



Anesthesia
MED441



4- Regional anesthesia technique

Objectives

- Relevant anatomy and surface landmark for Neuraxial block.
- Differences between spinal and epidural.
- Equipment and local anesthetics.
- Indication and contraindication.
- Side effects, complications and treatment.
- LAST

Color Index:

- Main Text
- 41 Doctor's notes
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Editing file

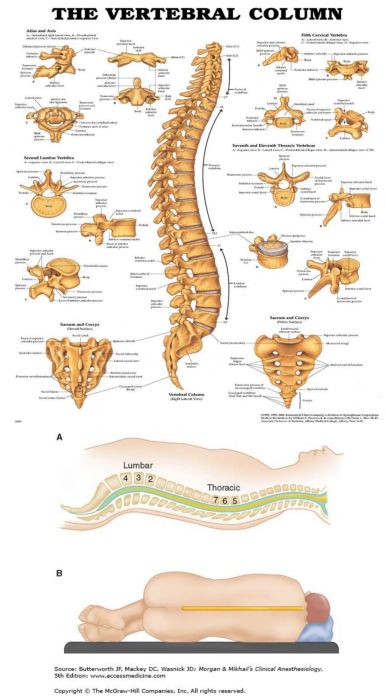
Case discussion

Anatomy

Vertebral column

Knowledge of anatomy for neuraxial blockade is essential!

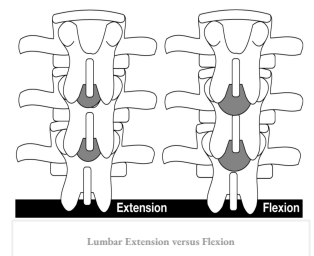
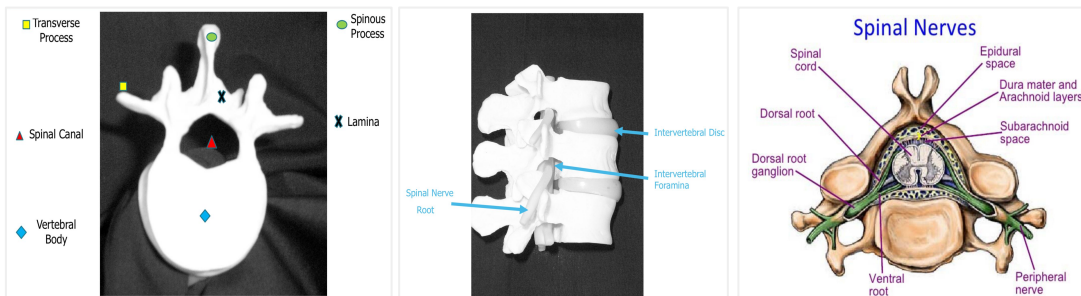
- **7 cervical vertebrae** transverse process has a bifida only up to c7
- **12 thoracic vertebrae** spinous processes incline caudally and can reach the transverse process of the lower vertebra making thoracic epidural difficult
- **5 lumbar vertebrae** To straighten the lumbar curvature we ask the pt to bring his knee near his chest (**FLEXION is imp to widen the space**) like In praying either sitting or lateral, but there are difficult situations such as pregnant women, fracture, old age >85, ankylosing spondylitis. lumbar spinous process is almost horizontal and wider space makes it easy access
- **5 fused Sacrum** The 5th sacral vertebrae has no laminae so there's no fusion in the midline so there's no spinous process, we can access this area especially in **pediatric we do caudal block at S5 (low epidural)** because it's easy to access, used in any **bilateral surgery** E.g. bilateral hernia in Adult you can do it but with difficulties and help of X ray and Fluoroscopy
- **Coccyx** primitive not very well developed



Individual vertebral anatomy

Each vertebra consists of:

- **Pedicle.**
- **Transverse process.**
- **Superior & inferior articular processes.**
- **Spinous process.**

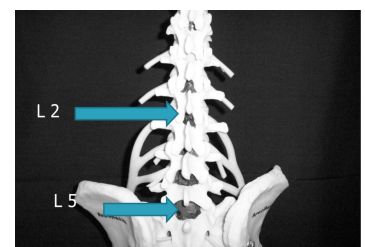


-spinal canal contains: spinal cord, meninges, CSF and spinal nerves

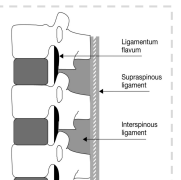
-When 2 pedicles go together above and below they make the intervertebral foramina (exit of the nerve roots)

vertebral anatomy

- Each vertebra is connected to the next by intervertebral discs.
- There are 2 superior and inferior articular processes (synovial joints) on each vertebra that allows for articulation.
- Pedicles contain a notch superiorly and inferiorly to allow the spinal nerve root to exit the vertebral column.
- Interlaminar spaces are larger in the lower lumbar region :If an anesthesia provider finds it challenging at one level it is important to remember that moving down one space may provide a larger space



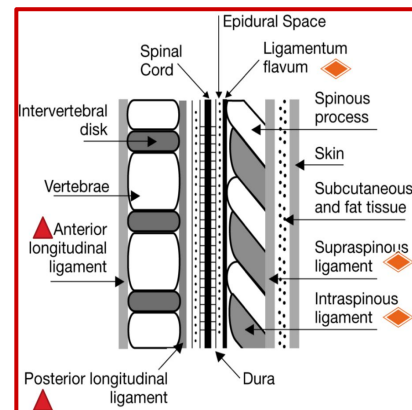
- ligamentum flavum: it's **yellow** connect the ventral parts of the laminae of adjacent vertebrae
 - Supraspinous ligament: connect the **tip** of spinous process from C7 down to the sacrum above it is called: ligamentum nuchae
 - Interspinous ligament: connect the spinous process
- The difference between spinal and epidural whether the needle penetrate the dura or not :**
- If the needle stops in the epidural space not penetrating the dura means it's epidural
 - If it penetrates the dura into intrathecal (subarachnoid space) it becomes spinal Anesthesia



