"EVALUATION OF LUMBAR SONOGRAPHY AS LEARNING AID FOR PERFORMING SUBARACHNOID BLOCK USING PARAMEDIAN APPROACH BY RESIDENT ANAESTHESIOLOGISTS "

By

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DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH CENTER, KOLAR, KARNATAKA

In partial fulfillment of the requirements for the degree of

DOCTOR OF MEDICINE

IN

ANAESTHESIOLOGY

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Date : **Dr SAI YASHASWINI G .**

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ABBREVIATIONS

Glossary	Abbreviations
USG	Ultrasound
IV	Intravenous
UG	Ultrasound guided paramedian
RCT	Randomized Controlled Trial
PG	Landmark guided paramedian
ASA	American Society of Anesthesiologists
SAB	Subarachnoid block
CNS	Central nervous system
CSF	Cerebrospinal fluid
PDPH	Post-dural puncture headache
PMSO	Paramedian sagittal oblique view
T1-view	Transverse interlaminar view
BMI	Body Mass Index
ASAPS	American Society of Anesthesiologists Physical Status
Kg	Kilogram
HR	Heart rate
PR	Pulse rate
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
NIBP	Non invasive blood pressure
MAP	Mean arterial pressure
ECG	Electrocardiogram
ESM	Erector spinae muscle;
TP	Transverse process

PM	Psoas muscle
AP	Articular process
SAP	Superior articular process
IAP	Inferior articular process
FJ	Facet joint
PC	Posterior complex
AC	Anterior complex
ITS	Intrathecal space
ISL	Interspinous ligament
TP	Transverse process
IEC	Institutional Ethical committee
PSO	Paramedian Sagittal Oblique plane
LFD	Ligamentum Flavum-Dura Mater
PLL	Posterior Longitudinal Ligament
PLC	posterior longitudinal complex

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ABSTRACT

BACKGROUND : Spinal anesthesia using midline technique may be difficult in some patients; in such patients pre procedural ultrasound paramedian and blind paramedian technique can be used. The following hypothesis was made, which states that preprocedural ultrasound will result in a successful dural puncture on first attempt, compared to conventional blind paramedian .

METHODS: A randomized controlled study in which 22 residents have enrolled, who were randomly allocated into two groups, ultrasound-guided paramedian [UG] and conventional blind paramedian [PG], with a study population of 150 with 75 in each group. A study was conducted on patients undergoing elective abdominal and lower limb surgeries after giving consent .

RESULTS :

The primary outcome is a successful dural puncture on the first attempt was higher in the ultrasound group with group UG (49.33%) with group PG (34.67%) with $p < 0.068$ which statistically not significant.

Number of attempts in group UG with a median of 2.0 (1 to 2) and group PG with a median of 2 (1 to 2.5) with $p < 0.096$, which is statistically not significant.

Time taken for spinal anesthesia in the UG group is 45 sec (38 to 49.5), and in the PG group with 48 sec (38 to 55), the p-value < 0.046, which is statistically significant.

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CONCLUSION: Ultrasound guiding has been demonstrated to increase the success rate of paramedian anaesthesia. It increases the the success rate of dural puncture and the rate of puncture on the first attempt. It also reduces the time required for a dural puncture. The preprocedural US guided paramedian hasn't shown much superiority compared to conventional blind paramedian in the general population

KEYWORDS : paramedian ultrasound , residents , spinal anesthesia

INTRODUCTION

Neuraxial anaesthesia is a term that denotes placing local anaesthetic medication in or around the Central Nervous System (CNS). Spinal anaesthesia (Subarachnoid block to be more specific) is a technique of neuraxial anaesthesia, of placing the local anaesthetic directly in the subarachnoid space. Subarachnoid block (SAB) also known as spinal block. This block has emerged as effective alternative to general anaesthesia and is also safe.[1,3]

Subarachnoid block is appropriate for many surgical procedures, that are done below the umbilicus level (T10) such as abdominal gynaecological procedures, obstetric anaesthesia, caesarean section, hip and knee joint replacements, hernia repairs, perineal surgery and prostatectomy. Patients can remain awake under mild sedation. Subarachnoid block is preferred in aged patients, particularly in individuals with diseases involving the cardiovascular system, respiratory system, diseases of kidney, liver and disorders of metabolism. SAB is also a suitable choice for providing anaesthesia in emergency situations such as surgeries of the lower limb in subject with a full stomach, who is intoxicated.[1,2,3]

Spinal anaesthesia has been performed traditionally by palpating the bony landmarks. These landmarks can give an approximate position and localization of the neuraxial spinal midline. Palpating the intercristal line and spinus process tips will identify the lumbar interspinous spaces and interlaminar spaces. Given that they may be blurry or distorted in individuals with obesity, prior spinal surgery, spinal deformity, as well as degenerative changes brought on by ageing, the technical difficulty of neuraxial blockade corresponds with the quality of perceptible surface landmarks.[1, 2]

Understanding of neuraxial anatomy is essential for administration of spinal anaesthesia . Appropriate dosed drugs have to be delivered to intrathecal space.

Ideal way to provide spinal anaesthesia is by successful puncture of dura with a single needle pass. Association of many complications like post-dural puncture headache (PDPH), paresthesia, and epidural hematomas with multiple attempts. Even though the approach used commonly for spinal anaesthesia is conventional midline approach, the paramedian approach is an equally good alternative, as it is less inclined to be affected by the osteoarthritic changes in the spine.[3-5]

In the paramedian approach, the amount of resistance encountered is small, as supraspinous ligaments and interspinous ligaments are not encountered commonly.

For performing a lumbar neuraxial block, USG (Ultrasonography) can be used. It can see the several structures in the lumbar spine, from the superficial thoracolumbar fascia to the spinal canal. Anatomy of the lumbar spine can be delineated using USG. We can do the whole procedure under the guidance of an ultrasound. Preprocedural ultrasound can be done. In adults, from the surface, the neuraxial structures and the spine are positioned around 5 to 7 centimeters deep. Hence for deeper penetration, a transducer with lower frequency is preferred Convex transducers broaden the range of vision and improve picture quality of deeper structures, but they may impair evaluation of superficial features.[4, 5] Hence, for USG of the lumbar spine, convex transducers are used.

Ultrasound can be proven beneficial in all those subjects having abnormal surface landmarks. The data available is not sufficient for promoting the use of USG routinely in all subjects.

Before the procedure, imaging with USG has the potential to outline the intervertebral level for a precise puncture, identify the ideal site for the Quincke's or Whitacre 's spinal needle insertion, and depth can be measured for successful neuraxial blockage. The transverse midline interlaminar view and parasagittal oblique view are the key USG views. USG can be helpful in the facilitation of neuraxial block in subjects with difficult palpatory landmarks, such as obesity, elderly, and patients having anatomical abnormalities in the vertebrae. Their usage has also become common in operation theatres. Traditionally, the lumbar block has been done with a surface landmark-guided technique. In the USG, the bone casts a dense acoustic shadow, as the USG does not penetrate the bone. The interpretation of lumbar spine anatomy in USG is based on the typical acoustic shadows due to the contours created by the bony surfaces on the lumbar vertebra, especially the posterior surface. T ll canal can be visualized only by the soft-tissue acoustic windows of the interlaminar and interspinous spaces. Ultrasound can be utilized to improvise the success rate of dural puncture has been reported for a long [6] and more frequently in the recent studies, especially in the subset of patients where the difficult dural puncture is predicted such as obese as well as elderly patients.[5, 7-9] Both pre-procedural ultrasound imaging as well as real-time USG guided spinal needle insertion has enhanced the spinal anaesthesia success rate by trained anesthesiologists.

Anaesthesiology residents are taught and trained to perform spinal anaesthesia using the conventional landmark based approach through the midline. In cases where midline approach to subarachnoid block is unsuccessful, they are trained to landmark guided utilize paramedian approach as an alternative technique. Traditional teaching involves didactic lectures as well as hands on simulation on mannequins. Sparse literature is available that involves successful utilization of lumbar ultrasound imaging by resident anaesthesiologists for performing neuraxial blockade.[10] Reports of their use in lumbar epidural catheter insertion is also available.[11] The evidence on use of USG for neuraxial blockade is evolving. It is useful, especially in subjects who have impalpable anatomical landmarks.[29, 30] Henceforth , the following study was conducted to conclude whether a preprocedural lumbar ultrasound scan can improve first needle insertion success while performing subarachnoid block compared with a landmark-guided approach.

AIM AND OBJECTIVES

AIM AND OBJECTIVES:

Primary Objective: To determine whether preprocedural lumbar ultrasound scan improves first needle insertion attempt success while performing subarachnoid block by resident anaesthesiologists when compared to landmark guided approach.

Secondary objectives: To compare among the groups,

I. The number of attempts and needle redirections to perform subarachnoid block

II. The total amount of time taken in seconds or minutes to perform the subarachnoid block.

III. Patient satisfaction score immediately after the block

IV. Periprocedural pain score rated by patient on Visual Analogue scale

V. Requirement of Verbal assistance from consultant anaesthesiologist

VI. Complications such as bloody tap, paraesthesias, failed or inadequate block

REVIEW OF LITERATURE

Review of literature:

A. Subarachnoid block:

Subarachnoid block is also known as spinal block. It is an effective alternate for general anaesthesia and is also safer. It is useful, especially in surgeries involving the lower extremities, surgeries involving the areas of perineum or surgeries involving lower body wall such as inguinal herniorrhaphy.[12, 13] Spinal anaesthesia has been the dominant form of neuraxial anesthesia, as epidural anaesthesia due to the technical challenges in identification of epidural space besides the problem of toxicity that arises with requirement of large local anesthetic doses for epidural anesthesia. Neuraxial anaesthesia is a term that denotes the introduction of local anaesthetic medication along the course of the CNS located in spinal cord . Using the neuraxial anesthesia technique (SAB), local anesthetic is administered by injection into the subarachnoid area .[12]

In administration of epidural anaesthesia, the anaesthetic medication is placed outside dura mater while in spinal anaesthesia, the anaesthetic medication is placed in the CSF.

The **subarachnoid block (SAB)** is popularly known as a spinal block. The term spinal anaesthesia is used interchangeably by some anaesthetists for SAB, although both epidural block and SAB are classified under spinal anaesthesia. Hence, it is desirable to use the names subarachnoid block and epidural block exclusively. Subarachnoid block is a comparatively easy block for learning and performing. It is also more satisfying technique with regards to the satisfaction of the subject, the anaesthetist and the surgeon.[14] This block offers exceptional operating conditions for surgeries that are done below the level of umbilicus. Also, it is possible and easy for an anaesthetist to bring the essential equipment's for providing excellent anaesthesia to one half of the body.

A.1. History:

An ophthalmologist, Carl Koller, from Vienna (1884) defined topical cocaine use for eye analgesia initially.[15] Then further progress was made by surgeons, William Halsted and.[16] Then

A scientist named Richard hall, hailing from New York City, had used cocaine to produce anesthesia by inoculating cocaine into nerves ,a neurologist from New York, JL Corning (1885) defined cocaine use for spinal anaesthesia.[17] Based on the literature, it is believed that he injected into epidural space as he did not mention about CSF efflux. August Bier, a surgeon from Germany, in 1898 was the first to perform the spinal anaesthesia by administering cocaine intrathecally for lower extremity surgeries.[18-20] Author barker, renounced surgeon (1907), had identified that the midline technique was much easier than a paramedian and the advantages of using hyperbaric solutions.[21] CSF loss was reported as a main problem in spinal anesthesia over the decades, which lead to development of smooth tip, smaller gauge needle and reduction of the Post Dural Puncture Headache (PDPH).

A.2. Indications and contraindications:

Indications:

SAB is appropriate for surgeries below T10 (umbilicus level) such as abdominal gynaecological procedures, obstetric anaesthesia, caesarean section, hip and knee joint replacements, hernia repairs, perineal surgery and prostatectomy. Patients can remain awake under mild sedation. Subarachnoid block is preferred in aged patients, particularly in individuals with diseases involving the cardiovascular system, respiratory system, diseases of kidney, liver and disorders of metabolism. SAB is also a suitable choice for providing anaesthesia in emergency situations such as surgeries of the lower limb in subject with a full stomach, who is intoxicated.[1,2,3]

Contraindications:

Absolute contraindications:

- sepsis at site of lumbar puncture
- coagulopathies
- unidentified neurological illness ,indeterminate neurologic disease ,
- raised intracranial pressure (ICP)
- patient refusal.[12]

The relativeRelative contraindications:

- septicemia/ sepsis in blood stream distinct from the site of lumbar puncture,
- severe mitral stenosis (MS) and severe aortic stenosis (AS),,
- left ventricular outflow obstruction (LVOT),,
- patients on anticoagulants, -hypovolemia, and
- unknown duration of surgery.[12, 18]

A.3. Clinical anatomy and physiology:

An adequate understanding of spinal anatomy is very much crucial for the administration of appropriately dosed drugs into subarachnoid space.

