AN OBSERVATIONAL STUDY OF EPIDURAL CATHETER INSERTION ON OVERWEIGHT PATIENTS USING EPIDURAL DEPTH CALCULATION

Dissertation submitted

IN THE PARTIAL FULFILMENT OF THE REQUIREMENTS

for award of the degree

M.D (Anaesthesiology) –

BRANCH X

GOVERNMENT CHENGALPATTU MEDICAL COLLEGE

Reg. No. 201720252

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

CHENNAI, TAMIL NADU.

OCTOBER 2020

CERTIFICATE

This is to certify that this dissertation entitled **"AN OBSERVATIONAL STUDY OF EPIDURAL CATHETER INSERTION ON OVERWEIGHT PATIENTS USING EPIDURAL DEPTH CALCULATION"** submitted by **DR R KAVYA** in partial fulfilment for the award of the degree Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr. M.G.R. Medical University, Chennai is a bonafide work done by her at Government Chengalpattu Medical College, during the academic year 2017- 2020.

Dean,
Govt. Chengalpattu Medical College,
Chengalpattu.

Prof.Dr.R. Mala M.D.,D.A,
Professor & HOD,
Department of Anaesthesiology,
Govt. Chengalpattu Medical College,
Chengalpattu

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BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **"AN OBSERVATIONAL STUDY OF EPIDURAL CATHETER INSERTION ON OVERWEIGHT PATIENTS USING EPIDURAL DEPTH CALCULATION"** submitted by **DR R KAVYA** in partial fulfilment for the award of the degree of Doctor of Medicine in Anaesthesiology for the october 2020 examination by the Tamilnadu Dr. M.G.R. Medical University, Chennai.

This is a bonafide original research work done by her in the Department of Anaesthesiology, Government Chengalpattu Medical College, under my guidance and supervision.

Prof.Dr.R. MALA M.D.,D.A.,
Professor & HOD,
Department of Anaesthesiology,
Govt. Chengalpattu Medical College, Chengalpattu.

DECLARATION

I, **DR R KAVYA** solemnly declare that this dissertation, entitled **"AN OBSERVATIONAL STUDY OF EPIDURAL CATHETER INSERTION ON OVERWEIGHT PATIENTS USING EPIDURAL DEPTH CALCULATION"** has been prepared by me under the expert guidance and supervision of Prof. **Dr. R.MALA M.D., D.A** Professor and HOD, Department of Anaesthesiology, Government Chengalpattu Medical College and Hospital and submitted in partial fulfilment of the regulations for the award of the degree M.D.(Anaesthesiology) by The TamilNadu Dr. M.G.R. Medical University and the examination to be held in October 2020.

This study was conducted at Government Chengalpattu Medical College Hospital, Chengalpattu. I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Place: Chengalpattu **(DR. R KAVYA)**

Date:

ACKNOWLEDGEMENT

I wish to express my sincere thanks to the **Dean** Government Chengalpattu Medical College, for having kindly permitted me to utilize the facilities of the college for the conduct of the study.

I am grateful to the Professor and Head of the Department of Anaesthesiology, Government Chengalpattu Medical College, **Prof. Dr. R.MALA M.D.,D.A.,** for her motivation, valuable suggestions, expert guidance, advice and for providing all necessary arrangements for conducting the study.

I also express my sincere gratitude to all the other Professors of Anaesthesiology, Government Chengalpattu Medical College for their constant motivation, encouragement and valuable suggestions.

I thank all the Assistant Professors of Anaesthesiology CMCH for their keen interest and support without which this study would not have been possible.

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

I express my gratitude to **Dr. R VIJAYENDIRAN M.D.,D.A,** Assistant Professor, Department of Anaesthesiology, Government Chengalpattu medical college for his constant support and advice.

I am very thankful to **Dr. V BALASUBRAMANIAN AND DR JUSTIN D** for his help in doing my statistical analysis.

I thank the Department of Surgery, CMCH , the faculty members for their kind cooperation and permitting me to use the hospital facilities for the study. I also thank the theatre personnel for their co-operation and assistance.

I wish to thank all the patients whose willingness and patience made this study possible.

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ABBREVIATIONS

BMI	BODY MASS INDEX
CAD	CORONARY ARTERY DISEASE
EDS	EPIDURAL DEPTH SPACE
PDPH	POST DURAL PUNCTURE HEADACHE
LOR	LOSS OF RESISTANCE
CSF	CEREBROSPINAL FLUID
CPAP	CONTINUOUS POSITIVE AIRWAY PRESSURE
RAMP	RAPD AIRWAY MANAGEMENT POSITIONER
DVT	DEEP VEIN THROMBOSIS
LFT	LIVER FUNCTION TEST
OSA	OBSTRUCTIVE SLEEP APNEA
REM	RAPID EYE MOVEMENT
IVC	INFERIOR VENA CAVA
CT	COMPUTED TOMOGRAPHY
SES	SKIN TO EPIDURAL SPACE

INTRODUCTION

Obesity is considered to be worldwide epidemic with associated comorbidities. Regarding anaesthetic management in obese individual proper prior planning should be done. Regional anaesthesia especially epidural anaesthesia is increasing used among increasing BMI patients due to difficult intubation.(1)

The prevalence of obesity is 1.6 billion as overweight individuals and 400 million as obese adults. WHO mainly classify obesity based on BMI.(2)

Whereas BMI = Weight in kg / Height in m^2

WHO Classification of obesity

WHO Classification of obesity	
Normal weight	BMI 18.9–24.9 kg/m^2,
Overweight	BMI 25–29.9 kg/m^2
obese	BMI >30 kg/m^2.
obesity class 1	BMI 30–34.9 kg/m^2
obesity class II	BMI 35–39.9 kg/m^2
obesity class III	BMI >40 kg/m^2
morbid obesity	BMI >40 kg/m^2
super obesity	BMI >50 kg/m^2

The physiological and anatomical changes associated with obesity, introduce multiple challenges for the anaesthetic management. Compared to normal weight individual, the increased BMI population are more prone for development of complications such as hypertension, diabetes, CAD hypothyroidism, and higher rates of Caesarean section preeclampsia ,gestational diabetes among obese parturient.[3]

Difficult intubation among the obese especially during induction of general anaesthesia is one of the most recognized causes of mortality, with a reported $1:250$ incidence of failed intubation in the obstetric population, compared to $1:2{,}280$ incidence in the general population . Increases in Mallampati scores have been correlated with increased BMI, due to deposition of fat and edema in the upper airway, increased risk for pulmonary aspiration and inadequate ventilation are also seen among obese individuals. hence proper placement of epidural catheter placement is required to prevent morbidity and mortality related to general anaesthesia. [4]

Even though regional anaesthesia has an upper hand compared to general anaesthesia, the increased amount of subcutaneous adipose tissue can pose for a great challenge for the anaesthesiologist. Other reason for failure of epidural anaesthesia can be due to inability to guide the needle through the interspinous ligament, false-positive identification of entry into the EDS due to excessive fat, difficulty in advancement of the needle due ligament calcification, malposition or dislodgement of the epidural catheter. Apart from the failure of epidural

anaesthesia, epidural placement is also associated with complications such as post dural puncture head ache (PDPH), inadvertent subarachnoid, subdural, or epidural venous placement, and epidural hematoma. Among the complications mentioned above postdural puncture headache following inadvertent dural puncture, is associated with a longer hospital stay.

Obesity constitutes a worldwide epidemic with prevalence rates which are increasing in most Western societies and in the developing world. By 2025, if this trend continues, the global obesity prevalence will reach 18% in men and exceed 21% in women. Furthermore, it is now well-established that obesity (depending on the degree, duration, and distribution of the excess weight/adipose tissue) can progressively cause and/or exacerbate a wide spectrum of co-morbidities, including type 2 diabetes mellitus, hypertension, dyslipidaemia, cardiovascular disease, non-alcoholic fatty liver disease, reproductive dysfunction, respiratory abnormalities, psychiatric conditions, and even increase the risk for certain types of cancer. [(3)]

Thus, usage of the below formula helps in identification of the epidural space depth and there by one can avoid accidental puncture to the subarachnoid space and false positivity of the epidural space. The formula given below has been studied by Sukdip et al exclusively among morbidly obese parturient along with pre procedural ultrasound. The formula is being elicited from the previous study done in there institution. In this study the same formula is being used in

Indian scenario among the overweight population of BMI 25 to 29.9kg/m^2 undergoing surgeries

EPIDURAL DEPTH EQUATION (cm)=

$$6.63-\{0.07*HT(inches)\}+\{0.02*WT(pounds)\}$$ [5]

AIM AND OBJECTIVES

1) Aim and objective of the study is to calculate the distance between skin to the epidural space using the formula

EPIDURAL DEPTH EQUATION (CM)= 6.63-

{0.07*HT(inches)}+{0.02*WT(pounds)}[5]

Prior to the conventional epidural catheter placement among overweight patients with BMI of 25 to 29.9 kg/m^2undergoing surgeries.

2) To compare the actual epidural depth space with the estimated epidural depth.

HISTORY OF EPIDURAL ANAESTHESIA.

In 1885, LEONARD CORNING, a neurologist, wanted to assess the action of cocaine by injecting the drug into subarachnoid space of a dog and was found out to have rapid onset of motor blockage of the hind limbs. After that he accidently injected cocaine into the epidural space of an adult male who was addicted to masturbation there by accidently inventing the epidural anaesthesia. The anaesthesia was evident to the patient only after the second dose which lasted for 20 minutes. He also coined the term spinal anaesthesia.[6]

1895- Fernand cathelin introduced epidural anaesthesia in the sacral region (caudal anaesthesia). He also demonstrated that epidural space ends in the neck region by injecting Indian ink dye into the caudal region of a dog.[6]

In 1902, the term regional anaesthesia was coined by HARVEY CUSHING.[6]

1910- LAWEN described the anatomy of the spinal and the epidural space.[6]

1921- FPAGES used epidural anaesthesia for surgery .[6]

1939- DOGLIOTTI described epidural space in depth and wrote a book about the same in detail.[6]

In 1949, MARTINEZ CURBELO of Havana, Cuba performed continuous epidural anaesthesia using tuohy needle and a ureteral catheter. the same technique was used by JEAN ATHANASE SICARD for non-surgical purpose for the relief of back pain.[6]

1951 – CRAWFORD used epidural anaesthesia for thoracic surgery.[6]

EMBRYOLOGY OF THE EPIDURAL SPACE

Embryology and histology of the transverse section of the foetus and adult lumbar spine was studied and found that by 13th week, the epidural space found to be filled with connective tissue whereas the dura mater was attached to the posterior longitudinal ligament and three distinct stages had been formed which later differentiated progressively within the connective tissue into

a. Primary epidural space
b. Reduced primary epidural space
c. Secondary epidural

The primary and the reduced primary epidural space is mainly determined by the spinal cord and its dura mater whereas the secondary epidural space is mainly determined by the vertebral canal walls.

By 13 the week, the posterior longitudinal ligament attaches to the vertebral body and posterior edge of intervertebral disc and Anterior internal vertebral venous plexus is formed. At 15th week, the posterior longitudinal ligament divides into deep and superficial layers.

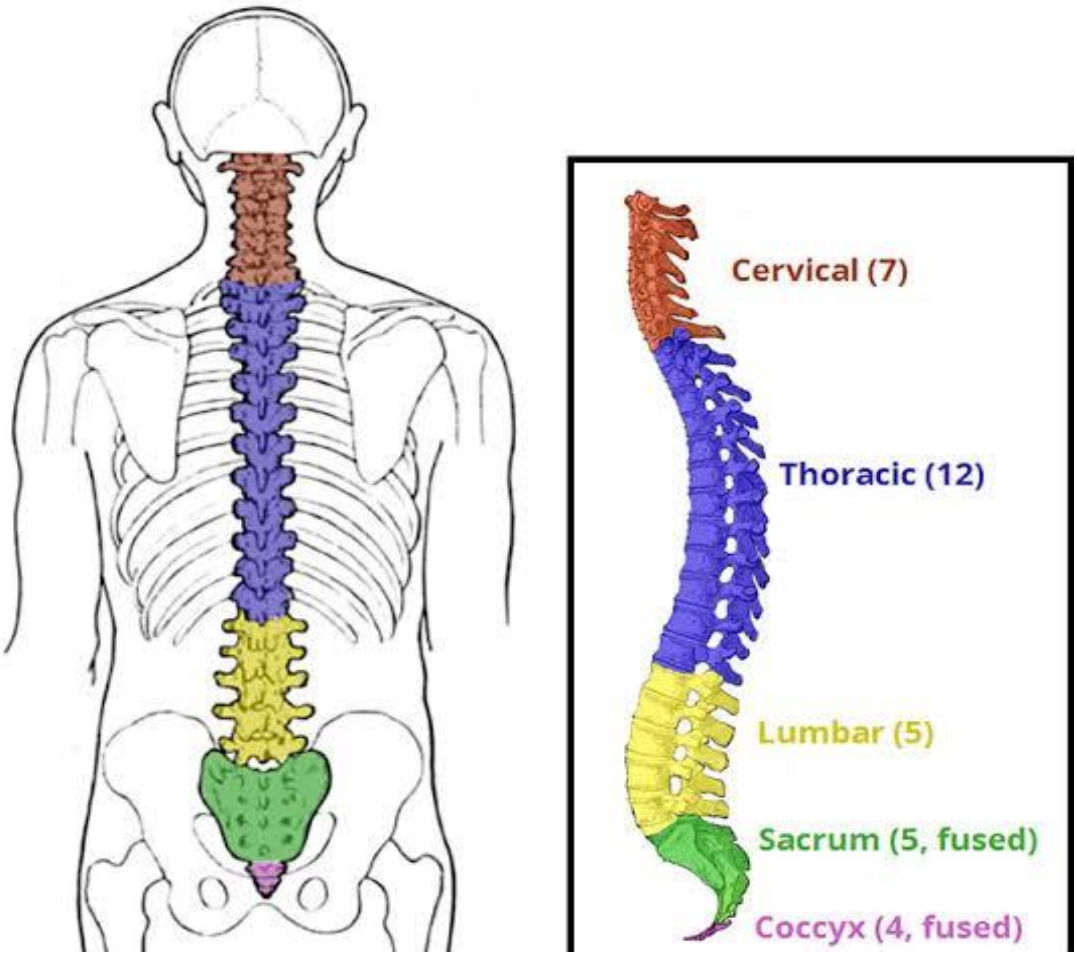
By 21-week, ligament like attachment occurs between dura and posterior longitudinal ligament

At 32 weeks, the dura mater gets adherent to the superficial layer of posterior longitudinal ligament.

At 39 weeks, adipocytes begin to develop within the epidural space

ANATOMY OF VERTEBRAL COLUMN

The vertebral column consists of 33 individual vertebrae. [7]



SPINAL CURVATURE

Normally vertebral column is S shaped with 4 curves at the level of cervical, thoracic, lumbar and sacral. Cervical and lumbar have convex curves, whereas thoracic and sacral have concave curves.

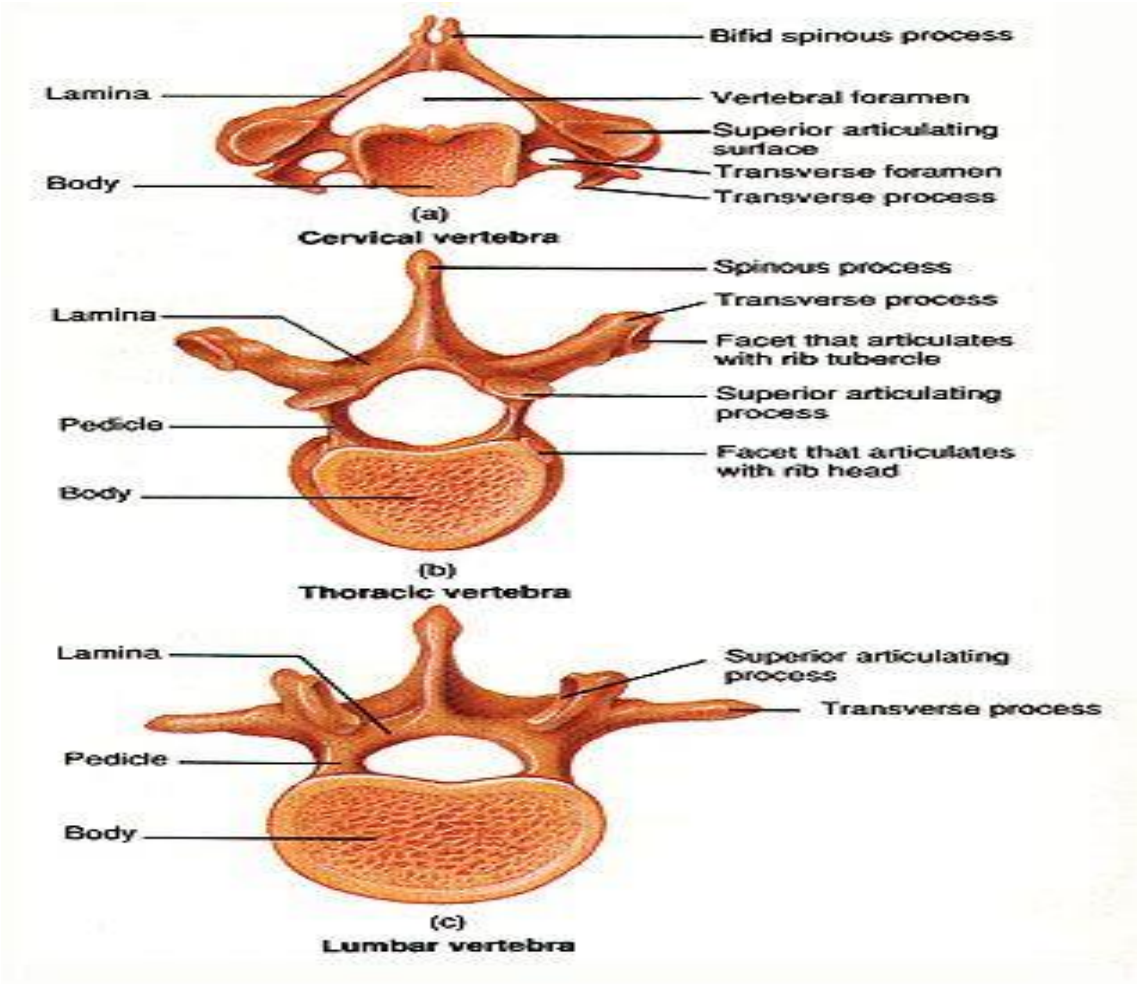
1) **CERVICAL**- there are 7 cervical vertebrae, they form the framework of neck region. Supports the head and are smaller in size. there are 2 transverse foramina and one vertebral foramen, they have short and bifid spinous process. They have smaller bodies, large vertebral arch,

2) **THORACIC**– they are 12 in number. They have larger body, long and angled spinous process with circular vertebral foramen. The transverse process projects posterolateral. They have three pairs of facets, 2 for the attachment of the ribs and 1 pair for the attachment of the transverse process.

