"A ONE YEAR PROSPECTIVE OBSERVATIONAL STUDY TO COMPARE THE SKIN-DURA MATER DISTANCE USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION UNDER SUBARACHNOID BLOCK"

By

REG NO.BA0118004

Dissertation

Submitted to the
KLE Academy of Higher Education and Research,
Belagavi, Karnataka.

In Partial Fulfillment
of the requirements for the degree of

M. D.

in

ANAESTHESIOLOGY

DEPARTMENT OF ANAESTHESIOLOGY,
JAWAHARLALNEHRUMEDICALCOLLEGE,
BELAGAVI, KARNATAKA

APRIL - 2021

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI, KARNATAKA

Endorsement

This is to certify that the dissertation entitled **"A ONE YEAR PROSPECTIVE OBSERVATIONAL STUDY TO COMPARE THE SKIN-DURA MATER DISTANCE USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION UNDER SUBARACHNOID BLOCK"** is a bonafide research work done by **REG NO.BA0118004.**

Dr. Rajesh Mane **MD DNB**
Professor and Head,
Department of Anaesthesiology,
J. N. Medical College,
Nehru Nagar, Belagavi – 10

Date:
Place: Belagavi

Dr. (Mrs) N.S Mahantshetti **MD**
Principal,
J. N. Medical College,
Nehru Nagar, Belagavi – 10

Date:
Place: Belagavi

PLAGIARISM ACCEPTANCE LETTER

KLE

JAWAHARLAL NEHRU MEDICAL COLLEGE

(Recognized by Medical Council of India, New Delhi)

Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 – 2471350 0831 – 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 07-09-2020

ACCEPTANCE LETTER

The softcopy of thesis entitled: **A ONE YEAR PROSPECTIVE OBSERVATIONAL STUDY TO COMPARE THE SKIN-DURA MATER DISTANCE USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION UNDER SUBARACHNOID BLOCK"** has been submitted for Anti-Plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **06%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BA0118004.
Postgraduate Student,
2018-19 Batch,
Department of Anesthesiology,
J. N. Medical College, Belagavi.

LIST OF ABBREVIATIONS USED

ASA	-	American Society of Anaesthesiologists
C	-	Cervical
cc	-	Cubic centimeter
CNS	-	Central nervous system
CSF	-	Cerebrospinal fluid
Hz	-	Hertz
IV	-	Intravenous
IVS	-	Intervertebral Space
kg	-	Kilogram
L	-	Lumbar
LP	-	Lateral Position
m	-	Meters
MHz	-	Megahertz
Mins	-	Minutes
ml	-	Millilitre
NIBP	-	Non invasive blood pressure
OT	-	Operation Theatre
S	-	Sacral
SC	-	Spinal cord
SP	-	Sitting Position
SAB	-	Subarachnoid block
SD	-	Standard deviation
SSD	-	skin subarachnoid depth
T	-	Thoracic

US	-	Ultrasound
USG	-	Ultrasonography
VC	-	Vertebral Column
α	-	Alpha
β	-	Beta
δ	-	Delta
μ	-	Micro
cm	-	Centimeter
G	-	Gauge
Lt	-	litre

ABSTRACT

Background and aims: The practice of subarachnoid block has routinely relied on the palpation of bony prominences, namely the iliac crests and spinous processes, together with sensory feedback during needle insertion. Ultrasound has proved to be a useful modality to ease in administration subarachnoid block in patients with difficult anatomies and reduce the perioperative complications. This study aims at comparing the skin subarachnoid distance(SSD)measured by Ultrasound as well as the conventional technique in relation to sitting position or lateral position. Secondly to reduce the number of attempts and complications related to spinal block

Methods: Three hundredpatients belonging to American society of Anaesthesiologists (ASA) I and II undergoing infraumbilicalsurgeries under spinal anaesthesia were randomized into two groups. Group SP – patients receiving in sitting position and Group LP –patients receiving in lateral position. Pre procedural USGwas used to measure SSD. Later, on the operation table (OT), SSD was measured with Quincke spinal needle using conventional landmark technique. Both the valueas were compared. Student's unpaired t-test and the Chi-square test were used to analyze the results, using the SPSS version 18 software.

Results:In the study, we found that the male population(4.94± 0.33cm) had longer skin to subarachnoid length than the femlaes(4.63± 0.29cm). In our study, there was not any significant difference regards to position (LP= 4.73 ±0.33cm, SP=4.75 ±0.29cm).We observed that the number of attempts and of rate of complications were significantly reduced.

Conclusions: pre procedural USG can be used as an useful tool to predict the needle depth in difficult spinal anatomies like scoliosis, obesity, edematous back, etc. thereby enabling us to perform a successful subarachnoid block

Keywords: ultrasonography, lateral, sitting position

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

INTRODUCTION

Neuraxial anaesthesia (Subarachnoid block) constitutes an indispensable component of modern anaesthetic practice and is one of the most commonly performed regional anaesthetic techniques.

In 1898, August Bier conducted the first subarachnoid block. He used the term "cocainisation" of the spinal cord, where he used 15mg of cocaine intrathecally for a patient undergoing segmental resection of the right ankle infected with tuberculosis.

Subarachnoid block is extensively used to facilitate surgeries involving lower limb, pelvis and lower abdomen.

The advantages are an awake and spontaneously breathing patient, reduction of usage of multiple drugs and cost effective.

The practice of subarachnoid block has routinely relied on the palpation of bony prominences, namely the iliac crests and spinous processes, together with sensory feedback during needle insertion.

However, these landmarks may be difficult to identify in few difficult cases such as in scoliosis, kyphoscoliosis, obesity, age-related changes, oedema over the back due to immobilization, etc. There are various problems encountered while administering subarachnoid block like multiple attempts, pain and discomfort for the patient, failed block, annoyed anesthetist for multiple attempts in altered spine anatomy. They require special assistance or expertise for a successful block.

Recently, Ultrasonography is coming up as a popular entity for subarachnoid blocks. It has been used as a preoperative assessment tool in predicting the feasibility of neuraxial blocks.

It requires detailed knowledge of spinal sono- anatomy and interventional skills of an expert.

USG, when incorporated as an aid to various blocks, provides numerous advantages over conventional method. It gives a proper visualization of the underlying anatomy. It provides an accurate estimation of appropriate site and track the pathway of the needle insertion. It helps in anticipating the difficulty in spinal anatomy before administering subarachnoid block. It also reduces the exposure of any radiation. It also helps in performing real time subarachnoid block.

The aim of using ultrasound is to identify the depth of subarachnoid space (SAS), and accurate location of the Intervertebral Space (IVS) thereby helps in reducing the number of attempts, attempts of puncturing at multiple levels and improves the success rates.

OBJECTIVES

The objectives of the present study were:

- **Primary objective**: To compare the skin- dura mater distance using USG and the spinal needle length with patient in left lateral position and sitting position under subarachnoid block.
- **Secondary objective**: To reduce the number of attempts and complications related to subarachnoid block.

REVIEW OF LITERATURE

Subarachnoid block is a form of neuraxialanaesthesia. When local anaesthetics are administered into subarachnoid space, the nerve roots are blocked

This block is practiced generally in lower abdominal surgeries, gynaecology procedures, urological surgeries, orthopaedic surgeries, etc

In 1885, James Leonard Corning, a neurologist, worked in Roosevelt hospital, who got inspired from Halsted and Hall, administered cocaine into the subarachnoid space of a dog, which resulted in immediate paralysis of the hind legs. Similarly, he performed the same procedure on a man in whom he administered cocaine into T11-T12 IVS which he presumed as subarachnoid space. He had repeated the injection when he didn't find any changes after 8 minutes. After 10 minutes, the patient reported marked sleepiness in his legs but was able to stand and walk. He had inadvertently given an epidural injection instead of a subarachnoid space.[(1)]

In 1898, August Karl Bier, a German surgeon, was the first person to successfully administer spinal anaesthesia with cocaine. Bier and his assistant, Dr. Otto Hildebrandt, experimented on each other by injecting cocaine intrathecally but had to abandon as they were developing severe post dural puncture headache (PDPH). Hildebrandt didn't report of any pain while noxious stimuli was applied to him. He attributed that the severe PDPH might have been caused by the loss of CSF and usage of smaller spinal needles would reduce the incidence considerably. Thereafter he administered cocaine intrathecally to six patients undergoing lower extremity surgeries.[(1)]

For spinal anaesthesia, the identification of the suitable IVS was done by simply palpating surfaces which gives an approximate location for spinal needle placement.

"In 1891, HeinirichQuincke, introduced the traditional landmark guided technique. In this technique, the iliac crest and the posterior lumbar spinous processes are used as the landmarks in which a Tuffier's line is drawn to identify the lumbar vertebra (L3-4)."

This technique was applicable only in patients who had normal spine anatomy. It was difficult to use this method in patients with difficult anatomy like in scoliosis, obesity, edematous back, etc. In these scenarios, use of ultrasound (US) helps in increase in success rates of lumbar puncture.

In 1971, "the first ones to perform central neuraxial blockade with US were Bogin and Stulin.In 1978, Ultrasound (US) was used by Porter and his team to determine the diameter of spinal canal and to visualize the lumbar spine."[(2)]

"Cork and colleagues used US to locate the landmarks relevant for epidural anaesthesia. Thereafter, US was used most often to preview the sonoanatomy of the spine and to take measurements of skin to epidural space."[(2)]

"In 2006 , Yamauchi had reported a case of an 80 year old man in whom lumbar spinal decompression surgery had been performed for lumbar spinal canal stenosis, was scheduled to have a femoro-femoral bypass because of arteriosclerosis obliterans where he observed the exact puncture point and distance from the skin to the spinal cord with ultrasound technique before performing spinal block in a post-

laminectomy patient proved that this technique is useful for patients with anatomical changes around the spine, and should be known to anaesthetists for such situations."[3]

"In 2009, Chong conducted a study on 279 successful nontraumatic Lumbar Punctures in paediatric oncology patients, in which he yielded a strong correlation between the LP needle depth and weight/height ratio, allowed them to predict the ideal LP needle depth. The best equation derived was Depth y(cm) = 10 [weight (kg)/height (cm)] + 1. However, this formula will need further validation in a prospective study. There were no mention of needle direction and number of attempts required for a successful block."[4]

"In 2009, O Donnell conducted ultrasound guided subarachnoid block in a 67 year old with BMI 44 kg/m^2observed paramedian and midline views of ligamentumflavum and posterior dura matter distance with 6.92cm and 6.13cm respectively with ultrasound."[5]

In 2010, "Jinn chin had conducted an ultrasound based spinal anaesthesia in a 40-year-old patient with ankylosing spondylitis who had undergone prior awake fibreoptic intubation in her previous surgery after failed multiple attempts in subarachnoid block. With the help of a pre procedural scan of the spine, L4-L5 IVS was wide enough to administer the subarachnoid block."[6]

"A cohort study conducted by J T Weed in 2011 in 60 patients undergoing lower extremity joint surgery under spinal anaesthesia gave evidence that ultrasound imaging of the Posterior Longitudinal Ligament is a reliable indicator for an open window to the intrathecal space, it also emphasises the potential role that ultrasound can play in the decision-making process."[7]

"In study done by Gnaho et al.in 2012, they found that spinal anaesthesia in sitting position at lumbar L3-L4 level the skin to anterior ligamentumflavum distance and spinal needle depth as (5.154 ± 0.95 cm) and (5.14 ± 0.97 cm) respectively and theestimated depth US and estimated depth normal were respectively 5.15 ± 0.95 cm and 5.14 ± 0.97 cm; these distances were not significantly different (p>0.0001)."[8]

"A study conducted in 2014 by SmitaPrakash et al, assessment of skin to subarachnoid distance in three different groups where they found out that adult males (4.81 ± 0.68 cm) was significantly longer than that observed in females (4.55 ± 0.66 cm) but was comparable with SSD in parturients (4.73 ± 0.73 cm)."[9]

In 2014, "Malarvizhi conducted a study in seventy-five young patients undergoing elective procedures under spinal anesthesia under the age <55years, where they interpreted, that in patients less than 40 years of age, clinical as well as sonographic examination of lumbar spine were equally good in predicting the correct space. Whereas in patients of age group 41-55years, sonogram gives better correlation for identifying the correct space though it is more time consuming. Hence, they concluded that though ultrasound is more useful in patients aged > 40 years, expertise is still needed in using this technique."[10]

"In 2016, a study was conducted by Rajib on 300 patients aged 18 to 60years, belonging to either sex, American Society of Anesthesiologists (ASA) physical status I and II, parturient females, scheduled to undergo elective abdominal or lower limb surgeries concluded that there is a variation in skin to SSD based on age, sex and BMI, with a greater SSD being observed in male and pregnant female patients compared to the non-pregnant female patients."[11]

"Another study conducted by VasundaraTyagi in 2019, an observational study was conducted in a total of 120 patients, to determine the subarachnoid space depth in overall population in relation to anthropometric measurement, ultrasonography measurement and actual depth by needle insertion. They concluded that ultrasound makes it possible to have an accurate estimation of the depth to reach intrathecal space and can help to reduce the no of attempts of needle insertion and also to reduce the failure and complication rates."[(12)]

In 2015, "a study conducted by Ucarli et al, the skin-spinal space distances detected with ultrasound in Group SP and Group LP were (5.47±0.56 cm) and (5.65±0.51 cm) respectively and the needle depth measurements were (5.52±0.69cm) and (6.25±0.92 cm) respectively. The mean needle depths of Group-LP were statistically found significantly higher than Group SP (p=0.002)." [(13)]

"In 2019, another study conducted by Sutagatti on 97 women with pre-eclampsia (PE), the skin-subarachnoid distance (SSD) in mild PE (4.6 ± 0.5 cm) & SSD-USG (4.3 ± 0.5 cm) was less compared to SSD in severe PE (5.2 ± 0.4 cm) & SSD-USG (4.9 ± 0.4 cm). SSD using USG had a mean of 4.5cm ± of 0.57 and correlated well with SSD on O.T table with a mean of 4.8cm. The mean difference (95% CI) between SSD-USG & SSD-OT was -0.3(-0.34 to -0.26). SSD measured by Stocker's formula was 5.7 ± 0.33 cm [SD=0.33]. The mean difference between SSD-Stocker's & SSD-OT was 0.91(0.81 to 1)."[(14)]

BASIC SCIENCES

Vertebral Column (VC)

VC is a component of axial skeletal system. It articulates with the skull superiorly and the pelvic bone inferiorly. The VC can be segregated into Cervical (7), Thoracic (12), Lumbar (5), Sacral (5-fused) and Coccygeal (4-fused) segments (all together 33 vertebrae). The VC encloses a Canal (vertebral canal) that contains the spinal cord. [15]

The Spinal cord is protected against any external physical forces by the bony cage formed by the vertebrae.

In humans, the length of the VC is

- Male : 71cm
- Female: 61cm[15]

Curves of the spine

The curvature of the spine in adults can be categorised as

- Convex anterior – curvature of Cervical (C) and Lumbar (L) segments.
- Concave anterior – curvature of the thoracic and sacral segments

The peculiar ‘S’ shaped VC develops after birth.

The VC is ‘C’ shaped during intrauterine period with the concave surface facing anteriorly. After birth, weight bearing and neck holding happens. This in turn leads to the development of additional curves.

In adults, the highest point of cervical and lumbar curves in supine position are at C_5 and L_5; lowest points of thoracic and sacral are at T_5 and S_2 respectively. (**Fig. 1**)

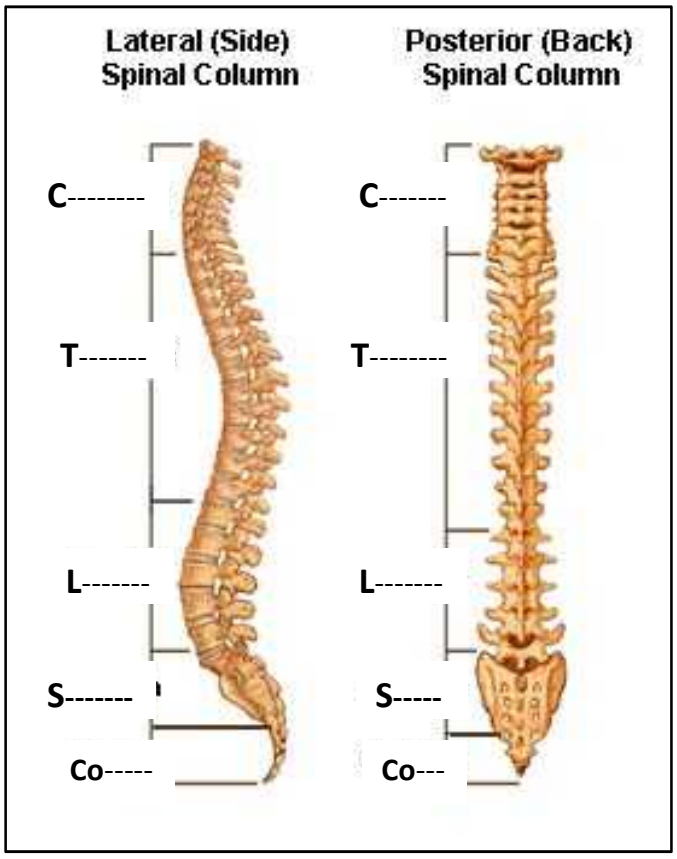


Figure 1: Vertebral Column (spinal column)

(C- Cranial, T-Thoracic, L- Lumbar, S- Sacrum, Co- Coccyx)

Vertebral ligaments

- They are tough fibrous bands stabilizing the spine and guarding the discs.
- There are four ligaments namely:
    1. Supra-spinous ligament: It extends from the C7 segment to the sacrum attached to the spinous processes. Above C7, It is also known as ligament of nuchae.

