"ULTRASOUND GUIDED ASSESSMENT OF THE TUFFIER'S LINE DISTANCE FROM L4-L5 INTERSPACE AND ITS CORRELATION BETWEEN ANTHROPOMETRIC MEASUREMENTS OF PATIENTS UNDERGOING SPINAL ANAESTHESIA"

By

Dr. AKHIL KUMAR

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

In partial fulfilment of the requirements for the degree of

DOCTOR OF MEDICINE
IN
ANAESTHESIOLOGY

Under the Guidance of

Dr. RAVI MADHUSUDHANA
Professor
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I hereby declare that this dissertation/thesis entitled **"Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing Spinal Anaesthesia"** is a bonafide and genuine research work carried out by me, under the guidance of **Dr. RAVI MADHUSUDHANA, MBBS, DA, DNB, MNAMS,** Professor, Department of Anaesthesiology and Critical care, Sri Devaraj URS Medical College, Tamaka, Kolar.

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ABSTRACT Background: Spinal anesthesia is a commonly used technique for various surgeries, including those involving the lower extremities and abdomen. The accuracy of identifying the L4-L5 interspace, which is crucial for proper spinal anesthesia, relies heavily on "Tuffier's line, an anatomical landmark formed by connecting the highest points of the iliac crests." However, the variability in the positioning of Tuffier's line across different individuals raises concerns about its accuracy. Ultrasound guidance has emerged as an alternative technique to improve the precision of identifying spinal landmarks. This study aims to assess the accuracy of ultrasound in identifying Tuffier's line and to explore its correlation with various anthropometric measurements, including height, weight, and body mass index (BMI). Objective: The "primary objective of this study was to evaluate the accuracy of Tuffier's line identification through ultrasound in patients undergoing spinal anesthesia. The secondary objective was to determine the correlation between the distance from Tuffier's line to the L4-L5 interspace and anthropometric measurements, such as height, weight, and BMI, in these patients." Methods: This was a "cross-sectional study conducted at R.L. Jalappa Hospital, Kolar, on 100 non-obstetric patients undergoing elective lower abdominal or lower limb surgeries under spinal anesthesia. After obtaining informed consent, participants were subjected to ultrasound for the identification of the L4-L5 interspace, and the distance from Tuffier's line to the L4-L5 interspace was measured. The patients' height, weight, and BMI were recorded, and statistical analysis was performed to examine the correlation between these anthropometric factors and the Tuffier's line distance." The "comparison of distances between male and female

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Date:

Dr. AKHIL KUMAR

Place: Kolar

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ABBREVIATIONS

ASA	American Society of Anaesthesiologists
BMI	Body Mass Index
CM	Centimetre
CSF	Cerebrospinal Fluid
CT	Computed Tomography
CTRI	Clinical Trials Registry
DF	Degrees of Freedom
ECG	Electrocardiogram
IV	Intravenous
L4-L5	Lumbar 4-Lumbar 5 Interspace
MRI	Magnetic Resonance Imaging
P-value	Probability Value
r	Pearson's Correlation Coefficient
R.L.	R.L. Jalappa Hospital
SD	Standard Deviation
US	Ultrasound

ABSTRACT

Background:

Spinal anaesthesia is a commonly used technique for various surgeries, including those involving the lower extremities and abdomen. The accuracy of identifying the L4-L5 interspace, which is crucial for proper spinal anaesthesia, relies heavily on "Tuffier's line, an anatomical landmark formed by connecting the highest points of the iliac crests." However, the variability in the positioning of Tuffier's line across different individuals raises concerns about its accuracy. Ultrasound guidance has emerged as an alternative technique to improve the precision of identifying spinal landmarks. This study aims to assess the accuracy of ultrasound in identifying Tuffier's line and to explore its correlation with various anthropometric measurements, including height, weight, and body mass index (BMI).

Objective:

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Methods:

This was a "cross-sectional study conducted at R.L. Jalappa Hospital, Kolar, on 100 non-obstetric patients undergoing elective lower abdominal or lower limb surgeries under spinal anaesthesia. After obtaining informed consent, participants were subjected to ultrasound for the identification of the L4-L5 interspace, and the distance from Tuffier's line to the L4-L5 interspace was measured. The patients' height, weight, and BMI were recorded, and statistical analysis was performed to examine the correlation between these anthropometric factors and the Tuffier's line distance." The "comparison of distances between male and female participants was conducted using the independent t-test or Mann-Whitney U test based on the data distribution."

Results:

The study revealed that the mean age of the participants was 47.2 years, with 62% of the participants being male. The anthropometric data showed that the mean height of participants was 161.1 cm, with a mean weight of 61.4 kg and an average BMI of 23.7 kg/m^2. The mean distance from Tuffier's line to the L4-L5 interspace was found to be 2.23 cm with a standard deviation of 0.47 cm. A strong positive correlation was observed between height and the distance from Tuffier's line to the L4-L5 interspace (Pearson's $r = 0.936$, $p < 0.001$). However, no significant correlation was found between BMI or weight and the distance from Tuffier's line.

Conclusion:

This study demonstrates that ultrasound-guided identification of Tuffier's line is a highly accurate method for spinal anaesthesia, offering a significant improvement over traditional palpation techniques. The findings suggest that height is an important factor influencing the distance from Tuffier's line to the L4-L5 interspace, with taller individuals typically having a greater distance. This indicates that the accuracy of needle placement may need to be adjusted based on a patient's height. Given the variability in anatomical landmarks, particularly in patients with challenging features, the study advocates for the integration of ultrasound into routine clinical practice to enhance the safety and efficacy of spinal anaesthesia.

Keywords: Spinal Anaesthesia, Ultrasound Guidance, Tuffier's Line, L4-L5 Interspace, Anthropometric Measurements, Precision Medicine

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INTRODUCTION

Spinal Anaesthesia forms a pervasively utilised methodology for lower extremity, lower abdominal, pelvic, and perineal surgical interventions, providing efficacious analgesia and anaesthesia via the “introduction of local anaesthetic agents into the cerebrospinal fluid of the lumbar spine. The principled identification of intervertebral level demarcation is quintessential to ensure procedural efficiency and lessen the potential for spinal cord traumatization. Conventionally, Tuffier’s line, a horizontal differentiation crisscrossing the superior aspect of the posterior iliac crests, has been the principal” anatomical referent for ascertaining appropriate vertebral levels for subarachnoid interventions [1]. Yet, the heterogeneity and subjectivity nature inherent in palpation-predicated identification of this landmark may precipitate consequential complication, encircling discernment of spinal levels and concomitant morbidity.

The progressions in ultrasound technological modalities have smoothed the appearance of a non-invasive, principled, and prompt methodological paradigm to surmount these precursors constraints. Ultrasound guided assessments proffer meticulous localisation of vertebral breakthroughs, including the L4-L5 interspace, thereby enabling anaesthesiologists to optimize procedural outcomes and augment patient safety parameters. This imaging make clear notable reconciling the methodological discrepancy between clinical palpation techniques and radiological evaluations, extending a sudden and accessible anatomical description in real-time clinical contexts.

It has been in stress for the systemic evaluation of the correlation between anthropometric measurements and spatial relationship of the “L4-L5 interspace from Tuffier’s line” employing ultrasonographic methodology originating from its propensity to regulate procedural precision. Existing scholarship have been articulating discordance in vertebral level identification when put next to clinical palpation with radiological or ultrasonographic techniques, stressing incorporation of objective imaging methodologies into quotidian clinical protocols.

Thus, ascertaining the accuracy and reproducibility of ultrasound-guided measurements in defining the “L4-L5 interspace distance from Tuffier’s line and its correlation with anthropometric parameters” in subjects undergoing spinal anaesthesia is crucial and the present study tends to analyse this. Through the said methodological approach, the study contributes to the burgeoning corpus of evidence supporting the integration of ultrasonography into standardized anaesthesia practice, supplementing procedural safety and efficiency for both clinical practitioners and patient populations.

OBJECTIVES

- The **Primary objective** of this study is to evaluate the accuracy of Tuffier's line identification by Ultrasonography of patients undergoing spinal anaesthesia.
- The **Secondary objective** is to determine the Tuffier's line distance from the L4 and L5 interspace and its correlation with Anthropometric measurements of patients, undergoing spinal anaesthesia."

REVIEW OF LITERATURE

Spinal anaesthesia includes a neuraxial blockade methodology wherein local anaesthetic agents are introduced into the subarachnoid milieu, precipitating ephemeral and reversible neural transmission inhibition. The pharmacological substrate fills the cerebrospinal fluid (CSF), stimulating conductive neural blockade principally at the spinal cord echelon [2]. This physiological interruption culminates in an abolition of sensory, motor, and autonomic functionality distal to the injection locus. The inhibitory force clear through the suppression of sodium channel functionality in the interior neural fibres, thus limiting action potential propagation. The effectiveness elements cover multifarious parameters including psychological considerations, concentration gradients and baricity indices of the anaesthetic compound, patient positional orientation, and cerebrospinal fluid rheological dynamics.

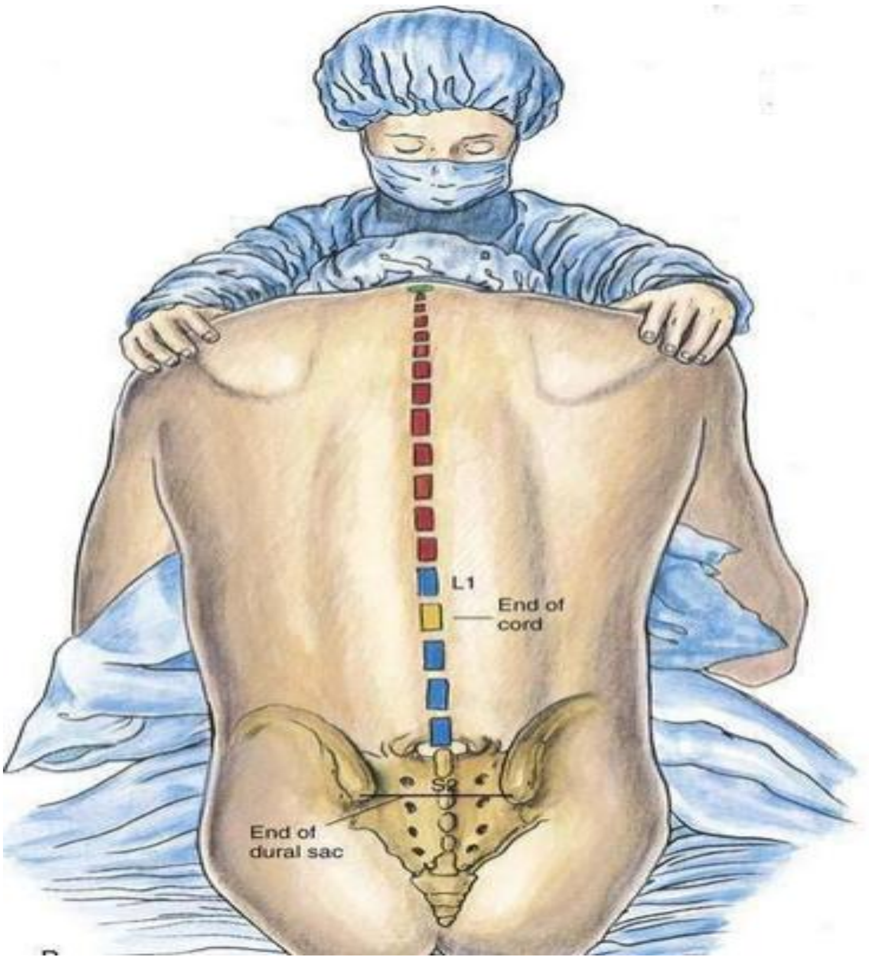


Figure 1: Spinal anaesthesia sitting position

Clinical Applications of Spinal Anaesthesia

The implementation across heterogenous surgical interventions, with particular prevalence in procedures involving the caudal abdominal region, pelvic architecture, perineal structures, and inferior extremities reflects spinal anaesthesia[3]. This neuraxial technique outline extensive utilisation in obstetrical interventions such as caesarean extractions, orthopaedic procedures including total knee arthroplasty and acetabulo femoral joint reconstructions, urological operations showed by transurethral prostatic resection (TURP), and specified inferior abdominal surgical procedure. The methodology confers superlative sensory and motor neural blockade categorised by rapid onset kinetics, foreseeable pharmaco dynamic sequelae, and diminished requisites for systemic anaesthetic modes. Spinal anaesthesia cut across the intraoperative analgesic provision, advancing the effectiveness in postoperative nociceptive mitigation protocols, wither as monotherapeutic interventions or in conjuction with adjunctive pharmacological entities such as opioid derivatives or @2-adrenergic agonists including clonidine [4].

Advantages and Limitations of Spinal Anaesthesia

A cardinal advantage of spinal anaesthesia resides in the circumvention of airway manipulation, notably advantageous in the patient populations presenting with challenging airway anatomical configurations or pulmonary comorbidities[5] This technique reflects intraoperative haemorrhagic sequelae consequent to sympathectomy induced vasodilatory phenomena and decreased venous hemodynamic return. However, spinal anaesthesia also has limitations, including the risk of hypotension due to sympathetic blockade, post-dural puncture headache, transient or permanent neurological complications, and unpredictable duration of effect. Careful patient selection, dose titration, and appropriate positioning can help mitigate these risks.

Importance of Accurate Landmark Identification for Lumbar Puncture

Anatomical Basis of Lumbar Puncture and Spinal Anaesthesia

The lumbar puncture technique relies on the identification of specific anatomical landmarks to ensure safe and accurate needle placement. Traditionally, the iliac crest serves as the primary landmark, “with the imaginary line connecting the highest points of both iliac crests (Tuffier’s line) generally intersecting the L4 vertebral body or the L4-L5 interspace. This anatomical reference is commonly used to guide needle insertion to avoid the conusmedullaris, which terminates at approximately L1 in adults. However, anatomical variations exist among individuals and the reliability of Tuffier’s line” as a consistent landmark is debated.[6]

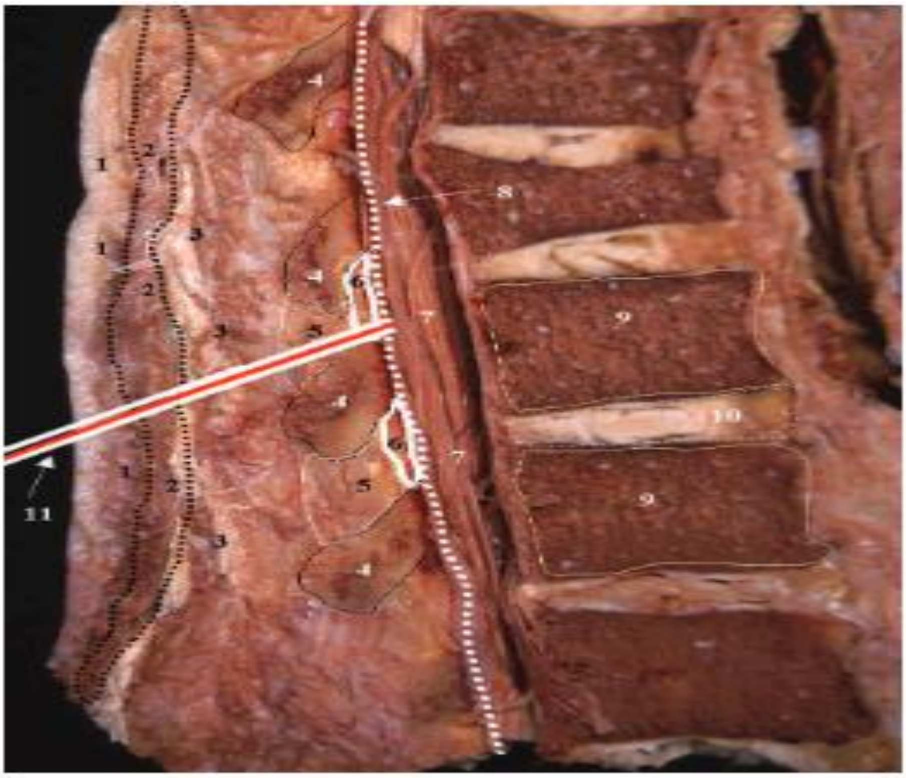
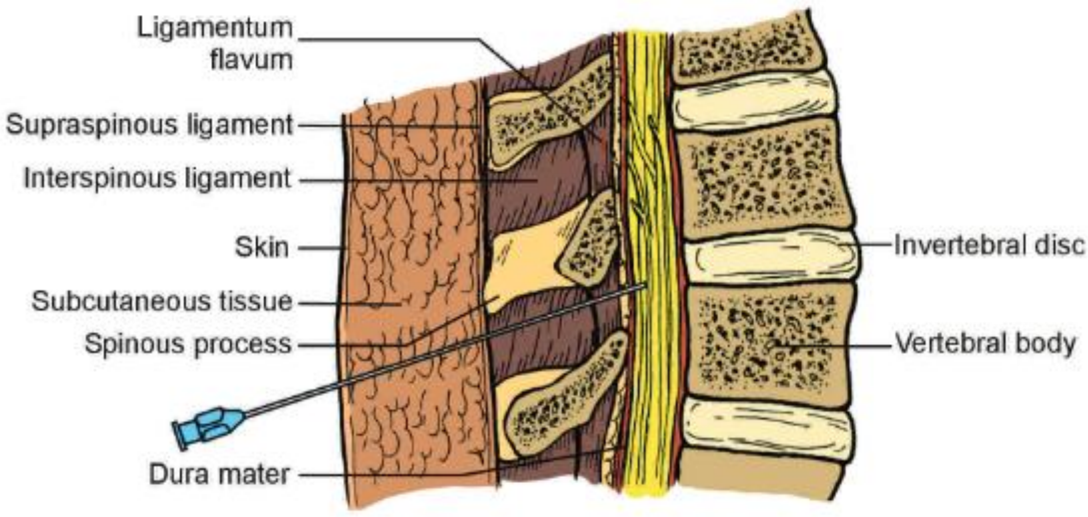


Figure 2: Sagittal section of the lumbar vertebrae illustrating the course of the lumbar puncture needle through skin.