Anatomy

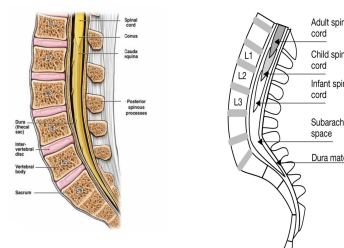
Ligaments that support Vertebral column

- Ventral side: Anterior and posterior longitudinal ligaments.
- **Dorsal side:** Important since these are the structures your needle will pass through!
Skin > subcutaneous and fat tissue > Supraspinous ligament > interspinous ligament > ligamentum flavum (thick / dense you can feel it when you penetrate) > epidural space > dura > subarachnoid space
- Ligaments are identified by tactile sensation. Dorsal ligaments are transversed during neuraxial blockade.
With experience the anesthesia provider will be able to identify anatomical structures by "feel".
ligamentum flavum: connect lamina above and lamina below, has lunar shape and joins together in the midline



Termination of the spinal cord

- **Adults: usually ends at L1.** There are anatomical variations. For most adults it is generally safe to place a spinal needle **below L2.**
- As a rule **NO** spinal anesthesia above L2, you can do L3, L4, L5, but **NEVER** above L2, in epidural anesthesia there's no limitation
- Children: ends at L2
- Infants: L3



Surface anatomy and landmarks

Bony landmarks never change whether the pt is tall or short, thin or obese

Locating prominent cervical and thoracic vertebrae:

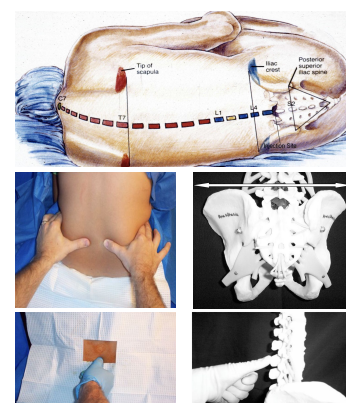
- C2 is the first palpable vertebrae.
- C7 is the most **prominent** cervical vertebrae you can easily feel it in your neck.
- With the patient's arms at the side the tip of the scapula generally corresponds with T7.
Angle of scapula is T7, spine of scapula is T3 (epidural for thoracic surgery).
Most of thoracic EA between T3-7.
- Spinous process are generally palpable to help identify the midline.
If unable to palpate the spinous process? one can look at the upper crease of the buttocks and line up the midline as long as there is no scoliosis or other deformities of the spine.
- **What is Tuffier's Line? (intercristal line) very imp in OSCE**
A line drawn between the highest points of both iliac crests will yield either the body of L4 spinous process or the L4-L5 interspace
Placing 2 thumbs medially, drawing an imaginary line connecting the iliac crest bilaterally.
bisect L4 spinal process, above L3-4 below L4-5 and both are good for spinal and epidural.

The 2 dimples we all have on our lower back is the posterior superior iliac spine on S2, which is the **end of the epidural space & dura mater.**

Put your 2 fingers on each of the dimples and with the 3rd finger make an equilateral triangle and this is your caudal space on S5. so, two fingers on S2 and one finger on S5 for caudal block mostly in pediatrics (low EA) for and procedure below the umbilicus or even above, it is easy and approachable.

Caudal is same as epidural but low approach and low dose.

Ligamentum flavum ends at S5 but including S5 as S5 is covered by sacrococcygeal membrane an extension of ligamentum flavum.



Anatomy

Subarachnoid space

The Subarachnoid Space is a continuous space that contains CSF, Spinal cord & nerves. Extends up to S2

CSF

Clear fluid that fills the subarachnoid space

Total volume in adults is ~100-150 ml (2 ml/kg)
75 kg male or female typically have 150ml CSF, half in the brain, half in the spinal cord

Volume found in the subarachnoid space is ~35-45 ml.

Continually produced at a rate of 450 ml per 24 hour period replacing itself 3-4 times

Specific gravity is between 1.003-1.007 (this will play a crucial role in the baricity of local anesthetic that one chooses).

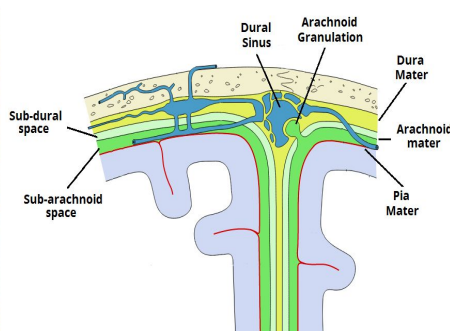
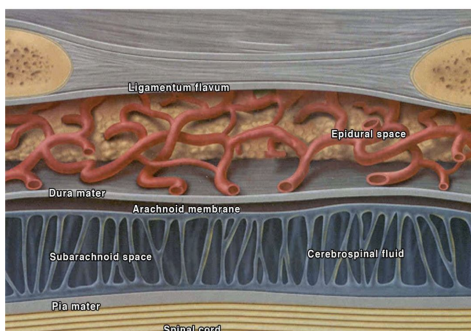
Reabsorbed into the bloodstream by arachnoid villi.

Body wt is the only measurement that coincides with CSF volume (this becomes important in the obese and pregnant).