2. Inter-spinous ligament (membranous): it lies between the supra-spinous ligament and the ligamentumflavum attaching the spinous processes of the vertebrae above and below.
3. Ligamentumflavum: It is a yellow elastic fiber. Extending from root of articular processes (lateral) to the spinous process (posterio-medially).
4. Longitudinal ligaments are two types binding the VC together (anterior and posterior).

Lumbar vertebrae

They are the largest among the other vertebrae (L1-L5) which bears the weight of the torso.

The lumbar vertebrae consists of

- A kidney-shaped vertebral body.
- Two pedicles directed backwards from the upper part of the body.
- Two laminae meeting posteriorly
- A **triangular**-shaped vertebral foramen
- Two transverse processes which are slender
- The spinous processes are shorter, thick, broad and quadrilateral in shape
- Two upper and lower articular processes that prevent rotation. Between contiguous vertebrae, they allow flexion and extension to a limit. (**Fig. 2,3)**

This anatomical orientation gives us the opportunity to access the neuraxial structures between two vertebrae.

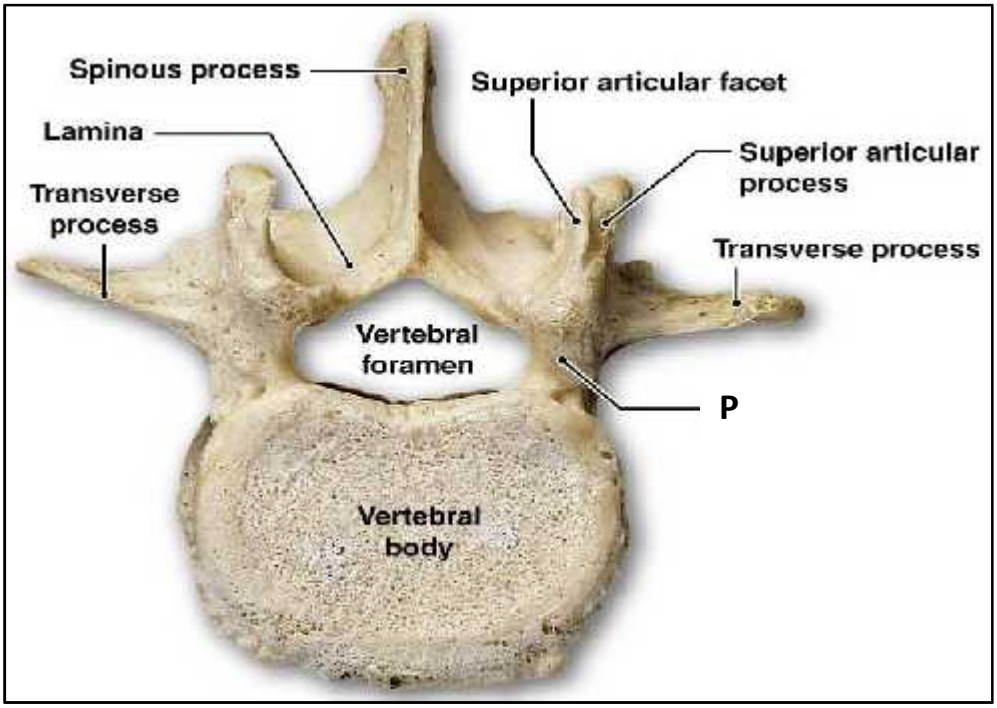


Figure 2. Lumbar vertebrae (top view)

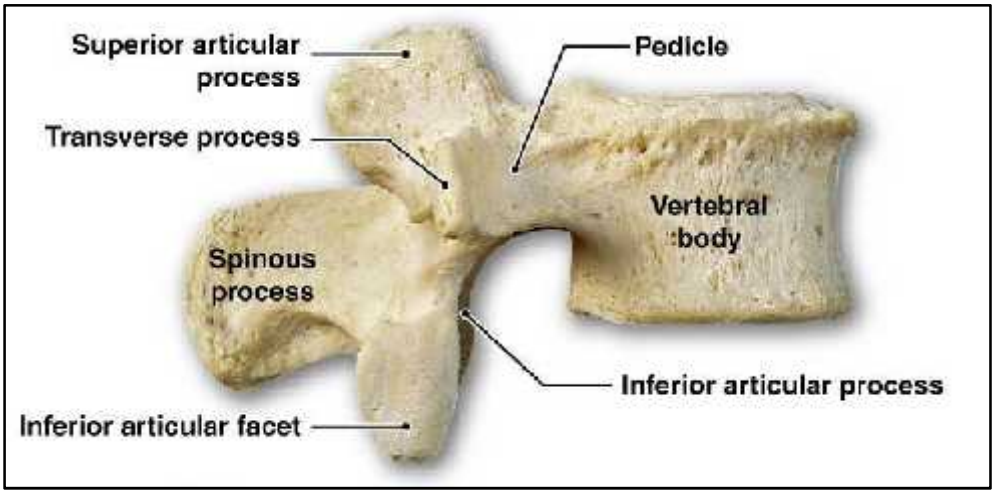


Figure 3. Lumbar vertebrae (lateral view)

Tuffier's line

It's a line from the tip of iliac crests passing over the 4th lumbar vertebrae in sitting position and via L4 – L5 space in lateral position. (**Fig. 4)** It is used in identifying the L4 – L5 space for the subarachnoid block (SAB).

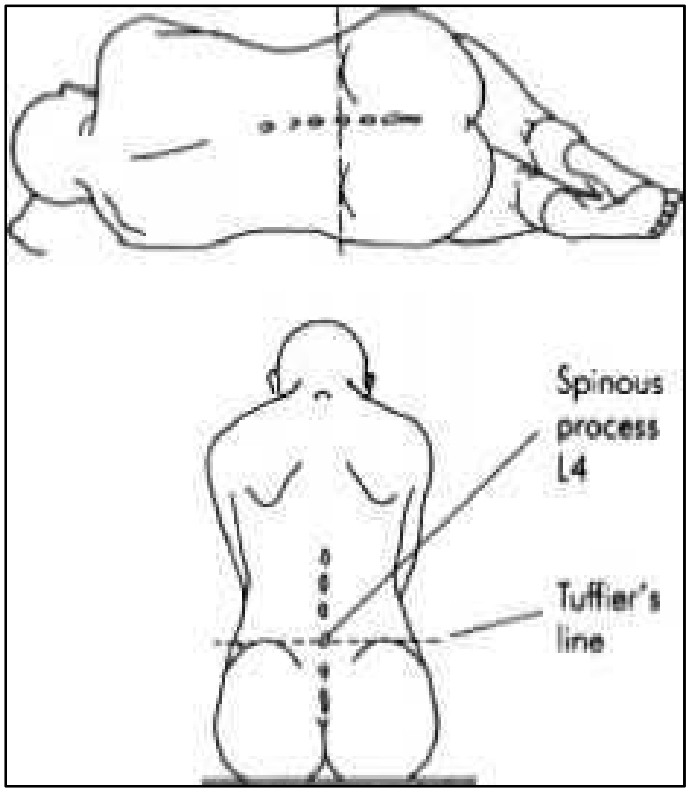


Figure 4: Tuffier's Line

Vertebral canal

Boundaries – Anterior: Vertebral Body.

Posterior: Spinous process, inter-spinous ligament.

Posterio – lateral: Laminae, ligamentumflavum.

Lateral: Pedicles

Superior: Foramen magnum

Inferior: Sacral hiatus.

The vertebral canal comprises of

- The spinal cord
- Dorsal root ganglia and the ventral rootlets
- Roots of spinal nerves
- Sympathetic trunk
- Rami communicantes
- Adipose tissue
- Blood vessels
- CSF
- Spinal membranes

Spinal cord (SC)

It is continuation of medulla oblongata from foramen magnum tapering into conusmedullaris. It then transforms to a fibrous filament (continuation of pia mater) attaching from apex of conus to the coccyx (FilumTerminale). At birth, it ends at L3 space and as the body grows, the VC grows faster than SC, therefore, ending at L1 or L2 vertebra in adults [Length - males (45 cm), females (42 cm)].

Blood supply:

1. Arteries:
    a. **Anterior spinal artery:**
        i. Solitary.
        ii. Runs in the anterior median fissure.
        iii. It is a branch of vertebral artery.
        iv. Supplies SC's anterior 2/3rd.

b. **Posterior spinal arteries** –

i. Paired.

ii. Runs in posterior sulci

iii. Can either arise from vertebral artery or postero-inferior cerebellar artery.

iv. Supply the remaining SC's posterior 1/3rd.

2. Veins:

a. The spinal veins (anterior and posterior) drain the SC.

b. The spinal veins in turn drain into the vertebral venous plexus (internal and external).

Spinal membranes

They are the outer linings that surround and protect the spinal cord.

The spinal cord and meninges are held by tough bands like structures (FilumTerminale) which is attached to coccyx distally.

Dura Mater

- Outermost layer meningeal layer.
- Epidural space lies in between the dura and vertebral canal.

Arachnoid Mater

- Middle layer – lies between dura and pia mater.
- Delicate avascular membrane.

- The subarachnoid space (containing CSF) separates the arachnoid mater from the pia mater.
- Lumbar cistern is the expanded subarachnoid space found distal to the conusmedullaris.
- It is this lumbar cistern where SAB and lumbar puncture are performed.

Pia Mater:

- Innermost layer among meninges.
- The spinal cord, nerve roots and even their blood vessels are covered by the pia mater.
- Filumterminale is fused with the pia mater inferiorly.
- Denticulate ligaments are the thickening if the pia mater found between the nerve roots.
- These denticulate ligaments suspend the SC in the VC.

ULTRASONOGRAPHY

Basics of ultrasonography:

- Ultrasound (US) is a name given to sound wave of high frequency over 20000 cycles per second (20 kHz).
- Human ear is audible to a range 20Hz- 20 kHz.
- Diagnostic Ultrasound pulses produced by the scanners produce 2-15MHz (1MHz= 1,000,000Hz). Various tissues alter the waves producing unique patterns.
- These echo waves gets transmitted from the US probe reaches the tissues where they can get reflected, scattered or refracted. The reflected echo waves reach the US probe back.

Principle:

- Piezoelectric phenomenon: first described by Pierre and Jacques Curie in 1880.
- When an electrical energy is supplied, the piezoelectric crystals (PEC) vibrate. This generates a pressure sound wave (ultrasound).
- When these waves hit medium, they undergo conformational changes.
- The transducer receives the returned waves as echoes, which are finally converted back into electrical signals.
- Gases are poor conductors while solids and fluids are good conductors of sound. Therefore, the US travels at low and high velocities in the respective medium.

- Propagation velocities of different media; Air= 330m/s, tissue 1040m/s, water 1480 m/s, bone= 4030m/s.
- Acoustic impedance is the resistance of sound through propagation of sound.
- It depends on density and velocity of sound. Air has the lowest impedance whereas bone has the maximum.
- Longer the distance travelled by the echo waves longer will be the time taken by it to reach the probe.
- The electrical signals returning to the transducer are reproduced as an image on the monitor. The returned echoes are processed through a microprocessor to produce a gray scale based on the strength and time of the echoes.

Different modes in ultrasound:

The various modes show the returning echoes in different ways.

1. **A-mode** (Amplitude mode):
    - It is a simple mode.
    - Echoes are represented as amplitudes and peaks.
2. **B-mode** (Brightness mode / gray scale image)
    - It is a two dimensional image.
    - Only a section of tissue is displayed at a time.
    - They become real-time images, if watched in a rapid sequence.
3. **Real time**:
    - This mode displays motion of the underlying tissue or organs as it is being scanned.
    - There is an option to “freeze” the image in motion, to study the image at a given time.

4. **M**-mode:
    - **T**his mode shows image as a wavy line.
    - It is another mode for showing motion. Used for cardiac ultrasound.

The following two methods can be incorporated for using Ultrasound as an aid during neuraxial procedures.

1. Pre-puncture ultrasound.
2. Real-time ultrasound.

Pre-puncture US helps to identify of the midline neuraxial structures, identify landmarks, estimate subarachnoid space depth, and facilitate spinal needle insertion.

Advantages of USG pre procedure are

- Increases the SAB efficacy.
- Decreases the complications associated with the blind approach.

What is a transducer?

Also known as a probe, is a device used to produce and receives sound waves that bounce off body tissues and are reflected and make echoes.

Types of transducers

The most commonly used crystals that are used in US probe is Lead Zirconatetitanate (PZT). Based on the type of the echo waves produced the transducers are classified as

1. Linear probe (4-13 MHz)
2. Curvilinear probe (2- 5 MHz)
3. Phased array (2-7 MHz)

Linear probe:

- The piezoelectric crystals are arranged in a linear fashion.
- This probe produces higher frequencies and higher resolution.
- Used in visualizing superficial tissues.

Curvilinear probe:

- The piezoelectric crystals are arranged in a curvilinear manner.
- It produces low frequencies and poor resolution
- The beam is convex in shape
- Used in imaging deeper structures.

So for viewing neuraxial structures, here we utilize the low frequency (2-5 MHz) or the curved array transducer.

Axis of the scan

There are two basic axes with which ultrasound scan can be performed; longitudinal (sagittal) and transverse axis.

- Sagittal scan:
    - Midline or Paramedian plane: Median sagittal spinous process view.
- Transverse scan:
    - Both the inter-spinous and the spinous process can be imaged.

Scanning Planes

- Includes four anatomical planes:
    - The Median plane.
    - The Sagittal plane.
    - The Transverse plane.
    - The Coronal plane.

Median plane: (the median sagittal plane)

It is a longitudinal plane that runs in the midline, dividing the body into two equal halves.

Sagittal plane:

It is parallel to the median plane (Perpendicular to the ground).

Transverse plane (the horizontal plane):

It is parallel to the ground.

Coronal plane:

It is perpendicular to all the above mentioned planes. It divides the body into anterior and posterior halves **(Fig.5)**.[16]

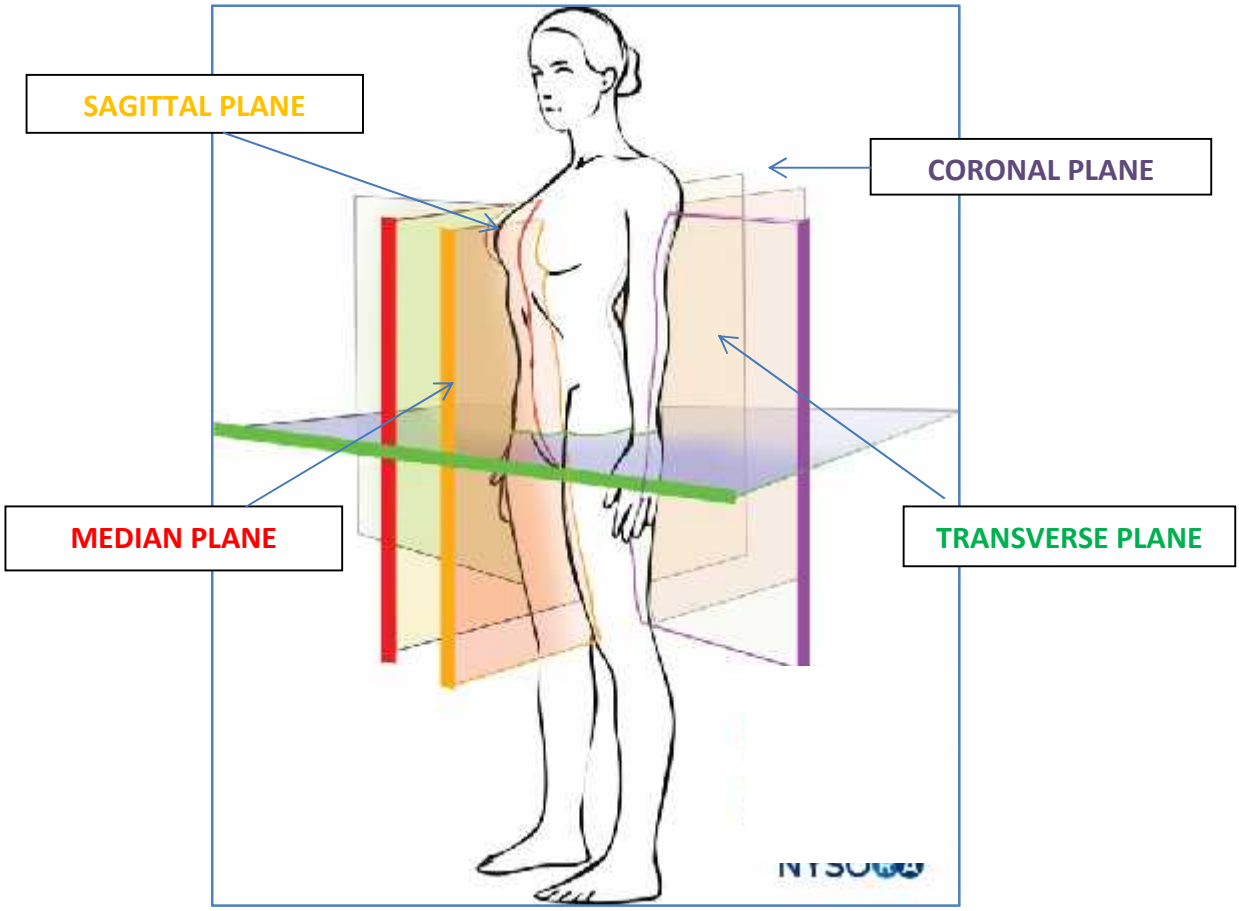


Figure 5: Anatomical planes

Sono-anatomy of the Spine

- One has to familiarize with various sonographic patterns to understand the sono-anatomy of spine.
- The patient is positioned in sitting or lateral with spine flexed maximally.
- In order to prevent air between the probe and the skin from disturbing the imaging process, a coupling medium (water based jelly, oils, etc.) is used.
- Curvilinear probe is used for imaging. It is kept along the longitudinal axis of the spine in the midline at the lumbar region.
- Sacrum is identified first as a continuous hyperechoic line. It casts a large acoustic shadow anteriorly.