(**1**) Subcutaneous tissue (**2**) supraspinous ligament (**3**) interspinous ligament (**5**) between the spinous processes (**4**), ligamentum flavum (**6**), dura mater (**8**), into the subarachnoid space and between the nerve roots of the cauda equina (**7**), (lumbar vertebral bodies (**9**), intervertebral disc (**10**) and lumbar puncture needle (**11**).

Figure 3: Line drawing of Sagittal section of the lumbar vertebrae with course of lumbar puncture needle.

Impact of Landmark Accuracy on Procedure Success

The implementation of spinal anaesthetic interventions is noticeably based upon identification of the lumbar intervertebral junction to ensure appropriate deposition of anaesthetic agents within the subarachnoid compartment. Imprecise landmark delineation may precipitate multiple needle insertion attempts, protracted procedural duration, and heightened patient discomfort. Unsuccessful localisation of the subarachnoid space can culminate in inadequate of failed spinal anaesthesia methodologies. Also, erroneous interspace identification may augment the risk of spinal corps traumatization if needle insertion occurs at a more cephalad level than intended.

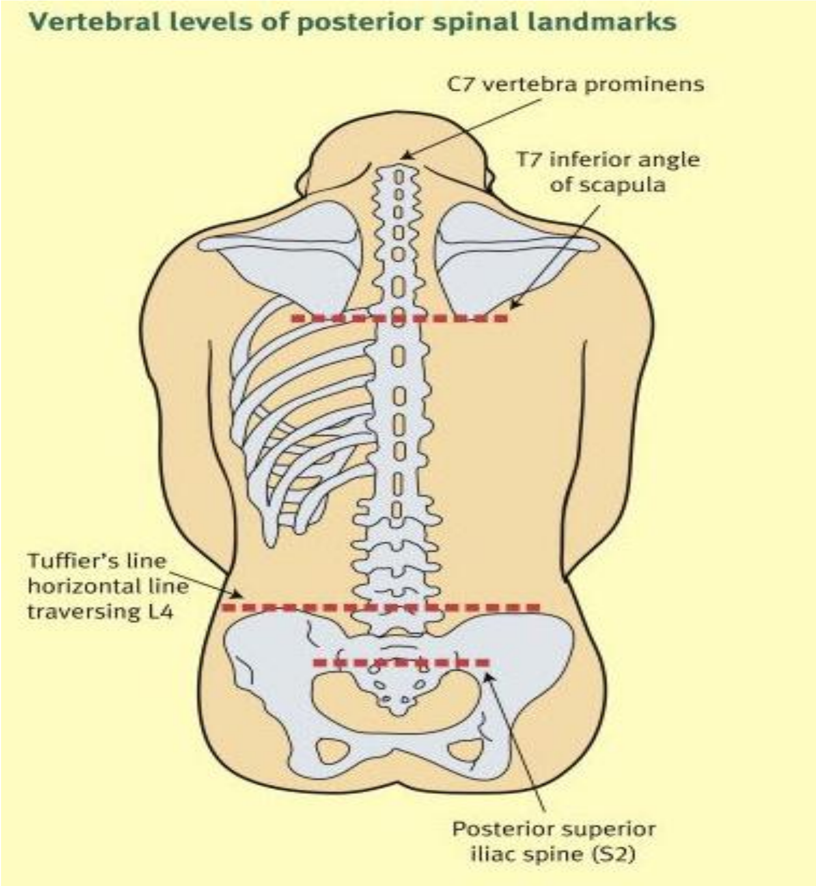


Figure 4: Tuffier's line, which connects the highest points of the iliac crests, to landmark space between 4th and 5th lumbar vertebrae for spinal anaesthesia.

Complications Associated with Incorrect Landmark Identification

Inaccurate palpation of spinal anatomical landmarks can be complicate including dural puncture failure, traumatic lumbar puncture, and neural injury. Multiple needle pathway rises the probability of post-dural puncture cephalgia consequent to cerebrospinal fluid extraversion. Moreover, unintentional high spinal anaesthesia may result in hemodynamic instability, respiratory compromise, or total spinal anaesthesia, conditions that possess potential life threating situations. Existing discourses shows conventional palpation-based techniques may not consistently correlate with imaging-confirmed spinal levels, leading to erroneous needle placement [7].

Challenges in Traditional Palpation-Based Techniques

Variability in Anatomical Landmarks

Conventional palpation-based methodologies rely upon external anatomical referents, affecting patient-specific factors including adiposity, spinal deformities, or previous surgical interventions. In patients with elevated body mass indices, excessive adipose tissue complicates osseous landmarks, "delaying accurate palpation of the iliac crests and precise estimation of the appropriate lumbar interspace." In geriatric population, degenerative alteration such as osteophyte formation or spinal canal stenosis can modify vertebral alignment, further complicating landmark identification procedures [8].

Limitations of the Tuffier's Line as a Consistent Reference Point

Tuffier's line has its widespread utilisation as an approximation of the L4-L5 interspace, but has inconsistency across varied demographic population [9]. Variability in the position of Tuffier's line has been documented in studies using imaging modalities such as fluoroscopy, MRI, and ultrasound. Research indicates that in some individuals, Tuffier's line aligns with L3-L4 rather than L4-L5, potentially leading to higher-than-intended needle placement. This discrepancy underscores the need for alternative or adjunctive methods to improve accuracy.

Failure Rate and Multiple Needle Attempts

Studies have demonstrated that the failure rate of spinal anaesthesia due to inaccurate palpation ranges from 10% to 30%, particularly in patients with difficult anatomical landmarks. Repeated attempts not only increase patient discomfort but also raise the risk of post-procedural complications. In teaching hospitals, where procedures are often performed by less experienced clinicians, the rate of failed lumbar punctures due to reliance on palpation alone is higher. The lack of tactile feedback in certain patient populations further contributes to procedural difficulty.

Complications Associated with Incorrect Needle Placement

Incorrect identification of the lumbar interspace can lead to needle misplacement, resulting in inadequate analgesia, failed blocks, or unintentional dural puncture. When the spinal needle is inserted too high (e.g., at L2-L3), there is a potential risk of direct spinal cord injury, "which can lead to neurological complications such as transient or permanent nerve damage." If the injection is administered too low, the spread of the anaesthetic may be inadequate, requiring additional interventions. Multiple insertion attempts increase the risk of epidural hematoma, infection, and prolonged procedural time.[10]

Introduction to Ultrasound as a Tool for Improving Precision

Role of Ultrasound in Spinal Anaesthesia

The rise of Ultrasound as an indispensable mode for increasing the precision of lumbar puncture and spinal anaesthesia administration was crucial. In contrast with the conventional palpation methodologies, ultrasonographic assessment eases contemporaneous visualization of lumbar vertebral structures, intervertebral junctions, and contiguous soft tissue architectural elements. Through enabling direct morphological evaluation of spinal anatomical outlines, ultrasound improves procedural precision in needle line and weakens the variability basic to surface landmark-oriented techniques. This imaging modality validates particular utility in patients showing challenging anatomical formations, such as those presenting with adiposity or scoliotic deformities.[11]

Comparison Between Palpation and Ultrasound Guided Techniques

Several works contrast with the "accuracy of palpation versus ultrasound-guided" methodologies for lumbar interspace identification. Pragmatic indication suggests that ultrasonographic guidance pointedly develops initial procedural success rates, reduces needle line iterations, and shortens interventional duration. Ultrasound-facilitated approaches have confirmed superiority in accurately defining the appropriate interspace, chiefly in clinical scenarios where palpation alone displays unreliability. Still, ultrasound-guided interventions have been associated with reduced incidence of adverse sequelae including post-dural puncture cephalgia and traumatic lumbar puncture complications.[12]

Advantages of Ultrasound in Landmark Identification

The advantageous attributes of ultrasonographic assessment in spinal anaesthesia involve greater visualization of vertebral columnar structures, optimized estimation of needle course parameters, and lessened reliance on subjective palpation proficiency. This mode enables the anaesthesiologist to predetermine optimal needle insertion coordinates, angulation, and deepness prior to procedural implementation. Ultrasound also make the way for the identification of anatomical variations, including abnormal vertebral alignment conformations or spinal deformities, which may find the middle ground in the worth of traditional landmark-oriented techniques.

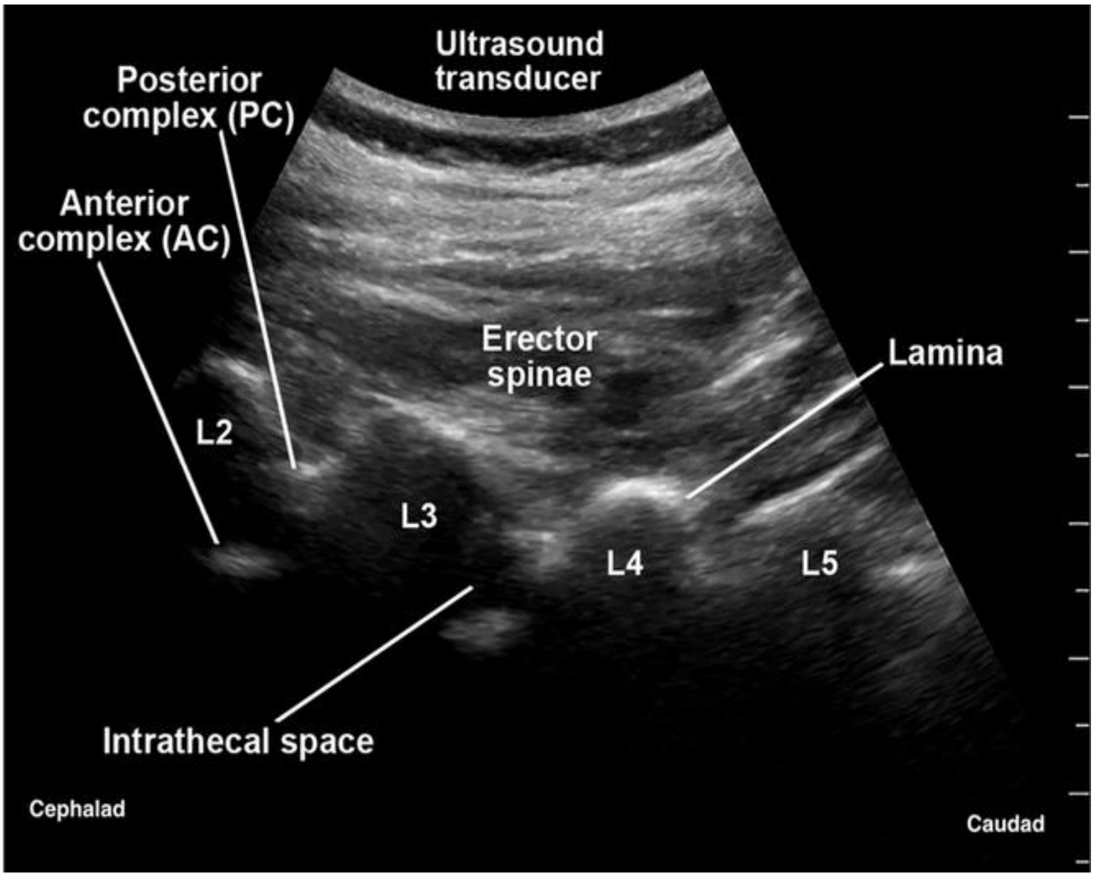


Figure 5: Para sagittal interlaminar ultrasound oblique view.

Spinal Anatomy and Biomechanics

Vertebral Column and Lumbar Spine Anatomy

The vertebral column set up the central axial supportive framework of the human anatomical structure, as long as stability, flexibility, and protective encasement for the spinal cord. It contains 33 vertebrae, written off into cervical, thoracic, lumbar, sacral, and coccygeal segments. Among these divisions, the lumbar region assumes critical functionality in weight-bearing and locomotion. The lumbar segment be made up of five vertebrae (L1-L5), which denote the most voluminous and mechanically vigorous elements to accommodate the biomechanical forces transmitted through the spinal axis. These vertebral structures parade specialized adaptations to withstand compressive and shear forces, which outweigh in bipedal posture and ambulatory activities.

The morphological characteristics of lumbar vertebrae include a far-reaching, reniform vertebral body, abbreviated and full-bodied pedicles, expansive laminae, and definite spinous processes. The facet joint articulations of the lumbar spine are mostly oriented in the sagittal plane at superior levels, transitioning to a more coronal orientation at the L5-S1 junction. This architectural arrangement documents momentous flexion and extension movements while restricting excessive rotational mobility, which is essential for maintaining spinal structural integrity. The lumbar region respectively serves as a conduit for principal neural elements, including the cauda equina, which assumes critical functionality in motor and sensory innervation of the lower extremities and pelvic viscera.

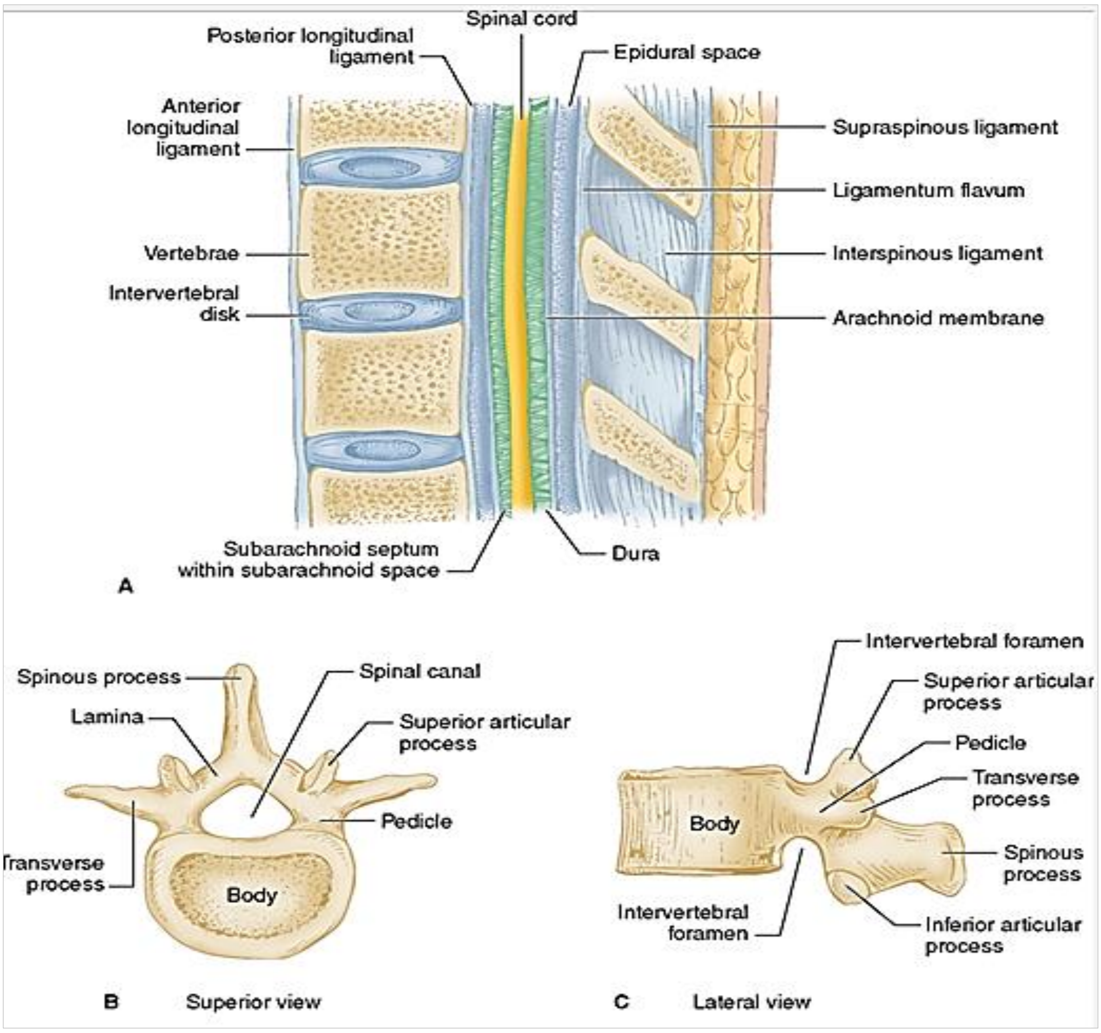


Figure 6: Sagittal section through lumbar vertebrae. B, C: Common features of vertebrae.

