
TEAM

ANESTHESIA

An illustration of anesthesia equipment, including a green ventilator mask and a purple oxygen tank with a tube, positioned to the right of the word 'ANESTHESIA'.

435

Regional anaesthesia techniques (neuraxial blockade)

{Color index: **Important**★ | **Notes** | **Book** | **433 Notes** | Extra | [Editing File](#)}

Objectives:

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

Big advise: DON'T SKIP DIAGRAMS

Done by: *Munira Alhussaini & Luluh Alzaghayer*

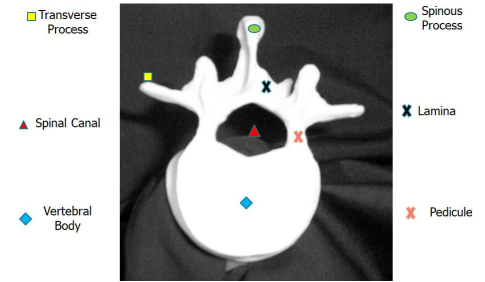
Revised by: *Dalal Alhuzaimi*



Anatomy¹:

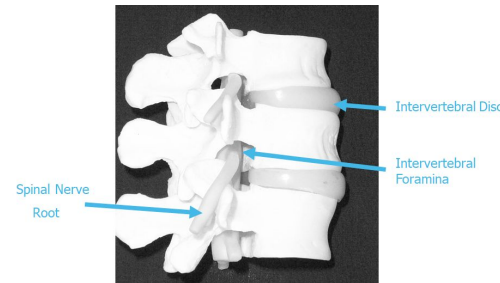
Knowledge of anatomy for neuraxial blockade is essential!

- 7 cervical vertebrae (lordosis)
- 12 thoracic vertebrae (kyphosis)
- **5 lumbar vertebrae (lordosis):**
 - **lumbar Lordosis is more pronounced in pregnancy (2 annoying things about it)**
 1. The distance from the skin to my target will be longer ,
 2. The spinous process will be near to each other:
 - if pt. in sitting position and I ask her to **bends** her back I will get 2 benefits:
 - Straighten lordosis,
 - giving a wider interlaminar space. (open up the space)
- Sacrum (5 fused) (kyphosis)
- Coccyx (4 immature , fused)
 - Do X-ray to check for subluxation in RA



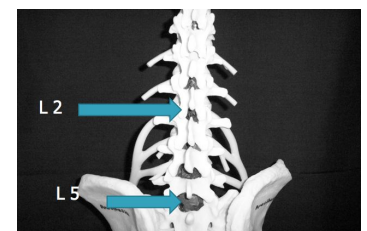
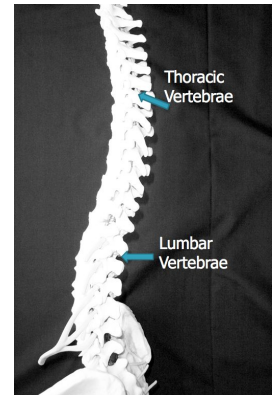
★ Individual Vertebral Anatomy:

- Each vertebra consists of (extremely important structures):
 - **pedicle,**
 - **transverse process** (landmark in paravertebral thoracic block or lumbar plexus block) ,
 - **superior and inferior articular processes,** and a **spinous process.**



→ Vertebral joints:

- 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 **Forming Intervertebral Foramina** to allow the spinal nerve root (anteriorly = motor, posteriorly = sensory) to exit the vertebral column.
- **Angle of transverse process** will affect how the needle is orientated for epidural anesthesia or analgesia.
- With flexion the **spinous process** in the lumbar region is almost **horizontal.** In the thoracic region the spinous process is angled in a **slight caudal angle.**
- **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. **But notice the first option is L4-L5 in usual cases.**