- The probe is directed upwards to obtain crescent shaped structures which reflect the tips of spinous processes of Lumbar vertebrae.
- The void between two spinous processes is the inter-spinous space.

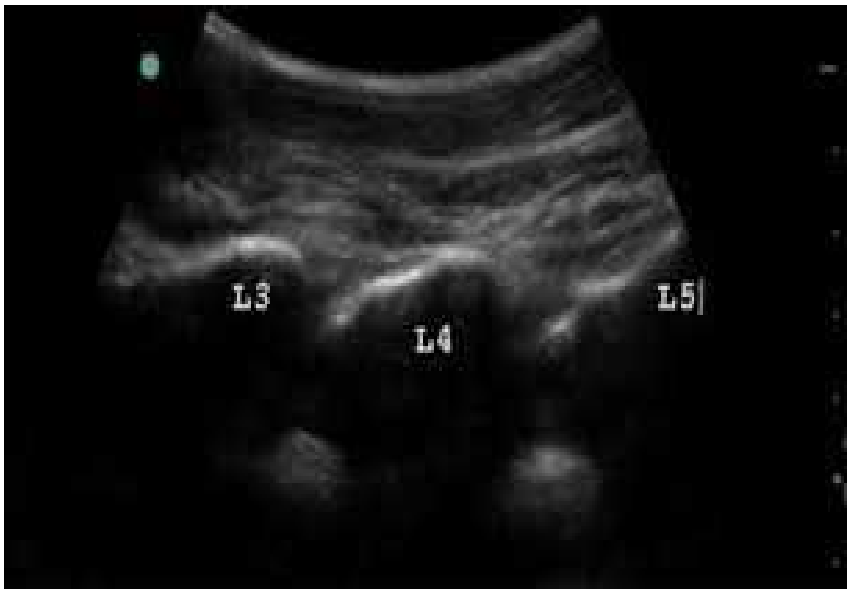


Figure 6: Sagittal View- Interlaminar Space

When the transducer is slid laterally, we get three signs of three important structures; **horse head sign**, **camel hump sign**, and **trident sign** (**Fig. 6**) for inter-laminar, articular face joint, and transverse process respectively.[16]

The order of the neuraxial structures when viewed through the inter-spinous space (outer to inner),

- The ligamentumflavum,
- Epidural space,
- Posterior dura,
- Intrathecal space(anechoic)
- Anterior dura.

The ligamentumflavum and posterior dura appear as bright coloured (hyper-echoic) lines. The epidural space is the hypoechoic area (a few millimetres wide) between the ligamentumflavum and the posterior dura.

The Cerebrospinal fluid is present in the intrathecal space which lies between the arachnoid and pia mater

For transverse view, the probe is placed at the spinous process initially which is shown as tall tower like structure (**tower sign**) with wing like patterns (**Fig. 7,8**) on either side which reflects the laminae of the vertebrae.[17] This bony acoustic impedance casts a hypoechoic shadow.

When the probe is directed up or down, midline structures viewed-ligamentumflavum, posterior dura, thecal sac and anterior complex and laterally the transverse process and articular facet joint seen.

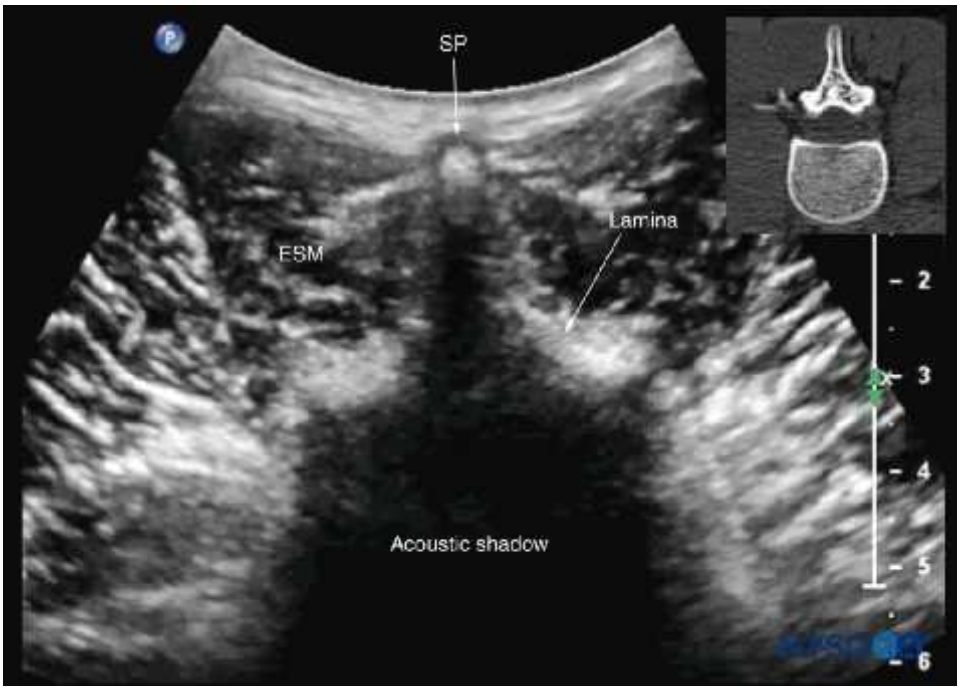


Figure 7: Tranverse View –At TheSpinous Process

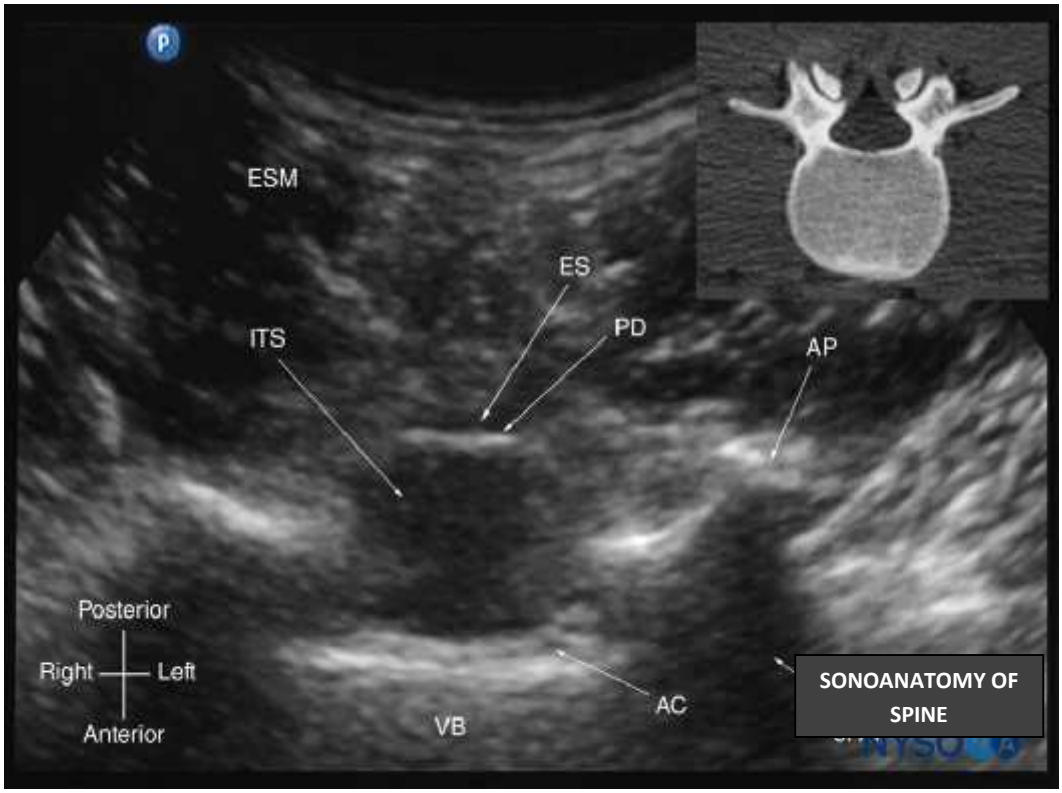


Figure 8. Transverse view - Interspinous space

(AC- Anterior complex, ESM- Erector spinae muscle, ITS- Intra Thecal Space, PD- Posterior Dura, LF- Lig.Flavum, AP- articular process, ES- epidural space, VB- vertebral body)

METHODOLOGY

The present study titled**" A ONE YEAR PROSPECTIVE OBSERVATIONAL STUDY TO COMPARE THE SKIN-DURA MATER DISTANCE USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION UNDER SUBARACHNOID BLOCK"** was carried out in the Department of Anaesthesiology**,** KLES Dr. PrabhakarKore Charitable Hospital, Jawaharlal Nehru Medical College, Nehru Nagar, Belagavi from January 2019 to December 2019.

Source of data:

Patients between the age group of 18- 60yrs, belonging to ASA Grade 1 and ll scheduled for infra-umbilical surgeries at KLES Dr. PrabhakarKore Charitable Hospital, Nehru Nagar, Belagavi between January 2019 to December 2019 were included.

Study design:

A One Year Hospital Based Prospective Observational Study.

Study period:

One year from January 2019 to December 2019.

Selection criteria

Inclusion:

- ASA physical status I and II
- Age between 18-60years.

- Weight – 50- 70kg
- Height – 160-170cm
- Patients undergoing elective infraumbilical surgeries.
- The surgeries included: urologic surgeries, general surgeries, gynecological surgeries and orthopedic surgeries.

Exclusion:

- Patients allergic to local anesthetics.
- Patients with coagulation abnormalities.
- Patients with spinal abnormalities and neurological deficits.
- Patients with infection at the site of subarachnoid blocks
- Pregnant patients
- Patients with spinal deformities.

Sample size:

A total sample size of 300 adult patients divided into 2 groups

- **Group SP**: Patients receiving subarachnoid block in **Sitting Position - 150**.
- **Group LP**- Patients receiving subarachnoid block in **left lateral position - 150**.

Sample size calculation:

The minimum sample size formula based on mean and standard deviation is

$$\text{Sample size (n)} = \frac{(z_\alpha + z_\beta)^2 (s_1^2 + s_2^2)}{(\bar{X}_1 - \bar{X}_2)^2}$$

Level of significance taken as 5%

The power of the test as 80%.

Type 1 error rate $\alpha = 0.05$

Type ll error rate $\beta = 0.2$

z_α is linked with the level of significance and z_β is linked with the power of the test.

For 5% level of the significance z_α =1.96 and z_β =0.84 for 80% power of the test.

$\bar{X}_1$ is the mean of skin - subarachnoid distance of the first group (5.47 cm).

$\bar{X}_2$ is the mean of skin - subarachnoid distance of the second group (5.65 cm).

s_1 is the standard deviation of the first group (0.56 cm)

s_2 is the standard deviation of the second group (0.51 cm).

Hence,

Zα=1.96, Zβ= 0.84, S1=0.56, S2= 0.51, X1=5.47, X2=5.65

With these values, the minimum sample size obtained is 139.

For ease of calculations and sake of consistent result, sample size was taken as 150. There were thus two groups of 150 each.

Method

- The approval of ethical committee acquired, informed written consent was taken and a total number of 300 patients undergoing elective infra-umbilical surgeries under spinal anesthesia were divided into two groups by using simple randomization technique.
- **Group SP**-Patients receiving subarachnoid block in **sitting position**,
- **Group LP**- Patients receiving subarachnoid block in **left lateral position**.
- In the preoperative room, an 18G intravenous line was secured.
- The palpation of bony surface landmarks was appreciated with the help of Tuffier's line.
- Each patient was preloaded with 10ml/kg of ringer lactate solution
- For selection of L3-L4interspace, a 2-5 MHz curvilinear probe (FUJIFILM Sonosonite, Inc, Bothel, WA 98021 USA) was first be placed on the sacral region at the middle line to view the continuous hyperechoic line.
- The probe was slid cranially to see the spinous processes. Since they looked like crescent shaped, (L3-L4) interspinous space was observed as hypoechoic. The neuraxial structures in IVS were detected through ultrasound. The ligamentumflavum-dura complex was observed as a hyperechoic line. Using the in-built caliper system, the measurement of skin-dura mater distance was recorded SS(USG).
- Standard monitors were used throughout the procedure, including non-invasive blood pressure monitoring, electrocardiogram, and pulse oximetry.
- Two assistants were utilized during the positioning of the patient.

- Group SP- patients were placed into the sitting position with their feet suspended and stepping on a stool at the edge of table.
- Group LP- patients were put into the lateral position and pillows were placed under their heads and shoulders.
- During application, one of the assistants waited in front of the patient and provided assistance to ensure the patient maintained the position.
- Following the guidelines for asepsis and antisepsis, subarachnoid anaesthesia was instituted at the L3-L4 interspace in sitting position or lateral position using 23G Quincke's spinal needle (9 cm).
- While the spinal needle with the stylet was in place, the measurement of skin-dura mater distance was recorded with the help of a sterile measuring scale in cm by placing it from the skin to the spinal needle end which was later subtracted from the whole needle length (SS).
- The patient received the spinal drug of 3ml of 0.5% hyperbaric bupivacaine
- One of the assistants provided assistance to ensure the patient isput to supine position immediately.
- The skin and dura mater depth, which was measured by the USG, was compared with the distance of the spinal needle at which CSF fluid was tapped.

STASTICAL ANALYSIS:

The study is focused on comparison of two groups. For the continuous quantitative variables mean and standard deviation will be calculated. The inter group continuous variables was compared using suitable tools of statistics like unpaired

student's t test. Two quantitative variables, within a group, was compared using student's paired t test.

Discrete variables were represented by median. Suitable graphs were used to depict the comparison.

The categorical data was expressed in terms of rates, ratios and percentages. The association between the outcome, clinical and demographic characteristics was tested using Chi-square test or Fisher's exact test.

For all the tests the value of p less than 5% (0.05) was considered significant.

RESULTS

This one-year observational study was carried out in the Department of Anaesthesiology**,** KLES Dr. Prabhakar Kore Charitable Hospital, Jawaharlal Nehru Medical College, Nehru Nagar, Belagavi from January 2019 to December 2019.

A total of 300 patients posted for infra-umbilical surgeries under spinal anaesthesia were divided into one of the two groups based on computer generated randomization table:

- **Group SP**: Patients receiving subarachnoid block in **Sitting Position (SP)-150**.
- **Group LP**- Patients receiving subarachnoid block in **Left Lateral Position (LP) -150**.

Data obtained was coded and analysed as below.

Demographic data of participants

Age (years):

In our study the age ranged from18 to 60 years with mean age being 39.12 ± 12.32cm. There was no statistically significant difference between group SP and group LP with regards to age.