The functional meaning of the lumbar spine out does sheer structural support. It assumes a key character in mobility, easing controlled flexion, extension, lateral deviation, and minimal rotational movements. These kinematic capabilities are requisite for executing quotidian activities such as ambulation, stooping, and lifting. By the same token, the biomechanical properties of the lumbar spine ensure optimal distribution of axial and shear forces, mitigating unnecessary strain on individual vertebral elements and intervertebral discs. The interrelationship between vertebral architecture, ligamentous support structures, and musculature is fundamental in preserving spinal integrity and preventing traumatic injury.

Intervertebral Disc and Ligaments

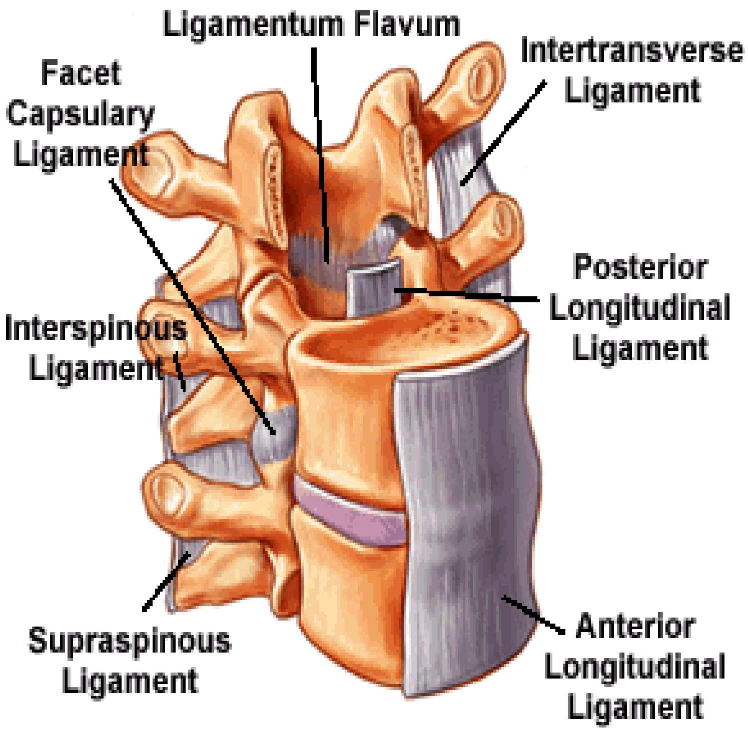


Figure 7: Intervertebral Disc and Ligaments

The intervertebral disc embodies a fibrocartilaginous structural element situated between adjacent vertebrae, operative as a shock-absorbing mechanism and simplifying intervertebral motion within the spinal column. It contains two principal “components: the annulus fibrosus and the nucleus pulposus. The annulus fibrosus consists of concentric lamellar arrangements of collagenous fibers that converse tensile strength and resistance to shearing forces. Contrariwise, the nucleus pulposus institutes a gelatinous core that distributes compressive loads uniformly across the discal structure. Degenerative variations or herniation of intervertebral discs can overpoweringly impact spinal biomechanics and actually influence the effectiveness of spinal anaesthetic interventions.

The lumbar spine, stabilized by an elaborated network of ligamentous structures that provide inert support and constrain excessive motion. The anterior and posterior longitudinal ligaments range longitudinally along the vertebral column, reinforcing the structural integrity of the intervertebral discs. The ligamentum flavum, a substantial elastic ligamentous band, connects adjacent laminae and underwrites to the posterior differentiation of the epidural space. The interspinous and supraspinous ligaments, positioned between the spinous processes, provide added stability, mostly during flexion movements. These ligamentous elements show a decisive part in maintaining spinal alignment, which is essential for precise needle placement during spinal anaesthetic administration.

Spinal Cord and Meningeal Coverings

An important component of the central nervous system, i.e., “the spinal cord, outspreads from the medulla oblongata and terminates at the conus medullaris, typically at the level of L1-L2 in adult individuals.” Caudal to this termination, the cauda equina, an aggregation of nerve roots, continues within the dural sac. The anatomical terminus of the spinal cord assumes chief standing in spinal anaesthesia, as it influences the selection of puncture sites to avert inadvertent neural traumatisation.

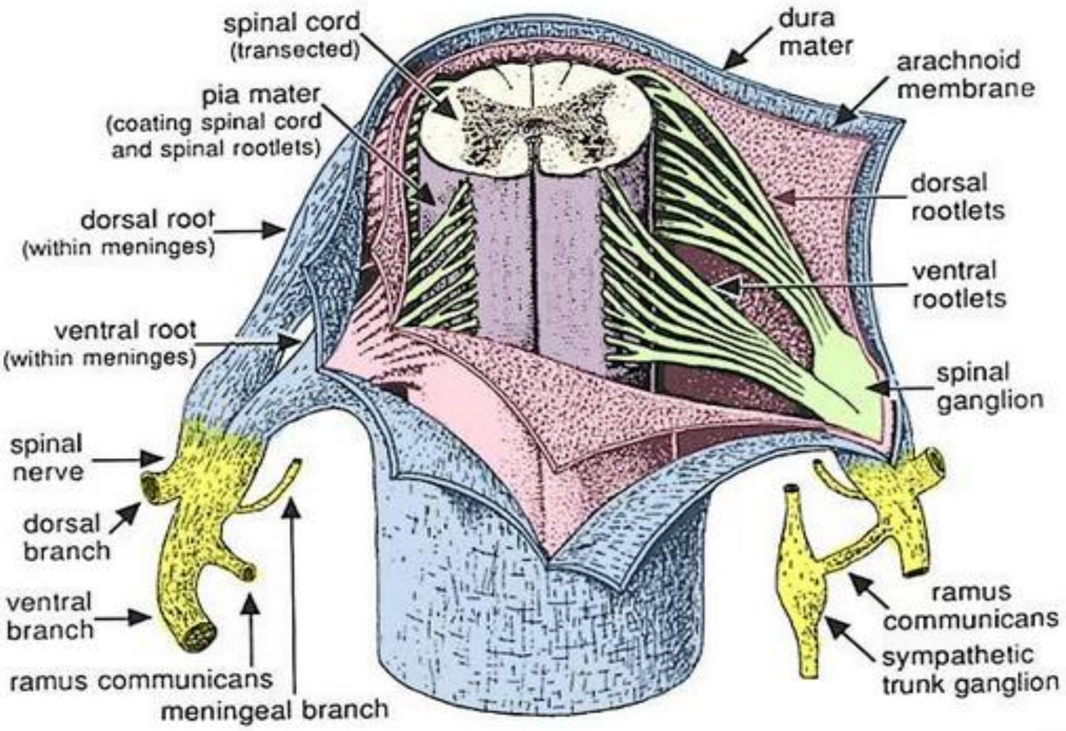


Figure 8: spinal cord Anatomy

"The spinal cord and nerve roots are covered by three meningeal layers: the dura mater, arachnoid mater, and pia mater." The dura mater founds the outermost stratum, provided that a buoyant protective covering those spreads caudally to the S2 level. The arachnoid mater, a subtle membrane-forming structure, be located in less the dura and contains cerebrospinal fluid (CSF) within the subarachnoid compartment. "The pia mater, the innermost layer, intimately keep toto the spinal cord and nerve roots." The incidence of CSF within the subarachnoid space enables unhampered diffusion of anaesthetic agents during spinal anaesthesia, guaranteeing active blockade of neural transmission mechanisms.

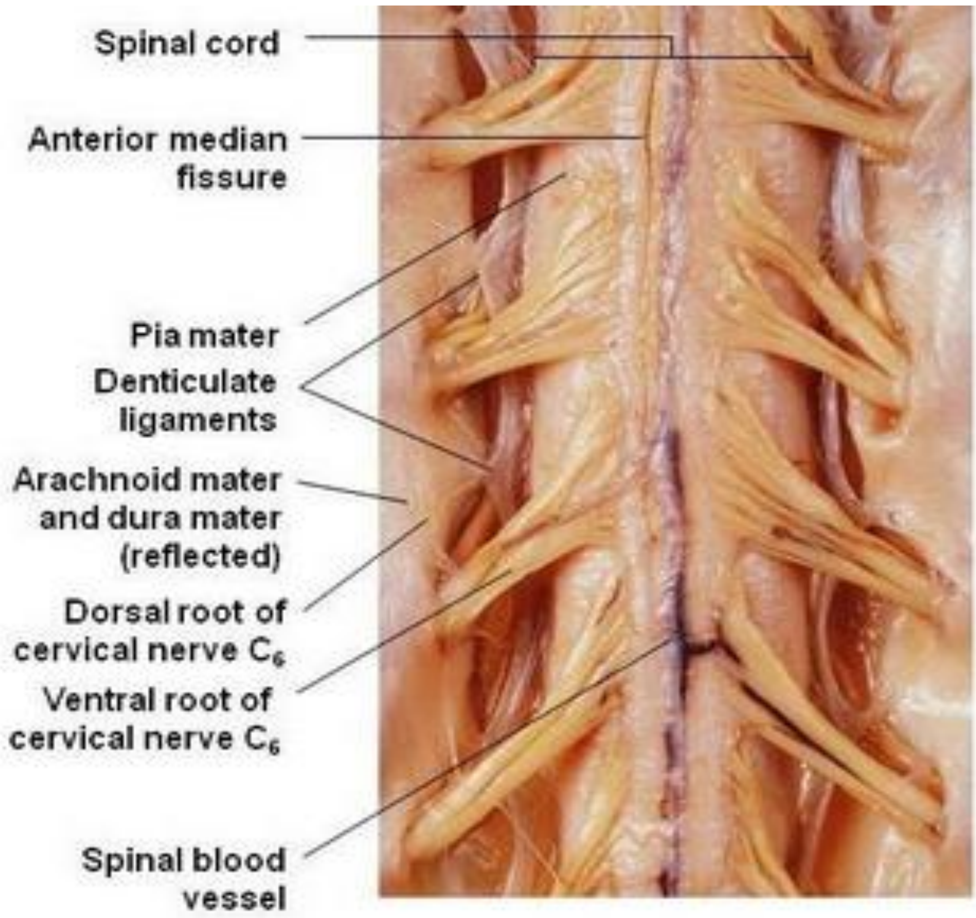


Figure 9: Spinal cord and associated structures

The anatomical relationship between these meningeal tops and the neighbouring osseous structures is critical for procedural precision in spinal anaesthesia. The L4-L5 interspace, commonly selected site for lumbar puncture, is chosen to minimize the risk of spinal cord injury while confirming tolerable access to the subarachnoid compartment. Given the interindividual variations in spinal anatomical formation, "ultrasound-guided assessment of the L4-L5 interspace and the Tuffier's line" can provide helpful understandings for improving needle placement and pleasing to the eye of success rates of spinal anaesthetic interventions

Tuffier's Line: Anatomical Basis and Clinical Relevance

"Definition and Historical Background of Tuffier's Line"

Tuffier's line, alternatively chosen as the intercristal line, signifies a bodily landmark utilized in clinical practice to approximate the "level of the L4-L5 intervertebral junction. It is defined as the horizontal plane crossing the superior aspects of the iliac crests bilaterally." This landmark has been widely employed by anaesthesiologists, neurologists, and other medical practitioners to guide lumbar puncture procedures, epidural catheter insertions, and spinal anaesthesia administration.[13]

The identification of Tuffier's line dates to the late 19th century, when the French anatomist and surgeon Jules Tuffier's described its utility in approximating the caudal terminus of the spinal cord. His observations underwrote suggestively to the growth of neuraxial anaesthetic methodologies, aiding clinicians to perform lumbar punctures with condensed risk of spinal cord traumatization. Throughout subsequent decades, Tuffier's line has become a standardized reference point for identifying appropriate needle insertion sites, chiefly for procedures necessitating access to the subarachnoid or epidural spaces.

Notwithstanding its historical implication, the steadfastness of Tuffier's line as an accurate anatomical landmark has been increasingly questioned due to important interindividual variations. Soundings utilizing imaging modes such as radiography, computed tomography (CT), and ultrasonography have opened irregularities in the actual vertebral level matching to Tuffier's line, stressing the demand for more specific methods of landmark identification in spinal interventional procedures.

Classical Identification of Tuffier's Line via Palpation

The usual method for identifying Tuffier's line bank on the surface palpation of the iliac crests. Clinicians trace the uppermost osseous prominences of the iliac crests bilaterally and conceptualize a hypothetical horizontal line crisscrossing the inferior dorsal region. This line is presumed to intersect the L4 vertebral body or the L4-L5 intervertebral junction. Following documentation, the practitioner opts for an appropriate needle insertion site to some extent superior or inferior to this landmark, liable upon the intended procedural objectives.[14]

Palpation-based identification of Tuffier's line denotes a skill-dependent process needful adequate training and experiential proficiency. Numerous factors, including subcutaneous tissue thickness, patient positioning, and practitioner expertise, can influence palpation accuracy. In persons with minimal adiposity and well-defined osseous landmarks, the palpation technique is relatively forthright. Though, in obese or elderly patients with weakened tactile landmark prominence, localization of the intercristal line becomes more and more challenging.

Although palpation remnants the major methodology in clinical settings, research has verified weighty inconsistency in its precision. Studies comparing palpation-based assessments with imaging modalities have discovered that in certain cases, the intercristal line may correspond to levels ranging from L3-L4 to L5-S1, conceivably leading to erroneous needle placement. Such variability features the need for adjunctive techniques, such as ultrasound guidance, to enhance precision in spinal anaesthesia administration.