CSF plays a role in patient to patient variability, in relation to block height and sensory/motor regression (80% of the patient to patient variability)

Membranes that surround the spinal cord (meninges):

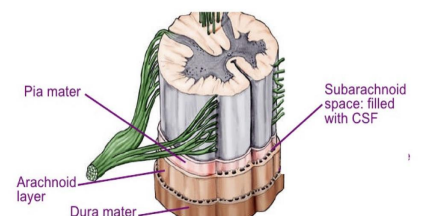
| Pia mater | Arachnoid mater | Dura mater ("tough mother") |
|--|---|--|
| highly vascular | non vascular | |
| <ul style="list-style-type: none"> - covers the spinal cord and brain -Filum terminalis is an extension of the pia mater attaches to the periosteum of the coccyx. | <ul style="list-style-type: none"> - attached to the dura mater. - Principal barrier to the migration of medications in and out of the CSF. | <ul style="list-style-type: none"> - extension of the cranial dura mater. - extends from the foramen magnum to S2. |



Meninges

Within the spinal canal, the spinal cord is surrounded by the EPIDURAL SPACE, filled with fatty tissue, veins, and arteries. The fatty tissue acts as a shock absorber.

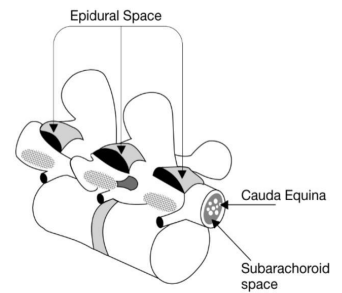
The spinal cord is covered by MENINGES which has three layers.



Anatomy

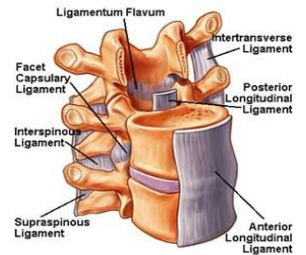
Epidural space anatomy :

- Extends from the foramen magnum to the sacral hiatus
 - That's why there's no limitation to which level we can do the epidural anesthesia unlike spinal anesthesia where we have to make sure we are below the level of L2
 - The epidural space surrounds the dura mater anteriorly, laterally, and most importantly to us posteriorly.
- Epidural = Extradural (we don't touch the dura)



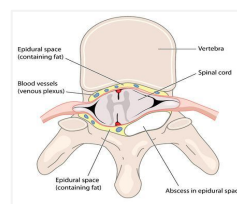
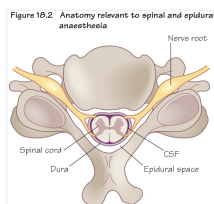
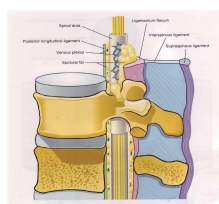
The Bounds of the Epidural Space are:

- Anterior posterior longitudinal ligament it's a very strong ligament, so most herniations happen laterally not anterior/posterior.
 - Lateral pedicles and intervertebral ligaments
 - Posterior ligamentum flavum: thick and dense
 - Posterior to the epidural space
 - Extends from the foramen magnum to the sacral hiatus S5
 - Distance from skin to ligament varies from 3-8 cm in the lumbar area. It is 4 cm in 50% of the patients and 4-6 cm in 80% of the patients.
 - Thickness of the ligamentum flavum also varies. In the thoracic area it can range from 3-5 mm and in the lumbar it can range from 5-6 mm. And thickness on the same level varies (the part in midline is the thickest part of this ligament)
- Epidural Potential space between the dura mater and ligamentum flavum 3-6mm
- Connect lamina above and below



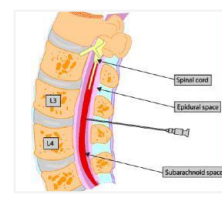
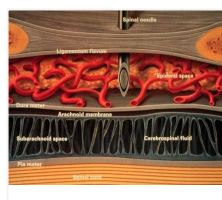
Contents of epidural space:

- 01 **Fat** acts as shock absorber
- 02 **Areolar tissue**
- 03 **Lymphatics**
- 04 **Blood vessels Highly vascular including the Batson venous plexus** (Valveless veins which are connected to the intrathoracic veins (which have a **negative pressure**). Because batson veins are valveless, intrathoracic negative pressure is passed on the epidural space. We know we are in the epidural space when we come upon negative pressure/ loss resistance (it is difficult to pass the needle). different type of syringe is used called loss of resistance syringe or we put drop of saline on top of the needle it will be sucked once it reach the dura



Once penetrated ligamentum flavum only: epidural block.

Penetrated The dura & arachnoid: Spinal Anesthesia.



Spinal Anesthesia

Injection of small amounts (2-3 ml) of local anaesthetics into the CSF at the level **below L2**, where the spinal cord ends, anesthesia of the lower body part below the umbilicus is achieved .




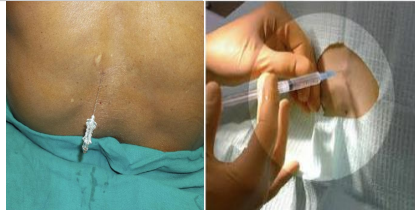
-Also called intrathecal anesthesia or subarachnoid block

-Spinal is faster and intense block while epidural takes more time to start.