Graph 1: Bar graph showing the distribution of age in years

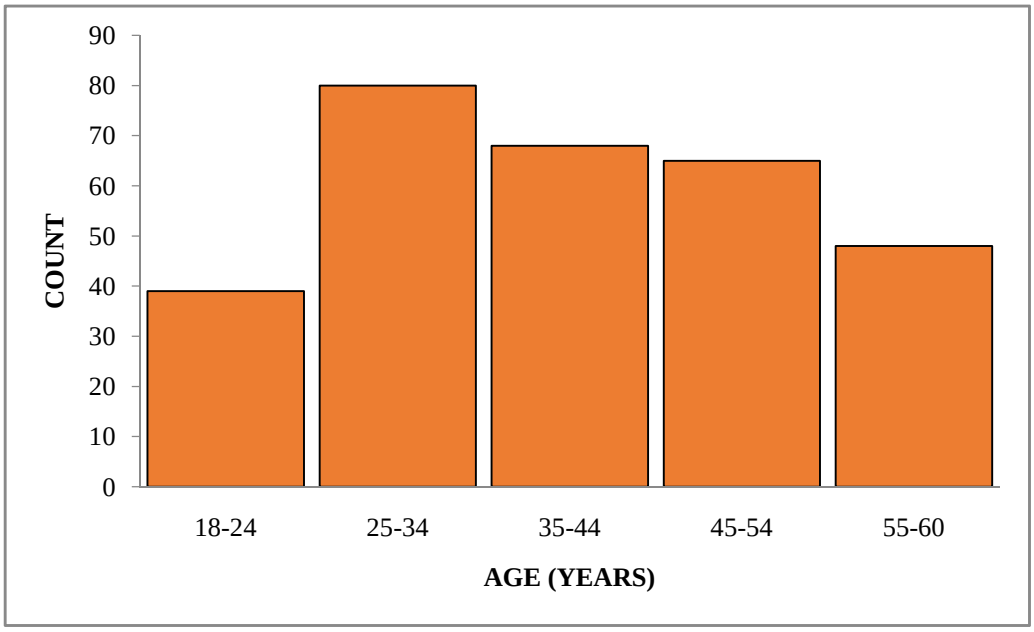


Table 1.1: Distribution of participants in terms of age

Age (years)	
Mean (SD)	39.2 ±12.32
Median	39
Range	18 -60

Weight:

The mean weight was 60.58+/- 5.45 of the total patients. We found out that there was statistically highly significant difference in group LP and SP ($p<0.001$)

Graph 2: Bar graph showing distribution of weight in kilograms

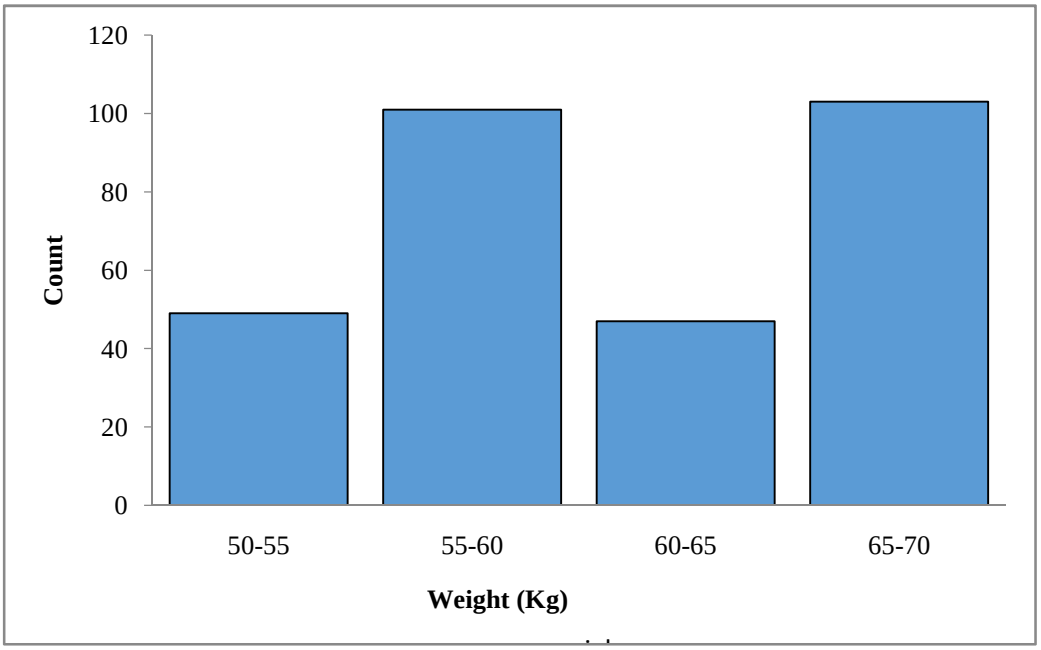


Table 1.2: Distribution of patients in terms of weight

Weight (Kg)	
Mean	60.58
Median	59
Range	50-70

Height:

The mean height was 164.65± 2.50of the total patients. It ranged from 160-170cm. There was no statistically significant difference in group LP and SP (p=0.8393).

Graph 3: Bar Graph Showing Distribution Of Height In Centimetres

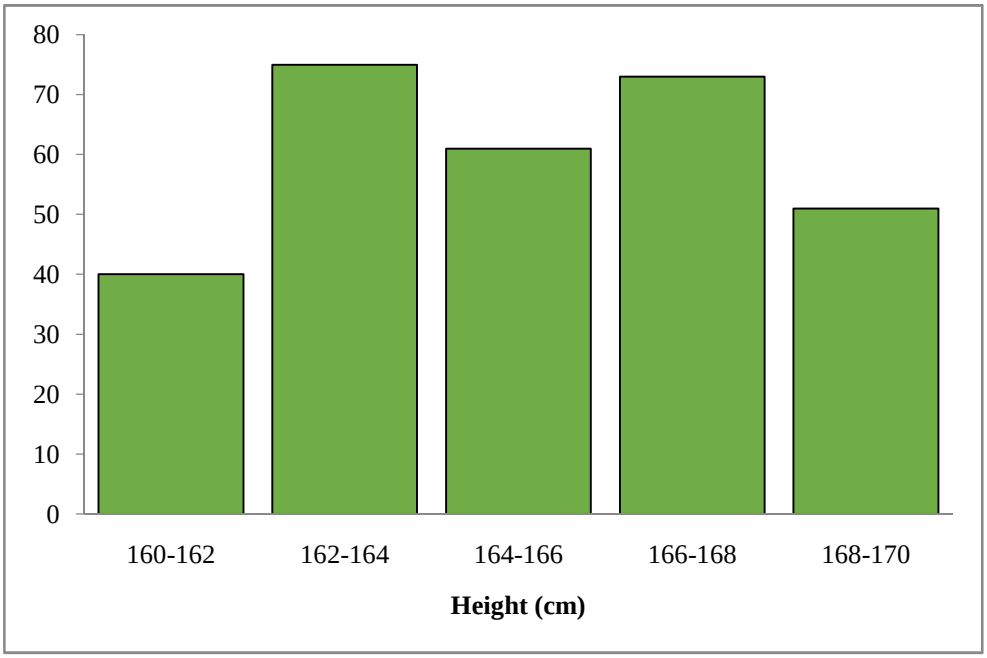


Table 1.3 Table for distribution of height

Height (cm)	
Mean	164.65
Median	165
Range	160-170

Table 2: Mean Age, Weight and Height

	Mean	**SD**	**Minimum**	**Maximum**	**p- value**
Age(years)	39.12	12.32	18	60	0.8941
Weight(kg)	60.58	5.45	50	70	<0.001
Height(cm)	164.65	2.50	160	169	0.8393

Gender:

In the total number of patients, 52.67% were females and 47.33% were males. There was not significant difference in the group LP and SP.

Table 3.Distribution of patients in terms of gender (n=300)

Gender	Frequency	Percentage (%)
Female	158	**52.67**
Male	142	**47.33**
Total	300	**100**

Graph 4.1: Pie Chart Showing the Distribution Of Gender

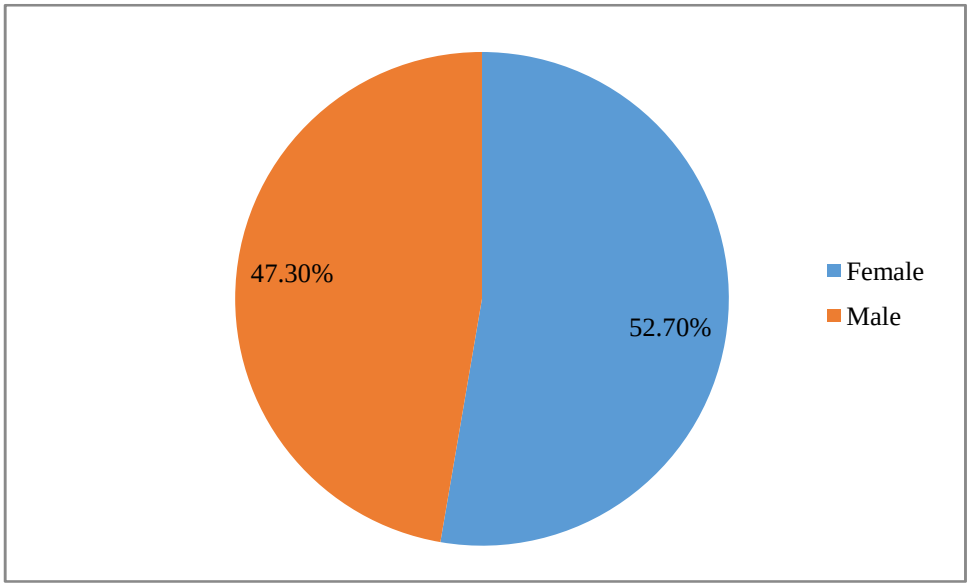


Table 4: ASA grading

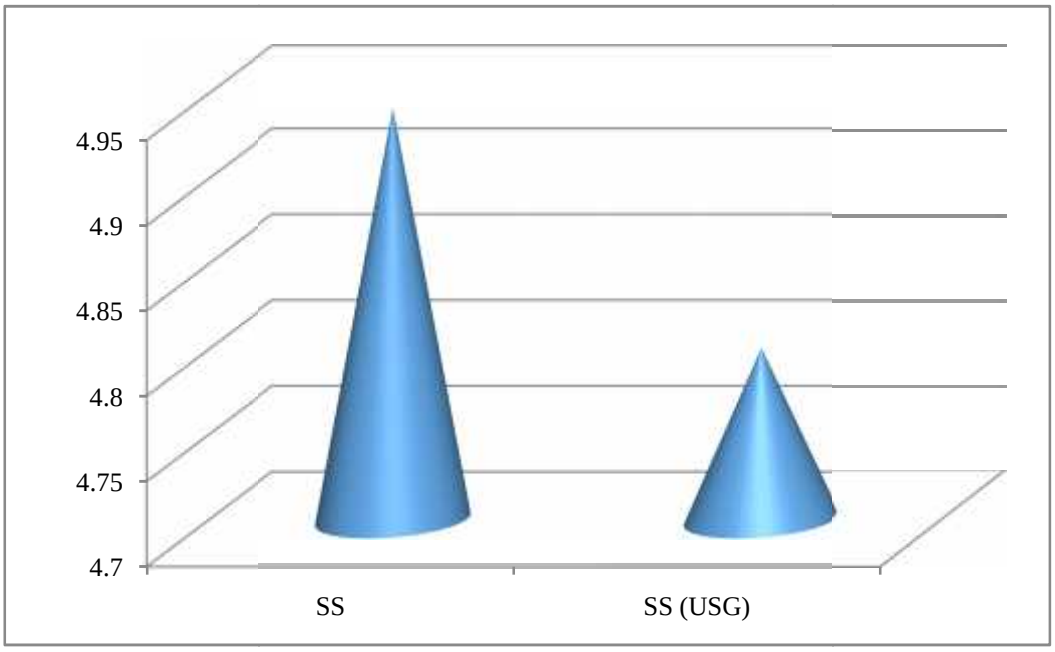
ASA	Number	Percentage
I	228	76.00
II	72	24.00
Total	300	100.00

Overall comparison between conventional method and US guided pre-procedural scan of depth of subarachnoid space

Table 5: Comparison of mean depth of conventional spinal length (SS) and USG(SS-USG) pre procedural scan

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.94	0.31	4.80	0.31	<0.0001	HS

Graph 5: Comparison of Overall Means of SS and SS (Usg)



In the present study, we found statistically highly significant difference between in distance measured by ultrasound SS(USG)and the needle depth (SS) measured in group SP and group LP (P<0.001)

Table 6: Comparison of the means of SS and SS (USG) in Males

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.93	0.47	4.72	0.32	0.0037	VS

In this study, the distance measured in males with USG was very significant compared to conventional technique. [SS= 4.93±0.47, SS(USG)=4.72±0.32) p=0.0037]

Graph 6: Comparison Of Means Of SS And SS(USG) Among Males

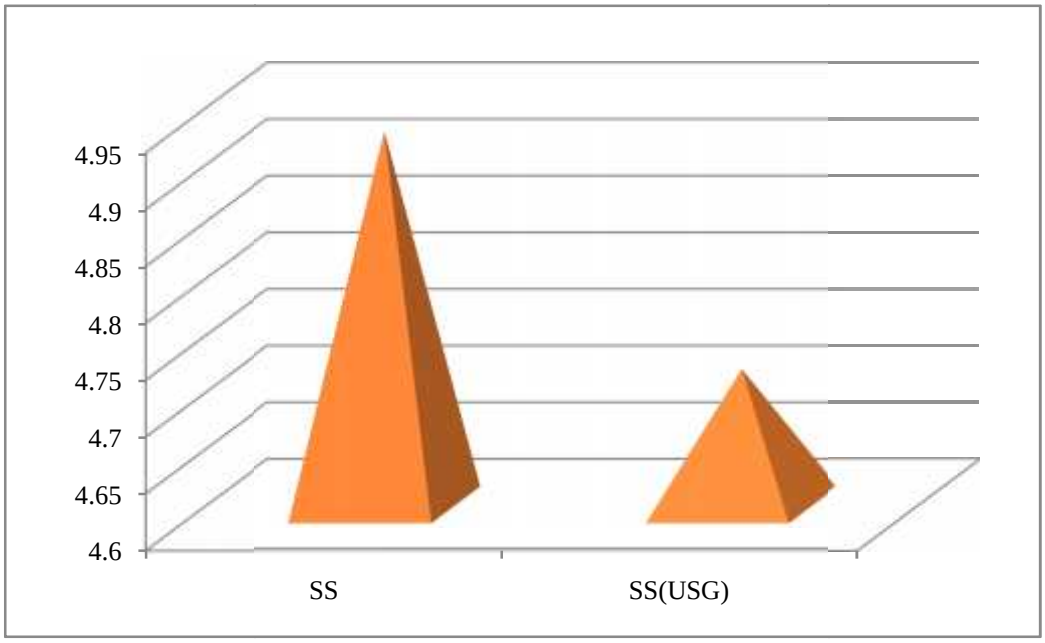


Table 7: Comparison of means of SS and SS (USG) in Females

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.22	0.49	4.06	0.43	0.0002	HS

In this study, the distance measured in females with USG was highly significant compared to conventional technique. [SS= 4.75±0.29, SS (USG)=4.59±0.43) p=0.0002].

Graph 7: Comparison of Means of SS And SS (USG) Among Females

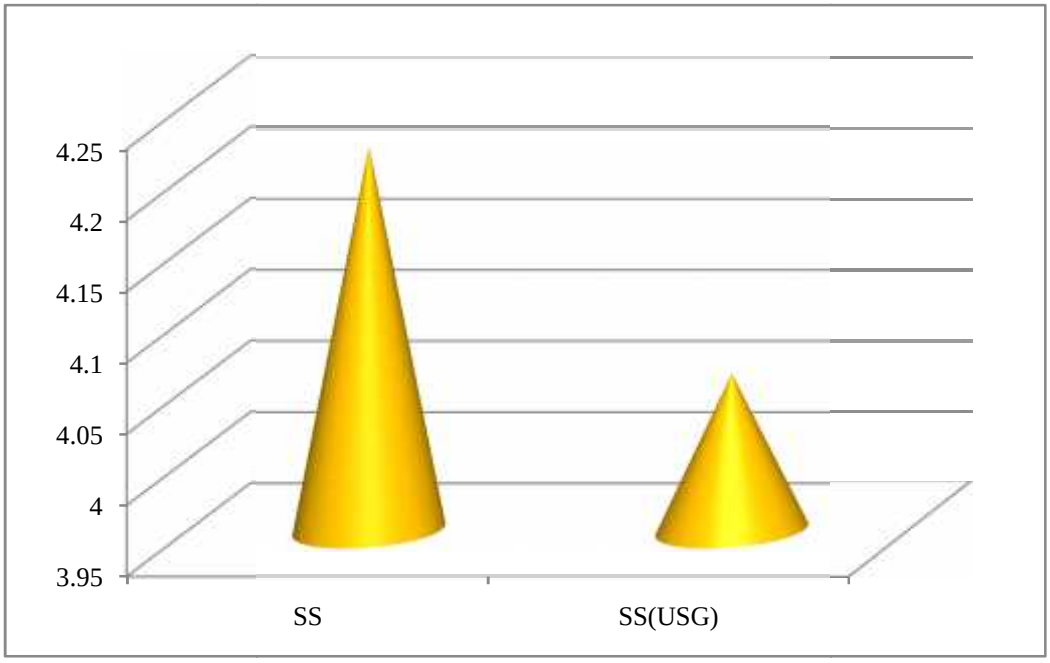


Table 8: Comparison of SS and SS-USG in Left lateral position (LP)