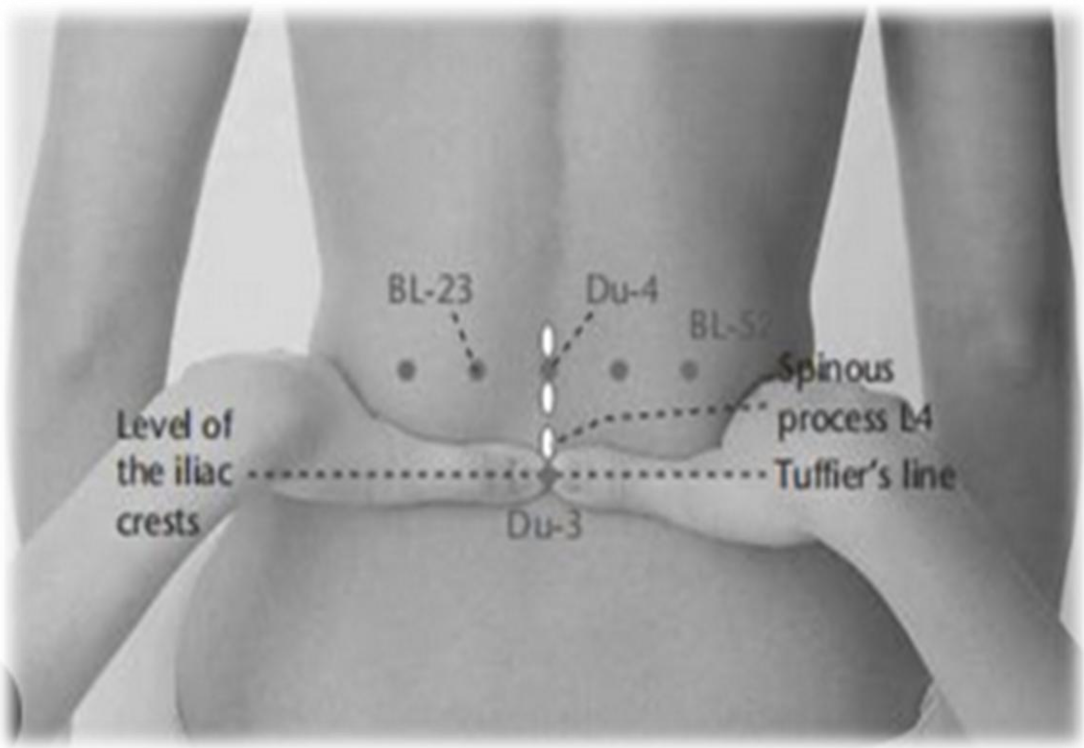


Figure 10: Identification of Tuffier's Line via Palpation

Anatomical Variability in the Positioning of Tuffier's Line across Populations

The position of Tuffier's line parades important anatomical variability among individuals rather than maintaining a fixed location. Numerous experiments have sightseen these variations and their implications for clinical practice. Factors such as age, sex, ethnicity, and overall body morphology influence the vertebral level at which the intercristal line intersects the spinal column.[15]

Population-based studies utilizing radiographic and ultrasonographic measurements have proved that in specific demographic groups, Tuffier's line may bring into line with higher or lower vertebral levels than usually anticipated. For occurrence, in certain Asian populations, the intercristal line has been detected at a relatively superior level compared to Western populations. Similarly, sex-based differences have been documented, with females often show signs of a comparatively higher positioning of Tuffier's line than males.

Aging also alters spinal anatomy that can affect Tuffier's line positioning. As individuals age, intervertebral disc degeneration, vertebral height reduction, and spinal curvature modifications can precipitate shifts in the relative location of osseous landmarks. This can result in overestimation or underestimation of the true L4-L5 interspace when be sure of exclusively on palpation techniques.

These anatomical variations highpoint the boundaries of a worldwide approach to spinal landmark identification. Given the likely for misidentification, clinicians must exercise judicious caution when utilizing Tuffier's line as the sole locus point for spinal procedures, mainly in patients with atypical anatomical characteristics.

Influence of Posture and Body Habitus on the Reliability of Tuffier's Line

Patient positioning shoulders a central role in the exactness of Tuffier's line identification." The alignment of the lumbar spine undertakes important alterations liable on whether the patient take up a sitting, lateral decubitus, or prone position. These positional variations affect the comparative height of the iliac crests and the arrangement of the vertebrae, leading to incongruities in interspace assessment

In the sitting position, the lumbar spine naturally has increased flexion, which can expand the interlaminar spaces and help needle insertion. Then again, excessive flexion may also relocate the perceived location of the iliac crests, resulting in inaccurate estimation of the L4-L5 interspace. In the lateral decubitus position, dissimilarities in pelvic tilt and spinal curvature can more complicate landmark identification, more commonly in obese or elderly patients with reformed spinal alignment.

Body habitus are another critical determinant influencing the reliability of Tuffier's line. In lean individuals, the iliac crests have greater prominence, needing more accurate palpation. On the other hand, in obese patients with increased subcutaneous adiposity, osseous landmarks may be difficult to palpate, requiring greater reliance on estimations rather than direct tactile valuation. In such clinical scenarios, imaging-guided techniques, especially ultrasound, offer a more precise methodology for identifying spinal landmarks and optimizing procedural accuracy.

The impact of posture and body habitus on Tuffier's line positioning stresses the importance of individualized assessment in spinal anaesthesia. Clinicians must spot these variations and consider alternative approaches, such as ultrasonography, to improve the precision of spinal landmark identification. By incorporating objective imaging techniques into routine practice, the limitations of palpation-based methods can be mitigated, in due course improving the safety and efficacy of neuraxial procedures.

Ultrasound in Spinal Anaesthesia: Principles and Techniques

Physics of Ultrasound and Imaging of the Lumbar Spine

Ultrasound imaging are operationalised based on the principles of high-frequency sound wave transmission and reflection. As ultrasound waves proliferate through tissues, they network differentially with structures of varying densities, producing echoes that are interpreted to produce immediate images. The lumbar spine, comprising bones, intervertebral discs, cerebrospinal fluid, and ligamentous structures, hand over imaging challenge due to the heterogeneity in acoustic impedance between these tissue elements.

In spinal ultrasonography, the principal landmarks include the vertebral bodies, spinous processes, laminae, interlaminar spaces, and the dura mater. These structures can be visualized utilizing various ultrasound probe orientations, including the transverse (axial) and paramedian (longitudinal) perceptions. The capacity to identify the L4-L5 interspace with precision is mostly appreciated for procedures such as spinal anaesthesia, epidural catheter placement, and lumbar puncture. Technological advancements in ultrasound, including high-frequency transducers and enhanced image resolution, have improved the accuracy of spinal landmark identification.

Advantages of Ultrasound-Guided Spinal Anaesthesia

The implementation of ultrasound in spinal anaesthesia converses numerous returns over outmoded palpation-based methodologies. A prime benefit is heightened accuracy in finding the optimal needle insertion site. Scholarship cites that ultrasound guidance supplements the ability to correctly locate the L4-L5 interspace, in so doing reducing the risk of misidentification and unintentional higher-level needle placement.

Ultrasound guidance has been associated with diminished risk of procedural snags, including failed blocks, post-dural puncture headaches, and unplanned nerve or vascular injury. By providing realistic, non-invasive imagining of anatomical structures, ultrasound allows clinicians to improve needle route and depth, curtailing trauma to surrounding tissues. This proves chiefly beneficial in obese patients, elderly individuals with transformed spinal anatomy, and those with scoliosis or previous spinal surgery, where palpation-based methods often validate unreliability.

Another plus of ultrasound-guided spinal anaesthesia resides in its input to improving procedural proficiency. Pre-procedural ultrasound scanning lets anaesthesiologists to explain lumbar anatomy in advance, follow-on fewer needle redirections and abbreviated procedural duration. This contributes to greater patient comfort and overall procedural success rates.

Ultrasound-Guided Localization of the L4-L5 Interspace

The identification of the L4-L5 interspace utilizing ultrasound follows a systematic practice. Initially, "a low-frequency curvilinear probe is positioned in the crosswise plane at the midline of the lumbar spine. The spinous processes clear as hyperechoic structures with posterior acoustic shadowing, while the interlaminar spaces exist as hypoechoic intervals between these structures.

In the paramedian longitudinal view, the ultrasound probe is aligned parallel to the spinal axis, aiding clearer visualization of the vertebral laminae", ligamentum flavum, and dura mater. This location proves mostly convenient for guiding needle insertion in real time, confirming optimum angulation and depth for dural puncture.

Clinicians must advance expertise in taking sonographic images to differentiate various echogenic structures. The dura mater and cerebrospinal fluid space, although challenging to visualize directly, can often be incidental by finding the posterior composite formed by the ligamentum flavum and the posterior dura. Through combination of these imaging techniques into clinical practice, the accuracy of spinal anaesthesia direction is knowingly heightened.

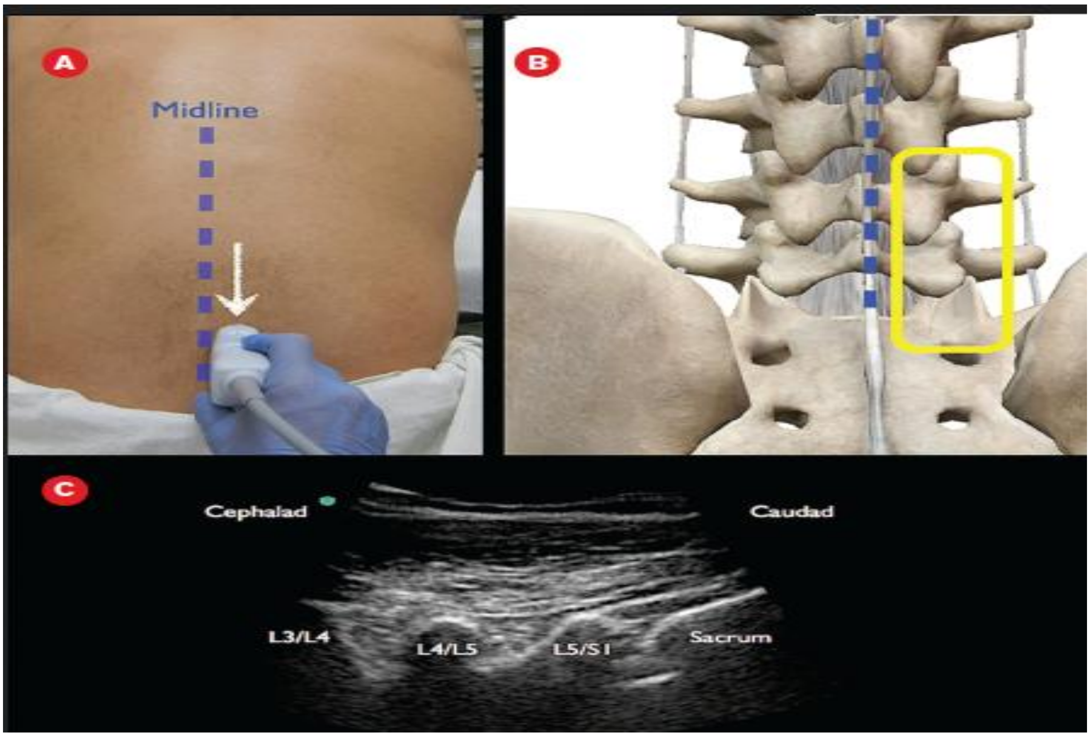


Figure 11: Ultrasound-Guided Localization of the L4-L5 Interspace

Variability in Tuffier's Line and Its Distance from the L4-L5 Interspace

The out-of-date dependence on Tuffier's line for spinal landmark identification has been throw down the gauntlet by evidence representing noteworthy anatomical variability. Studies utilizing imaging modes such as ultrasound and MRI have exposed that the intercristal line does not reliably parallel just to the L4-L5 interspace. In certain individuals, it aligns with the L3-L4 or even L5-S1 level, foremost to errors in spinal needle placement.[16]

Multiple factors pay to the variability of Tuffier's line positioning. Age-related alterations in spinal curvature, including kyphosis and intervertebral disc height reduction, can modify the relationship between external osseous landmarks and causal vertebral structures. In the same way, sex-based differences in pelvic morphology influence the relative height of the iliac crests, affecting the level at which Tuffier's line crosses the spine. Ethnic variations in vertebral alignment and body proportions further provide to this anatomical inconsistency.

The impact of obesity on Tuffier's line positioning is important. In obese individuals, extreme subcutaneous adiposity can vague osseous landmarks, resulting in palpation errors. The increased lumbar lordosis in overweight patients can transfer the apparent position of the intercristal line, extra complicating landmark identification. These findings put weight on the limitations of relying solely on palpation for spinal anaesthesia and point out the necessity for imaging-based adjuncts such as ultrasound.[17]

Correlation Between Anthropometric Measurements and Tuffier's Line Distance

Anthropometric parameters including height, body mass index (BMI), and pelvic scopes helps in determining spinal anatomical variations. Discourse has explored the correlation between these measurements and "the distance of Tuffier's line from the L4-L5 interspace," with conclusions portentous that taller individuals tend to show a lower-positioned intercristal line, while shorter individuals prove a quite higher positioning.[18]

BMI has been recognized as a weighty determinant influencing spinal landmark identification. In obese patients, the difficulty in palpating the iliac crests due to unnecessary adipose tissue have a say to errors in estimating the L4-L5 interspace. Investigations have planned the utilization of alternative anthropometric indices, such as waist-to-hip ratio and truncal fat distribution, to refine spinal landmark predictions in such populations.

Population-based studies have also verified disparities in vertebral alignment across different ethnic groups. For case, certain Asian populations have been stated to show a moderately higher intercristal line position compared to Western populations, influencing the selection of spinal anaesthesia techniques. Understanding these anthropometric correlations enables clinicians to adopt a more individualized approach to spinal landmark identification, minimizing errors and improving procedural success rates.

Clinical Implications of Ultrasound-Guided Landmark Identification

The integration of ultrasound into spinal anaesthesia practice has reflective implications for patient safety and procedural usefulness. By offering real, objective assessment of spinal anatomy, ultrasound lessens need on palpation-based methods, in that way lessening the risk of incorrect needle placement and associated hitches.

One of the most important clinical aids of ultrasound-guided spinal anaesthesia is its potential to improve success rates in challenging patient populations. Obese individuals, elderly patients with degenerative spinal alterations, and those with anatomical anomalies stem maximal benefit from ultrasound guidance, as it qualifies precise localization of the dural sac and intervertebral spaces.

The utilization of ultrasound as a pre-procedural mapping tool has been proved to reduce the incidence of traumatic lumbar punctures and various needle insertion efforts. This not only increases patient comfort but also reduces the likelihood of problems such as post-dural puncture headache and inadvertent spinal cord injury.

The future of neuraxial anaesthesia will to be expect a witness of increased adoption of ultrasound-guided techniques as gears of routine clinical practice. As technology advances and training programs integrate ultrasound education, anaesthesiologists will increasingly rely on imaging-based approaches to adjust patient outcomes.

COMPARATIVE STUDIES

Tantri et al., (2022) implemented a cross-sectional observational study at CiptoMangunkusumo National General Hospital to infere “the correlative relationship between age, sex, and anthropometric parameters with the spatial distance between the L4-L5 intervertebral junction and Tuffier's line utilizing ultrasonographic guidance. Upon statistical analysis of data resulting from 93 research subjects, the researchers determined that the mean distance of the L4-L5 interspace from Tuffier's line was −2.59 ± 1.58 cm. Inferential statistical procedures open a statistically significant correlation between height and sex with this measured distance, concluding in the derivation of a prognostic mathematical formula: 4.921 + [0.536 × (1 for male or 2 for female)] + (−0.052 × height in cm).” This empirical clarifies the considerable variability in Tuffier's line positioning and stresses the clinical meaning of ultrasonographic assessment in spinal anaesthetic procedures for improved procedural precision.[18]

Pysyk et al. (2010) in their methodologically rigorous inquiry to measure the accuracy of vertebral level identification utilizing clinical palpation of the intercristal line juxtaposed with ultrasonographic imaging in subjects positioned for neuraxial blockade. Within a cohort comprising 114 adult participants, a single investigator demarcated the cutaneous surface at the level “where the palpated intercristal line intersected the spinous processes. Employing a 2–5 MHz curved ultrasound transducer in paramedian orientation, the intervertebral levels were sequentially identified in cephalad progression from the sacral region. The comparative analysis demonstrated substantial discordance between palpation-based and ultrasound-confirmed vertebral levels,” highlighting the limitations of traditional landmark identification methodologies and reinforcing the imperative for objective imaging techniques in neuraxial anaesthetic practice. The study found that the palpated intercristal line corresponded to the L3-4 interspace in 73% of subjects, L4-5 in 14%, and L2-3 in 13%. Taller individuals and males were more likely to have the intercristal line positioned at L2-3 (mean height difference of 7.8 cm; P = 0.016). The findings highlight the inaccuracy of clinical landmark palpation, as ultrasound demonstrated that the intercristal line is often lower than traditionally assumed, underscoring the importance of imaging for precise neuraxial block placement.[19]

Margarido et al. (2011) conducted a study to assess the accuracy of the palpated intercristal line as a surrogate for the true radiological Tuffier's line in term pregnant women using ultrasound. Forty-five pregnant women, excluding those with scoliosis or prior spinal surgery, were evaluated in the sitting position. The anaesthesiologist palpated and marked the superior aspects of the iliac crests together, while a blinded investigator performed an ultrasound scan to identify the lumbar interspaces. The markings were compared by overlaying a transparent sheet. The study found that the palpated intercristal line was positioned above the L4-L5 interspace in all subjects, with the median intersection level just below L2-L3, ranging from above L1-L2 to above L4-L5. A low but significant positive correlation was observed between the intercristal line position and body mass index ($r = 0.32$; $P = 0.03$)." These findings indicate that in term pregnancy, the intercristal line determined by palpation is often positioned higher than the true Tuffier's line, potentially leading to incorrect vertebral level estimation during neuraxial procedures.[20]