¹ In regional anesthesia, Anatomy, Anatomy, Anatomy is essential

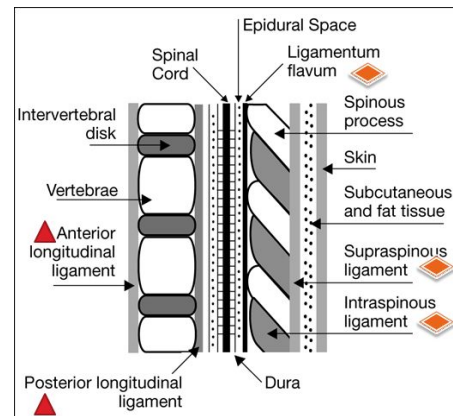
★ Ligaments that support the vertebral column:

▲ Ventral side:

Anterior and posterior longitudinal ligaments. Give support to vertebrae. When disc herniation happens, it goes laterally.

◆ Dorsal side:

- **Ligamentum flavum** (flavum=yellow): a dense ligament that stops at the sacral hiatus before S5. It is not penetrated in caudal anesthesia.
 - Connects the LAMINA (bc it surrounds by lamina)
 - Once you penetrate it with the needle, if you stop your needle will be in the **epidural space**. But if you proceed and you penetrate the dura the needle will be in the intrathecal space (spinal = subarachnoid) and its sign is dripping CSF.
- **Supraspinous ligament**: continuous ligament that starts from C7 and down to L5. Ligamentum nuchae is a continuity to Supraspinous ligament above C7.
- **Interspinous ligament**: interrupted ligament that connects the spinous processes above and below.

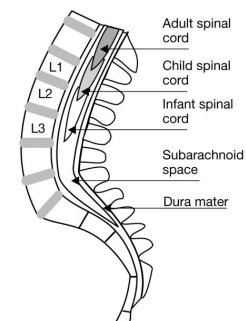


Dorsal ligaments are transversed during neuraxial blockade. They are important since these are the structures your needle will pass through!

With experience the anesthesia provider will be able to identify anatomical structures by **tactile sensation** "feel".

★ Termination of Spinal Cord:

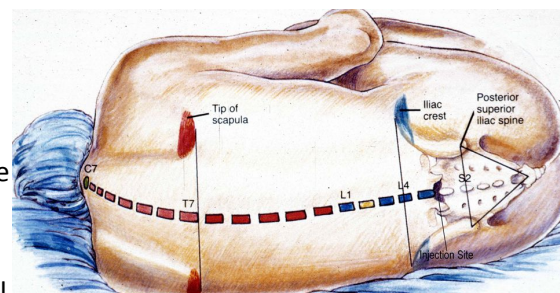
- **Adults**: usually ends at **L1**. There are anatomical variations.
 - For most adults it is generally safe to place a spinal needle below L2. (*cauda equina*)
- **Children**: ends at **L2**
- **Infants**: **L3**



★ Surface Anatomy and Landmarks: **MCQs + OSCE**

→ Locating prominent cervical and thoracic vertebrae:

- **C2** is the first palpable vertebrae
- **C7** is the **most prominent cervical vertebrae**
- With the patient's arms at the side the **tip of the scapula** generally corresponds with **T7**
- **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) OSCE**

- A line drawn between the **highest points of both iliac crests** will yield either the body of **L4 spinous process** (so, space below or above is good for me) or the **L4-L5 interspace**.
 - Bonney landmark doesn't change with the change of the physical body status of the pt. (obese, tall ..)

★ Anatomical Considerations of the Spinal Cord and Neuraxial Blockade:

The **Subarachnoid Space** is a continuous space that contains **CSF, Spinal cord & nerves**.

→ CSF:

- Clear fluid that fills the **subarachnoid space**
- **Total volume** in adults is **~100-150 ml** (2 ml/kg) (75 for brain, 75 for 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
- **Reabsorbed** into the bloodstream by **arachnoid villi**.
- **Specific gravity²** is between **1.003-1.007** (this will play a crucial role in the **baricity** of local anesthetic that one chooses):
 - anything in between is isobaric, anything below hypo anything above hyper
- 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)
- Body wt is the only measurement that coincides with CSF volume (this becomes important in the **obese and pregnant**)³.