The spinal anatomy consists of

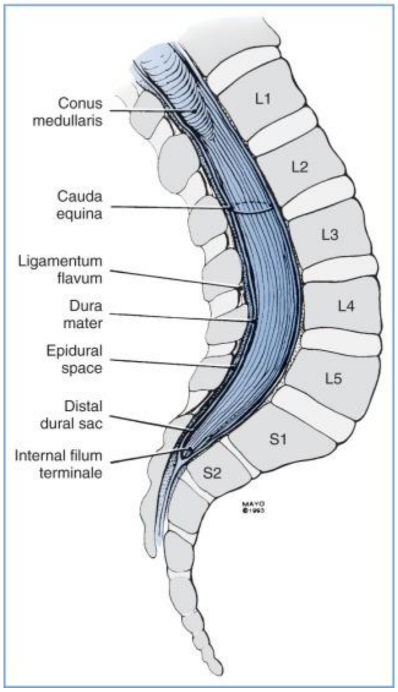
a) 7 cervical,

b) 12 thoracic,

c) 5 lumbar, and

d) 5 fused sacral vertebral bones.

Figure 1: Neuraxial anatomy of lumbar vertebrae and spinal cord



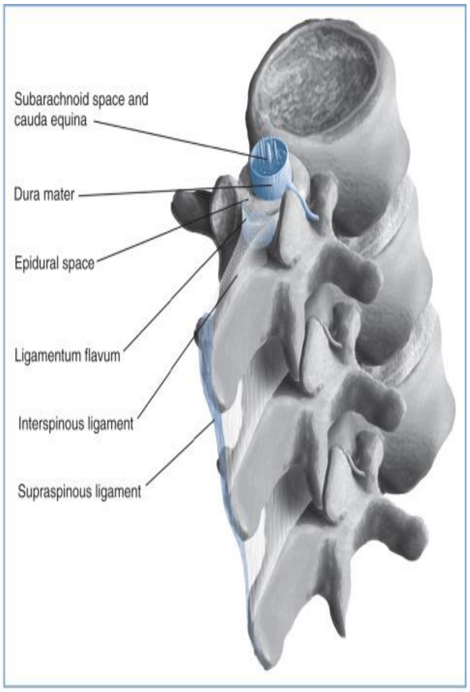
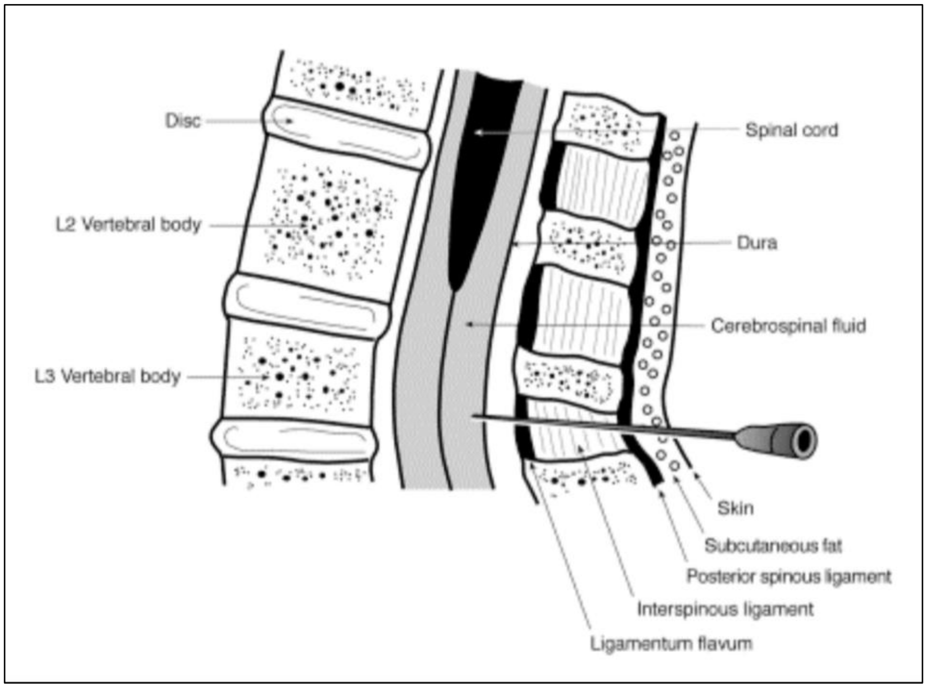


Image source: a. https://aneskey.com/spinal-epidural-and-caudal-anesthesia-anatomy-physiology-and-technique/
b. Illustration by Naveen Nathan, MD, Northwestern University Feinberg School of Medicine, Chicago, IL.

After

Figure 2: Subarachnoid block – clinical anatomy
Image courtesy: https://resources.wfsahq.org/atotw/subarachnoid-block-also-known-as-spinal-block/



In order to understand the level of block of target strictures, it is necessary to understand the dermatomal anatomy. In surgeries of the lower abdomen like lower abdominal caesarean section, incision is generally put below the level of T10 dermatome while to avoid pain and discomfort arising from tugging of peritoneum, coverage is needed up to the level of T4 dermatome.

Table 1: Dermatomal level of spinal block

Dermatome	Level of blockade
T10	Umbilicus
T7	Xiphoid process
T4	Nipple
C8	Finger of upper limbs – fifth finger

Figure 3: Dermatomal level of spinal block

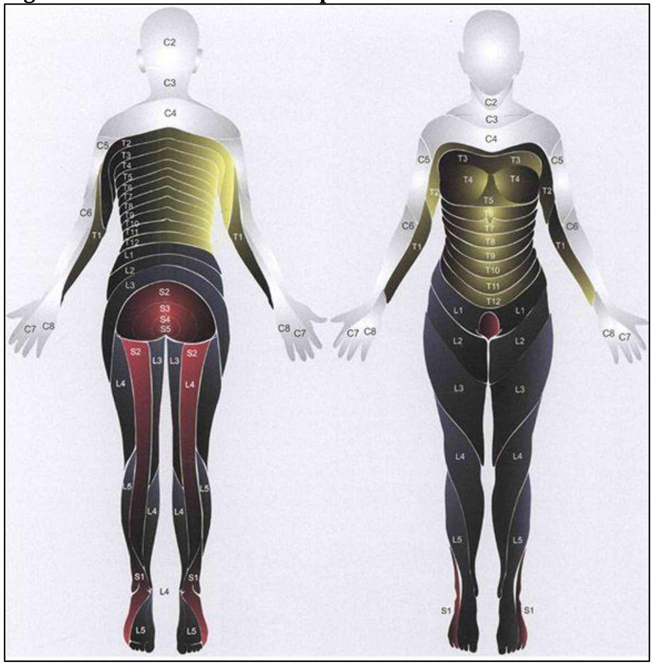


Image source: https://aneskey.com/spinal-anesthesia-4/#rfn2

The administration of medication in spinal anaesthesia is done only in lumbar area, that is also specifically in middle to lower lumbar levels. It is done in order to prevent spinal cord damage and also to avoid activity of medications injected intrathecally, resulting in any effect in cervical regions and upper thoracic regions. The conus medullaris is the point where spinal cord ~~–~~terminates. it can be found anywhere from the middle third of the T12 to the upper most of 1/3 rd of the L3[22], with the lower third of the L1 vertebra being its normal location~~.~~ .However, it has been neither gender nor age significantly affects where~~there is no significant difference in~~ the ~~position of the~~ conus ~~-~~medullaris is located.~~with regard to gender or age.~~ The dural sac has extended to the level spinal anaesthesia, the spinal needle must be inserted either at the L3~~-/~~L4 intervertebral the L4~~-/~~L5 intervertebral space.~~interspace.~~ The chance of occurrence of trauma to spinal cord trauma with higher interspaces, especially in obese patients.[23]

The blockade of conduction by local anaesthetics occur through sodium channel blockage in nerve membranes. Transmission of neural impulses are prevented. Differences in the amount of cephalad blockage of vasomotor tone, sensory loss to touch, , temperature discrimination ,sensory loss to pin prick and motor function are all manifestations of differential blockade.[24] The blockade is maximum for discrimination of temperature and vasomotor tone while the blockade is least for motor function. In spinal anaesthesia, the local anaesthetics have their action directly on the neural tissue, which are present in the subarachnoid space. Vascular uptake from these spaces explains the regression of anaesthesia. The concentration of local anaesthetic needed in spinal anaesthesia to produce adequate blockade of sodium channels is lower on comparison with nerves in epidural space, which are better protected. Hence in spinal anaesthesia, on comparison with epidural anaesthesia, there is a widespread band of differential bloackade.[24]

A.4. Approach and Procedure:

After appropriate selection of patient and preparation, ideal positioning of the patient is attained. During positioning, the patient is kept comfortable in order to create a straight path for insertion of needle in the space between the two palpable spinous processes. Sitting position is commonly used as it creates a symmetrical position comparison with lateral decubitus position.[12] In order to open the vertebral interspace, the patient is asked to flex the spine in sitting position, with legs hanging by the side. By palpation, the access site is then recognized, but it may be difficult to establish in patients with obesity. The procedure should be done under aseptic precautions, the patient should wear a head cap . The cleaning is done starting from selected site, going in circles and then going away. The cleaning solution which is mainly chlorhexidine solution is used then allowed to dry. Using a local anaesthetic, a wheal is formed at the selected site, either at the midline or at the paramedian.

I. **Midline approach:**

A single direction needle insertion is used to enter the intrathecal space, which is subarchanoid space. A spinal needle is first introduced into the skin with a marginal cephalad angle following local anaesthetic infiltration. It traverses skin, then the layer of subcutaneous fat, then it pierces the initial ligament supraspinous ligament and thereafter reaching interspinous ligament. As it passes through, compounding increase in tissue resistance will be felt. A pop would be felt on reaching the ligamentum flavum. The epidural space is reached on popping through this ligament. This space is for placement of medications that can be administered through epidural route and epidural catheters. This also presents the point where the loss of resistance is felt to the injection of saline or air. In case of administration of spinal anaesthesia, the needle has to be insertion till the dura mater and subarachnoid membranes are penetrated. This point is signalled by the free-flowing CSF.

II. Paramedian approach:

For administration of spinal anaesthesia through paramedian approach, the placement of local anaesthetic as a skin wheal is done at a distance of 1 centimetre (cm) inferior and lateral in correspondence to the midline. The spinal needle is then angled forward toward the midline. The L4 spinous process is identified using the iliac crest as a landmark. The finger is positioned at the caudal end of the L4 spinous process and moved inferiorly and laterally by one centimetre. The cephalad and medial angulations are used to insert the needle. The needle angled at about 10 degrees to 15 degrees towards the midline and at about 10 degrees to 15 degrees in the cephalad direction. If the needle comes into contact with the lamina, it should be adjusted in a cephalad direction, until the subarachnoid space is entered and CSF is obtained. In this approach, the supraspinous and interspinous ligaments are usually not encountered. Hence, there is little resistance encountered until reaching the ligamentum flavum.

The spinal needle traverses many structures, starting from the skin, depending on the type of approach used.[25, 26]

In case of midline approach, the following structures are traversed by the spinal needle:

Skin, followed by Subcutaneous fat, and three ligaments, which are the Supraspinous ligament, Interspinous ligament, ligamentum flavum, later on, followed by Dura mater, Subdural space, and finally followed, Arachnoid mater, and Subarachnoid space

With the paramedian approach, the following structures will be pierced by the spinal needle

Skin, followed by Subcutaneous fat, and only one ligament, Ligamentum flavum, later on, followed by Dura

***mater, Subdural space, and finally, followed Arachnoid mater and Subarachnoid space*.

Figure 4: Lumbar spine lateral and posterior views:

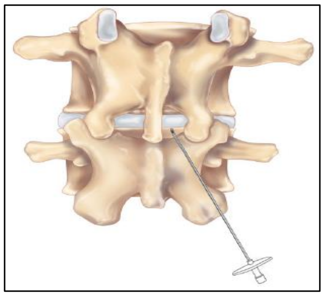


Image courtesy: https://www.acepnow.com/article/techniques-performing-paramedian-approach-lumbar-puncture/

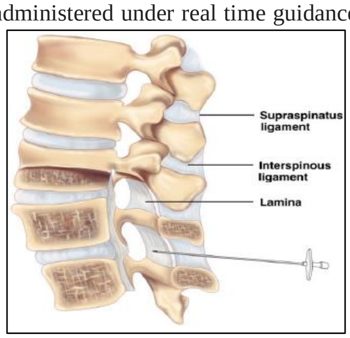
A.5. Complications of sub arachnoid block[27-29]:

Minor	Moderate	Major
• Nausea and vomiting • Mild hypotension • Shivering • Itch • Transient mild hearing impairment • Urinary retention	• Failed spinal • Post dural puncture headache[30]	• Direct needle trauma • Infection (abscess, meningitis) • Vertebral canal hematoma • Spinal cord ischemia • Cauda equina syndrome • Arachnoiditis • Peripheral nerve injury • Total spinal anesthesia • Cardiovascular collapse • Death

After administration of spinal anaesthesia, serious neurological complications can occur rarely. The most common complications are PDPH and hypotension. The mechanism of hypotension is due to sympathetic blockade.[27]

B. Role of usage of ultrasonography in SAB

Ultrasonography (USG) can play an effective role in administration of spinal anesthesia. It helps in understanding the lumbar spine anatomy. USG helps in visualization of the components of the lumbar spine.[30-32] USG can be done before administration of spinal anaesthesia or spinal anaesthesia can be administered under real time guidance of USG.[30, 31] The structures of the spine and the spinal cord are situated at a depth of approximately five to seven centimeters in almost all adults. Since anatomic structures are located deep within the human body, a low-frequency transducer (usually a convex/curved array) that penetrates deeper into the body is recommended.[30] In the literature, it



has been said to have a frequency between 2 and 9 MHz.[33] Convex transducers enable better visibility of deeper structures at the expense of superficial structures, hence enhancing the field of view.