Ozturk et al. (2016) conducted a prospective, randomized, controlled, "double-blinded trial to compare the accuracy of Tuffier's line with an alternative landmark—the tenth rib line—for identifying the L4-L5 interspace using ultrasound validation. The study included 200 patients aged 18 to 50 years, excluding individuals taller than 180 cm, shorter than 150 cm, or with a BMI greater than 30 kg/m^2." One anaesthesiologist marked the L4-L5 level in Group T using Tuffier's line and in Group R using the tenth rib line, while another blinded anaesthesiologist evaluated the accuracy of these markings via ultrasound. The results demonstrated a significantly higher accuracy rate for the tenth rib line (74%) compared to Tuffier's line (60%) ($p < 0.05$). No correlation was found between estimation success and demographic variables. "The study concluded that the tenth rib line is a more accurate anatomical landmark than Tuffier's line for palpation-based spinal level identification," though further research with multiple examiners and diverse patient populations is needed for validation.[21]

Amin et al. (2014) conducted a study to compare the accuracy of ultrasound (US) versus clinical assessment for determining spinal levels, using X-ray as the gold standard. A total of 200 patients were randomized into two groups: the Clinical Group," where spinal levels were determined by palpation and confirmed by fluoroscopy, and the Ultrasound Group, where ultrasound was used to identify the Tuffier's line. Comparison with X-ray findings revealed that the assumed clinical Tuffier's line matched the true level in only 12% of cases, with errors ranging from one level above (80%) to two levels above (7%), and in 1% of cases, it was at L2. In contrast, ultrasound misidentified the level in only 22% of patients, with minor errors of less than one level in 17% and one-level errors in 5%. "The study concluded that ultrasound is significantly more accurate than clinical assessment for spinal level identification" and is recommended for spinal anaesthesia to reduce the risk of spinal cord injury.[22]

Kim et al. (2019) articulates the evaluation of the accuracy considering Tuffier's line and the 10th rib line in identifying the L4-L5 intervertebral space using ultrasonography in elderly patients with hip fractures. "Seventy-nine patients scheduled for spinal anaesthesia were included. In the lateral decubitus position, the L4-L5 space was identified using both anatomical landmarks, the Tuffier's line, drawn between the highest points of the iliac crests, and the 10th rib line, connecting the lowest points of the rib cage. The intervertebral spaces were then confirmed by ultrasound." Correct identification of the L4-L5 space occurred in 59% of patients using the Tuffier's line and 57% using the 10th rib line (P = .87). Misidentifications were observed at L3-L4 (27% vs. 24%), L5-S1 (9% vs. 16%), and L2-L3 (5% vs. 3%), respectively. "The study outlined that both the Tuffier's line and the 10th rib line are undependable for estimating intervertebral space" in elderly patients undergoing spinal anaesthesia.[15]

Snider et al. (2008) conducted a study to assess the reliability of Tuffier's line as a landmark for identifying the L4-L5 interspace. The study observed 200 standing and 60 prone lumbar radiographs and found that the intercristal line most often intersected the L4 body or inferior endplate in men, and the L5 body or superior endplate in women. The study resolved that Tuffier's line demonstrated predictable sex-related differences, but its inconsistency across individuals makes it an unreliable sole landmark for spinal level identification. No correlation was found between weight, BMI, and the level of Tuffier's line.[23]

Kim et al. (2014) conducted a study to evaluate the accuracy of Tuffier's line for determining vertebral levels in parturient and non-parturient women using ultrasound. Forty parturient women at 37-41 weeks of gestation and forty non-pregnant women scheduled for regional anaesthesia were enrolled. The study involved identifying vertebral levels using ultrasonography in the left lateral position and marking each intervertebral space. Results showed that in non-pregnant women, the Tuffier's line intersected the L4 vertebral level (mean value 6.4 ± 0.9), whereas in parturient women, the line was more cephalad, intersecting at the L3 level (mean value 3.0 ± 1.0). The difference was statistically significant ($P < 0.05$). The study concluded that the vertebral levels intersected by the palpated Tuffier's line are more cephalad in parturient women compared to non-pregnant women".

MATERIAL & METHOD

Source of data

This study was conducted on non-obstetric patients without cardiac abnormalities, spine deformities, diseases, or complications and who met the inclusion criteria. These patients underwent spinal anaesthesia for “elective surgeries at R.L. Jalappa Hospital and Research Centre, Tamaka, Kolar”, after informed consent was obtained.

Method of collection

Eighty-five non-obstetric patients without cardiac abnormalities, spine deformities, diseases, or complications who met the inclusion criteria and underwent “spinal anaesthesia for elective surgeries at R.L. Jalappa Hospital and Research Centre, Tamaka, Kolar,” were selected, and informed consent was obtained.

Inclusion criteria

- Patients aged 18 to 60 years
- American Society of Anaesthesiologists (ASA) physical status grades I– II
- Patients scheduled for Lower abdominal and lower limb surgeries, non-cardiovascular, non-obstetric surgery under spinal anaesthesia

Exclusion criteria

- Patients refusing to participate in the study
- Spinal deformities or previous spinal surgery.
- Patients with contraindications for spinal anaesthesia such as infection at the site of injection, allergy to local anaesthetics, raised intracranial pressure coagulopathies.

Methodology

Sample size

Sample size was calculated by using the following formula

$$Total\ sample\ size\ (n) = \left[\frac{Z_\alpha + Z_\beta}{0.5 * ln\left(\frac{1+r}{1-r}\right)}\right]^2 + 3$$

Where Z_α = Standard normal value at α level of significance (at α = 0.05,)$Z_\alpha = 1.96$

Z_β = Standard normal value for β (at β = 20%)$Z_\beta = 0.8416$

r is the expected correlation based on previous study = 0.3 [1]

ln indicates natural logarithm

Minimum required Sample size calculated by above formula was 84.9≅85

The relation of Tuffier's line distance between the L4 and L5 interspace with anthropometric measurements was analyzed by computing the correlation coefficient. The comparison of Tuffier's line distance between the L4 and L5 interspace among males and females was performed using an independent t-test or Mann-Whitney U test, depending on the normality of the dependent variable.

SAMPLING PROCEDURE

- Prior to surgery, patients were kept in a standard fasting state (8 hours for solid food and 2 hours for clear fluids).
- Subjects were asked to complete an informed consent form one day prior to the anaesthesia procedure to participate in this research.
- The participants were seated in preparation for the spinal anaesthesia procedure, and their demographic information was recorded.
- Under the direction of an anaesthesiologist consultant, the investigator conducted a physical evaluation.
- The investigator marked the iliac crest on both sides and then drew a line connecting the two marks to form what is known as Tuffier's line (TF).
- The ultrasound machine (Philips) was set up, and the probe was covered with a sterile cover to prevent infection and gel was applied to provide better imaging.
- A curvilinear probe was placed in the transverse position on the middle of the vertebral line and moved from the sacrum toward the head.
- Marks from the spinous processes were connected to form a line on the middle of the vertebra (TS).
- The intersection point between TF and TS was also marked (TS-F).
- The ultrasound probe was placed perpendicular and moved from the sacrum midline to its paramedial position. The probe was then tilted to achieve a parasagittal oblique approach.
- In the parasagittal oblique position, the probe was moved toward the head, and the first lamina identified after the sacrum was L5.
- Every lamina from L1 to L5 was marked, and the midpoint between L4 and L5 was also marked (T4–5).

- The USG curved probe was placed back in the transverse position on the vertebral midline to confirm the T4–5 position.

- The distances from TS-F to T4–5 and from TS-F to the accompanying vertebra were measured.

- The measurement results were recorded and verified by a regional anaesthesia consultant.

- After obtaining ethical clearance, the study was registered with CTRI.

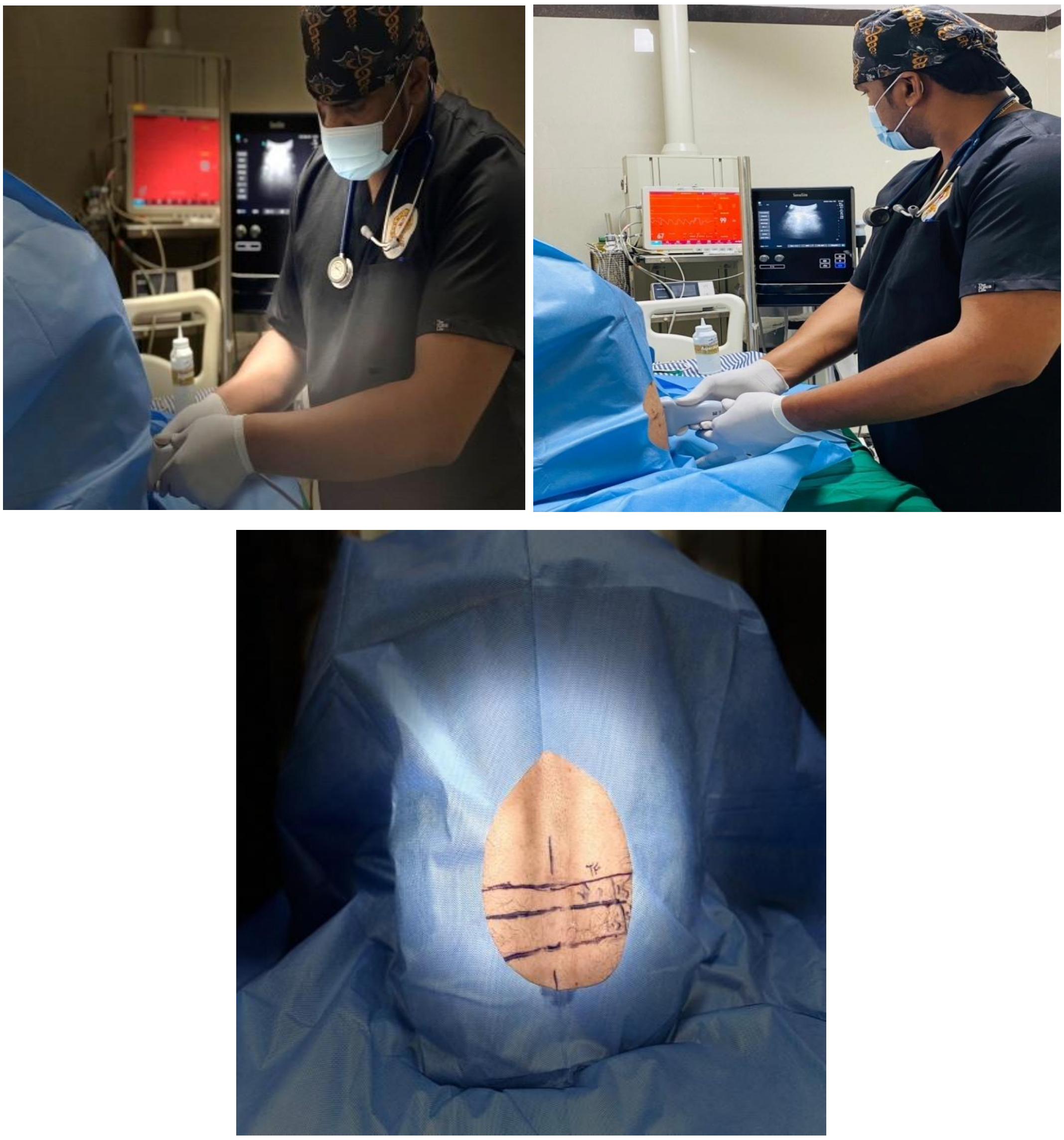


Figure 12: Ultrasound guided assessment of Tuffier's line distance from L4-L5 interspace.

STATISTICAL ANALYSIS

The statistical analysis for this "observational analytic study with a cross-sectional design" was conducted using appropriate statistical methods. Correlation coefficients were calculated to analyze the relationship between variables. The comparison of continuous variables, such as Tuffier's line distance, between male and female participants was performed using either "the independent t-test or the Mann-Whitney U test, depending on the normality of the data" as assessed during analysis. Other suitable statistical methods were applied as required based on the data characteristics. Data analysis was performed using statistical software including SPSS version 22.0, R Environment, MedCalc, and Microsoft Excel for calculations and visualization. Microsoft Word was used for documentation and reporting. Randomization was not applicable to this study. The statistical analysis and interpretation of results were overseen and verified by Dr.Sunanda C, a statistical consultant and former "assistant professor in the Department of Statistics, College of Veterinary and Animal Sciences," Wayanad, Kerala.

RESULTS

100 participants were there in the study

Table 1: Age distribution among study participants

Mean	47.2
Median	46
Standard Deviation	17.1
25th Percentile	33
75th Percentile	60

The mean age of the study participants was 47.2 years, with a median age of 46 years, indicating a relatively symmetric distribution. The age range was spread across the 25th percentile at 33 years and the 75th percentile at 60 years. The standard deviation was 17.1, reflecting a moderate level of variability in the age of the participants.

Table 2: Gender distribution among study participants

Sex	Count	% of total
Female	38	38.00%
Male	62	62.00%

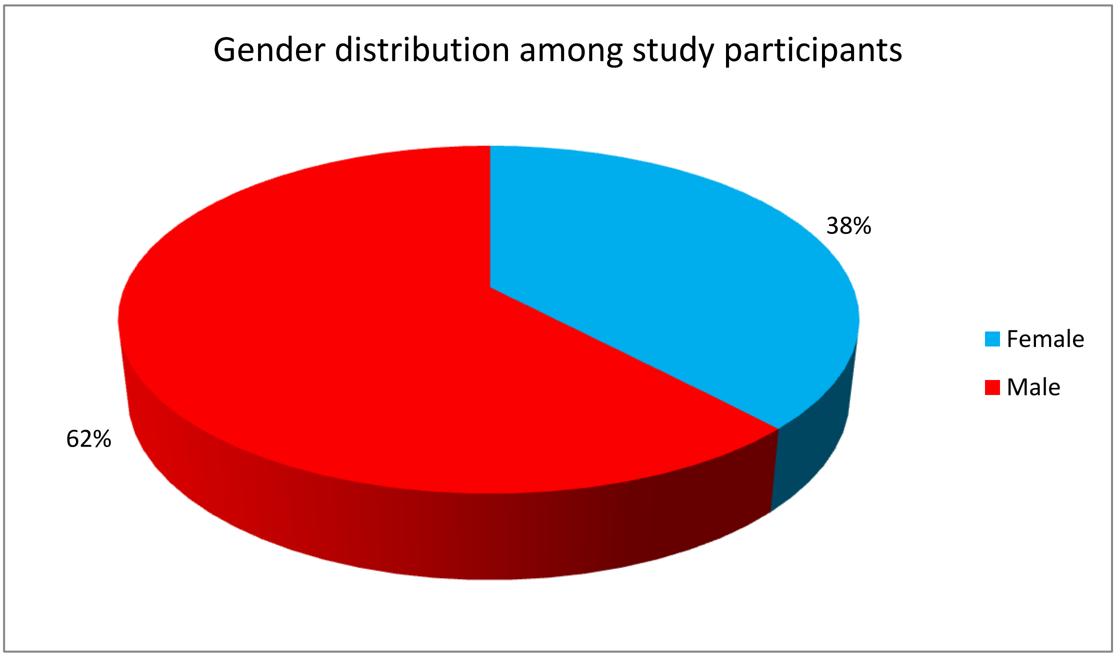


Figure 13: Gender distribution among study participants

Among the study participants, 62.0% were male (n = 62), while 38.0% were female (n = 38). This indicates a higher proportion of males in the study population compared to females.

