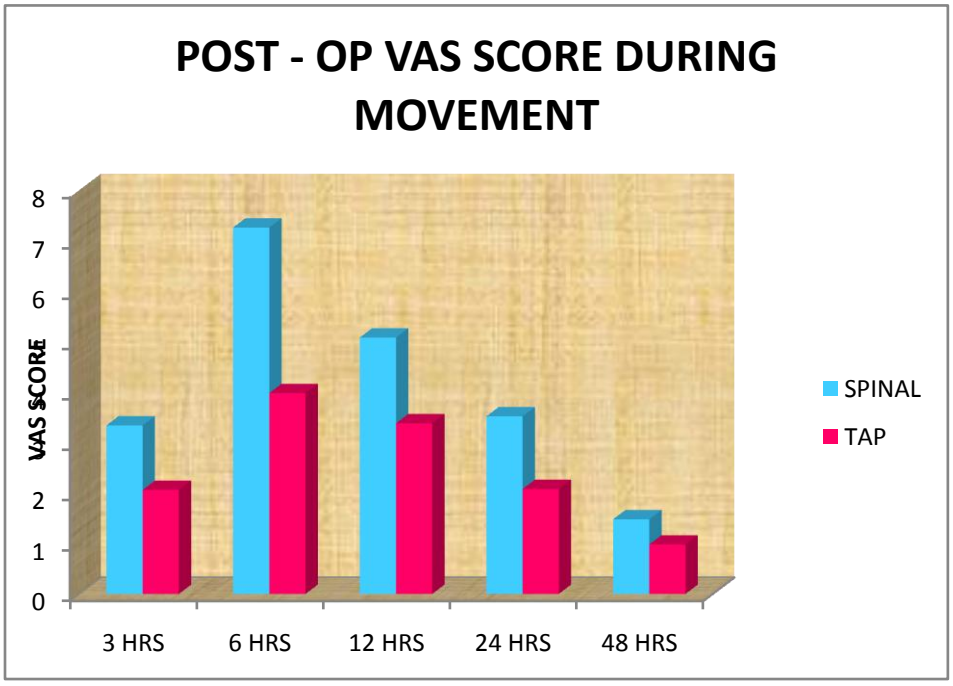

POST - OP VAS SCORE DURING MOVEMENT
VAS SCORE
8
7
6
5
4
3
2
1
0
3 HRS
6 HRS
12 HRS
24 HRS
48 HRS
SPINAL
TAP

TABLE 12 : VAS SCORE DURING

MOVEMENT

3 hrs	**SPINAL**	50	3.34±1.6	.008
	TAP	50	2.06±2.4	
6 hrs	**SPINAL**	50	7.26±.4	.000
	TAP	50	3.98±1.9	
12 hrs	**SPINAL**	50	5.08±.6	.030
	TAP	50	3.38±.6	
24 hrs	**SPINAL**	50	3.52±.7	.000
	TAP	50	2.08±.5	
48 hrs	**SPINAL**	50	1.48±.6	.000
	TAP	50	.98±.4	

Table 11 shows that the mean VAS score at rest during 3, 6, 12 and 24 hrs were lower in the TAP group which was statistically significant. The mean VAS score at rest was also lower in the TAP group at 48 hrs but it was not statistically significant.

Table 12 shows that the mean VAS score during movement at 3, 6, 12 , 24 and 48 hrs were lower in the TAP group which was statistically significant.

TABLE 13 : NUMBER OF ANALGESIC DOSES ON 1st POST-OP DAY

		N	Mean±SD	P Value
No of dose	**Spinal**	50	3.86±.70	.044 **Significant**
	TAP	50	2.60±.83	

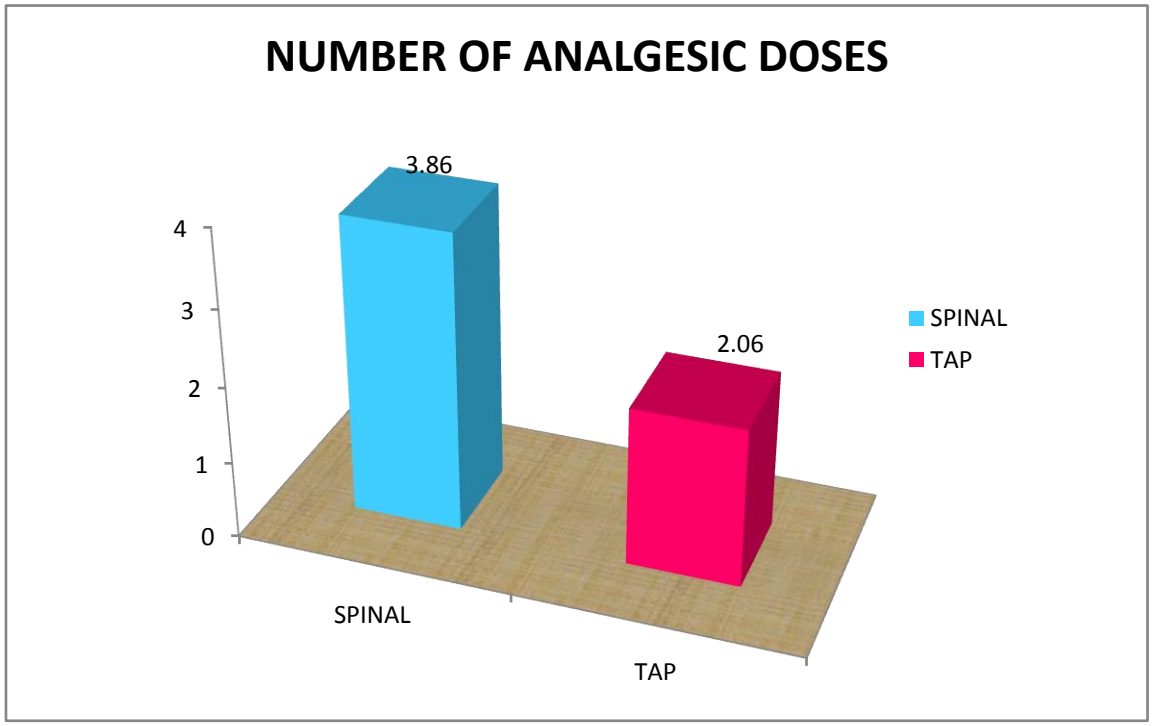


TABLE 14 : DURATION OF SURGERY

		Mean±SD	P Value
Duration	**SPINAL**	61.20±5.206	.795 **Not significant**
	TAP	61.80±5.226	

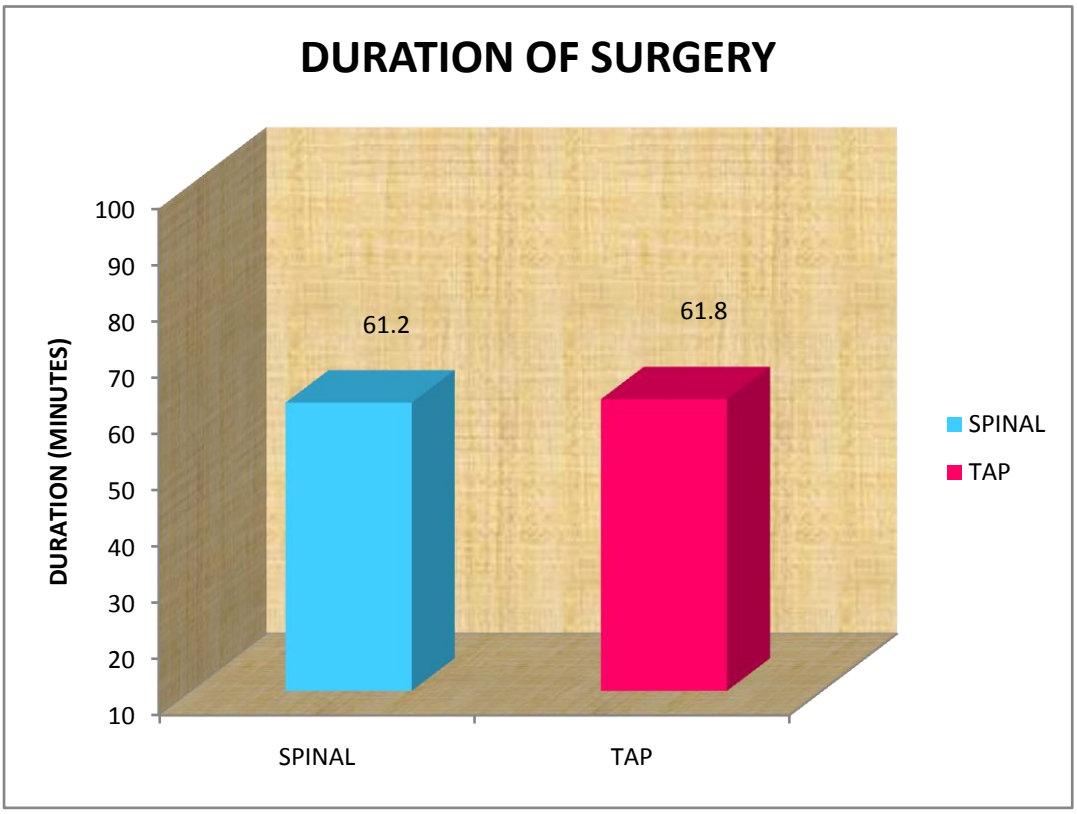


TABLE 15 : NAUSEA

	Nausea		
Group	**Yes**	**No**	**P Value**
Spinal	9(18%)	41(82%)	0.007
TAP	1(2%)	49(98%)	**significant**