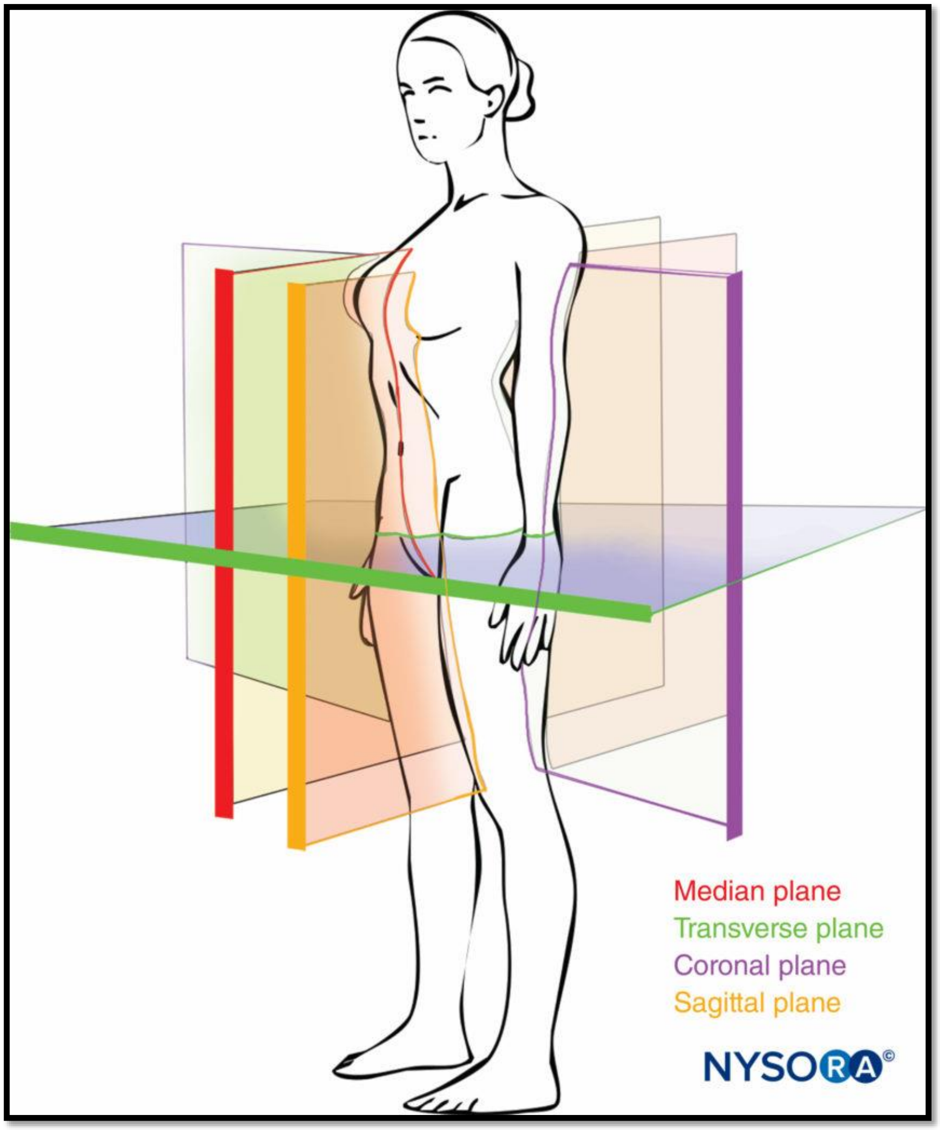


Figure 5: Various planes for spinal imaging

Several improvements have been implemented to reduce the morbidity associated with many tries and passes, including the pre-procedure ultrasound-guided midline approach[34] and the real-time ultrasound-guided approach[35.]

Conventional paramedian blind and ultrasound-guided paramedian were also studied.

USG has an effective role to play to administer spinal anaesthesia in a single attempt in subjects with difficult landmarks for lumbar anaesthesia. The amount of evidence available is insufficient for supporting the use of USG routinely in all subjects posted for spinal anaesthesia.[36]

Figure 6: Transverse scan (constructed) images of vertebra and spinal cord

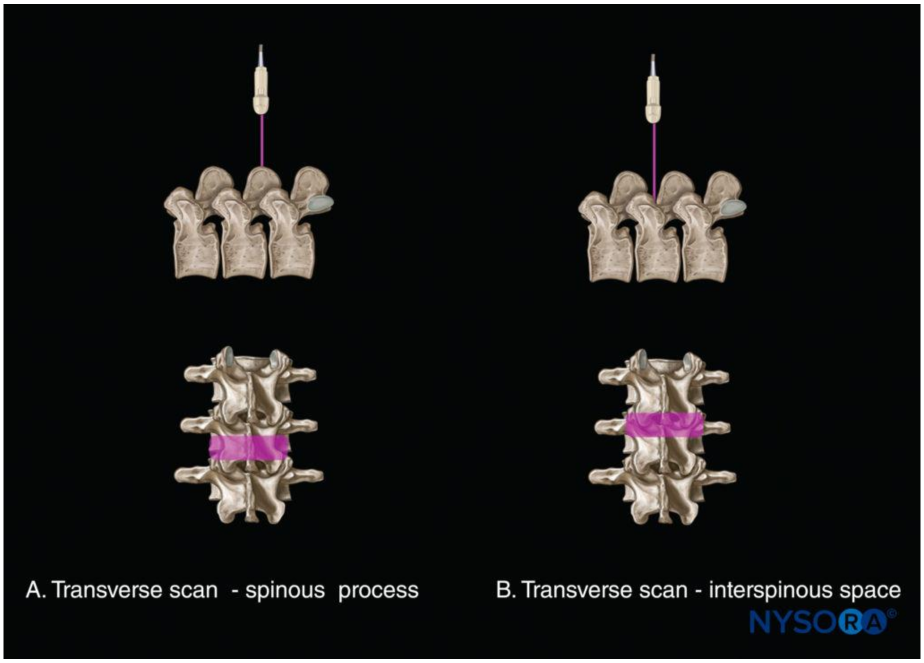
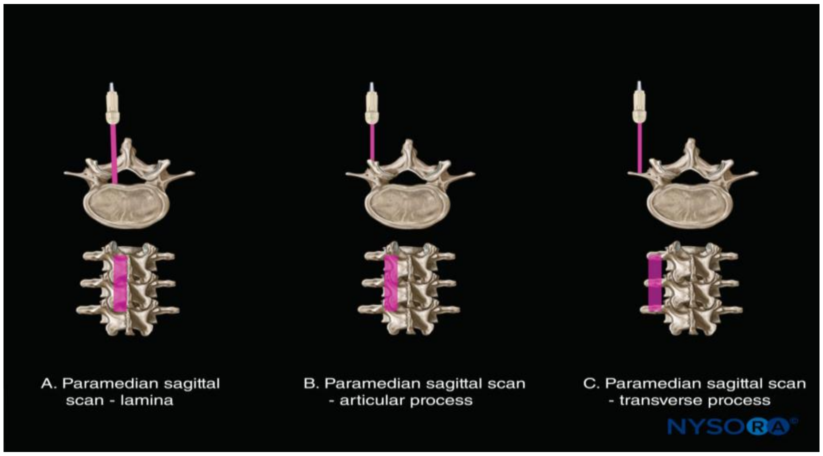
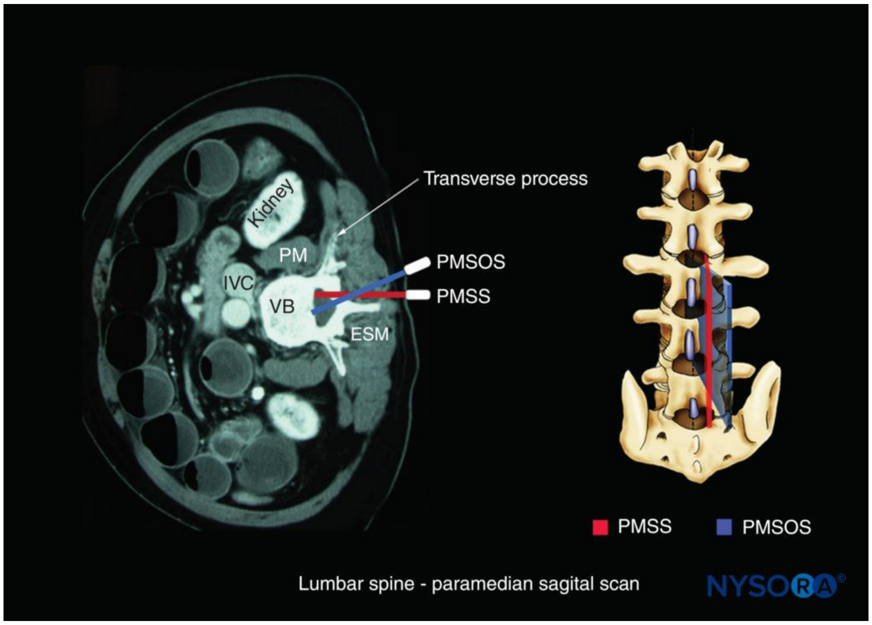


Figure 7 : Paramedian sagittal scan (constructed) images of the lumbar vertebra and the spinal cord in lumbar region





https://www.nysora.com/techniques/neuraxial-and-perineuraxial-techniques/spinal-sonography-and-applications-of-ultrasound-for-central-neuraxial-blocks/

Figure 8: Paramedian sagittal scan (constructed) images of vertebra and spinal cord

Prior to the procedure, USG imaging better to done to define the intervertebral level for precise puncture, identify the best point to insert the needle, and determine how much depth to advance the needle to achieve a successful neuraxial blockade.[37, 38] Parasagittal obliques and transverse midline interlaminar views were important ultrasonographic views for the paramedian spinal approach. USG can be helpful in facilitation of neuraxial block in subjects with difficult palpatory landmarks such as obesity, elderly, subjects with anatomical abnormalities in the lumbar axis of vertebrae such as, scoliosis , sclerosis ,ankylosing spondylitis . Their use has also become common in operation theatres. Traditionally, the lumbar block has been done with a surface landmark-guided technique. Utilization of Ultrasound imaging to improve the success of dural puncture have been documented for long[6] and more commonly in the following recent studies, especially in the subset of patients where difficult dural puncture is predicted such as obese as well as elderly patients.[5, 7-9] Both pre-procedural ultrasound imaging as well as real time USG guided spinal needle insertion have enhanced the spinal anaesthesia success rate by trained anesthesiologists. USG guided technique for neuraxial block has been reported to be commonly used.[34, 39]

B.1 Ultrasonographic images for neuraxial block and spine sono anatomy

In the USG, the bone casts a dense acoustic shadow, as the USG does not penetrate the bone. The interpretation of lumbar spine anatomy in USG is based on the typical acoustic shadows due to the contours created by the bony surfaces on the lumbar vertebra, especially the posterior surface. The spaces (acoustic windows) through which the vertebral column is seen are interlaminar and interspinous spaces.

Using USG, five basic views can be obtained systematically. They are "**parasagittal transverse process view, parasagittal articular process view, parasagittal oblique (interlaminar) view - PSO view, transverse spinous process view and transverse interlaminar (interspinous) view - TI view".**

Following this are used PSO and T 1 view, as structures like ligamentum flavum, spinal cord, anterior dura, posterior dura and posterior longitudinal ligament can be accessed through these views.

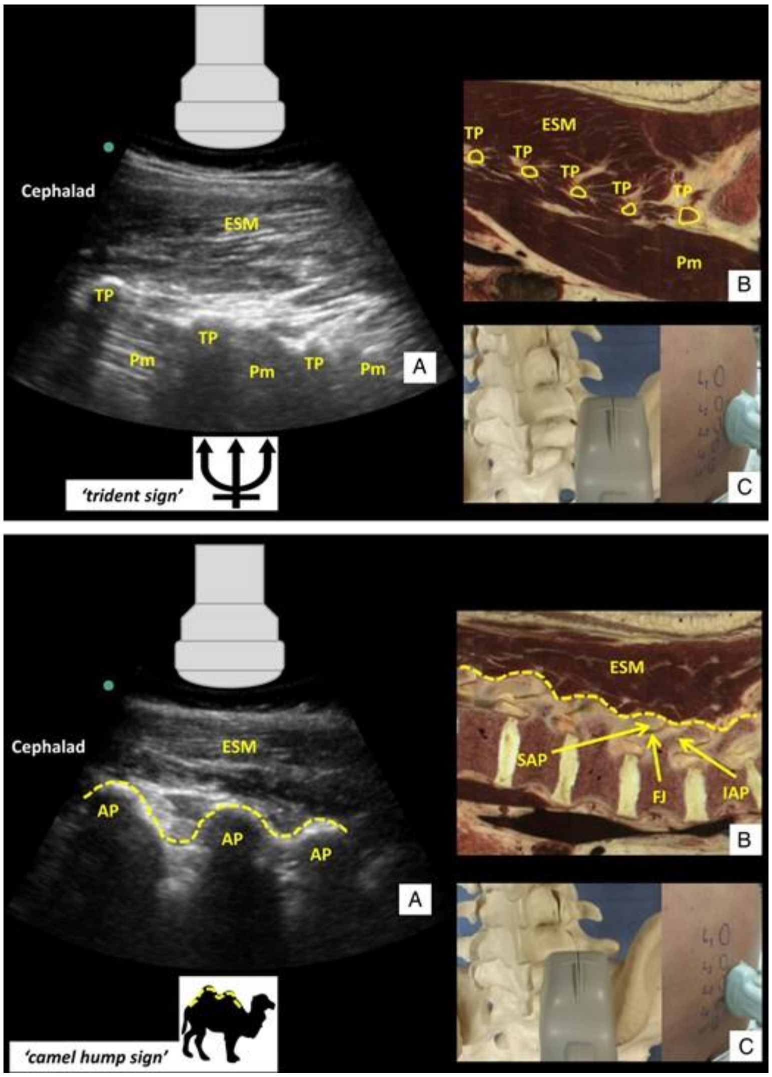


Figure 9: View of the lumbar spine's parasagittal transverse and articular processes

Picture in the top:

The lumbar spine is shown in a parasagittal transverse viewpoint (PST).