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.73	0.33	4.61	0.33	0.002	VS

Graph 8:Comparison Of Means Of SS And SS (USG) For Position LP

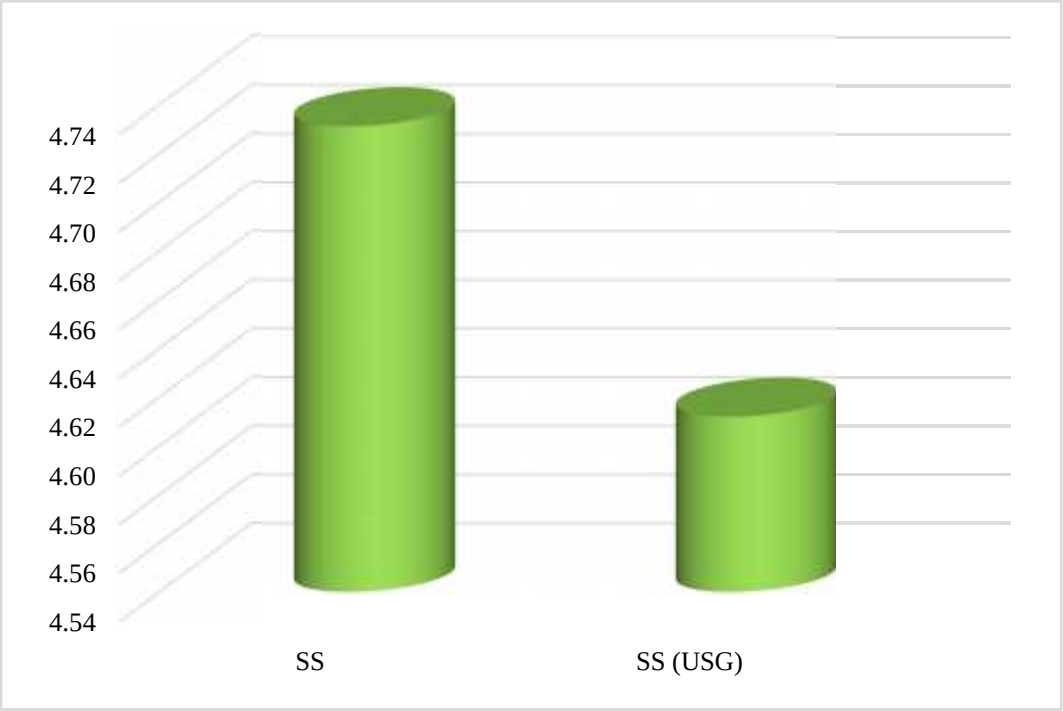
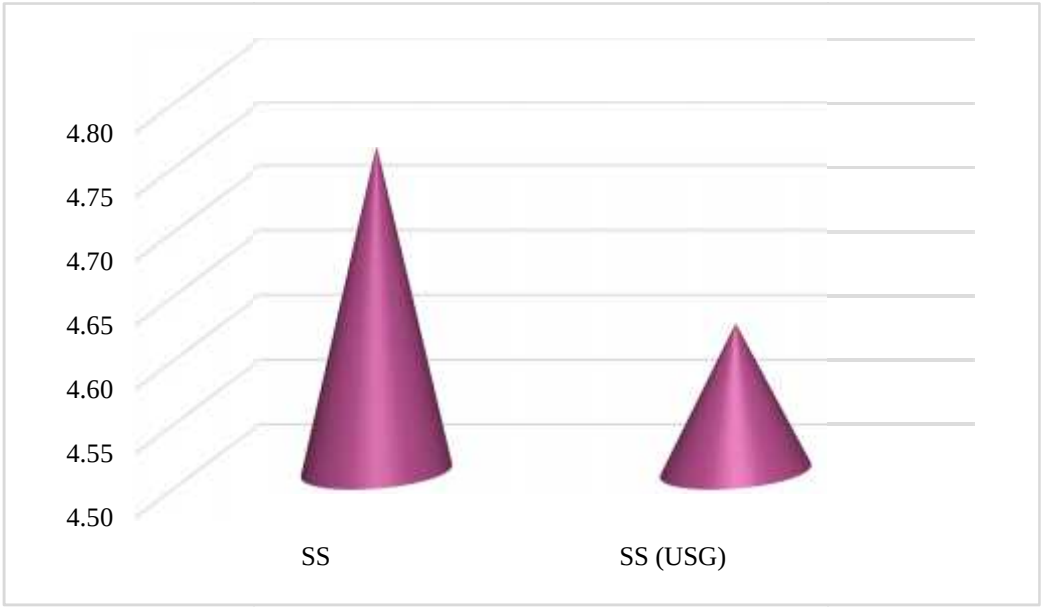


Table 9: Comparison of SS and SS-USG in Sitting position (SP)

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.75	0.29	4.60	0.43	0.0004	VS

Graph 9: Comparison of Means of SS And SS (USG) For Position SP



In this study, taking position into consideration (SP/LP), we found that sitting position (p=0.0004) was statistically very significant compared to lateral position (p=0.002).

Table 10: Comparison of SS and SS-USG in LP among Females

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.72	0.31	4.59	0.32	0.010	S

Graph 10: **Comparison Of Means Of Ss And Ss (Usg) For Position Lp Among Females**

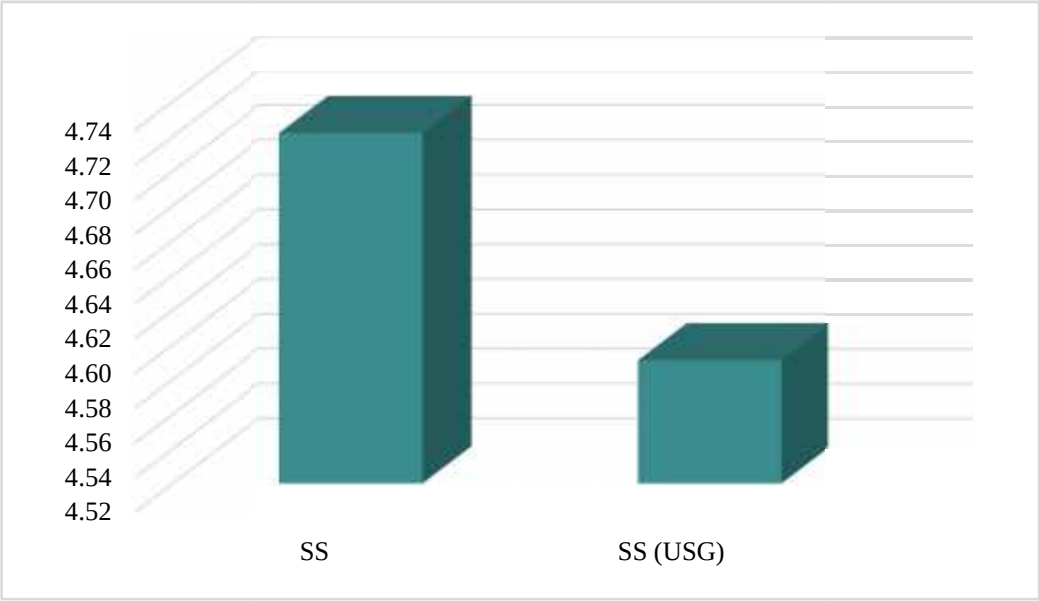
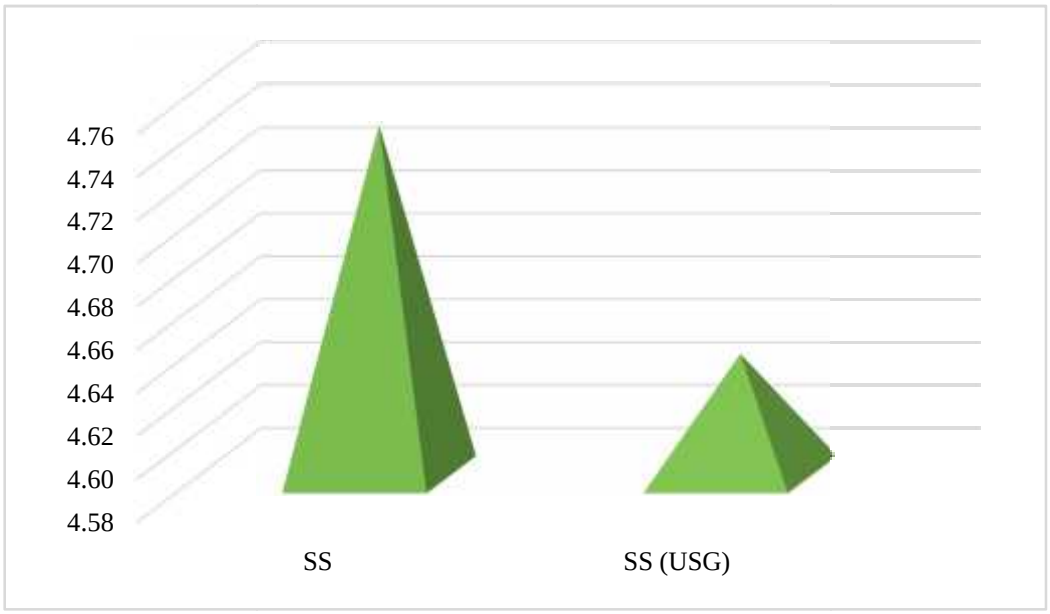


Table 11: Comparison of SS and SS-USG in LP among Males

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.74	0.35	4.64	0.35	0.074	NS

Graph 11: Comparison Of Means Of Ss And Ss (Usg) For Position Lp Among Males



There was statistically significant difference in females(p=0.01) compared to males(p=0.074) when they were positioned in Lateral position (LP).

Table 12: Comparison of SS and SS-USG in SP among females

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.77	0.27	4.59	0.52	0.0064	VS

Graph 12: Comparison Of Means Of SS And SS (USG) For Position Sp Among Females

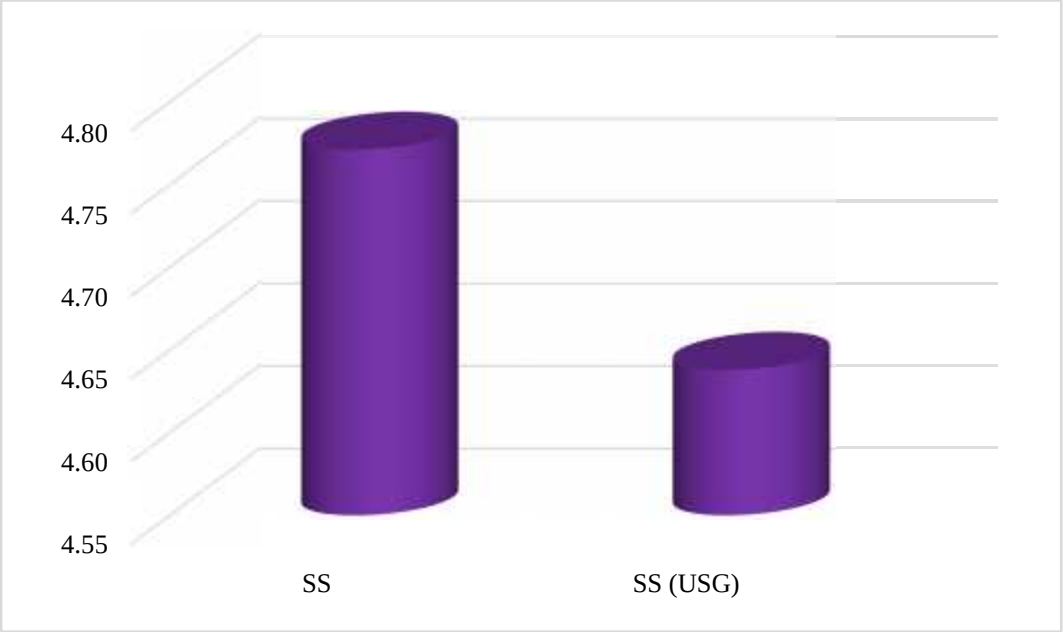
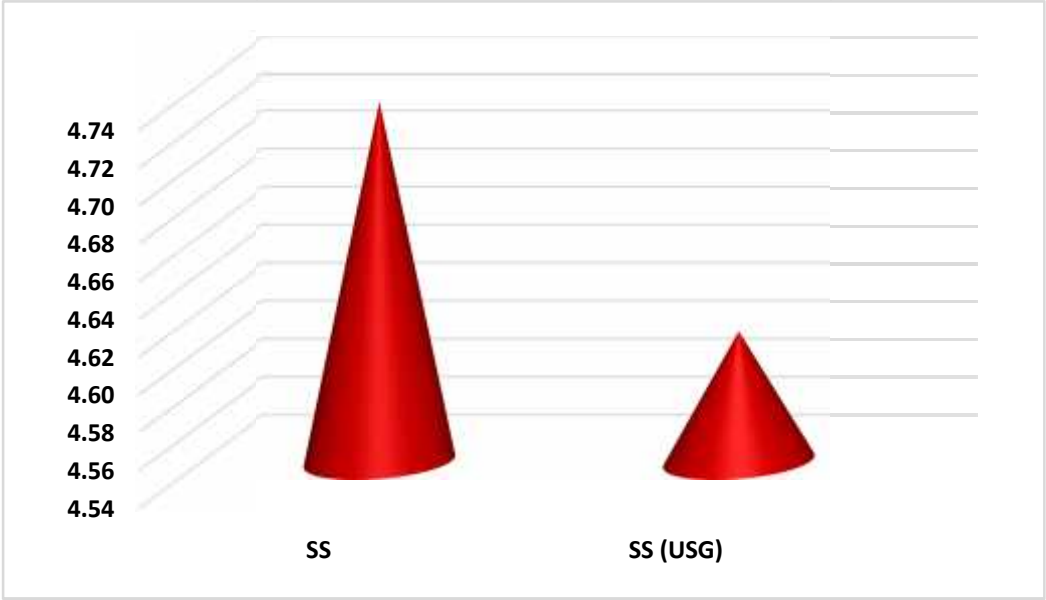


Table 13: Comparison of SS and SS-USG in SP among Males

SS		SS (USG)			
Mean	StandardDeviation	Mean	StandardDeviation	p-value	Inf
4.73	0.32	4.61	0.30	0.0193	S

Graph 13: Comparison Of Means Of SS And SS(USG)sition Sp Among Males



There was statistically significant difference in females(p=0.0064) compared to males(p=0.019) when they were positioned in Sitting position (SP).

Table 14: Number of attempts

Number of attempts	Number	Percentage
1	245	81.67
2	55	18.33
Total	300	100.00

We observed that after doing a pre procedural ultrasound scan there was a reduced number of attempts compared to the conventional technique.

Table

3 patients had complaints of post operative complications like nausea, pain at the injection site (0.01%).

DISCUSSION

For decades, anesthesiologists have been practicing the traditional landmark guided identification of Intervertebral Space(IVS) for subarachnoid block. Ultrasound (US) is a newer modality which has been gaining popularity in the recent years for the ease of administration of regional anaesthesia. Sonography aids in obtaining the anatomy of the neuraxial structures which helps us to guide and administer spinal blockade in patients with anatomical abnormalities like scoliosis, obesity, etc.

It provides us information regarding the underlying spinal anatomy which includes identification of IVS as well as the depth of subarachnoid space. It can be a very important tool for preoperative assessment of suspected difficult anatomy.

All clinical assessments in this study were done in both sitting and lateral position.L3-L4 IVS was taken into consideration for all patients.

Our study reinforces the usefulness of Ultrasound for pre-puncture information such as optimum puncture point, depth to reach intrathecal space, and the visibility of neuraxial anatomical structures.

A FUJIFILM Sonosonite Ultrasound machine was used for this study.

In selecting the probes for viewing the spinal sono-anatomy, we used the low frequency, curved array transducer (2-5Mhz) which showed the deeply placed neuraxial structures whereas the high frequency linear probe showed superficial structures which was not useful for our study.

For sonographic examination of lumbar spine, there are two sagittal view (longitudinal) and transverse view. First, we identify the sacrum in the midline

longitudinal view and trace up in cephalad direction to identify the L3-L4 IVS. "It provides information on interspinous spaces which can be visualized as a "camel hump 'pattern."[16]

In our study, we chose a transverse view for measuring the skin-dura distance to acquire a traverse view, a transverse scan was performed over the spinous process which was visualized as "tower sign".[17] We had to slide the transducer either cranially or caudally in order to produce an optimal interspinous view of the neuraxial structures (ligamentumflavum, posterior dura, intrathecal space, anterior dura, vertebral body).

"In a study conducted by Grau et al, they have shown that longitudinal paramedian access provides a larger permeable window, and improves the quality of pre-puncture diagnostics for neuraxial anesthesia or analgesia."[18]

Despite the preference of the longitudinal paramedian access to provide better sonograms of lumbar spine, we have been able to identify neuraxial structures as well as measure the skin-dura depth using transverse median plane. Our study was comparable with "Dhangar et al, as they measured the distance between skin puncture site and posterior complex in the transverse scan 4.87 ± 0.67 cm and correlated it with the depth of needle insertion procedure (4.79 ± 0.91 cm) after the procedure (P = 0.59)"[19]". Another study conducted by Sahota *et al*. showed that the estimates of the ultrasound, which determined the skin to epidural space depth in the transverse median view 6.5 ±1.1 cm,were comparable to those in the parasagittal oblique view (6.5 ± 1.2)."[20]

"Use of spinal ultrasound to predict the SSD was observed by Gnaho et al., who reported that an accurate estimation of SSD was possible using ultrasoundSS(USG): 5.15 ± 0.95 cm and SS: 5.14 ± 0.97 cm (p>0.0001)."[8]

In our study, we have taken anthropometric details of all patients like age, weight and height.

The patients taken for the study were in the age group of 18- 60 years, with a mean of 39.12 ±12.32years (p=0.8941). We found that larger group of the patients were in the age group 25- 34 years (n=80, 26%) followed by 35-44years (n=68, 22%)

As for weight, we took patients within the range of 50 -70 Kilograms(kgs) with a mean of 60.58 ± 5.45kgs (p<0.001). Most of the patients were in the range of 55-60kgs (n=101, 33.3%) and 65-70kgs (n=103, 34,3%).

For this study, the patients with height within the range of 160- 170 cm were taken, where we observed most of the patients were in the range of 162-164cm (n=75) and 166-168cm (n=73).

We had included patients with ASA I and II with majority of patients ASA I (76%) and the remaining ASAII (24%).

Females were of larger proportion in our study [n=158 (52.67%)]. So, this study comprised of mainly young, average built females(<35years).