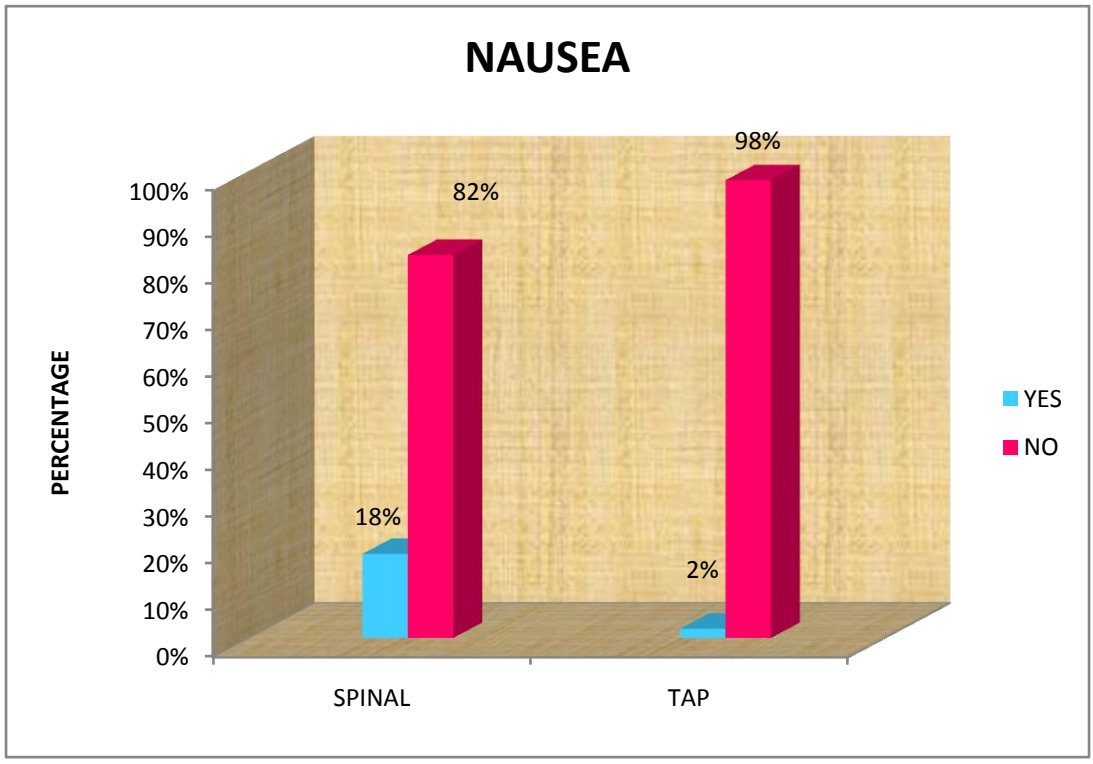


TABLE 16 : VOMITING

	Vomiting		
Group	**Yes**	**No**	**P Value**
Spinal	7(14%)	43(86%)	0.026
TAP	1(2%)	49(98%)	**significant**

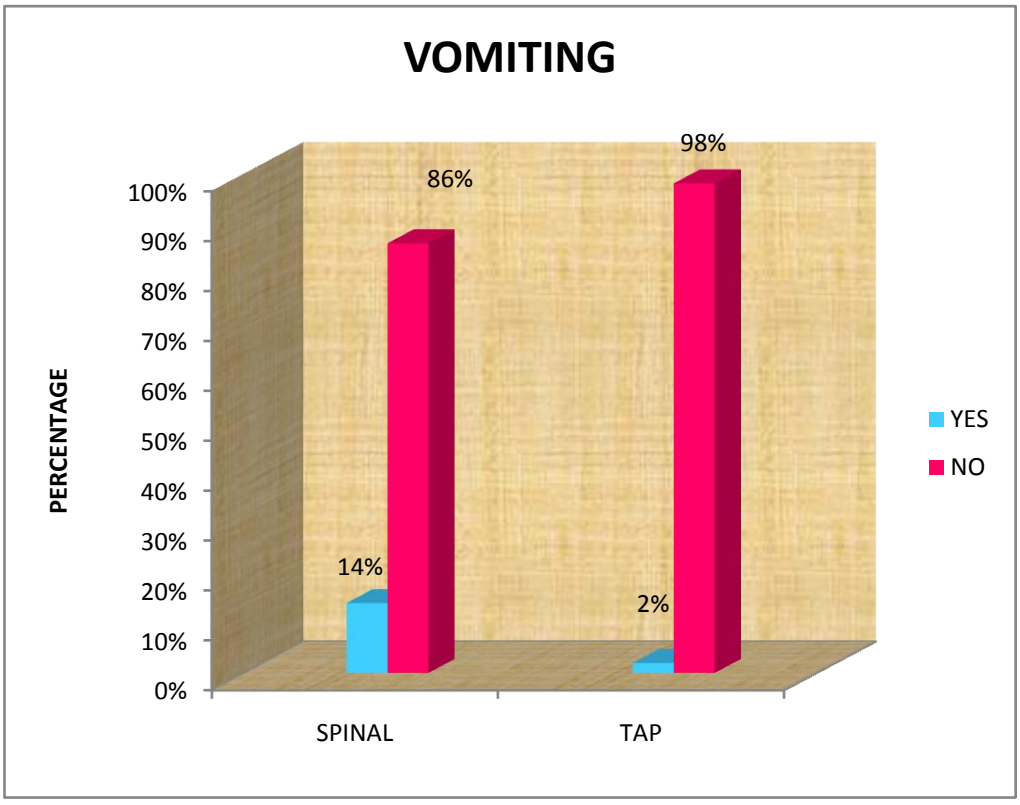


TABLE 17 : HEADACHE

	Headache		
Group	**Yes**	**No**	**P Value**
Spinal	15(30%)	35(70%)	.000
TAP	0	50(100%)	**Significant**