-**Spinal with adductor canal catheter** (analgesic post op) **does not paralyze the muscle** so patient can walk after surgery in the recovery room > less risk of DVT and PE especially in knee surgery. epidural post op analgesia cause paralysis > pt can't move

| Indications | Contraindications |
|---|---|
| <ul style="list-style-type: none"> • Most commonly used in C-sections • When women go for cesarean we do spinal while in vaginal delivery we do epidural (catheter) stay for 2-3 days. • Operations below the umbilicus hernia repairs gynaecological, urological • any operation on the perineum or genitalia. • orthopedics Unilateral knee replacement (not bilateral because bilateral takes a long time). • Now we are achieving adductor canal catheter : analgesia for the knee without paralyzing the muscle, so the patient can walk immediately • Used in short duration procedures, but if long time procedures we use epidural | <ul style="list-style-type: none"> • Absolute: • Refusal (most definitive contraindication) • Infection like bed sores or abscess around the site involved (to not carry infection into CSF) • Coagulopathy & anticoagulated patient (warfarin). • Severe hypovolemia if a patient came from the ER and have lost 2L of blood, DON'T do spinal because it will cause vasodilation, so give preloading 1L of crystalloid fluid • Increased ICP causes herniation • Severe aortic or mitral stenosis they have fixed CO and anesthesia cause vasodilation > they can't increase the CO to compensate the vasodilation (difficulty dealing with the sympathetic effect) • Relative: • Neurological deficit |

Position :

| Sterility & set | Sitting (easier) | Lateral decubitus If the patient can't sit Bring the knees to the chest | <u>single shot technique</u> |
|--|---|--|--|
|  |  |  © NYSORA.com |  Injecting lidocaine to anesthetize the skin & subcutaneous tissue |

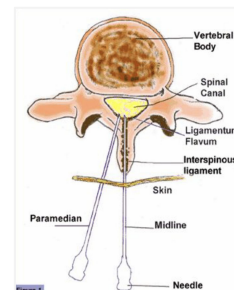
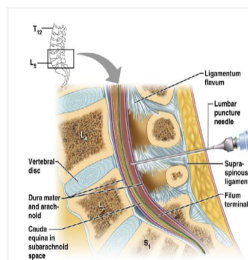
Midline Approach

Paramedian or Lateral Approach

Question: what layers does the needle penetrate?

1. Skin
2. Subcutaneous Tissue
3. **SupraSpinous ligament**
4. Interspinous ligament
5. Ligamentum flavum
6. Epidural space
7. Dura mater
8. Arachnoid mater

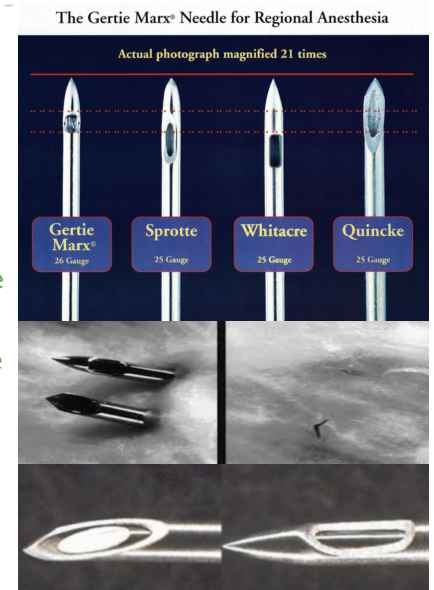
Same as midline excluding supraspinous & interspinous ligaments **Immediately to ligamentum flavum 10 degrees from the midline**
For old patients , calcified tendons



Spinal Anesthesia

Needle types

- Mainly two types: **Quincke** and **pencil point** (eg. Gertie marx, sprotte and whitacre are all called pencil point)
- Quincke needle is sharp, it cut (tears) the dura fibers leading to leakage of CSF, Young female patients are commonly prone to Post-Dural Puncture Headache (PDPH) so it is quite common in obstetric procedures.
- Pencil point needles are better in terms of post dural puncture headache we don't see it nowadays because when they penetrate the dura they only separate it rather than creating a hole behind that leaks CSF & once the needle is withdrawn the fibers will return to normal or pre-puncture position by elastic recoil.
- You need to choose a large gauge (small diameter) needle to reduce the risk of post-dural puncture headache. We usually use 27 gauge pencil point needles.



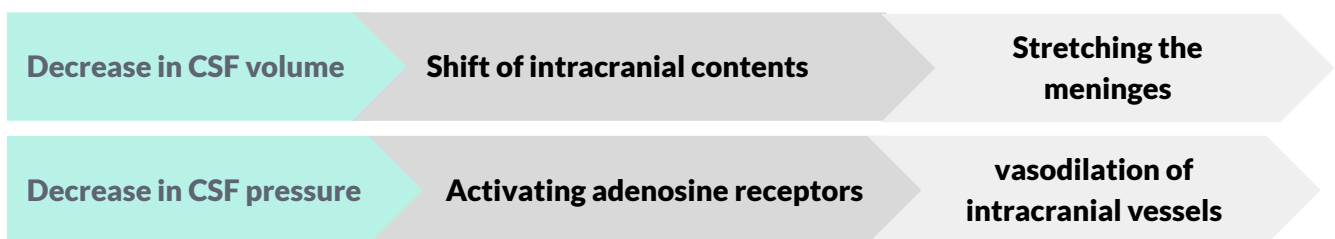
Post-dural puncture headache (PDPH)

- A side effect of spinal anesthesia.
- Depends on the design of the tip (blind end with sideboard) and gauge size (the smaller the better)
- Develop 12-48 hours after spinal anesthesia.
- Headache improve when lying supine.
- Increases when standing upright, If it not then it is not a PDPH

Differential Diagnosis

- Meningitis
- Sinusitis
- Migraine
- Pregnancy related hypertension
- Intracranial Pathology (sol)
- Dural Venous thrombosis,
- Pneumocephalus,
- Spontaneous intracranial hypotension.