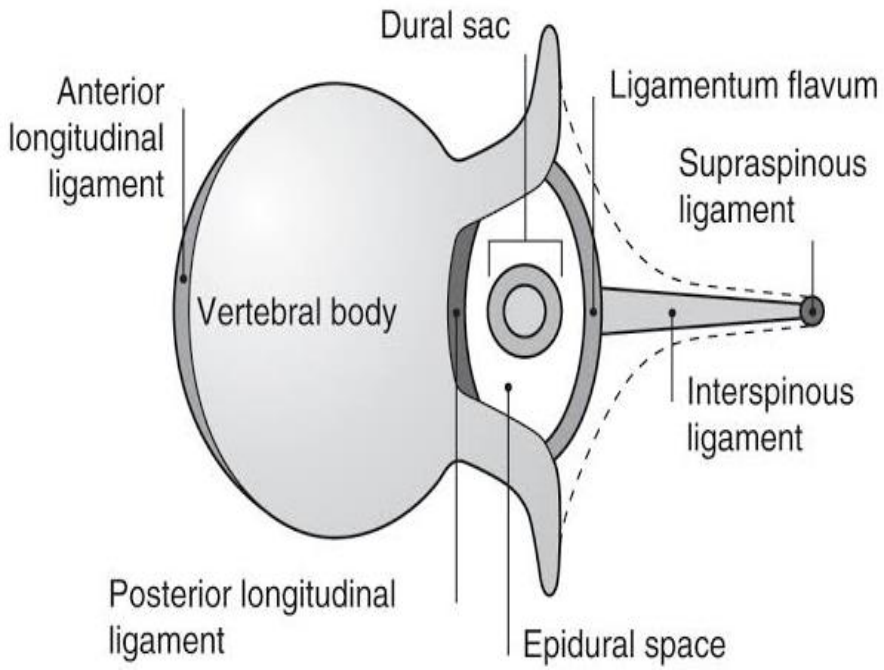
3) **LUMBAR** – there are 5 lumbar vertebrae. they have the thickest and the largest body since they are the weight bearing. they have thick and broad spinous process which project posteriorly for muscle attachment. They have one vertebral foramina.

4) **SACRAL VERTEBRAE** - they are 5 in number, though they are fused, remain rudimentary. They form the foundation for the pelvic girdle.

5) **COCCYX**– they are 4 in number, and are fused and inverted triangular in shape. Within the vertebral column epidural space and the subarachnoid space are present.



ANATOMY OF EPIDURAL SPACE



It is the space between the periosteum and the dura mater. Epidural space is a circular space surrounding the dura, it extends from foramen magnum to coccyx.

Cranially it is limited by the foramen magnum where the periosteal layer fuses with dura and

Caudally it extends up to sacrococcygeal membrane.

Anteriorly it is limited by posterior longitudinal ligament

Posteriorly by ligamentum flavum

Limited Laterally by the pedicles and intervertebral foramen [7]

TYPES OF EPIDURAL SPACE

The epidural space can be divided into cervical, thoracic, lumbar and sacral epidural spaces.

These spaces can be divided according to their margins. I.e. fusion of the periosteal layer to the dura.

1) Cervical epidural space- foramen magnum to lower margin of the 7th cervical vertebra.

2) Thoracic epidural space- lower margin of C7 to the upper margin of L1

3) The lumbar epidural space – lower margin of L1 vertebra to the upper margin of S1 vertebra.

4) The sacral epidural space – Upper margin of S1 to Sacrococcygeal membrane [7]

STRUCTURES PENETRATED DURING EPIDURAL PLACEMENT

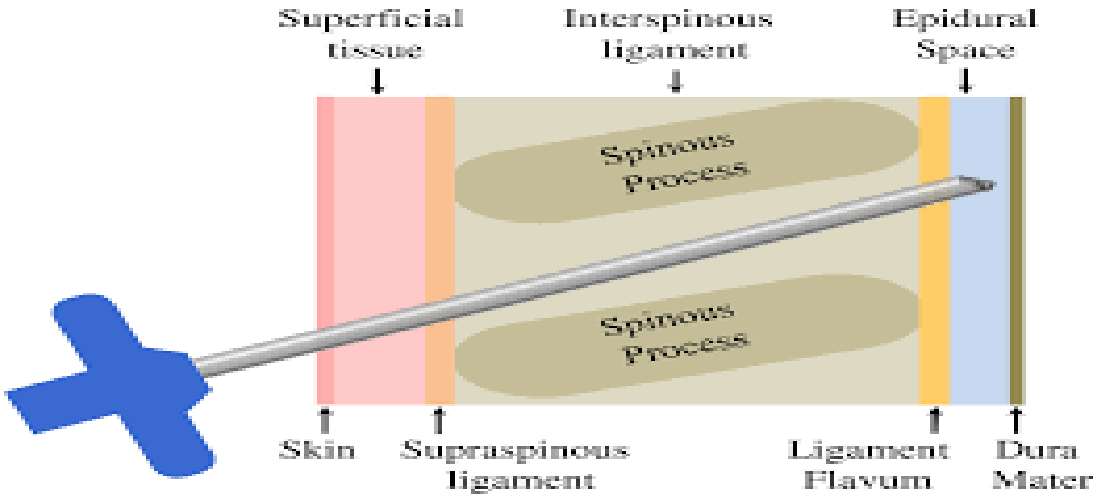
1) Skin

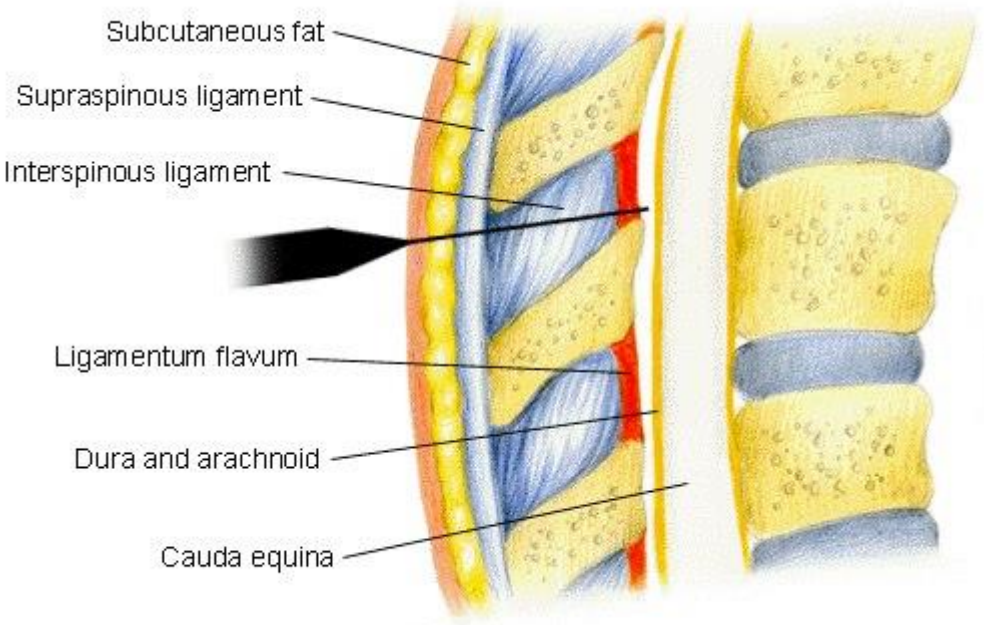
2) subcutaneous tissue.

3) Supraspinous ligament.

4) Interspinous ligament.

5) Ligamentum Flavum [7]


Superficial tissue
Interspinous ligament
Epidural Space
Spinous Process
Spinous Process
Skin
Supraspinous ligament
Ligament Flavum
Dura Mater


Subcutaneous fat
Supraspinous ligament
Interspinous ligament
Ligamentum flavum
Dura and arachnoid
Cauda equina

WIDTH

Width of the epidural space varies from spine to spine being greater at the level of sacrum and lower lumber and being less at the cervical spine. [8]

Cervical – 1-1.5mm

Upper thoracic – 2.5 to 3 mm

Lower thoracic 4-5 mm

Lumbar 5-6 mm

FACTORS AFFECTING EPIDURAL DEPTH

Maximum depth being at L3 – L4

1) Weight – increase in weight causes increase in epidural depth due to increase in subcutaneous fat there by increasing the skin to supraspinatus ligament.

2) Technique – midline or para median approach. compared to midline approach paramedian will have more skin to epidural space distance.

3) Angle of needle- more the acute angulation of the needle, more the distance between the skin to epidural space.

4) Position of patient.

5) Ethnic origin

6) Edema.

Contents

1) Connective tissue:

Multiple Strong bands exist between dura & anterior Longitudinal Ligament which leads to decrease in epidural space. Epidural space is most distend able posteriorly.

2) Epidural veins:

Internal vertebral venous plexus is mainly located within the epidural space. And they are the reason for blood tap. They are valve less veins. compression of the inferior vena cava leads to distension of the epidural veins especially during pregnancy and there increasing the incidence for bloody tap.

3) Spinal arteries –

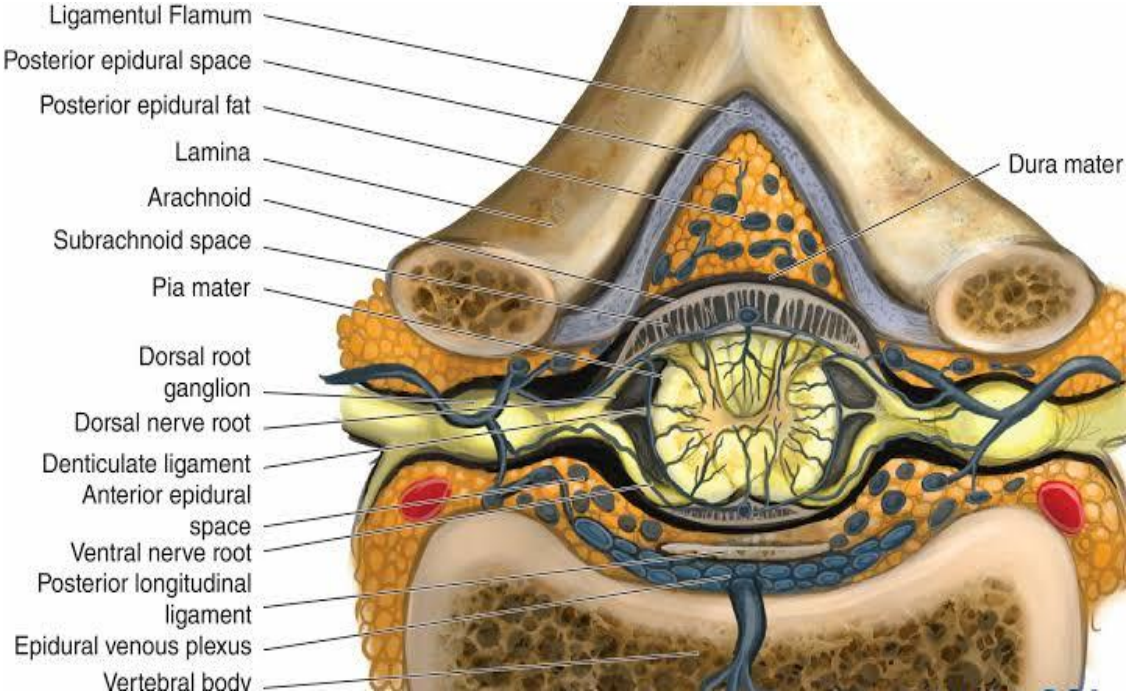
Located along the lateral aspects of the epidural space.

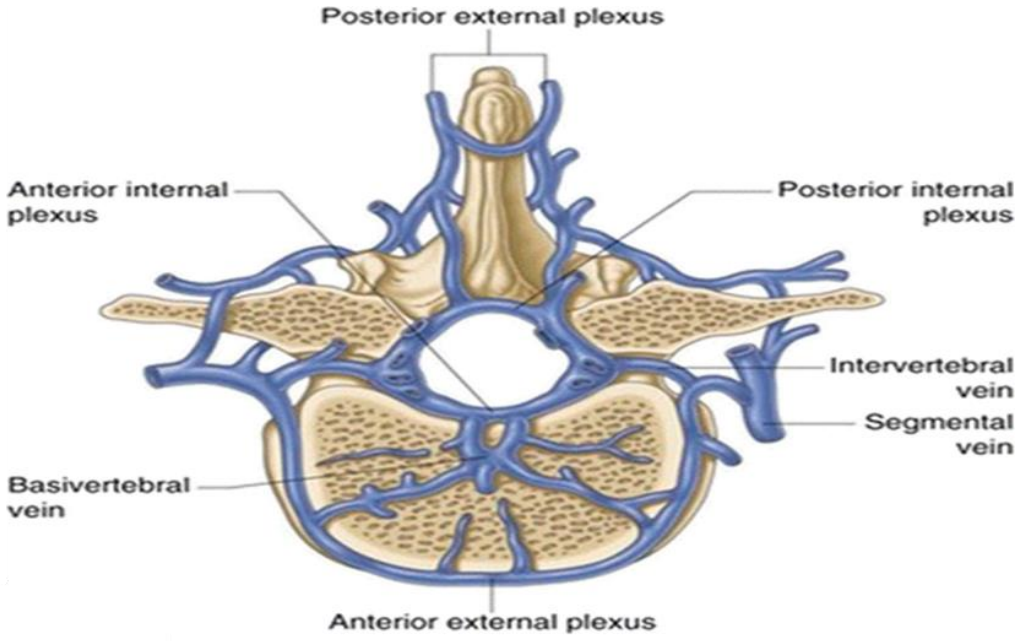
4) Epidural lymphatics:

They are mainly located near the Dural roots there by filtering out the microorganism and foreign body to prevent the spread of infection into the epidural space and the subarachnoid space.

5) Epidural fat:

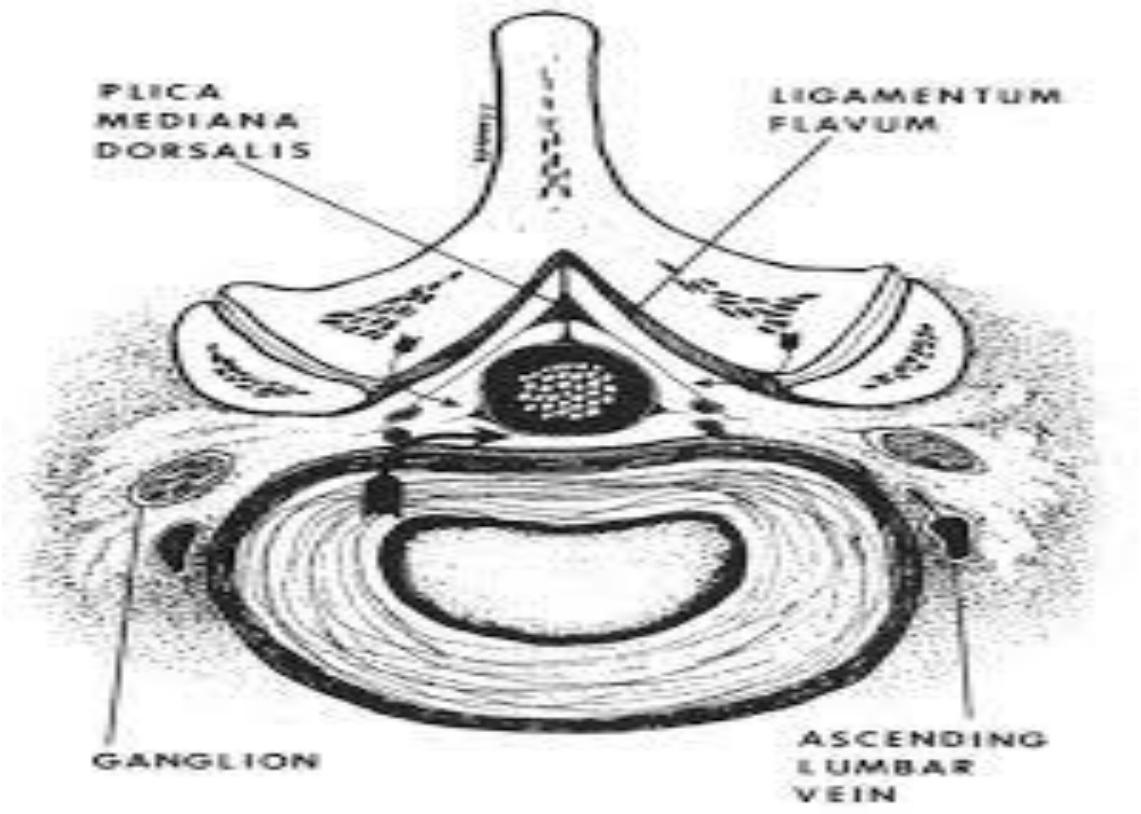
Abundant fat cells are present within the epidural space especially along the dorsal margin of the space and the dura which forms a sleeve around the spinal nerves , thereby protecting the nerves from the pulsatile moment of the dura, and also helps in the distribution of the lipophilic drugs , and prevents the damage to the dura mater against the periosteum during flexion and extension.


Ligamentul Flamum
Posterior epidural space
Posterior epidural fat
Lamina
Arachnoid
Subrachnoid space
Pia mater
Dorsal root ganglion
Dorsal nerve root
Denticulate ligament
Anterior epidural space
Ventral nerve root
Posterior longitudinal ligament
Epidural venous plexus
Vertebral body
Dura mater


Posterior external plexus
Anterior internal plexus
Posterior internal plexus
Intervertebral vein
Segmental vein
Basivertebral vein
Anterior external plexus

Plica median dorsalis

Plica median dorsalis is a dorsomedial ligament arising between dura mater and ligamentum flavum. This ligament may divide epidural space into right and left due to which partial spread of drug, difficulty in threading of epidural catheter, coiling of catheter may occur and there by leading failure of epidural anaesthesia. [8]



Pressure in Epidural space

Negative pressure in epidural space was initially described by HELDT and MOLONEY in 1928 [8]

Negative pressure is greatest in the thoracic region and minimal or absent in sacral region. The negative pressure in the epidural space ranges from -1 to -7 cm of water. [8]

The negative pressure in the epidural space is studied by **two theories**

1) Cone theory:

This theory explains negative pressure as an artefact secondary to the indentation of the dura by the advancing needle. From the recent studies also transducer mediated measurement between the interspinous ligament and subarachnoid space also explains the cones theory.

According to the study done by TELFORD AND HOLLOWAY, epidural space is always positive pressure, it becomes negative only after piercing the flavum which leads to tenting of the dura.

2) Transmission theory:

According to this theory the negative pressure in the epidural space is mainly due to the transmission of the intrapleural negative pressure via the intervertebral foramina into the peridural space. The initial or 'true' negative pressure is hypothesised to be due to initial bulging of the ligamentous flavum

which will return to resting position following the ligamentum flavum perforation.

Factors affecting negative pressure:

1) Marked flexion- increase the negative pressure.
2) Young person- positive impact over the negative pressure
3) Old people with ligament changes– decrease in negative pressure.
4) Patient on straining &being tense-increase in negative pressure.
5) Sitting position- increase in negative pressure.

Epidural space in children

Epidural space in children less than 6 years consist of spongy gelatinous lobules which leads to rapid longitudinal spread of drugs.

SITE OF ACTION OF LOCAL ANAESTHESIA

Acts on the nerves

1) As they traverse the peridural space
2) Nerves near the intervertebral foramina
3) Nerves present within the subarachnoid space via diffusion

DETECTION OF EPIDURAL SPACE

A) Negative pressure method

1) *Hanging drop sign* – a small drop of saline is placed at the hub of the needle when the space is reached the drop will get sucked in due to negative pressure.

2) *Capillary tube method* – In this method Odom used a capillary tube filled with saline with one or two bubbles and was attached to the hub of needle. on attaining the space, the saline gets sucked in and advancement of the air bubbles will be seen

3) *Manometer method* – A small U-shaped tube is used with water column and is attached to the hub of the epidural needle once the space is entered there Is immediate moment of the water column and thus explain the negative pressure within the epidural space.