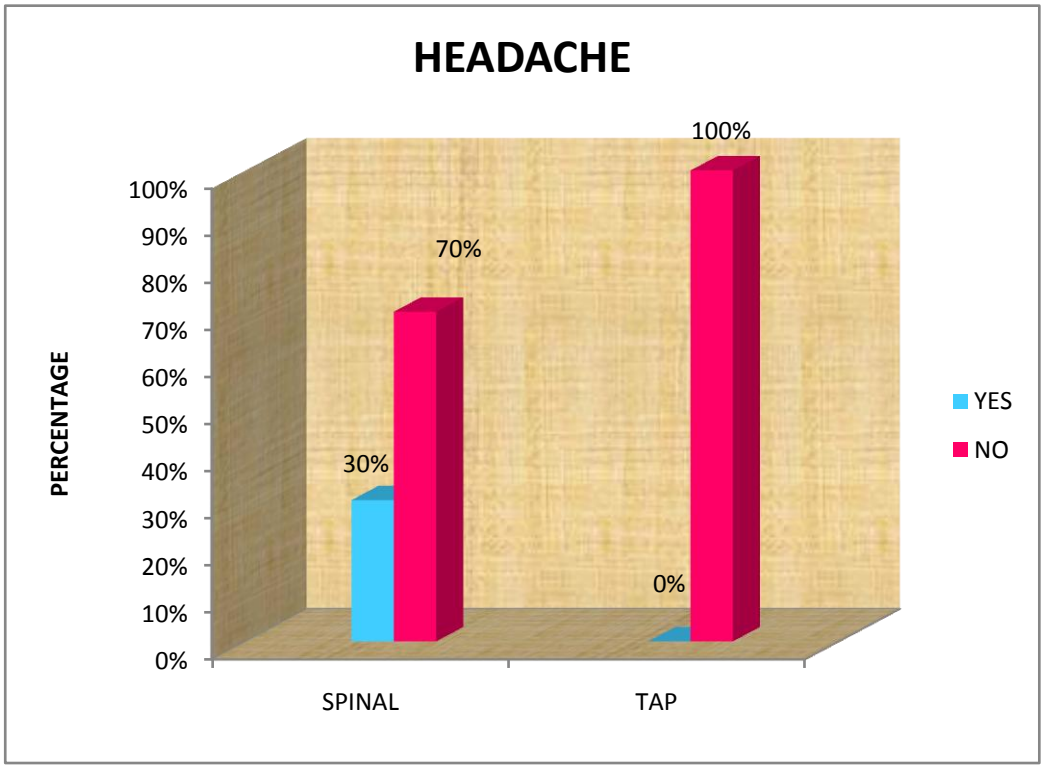


TABLE 18 : URINARY RETENTION

	Urinary retention		
Group	**Yes**	**No**	**P Value**
Spinal	10(20%)	40(80%)	0.000
TAP	0	50(100%)	**Significant**

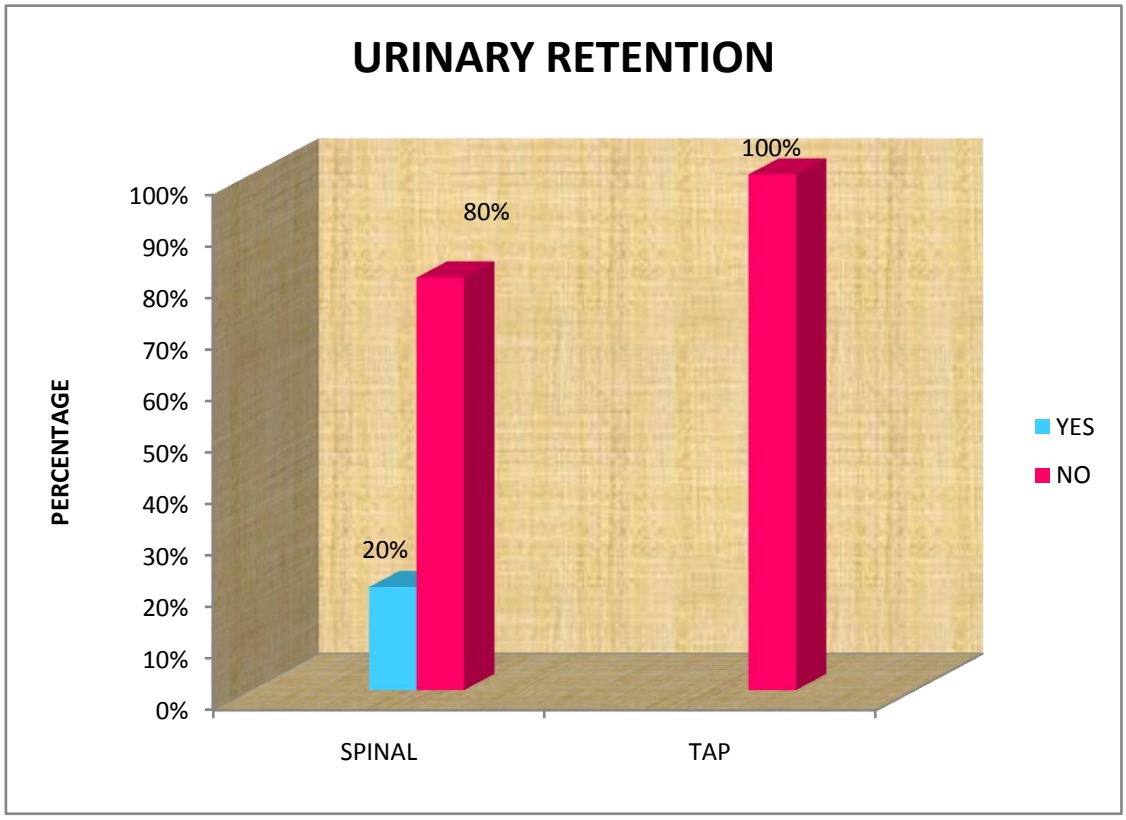
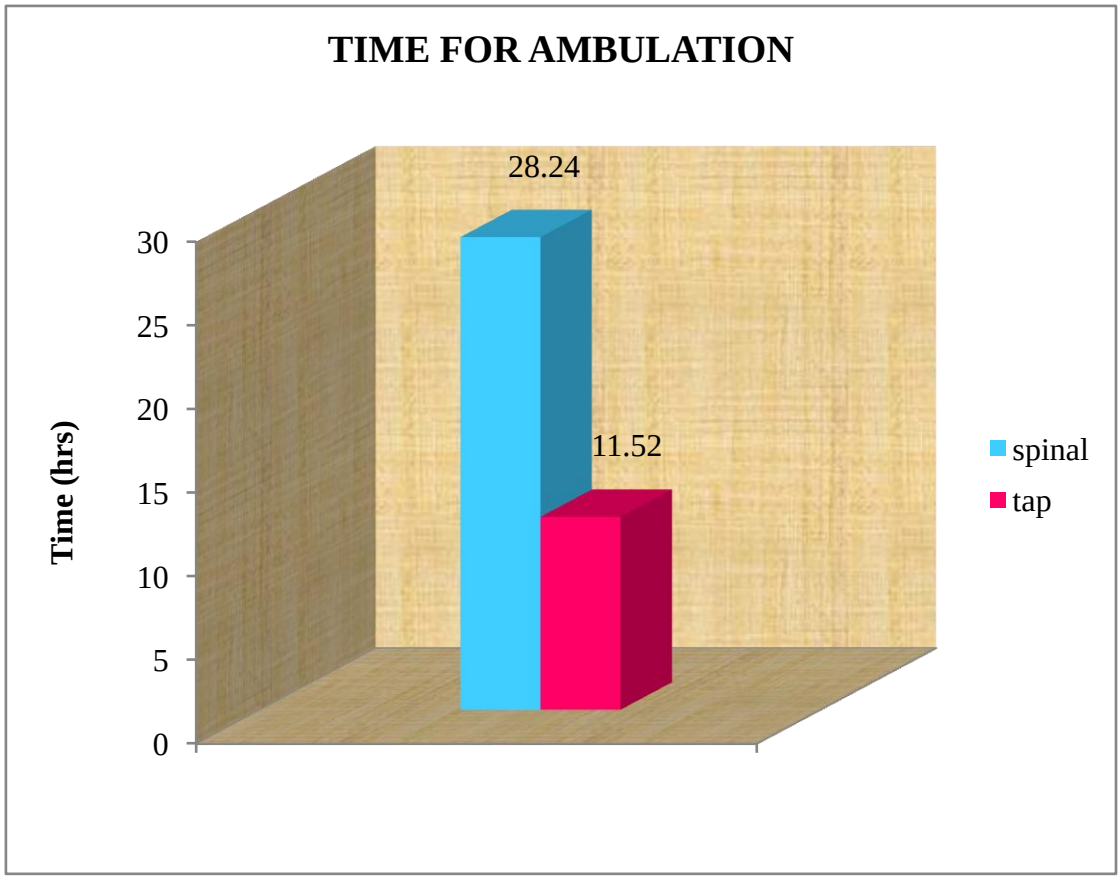


TABLE 19 : TIME FOR AMBULATION

		N	Mean±SD	P Value
Ambulation	**Spinal**	50	28.24±4.2	.000
	TAP	50	11.52±9.4	**Significant**



DISCUSSION

DISCUSSION

AGE AND GENDER DISTRIBUTION:

The mean age was 37.78±9.1 in Spinal Anaesthesia and 41.04±5 in TAP block. Out of the total 100 patients, 95 % were males.

The male preponderance is similar to other studies.