The Skin –Subarachnoid Distance (SSD) in our subjects (Indian population) is comparatively shorter than that observed in the Western population possibly because of anthropometric differences between the study subjects, our patients being shorter and less heavy. Our study had mean value of4.94± 0.31cm with conventional

technique and 4.80± 0.31cm measured by US. "A study conducted by Mehmet et al found that SSD value of Turkish population was 5.543 ± 0.647 cm which was 0.8 cm more than our population"[21], while in the study performed by "Basgül et al values (5.40±6.6 cm) were reported[21]. In studies conducted in Indian population, the values were comparable to our observations. "Prakash et al observed a mean SSD of 4.71±0.31cm in Indian population. [9] "Vasundaratyagi et al found SSD values of 4.1 ± 0.1cm with US and actual needle depth to be 4.2 ± 0.1cm."[12]

In our study, the ultrasound underestimated, the subarachnoid depth by 0.28-0.35cm because we were measuring the skin to ligamentumflavum –dura complex not skin to intrathecal space. The regression analysis showed that the estimation of the depth by ultrasound differs minimally from the SS (USG) as the SS increases.

In certain studies, SSD measurements are different depending on gender.Our study had significant difference in both males (4.94± 0.33cm) and females (4.63± 0.29cm) which was comparable to the following studies.

In the study done by Hazarika et al. on 300 patients they found out that Mean SSD was 4.37 ± 0.31 cm in the overall population. SSD in adult males was 4.49 ± 0.19 cm which was significantly longer than that observed in female's 4.18 ± 0.39 cm.[11] In the study done by Taman et al. in Egyptian population they found out that Mean SSD was 4.99 ± 0.48 cm in the overall population.[22]

In our study, SSD in adult males (4.93 ± 0.47 cm) was significantly longer than that observed in females (4.22 ± 0.49 cm).

In the study by Vasundaratyagi et al, studied in Indian population that there was significant difference in SSD between male (4.27 ± 0.55cm) and females (4.14 ± 0.60cm).[12]

Regarding position of the patients, there are studies which mentioned lateral position showed longer needle depth compared to sitting position. "A study conducted by Ucarli et al, the skin-spinal space distances detected with ultrasound in Group SP and Group LP were (5.47±0.56 cm) and (5.65±0.51 cm) respectively."[13]In our study, we did'nt compare needle depth of both sitting and lateral position in one patient, but were measured separately (LP= 4.73 ±0.33cm SP=4.75 ±0.29cm. We observed the patients were more comfortable in lateral position. "Khurrum et al, found different effects in sitting and lateral positions in terms of sensory, motor block and hemodynamic stability; but detected that the lateral position was more comfortable for patients"[23]

The mean total number of attempts was significantly less in ultrasoundgroup as compared to conventional group. In our study the success rates in the first attempt was 81.67% and 18.33% for second. Perlas et al showed that ultrasound is more accurate than palpation for correct identificationof lumbar interspaces and also decreases the number of attempts required to perform the block.[24] "Schnabel et al, detected the ultrasound provides less number of attempts."[25] Grau et al have also shown that use of real‐time ultrasound guidance for combined spinal–epidural insertion in a younger obstetric population significantly reduced the number of attempts required when compared to a traditional landmark‐based approach [26]

Few patients had complications like post operative pain at injection site, nausea (0.01%). Other complications like post dural puncture headache, infection at site, hypotension, vomiting were not observed like in other studies. Conroy et al noted complications like bloody tap, failed spinal taps, conversion to GA.[27]Ucarli noted patients having incidence of nausea, vomiting, hypotension, bradycardia[13]

The limitations of our study were:

Firstly, the difficulty in blinding of anesthesiologist for the study group, as the patients belonging to ultrasound group will have skin markings.

Secondly, failure to obtain an angle of the US wave. The needle direction can be affected if there any angle change which leads to the increased depth which in turn leads to redirection or increased attempts.

Thirdly, the study didn't include obese patients, difficult spine or pregnant patients with edematous backs; where in the role of sonogram would be of significance.

Finally, real time imaging was not taken into consideration which could have provided us with tracking of needle tip and drug distribution.

CONCLUSION

I conclude that pre procedure USG can be used as an useful tool to predict the needle depth in difficult spinal anatomies like scoliosis, obesity, edematous back, etc. Thereby enabling us to perform a successful subarachnoid block. It also helps in reducing the number of attempts and reduce the rate of complications related to subarachnoid blocks.

SUMMARY

Subarachnoid block is extensively used to facilitate surgeries involving lower limb, pelvis and lower abdomen. The practice of subarachnoid block has routinely relied on the palpation of bony prominences, namely the iliac crests and spinous processes, together with sensory feedback during needle insertion. Landmark guided techniques are not useful for difficult anatomy of spine. The use of ultrasonography has made the ease of administration of subarachnoid block.

This one-year prospective observational study carried out in Department of Anaesthesiology, KLES Dr. PrabhakarKore Charitable Hospital, Jawaharlal Nehru Medical College, Nehru Nagar, Belagavi from January 2019 to December 2019. 300 patients posted for infra-umbilical surgeries were divided into two groups using simple randomization technique, Group SP (n=150) patients receiving subarachnoid block in sitting position and Group LP (n=150) patients receiving subarachnoid block in left lateral position. Using ultrasound (FUJIFILM Sonosonite, a curved array transducer, 2-5MHz), the distance between the skin and dura, which was measured and was compared with the distance of the spinal needle which was obtained by conventional technique.

Demographic parameters were comparable in both the groups. In the study, we found that the male population (4.94± 0.33cm) had longer skin to subarachnoid length than the females (4.63± 0.29cm). In our study, there was not any significant difference regards to position (LP= 4.73 ±0.33cm, SP=4.75 ±0.29cm).We observed that the number of attempts and of rate of complications were significantly reduced.

Overall based on the findings of this study, we conclude that pre procedural USG can be used as a useful tool to predict the needle depth in difficult spinal anatomies like scoliosis, obesity, edematous back, etc. thereby enabling us to perform a successful subarachnoid block.

BIBLIOGRAPHY

1. Looseley A. Corning and cocaine: the advent of spinal anaesthesia. Grand Rounds. 2009;9:L1–L4 p. Landmark Case report.

2. Hadzic A. No Title. In: Hadzic's Peripheral nerve blocks and Anatomy for Ultrasound-guided Regional Anesthesia. p. 475–95.

3. Yamauchi M, Honma E, Mimura M, Yamamoto H, Takahashi E, Namiki A. Identification of the lumbar intervertebral level using ultrasound imaging in a post- laminectomy patient. Journal of Anesth. 2006;20(3):231–3.

4. Chong SY, Chong LA, Ariffin H. Accurate prediction of the needle depth required for successful lumbar puncture. Am J Emerg Med [Internet]. 2010;28(5):603–6.

5. O'Donnell D, Prasad A, Perlas A. Ultrasound-assisted spinal anesthesia in obese patients. Can J Anesth. 2009;56(12):982–3.

6. Chin KJ, Chan V. Ultrasonography as a preoperative assessment tool: Predicting the feasibility of central neuraxial blockade. Anesth Analg. 2010;110(1):252–3.

7. Weed JT, Taenzer AH, Finkel KJ, Sites BD. Evaluation of pre-procedure ultrasound examination as a screening tool for difficult spinal anaesthesia. Anaesthesia. 2011;66(10):925–30.

8. Gnaho A, Nguyen V, Villevielle T, Frota M, Marret E, Gentili ME. Assessing the Depth of the Subarachnoid Space by Ultrasound. Rev Bras Anestesiol. 2012;62(4):520–30.

9. Prakash S, Mullick P, Chopra P, Kumar S, Singh R, Gogia AR. A prospective observational study of skin to subarachnoid space depth in the Indian population. Indian J Anaesth. 2014;58(2):165–70.

10. A C M, S S. Assessment of Difficult Spinal Anaesthesia Using Pre Procedural Ultrasound Compared With Clinical Methods in Young Patients Undergoing Elective Surgeries. J Evol Med Dent Sci. 2014;3(45):11051–8.

11. Hazarika R, Choudhury D, Nath S, Parua S. Estimation of skin to subarachnoid space depth: An observational study. J Clin Diagnostic Res. 2016;10(10):UC06–9.

12. Tyagi V, Jain V, Agrawal B, Jain M, Rastogi B, Srivastava R. Compare the Depth of Subarachnoid Space Using Anthropometric Measurements, Ultrasonographic Measurements and Actual Depth by Needle Insertion. Ann Clin Lab Res. 2019;7(1):284.

13. Gulay U, Turkay M, Nadir SS, Aysin A. Ultrasound-guided evaluation of the lumbar subarachnoid space in lateral and sitting positions in pregnant patients to receive elective cesarean operation. Pakistan J Med Sci. 2014;31(1):1–6.

14. Sutagatti JG, Kurdi MS and Bilun PA. Ultrasonographic Estimation of Skin to Sub- arachnoid Space Depth in the Pre-eclamptic Indian Parturients and its

Comparison with Physical Index Based Formula – Ind J Applied Radiology . 2019;5(1):1–5.

15. Kayalioglu G. The Vertebral Column and Spinal Meninges. The Spinal Cord. Elsevier Ltd; 2009. 17–36 p.

16. Spinal Sonography and Applications of Ultrasound for Central Neuraxial Blocks - NYSORA [Internet]. [cited 2020 Sep 21]. Available from: https://www.nysora.com/techniques/neuraxial-and-perineuraxial-techniques/spinal-sonography-and-applications-of-ultrasound-for-central-neuraxial-blocks/

17. Lie J, Patel S. Ultrasound for obstetric neuraxial anesthetic procedures: Practical and useful? J Obstet Anaesth Crit Care. 2015;5(2):49.

18. Grau T, Leipold RW, Conradi R, Martin E, Motsch J. Efficacy of ultrasound imaging in obstetric epidural anesthesia. J Clin Anesth. 2002;14(3):169–75.

19. Sangeeta Dhanger, Stalin Vinayagam,[1] Bhavani Vaidhyanathan, Idhuyya Joseph Rajesh, and Debendra Kumar Tripathy Indian J Anaesth. 2018 Apr; 62(4): 280–284.

20. Sahota JS, Carvalho JCA, Balki M, Fanning N, Arzola C. Ultrasound estimates for midline epidural punctures in the obese parturient: Paramedian sagittal oblique is comparable to transverse median plane. Anesth Analg. 2013;116(4):829–35.

21. Sargin M, Hanedan B, Aydogan E, Toprak H, Akin F, Özmen S. Evaluation of factors that affect skin to subarachnoid space distance. J Heal Sci. 2017;7(1):23–6.

22. Taman H, Farid A, Abdelghaffar W. Measuring skin to subarachnoid space depth in Egyptian population: A prospective cohort study. Anesth Essays Res. 2016;10(3):468.

23. Shahzad K, Afshan G. Induction position for spinal anaesthesia: sitting versus lateral position. J Pak Med Assoc. 2013;63(1):11-15.

24. Anahi Perlas, MD, FRCPC,*† Luis E. Chaparro, MD,‡ and Ki Jinn Chin, Lumbar Neuraxial Ultrasound for Spinal and Epidural Anesthesia A Systematic Review and Meta-Analysis, Reg Anesth Pain Med 2016;41: 251–260

25. Schnabel A, Schuster F, Ermert T, Eberhart LH, Metterlein T, Kranke P. Ultrasound guidance for neuraxial analgesia and anesthesia in obstetric: a quantative systematic review. Ultraschall Med. 2012;33:132–137.

26. Grau, T., Leipold, R., Fatehi, S., Martin, E., & Motsch, J. (2004). Real-time ultrasonic observation of combined spinal–epidural anaesthesia. European Journal of Anaesthesiology, 21(1), 25-31.

27. Conroy PH, Luyet C, McCartney CJ, McHardy PG. Real-time ultrasound-guided spinal anaesthesia: A prospective observational study of a new approach. Anesthesiol Res Pract. 2013;2013.

ANNEXURE -I

CONSENT FOR PARTICIPATION IN RESEARCH STUDY

Mr/Mrs/Miss. _____ we are requesting you to enroll in a study titled **"A ONE YEAR CROSS SECTIONAL STUDY TO COMPARE THE SKIN-DURA MATER USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION" .**conducted by _____, Post Graduate in M.D. Anaesthesiology under the guidance of _____,Professor,Department of Anaesthesiology, J.N. Medical College, Belagavi under KAHER, Belagavi.

Respected Sir/Madam We request you to kindly enrol in this study. During the study you will be asked some questions regarding yourpresent complaint and you are supposed to answer to the best of your knowledge.

Your participation in this research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with J.N.Medical College. If you decide not to participate you are free to withdraw at any time.

Purpose of the study:

The purpose of research is to compare the skin dura mater distance with USG and the spinal needle length so as to reduce the incidence of post duralpucture headaches and decrease the number of attempts.

Procedure Involved:

If you agree to enrol in my study, I will ask you your present and past medical history.You will be clinically examined in detail and routine investigations like CBC, Platelet Count, ECG, Chest XRAY, etc.will be done accordingly. You will be allotted into one of the two groups randomly using a simple randomisation technique. You will be assessed by an ultrasound in either sitting or lateral position . One group will receive spinal anesthesia in sitting position and another group will spinal anesthesia in left lateral position.

Voluntary Participation/Withdrawal:

Taking part in the study is voluntary. You may choose not to enrol in this study. Your decision will not change present or future health care services offered to you at K.L.E. hospital.

Alternatives:

Even if you decline the participation in the study, you will get the routine line of management.

Privacy and Confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is

obtained in connection with this study and that can be identified with your identity remaining confidential.

Financial Incentives for participation:

No financial incentives are being offered to enrolled patients. It is purely being done with the idea of research and all the cost of the study will be borne by the investigator.

Compensation:

In the event of injury related to the study, treatment will be made available through KLES Charitable Hospital, Belagavi. There is no compensation or payment for such medical treatment by law.

Questions:

If you have any queries about your rights as a study subject, you may call Dr. ROOPA BELLAD, Professor, Department of Peadiatrics and Chairman, J.N. Medical College Institutional Ethical Committee for Human Subjects Research, Phone number-02473777, or extension 4032 at J.N. Medical College, Belagavi.

INFORMED CONSENT IN PARTICIPATION FOR RESEARCH TRIAL.

"A ONE YEAR CROSS SECTIONAL STUDY TO COMPARE THE SKIN-DURA MATER USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION."

. I, Mr/Ms/Mrs _____ voluntarily agree for the participation of myselfas a subject of study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or the Left Thumb Print of parent/gaurdian :

_____

Date:

Witness Name : _____ Signature:_____

Date:

Investigators Name: _____ Signature:_____

Date:

Place : _____

ANNEXURE – II

PROFORMA

" A ONE YEAR CROSS SECTIONAL STUDY TO COMPARE THE SKIN-DURA MATER USING USG AND THE SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION."

Name & Address of the patient:

_____

_____

Age of the Patient: _____ IP. No. _____

Weight of Patient: _____ Sex.

Anaesthesiologist: _____ Surgeon: _____

PREANAESTHETIC EVALUATION:

Chief Complaints:

Past History:

- History of Diabetes Mellitus/Hypertension/Asthma/Tuberculosis
- Drug Therapy:
- Previous Anaesthetic procedure/Previous surgeries:
- History of renal disease, hepatic disease and neurological diseases.

Family History

General Physical Examination:

Weight: Temperature: Pallor: Height

Cyanosis: Pedal Oedema: Clubbing:

Pulse : B.P: RR:

Airway Assessment:

Mouth Opening: Teeth:

Jaw Movements: MP Grading:

SYSTEMIC EXAMINATION:

Cardiovascular System:

Respiratory System:

Per Abdomen:

Central Nervous system:

Spine assessment:

INVESTIGATIONS:

CBC: Platelet count:

ECG: Chest Xray:

Any Other:

ASA STATUS: Grade 1 / 2

Diagnosis:

Proposed Surgery:

Inclusion Criteria:

- ASA physical status I and II
- Age between 18-60years.
- Weight – 50- 70kg
- Height – 160-170cm
- Patients undergoing elective infraumblical surgeries.
- The surgeries included: urologic surgeries, general surgeries, gynecologicalsurgeries andorthopaedic surgeries.

Exclusion Criteria:

- Patients allergic to local anaesthetics.
- Patients with coagulation abnormalities.
- Patients with spinal abnormalities and neurological deficits.
- Patients with infection at the site of subarachnoid block.

METHODOLOGY:

After obtaining the approval of ethical committee and written informed consent, a total number of patients undergoing elective infraumbilicalsurgeries under spinal anaesthesia will be divided into two groups by using simple randomisation technique.

- **Group SP**-Patients receiving spinal anaesthesia in **sitting position**,
- **Group LP**- Patients receiving spinal anaesthesia in**left lateral position**.
- In the the preoperative room, an 18G intravenous line will be secured .

- The palpation of bony surface landmarks (L4) will be appreciated with the help of Tuffier's line. For selection of L3-L4interspace, a 2-5 MHz curvilinear probe (FUJIFILMSonosonite, Inc, Bothel, WA 98021 USA) will first be placed on the sacral region at the middle line to view the continuous hyperechoic line.
- The probe will be slid in a cranial direction in order to see the vertebral processes. Since the spinous processes of lumbar vertebras will look like crescent shaped, (L3-L4) interspace will be observed hypoechoic. The sonoanatomic structures in intervertebral space will be detected through ultrasound. The measurement of skin-dura mater distance will be recorded.
- Each patient will be preloaded with 10ml/kg of ringer lactate solution half an hour before shifting to the operating room without any premedications.
- Standard monitoring will be used throughout the procedure, including non invasive monitoring, electrocardiogram, and pulse oximetry.
- Two assistants will be utilized during the positioning of the patient.
- Patients in Group SP will be placed into the sitting position after they sit on the edge of the operating table by suspending their feet and stepping on a stool.
- The patients in Group LP will be put into the lateral position and pillows will be placed under their heads and shoulders.
- During application, one of the assistants will wait in front of the patient and will provide assistance to ensure the patient maintains the position.
- Following the guidelines for asepsis and antisepsis, subarachnoid anaesthesia will be instituted at the L3-L4 interspace in sitting position or lateral position using 23G Quincke's spinal needle (9 cm).