(A)the anatomical cross section

(B) graphic from *visiblehuman.epfl.ch*); (C) ultrasound curvilinear probe placement. erector spinae muscle (ESM); transverse process (TP); psoas muscle (PM). The term trident sign also refers to the form of the acoustic shadows, which resemble the finger-like formed by the transverse processes.

Picture in the down

The lumbar spine's parasagittal articular process view (PSA)

(A) anatomical cross section (B) and ultrasound curvilinear probe placement (C). erector spinae muscle (ESM); articular process (AP); superior articular process (SAP) ; inferior articular process (IAP) ; facet joint (FJ)

(B) The articular processes are emphasized by dotted lines in (A) and (B), which mimic a sequence of camel humps (camel hump sign). "(Image courtesy of www.usra.ca.) [Anatomical section images courtesy Prof. R.D. Hersch, Ecole Polytechnique Fédérale de Lausanne (EPFL), site: http://visiblehuman.epfl.ch, with original 3D data from the Visible Human Project, US National Library of Medicine, Bethesda]."

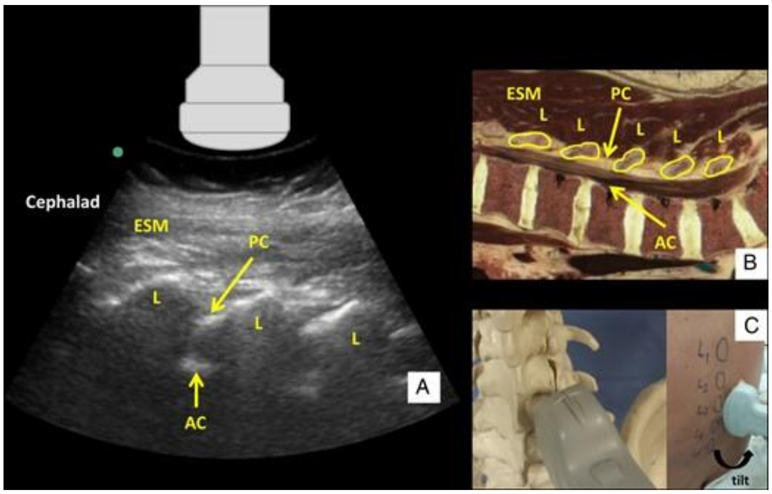


Figure 10: Lumbar spine in parasagittal oblique view (PSO)

(A) anatomical cross section (B) ultrasound curvilinear probe placement

(C) erector spinae muscle (ESM); lamina (L); posterior complex (PC); AC, anterior complex (AC). "(Image courtesy of www.usra.ca.) [Anatomical section image courtesy of Prof. R.D. Hersch, Ecole Polytechnique Fédérale de Lausanne (EPFL), site: http://visiblehuman.epfl.ch, with original 3D data from the Visible Human Project, US National Library of Medicine, Bethesda]."

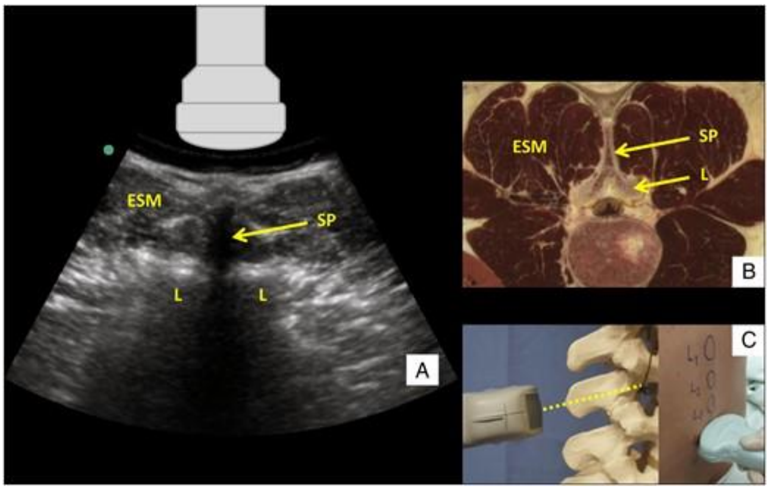


Figure 11: A transverse interspinous view of the lumbar spine

(A) anatomical cross section (B) ultrasound curvilinear probe placement

(C) erector spinae muscle (ESM); lamina (L); spinous process (SP). The ultrasound beam's direction is depicted by the dotted line in (C). "(Image courtesy of www.usra.ca.) [Anatomical section image courtesy of Prof. R.D. Hersch, Ecole Polytechnique Fédérale de Lausanne (EPFL), site: http://visiblehuman.epfl.ch, with original 3D data from the Visible Human Project, US National Library of Medicine, Bethesda]".

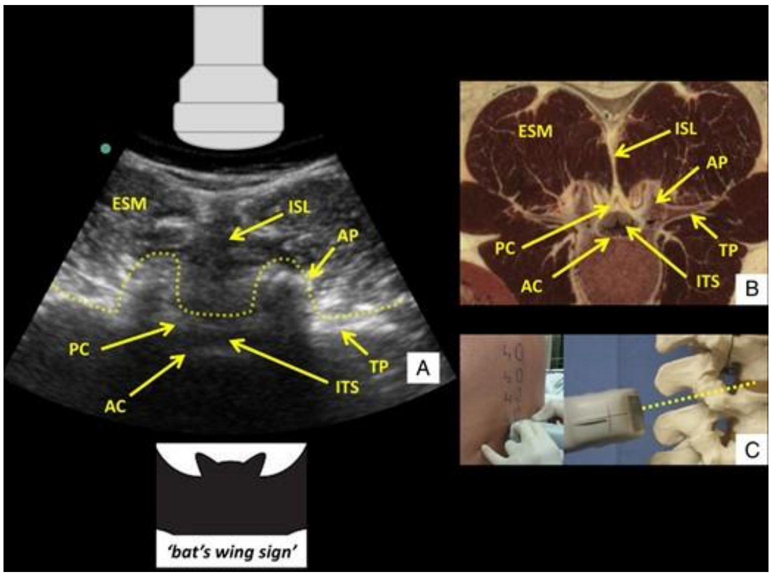


Figure 12: A transverse interlaminar view of the lumbar spine

(A) anatomical cross section (B) ultrasound curvilinear probe placement

(C) erector spinae muscle (ESM); PC, posterior complex (PC); anterior complex (AC); intrathecal space (ITS); interspinous ligament (ISL); articular process (AP); transverse process (TP). The contour of the ultrasonographic structures that gave rise to the "bat's wing sign" is indicated by the dotted line in (A). The direction of the ultrasonic beam is indicated by the dotted line in (C). "(Image courtesy of www.usra.ca.) [Anatomical section image courtesy of Prof. R.D. Hersch, Ecole Polytechnique Fédérale de Lausanne (EPFL), site: http://visiblehuman.epfl.ch, with original 3D data from the Visible Human Project, US National Library of Medicine, Bethesda]."

B.2.USG -guided neuraxial block administration through paramedian approach

A paramedian technique is preferred for giving spinal anesthesia patients with narrow interspinous spaces .It can be used to successfully enter the spinal needle into the intrathecal space. This technique of USG guided paramedian approach can also be used when a satisfactory TI view is not available.[40]

40 The transverse method The spinous process view consists primarily of the midline or spinous processes surrounding the desired intervertebral location. The spinous process shadow is centered on the ultrasound screen, and skin markings are generated at I the long edge's midpoint (which corresponds to the neuraxial midline); and (ii) the short edge's midpoint (corresponding to the spinous process in the transverse plane). At least two adjacent spinous processes are treated with this method. The first needle must be is one centimeter lateral to the midline and one centimeter superior to the lower spinous process line. With a little medial and cephalad angle (5°-10°), the needle is inserted alongside the spinous process. Tactile feedback (for example, contact with the bony lamina) will indicate the requirement for progressive needle redirection, often in a cephalad direction**.** On the other hand, the procedure is carried out similarly to the conventional neuraxial block method based on landmarks. This procedure requires a good knowledge about the vertebral anatomy.


Figure 13: The USG guided Paramedian sagittal oblique view /approach

It was reported by Grau et al.[41] that, the appropriate view for accessing the sono-anatomy of epidural space is the paramedian sagittal (or) parasagittal oblique view(PSOV). Following mentioned view is obtained by placing the transducer longitudinally at a distance of about one to two centimeters lateral to the spinous process. The transducer of the ultrasound is then was tilted slightly medially to send the ultrasonic beam toward the midline of the spine.

The transducer of the ultrasound is then moved anteriorly by counting the vertebrae in the lumbar region, initially from the sacrum and moving upwards , the accurate intervertebral level can be ascertained.[42, 43] Karmakar et al also reported that parasagittal oblique view approach is better on comparison with the median transverse axis and the median sagittal axis views, since a larger acoustic window is created.[30]

"The sacrum, laminae, ligamentum flavum, posterior dura, interlaminar space, intrathecal space, cauda equina and vertebral body/posterior longitudinal ligament/anterior dura complex can be identified by the following approach. The posterior complex is defined as the ligamentum flavum, epidural space, and posterior dura mater shown as a linear hyperechoic structure in the following plane. The anterior complex is a linear hyperechoic structure composed of the anterior dura mater, the posterior longitudinal ligament, and the posterior surface of the vertebral body or the intervertebral disc. In this way, the center of the anterior and posterior complexes, also known as the dural sac or intrathecal space, is recognized as an anechoic zone.[44"]

B.3. Importance of ultrasound in spinal anesthesia:

Utilization of Ultrasound imaging to improve the success of dural puncture has been reported in the recent studies, especially in the subset of patients where difficult dural puncture is predicted such as obese as well as elderly patients. Both pre-procedural ultrasound imaging as well as real time USG guided spinal needle insertion have been utilized to increase the rate of success of conducting spinal anaesthesia by trained anesthesiologists.

Anaesthesiology residents are taught and trained to perform spinal anaesthesia using the conventional landmark-based approach through the midline. In cases where midline approach to subarachnoid block is unsuccessful, they are trained to utilize paramedian approach as an alternative technique. Traditional teaching involves didactic lectures as well as hands on simulation on mannequins. Sparse literature is available that involves successful utilization of lumbar ultrasound imaging by resident anaesthesiologists for performing neuraxial blockade. Use of USG has become popular among the anaesthetists. Evidence has been accumulating about the role of USG guided lumbar epidural and lumbar spinal anaesthesia, especially in subjects with anatomical landmarks, that are impalpable.[45, 46]

B.4. Periprocedural pain: The administration of spinal anaesthesia is generally tolerated well. The procedure has small risks only. The most painful part could arise from administration of local anesthetic through subcutaneous rate initially in the procedure, that is before the point of spinal needle insertion.[47, 48]

C. Complications of spinal anaesthesia:

After the administration of spinal anaesthesia, the neurological complications occur very rarely. The complications that are most commonly reported are post dural puncture headache and hypotension.[27, 49-51] After administration of spinal anaesthesia, the occurrence of hypotension is due to the sympathetic blockade cause by the physiological phenomenon.[52-54]

One of the common side effects is Hypotension and it is reported in about 16% to 33% of subjects administered with spinal anaesthesia.[55] In elderly subjects, this response is exaggerated because of the negative influence on a resting sympathetic tone, which is relatively higher. The higher frequency of occurrence of hypotension in elderly in this scenario can also be explained by the decreased baroreceptor activity.[24, 56] The hypotension, that occurs after the onset of SA can be due to lowered systemic vascular resistance or a decrease in cardiac output or could be due to both**.**

In SAB, the major complications are rare. In case of the local anaesthetic medication reaching the brain stem, there can be development of dysphonia, upper limb weakness, loss of consciousness and airway protection is lost , hypotension, dyspnea, bradycardia and cardiac arrest. The subjects may require resuscitation and respiratory assistance and control of the airway. Hypoperfusion of the respiratory centers in the brainstem can also lead to respiratory arrest. Loss of consciousness accompanied by occurrence of pupillary dilation points towards the diagnosis of Total spinal. It is very short in duration it is not uncommon for the subjects to recover from total spinal completely at the end of the surgery. After controlling the airway and with the subject in mechanical ventilation, proper attention should be given to manage the in-heart variations and blood pressure fluctuations. But, under spinal anaesthesia (SA), subjects are at increased risk of respiratory depression and are more sensitive to sedation. It is also difficult to resuscitate subjects under SA, as these subjects are vasodilated and do not have respond appropriately to the conventional doses of vasopressor drugs that are commonly used in the Traditional Advanced Cardiac Life Support algorithms.

It reflects the changed pathophysiological pathways that leading to cessation of heart during the perioperative period. [57]

Other likely complications that occur due to the spinal anaesthesia consists of mainly direct injury to spinal nerves, transient neurologic syndrome, neuraxial hematoma, adhesive arachnoiditis and cauda equina syndrome, and post dural puncture headache meningitis. These subjects are also at risk of hypothermia due to vasodilation, loss of thermoregulation. Hence there should be deployment of active warning measures on these subjects, just like what is being done in general anaesthesia.