Comparison of age distribution with other studies:

Mean age	**Present study**	**Goyal et al(2014)[46]**	**Song et al[49]**
Group A	37.78±9.1	46.2 +/- 16.64	42 +/- 18
Group B	41.04±5	42.56 +/- 16.71	39 +/- 14

Comparison of gender distribution with other studies:

Gender	**Present study**	**Goyal et al**	**Kark et al[48]**	**Song et al[49]**
Males	95 %	100 %	97 %	86 %
Females	5 %		3 %	14 %

TYPE OF HERNIA:

Inguinal hernia is more common on the right side as the right testis descend later and also there is higher incidence of patent processus vaginalis on the right side.

Comparison of type of hernia with other studies:

Present study	**Indirect**	**Direct**	**Right**	**Left**
Spinal Anaesthesia	35(70 %)	15(30 %)	36(72 %)	14(28 %)
TAP block	34(68 %)	16(32 %)	35(70 %)	15(30 %)
Goyal et al[46]				
Group A	64 %	36 %	68 %	32 %
Group B	80 %	20 %	60 %	40 %
Manatakis et al[36]	55 %			

TIME TAKEN TO PERFORM THE PROCEDURE:

The mean time taken to perform Spinal Anaesthesia was 5.28±.497 and that for TAP block was 10.36±1.7, with a p value of 0.000, which is statistically significant. Thus TAP block requires more time to be performed.

A study done by **Manatakis et al**[36] showed the time taken to perform TAP block to be 9 +/ - 3 minutes.

ACHIEVEMENT OF SURGICAL ANAESTHESIA:

The mean time taken for the achievement of surgical anaesthesia after spinal anaesthesia was significantly less compared to TAP block.

In a study done by **Shibata et al** (2007)[21], the time taken for the onset of sensory block after USG guided TAP block was 30 minutes.

It was suggested by **Mc Donnell et al**[20] that the spread of local anaesthetic within the TAP takes place over several hours and hence early assessment may be misleading.

LEVEL OF BLOCK :

The dermatome level achieved after TAP block has been a controversy over a long period of time.

According to **Mc Donnel et al** (2007)[20], a level of T7 – L1 was obtained, whereas **Shibata et al (2007)**[21] observed the level to be T10.

In a study done by **Hebbard et al** (2009)[7], about half of the cases had a level of T10.

In the present study, about 78 % of the cases in Spinal Anaesthesia had a level of T6 and 88 % of the cases in TAP block had a level of T10.

HEMODYNAMIC CHANGES :

Various studies report that TAP blocks may be an effective alternative in patients who may not tolerate the hemodynamic derangements of central neuraxial blockade.

In spinal anaesthesia group, out of 50 patients, 11 patients (22 %) experienced hypotension and 8 patients(16 %) had bradycardia intra-operatively, whereas in TAP block group, none of the patients had hypotension or bradycardia.

DURATION OF SURGERY :

A study done by **Gultekin et al**[40] found that the average duration of surgery in Local Anaesthesia and Spinal Anaesthesia groups were 59±2.8 and 55±2.5 minutes, respectively. They observed no statistically significant difference between these two groups that are similar to our findings.

SUCCESS RATE :

Out of the 50 cases in Spinal Anaesthesia, all were successful (100%). In TAP block group, out of the 50 cases, 42 cases were

completely successful (84 %), and the remaining 8 cases (16 %) were given general anaesthesia intra-operatively. This was because in the 8 cases, surgical manipulation in the form of handling the tissue was more which couldn't be subdued with sedation and local infiltration.

A failure rate of 30 % was noted after TAP block by **Niraj et al[45].**

Manatakis et al[36] reported the success rate after TAP block to be 95 %. This high success rate could probably be due to the smaller sample size (20) of the study.

POST –OPERATIVE ANALGESIA :

Pain is the most important concern for a patient who is undergoing surgery. It does not always indicate the causative injury. Study done by **Song et al[48]** found that the need for conversion of local anaesthesia to general anaesthesia was because of pain during dissection of the sac. This can be minimized by dissecting the nerve first and applying minimum traction on the sac.

Pain during the post-operative period is mainly due to traction on the peritoneum or inadequate analgesia. In our study, pain was evaluated using the Visual Analog scale at 3,6,12,24 and 48 hrs after surgery. The number of analgesic doses required by the patients on the first post-operative day was also noted.

In the present study, post-operative VAS scores both at rest and during movement were significantly lower in TAP block group.

According to a study done by **Young(1987)[47],** 22% of patients who were operated under local anaesthesia did not need any post-operative analgesics in comparison to 8% of patients in spinal anaesthesia group.

In a study done by **Ozgun et al[50]**, the pain score at 24 hrs was lower in the local anaesthesia group compared to spinal anaesthesia.

Another study done by **Srivastva et al[44]** mentioned that 83 % of patients who were given local anaesthesia were able to walk by 6 hrs after surgery.

According to **Gultekin et al[40]**, postoperative complications rates were 3% after local anaesthesia and 6% after spinal anaesthesia. These results were similar to our results. There was no significant difference between the two techniques.

Belavy et al (2009)[25] observed that TAP block reduced opioid consumption in the first 6 hrs after Cesarean section.

A study done by **Mc Donnel et al[20]** showed that the pain scores at all post-operative times were reduced after TAP block, even at 24 hrs (1.7 +/- 1.7 vs 3.1 +/ - 1.5, $p < 0.005$).

Peterson et al[51] reviewed 7 studies which employed TAP block as part of multimodal analgesic component for managing post-operative pain after infra-umbilical surgeries. It was found that patients who were given TAP block had reduced need for morphine consumption. Also, the VAS scores were lower in 4 studies. There was a small reduction in post-op sedation, nausea and vomiting.

A meta-analysis done by **Charlton et al**[52] observed similar results i.e., reduction in need for morphine at 24 hrs. However, they could not find any difference in post-operative sedation, nausea and vomiting between TAP block patients and controls.

A study comparing the analgesic efficacy of TAP block with spinal morphine by **Mc Morrow et al**[53] showed that TAP block did not provide any additional benefit. This was probably because TAP block affects only the parietal pain whereas intrathecal morphine subdues both visceral and parietal pain.

A study done by **Griffiths et al**[54] observed that there was no additional benefit after TAP block after gynaecological surgery. It was speculated that the negative results of the study may be due to various factors such as there was a wide variation of age in the study group, large number of patients were obese and there was non-uniformity of the level of surgical incision i.e. some incisions were above the umbilicus. In some

cases, there was more surgical manipulation and hence TAP block would not have been effective.

SIDE EFFECTS :

In spinal anaesthesia group, 9 patients (18 %) had nausea and 41 patients (82 %) did not have nausea. In TAP block group, nausea was present in 1 patient (2 %). P value is 0.007 which is statistically significant. The patient who experienced nausea in TAP block group was given general anaesthesia intra-operatively.

Vomiting in the post-operative period occurred in 7 patients (14 %) after Spinal Anaesthesia and in 1 patient (2 %) after TAP block. This is statistically significant (p = 0.026).

Out of the 50 patients in Spinal Anaesthesia group, 15 patients(30 %) had headache, whereas none of the patients in TAP block group had headache. The calculated p value is 0.000 which is highly significant.

Urinary retention is a frequent concern after spinal anaesthesia. In the present study, 10 patients (20 %) experienced urinary retention after Spinal anaesthesia, whereas none of the patients after TAP block had this problem. P value is calculated to be 0.000, which is statistically significant. Several studies reported that the risk of occurrence of urinary retention after spinal anesthesia is up to 20%. The complications occurred

in 10% of the patients of SA group, and 6.7% of them suffered from urinary retention in a study comparing spinal anaesthesia with local anaesthesia[55].

AMBULATION :

The mean time taken to ambulate after Spinal Anaesthesia was 28.24 with a standard deviation of 4.2, whereas that for TAP block was 11.52 with a standard deviation of 9.4. P value of 0.000 is obtained, which is highly significant.

SUMMARY

SUMMARY

From the study, " A comparative study of Ultrasound guided Transversus Abdominis Plane block versus Spinal Anaesthesia for inguinal hernia repair in adults", the following conclusions were made :

- There was no demographic difference between the two groups.
- Compared to Spinal Anaesthesia, the time taken to perform the procedure and for achievement of surgical anaesthesia was more with USG guided TAP block.
- Hemodynamic changes such as hypotension and bradycardia were absent in TAP block.
- Success rate was more with Spinal Anaesthesia than TAP block.
- Post-operative analgesia was significantly better in TAP block patients.
- There were no significant complications reported after TAP block, whereas Spinal anaesthesia patients reported complications such as nausea, vomiting, headache and urinary retention, which was significant.
- TAP block patients were ambulated earlier.