Table 3: Anthropometry among study participants

Variable	Mean	Median	Standard Deviation (SD)	25th Percentile	75th Percentile
Height	161.1	160	11.51	150	168.5
Weight	61.4	60	11.81	53.8	72
BMI	23.7	23	3.73	21.3	24.6

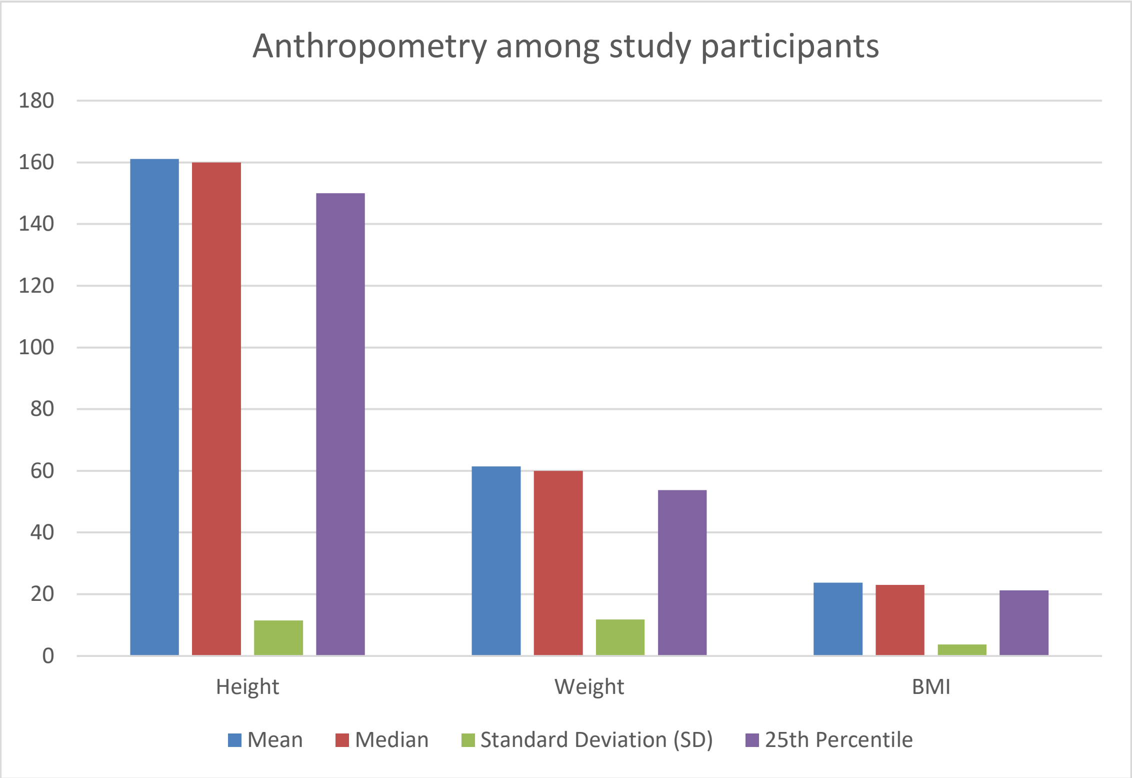


Figure 14: Anthropometry among study participants

The mean height of participants was 161.1 cm (SD: 11.51), with a median of 160.0 cm. Weight averaged 61.4 kg (SD: 11.81), with a median of 60.0 kg. The mean BMI was 23.7 kg/m² (SD: 3.73), and the median was 23.0 kg/m².

Table 4: L4-L5 Distance from Tuffier's Line

Descriptive Statistics	L4-L5 Distance from Tuffier's Line (cm)
Mean	2.23
Median	2.3
Standard Deviation	0.47
25th Percentile	1.87
75th Percentile	2.52

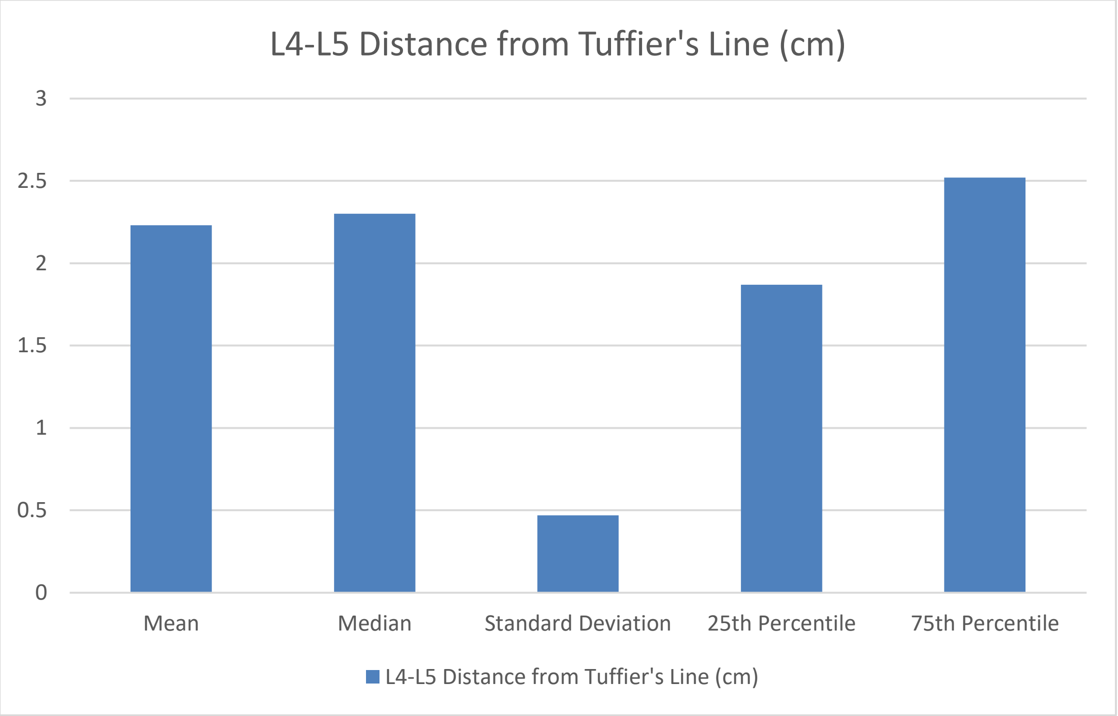


Figure 15: L4-L5 Distance from Tuffier's Line

The mean distance from Tuffier's line at the L4-L5 level was 2.23 cm (SD: 0.47), with a median of 2.30 cm. The interquartile range was between 1.87 cm (25th percentile) and 2.52 cm (75th percentile).

Table 5: Correlation Between Weight and L4-L5 Distance from Tuffier's Line

Variables	Pearson's r	df	p-value
Weight & L4-L5 Distance from Tuffier's Line	0.412	98	< .1

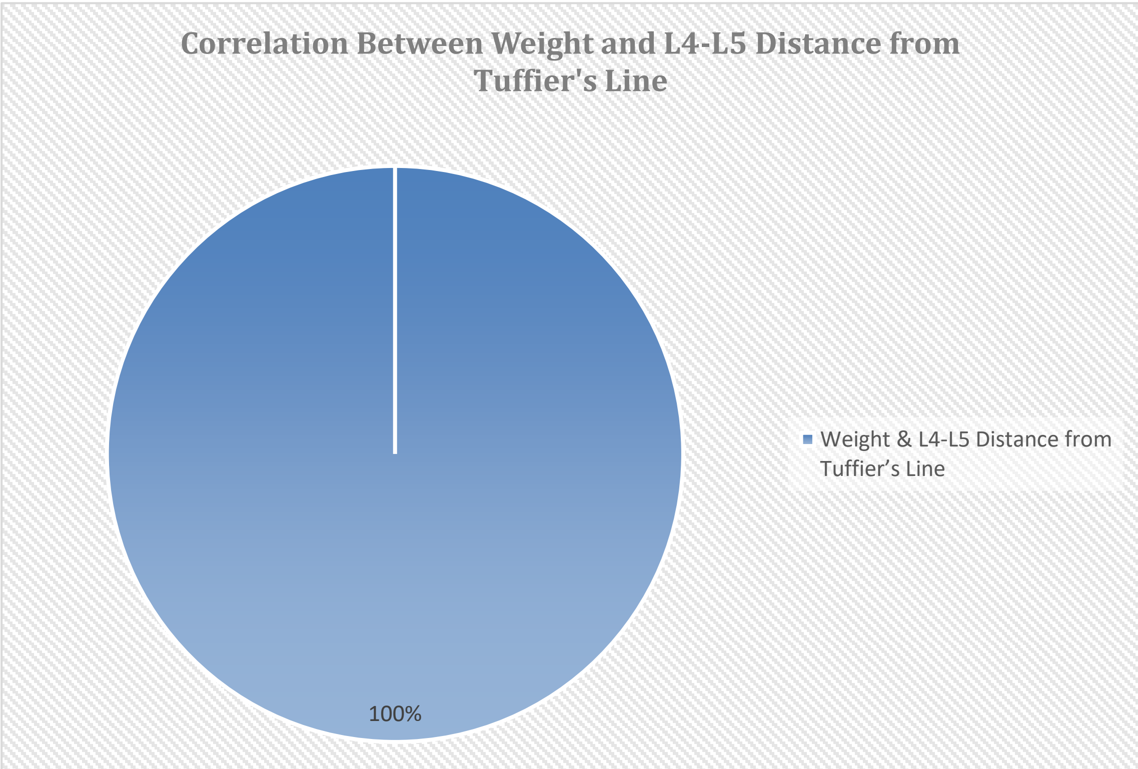


Figure16: Correlation between Weight and L4-L5 Distance from Tuffier's Line

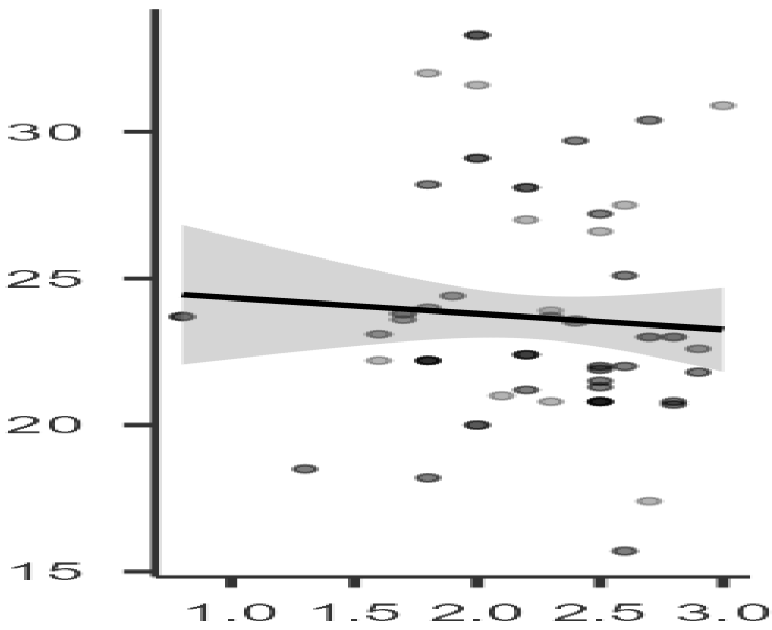
There was no correlation between weight and distance from Tuffier's line

Table 6: Correlation Between BMI and L4-L5 Distance from Tuffier's Line

Variables	**Pearson's r**	**df**	**p-value**
L4-L5 Distance & BMI	-0.068	98	0.502

The correlation between BMI and the L4-L5 distance from Tuffier's line was found to be weak and not statistically significant (Pearson's r = -0.068, p = 0.502) with 98 degrees of freedom. This suggests that there is no meaningful relationship between BMI and the distance from Tuffier's line in this study.

L4-L5 Distance from Tuffier’s line in cm



BMI

Figure 17: BMI plot

Table 7: Correlation Between Height and L4-L5 Distance from Tuffier's Line

Variables	Pearson's r	df	p-value
Height & L4-L5 Distance from Tuffier's Line (cm)	0.936	98	< .001

A strong positive correlation was observed between height and the L4-L5 distance from Tuffier's line (Pearson's $r = 0.936$, $p < .001$) with 98 degrees of freedom. This indicates that greater height is associated with an increased distance from Tuffier's line.

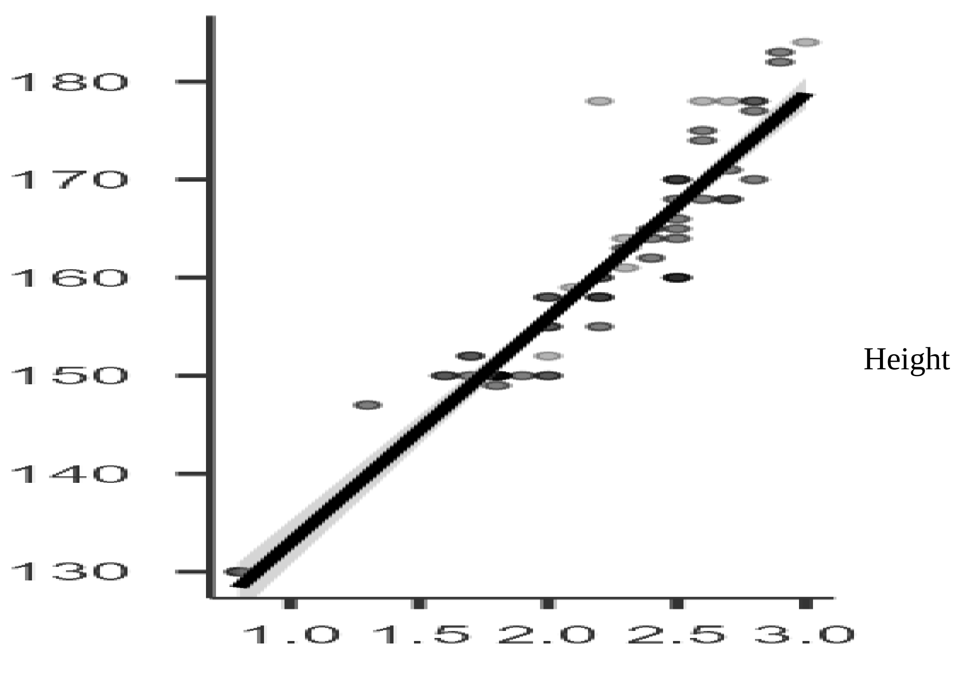


Figure 18: Height plot

DISCUSSION

Demographic Profile of Study Participants

The demographic profile of our study participants included 100 individuals, with a male predominance (62%) and an age range broadly distributed between 33 to 60 years, reflecting a mean age of 47.2 years. The anthropometric data revealed a mean height of 161.1 cm and a mean weight of 61.4 kg, with body mass index (BMI) averaging" at 23.7 kg/m².

When comparing these demographics with the studies cited in the literature review, such as Tantri et al. (2022)[27] and Pysyk et al. (2010)[29], our study aligns with the general age and BMI ranges typically considered for spinal anaesthesia research. These comparative studies, however, do not provide detailed demographic data like ours, focusing instead on the procedural aspects and outcomes of spinal anaesthesia. This comprehensive demographic insight in our study aids in understanding the impact of physical characteristics on the accuracy of Tuffier's line identification, enhancing the applicability of our results to a similar clinical population.

Accuracy of Tuffier's Line Identification Using Ultrasonography

Our investigation employed ultrasonographic techniques to assess the precision of Tuffier's line identification. The results open that ultrasonography shown superior accuracy in identifying the L4-L5 intervertebral space, with unimportant deviation from the anticipated anatomical reference point. This observation submits that ultrasonography stands for a dependable alternative to conventional palpation techniques, which often parade considerable error margins due to anatomical variations among patients.

Tantri and colleagues (2022)[27] documented a mean displacement of the L4-L5 intervertebral space from Tuffier's line, indicative of variability comparable to our observations. Our investigation, though, outspreads these results by launching correlations between these displacements and specific anthropometric parameters, thereby contributing an understanding of circumstances under which deviations might be anticipated. By the same token, Pysyk et al. (2010)29 clarified the difficulties essential in accurate vertebral level identification via palpation, indicating ultrasound's superior reliability. Our results authenticate these investigations, pin pointing ultrasonography's utility in boosting procedural precision and safety parameters in spinal anaesthesia administration.

Relationship Between Tuffier's Line Distance and Anthropometric Measurements

Our study reflects statistically significant correlation between anthropometric measurements, mainly height, and the measured distance from Tuffier's line to the L4-L5 intervertebral space. This relationship specifies that individuals of more stature typically show an increased distance from Tuffier's line to the L4-L5 interspace, portentous that height constitutes a critical variable in predicting needed adjustments for needle placement during spinal anaesthesia procedures.

Margarido and colleagues (2011)[30]in their investigation on gravid females and determined that the palpated Tuffier's line frequently obtainable at a position superior to the actual L4-L5 interspace, with minimal correlation to body mass index. In spite of the demographic differences in their study population, their findings align with our observations regarding the influence of physical measurements on Tuffier's line positioning. Both scholarly input support the proposition that individual anatomical variations meaningfully influence procedural landmarks in spinal anaesthesia, strengthening the value of incorporating ultrasonographic techniques for precise landmark identification.

Impact of Demographic Variability on Tuffier's Line Positioning

The results which have been outlined describe those demographic factors, including gender and age, can influence the accuracy of Tuffier's line identification. We observed that male subjects typically have a more caudal placement of Tuffier's line relative to the L4-L5 interspace compared to female subjects, attributable to differences in pelvic anatomy.

Ozturk et al. (2016)[31] and Kim et al. (2019)[21]both identified variability in Tuffier's line location across varied patient demographics. Specifically, Ozturk and colleagues

(2016) determined that an alternative anatomical reference point, the tenth rib line, provided superior accuracy compared to Tuffier's line for L4-L5 interspace identification, suggesting that outmoded methodologies may require reassessment or supplementation through imaging techniques in heterogeneous demographic populations.