B) Disappearance of the resistance

1) *Syringe technique*- Sicard and Forestier discovered this method using water in 1921 Pages introduced the same syringe method with air

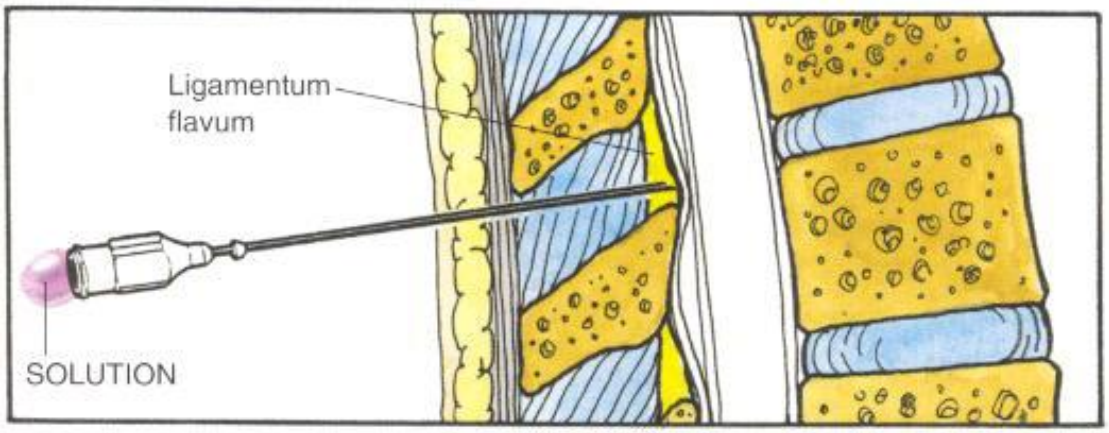
2) *Spring loaded syringe*

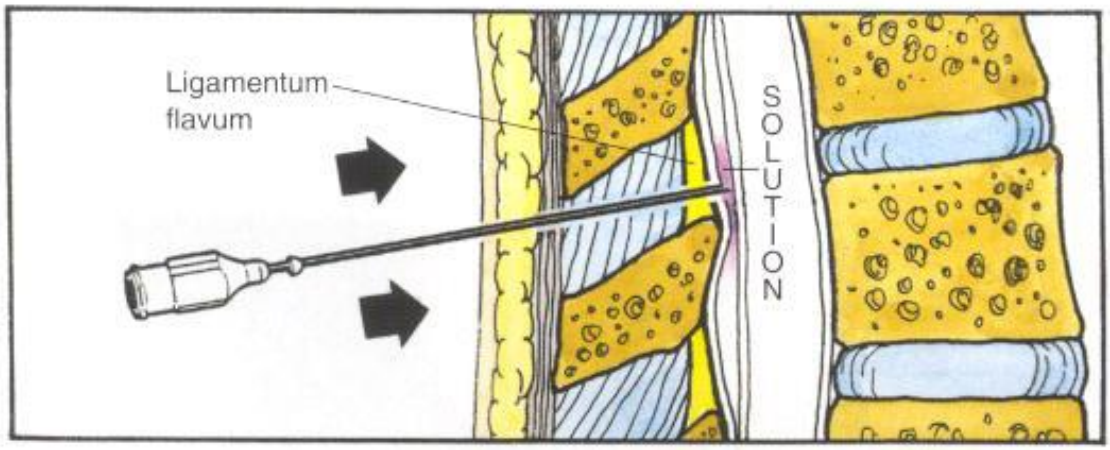
3) *Balloon method* – in this method small balloon with 2-3 ml of air with 50mmhg of pressure was attached to the needle. once the epidural space is reached collapse of the balloon will occur

4) *Brooks device*-in this method odoms capillary tube is used with one end sealed and filled with saline with one or two air bubble. Once the needle reached the ligamentum flavum one end of the tube is heated and a positive pressure is created once the space is reached advancement of the air bubble is seen

5) *Vertical tube of dawkins* – slight positive pressure is created along the vertical column of water in a tube and placed right angle to the hub, once the space s reached there will be drop in the water column

6) *Bonniot phenomenon* – When the epidural space is reached with bare needle without stylet or syringe attached an audible hiss sound is heard.


Ligamentum
flavum
SOLUTION


Ligamentum
flavum
SOLUTION

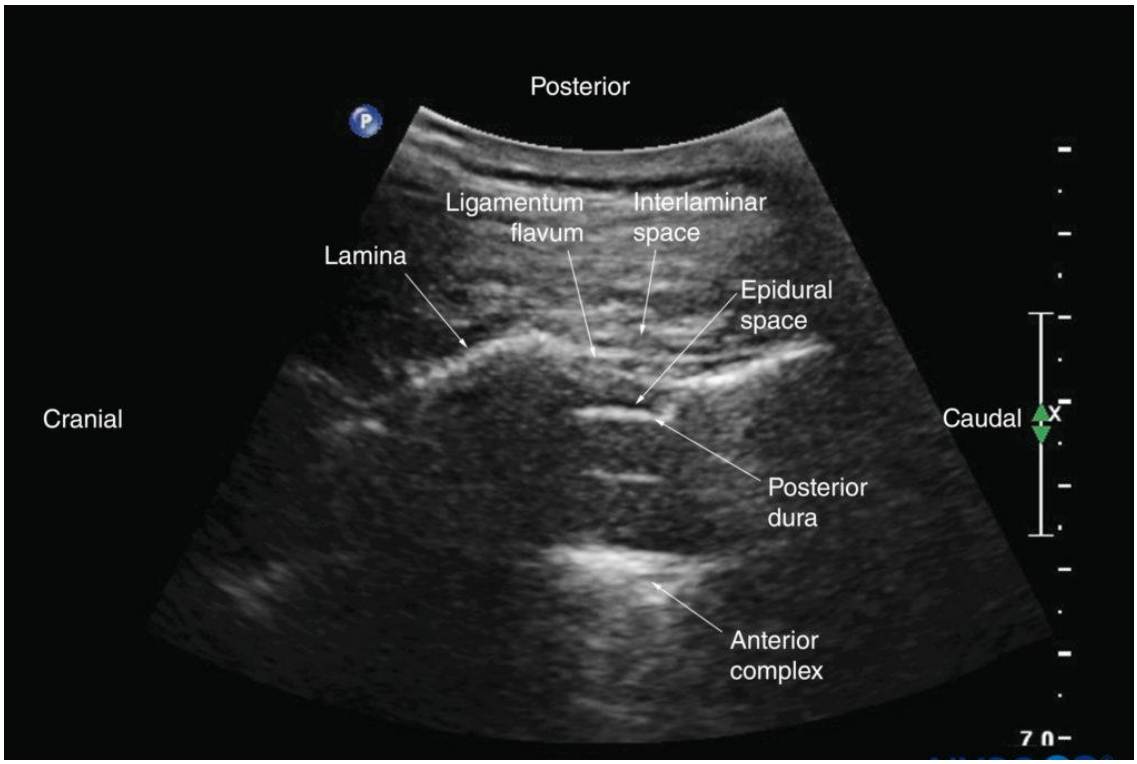
LATEST TECHQUIES DETEECTION OF EPIDURAL SPACE

1) 2D ultrasonography

1) Preprocedural scanning
2) Real time ultrasound guidance
3) Needle tracking
4) Real time 3D / 4D ultrasonography
5) Preacquired 3D images of spine
6) Machine vision

2) Acoustic radiation force impulse imaging

3) Fluroscopy [9]


Posterior
Ligamentum flavum
Interlaminar space
Lamina
Epidural space
Cranial
Caudal
Posterior dura
Anterior complex

IDENTIFYING NEEDLE ENTRY INTO EDS

1) Modification of LOR

1) Membrane in syringe technique
2) Epidural balloon
3) Epidrum
4) Episure auto detect
5) Auditory and visual display of pressure wave

2) Bioimpedance

3) Optical coherence tomography

CONFIRMING CATHERTER LOCATION IN THE EDS

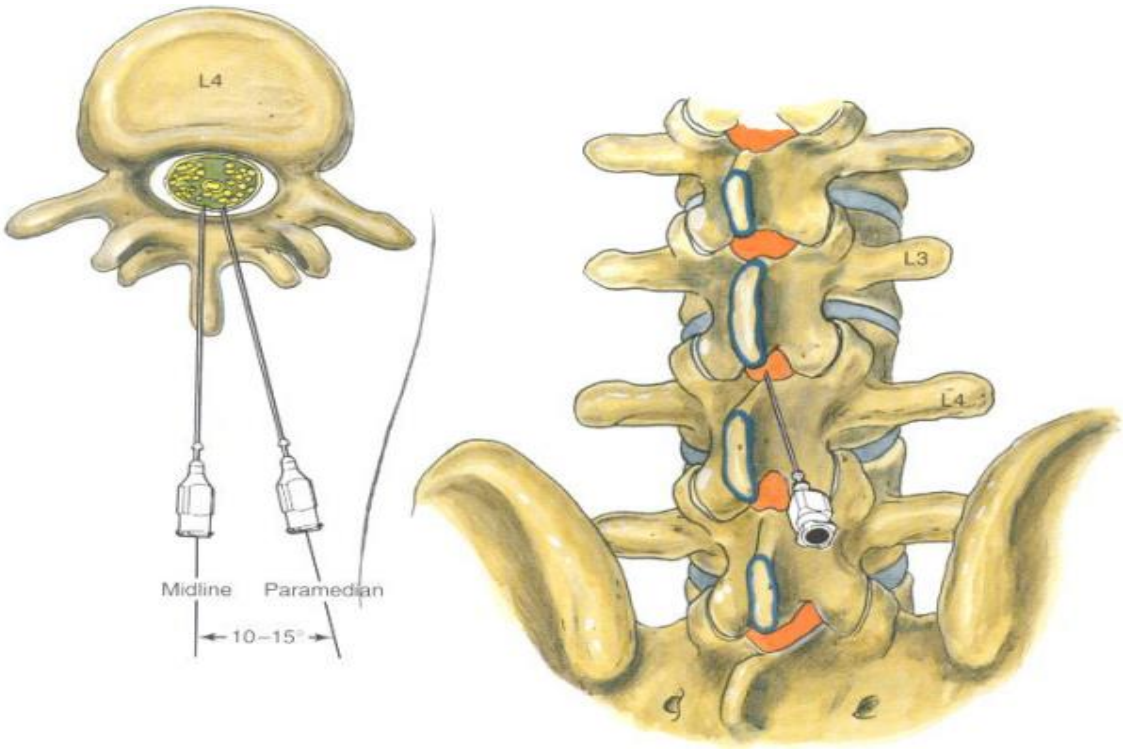
1) Epidural stimulation
2) Electrocardiography guided system
3) Epidurography
4) Epidural pressure waveform analysis
5) Near infrared tracking system
6) Ultrasonography.

Position

1) Sitting
2) Lateral decubitus position

Approach

1) Midline or median approach
2) Paramedian approach


L4
Midline
Paramedian
10–15°
L3
L4

TYPES OF EPIDURAL NEEDLE

1) Crawford point needle- It is mainly used for single shot epidural Less chance of dura puncture hence widely used for thoracic epidural Made up of stainless steel with 2% molybdenum to prevent corrosion Reusable needle with short bevel at 40 to 45 degree with smooth edges. [10]

2) Tuohy needle - Used for continuous epidural anaesthesia Tip has a bent with lateral opening Called tuohy Huber point needle. [10]

3) Hustead needle – Modified tuohy needle It has a rounded tip with bevel located 2.7mm from the tip [10]

4) Weiss winged needle

5) Sprotte needle

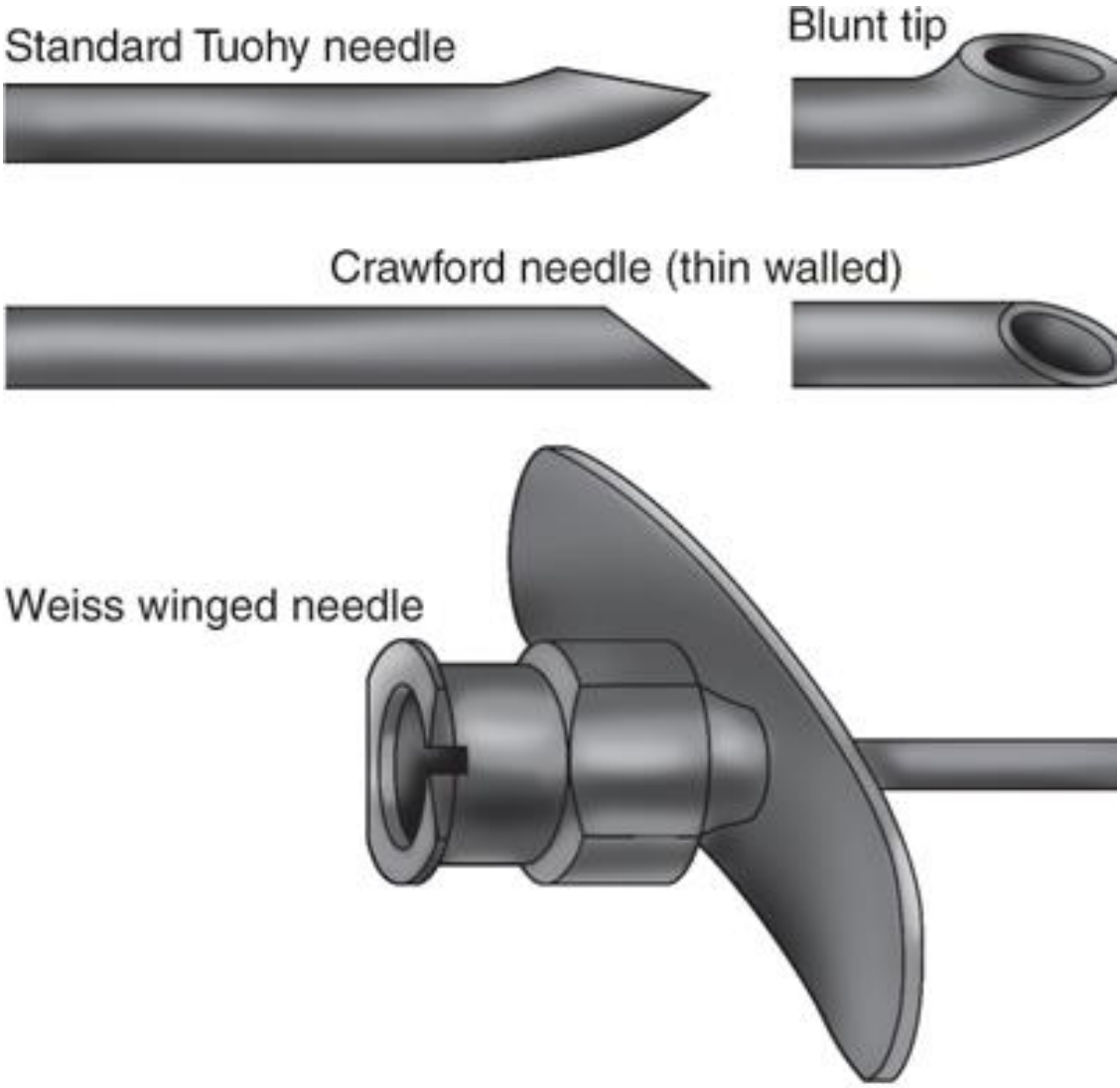
6) Wagner needle

7) Cheng needle – first needle with centimetre markings

8) Crawley needle

9) Folded needle

10) Bell needle. [10]


Standard Tuohy needle
Blunt tip
Crawford needle (thin walled)
Weiss winged needle

Indication for epidural anaesthesia

1) High risk patient
2) Cardiac disease
3) Pulmonary disease
4) Metabolic disorder
5) Contraindication for spinal and general anaesthesia
6) Obstetric analgesia

Advantages

1) Well defined area of anaesthesia
2) Compared to subarachnoid block, longer duration of anaesthesia
3) Less hemodynamic instability
4) Less incidence of nausea and vomiting
5) Only 1.5% of urinary retention hence less chance of urinary catheterisation [(8)]

Disadvantages

1) The degree of muscle relaxation is less compared to the subarachnoid block
2) Large quantity of drug volume is required for adequate block
3) Accidental dura puncture cause massive cerebrospinal fluid leak there by increase chance of PPDH
4) Bleeding within the space secondary to the epidural venous plexus injury
5) Patchy segmental block
6) Rarely back pain

Criteria for successful block

1) Onset anaesthesia should be within 10 mins of initial dose of drug
2) Negative aspiration for CSF and blood
3) Spread of anaesthesia should be progressive
4) Tingling sensation or heaviness
5) Evidence of sympathetic blockade such as vasodilatation, flushing raised skin temperature
6) In labour analgesia relief from uterine cramps

Technical Complication of epidural anaesthesia

1) Inadvertent Dural puncture
2) Total subarachnoid block
3) Subdural injection

Complications secondary to cannulation

Complication related to cannulation are mainly seen in 16G or 18 G tuohy needle

1) Bleeding – 18%
2) Failure in catheter insertion – 3%
3) Discomfort on catheter insertion – 2% [8]

Complication with catheter insertion

1) Misplacement of the epidural catheters into spinal nerve sleeve, blood vessel, subarachnoid space.
2) Kinking of the catheter
3) Occlusion
4) Knotting
5) Damage to the catheter at the insertion point
6) Severance and break on removal -more common
7) Shearing damage on bevel of needle
8) Catheter migration into subdural, subarachnoid or within epidural

INCIDENCE OF CATHETER BREAKAGE

Epidural - 0.08% i.e. 1/1200

Caudal - 0.10 % i.e. 1/1000[8]

Clinical complications

1) Massive or total subarachnoid block
2) Hypotension
3) Hypertension
4) Seizure and minor muscular twitching
5) Neurologic sequelae due epidural hematoma
6) Anaphylaxis to local anaesthesia
7) Failure of epidural block

OBESITY

Obesity is defined as a Metabolic disease in which greater proportion of the adipose tissue is deposited to such an extent that normal health and wellbeing of the individual are affected. The most common cause of morbidity and mortality in obese individuals are due to diabetes, hypertension, obstructive sleep apnoea, non-alcoholic fatty disease, osteoarthritis, and some form of cancers.