- While the spinal needle with the stylet will be in place, the measurement of skin-dura mater distance will be recorded with the help of a sterile measuring scale in cm.
- The patient will receive the spinal drug of 3ml of 0.5% hyperbaric bupivacaine.
- One of the assistants will provide assistance to ensure the patient is put to supine position immediately.
- The sensory and motor blocks will be checked every three minutes for 15mins then every five mins for 60mins and finally every 15mins until the sensory block has regressed to S2 dermatome.
- The distance between the skin and the dura, which will be measured by USG, will compared with the distance between the skin and the dura on the needle.

During surgery, the patients blood pressure, electrocardiogram and pulse oximetry will be recorded.

- The sensory level of block will be assessed in a caudal to cephalad direction using loss of cold sensation to a wet cotton swab.
- The motor block will be assessed using the modified bromage scale.

  0= no block, full straight leg raise possible.

  1=unable to straight leg raise, able to flex knee

  2= unable to flex knee, able to flex ankle

  3=no motor movement, complete motor block.
- Readiness for surgery was defined as loss of cold sensation > T10.

The occurrence of clinically relevant hypotension (defined as a decrease in systolic arterial blood pressure >20% from baseline values) will be treated with incremental doses of 6mg of IV Mephentermine.

Clinically relevant bradycardia (defined as heart rate <50 beats per min) will be treated with Iv. Atropine (0.6mg)

Observations:

Readings will be recorded in the following manner:

Technique used : _____.

Depth of skin to dura mater

Group SP	
USG skin dura mater distance (cm)	**Spinal needle length (cm)**

Group LP	
USG skin dura mater distance (cm)	**Spinal needle length (cm)**

SIGNATURE OF ANESTHESIOLOGIST: _____

SIGNATURE OF THE PRINCIPAL INVESTIGATOR: _____

ANNEXURE III – ETHICAL CLEARANCE CERTIFICATE

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http//www.jnmc.edu
E-Mail : dornc@jnmc.edu
Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 54 **Date: 24/11/2018**

REG NO.BA0118004

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A ONE YEAR PROSPECTIVE OBSERVATIONAL STUDY TO COMPARE THE SKIN-DURA MATER DISTANCE USING USG AND SPINAL NEEDLE LENGTH WITH PATIENT IN LEFT LATERAL AND SITTING POSITION UNDER SUBARACHNOID BLOCK ",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Arathi Darshan)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

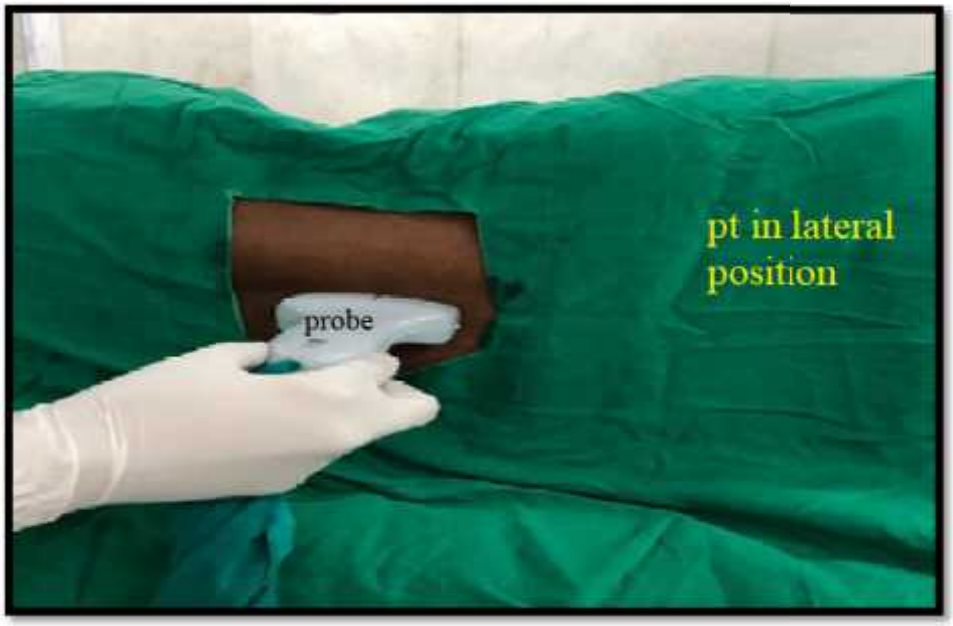
(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

51

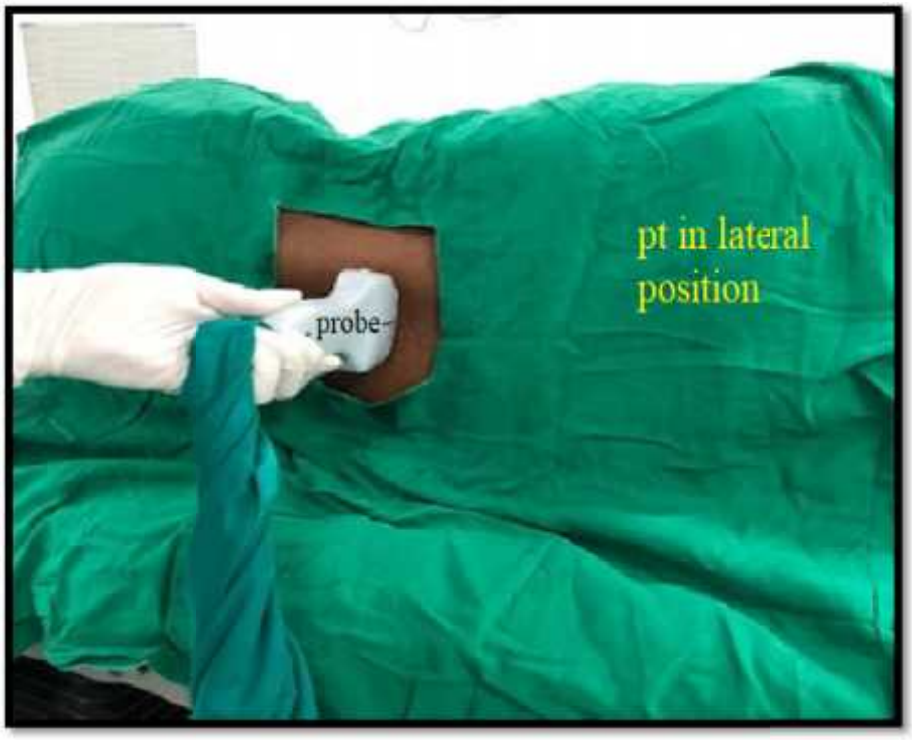
ANNEXURE –IV: PHOTOGRAPHS

PHOTOGRAPH 1: USG Machine

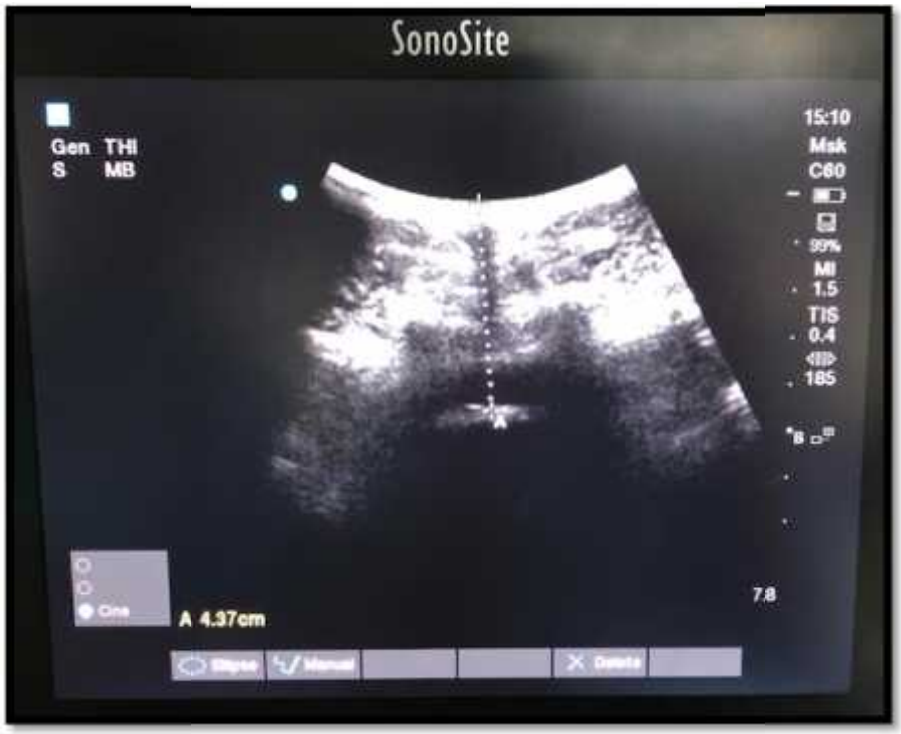
Photograph 2: USG probe in longitudinal view



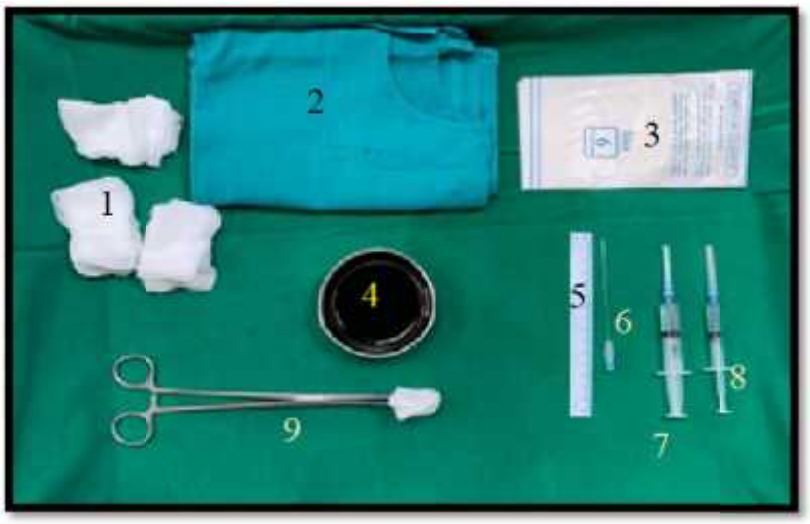
Photograph 3: USG probe in transverse view



Photograpgh 4: Ultrasound measurement of SS depth



Photograpgh 5: Spinal needle measurement with spinal tray



1-gauze, 2- hole towel, 3-gloves,4- betadine, 5-ruler, 6-Quincke spinal needle, 7,8-syringes, 9- sponge holding forceps

Photograph 6:Anaesthesia Machine

ANNEXURES V - MASTER CHART

sl no.	IP no.	Age (yrs)	Sex	Wt (kgs)	Ht (cms)	ASA	SS (cm)	SS (USG)	NOA	POSITION	Complications
1	914128	28	M	58	166	1	4.8	4.76	1	LP	nil
2	913884	30	F	60	164	1	5.4	5.36	1	SP	nil
3	914361	48	F	65	166	2	5	4.88	2	SP	nil
4	910757	27	F	55	160	1	4.7	4.66	1	LP	nil
5	911504	56	M	60	162	1	4.9	4.87	2	LP	nil
6	914584	31	F	62	165	1	4.8	4.64	1	SP	nil
7	911336	45	F	70	165	2	5.3	5.14	2	SP	nil
8	914355	35	M	60	164	1	4.1	4.07	1	SP	nil
9	915036	25	M	54	162	1	5.3	5.16	1	SP	nil
10	910030	57	M	64	165	2	5.6	5.38	1	LP	nil
11	914957	56	M	70	168	2	5.1	4.83	2	SP	nil
12	911745	22	M	50	166	1	4.9	4.88	1	SP	nil
13	916561	32	F	51	162	1	3.8	3.67	1	LP	nil
14	910198	25	F	53	160	1	4.7	4.56	1	LP	nil
15	914174	50	F	65	168	2	5	4.86	3	SP	pain at site
16	916291	28	F	50	166	1	4.9	4.8	1	LP	nil
17	916163	28	F	54	160	1	4.4	4.16	2	LP	nil
18	914926	41	F	62	165	1	5.2	5.18	1	SP	nil
19	916263	60	M	56	162	2	5.3	5.22	1	LP	nil
20	916195	55	M	70	165	2	5.1	4.96	1	LP	nil
21	916449	30	M	68	168	1	5.3	5.14	1	LP	nil
22	916663	27	F	56	162	1	4.7	4.56	2	LP	nil
23	913708	41	F	62	165	2	4.3	4.12	1	LP	nil
24	916795	60	F	55	164	1	4.7	4.56	1	SP	nil
25	916910	51	M	56	168	2	5	4.88	1	SP	nil
26	917623	60	F	54	166	2	4.9	4.78	2	LP	nil
27	917440	47	M	68	164	1	5.1	4.94	1	SP	nil
28	917838	47	F	50	162	1	4.4	4.26	1	LP	nil
29	917755	57	M	53	166	1	4.2	4.33	1	SP	nil
30	918067	60	M	62	168	1	4.2	4.44	1	SP	nil
31	918058	40	M	56	162	1	4.9	4.78	2	SP	nil
32	915624	45	F	67	167	2	5.00	4.96	1	LP	nil
33	918239	44	M	52	168	1	4.70	4.56	2	LP	nil
34	914944	56	F	55	166	1	4.7	4.58	1	SP	nil
35	918553	56	M	64	161	1	4.8	4.68	1	SP	nil
36	919974	23	F	66	166	1	4.5	4.46	1	SP	nil
37	919242	30	F	63	169	1	5.1	4.96	1	LP	nil
38	919976	28	F	57	166	1	4.8	4.74	2	SP	nil
39	918249	22	F	68	168	1	4.5	4.34	1	LP	nil
40	920155	18	M	69	163	1	4.8	4.66	3	SP	nil
41	920260	27	F	52	162	1	5	4.86	1	LP	nil
42	920187	25	F	58	168	1	4.4	4.34	1	SP	nil
43	920260	24	F	64	164	1	5.1	4.94	2	LP	nil
44	920221	25	F	65	168	1	4.7	4.56	2	SP	nil
45	920537	38	M	58	165	1	4.8	4.68	1	SP	nil
46	920144	32	M	57	162	1	4.4	4.32	1	SP	nil
47	919039	23	M	54	169	1	4.3	4.18	2	LP	nil
48	920465	43	F	55	163	2	4.8	4.67	1	SP	nil
49	921265	35	F	69	168	1	5.2	5.02	1	LP	nil
50	920679	25	F	61	164	1	4.4	4.38	1	SP	nil
51	920832	55	F	62	167	2	5.1	5.04	1	LP	nil
52	920710	27	F	54	166	1	4.8	4.65	1	SP	nil
53	924601	29	F	65	165	1	4.6	4.54	1	SP	nil
54	921309	28	F	67	168	1	4.9	4.77	2	SP	nil
55	921575	39	M	69	161	1	4.6	4.56	1	LP	nil
56	923896	40	M	66	168	1	5.1	4.95	1	LP	nil
57	924188	32	M	65	163	1	5	4.88	1	LP	nil
58	924010	30	M	54	165	1	4.5	4.42	2	SP	nil
59	922946	40	F	65	169	1	4.6	4.52	1	LP	nil