CONCLUSION

CONCLUSION

The Transversus Abdominis Plane block may be considered as an effective alternative to Spinal Anaesthesia in terms of hemodynamic stability, post – operative analgesia, lesser complications and early ambulation.

ANNEXURES

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ABBREVIATIONS

LIST OF ABBREVIATIONS

TAP - Transversus Abdominis Plane Block

SAB - Subarachnoid block

CSF - Cerebrospinal Fluid

ASA - American Society of Anaesthesiologists

NIBP - Non Invasive Blood Pressure

ECG - Electrocardiogram

MAP - Mean arterial pressure

HR - Heart rate

VAS - Visual Analog Scale

PROFORMA

PROFORMA

Patient Details :

Name : Unit :

Age : Ip no. :

Sex :

Type of hernia :

Date of surgery :

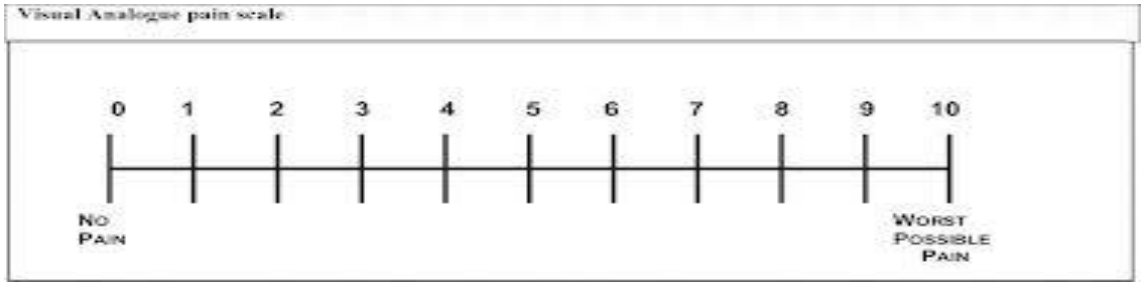
ASA PS class :

	Pre-op	10min	20 min	30 min	40 min	50 min	60 min	70 min
MAP(mm Hg)								
Heart rate/min								
Spo2								

Time taken to perform the block	
Achievement of surgical anaesthesia	
Dermatome level achieved	
Motor block	
Onset of discomfort	
Duration of surgery	

Vas score	**3 hrs**	**6 hrs**	**12 hrs**	**24 hrs**	**48 hrs**
At rest					
During movement					

Visual Analog Scale :



	yes	**no**
Nausea		
Vomiting		
Headache		
Urinary retention		
Time taken for ambulation		

CONSENT FORM

INFORMED CONSENT FORM

I am Dr. Tamalika Das, carrying out a study on the topic, **" A comparative study of Ultrasound guided Transversus Abdominis Plane(TAP) block versus Spinal Anaesthesia for Inguinal Hernia repair in adults".**

My research project guide is Dr. K. Santha Arulmozhi, MD.,DA.

My research project is being carried out under the department of

Anaesthesiology, Coimbatore Medical College and Government hospital.

RESEARCH BEING DONE:

'A COMPARATIVE STUDY OF ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK VERSUS SPINAL ANAESTHESIA FOR INGUINAL HERNIA REPAIR IN ADULTS'

PURPOSE OF RESEARCH

- To evaluate the efficacy and safety of TAP block as an anaesthetic method for inguinal hernia repair in adults, compared to spinal anaesthesia.
- To compare hemodynamic responses intraoperatively between TAP block and spinal anaesthesia.

- To compare post-operative pain levels, side effects and recovery following TAP block and spinal anaesthesia.

SAMPLE SIZE:

100 patients.

STUDY PARTICIPANTS:

Adults aged 20-45 years with ASA physical status I and II with uncomplicated unilateral inguinal hernia scheduled for elective open hernia repair.

LOCATION:

CMCH, Coimbatore.

PROCEDURES INVOLVED:

The research includes detailed clinical examination including medical history, physical examination. After the initial examination, patients will be randomly allocated into either group TAP(TAP block) or group SAB(Spinal Anaesthesia).

You, Shri./ Smt./ Kum. _____, aged ____ years, S/o / D/o / W/o _____, residing at _____ _____ are requested to be a participant in the research study titled 'A comparative

study of ultrasound guided Transversus Abdominis Plane(TAP) block versus Spinal Anaesthesia for Inguinal Hernia repair in adults' in Government Medical College Hospital, Coimbatore. You satisfy eligibility criteria as per the inclusion criteria. You can ask any question or seek any clarifications on the study that you may have before agreeing to participate.

DECLINE FROM PARTICIPATION

You are hereby made aware that participation in this study is purely voluntary and honorary and that you have the option and the right to decline from participation in the study.

PRIVACY AND CONFIDENTIALITY

You are hereby assured about your privacy. Privacy of subject will be respected and any information about you or provided by you during the study will be kept strictly confidential.

AUTHORIZATION TO PUBLISH RESULTS

Results of the study may be published for scientific purposes and/or presented to scientific groups, however you will not be identified; neither will your privacy be breached.

STATEMENT OF CONSENT

I, _____, do hereby volunteer and consent to participate in this study being conducted by Dr. Tamalika Das. I have read and understood the consent form / or it has been read and explained to me in my own language. The study has been fully explained to me, and I may ask questions at any time.

Signature / Left Thumb Impression of the Volunteer Date:

Signature and Name of witness Date:

ஒப்புதல் படிவம்

பெயர் :

வயது :

பாலினம் :

முகவரி :

அரசு கோவை மருத்துவக் கல்லூரியில் மயக்க மருந்தவியல் மருத்துவ துறையில் பட்ட மேற்படிப்பு பயிலும் மாணவி **மரு.தமாலிகா தாஸ்** அவர்கள் மேற்கொள்ளும் **குடலிறக்க அறுவை சிகிச்சைக்கு மேற்கொள்ளும் மயக்க மருந்து முறைகளான முதுகுத் தண்டுவடத்தில் ஊசி போடும் முறையோடு குடலிறக்க பகுதிக்கு செல்லும் நரம்புகளை மருந்து மூலம் செயலிழக்கச் செய்யும் முறையோடு ஒப்பிடுதல்** பற்றிய ஆய்வியல் செய்முறை மற்றும் அனைத்து விளக்கங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுபடுத்திக் கொண்டேன் ஏ்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடனும், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் ஏனனைப் பற்றிய அனைத்து விவரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

இடம் :

தேதி :