Surgery among obese population are considered as high risk hence careful planning, proper preoperative assessment, adequate anaesthetic management and strict DVT prophylaxis and proper post-operative pain relief should be given.[4]

IDEAL BODY WEIGHT;

Ideal body weight is the weight associated with lowest mortality rate for a given gender

Mainly used in life insurance

It is estimated using broke index

Males

Ideal body weight (KG) = HT (cm) -100

Females

Ideal body weight (KG) = HT (cm) – 105 [11]

PREDICTED BODY WEIGHT

Males

Predicted body weight (Kg) = 50=0.91*HT (cm) – 152.4

Females

Predicted body weight (Kg) = 45.5 +0.91*HT (CM) -152.4[11]

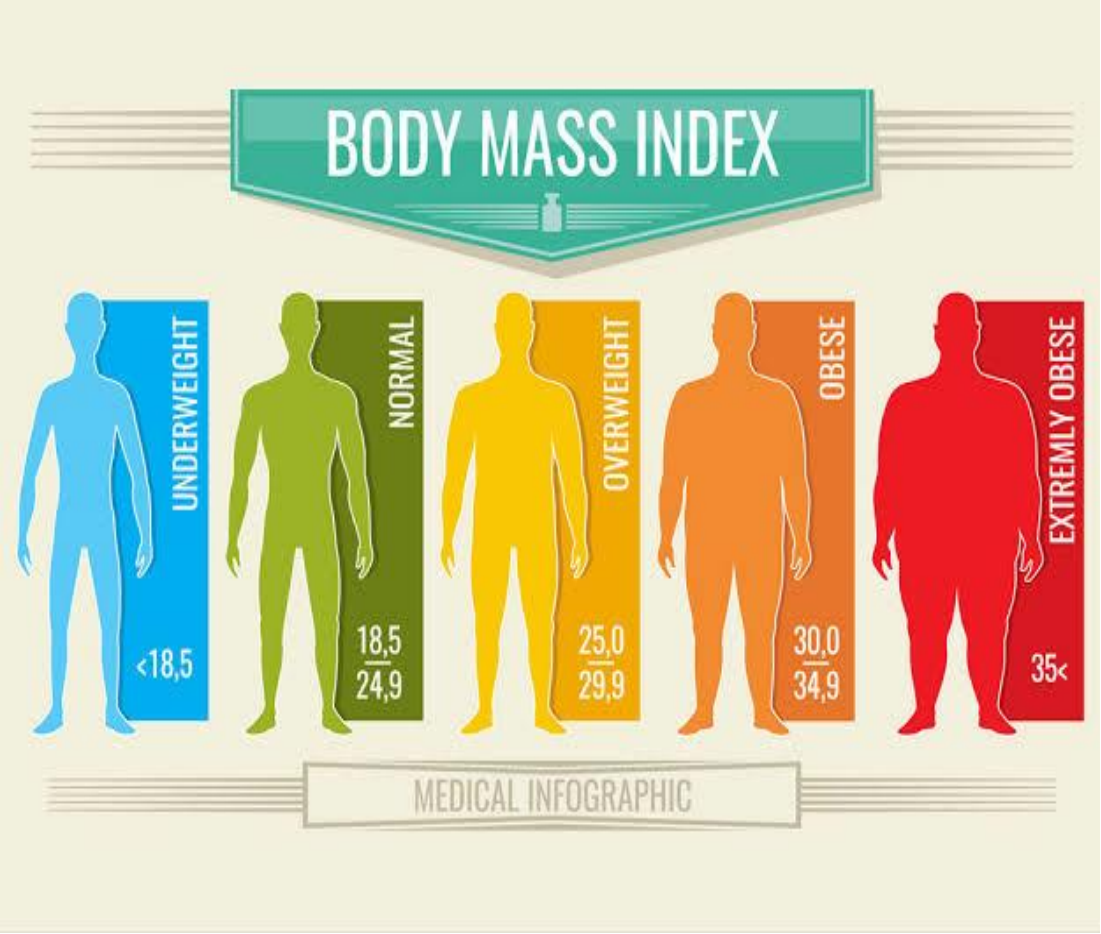
LEAN BODY WEIGHT

Lean body weight = Total body weight – adipose tissue

Males- 1.10*TBW-0.0128*BMI* TWB

Females – 1.07*TBW – 0.0148*BMI*TBW[11]

BODY MASS INDEX OR QUETELET INDEX-



Estimates the degree of obesity

BMI = body weight in kg/height in m^2 (11)

Obesity can be classified based on the anatomical distribution

Central or android obesity – predominant deposition of fat over the upper body (truncal deposition). it's associated with increased risk for cardiovascular disease and increased oxygen consumption.

Gynecoid or peripheral obesity – they are metabolically less active . they are common among females in which fat is deposited in the lower half of the body. Compared to android obesity , gynecoid obesity have better prognosis for mortality and morbidity.

The above two can be classified with body circumference indices such as

Waist circumference

Waist to height ratio

Waist to hip ratio

Implications of medical consequences of obesity

1) Respiratory – increased risk of perioperative hypoxemia hence

- Careful monitoring
- Use of supplemental oxygen
- CPAP will benefit
- RAMP position

- Extreme caution should be taken while administering respiratory depressant drugs due to poor respiratory drive.

2) Cardiovascular –

- increased chance of left ventricular hypertrophy due to increased blood volume and cardiac output .
- Increased risk of DVT secondarily to Increased proinflammatory and prothrombotic mediators.

3) Gastrointestinal –

- Due to lower PH and increased gastric volume more chance of regurgitation and high risk for the development of severe pneumonitis will be there.
- LFT should be done to rule out non-alcoholic liver disease.

4) Endocrine / metabolic-

- Due to insulin resistance, more chance of developing diabetes is present hence perioperative glucose monitoring should be done.

5) Genitourinary –

- increased risk for development of renal disease

6) Neurologic –

- careful padding of the extremities to be done to avoid peripheral nerve injury.

7) Haematology –

- Polycythaemia should be rules out secondary to prolonged apnoea

8) Musculoskeletal –

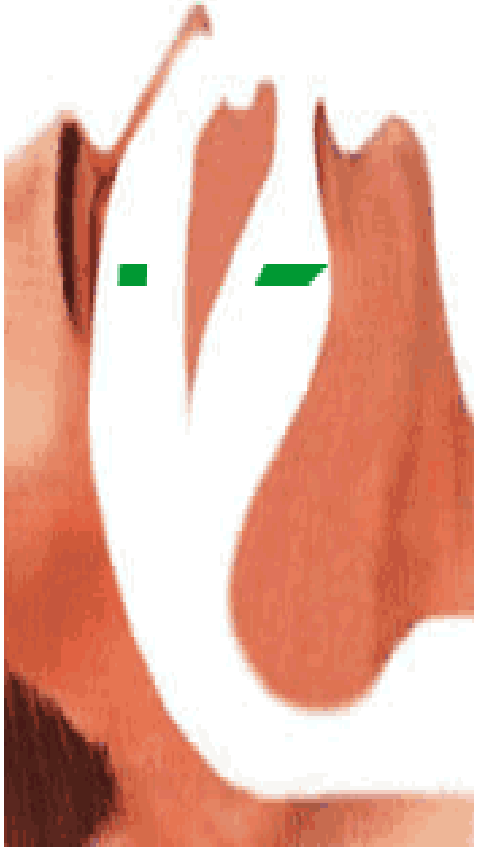
- osteoarthritis

9) Psychology –

- depression, decreased self esteem

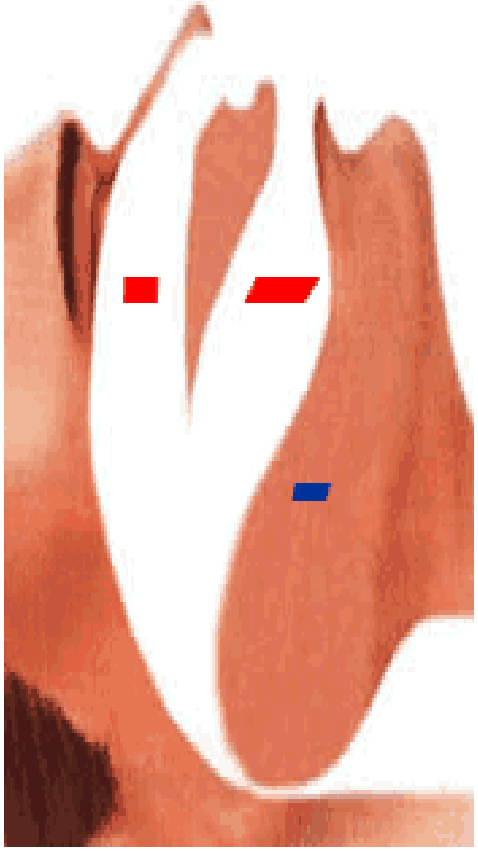
Obstructive sleep apnoea-

Obstructive sleep apnoea is more common among the obese population. They predisposes to airway difficulties during anaesthesia. Obstructive sleep apnoea is more common among the population who are associated with large neck circumference, male sex, chronic alcoholic. Among obese population Obstructive sleep apnoea develops due to passive collapse of the pharyngeal airway especially during deeper planes of sleep associated with snoring and intermittent air way obstruction resulting in hypoxaemia and hypercapnia. Obstructive sleep apnoea individuals have day time somnolence secondary to frequent arousal and disrupted sleep quality. Long standing obstructive sleep apnoea leads to systemic and pulmonary vasoconstriction, polycythaemia, right ventricular failure, cor pulmonale and type 2 respiratory failure.[(12)]



Normal Breathing

- Airway is open
- Air flows freely to lungs



Obstructive Sleep Apnea

- Airway collapses
- Blocked air flow to lungs

Anaesthesia consideration among Obstructive sleep apnoea :

1) Proper preoperative assessment

2) Regional anaesthesia techniques should be used to reduce sedatives and opiod requirement and post operative drowsiness

3) Airway maintenance is important

4) Since OSA is more common during REM sleep one should provide nocturnal oxygen to prevent hypoxia especially for 5 days post operatively

Obesity and regional anaesthesia

The advantage of the regional anaesthesia in obese population is that

1) There is less air way manipulation

2) Less administration of cardiopulmonary depressant drugs, since parenteral opioid cause increase risk of hypoxemia, high incidence of OSA, and other adverse respiratory events.

3) Good post-operative analgesia

4) Better post-operative outcome

5) Less extubating time when combined epidural with general anaesthesia

Physiological changes associated with neuraxial anaesthesia among patients with increased BMI

There is increased risk in development of cardiopulmonary changes in obese population.

1) Respiratory system-

There is alteration in FRC, ventilation, oxygenation, lung volume in obese population compared to normal individuals. Whereas supine and Trendelenburg position affects further more of the lung volume and capacity thereby causing lung collapse , atelectasis, hypoxia, ventilation perfusion mismatch.

One can measure the degree of pulmonary reserve in these population by measuring the saturation in both sitting and supine position.

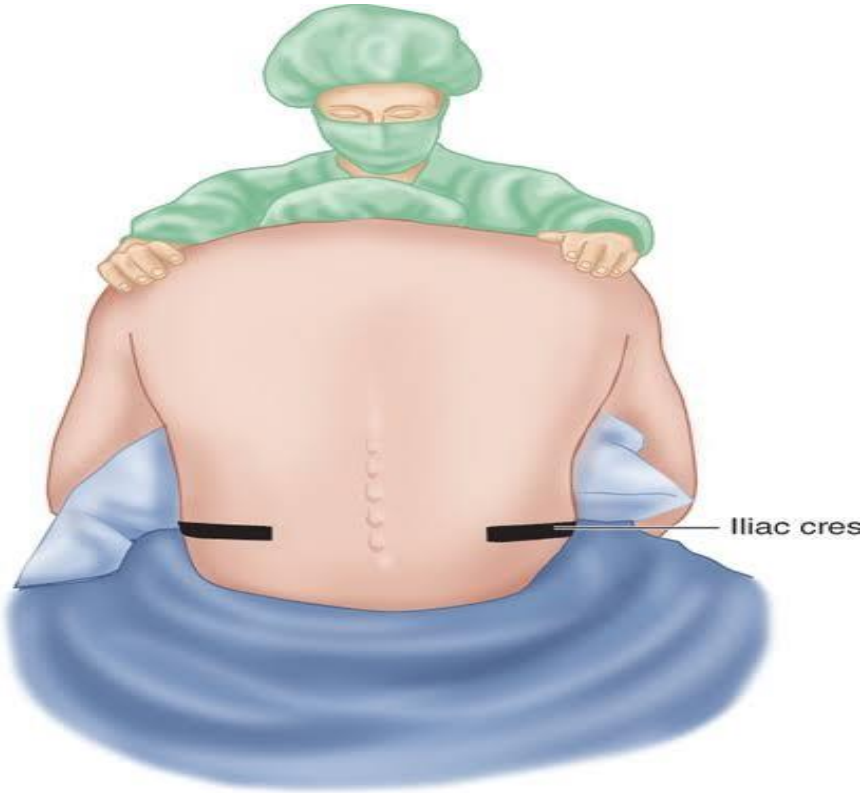
2) **Cardiovascular changes**

Excess fat in the abdominal cavity can cause compression of the IVC and can decrease in preload, cardiac output and reflex tachycardia.

3 out of 1000 obese patients experience cardiac arrest during perioperative period, especially on placing the patients in supine position[(11)]

POSITIONING AND PLACEMENT –

Positioning of the patient is very important among increased BMI population, compared to sitting position lateral decubitus position helps in identification of the bony landmarks. In case more fat deposition one can draw a line connecting the cervical spine to the upper border of the gluteal cleft , or skin folds at the level of iliac crest can taken as a landmark, in sitting position the patient spine should be parallel to the edge of the table. In some cases one can pass 25 g spinal needle for local infiltration and spinous process identification or can enquire the patient whether the needle prick is being felt at midline or not . But in raised BMI individual decreased sensation over the back is being studied. Ultrasound can be used for the identification of the epidural space, but rarely due to excess subcutaneous fat can caused difficulty in visualisation of the space there by leafing to entry of catheter onto false space and there by failure of block and increased chance of intraoperative conversion into general anaesthesia.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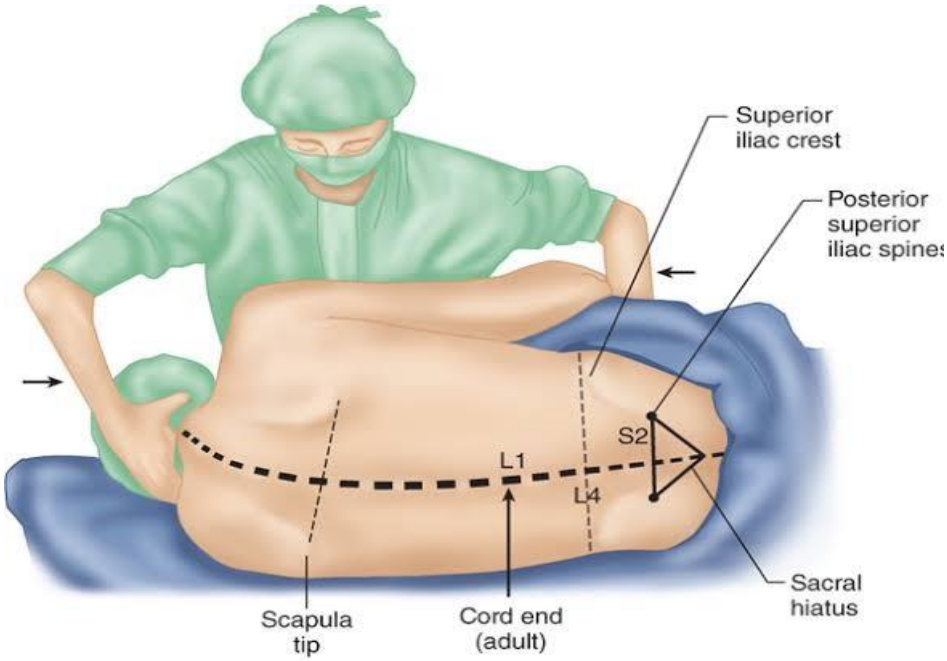

Superior
iliac crest
Posterior
superior
iliac spines
S2
L1
L4
Sacral
hiatus
Scapula
tip
Cord end
(adult)

Advantages of epidural anaesthesia in obese population

1) Prolongation of block

2) Titration of the dose

3) Less motor blockade

4) Hemodynamic stability

5) Post-operative analgesia

Disadvantages of epidural among obese population

Failure of epidural

Catheter dislodgement (due to the grip offered by the ligamentum flavum on the epidural catheter)

REVIEW OF LITERATURE

1) 2013, Sukdip singh et al did a study among 160 morbidly obese parturient undergoing labour epidural analgesia using EDE using the formula Epidural Depth (cm) = 6.63 − [0.07 × Ht(in)] +[0.02 × Wt(lbs)] and ultrasonography. In this study first the skin to the epidural space distance were measured using the formula and followed my usg guided epidural insertion were made, which resulted in a better clinical correlation than using the ultrasonography alone .[5]

2) In 2015 Alyssa Kosturakis et al did a study on 218non obstetrics cancer patients who are being posted for thoracic and abdominal surgeries at various thoracic epidural level and the objective of the study is to find the distance between skin to epidural space prior to surgery using computed tomography in addition with arthrometric and demographic data. Within one month prior to epidural placement diagnostic CT was taken and was reviewed by a blinded anaesthesiologist. among 218 patients, midline epidural approach was done in 96 and rest among 122, paramedian approach was done.

The mean LOR was measured to be 5.8+/- 1.30 cm and the mean SES-CT was 5.01 +/- 1.03 cm. According to Wilcoxon signed-rank test, p<0.001 hence the mean LOR and SES – CT difference was larger but according to Spearman correlation coefficient = 0.67, ;p< 0.0001 which is to be positively correlated Paramedian approach provided a better correlation between SES-CT AND LOR measurement than the median epidural approach due to spinal anatomy. Age is negatively correlated and BODY MASS INDEX is positively correlated. Due to multiple variations final linear regression model using a formula

Estimated LOR= 0.80+{0.90*(SES-CT) + {0.19*(MEDIAN=1,

PARAMEDIAN= 0) +(T3-T5=0.79 OR T6-T9=0.40) was used

Which showed a better prediction of (R 2 =0.5692 and p <0.0001)

Hence, it's been stated that use of pre-operative CT for the estimation of SES is highly beneficial to prevent accidental Dural puncture, spinal cord injury. but additional use of real time ultrasound will improve the better outcome of the study.[14]

3) In 2010 Pablo et all did a study in which ultrasonography was used for estimating the epidural space depth. 60 patients of either sex of ASA PS 1 AND 2 were selected. initially by palpatory method L3-L4 spine was identified and then usg was used and epidural depth (PU) was measured.

Followed by epidural needle was inserted and measured (BP). It was found that Mean PU values was 4.97 ± 0.51 cm and BP 4.97 ± 0.71 cm with Pearson's correlation coefficient of 0.66, and Bland-Altman analysis was found with an average difference of 0.0035 ± 0. .53 cm, with a 95% confidence limit of -0.228 to 0.221. there by proving that ultrasound for measuring epidural depth was found to be accurate.

4) In 2017 EunHee Chun et al did An observational study among 30 parturient of gestational age of more than 37 weeks of ASA PS 1 and 2. With BODY MASS INDEX<25 and> 25 kg/m2. The skin epidural depth of each lumbar intervertebral space from L2-3 to L5-S1 was measured using a 2-5 MHz curvilinear probe via paramedian sagittal view by a well trained anaesthesiologist in two positions { sitting – D-SIT and lateral position D LAT} the results were found to be that at the level of L3-L4 the difference between D LAT and D SIT were more when the BODY MASS INDEX is more than 25 (P = 0.042)and at the same lumbar level the difference between D SIT and D LAT was statistically insignificant with mean difference being less than 0.18 cm hence it's been concluded that positional change is positively correlated in parturient whose BODY MASS INDEX<25 kg/m2 and sitting position is useful in obese position for epidural placement [15].