60	925704	38	M	66	162	1	4.8	5.66	3	LP	nil
61	925591	32	F	56	167	1	4.4	4.26	1	SP	nil
62	925726	55	F	57	163	2	4.7	4.54	1	SP	nil
63	925938	21	F	59	167	1	4.9	4.68	1	SP	nil
64	926407	45	F	58	168	1	5.1	4.96	1	SP	nil
65	925684	45	F	67	163	2	4.9	4.72	1	LP	nil
66	921515	39	M	57	165	1	4.1	4.06	1	SP	nil
67	926436	45	F	54	168	1	4.8	4.66	1	LP	nil
68	926829	52	M	59	167	2	4.6	4.54	1	SP	nil
69	937027	57	M	66	163	2	4.8	4.72	1	LP	nil
70	934140	26	M	63	162	1	4.6	4.44	1	LP	nil
71	937446	21	M	61	166	1	4.9	4.78	1	SP	nil
72	937387	25	M	66	161	1	5.1	4.95	2	LP	PON
73	937227	23	M	63	167	1	5	4.86	1	SP	nil
74	936660	53	M	56	162	2	4.8	4.66	2	LP	nil
75	935585	32	M	67	165	1	5.2	5.06	1	SP	nil
76	937790	25	F	58	168	1	4.8	4.64	1	SP	nil
77	937595	30	M	52	164	1	4.6	4.56	1	LP	nil
78	937835	60	M	67	169	2	4.2	4.14	1	SP	nil
79	936029	22	F	59	163	1	4.6	4.43	2	SP	nil
80	936022	50	F	56	163	2	4.8	4.62	1	SP	nil
81	937188	34	F	67	166	1	5.2	5.14	2	LP	nil
82	938670	21	F	69	165	1	5.1	5.02	1	SP	nil
83	938746	25	F	55	163	1	4.8	4.65	1	SP	nil
84	937020	37	F	66	161	1	4.6	4.34	1	LP	nil
85	939198	30	F	57	163	1	4.9	4.68	1	SP	nil
86	938998	35	F	54	165	1	4.6	4.56	1	SP	nil
87	939215	41	M	63	168	1	5.1	4.96	1	LP	nil
88	939122	41	M	67	169	1	5.3	5.12	1	LP	nil
89	934143	45	M	69	163	1	5	4.88	1	SP	nil
90	938936	55	F	54	166	2	4.4	4.24	1	SP	nil
91	938661	53	M	53	162	2	4.3	4.18	1	LP	nil
92	939445	34	F	57	165	1	4.8	4.68	1	LP	nil
93	939376	60	M	52	163	2	4.4	4.32	1	LP	nil
94	939336	32	F	57	168	1	4.5	4.43	1	LP	nil
95	939346	48	M	58	169	1	4.1	4.06	1	SP	nil
96	938884	45	F	59	162	1	4.8	4.73	2	LP	nil
97	939552	26	M	53	165	1	4.2	4.07	1	LP	nil
98	938059	45	F	51	164	1	4.3	4.22	1	SP	nil
99	937906	36	M	67	163	1	5.1	4.96	2	LP	nil
100	940123	34	F	64	169	1	5.2	5.06	1	SP	nil
101	940020	35	F	58	161	1	4.3	4.12	1	SP	nil
102	938492	35	F	54	163	1	4.3	4.22	1	LP	nil
103	939144	36	F	52	166	1	4.6	4.48	1	LP	nil
104	940321	25	F	67	169	1	4.5	4.37	1	SP	nil
105	940427	45	F	69	161	1	4.8	4.64	1	SP	nil
106	941164	58	M	52	165	2	4.7	4.62	1	LP	nil
107	941078	40	F	57	162	1	4.4	4.29	1	LP	nil
108	938195	20	F	67	164	1	4.9	4.76	1	LP	nil
109	941807	35	M	69	169	1	5.3	5.12	2	LP	nil
110	941424	40	F	62	166	1	4.8	4.65	1	SP	nil
111	941228	35	F	53	162	1	4.3	4.24	1	LP	nil
112	941652	23	F	57	165	1	4.5	4.32	1	LP	nil
113	939787	35	M	54	166	1	4.1	4.02	2	LP	nil
114	938858	20	M	55	167	1	4.6	4.54	1	SP	nil
115	942081	60	M	59	165	2	4.7	4.56	1	LP	nil
116	923140	56	M	62	167	2	4.2	4.14	1	LP	nil
117	943205	28	F	66	161	1	4.3	4.22	1	SP	nil
118	943388	49	F	67	165	1	4.5	4.34	1	SP	nil
119	943615	38	M	64	162	1	4.9	4.78	1	SP	nil
120	942487	60	M	61	166	2	4.9	4.73	2	LP	nil
121	943367	40	M	56	164	1	4.4	4.24	1	LP	nil
122	943619	47	M	59	168	1	4.7	4.64	1	LP	nil

123	944153	25	F	67	163	1	5	4.68	2	SP	nil
124	943499	43	F	69	169	1	5.1	4.96	1	SP	nil
125	943515	45	M	63	165	1	4.4	4.32	2	LP	nil
126	942542	36	M	65	169	1	4.7	4.56	1	LP	nil
127	944196	45	F	54	168	1	4.4	4.32	1	SP	nil
128	944290	30	F	56	162	1	4.3	4.18	1	LP	nil
129	944271	50	M	57	161	2	4.9	4.66	1	SP	nil
130	944448	25	M	58	165	1	4.3	4.22	1	SP	nil
131	944542	33	M	52	161	1	4.5	4.38	1	LP	nil
132	944831	60	M	54	164	2	4.7	4.58	1	SP	nil
133	944284	26	M	65	168	1	5.1	4.97	1	SP	nil
134	945102	58	F	61	163	2	5.3	5.14	1	LP	nil
135	942725	20	F	54	166	1	4.4	4.25	2	LP	nil
136	944801	19	M	57	161	1	4.5	4.47	1	LP	nil
137	945289	22	F	67	165	1	4.7	4.54	1	SP	nil
138	946151	40	M	65	164	1	4.8	4.58	1	LP	nil
139	946143	58	M	63	162	1	4.6	4.52	1	SP	nil
140	946306	37	F	65	163	1	5	4.86	1	SP	nil
141	946137	54	M	54	166	1	4.1	4.03	1	LP	nil
142	946127	60	M	65	161	2	4.9	4.83	2	LP	nil
143	946401	33	F	57	162	1	4.6	4.46	1	SP	nil
144	946273	54	M	58	166	2	4.5	4.42	2	SP	nil
145	946315	48	M	53	162	1	4.3	4.16	1	LP	nil
146	946592	34	M	64	161	1	4.6	4.47	1	LP	nil
147	945487	43	F	66	167	1	4.8	4.73	1	SP	nil
148	943515	45	M	63	168	2	4.8	4.58	2	SP	nil
149	946310	60	F	61	166	2	5	4.88	1	LP	nil
150	946966	38	M	56	161	1	4.4	4.35	1	LP	nil
151	944821	60	M	64	162	2	4.8	4.65	1	SP	nil
152	945605	21	F	68	166	1	5.3	5.18	1	LP	nil
153	947098	23	F	56	165	1	4.5	4.38	1	LP	nil
154	945292	28	M	57	163	1	4.4	4.24	1	SP	nil
155	947319	30	M	55	163	1	4.5	4.36	1	SP	nil
156	947069	40	F	67	161	1	5.1	4.93	1	LP	nil
157	947275	37	M	65	163	1	5	4.86	1	SP	nil
158	945250	39	M	66	165	1	5.3	5.22	1	SP	nil
159	947188	20	M	69	164	1	4.9	4.77	1	LP	nil
160	947716	35	M	63	166	1	5.1	4.98	1	LP	nil
161	947124	28	F	55	169	1	4.3	4.17	1	LP	nil
162	947597	60	F	57	166	2	4.6	4.52	2	SP	nil
163	947649	42	M	65	161	1	4.8	4.67	1	LP	nil
164	947151	19	M	64	162	1	5	4.88	1	LP	nil
165	947801	38	F	57	166	1	4.6	4.54	1	LP	nil
166	948456	23	M	58	161	1	4.8	4.66	1	SP	nil
167	948978	45	F	64	162	1	5	4.85	1	SP	nil
168	948300	60	M	59	168	2	4.7	4.57	1	LP	nil
169	948850	18	M	66	167	1	5.1	4.96	1	LP	nil
170	944723	24	F	65	166	1	5	4.88	1	SP	nil
171	948831	22	F	68	161	1	5.2	5.12	2	LP	nil
172	948641	24	M	67	163	1	4.9	4.76	1	LP	nil
173	949117	20	M	57	165	1	4.6	4.42	1	SP	nil
174	947113	31	M	58	167	1	4.6	4.47	1	SP	nil
175	949335	24	F	66	161	1	4.5	4.44	1	LP	nil
176	949523	60	M	63	165	2	4.8	4.72	1	LP	nil
177	948488	58	M	56	168	1	4.6	4.46	1	SP	nil
178	946157	46	M	54	166	2	4.8	4.57	1	SP	nil
179	949171	40	F	57	161	2	4.6	4.45	1	LP	nil
180	950662	20	F	59	165	1	4.8	4.64	1	SP	nil
181	951618	53	M	66	166	2	4.6	4.43	1	SP	nil
182	952784	60	F	63	161	2	4.8	4.56	1	LP	nil
183	952627	38	F	54	166	1	4.4	4.24	1	LP	nil
184	952613	60	F	67	164	2	5.1	5.02	1	SP	nil
185	950981	52	M	65	161	2	5.1	4.98	2	LP	nil

186	950053	46	F	63	166	1	4.9	4.75	1	SP	nil
187	951676	30	F	57	168	1	4.5	4.34	1	SP	nil
188	951595	48	F	53	162	2	4.8	4.67	1	LP	nil
189	945250	39	M	65	165	1	4.6	4.38	1	LP	nil
190	951918	45	F	61	163	1	4.8	4.66	1	SP	nil
191	952130	25	F	55	166	1	4.5	4.43	2	SP	nil
192	953758	24	F	59	162	1	4.8	4.63	1	SP	nil
193	953496	35	F	57	165	1	4.4	4.32	1	LP	nil
194	953466	28	F	63	166	1	4.8	4.66	2	SP	nil
195	950549	44	M	59	168	1	4.3	4.24	1	LP	nil
196	951708	54	M	55	162	2	4.4	4.18	1	SP	nil
197	953204	33	M	57	165	1	4.6	4.44	1	SP	nil
198	953268	56	F	59	166	2	4.5	4.34	1	LP	nil
199	956614	60	M	63	162	2	4.9	4.65	1	SP	nil
200	949150	53	M	65	165	2	5.1	4.98	1	SP	nil
201	959518	24	M	66	165	1	5.2	5.08	1	LP	nil
202	954486	34	M	69	166	1	5.1	4.94	1	LP	nil
203	953920	29	F	55	162	1	4.8	4.63	1	SP	nil
204	955075	28	F	58	165	1	4.8	4.66	1	SP	nil
205	955059	46	F	53	168	1	4.6	4.36	2	LP	nil
206	954942	48	M	65	166	2	4.8	4.73	1	SP	nil
207	955612	24	F	67	161	1	5	4.87	1	LP	nil
208	954199	40	F	63	163	1	4.6	4.34	1	LP	nil
209	950857	38	M	69	162	1	5.1	4.96	1	SP	nil
210	954642	25	M	67	165	1	5	4.92	1	SP	nil
211	954477	45	F	59	166	1	4.5	4.38	2	LP	nil
212	949731	52	F	66	167	1	4.9	4.67	1	LP	nil
213	955802	34	M	65	166	1	4.9	4.85	2	LP	nil
214	954344	43	F	57	168	1	4.4	4.24	1	SP	nil
215	955440	44	F	69	161	1	5.2	5.16	1	LP	nil
216	955734	19	M	56	162	1	4.7	4.53	1	SP	nil
217	956248	60	F	51	165	2	4	3.96	1	SP	nil
218	955117	46	F	54	163	1	4.5	4.43	1	LP	nil
219	956009	45	F	52	165	1	4.5	4.32	1	LP	nil
220	953334	55	F	57	166	2	4.7	4.56	1	SP	nil
221	956682	40	M	67	167	1	5	4.79	1	LP	nil
222	956614	35	F	69	163	1	4.8	4.68	1	LP	nil
223	955803	38	F	56	166	1	4.6	4.51	1	LP	nil
224	955955	46	M	59	165	1	4.4	4.27	1	SP	nil
225	956737	41	M	55	165	1	4.5	4.36	2	SP	nil
226	957138	45	F	59	166	1	4.8	4.58	2	SP	nil
227	957219	45	F	54	165	1	4.6	4.46	1	LP	nil
228	956015	24	F	55	165	1	4.8	4.57	1	LP	nil
229	957133	21	M	57	161	1	4.6	4.46	1	LP	nil
230	957024	50	M	67	164	2	5.1	4.96	2	LP	nil
231	955272	57	F	66	163	2	4.8	4.57	1	SP	nil
232	949522	58	M	69	162	2	5	4.87	1	LP	nil
233	951286	40	F	63	167	1	5.2	5.12	1	LP	nil
234	954709	58	M	54	163	2	4.6	4.43	1	SP	nil
235	955165	40	M	64	165	1	4.9	4.78	1	SP	nil
236	956185	39	F	54	168	1	4.4	4.24	1	LP	nil
237	957129	45	F	66	166	1	4.8	4.67	2	LP	nil
238	938520	46	F	55	161	1	4.3	4.22	2	LP	nil
239	956020	45	M	57	163	1	4.6	4.45	1	LP	nil
240	958589	54	M	58	166	2	5.1	4.97	1	SP	nil
241	956956	30	M	65	167	1	4.8	4.66	1	SP	nil
242	973389	52	F	66	162	2	5.1	4.98	1	LP	nil
243	969336	58	M	58	168	2	4.7	4.54	1	LP	nil
244	976017	32	M	69	162	1	5.2	5.06	1	SP	nil
245	976653	45	F	65	169	1	4.8	4.67	1	LP	nil
246	976374	18	M	58	166	1	4.5	4.34	2	SP	nil
247	976282	30	F	68	161	1	4.9	4.78	1	LP	nil
248	977850	52	M	66	169	2	4.8	4.66	1	SP	nil

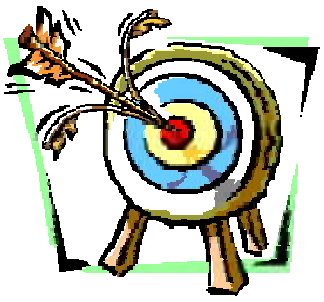
249	974561	30	M	69	161	1	4.7	4.56	1	LP	nil
250	978026	54	F	65	166	2	5.2	5.06	1	LP	nil
251	978440	38	M	56	163	1	4.8	4.65	1	SP	nil
252	978414	49	F	59	166	1	4.8	4.72	1	SP	nil
253	977307	54	F	55	163	1	4.1	4.02	1	LP	nil
254	976264	40	M	53	165	1	4.2	4.04	1	LP	nil
255	976701	51	F	55	166	1	4.7	4.53	1	SP	nil
256	980433	27	M	56	162	1	4.2	4.13	1	SP	nil
257	977855	32	F	58	167	1	4.5	4.32	1	SP	nil
258	980432	32	F	68	162	1	4.7	4.56	1	LP	nil
259	980908	40	F	67	168	1	5	4.88	1	LP	nil
260	980917	31	F	66	166	1	5.1	4.88	1	SP	nil
261	981022	50	M	65	162	1	4.9	4.76	2	LP	nil
262	981277	47	F	63	161	1	4.8	4.53	1	SP	nil
263	973922	45	M	56	167	1	4.3	4.15	1	SP	nil
264	981028	38	M	58	168	1	4.7	4.52	1	LP	nil
265	975655	60	M	67	166	2	5.1	5.06	1	SP	nil
266	981293	26	F	69	161	1	5.2	5.12	1	SP	nil
267	981068	57	M	55	162	1	4.1	4.02	2	LP	nil
268	981776	60	M	57	167	2	4.8	4.66	1	LP	nil
269	981745	56	M	68	161	2	5.3	5.16	1	SP	nil
270	981057	29	F	54	162	1	4.3	4.16	1	LP	nil
271	982194	42	F	58	167	2	4.7	4.54	2	SP	nil
272	980926	43	M	65	168	1	4.9	4.78	1	SP	nil
273	982542	45	M	66	163	1	4.8	4.66	3	LP	pain at site
274	982045	20	F	69	161	1	5.2	5.02	1	LP	nil
275	983155	35	F	61	165	1	5	4.88	1	LP	nil
276	984161	52	M	54	166	2	4.5	4.34	1	SP	nil
277	981869	32	M	55	168	1	4.3	4.21	2	LP	nil
278	983787	40	F	57	161	2	4.7	4.56	1	SP	nil
279	984482	24	F	65	169	1	4.9	4.76	2	SP	nil
280	984505	26	F	66	161	1	4.8	4.66	1	LP	nil
281	984260	26	F	63	165	1	5	4.84	1	SP	nil
282	983903	40	F	57	163	1	4.6	4.51	1	SP	nil
283	984315	58	F	64	162	2	4.9	4.78	1	LP	nil
284	974416	26	F	58	168	1	4.6	4.46	1	LP	nil
285	984187	34	M	65	169	1	5	4.82	1	SP	nil
286	984267	25	F	68	167	1	5.3	5.17	2	SP	nil
287	983484	40	M	66	167	1	5	4.92	1	SP	nil
288	985406	50	M	54	161	2	4.5	4.34	1	SP	nil
289	985458	22	M	57	162	1	4.4	4.26	1	SP	nil
290	983454	28	M	52	166	1	4	3.98	1	LP	nil
291	984563	29	F	59	167	1	4.7	4.58	1	LP	nil
292	985933	28	F	68	165	1	5.2	5.08	1	SP	nil
293	955907	50	F	63	161	2	4.9	4.76	1	LP	nil
294	986574	58	F	67	165	2	5.1	4.98	1	SP	nil
295	985402	25	F	55	161	1	4.8	4.78	2	LP	nil
296	984822	42	F	58	162	1	4.5	4.34	1	SP	nil
297	987653	60	F	53	168	2	4.4	4.22	1	LP	nil
298	989019	40	F	65	166	1	4.6	4.56	1	SP	nil
299	989108	28	M	64	161	1	5	4.88	1	SP	nil
300	988548	30	M	56	163	1	4.5	4.34	1	SP	nil

ANNEXURE-VI

KEY TO MASTERCHART

IP	-	In patient
ASA	-	American society of Anaesthesiologists
F	-	Female
SS	-	Skin subarachnoid depth
USG	-	Ultrasonography
LP	-	Lateral position
SP	-	Sitting position
M	-	Male
Ht	-	Height
Wt	-	Weight
NOA	-	Number of Attempts

Introduction



Objectives

Review of Literature

Basic Sciences

Methodology

Results

Discussion

Conclusion

Summary

Bibliography

Annexure-I

Annexure-II

Annexure-III

Annexure-IV

Annexure-V

Annexure-VI