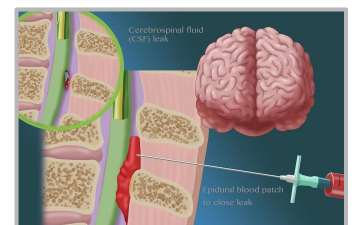
Mechanism: Persistent leakage of CSF Leading to:



- **Monro law:** the volume in the cranial cavity consists of fixed brain tissue, CSF, blood.
- If the CSF decreases so the blood will increase, meaning we have vasodilation = headache. Giving caffeine will cause vasoconstriction and the patient will feel better.

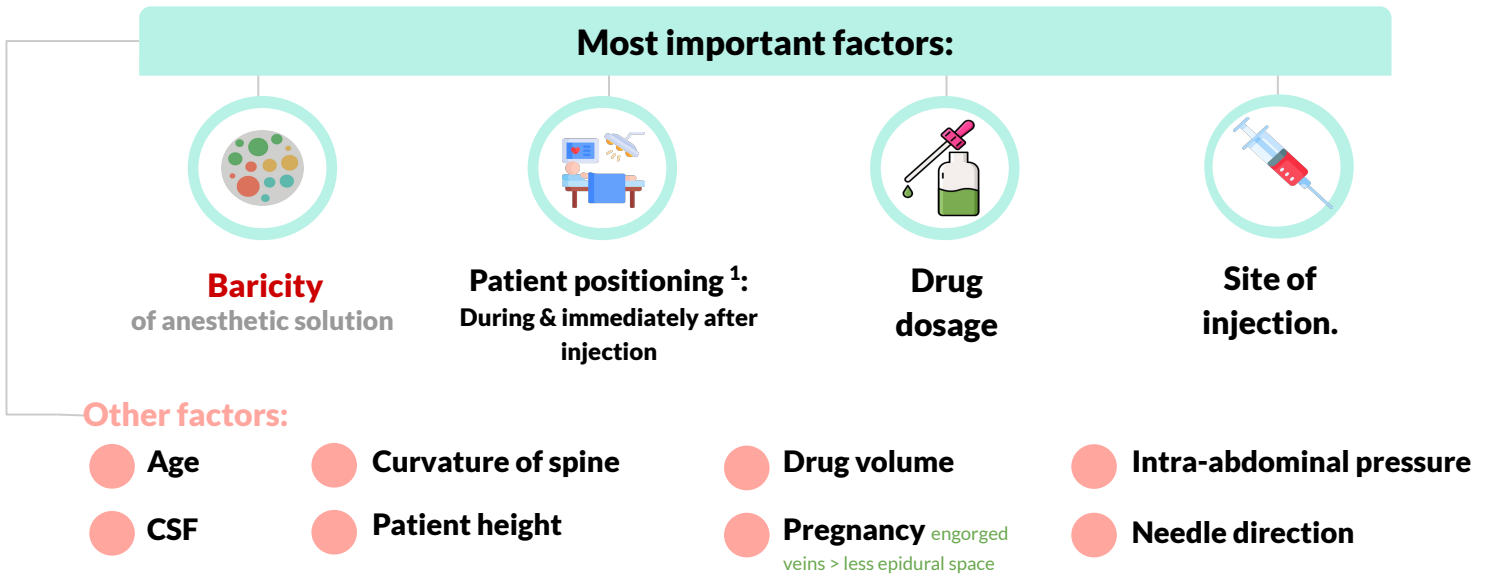
Treatment

- **Conservative:** by lying supine, giving fluids (Hydration), caffeine 200mg (vasoconstriction), paracetamol or ibuprofen.
- **Epidural blood patch:** if pt did not improve with conservative treatment after 24 hours, I have to go to the epidural space above the previous puncture site, taking 20 ml of patient own blood (autologous blood) and injecting it in the epidural space (the fibrin and other blood products will close like a glue the defect and the relief happens almost immediately).



Spinal Anesthesia

Factors affecting the level of spinal anesthesia:



Baricity (a concern only in spinal anesthesia)

| Baricity | Preparation | Flow Characteristics | Notes |
|--|---|--|--|
| Hyperbaric² >1.007 (Heavy) sink | • Typically prepared by mixing local with dextrose | <ul style="list-style-type: none"> • Flow is to most dependent area due to gravity • Very predictable spread <i>Given in short dental procedures</i> | Hyperbaric bupivacaine & lidocaine. <ul style="list-style-type: none"> • Sterile, clear • Preservative free • 3 ml ampoules • See the expiry date • Be sure it is bupivacaine? |
| Hypobaric³ <1.003 | • Prepared by mixing local with sterile water | • Flow is to highest part of CSF column. | |
| Isobaric 1.003-1.007 | • Neutral flow that can be manipulated by positioning Increased dose has more effect on duration than dermatomal spread. We don't use it in spinal. In epidural anesthesia the baricity doesn't matter so we use an isobaric solution. | | Isobaric bupivacaine (20 ml) Slow onset (30 min), less dense block. Used for epidural anesthesia. |

Note: Be cognizant of high & low regions of spinal column

1- If you place the head down the anesthetic will go up to the the brain due to the position which also play a role

2- We are injecting liquid inside liquid, that's why it's important to choose **hyperbaric bupivacaine only in spinal anesthesia**, while the epidural you inject into space so there's no issue (MCQ)

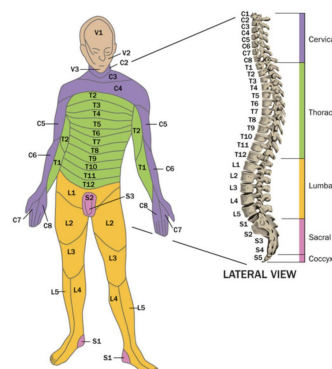
3- It has low gravity in relative to CSF, so it will go up to the brain if you use it in spinal anesthesia causing total spinal anesthesia!