5) In 2017 Wani et al, did a study in which skin to epidural space distance was evaluated at two level T6-7, T9-10 using T2 weighted sagittal MRI among 109 children whose age group were between 1 month to 8 years. two measurements were taking inclined and straight. using linear regression model (both univariate and multivariate) association between inclined SES and age, height and weight were studied. which demonstrated a strong correlation between inclined SES and weight were seen. based upon the association two formula were obtained T 6-7inclined (mm) = 7 + 0.9 × kg and T 9-10inclined (mm) = 7 + 0.8 × kg which serves as guide for the placement of epidural. and this study also concluded that MRI is the most accurate tool for assessing the epidural dept due to the detailed description of the spinal anatomy.[16]

6) In 2004 M. C. Kao et al did an observational study among 30 male patients who are been posted for abdominal surgery with pre-operative diagnostic CT scan. During scan skin epidural space distance was measured at the level of T10-11(estimated SES) .under strict aseptic precaution , paramedial approach, with LOR method , SES measured (actual SES) and found that estimated SES is greater than actual SES with mean difference of 0.4 cm. multiple factors were also being correlated

with the study such as weight , body mass index, body fat percentage and height. SES is positively correlated with weight, body mass index a body fat percentage and negative for height. Actual SES also varies with individual due to variation in angle of insertion.[17]

7) 2017 Hasanin AM et all conducted a study among 48 patients, who were were divided into two groups, among one traditional manual palpation method for the placement of epidural was used and in another group prior ultrasound was used to assess the site to be inserted by the epidural needle , angle of insertion and epidural space depth was also measured and it was found out that it reduced the number of epidural needle insertion (p – 0.008) number of attempts for needle redirection (p=0.00) and accidental Dural puncture. hence concluding that pre procedural ultrasound minimise the time for successful epidural placement.[18]

8) With the help of computed tomography Bakh JH et all measured epidural depth among healthy male individuals between the age group of 20 to 25 yrs. of age. physical parameters such as weight, weight height ratio, weight neck circumference ratio, waist circumference and waist circumference height ratio were measured. The distance between supraspinatus ligament to posterior triangular epidural space has no

correlation with the physical parameter measurement. These physical parameter measurements were positively correlated with the distance between skin to supraspinatus ligament.[19]

9) Komaljit Kaur Ravi et all, in 2011 did a study among 120 patients of either sex and between the age group of 18to 70 yrs being posted for lower abdominal surgeries. among them 60 patients are of body mass index>30 and rest of the 60 patients with body mass index<30kg/m2 ,height of 141 cm to 180 cm and weight 41 Kg to 100 Kg. this study concluded that weight and body mass index are positively correlated with the epidural depth space and found out to be statically significant with p of <0.01. where as age and height are not correlated. Hence more the weight and body mass index more the EDS[13]

10) In 2017 did a study on epidural space localisation using various new methods. For this study he selected and reviewed 48 articles and broadly classified into 3 groups

    1) Guidance of the epidural needle
    2) Needle entry point
    3) Confirmation of the catheter location

The aim of his study was to identify a newer method which will be easy to learn and perform with better specificity and sensitivity, feasible and cost effective. Even though many newer methods have a upper hand on identifying the epidural space especially among infants and difficult spine, than traditional method still they don't qualify as a ideal method for the localisation of the epidural space.[9]

11) In 2018 , Amit Kumar Chauchan et al conducted a study with the use of ultrasound of 2-5 Hz curvilinear probe at the level of L3-4, transverse plane. In this study 98 patients of either sex and with ASA PS 1 AND 2 requiring lumbar epidural was selected . pre procedural ultrasound measurement of the epidural measurement was made followed by conventional placement of the epidural was placed and confirmed by LOR method. This study provided a good correlation with the ultrasound and conventional needle entry with Pearson correlation of 0.935 . there by providing a accurate needle entry and higher success rate and less percentage of attempts and failure.[20]

12) Darrieutort Laffite C in 2015 conducted a randomised control study among 80 patients of age >60 and body mass index>30 using ultrasound and conventional method. in this study two groups were there each

comprising of 40 patients.in one group ultrasound guided epidural placement was done and other group traditional method for epidural placement was done. pain was assessed during the procedure. There was a positive correlation with the body mass index and a negative correlation with the age. There was also reduction in the intensity of the pain when ultrasound was used for the epidural placement compared to the traditional palpatory method. [21]

13) In 2011 Vricella LK et al conducted a study to determine complications secondary to epidural anaesthesia during labour among 125 morbidly obese parturient along 125 normal patients of same age and race . it was found that patients with morbidly obese parturient have more risk for developing hypotension and frequent fetal heart rate deceleration than the normal weight parturient during term gestation following epidural.[22]

14) In 1988 Hirabayashi et al conducted a study among 1007 patients with weight ranging from 50 to 60 kg and height of 1.5 t 1.7 m. this study concluded that there is positive correlation with the weight and the epidural depth than the height. In male population the skin epidural space was more than the female population. [23]

15) In 2009 Balki et al did a study among 46 obese parturient with pre pregnancy body mass index of >30 kg/m2 who requested for epidural analgesia. Initially usg guided measurement of the skin to epidural space were measured followed by a blinded anaesthesiologist did epidural place with the conventional method at the level of L3-L4. The Pearson correlation coefficient between ultrasound and the normal conventional method was 0.85.thus, providing a strong correlation between the pre procedural ultrasound guided estimation of skin to epidural space to convention method. Hence concluding that ultrasound facilitate in placement of epidural in obese population with less frequency of attempts and failure. [24]

16) In 2005 Lai HC et al did a retrospective study among 998 adult who were posted for elective major cardiothoracic or abdominal surgery requiring thoracic epidural for analgesia.in this study the epidural space is obtained by inserting needle via paramedian approach and skin to the epidural space were measured using the markings in the epidural needle. the mean of the skin to the epidural space at the level of thoracic level was 5.11± 0.94 cm which was correlated positively with the body weight. Even one step linear multivariate regression analysis were done which showed that there is an increase in 0.39 cm in depth with each 10 kg weight. [25]

17) In 2009 , Brummett CM et al done a study among 86 patients undergoing lumbar transforaminal epidural steroid injection at the level of L3-L4, L4-L5 , L5-S1. Pre insertion of the epidural needle patents BMI wer recorded and fluoroscopic guided skin to epidural space were measured. Using regression analysis skin to epidural distance and its relation with the BMI was studied. The mean of depth were

Underweight- 6.3 cm

Normal- 7.5 cm

overweight- 8.4 cm

Obese 1 – 10 cm

Obese 2- 10.4 cm

Obese 3 -12.2 cm

Which showed that there in positive correlation with epidural depth with increasing BMI. But no relation with the age ,sex , race, needle angulation or intervertebral level.[26]

18) In 2003 Shiroyama K et al did a study among 95 japanese parturient who requested for epidural anaesthesia, at the L1-L2 level. Initially pre procedural measurement of physical parameters were done followed by epidural needle was inserted via midline approach and skin to the epidural space was measured with 0.5 cm epidural needle. The space was

confirmed with loss of resistance method. regression equation was studied to correlate between the physical parameters and the epidural space .the following formula was used as a clinical guide for the epidural catheter placement

Skin to epidural distance = 0.05 * body weight in kg + 0.36

The median of skin to the epidural distance was 3.5 cm and it was positively correlated with the weight of the patient.[27]

19) In 1998 Aldrete JA et al a retrospective study was done using 100 sagittal films of MRI of the patients who had chronic head ache or cervicobrachial radiculopathy . measurement of the skin to the epidural space were measured with the ruler and it was found that maximum distance from skin to the epidural space was noted at the level of C6 -C7 and C7- T1 with a mean value of 5.7 cm. especially among the obese individuals the accumulation of the fat was more at the level of lower cervical and upper thoracic level there by development of hump pad. Thus increase in BMI the more in development of the hump pad there by increasing the distance between the skin to the epidural space. [28]

20) In 2003 , Han KR et al did a study among 816 patients who required cervical epidural block for acute pain , chronic pain , pain syndrome secondary to cancer involving head and neck face .with the help of the physical parameters such as age , weight , height and neck circumference the correlation with the skin to epidural space was studied. In the above patients cervical epidural block was done at the level of C5 – C6 , C6-C7, C7 to T1.

The mean of value of skin to epidural space at the level of

1) C5 – C6 = 4.7 ±0.6 cm in males and 4.0 ±0.6 in females
2) C6-C7 = 5.1± 0.6 cm in males and 4.6 ±0.6 in females
3) C7 to T1 = 5.6 ±0.8 cm in males and 5.0 ±0.6 in females

Linear regression study for the above showed a positice correlation between the weight , BMI , and body mass index to the skin to the epidural space [27].

DATA ANALYSIS:

The collected data entered in MS Excel and was analysed by using SPSS version 16 software.

MATERIALS AND METHODS

STUDY TYPE:

Prospective observational study

STUDY GROUP:

Overweight patients undergoing surgeries between the age group of 20yrs to 60yrs of either sexes of ASA PS 1 or 2

SAMPLE SIZE: 130

Sample size was obtained after applying the formula below.

$N=Z^2(1-\alpha\backslash 2)pq/d^2$

Z=1.96 standard normal deviation for 95% confidence interval

P=prevalence =92%

Q=100-p =8%

D=absolute precision =5%

N=1.96*1.96*92*8/5*5 =114

Non response=10% =126 rounded to 130

STUDY POPULATION:

Patient Admitted in Orthopaedics, General Surgery, Obstetrics Department in Chengalpattu Medical College and Hospital, Chengalpattu

STUDY SETTING:

DEPT OF ANAESTHESIOLOGY,

CHENGALPATTU MEDICAL COLLEGE AND HOSPITAL,

CHENGALPATTU.

STUDY DURATION : 1 YEAR

INCLUSION CRITERIA

1. Those giving informed written consent
2. Overweight patients undergoing surgeries between the BODY MASS INDEX of 25 to 29.9.
3. Age group 20 to 60 yrs
4. Both sexes
5. ASA PS 1 and 2

EXCLUSION CRITERIA

1. Patients Refusal Uncooperative Patient
2. ASA PS 3 AND ABOVE
3. 3 severe haemorrhage
4. Shock

5. Spine defects or post laminectomy surgery

6. Bleeding diathesis

7. Local inflammation

Methodology

After obtaining approval letter from the Institutional Ethical Committee , 130 Patients were selected based on the inclusion criteria explained above and informed written consent was obtained from each one of them in their own language after explaining about the study. Patient's details were recorded after ensuring confidentiality and same was maintained throughout the course of the study. In this study Patients were assessed preoperatively and are examined clinically with relevant investigations along with height and weight .

On the day of surgery, patient was shifted to the operation theatre . prior to the procedure ,Anaesthesia machine was checked along with emergency airway equipment's like laryngoscopes, blades of different sizes, endotracheal tubes, LMAs, oropharyngeal airways were also kept ready. An emergency drug tray containing all the emergency drugs along with defibrillator was also kept ready.

Patient was connected to the monitors such as pulse oximeter, ECG , NIBP. Followed by Intravenous cannulation was done with 18G venflon and IV fluids was started. 500ml of isotonic fluid was transfused pre procedure.

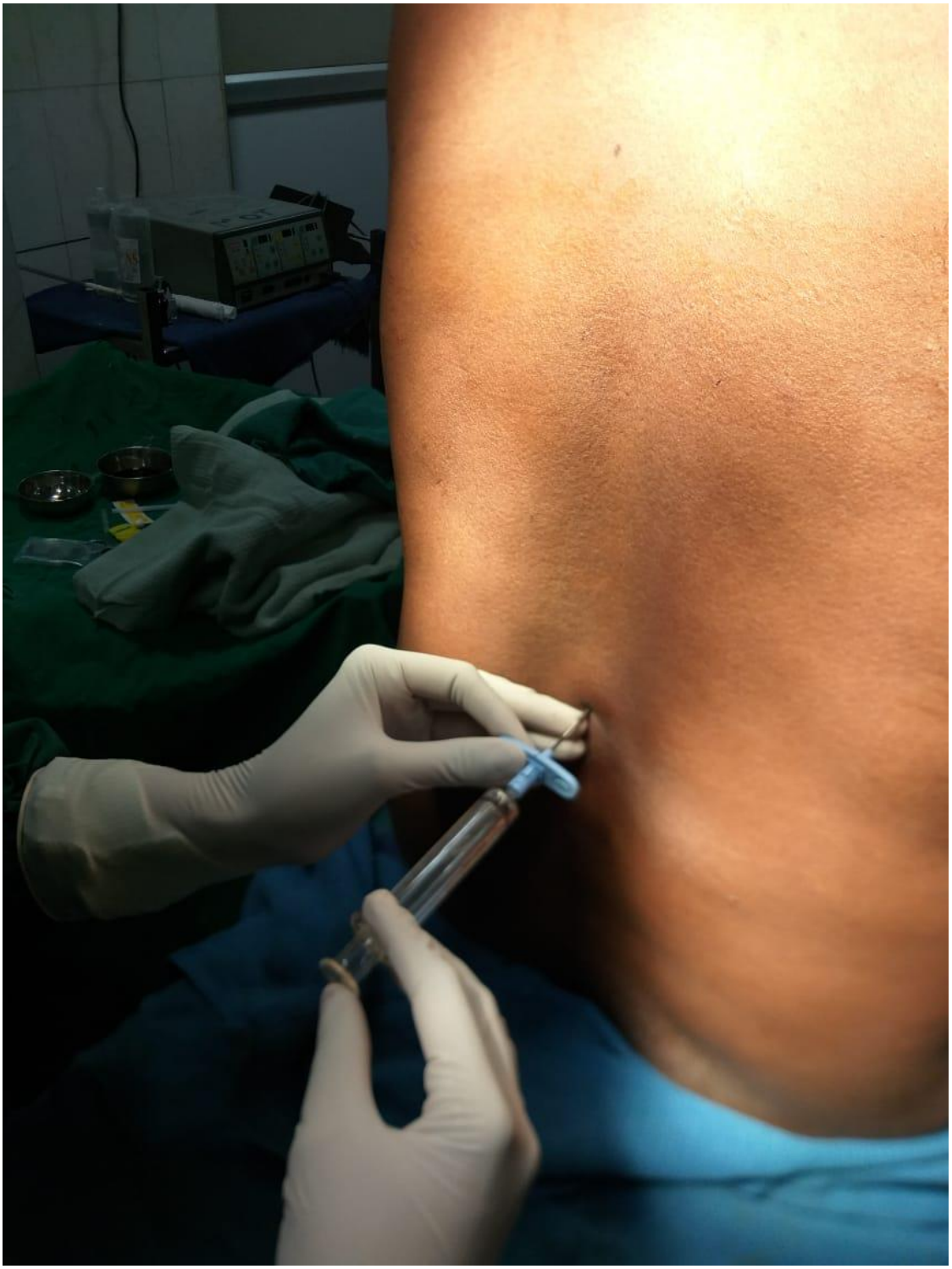
EQUIPMENTS :

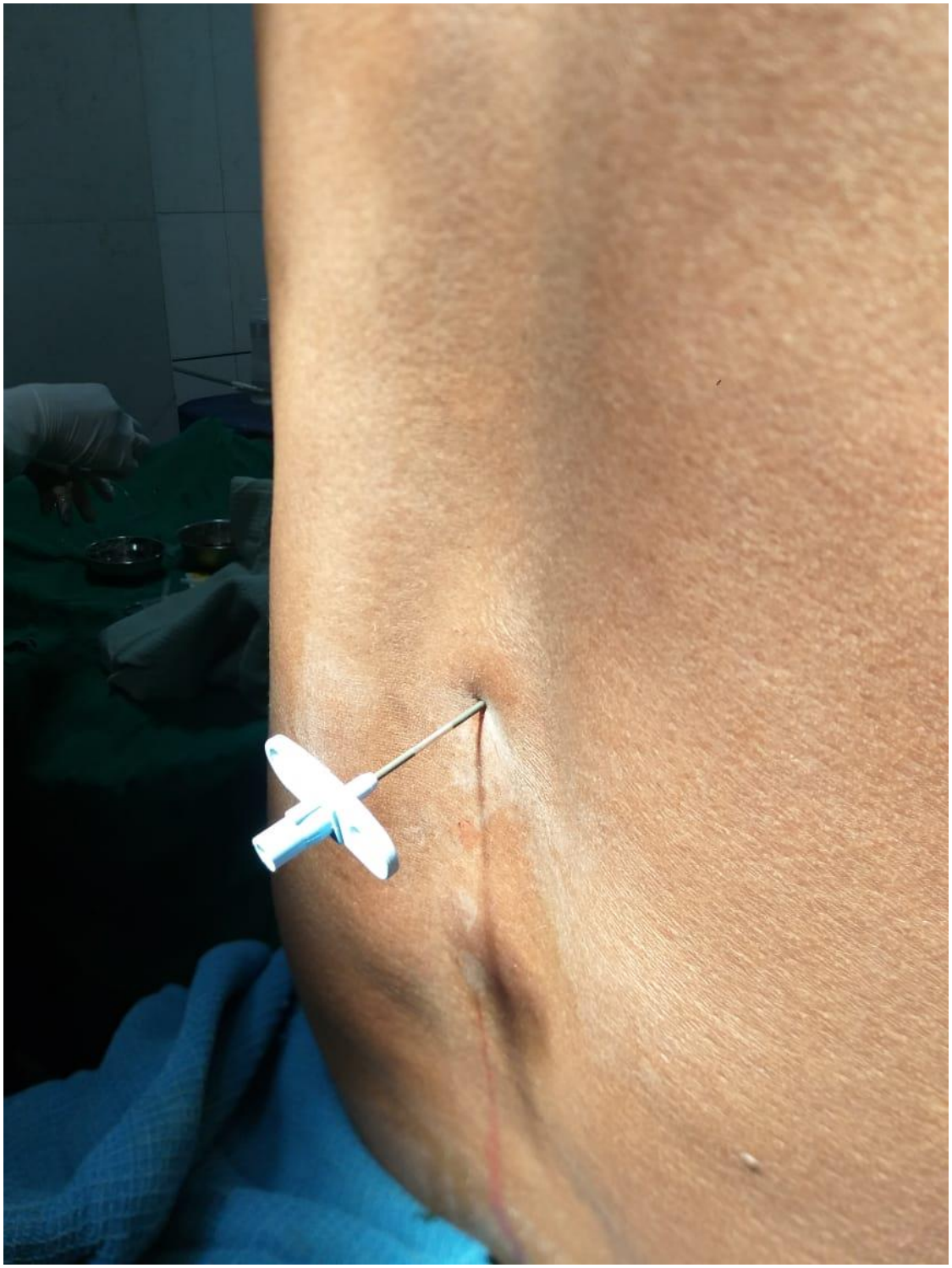
1. Sterile tray.
2. Sterile towel.
3. Sterile gauze
4. Sponge holding forceps.
5. Povidone iodine solution.
6. 2ml syringe with 24 G needle for skin infiltration with 2% lignocaine.
7. 5ml syringe for the test dose(3ml of 1.5% lignocaine with 15 microgram of adrenaline)
8. 16-gauge Tuohy needle.
9. 5 ml glass syringe for identification of the epidural space via loss of resistance method.

PROCEDURE

Using the formula 6.63-(0.07* height in inches + 0.02* weight in pounds)[5] epidural space depth was calculated followed by Under strict aseptic precaution ,right lateral position ,at the level of T10-T11, T12-L1, L1-L2 (based on the surgery and dermatomal level) 16 g tuohy needle 1cm marking was used following skin infiltration with 2 ml of 2% of lignocaine. Epidural space was detected with traditional loss of resistance method with 5 ml glass syringe and followed by catheter was inserted. The point at which the epidural space was achieved has been marked with a sterile marker pen on the Tuohy needle. Followed by test dose of 1.5%lignocaine with 15 microgram of adrenaline was given to rule out vascular or subarachnoid space infiltration. Catheter was

secured with plasters and followed by drug of required for sensory or motor blockade was given for the surgical procedure. After completion of the epidural catheter placement the distance between the skin to the epidural space was measured from the tip of the Tuohy needle to the point at which is being marked by a sterile ruler scale.





RESULTS

The study included 130 patients belonging to the overweight category between the body mass index of 25 to 29.9 , conducted over a period of one year. Informed written consent was taken from all patients who participated in the study.