கையொப்பம் / ரேகை

MASTER CHART

MASTER CHART

S.No.	Name	Age	Sex	Inguinal hernia	IP. No.	Anaesthesia	Success of the block	Mean arterial pressure (mm Hg)									Heart rate /min									Time taken to perform the block	Achievement of surgical anaesthesia	Dermatome level	Bromage scale	Onset of discomfort	At the end of surgery	Post -op VAS score -at rest					Post-op VAS score during moveme					No. Of analgesic doses in first 24 hrs	Nausea	Vomiting	Headache	Urinary retention	Ability to ambulate(hrs)
								Pre-op	10 min	20 min	30 min	40 min	50 min	60 mi	70 mi	80 mi	Pre-op	10 mi	20 mi	30 mi	40 min	50 mir	60 mi	70 mi	80 min						Sensory	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs						
1	Kumar	22	Male	R direct	42792	SAB	Yes	72	68	52	60	66	67	70	72		88	67	58	76	77	76	78	80		5 min	10 min	T4	3		T6	7	7	4	4	1	7	7	5	4	1	4	no	no	no	no	24
2	Manoj	31	Male	L direct	42362	SAB	Yes	86	80	67	64	72	70	71			90	80	84	76	78	76	77			5 min	8 min	T4	2		T6	1	6	5	4	1	2	7	5	4	1	4	no	no	no	no	26
3	Nagaraj	44	Male	L direct	43726	SAB	Yes	76	70	66	64	68	69	68			74	70	78	80	82	80	83			5 min	8 min	T6	2		T8	1	6	4	3	1	2	7	4	4	1	4	no	no	no	no	28
4	Chandrasekar	45	Male	R indirec	43792	SAB	Yes	76	70	59	64	64	63	65			64	58	56	54	55	54	60			5 min	9 min	T6	3		T8	1	6	5	4	0	1	7	5	5	1	5	no	no	no	yes	24
5	Bipon Thaba	26	Male	R direct	47091	SAB	Yes	82	76	72	76	80	76	77			74	66	64	70	73	70	73			5 min	5 min	T6	3		T8	1	6	5	4	0	1	7	5	5	2	4	no	no	no	no	27
6	Nagammal	18	Female	R indirec	52912	SAB	Yes	70	66	66	64	70	67	64			78	70	72	76	75	76	77			6 min	6 min	T6	3		T8	2	6	4	3	1	3	7	6	5	1	5	yes	yes	yes	no	30
7	Duraiswami	34	Male	R indirec	54714	SAB	Yes	74	70	68	62	70	74				76	70	66	72	70	72				5 min	7 min	T6	3		T8	1	7	5	4	2	1	7	6	4	2	4	yes	no	no	no	24
8	Jayakumar	37	Male	R indirec	56336	SAB	Yes	82	80	74	76	80	77	76	78		86	76	72	80	78	80	77	76		5 min	8 min	T8	3		T10	7	7	5	3	1	8	7	6	4	2	5	no	no	no	yes	26
9	Sakthivel	45	Male	R indirec	58099	SAB	Yes	68	66	60	66	64	60	63			72	62	66	70	73	70	72			5 min	5 min	T6	2		T8	1	7	4	3	2	3	8	5	4	2	4	no	no	no	no	20
10	John	45	Male	R indirec	58078	SAB	Yes	70	65	55	66	68	66	69			76	70	56	68	70	68	70			5 min	8 min	T6	3		T8	1	6	5	4	1	3	7	6	4	3	3	no	no	no	no	22
11	Paramasivam	45	Male	R indirec	61112	SAB	Yes	76	71	66	62	68	67				74	70	78	80	78	80	76			5 min	5 min	T6	3		T8	1	6	4	3	1	2	7	4	3	1	4	no	no	no	yes	20
12	Md. Gouse	45	Male	L indirect	61396	SAB	Yes	76	74	66	64	68	68	70			76	70	66	72	73	72	70			5 min	6 min	T6	3		T8	2	6	6	4	1	3	7	5	4	2	5	no	no	no	no	29
13	Venkatesh	20	Male	L direct	61413	SAB	Yes	70	55	62	66	68	66	67			82	74	70	74	73	74	80			6 min	8 min	T6	2		T8	2	6	5	3	1	3	7	5	3	2	4	no	no	no	no	30
14	Kumaraswami	45	Male	L indirect	61839	SAB	yes	68	65	60	58	62	65	63			70	62	60	64	67	64	68			6 min	7 min	T8	2		T10	3	6	4	3	1	3	7	5	4	1	4	Yes	yes	Yes	yes	24
15	Rajarajan	43	Male	R direct	61840	SAB	Yes	72	56	64	60	66	64	60			78	62	57	70	74	70	76			5 min	10 min	T6	2		T8	2	7	4	3	1	3	8	5	3	1	4	Yes	yes	Yes	yes	26
16	Eswaran	43	Male	R indirec	61583	SAB	Yes	54	44	58	60	62	58	56			72	78	74	82	85	82	80			5 min	8 min	T4	3		T6	3	6	4	3	1	4	7	5	3	1	3	no	no	yes	no	30
17	Anburaj	45	Male	R indirec	63017	SAB	Yes	60	50	65	65	56	68	66			70	74	74	72	74	72	73			5 min	9 min	T6	3		T8	2	6	5	3	1	3	7	6	4	1	5	yes	yes	no	yes	32
18	Manoharan	45	Male	R indirec	64409	SAB	Yes	109	94	93	90	100	94	90	86		76	64	54	50	67	60	64	68		5 min	12 min	T6	3		T8	3	7	5	3	0	3	8	6	4	1	4	no	no	no	no	29
19	Bagavan	45	Male	R indirec	64437	SAB	Yes	62	65	54	65	52	55	54			76	70	72	80	75	80	77			5 min	11 min	T6	2		T8	2	6	5	3	1	3	7	6	4	1	4	no	no	no	yes	28
20	Palanisamy	45	Male	R indirec	64445	SAB	Yes	55	46	56	58	60	54	52			84	76	78	80	78	80	76			6 min	15 min	T6	3		T8	2	6	5	3	0	3	7	6	4	1	4	no	no	no	no	22
21	Parimalam	45	Female	R indirec	66068	SAB	Yes	62	60	64	66	70	74	76			72	76	76	70	72	70	70			5 min	6 min	T6	3		T8	3	7	5	3	1	3	8	5	4	1	5	no	no	no	yes	32
22	Manikandan	27	Male	R indirec	66092	SAB	Yes	78	72	56	60	68	69	70			80	74	68	76	75	76	78			5 min	8 min	T6	3		T8	3	6	5	4	2	4	7	5	4	2	4	no	no	yes	no	36
23	Arumugam	45	Male	R indirec	66220	SAB	Yes	90	85	82	80	84	85	87			78	70	72	74	74	74	76			5 min	12 min	T6	3		T8	2	6	5	3	2	4	7	6	4	2	4	no	no	no	no	34
24	Moorthi	36	Male	R indirec	67647	SAB	Yes	82	76	78	76	80	81	80	78		82	78	78	80	76	80	78	80		5 min	10 min	T8	3		T10	2	6	5	3	1	3	7	5	3	2	4	no	no	no	yes	30
25	Suresh	25	Male	R indirec	67643	SAB	Yes	76	70	70	68	74	75	73			80	76	76	70	68	70	78			6 min	12 min	T6	2		T8	3	7	4	3	2	5	8	5	4	2	4	no	no	yes	no	32
26	Jothi	43	Female	R indirec	69005	SAB	Yes	74	72	70	66	70	73	70	72		84	76	80	86	85	86	85	87		5 min	13 min	T6	3		T8	6	7	5	3	2	7	8	6	5	2	5	no	no	no	no	34
27	Johnson	30	Male	R direct	69754	SAB	Yes	68	66	60	62	66	65	66			72	64	68	70	72	70	70			5 min	9 min	T6	3		T8	2	6	4	2	1	3	7	5	3	1	4	no	no	no	no	36
28	Unni Kannan	45	Male	R direct	69229	SAB	Yes	70	65	54	68	72	71	72			80	72	57	70	77	70	76			5 min	10 min	T6	3		T8	2	7	4	3	2	3	8	4	3	2	3	no	no	no	yes	26
29	Govindaraj	30	Male	L indirect	70599	SAB	Yes	74	68	66	68	72	76	77			84	76	78	82	83	82	84			5 min	12 min	T6	3		T8	2	6	4	3	2	3	7	5	3	2	3	no	no	no	no	24
30	Williams	45	Male	L indirect	71364	SAB	Yes	72	66	55	68	74	70	68	70		80	72	56	84	85	84	83	85		5 min	12 min	T6	2		T8	6	7	4	3	2	7	8	5	4	2	3	no	no	no	no	30
31	Ravi	36	Male	L direct	71327	SAB	Yes	68	55	60	64	66	60	62			76	70	72	78	80	78	71			5 min	10 min	T6	2		T8	2	6	5	3	2	4	6	5	4	2	3	no	no	no	no	32
32	Balan	40	Male	L direct	72869	SAB	Yes	66	64	60	68	64	62	60			70	64	66	68	74	68	68			6 min	12 min	T6	2		T8	3	7	4	3	1	5	8	5	3	2	3	no	no	no	no	34
33	Suresh	22	Male	R direct	74099	SAB	Yes	60	62	65	65	56	58	56	60		70	72	74	72	70	72	71	73		5 min	11 min	T6	2		T8	2	6	4	3	1	4	7	5	3	2	3	no	no	no	no	33
34	Shajahan	45	Male	R direct	75797	SAB	Yes	72	67	66	68	70	67	63			84	88	76	90	87	90	88			6 min	13 min	T6	2		T8	2	6	4	3	2	3	7	5	3	2	3	yes	yes	yes	no	35
35	Sasikumar	45	Male	L direct	75771	SAB	Yes	66	65	50	66	68	65	63			76	78	56	78	80	78	75			5 min	10 min	T8	2		T8	2	6	4	3	1	3	7	5	3	2	3	no	no	yes	no	27
36	Muthu	45	Male	L indirect	76028	SAB	Yes	58	50	48	53	57	60	58			90	86	60	88	86	88	85			5 min	9 min	T6	3		T8	1	6	4	2	0	2	7	5	3	2	3	no	no	yes	no	26
37	Karuppuswami	44	Male	R indirec	76005	SAB	Yes	64	50	52	55	54	58	57			96	90	84	90	87	90	89			6 min	13 min	T8	2		T8	2	7	4	3	1	3	8	5	3	2	3	no	no	no	no	28
38	Surijith	20	Male	R indirec	76277	SAB	Yes	64	63	48	62	66	65	60			89	84	59	76	85	76	79			5 min	10 min	T6	2		T8	1	7	4	3	1	3	8	5	4	2	4	no	no	no	no	31
39	Paramasivam	45	Male	R indirec	77445	SAB	Yes	68	66	60	68	70	69	70			73	80	82	76	78	76	77			6 min	8 min	T8	3		T10	1	6	4	2	1	4	7	5	4	1	3	no	no	yes	no	33
40	Manikam	45	Male	R indirec	79851	SAB	Yes	78	76	70	72	76	73				88	80	90	86	85	86				7 min	10 min	T6	3		T8	1	6	4	2	1	4	7	5	3	1	5	yes	no	yes	no	35
41	Madhanakandan	25	Male	R indirec	80735	SAB	Yes	65	64	50	66	68	61	63			76	78	58	75	78	75	73			6 min	12 min	T6	3		T8	2	7	3	2	0	4	8	5	3	1	3	yes	yes	no	no	32
42	Maheswari	45	Female	R indirec	81225	SAB	yes	76	73	78	72	80	78	77			87	90	82	76	84	76	85			5 min	13 min	T8	3		T10	1	6	4	2	0	4	7	5	3	1	4	yes	no	yes	no	30
43	Panjalingam	45	Male	R indirec	1916	SAB	Yes	66	66	68	70	66	65	67			77	70	65	71	73	71	74			5 min	12 min	T6	2		T6	0	7	3	1	0	0	8	4	2	0	4	yes	yes	yes	no	29
44	Karthik	20	Male	R indirec	6454	SAB	Yes	65	67	66	70	62	59	60			83	77	80	73	75	73	77			5 min	10 min	T6	3		T8	2	6	3	2	0	4	7	5	3	2	3	no	no	no	no	22
45	Kumaresan	44	Male	R direct	6618	SAB	Yes	73	75	78	70	76	75	77			61	66	68	64	66	64	60			5 min	10 min	T8	2		T10	1	7	3	1	0	1	8	5	2	1	5	no	no	no	no	23
46	Murugesan	45	Male	L direct	6809	SAB	yes	87	80	67	77	82	80	83			73	77	57	78	80	78	75			6 min	12 min	T6	3		T8	1	6	3	2	0	1	7	3	2	0	3	no	no	no	no	25
47	Michael	42	Male	L indirect	8953	SAB	Yes	77	70	58	73	75	76	77			88	80	76	80	80	80	85			5 min	10 min	T6	2		T8	2	6	4	2	0	4	7	5	3	1	4	no	no	no	no	26
48	Venkatesh	31	Male	L indirect	14465	SAB	Yes	65	64	60	60	66	68	69			77	70	72	75	75	75	75			6 min	15 min	T6	2		T8	2	6	4	2	0	4	7	5	3	1	4	no	no	yes	no	25