-**Saddle block:** When We give anesthetic and ask the patient to sit for 5 - 10 min it will go down leading to sacral nerve block only .Used for anal surgery

Q: hyperbaric 0.5% (Marcaine) bupivacaine is used for which one ? A-epidural **B-spinal** C-lumbar D-brachial

spinal anesthesia levels :

| Dermatome | Application |
|-------------------------------|--|
| C4 (Clavicle) | Chest surgery. |
| T4- T5 (Nipple) | Upper abdominal surgery. |
| T6-T8 (Xiphoid) | intestinal surgery, appendectomy, gynecologic pelvic surgery, & ureter,renal pelvic surgery. |
| T8 (Lower border of rib cage) | Abdominal surgery. |
| T10 (Umbilicus) | transurethral resection, obstetric vaginal delivery, and hip surgery. |
| L1 (Inguinal ligament) | transurethral resection, if no bladder distension, thigh surgery, lower limb amputation. |
| L2-L3 (Knee and below) | Foot surgery. |
| S2-S5 (Perianal) | Perianal surgery. |



Spinal Anesthesia

Sympathetic, Sensory & Motor Blockade

Spinal Injection:



Sympathetic block is 2 dermatomes higher than sensory block



Motor block is 2 dermatomes lower than sensory block



Detect the sensory level by cold sensation test (Ice cubes).

Block Order:

B (Automatic)

C= A delta

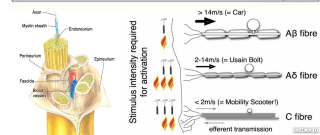
A Beta

A alfa

| Neuron type | Function | Myelination | Order of Blockade | Signs of Blockade |
|-------------|--|--------------|-------------------|--|
| A alpha | Motor - skeletal muscle | Myelinated | Fifth | Loss of motor function |
| A beta | Sensory - touch, pressure | Myelinated | Fourth | Loss of sensation to touch and pressure |
| A gamma | Motor - muscle spindles proprioception | Myelinated | Third | Loss of proprioception |
| A delta | Fast pain temperature | Myelinated | Second | Pain relief, loss of temperature sensation |
| B | Autonomic, Pre-ganglionic sympathetic | Myelinated | First | Increased skin temperature |
| C | Slow pain, autonomic, sympathetic, polymodal nociceptors | Unmyelinated | Second | Pain relief, loss of temperature sensation |

C. Classification of nerve fibers (in humans)

| Fiber type | Function according to fiber type (I, II, and III types - H) | Diameter (µm) | Conduction rate (m/s) |
|------------|---|------------------------|-----------------------|
| Aα | Skeletal muscle efferent, afferents in muscle spindles (I) and tendon organs (II) | 11-16 | 60-80 |
| Aβ | Mechanoreceptors of skin (II) | 6-11 | 30-60 |
| Aγ | Muscle spindle efferents | 1-6 | 2-30 |
| Aδ | Skin afferents temperature and "fast" pain (III) | 1-6 | 2-30 |
| B | Sympathetic preganglionic, visceral afferents | 3 | 3-15 |
| C | Skin afferents "slow" pain; sympathetic postganglionic afferents (IV) | 0.5-1.5 (unmyelinated) | 0.25-1.5 |



- Sympathetic fibers (Automatic) are the highest sensitivity towards local anesthesia then sensory fibers (intermediate) then motor fibers (lowest)

- B fibers (preganglionic sympathetic) are the fastest to be blocked > vasodilation & hypotension

- The sympathetic is 2 levels higher than sensory and sensory is 2 levels higher than the motor

- We always keep ice cubes available to place them in the Pt skin and check for sensory feeling of the Pt. starting from the top of the Pt's back till you reach the umbilicus and the Pt say NO then your sensory level is T10, sympathetic is T8, motor is T12, If sensory level at T4 (overdose of local anesthesia) then the sympathetic will be at T2

- we can't know sympathetic or motor but we can know the sensory staging using ice cubes and asking the patient about the sensation until it's not felt, if at T4, so sympathetic at T2 (2 segments above) causing vasodilation resulting in cold hands but warm feet > compensatory vasoconstriction in the upper body) and the motor at T6

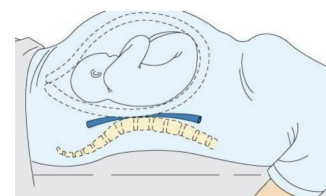
Complications

| | | | |
|--|---|--|--|
| | Hypotension (most common) MCQ Q: the most common side effect? You can't have spinal or epidural without it, if there was no hypotension means something went wrong with the injection, it that has to happen | | TNS Transient neural stimulus, pain in buttocks, then analgesia, then nothing. |
| | Epidural hematoma if patient is on anticoagulants/coagulopathy | | Epidural abscess in immunocompromised or with improper aseptic technique. |
| | Meningitis | | Cauda equina |
| | Bradycardia- Cardiac arrest | | Back pain |
| | Neurological deficit | | Failed block |
| | Spinal headache: <ul style="list-style-type: none"> Onset typically occurs first or second day post-op Treatment: Bed rest, Fluids, Caffeine, Blood patch Larger needle size increase severity. • More common in women ages 13-40 | | |
| <p>Best way to treat hypotension is physiologic not pharmacologic</p> <ul style="list-style-type: none"> Primary Treatment: Increase the cardiac preload using large IV fluid (Ringer's Lactate) bolus within 30 minutes prior to spinal placement, minimum 1 liter of crystalloid Secondary Treatment: Pharmacologic vasopressor agents 5-10 mg Ephedrine or 50-100µg phenylephrine but it's not preferable. | | | |

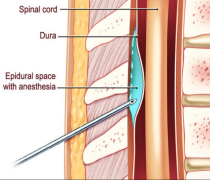


IVC syndrome "aortocaval compression" (pregnancy)

Seen with spinal anesthesia in **cesarean section**, epidural in vaginal birth

The uterus, **IVC and vertebrae are compressed**. this complication can happen with any pregnant women any time even at home but It will be more intense during spinal anesthesia because of the hypotension, we do a left uterine displacement during the surgery to relieve the pressure from the IVC and we advise them not to lie supine but to better lie in their left side (the IVC is more right sided), place wedge under the right buttock.