One of the common complications occurring after an inadvertent puncture of the duramater is Post dural puncture headache, also known as PDPH. It occurs commonly in younger age groups and is more common in females compared to males. Other is factors include pregnancy, a lower BMI and vaginal delivery. The technique used to administer SA, the needle size, and the design of the needle all influence how rapidly PDPH arises .[58] Its incidence has been reported at about 1%.[58, 59] It is characterized and diagnosed by a typical postural headache, that gets severe on standing or sitting, while it tends to improve on sleeping or lying down. A proper diagnosis and management is necessary as it PDPH can be incapacitating.

C. LACUNAE OF LITERATURE:

Only sparse literature is available that involves successful utilization of lumbar ultrasound imaging by resident anaesthesiologists for performing neuraxial blockade.[10] The use of USG by anaesthetists has become familiar for getting venous access and in providing anesthesia regionally. The evidence regarding role of USG in SAB is emerging, especially in subjects with anatomical landmarks, that are impalpable.[29, 30] Hence there is a need to evaluate role of preprocedural lumbar ultrasound scan in performing subarachnoid block on comparison with traditional approach.

D. MOST RELEVANT STUDIES:

Creamery M et al. (2016) did their RCT on 20 women undergoing cesarean deliveries with complex lumbar spinous processes which aren’t palpable. They compared pre-procedural lumbar USG with palpation of landmark for locating needle point. They discovered that the mean (SD) BMI of the two groups did not differ (ultrasonic 39.1 5.02 kg/m2 vs. palpation 38.3 3.77 kg/m2). When compared to the palpation group. The ultrasound group had significantly fewer needle passes of median 3.0 with interquartile range of 1.8-3.2 (P=0.03). The ultrasound (UG) group took longer to detect the needle insertion site (ultrasound range of (91.8 -30.8) s vs. palpation range of (32.6 - 11.4 s), P 0.001 which is statistcally significant. The entire procedure time for both groups was the same (ultrasound in the range of (191.8 - 49.4) vs. palpation in the range of (192 -110.9 s,) P=0.99). this is not statiscally significant

This study recorded that USG can decrease number of needle redirections without affecting the overall time taken for the procedure.[60]

Sahin T et al[61] (2014) did their study on 100 parturients who underwent caesarean delivery with ultrasound guided spinal anaesthesia assessed the outcomes in both obese and lean patients. One hundred parturients, out of which 50 of whom were thin (BMI 30 kg/m(2)) and the other half of 50 of whom were obese (BMI 30 kg/m(2)) and, were randomized into ultrasonography and control groups. In lean parturients (group 1, n = 25) and obese parturients (group 2, n = 25), subarachnoid block was performed with a prepuncture ultrasound examination. In thin patients (group 3) and obese patients (group 4,) SAB was performed using a conventional technique with a paramedian approach. Primary objectives were number of needle attempts and puncture levels. Ultrasound (US) groups (p 0.001) outperformed with fewer puncture attempts and higher puncture levels. Following USG supervision, the very first trial success rate in obese patients was 92%, compared to 44% when using a conventional technique (p 0.001). The intercristal line was found in 52% of lean individuals and 54.2% of obese patients, respectively, at the L3-L4 and L2-L3 interspaces. The spinal surgery required less time in the US groups (22 vs. 52 s, p = 0.031). They identified a substantial correlation between ultrasonography and needle depth (r = 0.709, p 0.001).

Li M.,et al[62] (2019) did a RCT on 80 obese parturients undergoing cesarean deliveries to compare between USG assisted technology and palpation of conventional landmarks technique . They received a pre-procedure ultrasound assessment (ultrasound group, n = 40) or even the standard landmark-guided procedure (landmark group, n = 40). Each individual received spinal anesthesia while in the lateral position. The ultrasonography group had a considerably higher first-try success rate (87.5% vs. 52.5%; P =.001), fewer patients requiring >10 needle attempts (1 vs. 17; P =.001), and fewer skin punctures and needle passes (P .001 for both). The first-try success rate for the ultrasonography group was much higher (87.5% vs. 52.5%; P =.001), there were fewer instances requiring >10 needle attempts (1 vs. 17; P.001), and there were also fewer skin punctures and needle passes (P .001 for both). The entire procedure time for both groups was the same (ultrasound in the range of (191.8 -49.4) vs palpation in the range of (192 -110.9 s,) P=0.99). this is not statically significant

Furthermore, the ultrasonography group took longer time to locate the needle insertion site (P =.001). The ultrasonography group had a significantly better percentage of first-attempt success (P.041), fewer cases with more than 10 needle passes (P.01), and shorter procedure timelines, including the time required to determine the needle insertion spot (P.001).

They observed improved success rate in first attempt, less puncture attempts and needed passes, shortened time of the procedure in total and improved satisfaction of the patient in pre-procedural ultrasound examination group.

Ray TK et al[63] (2022) in their study evaluated conventional landmark vs pre-procedural USG landmark assessment by paramedian approach for SAB . The trial included sixty senior patients aged 60 and up who had agreed to have invasive procedures with spinal anaesthesia. Participants were allocated at random to either conventional landmark guidance (Group PG) or preprocedural ultrasound-assisted (Group UG) spinal anaesthesia. The number of needle redirections was not substantial, and the ultrasound group outperformed the landmark group in terms of success rates on

the first attempt with no redirection. Preprocedural ultrasound-assisted method took barely any less time to administer spinal anaesthesia than landmark-guided method ([67.65] vs. [50.19]; (P = 0.90). Both the periprocedural pain levels (2.90[2.07] vs. 2.87[1.57]) and desire for a similar future intervention (66.7 vs. 66.7%) were comparable between the groups.Participants were allocated at random to either conventional landmark guidance (Group PG) or preprocedural ultrasound-assisted (Group UG) spinal anaesthesia
They concluded that there was no clear superior benefit in use of Pre-procedure USG on comparison with conventional approach of landmark assessment by paramedian approach for lumbar spinal anesthesia in geriatric population and its use can be advocated only in settings where the use of conventional approach can be challenging technically.

Kalagara H et al[38] in their review article on evidence based recommendations observed that.. The interlaminar space, midline, vertebral level, and depth of the all spaces can be identified. Ultrasound imaging allows for the planning of an ideal trajectory for a successful block and also offers details on the ideal approach angle and direction. These advantages are especially pronounced for patients with expected complex spinal architecture and when experienced operators do the ultrasound evaluation. According to recent research, they noted, pre-procedural neuraxial ultrasound imaging may lessen issues including vascular puncture, headaches, and backaches. They recommended that the use of neuraxial imaging, before the procedure should be done routinely.

Chin KJ et al[34] (2011) conducted a study on 120 orthopaedic subjects, who were obese and had spinous processes, which were poorly palpable. 120 orthopaedic patients with BMI > 35 kg/m^2 and difficult spinous processes, severe lumbar scoliosis, or a operated lumbar spine surgery were recruited. Patients were randomly allocated to receive spinal anaesthesia using the traditional surface landmark-guided method (group LM) or an ultrasound-guided technique (group US) Patients in group

US got a preprocedural ultrasound assessment to locate and designate an appropriate needle insertion position. According to their findings, group US had a twice as high first-attempt success rate as group LM (65% vs. 32%). (P 0.001). There was a twofold difference in the number of needle insertion tries (group US, 1 [1-2] vs. group LM, 2 [1-4]; P 0.001). The needle passes (group US, 6 [1-10] vs. group LM, 13 [5-21]; P = 0.003). The group US required more time to construct landmarks (6.7 3.1 vs. group LM, 0.6 0.5 min; P 0.001), although this was partially offset by a shorter spinal anaesthetic performance time (5.0 4.9 vs. group LM, 7.3 7.6 min; P = 0.038). Individuals with BMIs > 35 kg/m and patients having barely discernible landmarks had similar findings in subgroup studies. They recorded that in USG group on comparison with conventional LM group, the rate of first-attempt success was two times higher. They also concluded that use of USG in subjects with difficult landmarks, before the procedure enhances the spinal anaesthesia performance in non-obstetric subjects.

Chong SE et al[64] (2017) did a RCT on sixty subjects and compared USG with Palpation guidance on efficacy of paramedian spinal anaesthesia. The patients' age is from 18 to 75, BMI of 30 kg/m2). The operative limb was placed at the dependent site in all patients. The UG (ultrasound guidance) had a greater rate of successful initial tries (87 vs 43%, P0.001) than the PG-Palpation Guidance (87 vs 43%, P0.001). In the UG, single needle attempts were similarly more successful (47 vs 20%, P=0.028). The UG required less time for a successful dural puncture [0.69 (1.01) versus 1.60 (1.19) min, P=0.002]. It was concluded that with the use of real-time USG , spinal anaesthesia (paramedian approach) rate of success can be improved and it is known to reduce the number of attempts . The dural puncture time was also shortened and the single needle pass success rate was also improved.

Canturk M et al[65] (2020) conducted a study on 100 non pregnant ASA I to III subjects for estimating the Epidural space depth using pre-procedural ultrasound scan. The distance between the marker and the needle tip was used to determine the ND, or real epidural depth. The L3–4 intervertebral space was used for all epidural placements, and a sterile marker was used to identify the epidural needle. At the L3-4 intervertebral space, the ED/TM and ED/PSO (skin to epidural space depth in TM plane and paramedian sagittal oblique PSO plane) were measured using a 2-5 MHz curved array probe. The dimensions of the ND were 48.986.91 mm, ED/PSO were 48.926.91 mm, and ED/TM were 48.906.91 mm. With regard to ND and ED/PSO, the Pearson correlation coefficient was 0.995 (p 0.001) and 0.994 (p 0.001) with regard to ED/TM. They concluded that Paramedian Sagittal Oblique (PSO) plane was comparable to Transverse median (TM) plane in accurately estimating the epidural depth.

Kallidaikurichi Srinivasan K et al[4] (2015) compared the use of USG before the procedure in paramedian approach for administration of spinal anaesthesia with the conventionally used approach of Landmark guided administration in midline. The preprocedural ultrasound-guided paramedian approach and group C (conventional) were randomly assigned to 50 each out of the patients were not aware of which group they were in. An anesthesiologist consultant gave all spinal anaesthetics. In group C, spinal anaesthesia was being administered via a midline technique and clinically palpated landmarks. In group P, a preprocedural ultrasound scan was used to mark the paramedian insertion location, and spinal anaesthesia was administered via the paramedian method. Average passes in group P were almost 0.34 times higher than in group C, which is a statistically significant difference (P = 0.01). Likely 0.25 times as many attempts were made on average in group P compared to group C (P = 0.0021). Group P required 81.5 (99% confidence interval, 68.4-97 seconds) more time than group C to properly identify the landmarks on average (P = 0.0002). All other characteristics were identical across the two groups, including scores for periprocedural pain, periprocedural patient discomfort on a visual analogue scale, conversion to general anaesthesia, paraesthesia, and radicular pain during needle insertion. They came to the conclusion that using a USG examination prior to knee replacement surgery could greatly minimise the required number of attempts and passes for

SAB in participants.

Ghosh SM et al[39] (2015) in their review article observed that in subjects with difficult anatomical landmarks in the spine, USG guided neuraxial block is effective. They also recommended that the anaesthetists should get used to the procedure of employing USG for assisting neuraxial block.

MATERIALS AND METHODS:

DATA COLLECTION :

This study encompassed patients admitted for surgical procedures under spinal anesthesia. in anesthesia department at R. L. Jalappa Hospital and Research centre, Tamaka, Kolar.

- Study Design: Randomized prospective single blinded study.
- Sample Size: 150 [4] Patients were allocated into two groups. A total of 22 resident anaesthesiologists were divided into two groups at random, with each resident performing spinal anaesthesia on five patients.
- Power 0.8 and alpha error <5%, parameter like rate of successful first attempt dural puncture between the two group, sample size can be calculated
- Duration of study: From January 2021 to July 2022.
- Sampling Method: Allocation of patients as well as resident anaesthesiologists into both groups were done using Computer generated random number tables.

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2 / \kappa)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_2 = \frac{(\kappa * \sigma_1^2 + \sigma_2^2)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

The notation for the formulae are:

n_1 = sample size of Group 1

n_2 = sample size of Group 2

σ_1 = standard deviation of Group 1

σ_2 = standard deviation of Group 2

Δ = difference in group means

κ = ratio = n_2/n_1

$Z_{1-\alpha/2}$ = two-sided Z value (eg. Z=1.96 for 95% confidence interval).

$Z_{1-\beta}$ = power

METHOD OF COLLECTION OF DATA:

INCLUSION CRITERIA:

- Patients among age group (18 to 70) years old with a BMI of range of 18.5 - 30 kg/m^2 and a ASA physical status 1 or 2 undergoing abdominal surgeries and lower limb procedures under spinal anaesthesia.
- Anaesthesiology residents who almost had completed one year of the residency program were included in this study.

EXCLUSION CRITERIA

- Patients who refused to be included in the following study

- Contraindicated for spinal anaesthesia such as infection at the site of injection, hypovolemia, allergy to local anaesthetics, raised intracranial pressure, coagulopathies and fixed cardiac output conditions
- Anaesthesiology residents who have already been proficient with paramedian approach to subarachnoid block i. e. who have already performed more than 10 times

METHODOLOGY:

After receiving Institutional Ethical Committee (IEC) approval, this study was carried out in anesthesiology department at R.L. Jalappa hospital. Prior to the start of the investigation, permission was sought.