49	Ravi	35	Male	R indirec	20619	SAB	Yes	87	78	80	77	82	80	85			75	70	66	74	73	74	77			5 min	15 min	T8	3		T10	2	6	4	3	1	6	7	5	3	1	4	no	no	no	no	26
50	Sakthivel	31	Male	R indirec	20593	SAB	Yes	77	73	70	78	73	70	72			85	80	74	82	80	82	80			5 min	12 min	T6	2		T8	1	6	3	1	0	1	7	5	3	2	4	no	no	yes	no	25
51	Muthusamy	45	Male	L indirect	27991	TAP	Yes	82	80	86	90	88	90	88			90	94	96	88	90	88	89			10 min	20 min	T10	0		T10	1	1	5	0	0	1	2	4	2	2	2	no	no	no	no	8
52	Ramalingam	45	Male	L indirect	26312	TAP	Yes	66	65	70	72	68	70	73			82	77	86	78	80	78	79			10 min	20 min	T10	0		T10	1	1	1	0	0	1	1	2	2	0	2	no	no	no	no	8
53	Perumal	32	Male	R direct	26449	TAP	Yes	72	70	79	71	74	71	72			76	78	74	79	77	79	82			12 min	20 min	T10	0		T10	1	1	2	1	0	1	1	2	2	0	3	no	no	no	no	10
54	Ramalingam	38	Male	R indirec	25603	TAP	Yes	69	66	72	75	70	68	70			86	90	82	84	84	84	87			8 min	20 min	T10	0		T10	0	1	2	1	0	0	2	3	1	0	2	no	no	no	no	10
55	Lathika	37	Female	R direct	25564	TAP	GA	85	80	77	71	75	73	74			92	85	90	88	87	88	89			15 min	10 min	T10	0	24 min	T10	5	4	3	2	1	6	5	3	2	1	4	no	no	no	no	8
56	Sakthivel	45	Male	R indirec	25428	TAP	Yes	67	63	68	70	65	63	64			75	78	73	76	77	76	77			10 min	20 min	T10	0		T10	0	1	2	1	0	0	3	3	1	0	2	no	no	no	no	10
57	Subramani	45	Male	L direct	25855	TAP	Yes	71	68	74	77	75	73	72			93	94	88	89	90	89	90			8 min	20 min	T10	0		T10	1	1	2	1	0	1	2	3	1	0	2	no	no	no	no	8
58	Cheran	42	Male	L indirect	23180	TAP	GA	65	62	60	58	62	60	61			75	68	70	72	75	72	75			10 min	30 min	T10	0	30 min	T10	6	5	4	2	1	7	6	5	2	1	5	no	no	no	no	27
59	Hussain	45	Male	L indirect	18641	TAP	Yes	77	70	69	66	70	68	69			87	80	78	82	85	82	85			10 min	11 min	T10	0		T10	1	4	3	2	0	1	5	4	3	1	3	no	no	no	no	28
60	Karuppuswamy	44	Male	R direct	23941	TAP	Yes	88	86	90	85	86	83	85	85		90	92	88	90	93	90	92	95		10 min	20 min	T10	0		T10	0	5	2	1	0	0	6	3	2	1	2	no	no	no	no	7
61	Kumar	31	Male	R indirec	21133	TAP	Yes	75	74	78	74	70	66	67			72	79	75	80	78	80	82			10 min	20 min	T10	0		T10	1	4	2	2	0	1	5	3	2	1	2	no	no	no	no	7
62	Anifa	45	Male	R indirec	23696	TAP	Yes	68	70	72	66	65	61	62			79	82	72	75	80	75	79			10 min	20 min	T10	0		T10	0	4	2	1	1	0	5	3	2	1	2	no	no	no	no	8
63	Rangasamy	39	Male	R indirec	23211	TAP	GA	75	75	70	66	69	67	68			77	70	65	78	76	78	79			15 min	25 min	T10	0		T10	5	5	2	1	1	6	5	3	2	1	2	no	no	no	no	7
64	Krishnan	42	Male	R indirec	30918	TAP	Yes	83	82	80	76	81	79	80	78	83	87	80	84	90	88	90	86	88	92	12 min	20 min	T10	0		T10	1	1	3	1	0	1	2	4	2	1	3	no	no	no	no	7
65	Chandran	45	Male	R indirec	31513	TAP	Yes	68	66	70	72	70	66	70			75	79	80	76	77	76	75			10 min	25 min	T10	0		T10	0	1	2	1	1	0	2	3	2	1	2	no	no	no	no	6
66	Jayaraman	45	Male	R indirec	30885	TAP	Yes	83	85	87	89	78	74	73			79	84	78	85	85	85	83			10 min	20 min	T10	0		T10	0	2	3	1	0	0	3	4	2	1	2	no	no	no	no	6
67	Manikavasakam	30	Male	L direct	31574	TAP	Yes	69	71	73	70	72	70	72			74	80	76	78	80	78	77			10 min	20 min	T10	0		T10	0	2	2	1	0	0	3	3	2	1	3	no	no	no	no	7
68	Ramki	24	Male	R indirec	33134	TAP	Yes	73	75	75	77	75	70	71			79	82	80	85	84	85	87			10 min	20 min	T10	0		T10	0	2	2	1	0	0	3	3	1	1	2	no	no	no	no	7
69	Muthu	45	Male	L direct	35721	TAP	Yes	83	85	85	86	90	85	86			79	83	87	90	87	90	88			9 min	22 min	T10	0		T10	0	2	2	1	1	0	3	3	2	1	2	no	no	no	no	7
70	Thannasi	42	Male	L direct	40075	TAP	Yes	67	68	70	71	70	67	70			75	80	83	78	80	78	77			11 min	20 min	T10	0		T10	0	2	2	1	0	0	3	3	2	1	2	no	no	no	no	6
71	Narayanan	44	Male	L direct	38341	TAP	GA	69	70	75	77	70	75	77			79	87	85	88	85	88	87			10 min	23 min	T11		25 min	T11	7	6	4	2	1	7	7	4	3	1	4	yes	yes	no	no	36
72	Rangasamy	45	Male	R indirec	37803	TAP	Yes	76	78	80	77	79	76	77	78		85	87	90	82	84	82	83	87		15 min	25 min	T10	0		T10	2	2	3	2	0	2	3	4	2	1	2	no	no	no	no	6
73	Gandhan	45	Male	R indirec	38279	TAP	GA	64	58	62	65	60	58	60			72	77	80	74	77	74	75			10 min	20 min	T11		30 min	T11	6	5	3	2	0	6	6	4	2	1	4	no	no	no	no	35
74	Raj	45	Male	R indirec	37887	TAP	Yes	69	70	71	73	70	71	72			87	90	86	88	87	88	87			12 min	25 min	T11	0		T11	1	5	2	1	0	1	6	3	2	1	2	no	no	no	no	6