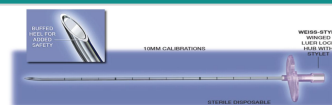


Epidural anesthesia

| Anatomy | Position | Anesthetic agent | Duration |
|---|---|--|--|
| Needle inserted into epidural space | C- shaped position | Isobaric bupivacaine (20 ml) | Slow onset (30 min), less dense block But can last up to 5 days |
|  |  |  | It could be done at any level, sometimes done at cervical for dick pain management |

Needle

Tuohy needle total length = 8 cm & you'll enter the needle up to 5.5 cm



Epidural test does

- After checking the catheter.
 - Careful aspiration, NO blood or CSF.
 - 3 ml Lidocaine 1.5% mixed with epinephrine 5 micg/ml.
 - With careful monitoring, give the epidural injection 15-20 ml bupivacaine in allequete.
- **Epidural test dose done only in epidural**, 20 ml is a large quantity. if the catheter migrate intrathecal it will cause total spinal anesthesia or if it gets inside the vessels it will cause local anesthesia systemic toxicity (LAST) so we need a test dose, if tachycardia happened or there was a rise in bp 20% from baseline after the dose test that means the catheter inside one of the vessels if not you are in safe side. Second wait for 5 mins then ask the Pt to move his feet & big toe if it still moving means it's not intrathecal and you are in the safe side. Not done with spinal because it only 2 -4 ml

Question: test dose is done in ? **A-epidural** B-spinal C-lumbar D-brachial

- **C max** is the acceleration / rate of rise of local anesthetics concentration in the plasma, faster C max > more severe symptoms. So it's more important than drug level.

Technique

- 1- Insert the needle slowly into the subcutaneous tissue
- 2- Remove the stylet and put in the syringe (we fill the syringe with either water, saline, or air)
- 3- start putting pressure in the plunger while inserting the needle more
- 4- once the plunger stop returning back (loss of resistance) means you finally entered the epidural space
- 5- replace the syringe with the catheter

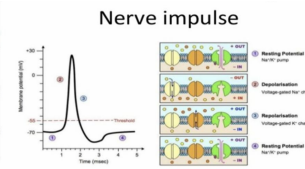
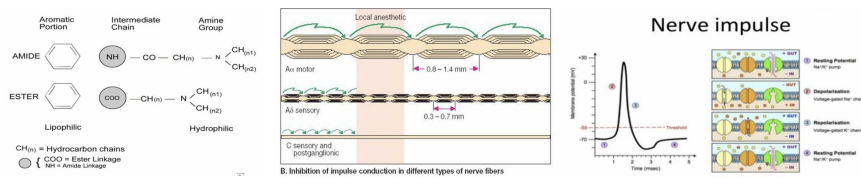
| Loss of resistance | Catheter ² | Set | |
|---|---|--|---|
|  |  |  |  |

| | Block Onset | Duration | Technique | Amount needed of Local anesthesia |
|-----------------|-------------|----------|-------------|-----------------------------------|
| Spinal | 3-4 mins | 2-3 hrs | Single shot | 2-3 ml (hyperbaric) |
| Epidural | 15-30 mins | 4-5 days | Catheter | 20 ml (isobaric) |

Local anesthetics

Local anesthetic

| | | | | | |
|----------------------|--|-------------|---------------|------------|------------|
| Amide Group | Lidocaine | Mepivacaine | Bupivacaine | Etidocaine | Prilocaine |
| Ester Group | Cocaine | Procaine | Chlorprocaine | Tetracaine | |
| Mechanism of action | <p>Un-ionized local anesthetic diffuses into nerve axon >due to high acidity ionized form > binds the receptors of the Na channel in the inactivated state. It blocks voltage gated sodium channels from inside cell and it's reversible (by the amine group in the anesthetic agent). While nerve toxins blocks Na channels from outside and is irreversible</p> | | | | |
| Duration of action | <ul style="list-style-type: none"> • The degree of protein binding is the most important factor • Lipid solubility is the second leading determining factor, controls potency. • Greater protein bound + increase lipid solubility = longer duration of action and more toxic • PKa: PH at which half of the drug is ionized and half is not ionized When PH is closer to PKa of the drug = the drug is faster | | | | |
| Toxicity & Allergies | <ul style="list-style-type: none"> • Esters: Increase risk for <u>allergic reaction</u> due to para-aminobenzoic acid produced through ester-hydrolysis <u>not in the market anymore, currently toclo procaine is being used in north america</u> • Amides: Greater risk of plasma toxicity due to slower metabolism in liver. | | | | |