Following informed consent, patients were to randomized one of two study groups using a randomization schedule which was generated by computer:
conventional paramedian technique (group PG), pre-procedural US-guided paramedian technique (group UG). Following study has a limitation as it was impossible to blind the residents doing procedure and the data collector. Only the patients were informed of the study's existence. 22 residents were separated into groups of five, with each group performing five students [5].

Group Ultrasound Guidance (UG): Residents in this group were taught how to use a Paramedian Sagittal Oblique (PSO) plane to locate the L3-L4 intervertebral space and visualize the intrathecal space between the Ligamentum Flavum-Dura Mater (LFD) complex and the Posterior Longitudinal Ligament (PLL). The sacrum was identified and the interlaminar space between L5 and S1 was found after getting a paramedian sagittal oblique image of the neuraxis. Interlaminar spaces were counted from below downwards, each interlaminar spaces corresponds to following laminar spaces. The point of needle insertion was indicated on the surface, and the needle's direction was recorded. The interspinous area, which clearly shows the anterior (ligamentum flavum dura complex [LFD]) and posterior (posterior longitudinal complex [PLC]) complexes.

Group Palpation Guidance (PG): In this group, the residents were taught using didactic lectures, the performance of paramedian subarachnoid block using palpation of landmarks. After confirming the correct interspinous space, The needle was then inserted 1 cm lateral and inferior to the corresponding interspace, which goes cephalic and medially angled. In order to extract cerebrospinal fluid, the needle was moved toward the cephalic direction after making contact with the lamina and then progressively advanced into the subarachnoid area.

Using a computer-generated random number table, patients who met the above mentioned inclusion and exclusion criteria were also randomized to either of the 2 aforementioned groups.
On considering the study nature and settings, it was not possible to blind the anaesthesia residents, who performed the procedure. The observer who collected the data was also not blinded.

After performing immediate pre anaesthetic evaluation and shifting the patient on to the operation table, Standard monitoring of Noninvasive blood pressure (NIBP), 5 electrode Electrocardiogram (ECG) and Oxygen saturation (SpO2) were documented and intravenous access secured.
Patients were made to sit in comfortable position for performing preprocedural USG for doing markings for paramedian, and surface marking was performed under the direct supervision of a consultant anaesthesiologist.

Strict asepsis was maintained while performing subarachnoid block. Skin infiltration with 2 % Lignocaine was done at the point of needle insertion. A 25 G Quincke-Babcock spinal needle was used to perform the block using any of the techniques mentioned above based on group allocation.

After confirming the correct position of the needle by aspirating clear cerebrospinal fluid (CSF), pre-determined dose of 0.5% Bupivacaine Heavy was injected and the patient were positioned supine and level of block achieved was noted.

Parameters observed:

1. Successful dural puncture in the first attempt.

2. Number of needle attempts required for successful dural puncture.
    - A subsequent needle attempt is described as the complete withdrawal of the Spinal needle from the following structures followed by reinsertion.
    - The resident was allowed a maximum of three attempts to perform the block, and if failed, the block was performed by the consultant anaesthesiologist.

3. Number of needle redirections
    - A needle redirection is described as a partial withdrawal of the needle from the patient's skin as well as a shift in the needle's course of insertion.

- No more than 6 needle redirections were permitted in each attempt.

4. Total amount of time taken to perform the spinal anaesthesia: identified as The time from the first insertion of the spinal needle till withdrawal of the spinal needle after intrathecal injection of the anaesthetic solution .

5. The patient's satisfaction score: very good, good, satisfactory or poor.

6. Periprocedural Pain score – scoring was given by patients immediately after achieving the spinal block completion on a Visual Analog scale from 0 to 10 for the procedure (0- no pain, 10- worst pain)

7. Success of spinal anesthesia - identified as a sensory block level above T10 within 30 minutes of administration of the local anaesthetic.

8. Required the senior consultant's verbal assistance while the resident performs the procedure

9. Complications such as bloody tap or paresthesia.

STATISTICAL ANALYSIS:

- The sample size will be calculated based on a 20% difference in the percentage of successful first attempt dural puncture (main goal) between the two groups, with a target power of 80% and a Type 1 error rate of 5%.

- The major outcome variables were Dural Puncture, Number of Attempt, Number of Needle Direction, Time Taken (Sec), Success, and Bloody Tap. Study Group (USG Group Vs Palpation Group) was considered as Primary explanatory variable. Socio-demographic data and clinical variables formed the group of explanatory variables.

- Diagrams like pie diagram, cluster bar chart and boxplot were used to represent the data wherever appropriate.

- The main result was a dural puncture that performed well on the first attempt., which will be presented in figures and percentages.

- The Chi square test will be used for inferential analysis. When necessary, Fisher's exact test will be applied

- Numbers and percentages will be used to describe them. Chi square test inferential analysis will be carried out. When appropriate, Fisher's exact test will be utilised
- For data which do not follow a normal distribution like no. of attempts, no. of redirections, and pain scores, descriptive characteristics will be expressed as medians with interquartile range (IQR). Inferential analysis will be done with Mann-Whitney U-test.
- For data which are continuous, like the time needed for performing spinal anaesthesia, descriptive characteristics will be expressed as Mean ± Standard deviation. ANOVA (Analysis of variance) and independent sample t-tests will be performed.
- The level of statistical significance was set at 0.05.
- All the quantitative measures will be presented by (Mean+/-SD), Confidence interval (C.I.) and qualitative measures like gender, ASA Physical status etc.…by proportions and CI
- CoGuide software was used to analyse the data:

1. BDSS Corporation, 2020. BDSS Corp., India, coGuide Statistics software, Version 1.0.

Results:

In our study 150 patients posted for surgery under spinal anaesthesia were allocated into two groups GROUP UG (Ultrasound paramedian) and GROUP PG (Paramedian blind). Following are results obtained after statistical analysis (TABLE: 1)

Among the study population, 75 (50.00%) participants were in Group (UG Group) and 75 (50.00%) participants were in Group (P Group). (Table 1)

Table 1: Descriptive analysis among the study population (N=150)

Study Groups	Frequency	Percentage
Groups (UG)	75	50.00%
Groups (PG)	75	50.00%

Table 2 compares age distribution between the groups UG and PG. There is significant statistical difference in age distribution between the two groups.

Table 2: Comparison of Age among Study Groups (N=150)

Age	Group		P Value
	UG (N=75)	PG (N=75)	
	Mean ± SD	Mean ± SD	
	41.39 ± 12.28	51.69 ± 15.23	<0.001

Table 3 and figure 2 compares gender distribution between the groups UG and PG. There is significant statistical difference in gender distribution between the 2 groups.

Table 3: Comparison of Gender with Study Group in the study population (N=150)

Gender	Group		Chi square value	P value
	UG (N=75)	PG (N=75)		
Male	41 (54.67%)	48 (64.00%)	1.35	0.2446
Female	34 (45.33%)	27 (36.00%)		

.

Figure 2: Cluster Bar chart of Comparison of Gender among study groups (N=150)

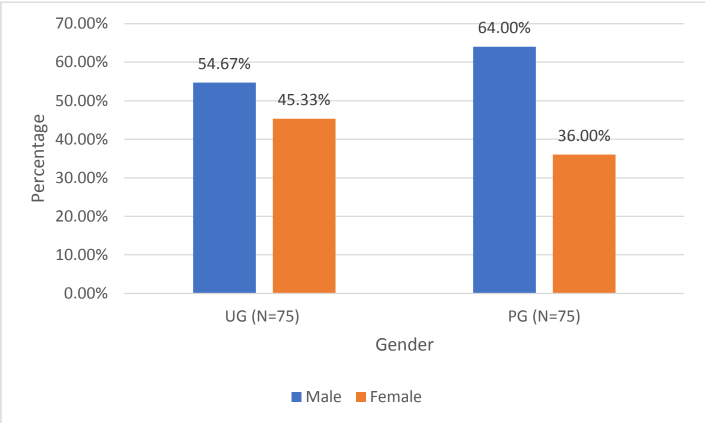


Table 4 and figure 3 shows comparisons of successful dural puncture in first attempt among the two groups

Among Group 1, 37 (49.33%) participants were successful in perfoming dural puncture in first attempt and among Group 2, 26 (34.67%) participants were successful in perfoming dural puncture in first attempt . (Table 4 & Figure 3). There is no statistical difference between the two groups with respect to the successful dural puncture in 1st attempt.

Table 4: Comparison of Successful dural puncture in 1st attempt

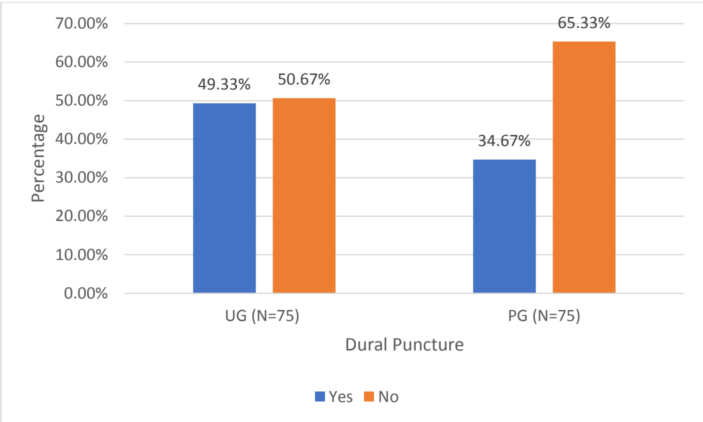
{1=yes, 2=no}

Dural Puncture	**Study Group**		**Chi square value**	**P Value**
	Group 1 (N=75)	**Group 2 (N=75)**		
Yes	37 (49.33%)	26 (34.67%)	3.31	0.0688
No	38 (50.67%)	49 (65.33%)		

No Test is Applicable due to the nature of the data because of the zero-cell value

Figure 3: Cluster Bar chart of Comparison of Dural Puncture among the Study Groups

(N=150)



The total number of attempts in Group UG was around the median of 2 with an interquartile range of 1.0 to 2.0. In group (PG) the median value was 2 with an interquartile range of 1.0 to 2.5. The p-value of 0.098 was obtained with respect to the total number of attempts which is statistically not significant.

(Table 5 and Figure 4)

Table 5: Comparison of Total No of Attempts among the study groups (N=150)

Parameter	Total No of Attempts	Mann Whitney U Test (P Value)
	Median (IQR)	
UG (N=75)	2.00(1.0 to 2.0)	0.0908
PG (N=75)	2.00(1.0 to 2.5)	

Figure 4: Boxplot of Comparison of Number of Attempt among study groups (N=150)

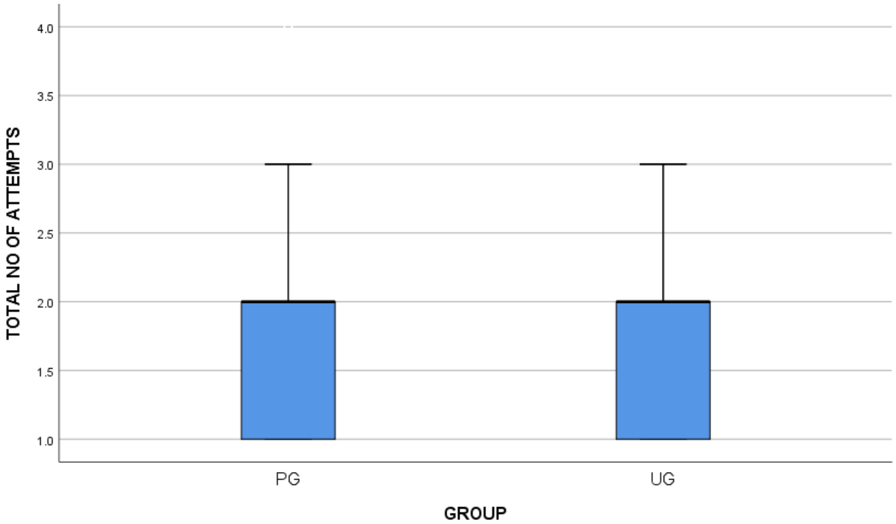


TABLE 6:

Number Of Attempts For Successful Dural Puncture

ATTEMPTS	UG GROUP	PG GROUP
1	35	22
2	31	34
3	4	10
4	0	9

In group UG, the total number of redirections where around the median of 2.00 with an interquartile range of 2.0 to 2.0. In group PG, the median was 2.00 with an interquatile range of 1.0 to 2.0. The p-value of 0.0095, was obtained which is statistically significant. The group PG has fewer redirections when compared to group UG (Table 7 and Figure 5)

Table 7: Comparison of Total No of Redirections among Study Groups (N=150)

Parameter	Total No of Redirections	Mann Whitney U Test (P Value)
	Median (IQR)	
UG (N=75)	2.00(2.0 to 2.0)	0.0095
PG (N=75)	2.00(1.0 to 2.0)	

Figure 5: Boxplot of Comparison of Total No of Redirections among Study Groups (N=150)