The study enrolled a total of 130 patients which included 46 females and 84 males. The male is to female distribution is depicted in the chart below

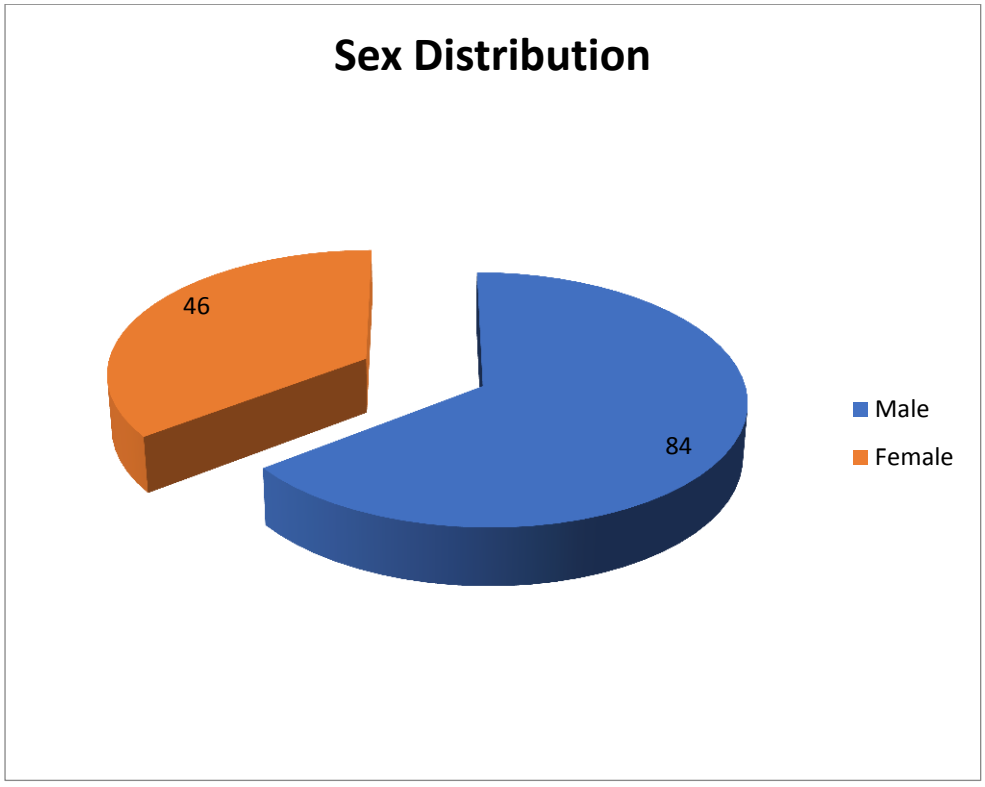


Figure 1: Sex Distribution of patients taking part in the study

There were a greater number of males in the study compares to females

Age Distribution

The mean age of patients was 39.68 ±9.91 years with age ranging from 21 – 60 years. he mean age of women was 37.13 years while that of men was 41.08 years. Majority of patients between were in the age group of 41-50 years. The age distribution is given in the figure below.

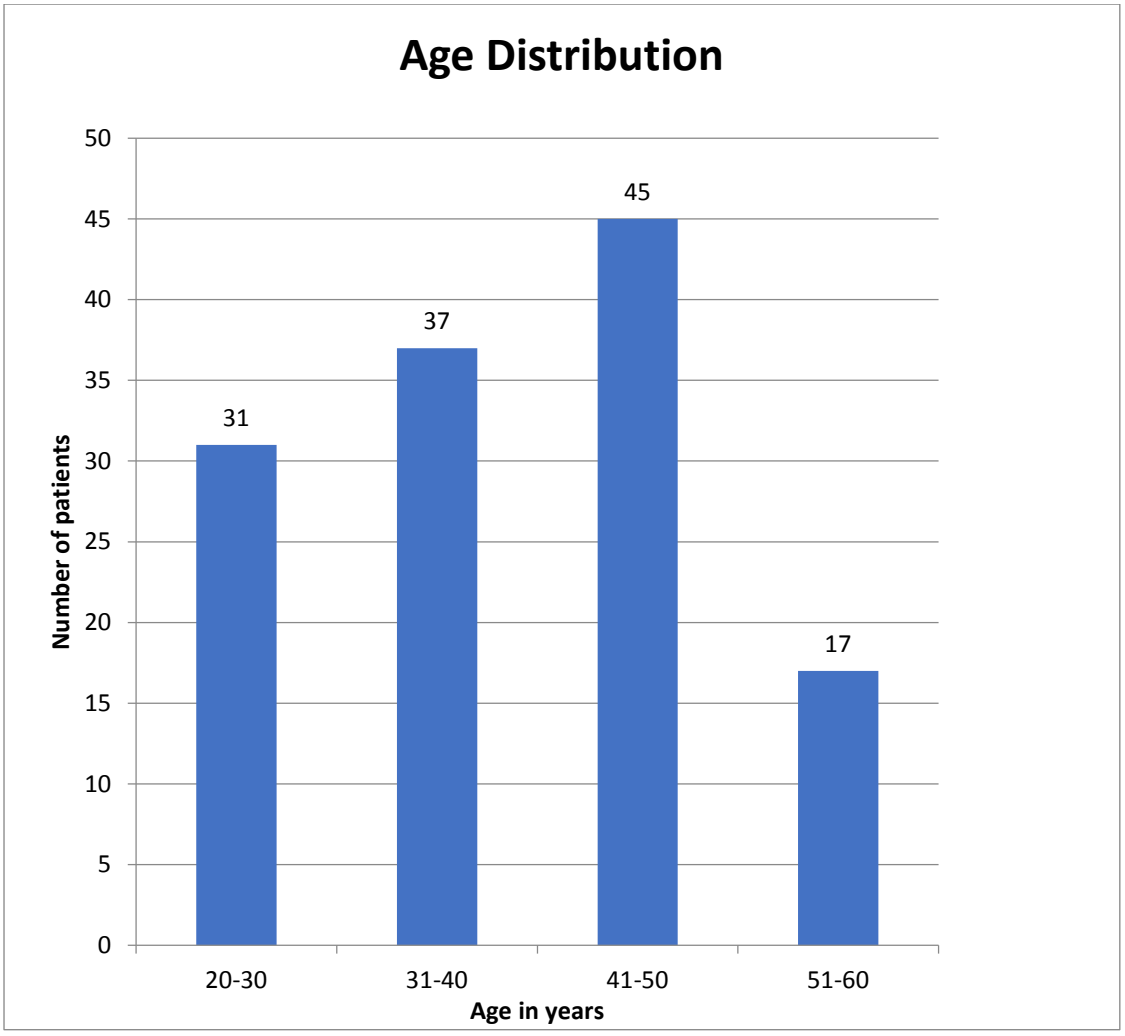


Figure 2: Age Distribution of patients taking part in the study (age in years)

Height Distribution

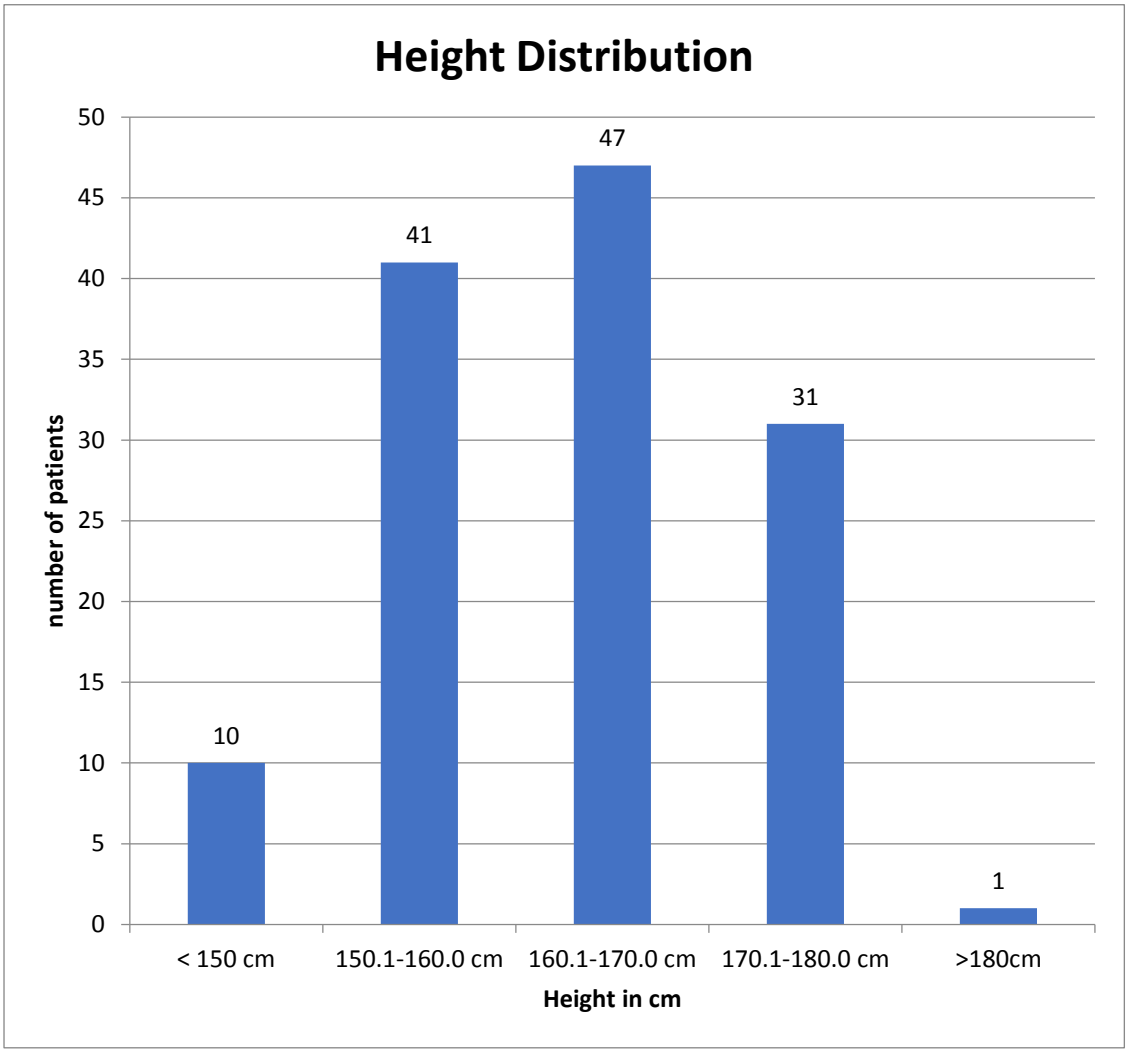


Figure 3: Height distribution of the patients taking part in the study

The mean height of the sample population was 162.6 ±9.09cm with the height ranging from 145 to 185 cm.

Weight Distribution

The mean weight was 73.78 ±9.23 kgs with 50 patients in the weight group of 61-70 kilograms(kgs), 37 patients in the weight group of 71-80 kgs. The weight distribution is given in the graph below.

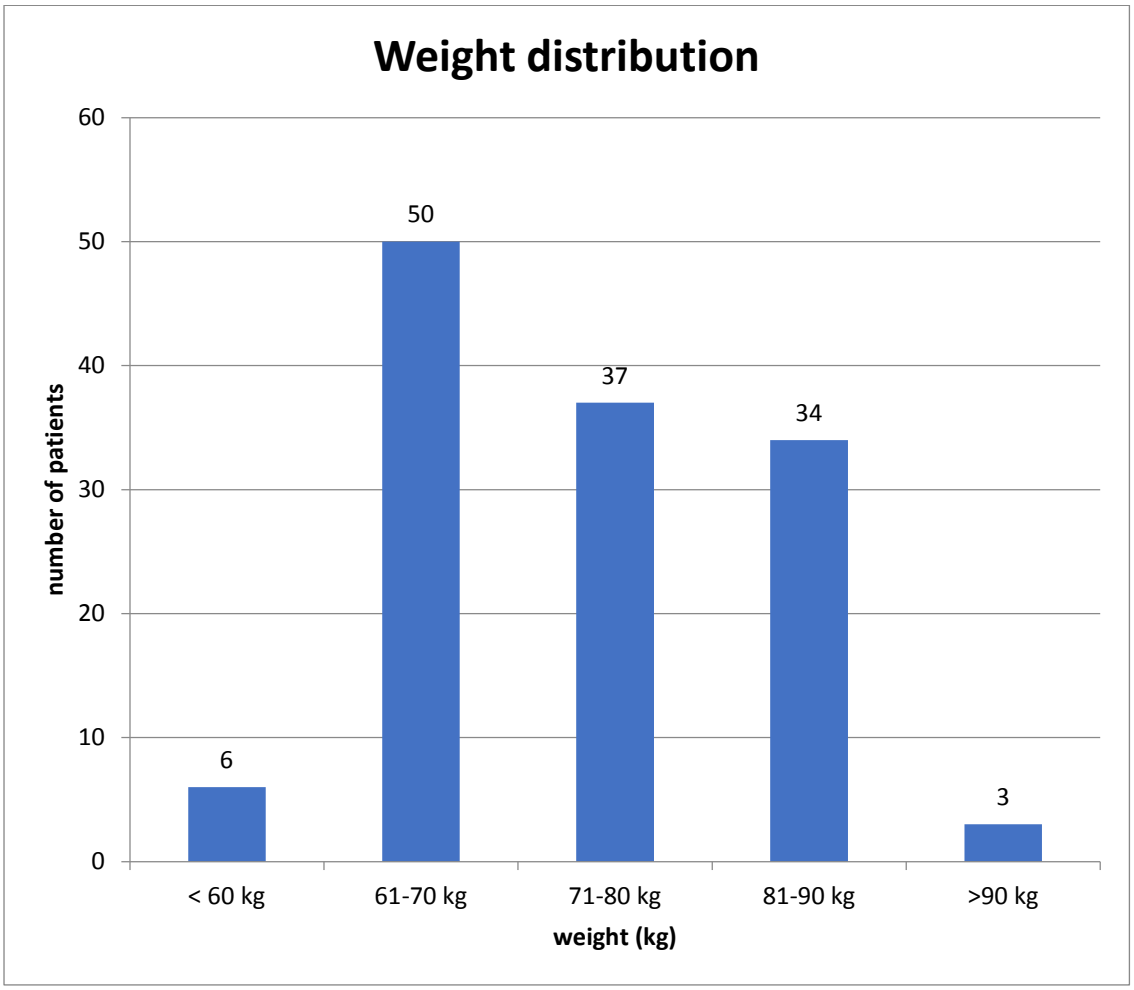


Figure :4 Weight distribution of the patients taking part in the study

BODY MASS INDEX PATTERN

All patients were over weight. On calculating the body mass indexand plotting it, 32.31% of the population had body mass indexof 28.1-29. Another 23.07% had body mass indexof 27.1-28.0 and 21.54% had body mass indexof 26.1-27.0. The body mass index of patients has been charted in the graph below

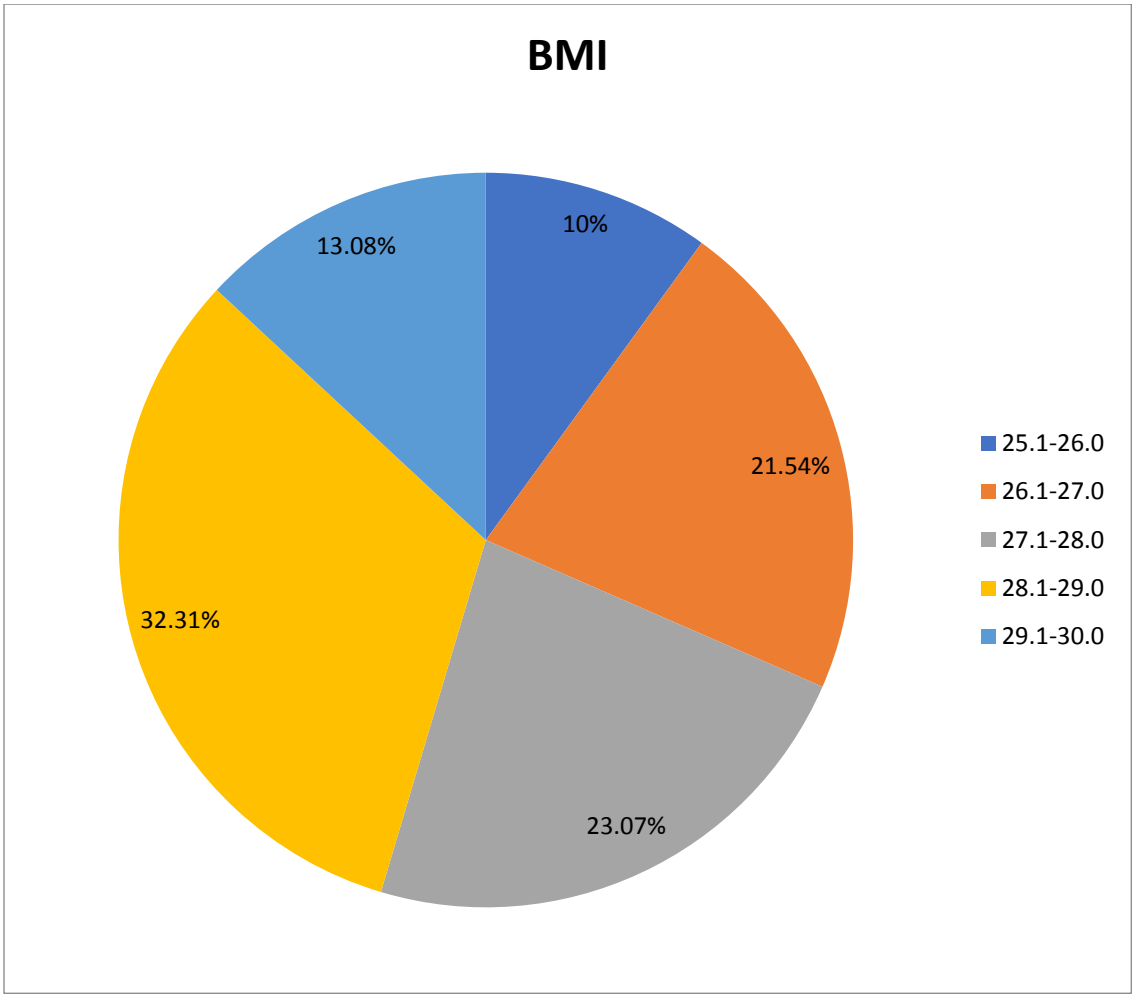


Figure 5 : BMI distribution(overweight) of the patients taking part in the study .

EPIDURAL POSITION

The commonest position of epidural insertion was right lateral position (87.7%). In 12.3% population it was done in the sitting position.

Table 1: Positions of epidural insertion

Position	Frequency	Percent(%)
Right lateral	114	87.7%
Sitting	16	12.3%

Epidural Insertion Levels

The various levels of epidural insertion is given below. On analysis, the commonest level of insertion was between T10-T11 (40%). The next commonest level was between T12 and L1 and the third common level was between L1 and L2.

Table 2: Epidural Insertion Levels

Epidural insertion levels	Frequency	Percent(%)
L1-L2	30	23.1
T10-T11	52	40.0
T12-L1	48	36.9

There was bloody tap in nine patients (6.9%) and accidental dural puncture in 6 patients (4.6%).

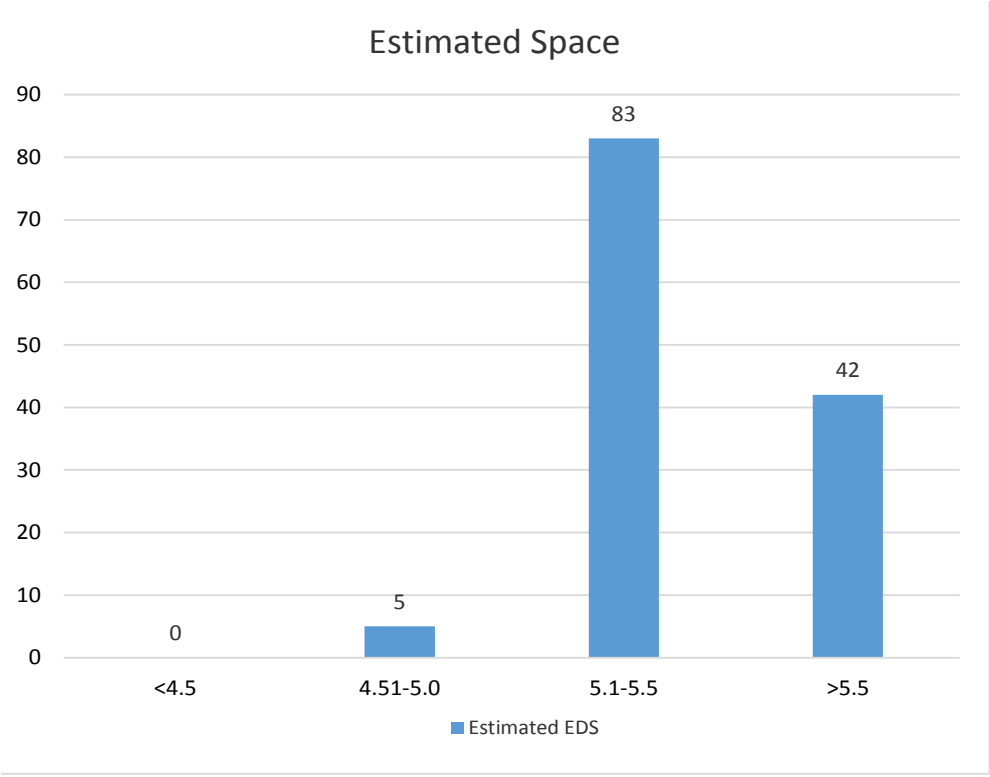


Figure 6 : estimated epidural depth space of the patient taking part in the study

Among 130 study population of either sex belonging to overweight category of BMI 25 to 29.9 kg/m^2 , the estimated epidural depth space after deriving from the formula, 83 of them have epidural space depth ranging from 5.1 to 5.5 cm , among 42 the depth were more than 5.5 cm and only 5 of the study population have depth ranging from 4.51 to 5 cm .