75	Mohan	45	Male	L indirect	40687	TAP	Yes	87	88	91	85	88	80	82			92	98	86	88	90	88	90			10 min	20 min	T10	0		T10	0	5	2	1	0	0	6	3	2	1	2	no	no	no	no	8
76	Manoj	31	Male	L indirect	42362	TAP	Yes	65	66	70	68	72	70	72			75	80	76	80	82	80	79			12 min	20 min	T10	0		T10	0	5	2	2	1	0	6	3	2	2	3	no	no	no	no	7
77	Saravanan	44	Male	L indirect	46857	TAP	GA	72	73	78	75	77	77	79			82	90	86	84	87	84	85			10 min	15 min	T11		22 min	T11	6	5	3	2	0	6	6	4	2	1	4	no	no	no	no	34
78	Raj	45	Male	R direct	7887	TAP	Yes	67	70	72	69	74	74	76			73	80	82	77	76	77	73			8 min	18 min	T10	0		T10	1	1	2	1	0	1	2	3	1	0	2	no	no	no	no	7
79	Vasudevan	28	Male	R direct	44161	TAP	Yes	70	72	74	75	78	76	73			86	90	85	88	90	88	87			10 min	20 min	T10	0		T10	2	2	2	1	1	2	4	3	2	1	2	no	no	no	no	6
80	Narasimman	47	Male	L indirect	44400	TAP	GA	68	70	70	72	70	75	73			73	78	82	75	78	75	79			13 min	20 min	T11		35 min	T11	7	6	3	2	0	7	7	4	3	1	4	no	no	no	no	36
81	Mariyappan	40	Male	R direct	47636	TAP	Yes	72	73	74	76	75	73	70			67	73	70	78	80	78	80			8 min	18 min	T10	0		T10	1	1	3	1	0	1	4	4	3	2	2	no	no	no	no	7
82	Santhanam	45	Male	R indirec	46768	TAP	Yes	90	93	95	94	96	98	94			100	103	96	95	98	95	96			7 min	20 min	T10	0		T10	2	2	3	1	0	2	3	3	2	1	2	no	no	no	no	7
83	Chandrasekar	45	Male	R indirec	48321	TAP	Yes	65	67	68	66	62	68	66			78	83	76	80	86	80	81			10 min	20 min	T10	0		T10	1	2	3	2	1	1	3	4	2	1	2	no	no	no	no	8
84	Palanisamy	45	Male	R indirec	47618	TAP	Yes	74	76	74	76	80	82	80	78	82	82	83	87	90	95	90	86	88	85	9 min	20 min	T10	0		T10	0	0	3	1	0	0	0	3	2	1	2	no	no	no	no	8
85	Sundaram	45	Male	R indirec	45913	TAP	GA	64	66	70	66	75	70	66			74	78	85	88	90	88	85			10 min	18 min	T11		32 min	T11	7	6	4	2	0	7	7	4	3	1	4	no	no	no	no	33
86	Dhaman	45	Male	R indirec	53144	TAP	Yes	72	73	75	80	85	80	76			73	76	85	89	90	89	76			13 min	25 min	T10	0		T10	6	5	3	2	0	6	6	4	2	1	4	no	no	no	no	25
87	Ganesan	41	Male	R indirec	57676	TAP	Yes	65	67	68	64	60	56	55			72	76	75	78	86	78	80			10 min	20 min	T10	0		T10	0	0	3	2	1	0	0	4	2	1	3	no	no	no	no	7
88	Govindaraj	45	Male	R indirec	54329	TAP	Yes	73	74	75	70	75	70	66			83	87	89	85	85	85	84			12 min	22 min	T10	0		T10	1	2	2	1	0	1	4	3	2	1	2	no	no	no	no	7
89	Ayyapan	45	Male	L direct	55712	TAP	Yes	82	85	84	89	85	83	80			95	99	96	93	96	93	92			10 min	20 min	T10	0		T10	1	2	3	1	0	1	4	3	2	1	3	no	no	no	no	7
90	Arumugam	45	Male	L direct	56252	TAP	Yes	65	67	64	66	68	67	63			74	78	76	80	85	80	76			10 min	20 min	T10	0		T10	2	2	3	2	0	2	4	4	3	1	2	no	no	no	no	7
91	Kali	45	Male	R indirec	56310	TAP	Yes	58	57	61	64	60	58	55			65	70	69	66	68	66	70			10 min	25 min	T10	0		T10	1	2	3	1	0	1	4	3	2	1	3	no	no	no	no	7
92	Sarathy	45	Male	R direct	57031	TAP	Yes	59	60	62	70	65	61	60			69	72	85	80	82	80	78			12 min	15 min	T10	0		T10	7	6	3	1	0	7	8	4	3	2	4	no	no	no	no	24
93	Shanmugasundara	32	Male	L indirect	56301	TAP	Yes	60	61	60	64	65	63	60			74	78	76	73	75	73	76			10 min	20 min	T10	0		T10	2	2	3	2	0	2	4	3	2	1	2	no	no	no	no	7
94	Subramaniam	45	Male	L direct	58239	TAP	Yes	56	58	58	60	57	55	53	55		67	70	65	66	68	66	71	69		9 min	17 min	T10	0		T10	3	3	2	1	0	3	5	3	2	1	3	no	no	no	no	8
95	Mariyappan	45	Male	R indirec	50826	TAP	Yes	61	63	65	64	67	60	63			75	77	74	70	75	70	71			10 min	20 min	T10	0		T10	3	3	3	2	0	3	5	4	2	1	2	no	no	no	no	8
96	Ramasamy	45	Male	R indirec	56311	TAP	Yes	63	64	64	63	65	64				72	72	74	70	73	70				10 min	20 min	T10	0		T10	2	2	2	1	0	2	5	3	2	1	3	no	no	no	no	7
97	Gunasekaran	45	Male	R indirec	43180	TAP	Yes	64	66	64	62	66	70	73			74	76	78	72	74	72	73			10 min	20 min	T10	0		T10	3	5	3	1	0	3	7	3	2	1	2	no	no	no	no	7
98	Ramjad	45	Male	R direct	41245	TAP	Yes	72	74	74	74	76	77	75			84	89	85	88	87	88	83			8 min	15 min	T10	0		T10	1	1	3	1	0	1	3	4	3	2	3	no	no	no	no	7
99	Sarathy	45	Male	R indirec	57071	TAP	Yes	58	60	61	64	60	65	67			65	70	69	66	67	66	65			10 min	25 min	T10	0		T10	1	1	3	2	1	2	3	3	2	1	2	no	no	no	no	6
100	Subramaniyam	44	Male	R indirec	58239	TAP	Yes	65	67	64	66	68	70	73	75	76	74	78	76	80	77	80	75	79	81	10 min	20 min	T10	0		T10	0	0	3	2	0	0	0	4	3	1	2	no	no	no	no	6