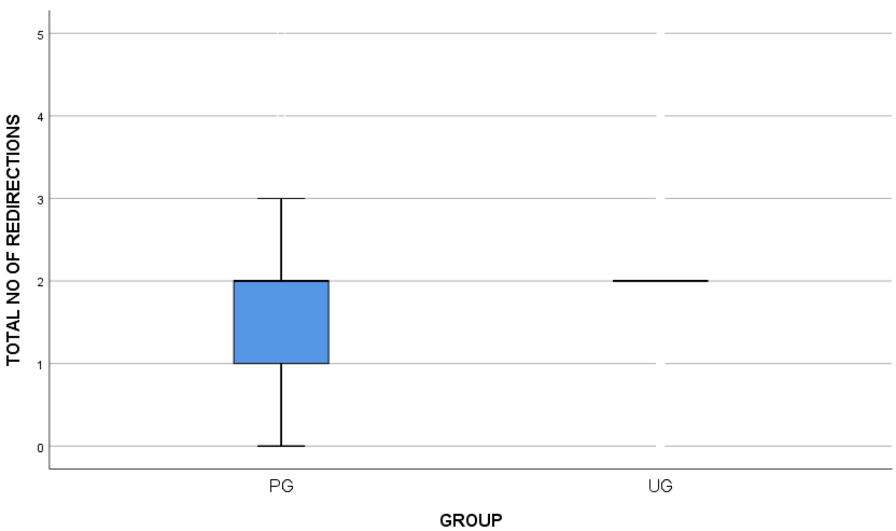


TABLE 8:
ANALYSIS OF NUMBER OF REDIRECTIONS:

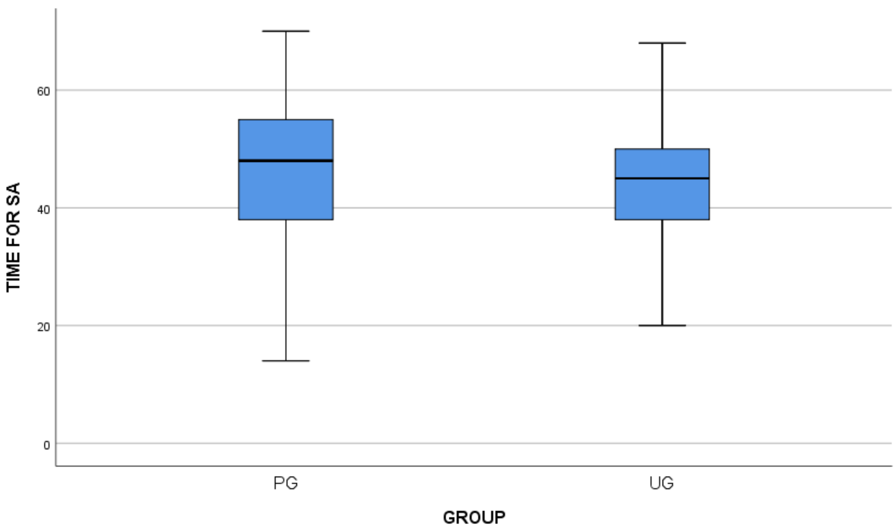
NUMBER OF REDIRECTIONS	UG	PG
0	5	9
1	12	23
2	46	26
3	7	7
4	0	2
5	1	1

In group UG, the time for spinal anesthesia was around 45.00 secs (38.0 to 49.5) and in group PG, the median value was 48.00 secs (38.0 to 55.0) with a p-value of 0.0464, which is statistically significant. Group UG has taken lesser time for performing spinal anaesthesia. (Table 9 and Figure 6)

Table 9: Comparison of time for SA among Study Groups (N=150)

Parameter	Time for SA Median (IQR)(secs)	Mann Whitney U Test (P Value)
UG (N=75)	45.00(38.0 to 49.5)	0.0464
PG (N=75)	48.00(38.0 to 55.0)	

Figure 6: Boxplot of Comparison of Time for SA among Study Group (N=150)



Overall patient satisfaction score was obtained after the procedure. In Group UG 48 (64.00%) participants had good patient satisfaction. In Group PG, 1 (1.33%) participant had good patient satisfaction. (Table 10 & Figure 6)

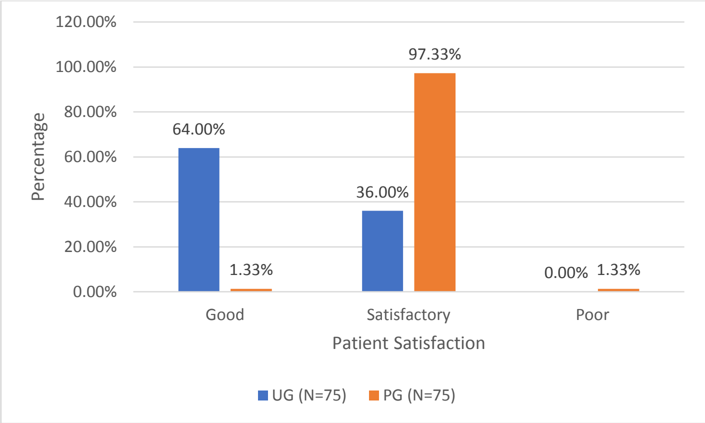
Table 10: Comparison of Patient satisfaction among Study Groups (N=150)

Patient satisfaction	Study Group		P Value
	Group 1 (N=75)	Group 2 (N=75)	
Good	48 (64.00%)	1 (1.33%)	*

Satisfactory	27 (36.00%)	73 (97.33%)	
Poor	0 (0.00%)	1 (1.33%	

No Test is Applicable due to the nature of the data because of the zero-cell value

Figure 7: Cluster bar chart of Comparison of Patient satisfaction among Study Groups (N=150)



In group UG, visual analog scale values were around 4.00(4.0 to 4.0) and in group PG the score was 3.00 (3.0 to 4.0) with a p-value of 0.001, which is statistically significant, Group UG has a slightly higher pain score when compared to group PG. This value though statistically significant does not appear significant clinically. (Table 11 and Figure 8)

Table 11: Comparison of Visual Analog scale among Study Groups (N=150)

Parameter	Visual Analog scale	Mann Whitney U Test (P Value)
	Median (IQR)	

UG (N=75)	4.00(4.0 to 4.0)	<0.001
PG (N=75)	3.00(3.0 to 4.0)	

Figure 8: Cluster bar chart of Comparison of Visual Analog scale among Study Groups (N=150)

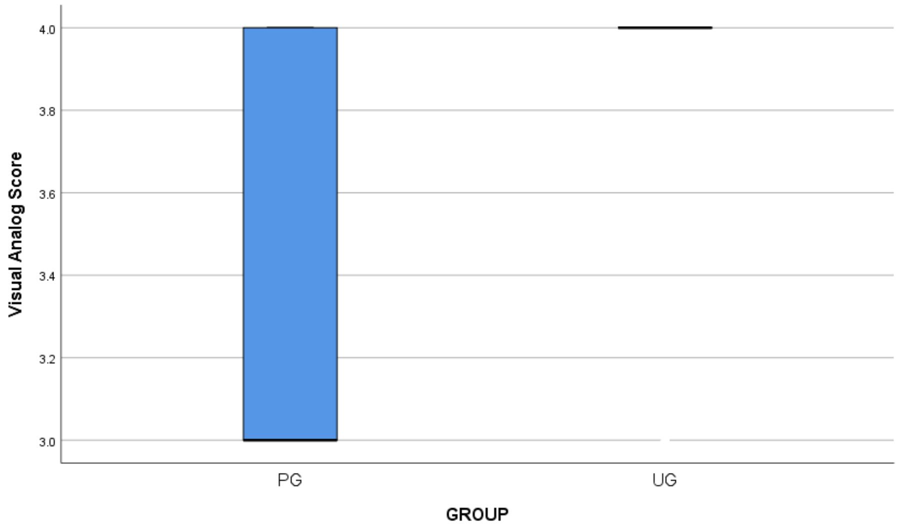


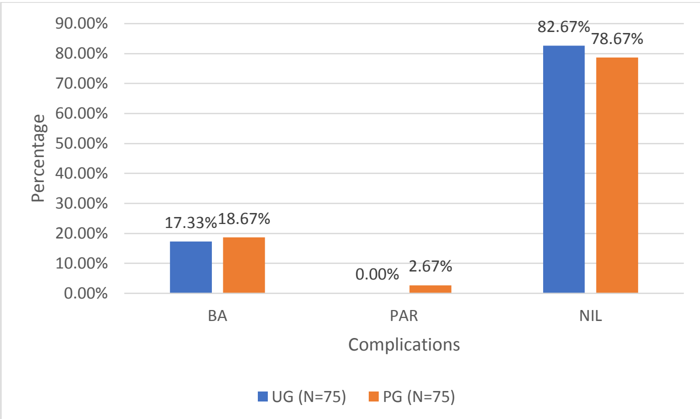
Table 12: Comparison of Complication among Study Groups (N=150)

Complications	Study Group		P Value
	UG (N=75)	**PG (N=75)**	
BA	13 (17.33%)	14 (18.67%)	*
PAR	0 (0.00%)	2 (2.67%)	
NIL	62 (82.67%)	59 (78.67%)	

***No Test is Applicable due to the nature of the data because of the zero-cell value**

In group UG, complications were around bloody tap 13 (17.3%), paraesthesia 0% and in group PG the score were around bloody tap 14 (18.67%) , paraesthesia 2 (2.65%) (Table 12 and Figure 9)

Figure 9: Cluster bar chart of Complications among Study Groups (N=150)



In Group UG and group PG both groups needed verbal assistance (80- 90%) participants were in requirement of verbal assistance. P value is statistically insignificant (Table 13)

Table 13: Comparison of Requirement of verbal assistance among Study Groups (N=150)

	Study Group		Chi square value	P Value
	UG (N=75)	PG (N=75)		
Yes	62 (82.67%)	68 (90.67%)	2.08	0.1495
No	13 (17.33%)	7 (9.33%)		

Discussion:

Spinal anaesthesia has been performed traditionally by palpating the bony landmarks.

Understanding of neuraxial anatomy is essential for administration of spinal anaesthesia and delivery of appropriately dosed anaesthetic into the intrathecal (subarachnoid) space. Successful dura puncture with a single needle pass is the optimal method for delivering spinal anaesthesia. With repeated attempts, there are higher chances of consequences such epidural hematomas, paresthesia, and post-dural puncture headache. Even though the approach used commonly for spinal anaesthesia is conventional midline approach, the paramedian approach is an equally good alternative, as it is less inclined to be affected by the osteoarthritic changes in the spine.[3-5] In order to decrease the morbidity occurring due to multiple attempts and passes, several variations are defined like pre-procedural ultrasound imaging . It has the capability to accurately delineate intervertebral level for puncture to administrator spinal anesthesia. It is possible to determine with accuracy the ideal site for needle insertion for a successful neuraxial block and the depth needed for needle advancement . However, the existing evidence does not support routine use of USG in all patients. As a result, the current investigation was conducted in an Indian tertiary care institute.

Study objectives, sample size and socio-demographic characteristics:

The present study was carried out to determine, whether preprocedural lumbar ultrasound scan can improve first needle insertion attempt success while performing subarachnoid block on comparison with landmark guided approach. The objectives of the following study were similar to that of the studies done by Li M et al[62] (2019), Chong SE et al[64] (2017), Creaney M et al[60] (2016), Sahin T et al[61] (2014) and Chin KJ et al[34] (2011).

A total of 150 subjects undergoing surgeries of the lower abdomen and lower limbs, under spinal anaesthesia were included in the present study. 75 subjects were recruited into Group UG (USG guided group – USG group) and 75 subjects into Group PG (Control or Palpation guided [PG] group). Li M et al[62] (2019), Creaney M et al[60] (2016) and Sahin T et al[61] (2014) in their study included pregnant women scheduled for caesarean section. Chin KJ et al[34] did their study on 120 orthopaedic subjects while Chong SE et al[64] did their study on 60 subjects, who were aged between 18 to 75 years with Body Mass Index ≤ 30 kg/m^2. Chin KJ et al[34] in their study included subjects with Body Mass Index greater than 35 kg/m2 and spinous processes, which were poorly palpable. Sahin T et al[61] did their study on 100 parturients by including 50 thin subjects (BMI <30 kg/m^2) and the other half is 50 obese subjects (BMI ≥30 kg/m^2). Chin KJ et al[34] did their study in Canada, Chong SE et al[64] in Malaysia, Sahin T et al[61] in Turkey, Li M et al[62] in China and Creaney M et al[60] in Ireland.

Out of the 150 subjects, 59.33% were males. The gender distribution was comparable between the groups, 54.67% males in USG guided group compared to 64% males in Palpation guided group. But there was a significant difference in mean age between the groups. The mean age in PG group (51.69 years) was significantly higher than mean age in USG group (41.39 years).

Effectiveness:

The lumbar spine many components can be visualised via USG, from the thoracolumbar fascia through the spinal canal. In the present study, in the USG guided group, half of the subjects (37 subjects) had a successful dural puncture (49.3 %) while in control group, 34.6% (26/75 subjects) had a successful dual puncture. Multiple attempts at successful dural puncture with a single needle pass are related with an increased risk of consequences such as post-dural puncture headache, paresthesia, and epidural hematomas. In the USG guided group, 49.33% had a successful first needle insertion/dural puncture in first attempt, but in control group, only 34.67% had reported success in first attempt. But this difference was not statistically significant. 90.67% required verbal assistance in palpation guided control group compared to only 82.67% in USG guided group. The findings of the present study were similar to the other studies reported in the past substantiating the use of USG guided SAB.

In the paramedian approach, the amount of resistance encountered is small, as supraspinous ligaments and interspinous ligaments are not encountered commonly. 65.33% of subjects did not have a successful dural puncture in 1st attempt in the palpation guided control group[12].