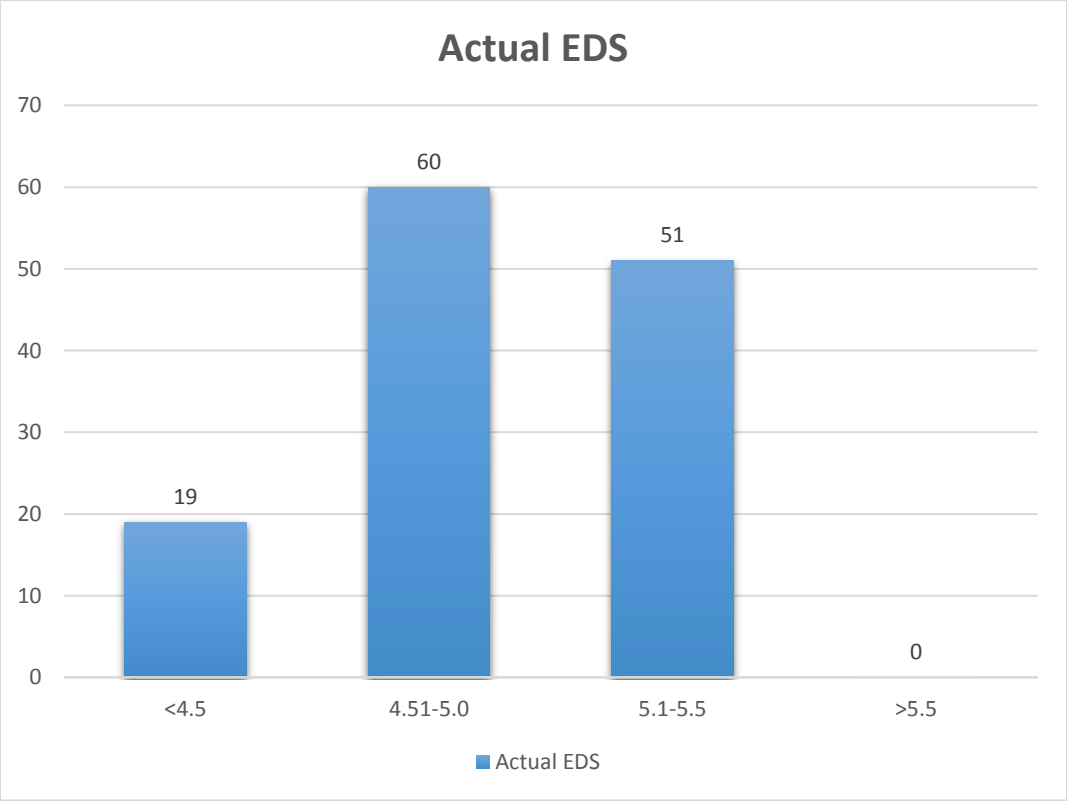


Figure 7 : actual epidural depth space of the patient taking part in the study

Following the conventional method of epidural catheter placement , the actual epidural depth space among 130 population were studied and found to have 4.5 to 5 cm among 60 study population, among 51 study population the

actual epidural depth space was 5.1 to 5.5 cm . only 19 among the rest 130, have epidural depth space less than < 4.5

Actual and estimated EDS Comparison

The mean Estimated EDS using the formula was 5.34± 0.22 with a minimum of 4.80 and maximum of 5.90 . In contrast the actual EDS ranged from 4.00 to 5.25 with a mean of 4.66 ± 0.33.

The mean of the difference between the two was 0.687 ±0.19 .

The actual EDS and estimated EDS was charted on a scatter plot diagram. (below)

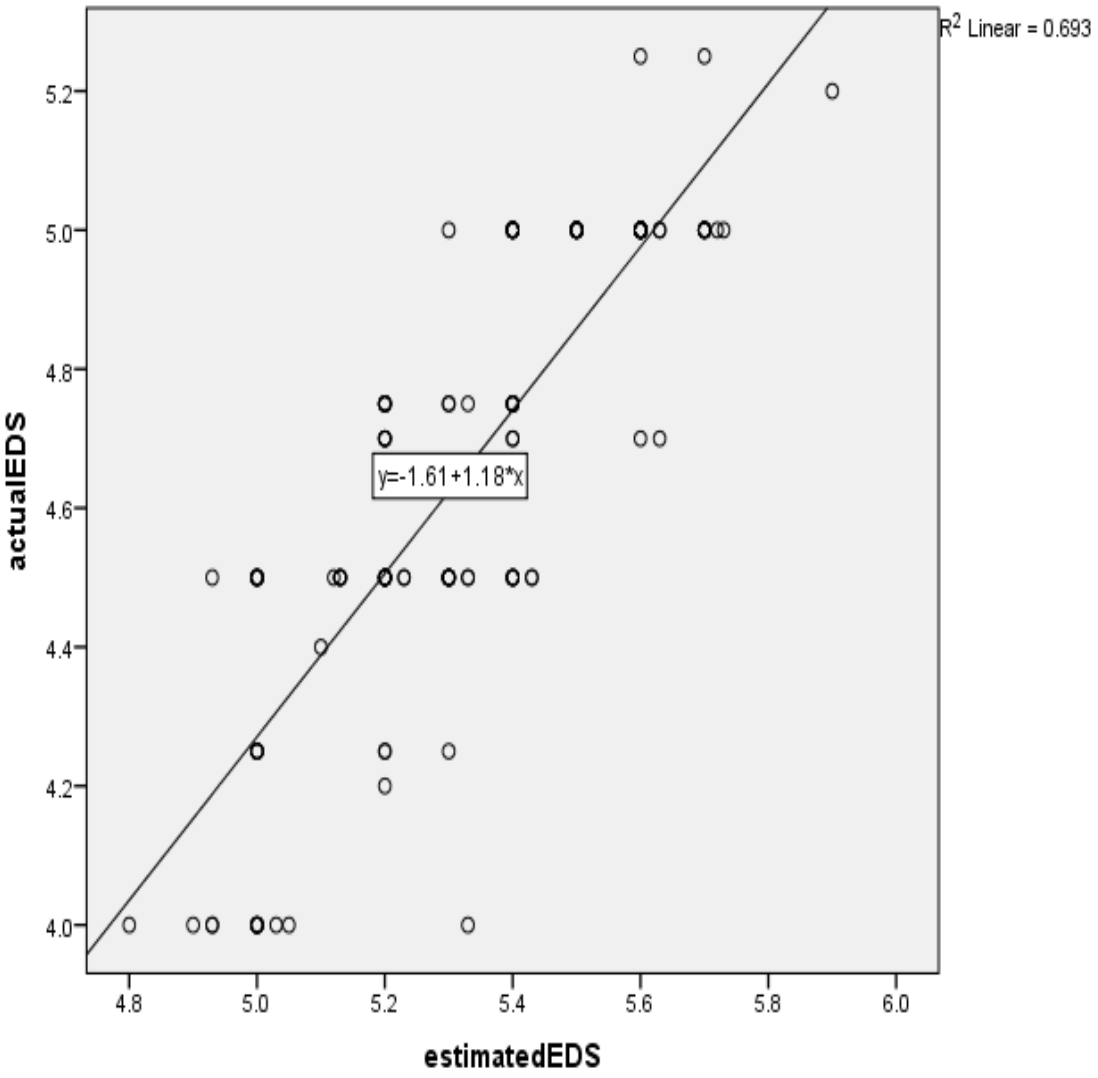


Figure 8 : Scatter Plot Diagram

Table 3 : One sample t test analysis

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
ESTIMATED EDS	273.113	129	.000	5.34708	5.3083	5.3858
ACTUAL EDS	160.402	129	.000	4.66731	4.6097	4.7249

t Test done showed a significant difference between the actual and the estimated depth (P=0.000). This indicates that estimated and actual differ and this is not by chance. The mean of estimated EDS is significantly more than actual EDS. Use of estimated EDS can therefore cause erroneous estimation of depth and failure of epidural. This suggests this formula is not applicable as it is in the Indian scenario, at least without doing a wider analysis for its efficacy in a larger population subset.

Table 4 : One sample t test analysis

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
difference	40.868	129	.000	.68654	.6533	.7198

Intra class correlation for single measure using reliability analysis was 0.769 and is statistically significant. This shows there is a strong correlation between estimated and actual values

DISCUSSION

In the Study conducted by Komaljit Kaur Ravi et al, the age group selected was 18 to 70 yrs., and the mean age with body mass index< 30 was 44.77 ± 16.59 years in males and 46.53 ± 13.85 years in females and in patients with BODY MASS INDEX> 30 48.43 ± 14.63 years in males and 53.80±10.59 years in females. In the study conducted by Hasanin AM et al the mean age group for manual palpation was 38±4.5 and for ultrasound guided epidural placement it was 40 ±3.3 . whereas the study conducted by Bakh JH the age group selected were 20 -25 yrs.[18][13][19]. In my study the age group was 20 to 60 years with the means age group being 39.68 ±9.91 yrs among the overweight patients. In the Study conducted by Komaljit Kaur Ravi et al the height of patients ranged from 141 cm to 180 cm and in my study the height ranged from 145 to 185 cm and the mean height being was 162.6 ±9.09cm [13]

Regarding weight and body mass index, Alyssakosturakis et al studied among 218 non obstetrics cancer patients with mean weight ranging from 82.87 ± 19.50 kg and body mass index of 28.55± 5.96 kg and in the study conducted by Amit kumar Chauhan et al the weight ranged from 45 to 85 with mean of 64.2 ±8.65 and body mass index ranging from18.97 to 29.5 with mean being 24±2.58 . Darieutort laffitec conducted among the patients with body mass index of >30. And the study done by Komaljit Kaur Ravi et al the patients weighted 41 Kg to 100 Kg, and body mass index<30 . In this study they found that the mean epidural space depth increased from 38.25 ±7.07mm to 45.33 ± 5.01mm . The

which is considered to be statistically significant with epidural depth and body mass index ($p < 0.01$).[13][21][20][14].

Among the patients with weight 61 kg to 140 kg, >30 the mean epidural space depth increased from 50.00 ± 0.00mm to 63.64 ± 10.02mmwhich is considered to be statistically significant ($p < 0.01$) , in my study among 130 study population the weight ranged from 50 to 93 with body mass index of 25 to 29.9 with the mean weight being 73.78 ±9.23 kgs.

Among the general population the rate of accidental dural puncture is about 1% to 5%. In the study conducted by sukdip et al the incidence of dural puncture was 0.6% following usage of pre procedural ultrasound . where as in the study conducted by balki et al there were no accidental dural puncture. In my study the incidence of accidental dural puncture was 4.6 % and 6.4% had bloody tap .[5]

In the study conducted by chun et al, parturient with body mass index >25 and <25 was included to measure the epidural depth in sitting and lateral position and it was found that the difference between the sitting and lateral is more among the parturient whose body mass index is >25 and sitting position is more helpful in obese than lateral position. In my study most 87.7% of the patients were placed in lateral position and rest 12.3% were in sitting position.[20]

In the study done by sukdip et al the estimated epidural depth space was 6.5 ±0.6 cm and actual epidural depth space was 6.6 ±1.0 cm among morbidly

obese parturient , in my study the mean of estimated epidural depth space was 5.34 ±0.22 and the mean of the actual epidural depth space was 4.66±0.33 among overweight population of BMI 25 to 29.9 kg/m^2 . There by proving that the epidural depth space is positively correlated with the BMI. More the BMI more being the epidural depth space .[5]

In the study done by sukdip et al the mean of difference between the estimated and the usg guidance were less n was more significant In my study even though The mean difference between the actual and estimated skin to epidural space is 0.68 and even being strictly significant., the mean of the estimated skin to epidural space is more than the actual skin to epidural space . Hence usage of this formula solely may lead to increased chance of accidental dural puncture and there by failure of the epidural.[5]

LIMITATIONS OF THE STUDY

This study was a non-randomised study with small population size with study group including only overweight patients. Also, we had not included ultrasound as a part of the study.

CONCLUSION

Since the mean of estimated skin to epidural depth is significantly more than actual skin to epidural depth, use of this formula can cause erroneous estimation of the skin to the epidural depth. This suggests that this formula is not applicable as it is in the Indian scenario, at least without doing a wider analysis for its efficacy in a larger population subset , with various BMI groups and may be analysed with ultrasonography.

BIBLIOGRAPHY

1. Managing anesthesia for cesarean section in obese patients: current perspectives [Internet]. [cited 2019 Nov 5]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4993564/

2. Definitions, Classification, and Epidemiology of Obesity - Endotext - NCBI Bookshelf [Internet]. [cited 2019 Nov 5]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279167/

3. Kyrou I, Randeva HS, Tsigos C, Kaltsas G, Weickert MO. Clinical Problems Caused by Obesity. In: Feingold KR, Anawalt B, Boyce A, Chrousos G, Dungan K, Grossman A, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000 [cited 2019 Nov 7]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK278973/

4. Nguyen DM, El-Serag HB. The Epidemiology of Obesity. Gastroenterol Clin North Am. 2010 Mar;39(1):1–7.

5. Singh S, Wirth KM, Phelps AL, Badve MH, Shah TH, Sah N, et al. Epidural catheter placement in morbidly obese parturients with the use of an epidural depth equation prior to ultrasound visualization. ScientificWorldJournal. 2013;2013:695209.

6. Waurick K, Waurick R. [History and Technique of Epidural Anaesthesia]. Anasthesiologie Intensivmed Notfallmedizin Schmerzther AINS. 2015 Jul;50(7–8):476–82; quiz 483.

7. Richardson J, Groen GJ. Applied epidural anatomy. Contin Educ Anaesth Crit Care Pain. 2005 Jun 1;5(3):98–100.

8. Principles of anaesthesiology general and regional , vincent J Collins , 3 rd edition.

9. Elsharkawy H, Sonny A, Chin KJ. Localization of epidural space: A review of available technologies. J Anaesthesiol Clin Pharmacol. 2017;33(1):16–27.

10. Frölich MA, Caton D. Pioneers in Epidural Needle Design. Anesth Analg. 2001 Jul;93(1):215.

11. Clinical anaesthesia , Paul G Barash, 8 th edition.

12. Rudra A, Chatterjee S, Das T, Sengupta S, Maitra G, Kumar P. Obstructive sleep apnoea and anaesthesia. Indian J Crit Care Med Peer-Rev Off Publ Indian Soc Crit Care Med. 2008;12(3):116–23.

13. Ravi KK, Kaul TK, Kathuria S, Gupta S, Khurana S. Distance from Skin to Epidural Space: Correlation with Body Mass Index (BMI). J Anaesthesiol Clin Pharmacol. 2011 Jan;27(1):39–42.

14. Kosturakis A, Soliz J, Su J, Cata JP, Feng L, Harun N, et al. Using Computed Tomography Scans and Patient Demographic Data to Estimate Thoracic Epidural Space Depth [Internet]. Pain Research and Treatment. 2015 [cited 2019 Nov 4]. Available from: https://www.hindawi.com/journals/prt/2015/470240/

15. Chun, Eun & Chung, Rack & Kim, Youn & Jin, So. (2017). The Skin-to-epidural distance of parturients by ultrasonography: sitting position versus left lateral position. Anesthesia and Pain Medicine. 12. 132-136. 10.17085/apm.2017.12.2.132.

16. Wani TM, Rafiq M, Nazir A, Azzam HA, Al Zuraigi U, Tobias JD. Estimation of the depth of the thoracic epidural space in children using magnetic resonance imaging. J Pain Res. 2017 Mar 28;10:757–62.

17. Kao MC, Tsai SK, Chang WK, Liu HT, Hsieh YC, Hu JS, et al. Prediction of the distance from skin to epidural space for low-thoracic epidural catheter insertion by computed tomography. Br J Anaesth. 2004 Feb;92(2):271–3.

18. Hasanin AM, Mokhtar AM, Amin SM, Sayed AA. Preprocedural ultrasound examination versus manual palpation for thoracic epidural catheter insertion. Saudi J Anaesth. 2017;11(1):62–6.

19. Bahk JH, Kim JH, Lee JS, Lee SC. Computed tomographic study of lumbar (L3-4) epidural depth and its relationship to physical measurements in young adult men. Reg Anesth Pain Med. 1998 Jun;23(3):262–5.

20. Chauhan AK, Bhatia R, Agrawal S. Lumbar epidural depth using transverse ultrasound scan and its correlation with loss of resistance technique: A prospective observational study in Indian population. Saudi J Anaesth. 2018;12(2):279–82.

21. Darrieutort-Laffite C, Bart G, Planche L, Glemarec J, Maugars Y, Le Goff B. Usefulness of a pre-procedure ultrasound scanning of the lumbar spine before epidural injection in patients with a presumed difficult puncture: A randomized controlled trial. Jt Bone Spine Rev Rhum. 2015 Oct;82(5):356–61.

22. Vricella LK, Louis JM, Mercer BM, Bolden N. Impact of morbid obesity on epidural anesthesia complications in labor. Am J Obstet Gynecol. 2011 Oct;205(4):370.e1-6.

23. Hirabayashi Y, Matsuda I, Inoue S, Shimizu R. The distance from the skin to the epidural space. J Anesth. 1988 Sep 1;2(2):198–201.

24. Balki M, Lee Y, Halpern S, Carvalho JCA. Ultrasound imaging of the lumbar spine in the transverse plane: the correlation between estimated

and actual depth to the epidural space in obese parturients. Anesth Analg. 2009 Jun;108(6):1876–81.

25. Lai H-C, Liu T-J, Peng S-K, Lee K-C, Luk H-N, Lee S-C. Depth of the thoracic epidural space in paramedian approach. J Clin Anesth. 2005 Aug;17(5):339–43.

26. Brummett CM, Williams BS, Hurley RW, Erdek MA. A prospective, observational study of the relationship between body mass index and depth of the epidural space during lumbar transforaminal epidural steroid injection. Reg Anesth Pain Med. 2009 Apr;34(2):100–5.

27. Shiroyama K, Izumi H, Kubo T, Nakamura R. Distance from the skin to the epidural space at the first lumbar interspace in a Japanese obstetric population. Hiroshima J Med Sci. 2003 Jun;52(2):27–9.

28. Aldrete JA, Mushin AU, Zapata JC, Ghaly R. Skin to cervical epidural space distances as read from magnetic resonance imaging films: consideration of the “hump pad.” J Clin Anesth. 1998 Jun;10(4):309–13.