Clinical Implications of Ultrasound-Guided Identification of Spinal Landmarks

The clinical inferences of our findings are important, indicative of ultrasound-guided identification of spinal landmarks pointedly develops procedural safety and efficacy. By providing visualization of spinal anatomical structures, ultrasound guidance minimizes the risk of complications associated with inaccurate needle positioning.

Amin et al. (2014)[32] and Kim et al. (2014)[19] reported that ultrasonography enhances the precision of spinal level identification compared to clinical assessment alone. Our results support these conclusions, suggesting that routine implementation of ultrasonography could benefit diverse patient populations, particularly those presenting with anatomical variations that find the middle ground regarding reliability of palpation techniques.[24]

SUMMARY OF RESULTS

Through evaluating ultrasonographic applications in Tuffier's line identification for spinal anaesthesia administration and its relationship with anthropometric parameters. The principal findings can be summarized as follows:

Ultrasonographic Accuracy: Ultrasonography make evident exceptional precision in identifying the L4-L5 intervertebral space, through clear advantages over outmoded palpation methodologies by reducing error margins and outlining landmark identification precision.

Anthropometric Parameter Influence: A significant correlation arose between subjects' height and the measured distance from Tuffier's line to the L4-L5 interspace. This shows that taller individuals naturally present with improved distance to this interspace, signifying height as a critical consideration when planning needle insertion lines for spinal anaesthesia.

Demographic Variation: The investigation reflects that demographic factor, principally gender, influence Tuffier's line positioning. Notably, male subjects frequently showed more “caudal placement of Tuffier's line relative to the L4-L5 interspace” compared to female subjects.

Clinical Applications: The findings outline the clinical value of uniting ultrasonographic techniques in spinal anaesthesia procedures. Implementation of ultrasound technology qualifies practitioners to improve procedural accuracy and safety profiles, effectively mitigating risks associated with inaccurate needle positioning.

LIMITATIONS

Population Homogeneity: The investigation was conducted on a homogeneous cohort of non-obstetric, non-cardiac patients, potentially limiting broader applicability of findings.

Sample Size Constraints: The relatively modest sample size may impact the statistical sturdiness and generalizability of the investigational outcomes.

Single-Centre Design: The results may not be characteristic of other clinical environments due to institution-specific protocols and practices.

Absence of Longitudinal Follow-up: The investigation lacked follow-up assessments to evaluate long-term complications or efficacy parameters.

Comparative Group Deficiency: The absence of a control group utilizing traditional palpation techniques excluded direct outcome comparison between methodologies.

CONCLUSION

Within the scholarly and practical importance in medical diagnostic discourse, our investigation has established ultrasonography as a vital technological advancement for understanding the precision and safety parameters of spinal anaesthesia procedures. Through accurate identification of Tuffier's line and its spatial relationship to the L4-L5 intervertebral space, ultrasonography lessens dependence on less reliable palpation techniques and minimizes procedural complications, especially in patients presenting with anatomical variations. These findings reflect integrating ultrasonographic methodologies into routine spinal anaesthesia practice, promoting raised up standards of care through greater precision and safety in anaesthesia management. This approach not only aligns with current technological advancements in medical imaging but also contributes to improved patient outcomes in surgical paradigm.

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ANNEXURE

PROFORMA

Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing spinal Anaesthesia

Investigators: Dr. Akhil Kumar / Dr. Ravi M

Name of the patient: Age/Sex:

IP No. : Ward: ASA grade:

General Physical Examination:

HEIGHT	
WEIGHT	
BMI	

Measurement of Tuffier's Line distance from L4-L5 interspace:

Diagnosis:

Surgery:

PATIENT INFORMATION SHEET

Study: Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing spinal Anaesthesia

Investigators: Dr. AKHIL KUMAR / Dr Ravi M

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

Details:

This study will be conducted on non-obstetric patients without cardiac abnormalities/spine deformities /diseases/complication and matching inclusion criteria, undergoing spinal anaesthesia for elective surgeries at R. L. Jalappa Hospital, Tamaka, Kolar are included in the study. Patients who meet exclusion criteria will be excluded from the study. This study aims to assess the ultrasound measurements used to determine the L4-L5 interspace's distance from the Tuffier's line for spinal anaesthesia

Patient and the attenders will be completely explained about the procedure being done under ultrasound guidance. Throughout the study if any form of payment/purchase is necessary, it will be completely borne by the investigator. No extra cost will be charged for patient throughout the study.

Please read the above mentioned 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 required information and relevant history will be taken. The collected information 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 do not 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. Akhil Kumar (Principal investigator)

Contact number: 7907847327

ರೋಗಿಯಮಾಹಿತಿಹಾಳೆ

ಅಧ್ಯಯನ: ಬೆನ್ನುಮೂಳೆಯಅರಿವಳಿಕೆಗೆಒಳಗಾಗುವರೋಗಿಗಳವಯಸ್ಸು, ಲಿಂಗ, ತೂಕ, ಎತ್ತರಮತ್ತು BMI ಯೊಂದಿಗೆಅಲ್ಟ್ರಾಸೌಂಡ್ಮಾರ್ಗದರ್ಶನಮತ್ತುಪರಸ್ಪರಸಂಬಂಧವನ್ನುಬಳಸಿಕೊಂಡು L4 ಮತ್ತು L5 ಇಂಟರ್ಸ್ಪೇಸ್ನಡುವಿನಟಫಿಯರ್ಸ್ಲೈನ್‌ಅಂತರದಮೌಲ್ಯಮಾಪನ.

ತನಿಖಾಧಿಕಾರಿಗಳು: ಡಾ. ಅಖಿಲ್ಕುಮಾರ್ / ಡಾ. ರವಿಎಂ

ಅಧ್ಯಯನಸ್ಥಳ:
ಆರ್ಎಲ್ಜಾಲಪ್ಪಆಸ್ಪತ್ರೆಮತ್ತುಸಂಶೋಧನಾಕೇಂದ್ರವುಶ್ರೀದೇವರಾಜರವೈದ್ಯಕೀಯಕಾಲೇಜು, ಟಮಕ, ಕೋಲಾರ.

ವಿವರಗಳು: ಈಅಧ್ಯಯನವನ್ನುಹೃದಯವೈಪರೀತ್ಯಗಳು / ಬೆನ್ನುಮೂಳೆಯವಿರೂಪಗಳು / ರೋಗಗಳು / ತೊಡಕುಗಳುಮತ್ತುಹೊಂದಾಣಿಕೆಯಸೇರ್ಪಡೆಮಾನದಂಡಗಳಿಲ್ಲದಪ್ರಸೂತಿ-ಅಲ್ಲದರೋಗಿಗಳಮೇಲೆನಡೆಸಲಾಗುವುದು, ಆರ್. ಹೊರಗಿಡುವಮಾನದಂಡಗಳನ್ನುಪೂರೈಸುವರೋಗಿಗಳನ್ನುಅಧ್ಯಯನದಿಂದಹೊರಗಿಡಲಾಗುತ್ತದೆ. ಈಅಧ್ಯಯನವುಬೆನ್ನುಮೂಳೆಯಅರಿವಳಿಕೆಗಾಗಿಟಫಿಯರ್ಸ್ಲೈನ್‌ನಿಂದ L4-L5 ಇಂಟರ್‌ಸ್ಪೇಸ್‌ನಅಂತರವನ್ನುನಿರ್ಧರಿಸಲುಬಳಸಲಾಗುವಅಲ್ಟ್ರಾಸೌಂಡ್‌ಅಳತೆಗಳನಿಖರತೆಯನ್ನುನಿರ್ಣಯಿಸುವಗುರಿಯನ್ನುಹೊಂದಿದೆ.

ರೋಗಿಯುಮತ್ತುಹಾಜರಾದವರಿಗೆಅಲ್ಟ್ರಾಸೌಂಡ್ಮಾರ್ಗದರ್ಶನದಲ್ಲಿಡಾನ್ಮಾಡುವಕಾರ್ಯವಿಧಾನದಬಗ್ಗೆಸಂಪೂರ್ಣವಾಗಿವಿವರಿಸಲಾಗುವುದು.
ಅಧ್ಯಯನದಉದ್ದಕ್ಕೂಯಾವುದೇರೀತಿಯಪಾವತಿ/ಖರೀದಿಅಗತ್ಯವಿದ್ದರೆ,
ಅದನ್ನುತನಿಖಾಧಿಕಾರಿಯುಸಂಪೂರ್ಣವಾಗಿಭರಿಸಬೇಕಾಗುತ್ತದೆ.
ಅಧ್ಯಯನದಉದ್ದಕ್ಕೂರೋಗಿಗೆಯಾವುದೇಹೆಚ್ಚುವರಿವೆಚ್ಚವನ್ನುವಿಧಿಸಲಾಗುವುದಿಲ್ಲ

ದಯವಿಟ್ಟುಮೇಲಿನಮಾಹಿತಿಯನ್ನುಓದಿಮತ್ತುನಿಮ್ಮಕುಟುಂಬಸದಸ್ಯರೊಂದಿಗೆಚರ್ಚಿಸಿ.
ಅಧ್ಯಯನಕ್ಕೆಸಂಬಂಧಿಸಿದಂತೆನೀವುಯಾವುದೇಪ್ರಶ್ನೆಯನ್ನುಕೇಳಬಹುದು.
ನೀವುಅಧ್ಯಯನದಲ್ಲಿಭಾಗವಹಿಸಲುಒಪ್ಪಿದರೆನಾವುಅಗತ್ಯವಿರುವಮಾಹಿತಿಯನ್ನುಸಂಗ್ರಹಿಸುತ್ತೇವೆಮತ್ತುಸಂಬಂಧಿತಇತಿಹಾಸವನ್ನುತೆಗೆದುಕೊಳ್ಳುತ್ತೇವೆ.
ಸಂಗ್ರಹಿಸಿದಮಾಹಿತಿಯನ್ನುಪ್ರಬಂಧಮತ್ತುಪ್ರಕಟಣೆಗೆಮಾತ್ರಬಳಸಲಾಗುತ್ತದೆ.

ನಿಮ್ಮಿಂದಸಂಗ್ರಹಿಸಲಾದಎಲ್ಲಾಮಾಹಿತಿಯನ್ನುಗೌಪ್ಯವಾಗಿಇರಿಸಲಾಗುತ್ತದೆಮತ್ತುಯಾವು ದೇಹೊರಗಿನವರಿಗೆಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ.

ನಿಮ್ಮಗುರುತನ್ನುಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ.

ಈಅಧ್ಯಯನವನ್ನುಒಪ್ಪಿಕೊಳ್ಳಲುಯಾವುದೇಒತ್ತಾಯವಿಲ್ಲ.

ನೀವುಭಾಗವಹಿಸಲುಬಯಸದಿದ್ದರೆನೀವುಪಡೆಯುವಕಾಳಜಿಯುಬದಲಾಗುವುದಿಲ್ಲ.

ಈಅಧ್ಯಯನದಲ್ಲಿಭಾಗವಹಿಸಲುನೀವುಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದಸಮ್ಮತಿಸಿದರೆಮಾತ್ರನೀವುಸ ಹಿ/ಹೆಬ್ಬೆರಳಿನಗುರುತನ್ನುಒದಗಿಸಬೇಕಾಗುತ್ತದೆ.

ಹೆಚ್ಚಿನಮಾಹಿತಿಗಾಗಿಸಂಪರ್ಕಿಸಿ:

ಡಾ.ಅಖಿಲ್ಕುಮಾರ್

(ಪ್ರಧಾನತನಿಖಾಧಿಕಾರಿ)

ಸಂಪರ್ಕಸಂಖ್ಯೆ: 7907847327

INFORMED CONSENT FORM

Sl no:

Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing spinal Anaesthesia

Date:

I, ____ aged _____________,
have been Explained in an understandable language about the purpose of the

Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing spinal Anaesthesia

Hence, hereby I give my valid written informed consent without any force or prejudice to be part of the study.

The nature and risks involved have been explained to me to my understanding and satisfaction. I have been 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 understand throughout the study if any form of payment/purchase is necessary, it will be completely borne by the investigator. I will not be charged any extra cost throughout the study.

I consent voluntarily to take part as a participant in this research. I hereby give my full valid 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 videographed 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.

Patient's consent (Signature/Thumb impression): ______________________

Name of patient: _______________________

Witness 1 (Signature/Thumb impression): ______________________

Name of witness 1: __________________________________

Relationship to patient: __________________________________

Research/Study conducting Doctor's signature: ______________________

Name of Doctor: Dr. Akhil Kumar (Principal investigator)

ಮಾಹಿತಿನೀಡಿದಒಪ್ಪಿಗೆನಮೂನೆ

ಎಸ್ಎಲ್ಸಂಖ್ಯೆ

ಬೆನ್ನುಮೂಳೆಯಅರಿವಳಿಕೆಗೆಒಳಗಾಗುವರೋಗಿಗಳವಯಸ್ಸು, ಲಿಂಗ, ತೂಕ, ಎತ್ತರಮತ್ತು BMI ಯೊಂದಿಗೆಅಲ್ಟ್ರಾಸೌಂಡ್ಮಾರ್ಗದರ್ಶನಮತ್ತುಪರಸ್ಪರಸಂಬಂಧವನ್ನುಬಳಸಿಕೊಂಡು L4 ಮತ್ತು L5 ಇಂಟರ್ಸ್ಪೇಸ್ನಡುವಿನಟಫಿಯಸ್ಲೈನ್ಅಂತರದಮೌಲ್ಯಮಾಪನ

ದಿನಾಂಕ:

ನಾನು,

____

________________________________ , ಅಲ್ಟ್ರಾಸೌಂಡ್ಮಾರ್ಗದರ್ಶನವನ್ನುಬಳಸಿಕೊಂಡು L4 ಮತ್ತು L5 ಇಂಟರ್ಸ್ಪೇಸ್ನಡುವಿನಟಫಿಯಸ್ಲೈನ್ಅಂತರದಮೌಲ್ಯಮಾಪನಮತ್ತುವಯಸ್ಸು, ಲಿಂಗ, ತೂಕ, ಎತ್ತರಮತ್ತುಪ್ಯಾಟ್ನಅಡಿಯಲ್ಲಿ BMI ಯೊಂದಿಗಿನಪರಸ್ಪರಸಂಬಂಧದಅಧ್ಯಯನದಉದ್ದೇಶದಬಗ್ಗೆಅರ್ಥವಾಗುವಭಾಷೆಯಲ್ಲಿವಿವರಿಸಲಾಗಿದೆ. ಸ್ಪೈನಲ್ಅರಿವಳಿಕೆಆದ್ದರಿಂದ, ಈಮೂಲಕನಾನುಅಧ್ಯಯನದಭಾಗವಾಗಲುಯಾವುದೇಬಲಅಥವಾಪೂರ್ವಾಗ್ರಹವಿಲ್ಲದೆನನ್ನಮಾನ್ಯಲಿಖಿತತಿಳುವಳಿಕೆಯನ್ನುನೀಡುತ್ತೇನೆ.

ಒಳಗೊಂಡಿರುವಸ್ವಭಾವಮತ್ತುಅಪಾಯಗಳನ್ನುನನ್ನತಿಳುವಳಿಕೆಮತ್ತುತೃಪ್ತಿಗೆವಿವರಿಸಲಾಗಿದೆ. ನಡೆಸುತ್ತಿರುವಅಧ್ಯಯನದಬಗ್ಗೆನನಗೆವಿವರವಾಗಿವಿವರಿಸಲಾಗಿದೆ. ನಾನುರೋಗಿಯಮಾಹಿತಿಹಾಳೆಯನ್ನುಓದಿದ್ದೇನೆಮತ್ತುಯಾವುದೇಪ್ರಶ್ನೆಯನ್ನುಕೇಳಲುನನಗೆಅವಕಾಶವಿದೆ. ನಾನುಕೇಳಿದಯಾವುದೇಪ್ರಶ್ನೆಗೆನನ್ನತೃಪ್ತಿಗೆಉತ್ತರಿಸಲಾಗಿದೆ. ಯಾವುದೇರೀತಿಯಪಾವತಿ/ಖರೀದಿಅಗತ್ಯವಿದ್ದಲ್ಲಿಅದನ್ನುಸಂಪೂರ್ಣವಾಗಿತನಿಖಾಧಿಕಾರಿಯೇಭರಿಸಬೇಕಾಗುತ್ತದೆಎಂದುನಾನುಅಧ್ಯಯನದಉದ್ದಕ್ಕೂಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ. ಅಧ್ಯಯನದಉದ್ದಕ್ಕೂನನಗೆಯಾವುದೇಹೆಚ್ಚುವರಿವೆಚ್ಚವನ್ನುವಿಧಿಸಲಾಗುವುದಿಲ್ಲ.