The median number of attempts was 2 with IQR of 1 to 2 in USG guided group compared to 2 attempts with IQR of 1 to 2.5 in control group. There was no significant difference in median number of attempts between the groups. Successful first attempts were higher in the USG than the control group (87 *vs* 43%, *P*<0.001) in the study by Chong SE et al[64]. Additionally, they noticed that the USG group had a greater rate of successful single needle pass (47 vs 20%, P=0.028).Similar results were reported by Conroy PH et al[35] (Indentical reports were reported by conroy PH , succesful first attempt was higher in UG group compared with PG group . (87 % vs 43). Brinkmann S et al[66] had achieved successful needle puncture in 35% of the patients using real-time ultrasound and in 55% in preprocedural ultrasound. . Niazi AU had done a study with results obtained as follows with preprocedural ultrasound success rate was 70% in - the plane approach and 55% in out-of- plane approach.

The use of USG in the study by Creamery M et al. decreased the number of needle passes without increasing the procedure's overall duration. Sahin T et al [60]. found in their study that the ultrasonography group had fewer attempts for puncture. According to Li M et al's[61] study, the ultrasonography group had significantly better first-attempt success rates than the control group (87.5% vs 52.5%; P =.001), fewer cases requiring >10 needle passes (1 vs 17; P.001), and fewer skin punctures and needle passes (P.001 for both) than the control group..

Karthikeyan had conducted a study resulted in number of needle attempts were noted in UG group number was around 8.3 when compared to group C which is conventional midline group which is 4 , this difference was very much significant. Three groups were compared by ricks6, with The primary outcome was successful dural puncture which was higher in groups LM landmark guided (77) followed by UM ultrasound midline (73%) and ultrasound paramedian UP of around 42%. P-value was statistically significant. The US technique required fewer attempts and fewer needle attempts to enter the subarachnoid space, according to Srinivasan 35et al comparison 's of a paramedian vs. a palpation at midline approach for an elderly orthopaedic group.

A similar study conducted by Turkstra 79et al. concluded that there is not much-added advantage of using preprocedural ultrasound by junior residents for doing spinal anesthesia.

In the present study, the median time taken for administering spinal anaesthesia was less in USG guided group (45 seconds) compared to the palpation guided control group (48 seconds). It was statistically significant that the groups had a median difference of 3 seconds. Chong SE et al64 conducted a study. In the following study, the UG group took 0.69 sec less time for dural puncture than the PG group, which took 1.60 min, the P value was statistically significant. This was consistent with the findings of Conroy et al.[35] They observed a time of 1.2 minutes with a range of 0.2 to 15 minutes. A study conducted by ritiz concluded that the time taken to perform the spinal anesthesia was not different between groups LM and UM (87.24 ± 79.51 s and 116.32 ± 98.12 s, respectively) but shorter than in group UP (154.58 ± 91.51 s; $P < 0.001$).

Patient satisfaction

The level of satisfaction of the patients was rated as good by 48% in USG guided(UG) group compared to only one subject (1.33%) rating as good in palpation guided (PG) control group in the present study. The difficulty in administration of spinal anesthesia has correlation with palpability of the surface landmarks. These landmarks may get distorted in subjects who are obese, subjects with previous history of spine surgeries, subjects with spine deformities and subjects having degenerative changes, which are associated with aging.[1, 2] Li M et al in their study observed that the satisfaction scores of the subjects were increased significantly in USG group (p value of 0.001).[62]There was no statistical difference by the study conducted by the Turkshtra et al.[78] in patient satisfaction scores .

Periprocedural pain:

It was analyzed by VAS score in the present study. There was a significant difference in median peri-procedural pain between the groups with higher VAS score of 4 in the USG group compared to only 3 in the PG group. But Ray TK et al in their study observed that peri-procedural pain scores were similar between the groups, 2.9 vs. 2.87 with a p value of 0.94. Also the willingness for a similar intervention in the future was also similar between the groups.[63] They concluded that there was no clear superior benefit in use of Pre-procedure USG on comparison with conventional approach of landmark assessment by paramedian approach for lumbar spinal anesthesia in geriatric population and its use can be advocated only in settings where the use of conventional approach can be challenging technically.

Karthikeyan conducted a study on landmark and ultrasound-guided paramedian in which VAS pain scores were similar in two groups and were statistically insignificant. There was no statistical difference by the study conducted by the Turkshtra[78] et al. preprocedural VAS scores The pre-procedural pain score was higher in UP than in the other two groups as the needle has to pierce the erector spinal muscle, according to ritiz et al [6].

Complications:

The frequency of successful needle manipulations is the key metrics used to quantify the technical challenges associated with administering SA. Complications such as post-dural puncture headache, paresthesia, and epidural hematoma have been linked to an increase in the number of attempts. [2, 3] The optimal method for administering spinal anaesthesia is a successful dural puncture with a single needle pass because additional attempts raise the risk of complications. Kalagara H et al[38] in their review article observed that based on recent evidence, use of neuraxial USG, before the procedure can reduce the rate of occurrence of complications like headache, puncture of the vessels and back pain.

1. **Bloody tap**

In group UG, complications were around bloody tap 13 (17.3%), and in group PG the score were around bloody tap 14 (18.67%) which is stastically not significant .There was no statistical difference by the study conducted by the Turkshtra et al [78] in bloody tap . Increase in number of attempts in UP group had more incidence of bloody tap according to study conducted by ritiz et al[6].

2. **Paresthesia**

No paresthesia was noted in UG group whereas in PG group 2.65% of patients had paresthesia . Paresthesia elicitation is a substantial risk factor for permanent neurologic impairment following spinal anaesthesia. [3, 71]

The USG guided technique also has its limitations. In the populations intended for USG guided dural puncture, there can be restrictions in imaging the vertebral canal on USG. Structures such as the ligamentum flavum, dura mater, and the posterior portion of the vertebral body may be difficult to see. Because of the attenuation that occurs when ultrasound travels a greater distance in soft tissue, identifying structures in obese patients can be challenging. Because of the varying speeds in adipose layers which are irregularly shaped, a phase aberration effect can also occur.[72]

To summarise, ultrasonography guided SAB has the potential to increase the success rate of paramedian spinal anaesthesia. It increases the success rate of single needle pass, reduces the number of attempts required, and reduces the time required to perform a dural puncture.

Conclusions:

Pre-procedural ultrasound imaging determines the optimal intervertebral level, point of needle entry , and depth of needle progression for a successful SAB.

It increases the success rate of dural puncture and the rate of puncture on the first attempt. It also reduces the time required for a dural puncture.The preprocedural US guided paramedian hasn't shown much superiority compared to conventional blind paramedian in the general population

SUMMARY

This was a randomized single blind comparative clinical study conducted on 150 patients undergoing spinal anaesthesia at R L Jalappa Hospital, Department of Anaesthesia, Sri Devaraj Urs Medical College, A Constituent of SDUAHER, Tamaka, Kolar from study period January 2021 to May 2022 after obtaining permission from Institutional Ethical Committee. 150 patients were included in the study who were divided into 75 in each group belonging to Age 18 to 70 years with BMI 18.5-30kg/m^2 and ASA-physical status 1 or 2 undergoing abdominal surgeries and lower limb procedures after obtaining informed consent.

Patients were allocated into two groups: ultrasound guided paramedian and blind paramedian group , randomly . 22 anesthesia residents were divided into 2 groups and prior ultrasound guided paramedian and blind paramedian teaching aid was given to both the residents. Successful dural puncture on first attempt, number of attempts, number of redirections, time taken to perform SAB, verbal assistance and complications were noted.

It was identified that there was no significant difference between the two groups.

Time for spinal anaethesia in ultrasound guided paramedian was less compared to paramedian blind

which was around 3 sec . There is no significant difference in number of needle attempts , number of needle redirections , and verbal assistance . There is no significance in successful dural puncture in first attempt.

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ANNEXURE -1

PROFORMA

Serial No.

Title of the study: Evaluation Of Lumbar Sonography As A Learning Aid For Performing Subarachnoid Block Using Paramedian Approach By Resident Anaesthesiologists

Investigators: Dr Sai Yashaswini G, Dr Sujatha MP

1. UHID No: 2. Age (yrs)

3. Gender : M/ F 4. BMI (kg/m 2)

5. ASA grade:

Diagnosis: Surgery:

Baseline vitals:

Heart Rate: Mean Arterial pressure: SpO2:

Study Parameters:

1. Successful dural puncture in the first attempt – YES / NO

2. Total Number of needle attempts required for successful dural puncture -

(An additional needle attempt is defined as complete withdrawal of the Spinal needle from the skin and subsequent reinsertion.)

3. Total Number of needle redirections -

(A needle redirection is defined as an incomplete withdrawal of the needle from the patient's skin and change in its path of insertion. No more than 6 needle redirections will be permitted in each attempt.)

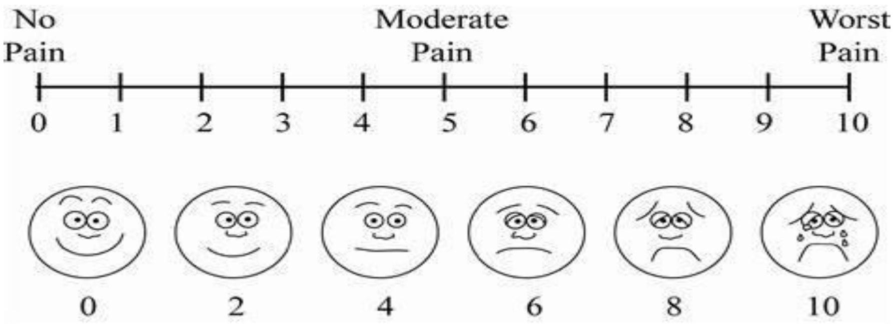
4. Time taken to perform the spinal anesthesia (in minutes):

(defined as the time from the first insertion of the spinal needle till withdrawal of the spinal needle after intrathecal injection of the anaesthetic solution

5. Patient satisfaction immediately after spinal block completion:

1- Very good
2- Good
3- Satisfactory
4- Poor
6. Periprocedural Pain score rated by patients immediately after spinal block completion

6. Visual Analog scale :



7. Success of spinal anesthesia (defined as a sensory block level above T10 within 30 minutes of administration of the local anaesthetic) – YES / NO

8. Requirement of verbal assistance from the attending anesthesiologist while the resident is doing the Procedure- YES / NO

9. Complications :

   a) Bloody tap : YES / NO

   b) Paresthesia : YES / NO

ANNEXURE -

PATIENT INFORMATION SHEET

Patient Information Sheet

Title of the study: Evaluation Of Lumbar Sonography As A Learning Aid For Performing Subarachnoid Block Using Paramedian Approach By Resident Anaesthesiologists"

Study location: R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Details -All Patients posted for surgery under spinal anaesthesia which lasts for less than 2 hours will be included in this study. Patients with co morbid conditions will be excluded from the study. This study aims to determine whether preprocedural lumbar ultrasound scan improves first needle insertion attempt success while performing subarachnoid block by resident anaesthesiologists when compared to landmark guided approach. Patients attenders will be completely explained about the procedure being done that is Ultrasound Guided spinal anesthesia will avoided in patients with contraindications for spinal such as

infection at site if injection, uncorrected hypovolemia , allergy ,increased intracranial pressure , coagulopathy, sepsis , fixed cardiac output states , indeterminate neurological disease ultrasound guided spinal anesthesia through paramedian approach.

Please read the information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study, we will collect information. Relevant history will be taken. This information collected will be used only for dissertation and publication. All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

For further information contact

Dr. Gorle sai yashaswini

Post graduate

Dept of Anaesthesia, SDUMC Kolar

Mobile no: 7093153929

ANNEXURE -3

INFORMED CONSENT FORM

NAME OF THE INSTITUTION: SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

TITLE OF THE PROJECT:

EVALUATION OF LUMBAR SONOGRAPHY AS TEACHING AID FOR PERFORMING SUBARACHNOID BLOCK USING PARAMEDIAN APPROACH BY RESIDENT ANAESTHESIOLOGISTS.

Date:

I, ____ aged _____________ ,after being explained in my own vernacular language about the purpose of the study and the risks and complications of the procedure, hereby give my valid written informed consent without any force or prejudice for using ultrasound guided

spinal anaesthesia through paramedian approach . The nature and risks involved have been explained to me to my satisfaction. I have explained in detail about the study being conducted. I have read the patient information sheet and I have had the opportunity to ask any question. Any question that I have asked, have been answered

to my satisfaction. I consent voluntarily to participate as a participant in this research. I hereby give consent to provide my history, undergo physical examination, undergo the procedure, undergo investigations and provide its results and documents etc to the doctor / institute etc. For academic and scientific purpose, the operation /

procedure, etc may be photographed or photographed. All the data may be published or used for any academic purpose. I will not hold the doctors / institute etc responsible for any untoward consequences during the procedure / study.

A copy of this Informed Consent Form and Patient Information Sheet has been provided to the participant.

____

(Signature & Name of Pt. Attendant)

(Signature/Thumb impression & Name of Patient/Guardian)

(Relation with patient)

Witness 1:

Witness 2:

____

(Signature & Name of Research person /doctor)

KEY TO MASTER CHART

SLNo.	Serial number
M	Male
F	Female
No.	Number
SA	Spinal anesthesia
Pt	Patient
VAS	Visual analogue scale
VA	Verbal anesthesia
BA	Bloody tap
PA	Paresthesia
UG	Ultrasound guided paramedian
PG	Paramedian blind