ANNEXURES

ETHICAL COMMITTEE APPROVAL

INSTITUTIONAL ETHICAL COMMITTEE

CHENGALPATTU MEDICAL COLLEGE, CHENGALPATTU

Title of Work	:	An observational study of epidural Catheter Insertion on overweight patients using epidural depth Calculation.
Principal Investigator	:	Dr.R.Kavya
Designation	:	1st yr PG
Co-Investigators	:	Dr.Mala,M.D.,D.A., Professor and HOD, Department of Anaesthesiology
Department	:	Anaesthesiology

The request for an approval From the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 27.03.2018 at the Medical Education Unit, Government Chengalpattu Medical College, Chengalpattu at 11.00 AM.

The Members of the committee, the Secretary and the Chairman are pleased to inform you that your proposed project mentioned above is approved.

You should inform the IEC in case of any changes in study procedure, site, investigator investigation or guide or any other changes.

1. You should not deviate from the area of work for which you applied for ethical clearance.
2. You should inform the IEC immediately, in case of any adverse events or serious adverse reactions.
3. You should abide to the rules and regulations of the institution(s).
4. You should complete the work within the specific period and if any extension is required, you should apply for permission again and do the work.
5. You should submit the summary of the work to the ethical committee on complete of work.

MEMBER-SECRETARY,
IEC,CHENGALPATTU MEDICAL COLLEGE
CHENGALPATTU.

15/5/18
DEAN
CHENGALPATTU MEDICAL COLLEGE
CHENGALPATTU.

PROFORMA

CASE NO:

DATE:

NAME:_____ AGE:_____

WEIGHT:_____HEIGHT:_____

BODY MASS INDEX: **PREVIOUS EPIDURAL:**

MEDICAL HISTORY:

MEDICATIONS:

INVESTIGATIONS: BLOOD GROUP: HIV/ HBSAG/HCV: PLATELET COUNT:

HB/HCT: BLOOD SUGAR: OTHERS:

VITALS: BP: PR: TEMP: CVS:

RS: AIRWAY: SPINE: OTHERS

ANAESTHESIOLOGIST-DR.

SURGEON-DR.

DIAGNOSIS: **PLAN :**

BLOCK:

POSITION:

SPACE:

TECHNIQUE:

NEEDLE:

GUAGE:

SKIN EPIDURAL SPACE DISTANCE:

CATHETER MARK AT SKIN:

BLOOD TAP:

DURAL TAP:

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	difference	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	FAILURE OF EPIDURAL

PATIENTS FEEDBACK

SIGNATURE

INFORMED CONSENT FOR EPIDURAL

PARTICIPANT NAME:_____AGE:-_____IP.NO_____ DATE_____

1. I,_____RESIDING AT _____

_____

_____

UNRESERVEDLY AND IN MY FULL SENSES GIVE MY COMPLETE CONSENT TO:

i) UNDERGO THE PROCEDURE OF EPIDURAL CATHETER INSERTION WITH EPIDURAL DEPTH CALCULATION

ii) SUBODY MASS INDEXSSION OF MY WIFE/HUSBAND/SON/ DAUGHTER/SON IN LAW/DAUGHTER IN LAW/ RELATIVE TO THE PROCEDURE OF EPIDURAL ANALGESIA FOR REDUCING THE PAIN OF LABOUR.

2. THE NEED, NATURE, PROCEDURE, SEQUELAE, LIABILITIES, CONSEQUENCES AND OTHER DETAILS OF THE ANAESTHETIC PROCEDURE HAVE BEEN EXPLAINED FULLY TO ME AND I UNDERSTAND THE SAME.
3. THE FOLLOWING THINGS WERE DISCUSSED AND EXPLAINED TO ME IN DETAIL:
   i) THE OTHER SIDE EFFECTS LIKE POSTDURAL PUNCTURE HEADACHE AND ITS TREATMENT OPTIONS HAVE BEEN DISCUSSED.
   ii) OTHER MAJOR SIDE EFFECTS, REMOTELY ASSOCIATED WITH THE PROCEDURE AND THEIR OUTCOME HAVE BEEN DISCUSSED.
   iii) THIS PROCEDURE IS OPTIONAL AND IS PROVIDED BY THE ANAESTHESIOLOGIST ON THE PAIENT'S REQUEST.

4. I ALSO GIVE CONSENT FOR ANY CHANGE IN THE LINE OF TREATMENT OR ALTERNATIVE PROCEDURE AS MAY BE FOUND NECESSARY AND DECIDED FIT DURING THE COURSE OF SURGERY IN THE BEST INTEREST OF MY HEALTH/ THE HEALTH OF MY WIFE/HUSBAND/SON/DAUGHTER/SON INLAW/DAUGHTER IN LAW/RELATIVE.
5. I GIVE CONSENT FOR USING THE DETAILS OF MY ILLNESS/ ILLNESS OF MY WIFE/HUSBAND/SON/DAUGHTER/SON INLAW/DAUGHTER IN LAW/RELATIVE AND TREATMENT FOR RESEARCH, SCIENTIFIC PAPER PUBLICATIONS AND MEDICAL EDUCATION. THIS MAY INCLUDE MEDICAL RECORDS, INVESTIGATIONS, PHOTOGRAPHS AND VIDEOS.
6. THE CONTENTS OF ABOVE HAVE BEEN THOROUGHLY EXPLAINED TO ME IN MY FAMILIAR LANGUAGE BY THE ATTENDING DOCTOR.

SIGNATURE OF ATTENDING DOCTOR
SIGNATURE OF THE PATIENT/REPRESENTATIVE

WITNESESS

1. 2.

PATIENT CONSENT FORM

STUDY DETAIL:

"AN OBSERVATIONAL STUDY OF EPIDURAL CATHETER INSERTION ON OVERWEIGHT PATIENTS USING EPIDURAL DEPTH CALCULATION"

STUDY CENTRE:

CHENGALPATTU MEDICAL COLLEGE AND HOSPITAL, CHENGALPATTU

PATIENT NAME:_____ AGE:_____

IP NO_____

I CONFIRM THAT I HAVE UNDERSTOOD THE PURPOSE OF PROCEDURE FOR THE ABOVE STUDY.

I HAVE THE OPPORTUNITY TO ASK THE QUESTION AND ALL MY QUESTIONS AND DOUBTS HAVE BEEN ANSWERED TO MY SATISFACTIONS.

I UNDERSTAND THAT MY PARTICIPATION IN THE STUDY IS VOLUNTARY AND THAT I AM FREE TO WITHDRAW AT ANYTIME WITHOUT GIVING ANY REASONS, WITHOUT MY LEGAL RIGHTS BEING AFFECTED.

I UNDERSTAND THAT INVESTIGATOR, REGULATORY AUTHORITIES AND ETHICS COMMITTEE WILL NOT NEED MY PERMISSION TO LOOK AT MY HEALTH RECORD BOTH IN RESPECT TO THE CURRENT STUDY AND ANY FURTHER RESEARCH THAT MAY CONDUCTED IN RELATION TO IT, EVEN IF WITHDRAW FROM THE STUDY, I UNDERSTAND THAT MY IDENTITY WILL NOT BE REVEALED IN ANY INFORMATION RELEASED TO THIRD PARTIES OR PUBLISHED, UNLESS AS REQUIRED UNDER THE LAW. I AGREE NOT TO RESTRICT THE USE OF ANY DATA OR RESULTS THAT ARISE FROM THE STUDY.

I AGREE TO TAKE PART IN ABOVE STUDY AND TO COMPLY WITH THE INSTRUCTIONS GIVEN DURING THE STUDY AND FAITHFULLY

COOPERATIVE WITH THE STUDY TEAM AND TO IMMEDIATELY INFORM THE STUDY STAFF IF I SUFFER FROM ANY DETERIORATION IN MY HEALTH OR WELLBEING OR ANY UNEXPECTED OR UNUSUAL SYMPTOMS.

I HEREBY GIVE CONSENT TO PARTICIPATE IN THIS STUDY.

I HEREBY GIVE PERMISSION TO UNDERGO COMPLETE CLINICAL EXAMINATIONS AND DIAGNOSTIC TEST.(5)

SIGNATURE/ THUMB IMPRESSION:

SIGNATURE OF THE INVESTIGATOR:

PATIENT NAME AND ADDRESS:

PLACE:

DATE:

சுயஒப்புதல்படிவம்

ஆய்வு செய்யப்படும் தலைப்பு : "எபிடரல் ஆழம் கால்குலேட்டரைப் பயன்படுத்தி அதிக எடை கொண்ட நோயாளிகளுக்கு எபிடரல் கேத்தீட்டர் செருகும் ஒரு ஆய்வு"

ஆய்வு செய்யப்படும் இடம்:

பங்கு பெறுபவரின் பெயர்:

பங்கு பெறுபவரின் வயது: பங்கு பெறுபவரின் எண் :

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டுள்ளது. நான் இவ்வாய்வில் தன்னிச்சையாக பங்கேற்கின்றேன். எந்த காரணத்தினாலோ, எந்த சட்டசிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்கு பெறும் மருத்துவர், என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவை இல்லை என அறிந்து கொள்கிறேன். இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்கமாட்டேன்.

இந்த ஆய்வில் பங்குகொள்ள ஒப்புக்கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம்: சாட்சியாளரின் கையொப்பம்

இடம்: இடம்:

தேதி: தேதி :

பங்கேற்பவரின் பெயர் மற்றும் விலாசம்:

ஆய்வாளரின் கையொப்பம்:

இடம்: தேதி:

MASTER CHART

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
A1	25	F	161.2	66	25.4	5.13	4.5	0.63	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
A2	28	M	156.1	63	25.9	5.05	4.	1.05	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
A3	51	M	152	61	26.4	5.03	4	1.03	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
A4	44	M	153.1	68	29	5.33	4.5	0.83	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
A5	53	M	154	69	28.9	5.4	4.5	0.9	SITTING	T10-T11	2	-	YES
A6	28	F	163.9	74	27.5	5.33	4.5	0.8	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
A7	31	M	173.4	84	27.9	4.93	4	0.93	SITTING	T12-L1	2	-	-
A8	56	M	171.6	85	28.9	4.93	4.5	0.43	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
A9	32	F	163.4	71	26.6	5.23	4.5	0.73	SITTING SITTING	T12-L1	4	-	-
A10	34	M	161.6	70	26.8	5.13	4.5	0.63	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
B1	29	M	171	85	29.1	4.93	4	0.93	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
B2	58	M	165	79	29	5.63	4.7	0.9	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
-B3	33	F	175	81	26.4	5.43	4.5	0.9	RIGHT LATERAL DECUBITUS	T12-L1	1	-	YES
B4	36	M	171	83	28.4	4.93	4.25	0.68	RIGHT LATERAL DECUBITUS	T10-T11	1	YES	-
B5	57	M	153.4	67	28.5	5.33	4	1.33	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
B6	37	M	156.4	67	27.4	5.23	4.5	0.73	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
B7	22	M	160.3	67	26.1	5.13	4.5	0.63	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
B8	38	M	155.5	64	26.5	5.13	4.5	0.63	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
B9	39	F	150.9	61	26.8	5.12	4.5	0.62	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
B10	40	M	152.7	63	27	5.2	4.2	1	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
C1	54	M	153.6	67	28.4	5.4	4.5	0.9	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
C2	31	M	164.4	80	29.6	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
-C3	25	M	170.7	87	29.9	5.73	5	0.73	SITTING	T10-T11	2	-	-
C4	32	F	170.5	83	28.6	5.72	5	0.72	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
C5	36	M	161.7	70	26.8	5.63	5	0.63	RIGHT LATERAL DECUBITUS	L1-L2	1	YES	-
C6	34	M	160.9	73	28.2	5.43	4.5	0.93	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
C7	51	M	170.2	84	29	5.63	5	0.63	RIGHT LATERAL DECUBITUS	T10-T11	1	-	YES
C8	37	M	163.2	74	27.8	5.4	4.7	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
C9	34	F	175.4	86	28	5.6	4.7	0.9	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
C10	33	M	171.3	87	29.6	5.7	5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
D1	28	M	153.6	67	28.4	5.4	4.75	0.7	RIGHT	L1-L2	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
									LATERAL DECUBITUS				
D2	38	M	155.3	69	28.6	5.3	4.5	0.8	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
D3	59	F	157.8	63	25.3	5.1	4.25	0.9	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
D4	29	F	160.2	66	25.7	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
D5	31	M	155.4	63	26.1	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
D6	33	F	150.3	61	27	5.2	4.25	1	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
D7	60	M	152.6	62	26.6	5.1	4	1.1	SITTING	T12-L1	2	-	YES
D8	38	F	153.4	68	28.9	5.3	4.25	1.1	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
D9	27	M	165.4	81	29.6	4.9	4	0.9	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
D10	60	F	172.8	86	28.8	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
E1	39	F	170.4	84	25.5	5.5	5	0.5	RIGHT LATERAL	L1-L2	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
									DECUBITUS				
E2	54	M	161.6	71	27.2	5.2	4.75	0.5	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
E3	38	F	160.8	72	27.8	5.4	4.7	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
-E4	57	F	170.1	85	29.4	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
E5	24	M	164.2	75	27.8	5.4	4.5	0.9	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
E6	37	F	174.4	87	28.6	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	YES	-
E7	41	M	171.4	87	29.6	5.7	5	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
E8	56	M	153.6	67	28.4	5.4	4.5	0.9	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
E9	47	F	155.4	70	29.4	5.9	5.2	0.7	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
E10	42	M	160	65	25.4	5	4	1	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
F1	55	M	155	62	25.8	5.1	4	1.1	RIGHT	T10-T11	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
									LATERAL DECUBITUS				
F2	23	F	150	60	26.7	5.1	4.25	0.9	RIGHT LATERAL DECUBITUS	T12-L1	1	-	YES
F3	43	M	152	61	26.4	5.1	4	1.1	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
F4	50	F	153	67	28.6	5.4	4.5	0.9	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
F5	26	M	165.1	70	25.7	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
F6	53	F	172	85	28.7	5.6	5	0.6	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
F7	21	M	170	84	29.1	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
F8	50	M	161	70	27	5.2	4.5	0.7	SITTING	L1-L2	2	-	-
F9	27	F	160	71	27.7	5.2	4.7	0.6	SITTING	T12-L1	2	-	-
F10	56	M	170	86	29.8	5.7	5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
G1	49	M	164	78	29	5.4	5	0.4	RIGHT LATERAL DECUBITUS	L1-L2	2	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
G2	46	F	174	81	26.8	4.8	4	0.8	SITTING	T12-L1	1	-	-
G3	60	M	171	86	29.4	5.7	5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
G4	27	F	153	68	29	5.4	5	0.4	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
G5	45	M	155	71	29.6	5.4	5	0.4	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
G6	44	M	145	55	26.2	5	4.25	0.8	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
G7	29	F	147	58	26.8	5.1	4	1.1	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
G8	46	M	150	63	28	5.2	4.25	1	RIGHT LATERAL DECUBITUS	T12-L1	1	-	YES
G9	43	M	151.5	64.5	28.1	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
G10	42	M	165	78	28.7	5.4	5	0.4	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
H1	41	M	180	92	28.4	5.7	5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
H2	44	F	164	78.5	29.2	5.6	5	0.6	RIGHT	T12-L1	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
									LATERAL DECUBITUS				
H3	27	M	171	84.5	28.9	5.6	5.25	0.4	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
H4	43	F	161	74	28.5	5.4	5	0.4	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
H5	49	M	170	81	28	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	YES	-
H6	45	M	148	60	27.4	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
H7	44	M	153	65.5	28	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
H8	26	F	149	61	27.5	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
H9	46	F	151	63	27.6	5.2	4.7	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
H10	47	M	152.4	65.5	28.2	5.2	4.7	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
I1	48	M	154.8	68	28.4	5.4	5	0.4	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
I2	28	F	155.9	68	28	5.3	4.75	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
I3	50	M	156.4	65	26.6	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
I4	49	F	178.5	89	27.9	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	YES
I5	47	M	144	55.5	26.8	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
I6	48	M	147	59	27.3	5.2	4.75	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
I7	43	M	148.5	61	27.7	5.3	4.5	0.8	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
I8	26	F	154.1	65	27.4	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
I9	44	M	158	69	27.6	5.3	4.5	0.8	SITTING	T12-L1	2	-	-
I10	46	F	160.4	72	28	5.2	4.75	0.5	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
J1	29	M	167	78	28	5.4	4.75	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
J2	45	M	173	84	28.1	5.5	5	0.5	RIGHT	T12-L1	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
									LATERAL DECUBITUS				
J3	47	F	161.9	73.5	28	5.3	5	0.3	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
J4	50	M	186	93	26.9	5.6	5	0.6	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
J5	48	M	165.4	78	28.5	5.5	5	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
J6	25	F	166	73	26.5	5.3	4.5	0.8	SITTING	T10-T11	2	-	-
J7	42	M	168	75	26.6	5.3	4.5	0.8	SITTING	T12-L1	2	-	-
J8	44	M	164.5	76	28.1	5.5	5	0.5	SITTING	L1-L2	2	-	-
J9	41	F	168	79	28	5.4	5	0.4	SITTING	T10-T11	2	-	YES
J10	48	M	162	75	28.6	5.5	5	0.5	SITTING	T12-L1	2	-	-
K1	30	F	165	71	26.1	5.2	4.7	0.5	SITTING	L1-L2	2	-	-
K2	47	M	170	75	26	5.3	4.5	0.8	SITTING	T10-T11	2	-	-
K3	46	M	168	71	25.2	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
K4	25	F	170	82	28.4	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	2	-	-
K5	45	M	171	81	27.7	5.4	4.75	0.7	RIGHT LATERAL DECUBITUS	T12-L1	2	YES	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
K6	49	M	149	61	27.5	5.1	4.25	0.9	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
K7	45	F	154	69	29.1	5.4	4.75	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
K8	28	M	157	69.5	28.2	5.3	4.5	0.8	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
K9	44	F	161	69.5	26.8	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
K10	41	M	152.5	62	26.8	5.1	4.5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
L1	37	M	151.4	63	27.5	5.2	4.5	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
L2	31	F	164.8	78	28.7	5.5	5	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
L3	27	F	177	80	25.5	5.3	4.75	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
L4	39	M	169	84	29.4	5.7	5.25	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
L5	36	M	175	89	29.1	5.7	5	0.7	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
L6	35	M	178	90	28.4	5.6	5	0.6	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
L7	38	F	165.5	80	29.2	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
L8	26	M	165	78	28.1	5.5	5	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	YES
L9	38	M	166.5	79	28.5	5.6	5	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
L10	34	F	160.5	74	28.7	5.4	4.75	0.7	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
M1	36	M	164	75	27.9	5.5	5	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
M2	36	M	173	85	28.4	5.5	5	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
M3	28	M	176	88	28.4	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
M4	39	F	175.5	88	28.6	5.7	5	0.7	RIGHT LATERAL DECUBITUS	L1-L2	1	-	-
M5	35	M	176.5	82	26.3	5.4	5	0.4	RIGHT LATERAL DECUBITUS	T10-T11	1	YES	-

PATIENT	AGE	SEX	HT in cm	WT in kg	BODY MASS INDEX	ESTIMATED EDS	ACTUAL EDS	DIFFERENCE	POSITION	LEVEL OF EPIDURAL INSERTION	NO OF ATTEMPTS	ACCIDENTAL DURAL PUNCTURE	BLOODY TAP
M6	29	F	176.5	80	25.7	5.2	4.75	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
M7	34	M	164.5	75	27.7	5.4	5	0.4	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
M8	31	M	178.5	80	25.1	5.2	4.75	0.5	RIGHT LATERAL DECUBITUS	T12-L1	1	-	-
M9	30	F	174	86	28.4	5.6	5	0.6	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-
M10	49	M	173	80	26.7	5.33	4.75	0.5	RIGHT LATERAL DECUBITUS	T10-T11	1	-	-