ಈಸಂಶೋಧನೆಯಲ್ಲಿಪಾಲ್ಗೊಳ್ಳುವವರಾಗಿಭಾಗವಹಿಸಲುನಾನುಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದಸಮ್ಮತಿಸುತ್ತೇನೆ. ನನ್ನಇತಿಹಾಸವನ್ನುಒದಗಿಸಲು, ದೈಹಿಕಪರೀಕ್ಷೆಗೆಒಳಗಾಗಲು, ಕಾರ್ಯವಿಧಾನಕ್ಕೆಒಳಗಾಗಲು, ತನಿಖೆಗೆಒಳಗಾಗಲುಮತ್ತುಅದರಫಲಿತಾಂಶಗಳುಮತ್ತುದಾಖಲೆಗಳನ್ನುಇತ್ಯಾದಿಗಳನ್ನುವೈದ್ಯರು /

ಸಂಸ್ಥೆಇತ್ಯಾದಿಗಳಿಗೆಒದಗಿಸಲುನಾನುಈಮೂಲಕನನ್ನಸಂಪೂರ್ಣಮಾನ್ಯಒಪ್ಪಿಗೆಯನ್ನುನೀಡುತ್ತೇನೆ. ಶೈಕ್ಷಣಿಕಮತ್ತುವೈಜ್ಞಾನಿಕಉದ್ದೇಶಕ್ಕಾಗಿ, ಕಾರ್ಯಾಚರಣೆ / ಕಾರ್ಯವಿಧಾನಇತ್ಯಾದಿಗಳನ್ನುವೀಡಿಯೊಗ್ರಾಫ್ಮಾಡಬಹುದುಅಥವಾಛಾಯಾಚಿತ್ರ.

ಎಲ್ಲಾಡೇಟಾವನ್ನುಪ್ರಕಟಿಸಬಹುದುಅಥವಾಯಾವುದೇಶೈಕ್ಷಣಿಕಉದ್ದೇಶಕ್ಕಾಗಿಬಳಸಬಹುದು. ಕಾರ್ಯವಿಧಾನ / ಅಧ್ಯಯನದಸಮಯದಲ್ಲಿಯಾವುದೇಅಹಿತಕರಪರಿಣಾಮಗಳಿಗೆನಾನುವೈದ್ಯರು / ಸಂಸ್ಥೆಇತ್ಯಾದಿಗಳನ್ನುಹೊಣೆಗಾರರನ್ನಾಗಿಮಾಡುವುದಿಲ್ಲ.

ಈತಿಳುವಳಿಕೆಯುಳ್ಳಒಪ್ಪಿಗೆನಮೂನೆಯಪ್ರತಿಯನ್ನುಮತ್ತುರೋಗಿಯಮಾಹಿತಿಹಾಳೆಯನ್ನುಭಾಗವಹಿಸುವವರಿಗೆಒದಗಿಸಲಾಗಿದೆ.

ರೋಗಿಯಒಪ್ಪಿಗೆ (ಸಹಿ/ಹೆಬ್ಬೆರಳಿನಗುರುತು): ____________________

ರೋಗಿಯಹೆಸರು: ______________________

ಸಾಕ್ಷಿ 1 (ಸಹಿ/ಹೆಬ್ಬೆರಳಿನಗುರುತು): ______________________

ಸಾಕ್ಷಿಯಹೆಸರು 1: _________________________________

ರೋಗಿಗೆಸಂಬಂಧ: ______________________________

ಸಂಶೋಧನೆ/ಅಧ್ಯಯನನಡೆಸುವವೈದ್ಯರಸಹಿ: ____________________

ವೈದ್ಯರಹೆಸರು: ಡಾ. ಅಖಿಲ್ಕುಮಾರ್ (ಪ್ರಧಾನತನಿಖಾಧಿಕಾರಿ)

MASTER CHART

"Ultrasound guided assessment of the Tuffier's Line distance from L4-L5 interspace and its correlation between Anthropometric measurements of patients undergoing Spinal Anaesthesia"

SL. NO	UHID	AGE	SEX	HEIGHT	WEIGHT	BMI	L4-L5 DISTANCE FROM TUFFIER'SLINE IN CM	DIAGNOSIS	SURGERY
1	470628	59	M	164	56	20.8	2.5	BPH	TURP
2	466052	76	M	158	56	22.4	2.2	BPH	TURP
3	469714	33	M	149	62.5	28.2	1.8	LEFT URETRIC CALCULUS	URSL
4	484530	50	M	164	80	29.7	2.4	LEFT LEG NECROTISING FASICITIS	FACIOTOMY
5	485778	25	F	158	56	22.4	2.2	FISSURE IN ANO	SPINCTEROTOMY
6	407518	41	M	177	65	20.7	2.8	ACUTE APPENDICITIS	APPENDISECTOMY
7	448505	36	M	183	72.9	21.8	2.9	URETRAL STRICTURE	CYSTOSCOPY
8	470305	33	F	168	62	22	2.6	ACUTE APPENDICITIS	APPENDISECTOMY
9	461652	41	M	160	55	21.5	2.5	PERIANAL ABCESS	INCISION AND DRAINAGE
10	464424	43	F	150	55	24.4	1.9	CULLULITIS RT LEG	ABOVE KNEE AMPUTATION
11	453280	68	M	155	51	21.2	2.2	NON-HEALING ULCER RT LEG	WOUND DEBRIDEMENT
12	434448	62	M	150	52	23.1	1.6	S/P FACIOTOMY	SPLIT SKIN GRAFTING
13	457080	72	M	150	50	22.2	1.8	INDIRECT INGUINAL HERNIA	LICHENSTEIN HERNIOPLASTY
14	466688	31	M	166	75	27.2	2.5	SCROTAL HERNIA	HERNOPLASTY
15	473987	60	M	150	53	23.6	1.7	INGUINA HERNIA	HERNIOPLASTY
16	150824	24	F	150	41	18.2	1.8	FISSURE IN ANO	ANAL SPINCTREROTOMY
17	470020	26	M	171	89	30.4	2.7	VARICOCELE	VARICOSELECTOMY
18	471978	49	M	162	62	23.6	2.4	EXTRERNAL HEMMAROID	HEMMAROIDECTOMY
19	466467	74	M	163	63	23.7	2.3	HEALING ULCER LT FOOT	SPLIT SKIN GRAFTING
20	297135	48	M	174	76	25.1	2.6	NON-HEALING ULCER LT FOOT	WOUND DEBRIDEMENT

21	464412	67	M	168	60	21.3	2.5	RT. DISTAL FEMURENCHONDRA	BIOPSY/ SAB
22	297141	22	M	170	60	20.8	2.5	CRUSHING INJURY OF 3rd TOE OF LEFT FOOT	WOUND DEBRIDEMENT, AMPUTATION, K-WIRE FIXATION
23	461652	62	F	160	56	21.9	2.5	RT FEMUR IT #	CRIF, PFN FIXATION
24	464434	29	M	170	60	20.8	2.8	NEAR COMPLETE TEAR OF RT ACL	ARTHROSCOPIC RECONSTRUCTION ON ……SAB
25	454280	70	M	170	60	20.8	2.5	LEFT FIBULAR # extensor tendon injury	ORIF, LONG PLATE FIXATION FOR LEFT FIBULA#
26	434348	60	F	147	40	18.5	1.3	NECK OF FEMUR # L SIDE	BIPOLAR HEMIARTHROPLASTY
27	457180	72	M	165	60	22	2.5	WOUND OVER THE RT LEG	SSG
28	460163	35	M	165	64	23.5	2.4	P/O/C/O ABOVE KNEE AMPUTATION OF RT. LL	WOUND DEBRIMENT
29	431340	60	F	158	50	20	2	RT.IT #	CRIF, LONG PFN FIXATION FOR RT. LL
30	490040	30	M	178	73	23	2.8	LEFT LEG BOTH BONE #	ORIF/CRIF, PLATING/NAILING FOR LT. TIBIN RUSH PIN FOR LT. FIBULA
31	477264	55	M	168	65	23	2.7	CELLULITIS OF LEFT LL	WOUND DEBRIMENT
32	496580	41	M	160	72	28.1	2.2		FACIOTOMY
33	496723	15	M	130	40	23.7	0.8	CLOSED DISPLACES NECK OF FEMUR # OF R FEMUR	CRIF + SCREW FIXATION
34	419040	70	F	152	55	23.8	1.7	DAFECTED RAW WOUND OVER L FOOT & ANKLE	STSG
35	335461	46	F	155	70	29.1	2	AVB	TAH
36	413504	43	F	150	50	22.2	1.8	P3 L3/CA CERVIX IIB SCC	ISBT
37	348926	29	F	150	75	33.3	2	GsP2L2/ 37 W 5d GA C CEPHALIC ….PREVIOUS LSCS	ELECTIVE LSCS
38	458014	42	F	150	54	24	1.8	P2L2/AVB LEIOMYOMA	TAH, BSO
39	456226	50	F	182	75	22.6	2.9	P2L1P1 AVB LEIOMYOMA	TAH, BSO
40	461645	56	F	175	48	15.7	2.6	P2L2A1 AVB LEIOMYOMA	TAH, BSO
41	471628	59	M	164	56	20.8	2.3	BPH	TURP
42	465853	45	M	178	55	17.4	2.7	LACERATED WOUND	PRIMARY SUTURING
43	113636	15	M	159	53	21	2.1	HYDRONEPHROSIS	DJ STENTING
44	460039	23	M	152	73	31.6	2	PROXIMAL URETRIC CALCULUS	URSL PLUS DJ STENTING
45	460263	52	M	161	62	23.9	2.3	URETRIC CALCULUS	URSL PLUS DJ STENTING
46	493440	63	M	160	68	26.6	2.5	WET GANGRENE RIGHTG FOOT	WOUND DEBRIDEMENT
47	490080	50	M	184	100	30.9	3	LEFT INGUINAL HERNIA	LICHENSTEIN HERNIOPLASTY

48	470476	54	F	150	72	32	1.8	UMBILICAL HERNIA	MESH REPAIR
49	494738	46	F	150	50	22.2	1.6	VARICOCE VEIN RIGHT LEG	TRENDLENDBURG PROCEDURE
50	494829	27	F	178	87	27.5	2.6	FISSURE IN ANO	FISSURECTOMY
51	490040	30	M	178	73	23	2.8	LEFT LEG BOTH BONE #	ORIF/CRIF, PLATING/NAILING FOR LT. TIBIN RUSH PIN FOR LT. FIBULA
52	477264	55	M	168	65	23	2.7	CELLULITIS OF LEFT LL	WOUND DEBRIMENT
53	496580	41	M	160	72	28.1	2.2	post snake bite	FACIOTOMY
54	496723	15	M	130	40	23.7	0.8	CLOSED DISPLACES NECK OF FEMUR # OF R FEMUR	CRIF + SCREW FIXATION
55	419040	70	F	152	55	23.8	1.7	DAFECTED RAW WOUND OVER L FOOT & ANKLE	STSG
56	335461	46	F	155	70	29.1	2	AVB	TAH
57	413504	43	F	150	50	22.2	1.8	P3 L3/CA CERVIX IIB SCC	ISBT
58	348926	29	F	150	75	33.3	2	previous 2 lscs	abdominal tubectomy
59	458014	42	F	150	54	24	1.8	P2L2/AVB LEIOMYOMA	TAH, BSO
60	456226	50	F	182	75	22.6	2.9	P2L1P1 AVB LEIOMYOMA	TAH, BSO
61	461645	56	F	175	48	15.7	2.6	P2L2A1 AVB LEIOMYOMA	TAH, BSO
62	516361	59	M	164	56	20.8	2.5	BPH	TURP
63	508374	76	M	158	56	22.4	2.2	BPH	TURP
64	511252	33	F	149	62.5	28.2	1.8	LEFT URETRIC CALCULUS	URSL
65	516175	50	M	164	80	29.7	2.4	LEFT LEG NECROTISING FASICITIS	FACIOTOMY
66	517595	25	F	158	56	22.4	2.2	FISSURE IN ANO	SPINCTEROTOMY
67	518137	41	M	177	65	20.7	2.8	ACUTE APPENDICITIS	APPENDISECTOMY
68	518008	36	M	183	72.9	21.8	2.9	URETRAL STRICTURE	CYSTOSCOPY
69	513452	33	M	168	62	22	2.6	ACUTE APPENDICITIS	APPENDISECTOMY
70	517477	41	F	160	55	21.5	2.5	PERIANAL ABCESS	INCISION AND DRAINAGE
71	518456	43	M	150	55	24.4	1.9	CULLULITIS RT LEG	ABOVE KNEE AMPUTATION
72	510122	68	F	155	51	21.2	2.2	NON-HEALING ULCER RT LEG	WOUND DEBRIDEMENT
73	516696	62	M	150	52	23.1	1.6	S/P FACIOTOMY	SPLIT SKIN GRAFTING
74	516087	72	F	150	50	22.2	1.8	INDIRECT INGUINAL HERNIA	LICHENSTEIN HERNIOPLASTY
75	473341	31	M	166	75	27.2	2.5	SCROTAL HERNIA	HERNOPLASTY
76	518002	60	F	150	53	23.6	1.7	INGUINA HERNIA	HERNIOPLASTY

77	517265	24	M	150	41	18.2	1.8	FISSURE IN ANO	ANAL SPINCTREROTOMY
78	514767	26	M	171	89	30.4	2.7	VARICOCELE	VARICOSELECTOMY
79	514857	49	M	162	62	23.6	2.4	EXTRERNAL HEMMAROID	HEMMAROIDECTOMY
80	513452	74	M	163	63	23.7	2.3	HEALING ULCER LT FOOT	SPLIT SKIN GRAFTING
81	514723	48	M	174	76	25.1	2.6	NON-HEALING ULCER LT FOOT	WOUND DEBRIDEMENT
82	409947	67	M	168	60	21.3	2.5	RT. DISTAL FEMURENCHONDRA	BIOPSY/ SAB
83	307525	22	M	170	60	20.8	2.5	CRUSHING INJURY OF 3rd TOE OF LEFT FOOT	WOUND DEBRIDEMENT, AMPUTATION, K-WIRE FIXATION
84	513441	62	F	160	56	21.9	2.5	RT FEMUR IT #	CRIF, PFN FIXATION
85	514753	29	M	170	60	20.8	2.8	NEAR COMPLETE TEAR OF RT ACL	ARTHROSCOPIC RECONSTRUCTION ON ……SAB
86	510878	70	M	170	60	20.8	2.5	LEFT FIBULAR # extensor tendon injury	ORIF, LONG PLATE FIXATION FOR LEFT FIBULA#
87	370125	60	F	147	40	18.5	1.3	NECK OF FEMUR # L SIDE	BIPOLAR HEMIARTHROPLASTY
88	511893	72	M	165	60	22	2.5	WOUND OVER THE RT LEG	SSG
89	428144	35	M	165	64	23.5	2.4	LOWER LIMB CELLULITIS	WOUND DEBRIMENT
90	370521	60	F	158	50	20	2	LEFT IT #	CRIF, LONG PFN FIXATION FOR LT. LL
91	500954	30	M	178	73	23	2.8	RIGHT BOTH BONE #	ORIF/CRIF, PLATING/NAILING FOR LT. TIBIN RUSH PIN FOR RT.FIBULA
92	479482	55	M	168	65	23	2.7	CELLULITIS	WOUND DEBRIMENT
93	412578	41	M	160	72	28.1	2.2		FACIOTOMY
94	512195	15	M	130	40	23.7	0.8	CLOSED DISPLACES NECK OF FEMUR # OF RIGHT FEMUR	CRIF + SCREW FIXATION
95	573142	70	F	152	55	23.8	1.7	DAFECTED RAW WOUND OVER L FOOT & ANKLE	WOUND DEBRIDEMENT
96	428415	46	F	155	70	29.1	2	AVB	TAH
97	522143	43	F	150	50	22.2	1.8	P3 L3/CA CERVIX IIB SCC	ISBT
98	541365	29	F	150	75	33.3	2	GsP2L2/ 37 W 5d GA C CEPHALIC ….PREVIOUS LSCS	ELECTIVE LSCS
99	374512	89	M	178	75	27	2.2	GRADE 4 BPH	TURP
100	331589	60	F	158	52	20	2	UMBLICAL HERNIA	MESH REPAIR