Local Anesthetic Systemic Toxicity (LAST) important

| | |
|--------|---|
| Causes | <ul style="list-style-type: none"> • Intravascular injection Due to the C-max, immediate building up of Anesthetics in the plasma. It's dangerous because it's really fast that there is no time for the body to defense Spinal anesthesia has more severe hypotension because it's very fast acting while epidural need 15-30 min to complete block giving time to compensate better. • Exceeding the maximum safe dose: <ul style="list-style-type: none"> - Bupivacaine (2 mg/kg) Used in nerve block, long acting, more potent, higher cardiac toxicity, 75kg > 150ml - Lidocaine (5 mg/kg). Most common. used in plastics, dental, and skin anesthesia, short acting, 100kg > 500ml |
|--------|---|

| Manifestations | CVS: >Tachycardia and hypertension > Hypotension > Wide QRS >VF > Cardiac arrest | <table border="1"> <thead> <tr> <th>Minor associated with low plasma levels</th> <th>Major associated with high plasma levels</th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> • Perioral numbness • Facial tingling • Restlessness • Tinnitus • Metallic taste • Vertigo • Slurred speech </td> <td> <ul style="list-style-type: none"> • Sudden loss of consciousness • Tonic clonic seizure • Cardiovascular Collabs • Cardiac arrest </td> </tr> </tbody> </table> | Minor associated with low plasma levels | Major associated with high plasma levels | <ul style="list-style-type: none"> • Perioral numbness • Facial tingling • Restlessness • Tinnitus • Metallic taste • Vertigo • Slurred speech | <ul style="list-style-type: none"> • Sudden loss of consciousness • Tonic clonic seizure • Cardiovascular Collabs • Cardiac arrest |
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Intubate and ventilate immediately to prevent hypoxia, hyperkalemia that causes Acidosis which will shift the local Anesthesia from protein binding to free type which rises the toxicity

| | | |
|------------|--|---|
| Management | <p>Local Anesthetic Systemic Toxicity</p> | <p>Recognition of Severe Toxicity</p> <ul style="list-style-type: none"> • Alteration in mental status • Cardiovascular collapse • May occur some time after initial injection <p>Immediate Management</p> <ul style="list-style-type: none"> • Call for help • Stop LA administration • Maintain airway • Confirm or establish IV access • Control seizures (benzodiazepines) • Start IV lipid emulsion <p>Circulatory Arrest Not Present</p> <ul style="list-style-type: none"> • Conventional therapy for hypotension and arrhythmias • Continue IV lipid emulsion <p>Circulatory Arrest Present</p> <ul style="list-style-type: none"> • Start CPR and ACLS (low-dose epinephrine) • Continue IV lipid emulsion • Avoid lidocaine for arrhythmia management • Consider cardiopulmonary bypass <p>Follow-Up</p> <ul style="list-style-type: none"> • Admission to intensive care unit • Close monitoring until sustained recovery achieved |
|------------|--|---|

Lecture Quiz

Question 1: All of the following factors may influence the spinal level achieved during spinal anesthesia, except:

- A. Drug dose
- B. Needle direction
- C. Patient position at the time and immediately following injection
- D. Patient weight

Question 2: During placement of an interscalene block utilizing 0.5% bupivacaine, a 62-year-old patient suddenly starts experiencing seizures and loses consciousness. Which of the following statements regarding local anesthetic toxicity is correct?

- A. Seizure is a sign of neurotoxicity from high dose of local anesthetic
- B. Loss of consciousness is a sign of low-dose local anesthetic neurotoxicity
- C. The seizure threshold is increased by the administration of thiopental
- D. Seizure may have been caused by injection of the local anesthetic into cervical nerve root

Question 3: A 27-year-old G2P1 at 39 2 weeks' gestation is electing to have spinal anesthesia for a repeat cesarean section. Five minutes after bupivacaine spinal injection, the patient becomes hypotensive and is complaining of tingling in her fingers with subjective difficulty breathing. Her oxygen saturation remains 100% and blood pressure is 95/55. The most likely etiology is:

- A. Engorgement of epidural veins contributed to inadvertent intravascular injection of the local anesthetics
- B. Decrease in volume of CSF in the subarachnoid space facilitated higher spread of local anesthetics
- C. Severe patient anxiety
- D. Increased peripheral nerve sensitization to local anesthetics

Question 4: During epidural placement using a midline approach, the epidural needle penetrates all the following anatomical layers, except:

- A. Ligamentum flavum
- B. Subarachnoid membrane
- C. Supraspinous ligament
- D. Intraspinal ligament

Question 5: A 75-year-old female with ovarian cancer is scheduled for total abdominal hysterectomy/bilateral salpingo oophorectomy and tumor debulking. A thoracic epidural anesthesia was performed using a test dose of 1.5% lidocaine with 1:200,000 epinephrine injected through the epidural Tuohy needle that resulted in no evidence of adverse sequelae. An epidural catheter was then threaded through the needle followed by evidence of negative aspiration through the catheter. A total of 10 mL 0.5% bupivacaine was administered through the epidural catheter. Thirty seconds later, the patient became agitated and complained of lightheadedness, tinnitus, and feeling faint, but still able to move all of her extremities. Her BP decreased from 150/70 to 100/45 mm Hg and her HR decreased from 85 to 55 bpm. The patient maintained spontaneous breathing throughout with an oxygen saturation (SpO₂) of 95%. The most likely diagnosis is:

- A. Local anesthetic systemic toxicity (LAST)
- B. High epidural anesthesia
- C. Total spinal anesthesia
- D. Anaphylactic reaction

Question 6: All of the following local anesthetic systemic toxicity (LAST) treatment measures should be performed when caring for a patient who may be experiencing toxicity, except:

- A. Stop epidural medication administration
- B. Support the airway with 100% oxygen
- C. Administer intravenous epinephrine according to ACLS protocols
- D. Administer an intralipid bolus and continuous infusion



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