★ Membranes that surround the spinal cord (meninges):

- "ختمر عليها مرور الكرام"

Pia mater	Arachnoid mater	Dura mater ("tough mother")
highly vascular	non vascular	
covers the spinal cord and brain Filum terminalis is an extension of the pia mater attaches to the periosteum of the coccyx.	attached to the dura mater. (no potential space) Principal barrier to the migration of medications in and out of the CSF.	extension of the cranial dura mater, extends from the foramen magnum to S2. between the 2 dimples that represent posterior superior iliac spine

★ Epidural Space Anatomy:

Extends from the foramen magnum to the sacral hiatus (at the end of S5). The epidural space surrounds the dura mater anteriorly, laterally, and **most importantly** to us **posteriorly**.

→ The Bounds of the Epidural Space are as follows:

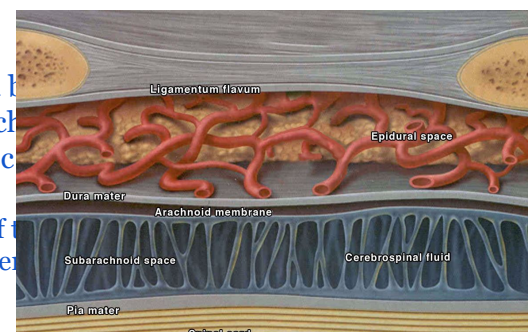
- **Anterior:** posterior longitudinal ligament
- **Lateral:** pedicles and **intervertebral** ligaments
- **Posterior:** **ligamentum flavum**:
 - Posterior to the epidural space
 - Extends from the foramen magnum to the sacral hiatus
 - Distance from skin to ligament varies from 3-8 cm in the lumbar 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.

² For any liquid there is a Specific gravity, this liquid physics should be considered in spinal anesthesia where we inject drug that is liquid in the CSF which

- **Why we didn't talk about baricity in the epidural?** because it's in the EPIDURAL SPACE which is doesn't matter

³ CSF volume in obese pt., pregnant or in HTN pt. where there is squess of f

- That's why in pregnant the amount of drug used in her case is lesser



→ **Contents of the Epidural Space:**

- **Fat:** acts as a shock absorber.
- **Areolar tissue**
- **Lymphatics**
- **Blood vessels** including the **Batson venous plexus** are connected to the intrathoracic veins and they are valveless veins > transmitting the **-ve pressure** of the great intrathoracic veins , so when you inject and feel the loss of resistance it means you're in the epidural space. A very important clinical sign which is called **"Drop sign"** !! Again, **loss of resistance = in epidural anesthesia!**

Spinal anesthesia: (NO SPINAL ABOVE L2 - while NO LIMITATION with Epidural)⁴

Type of the **Central (neuraxial) blockade** where Injection of **small amounts** (2-3 ml , why not more? Bc it going to dilute with the CSF) 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 (T10)** is achieved. (your end point in spinal anesthesia is dripping CSF)

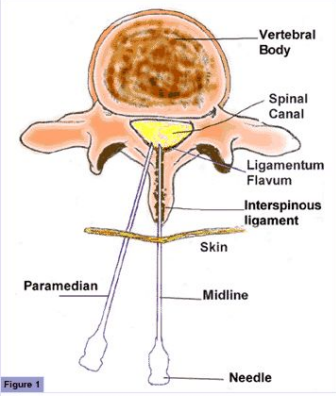
- Spinal has a **very rapid onset (3-5min)** and heavier because the drug is dealing with nerves directly with **no barrier**, a **ONE SHOT** technique that's why it's used in procedures lasting **2-3 hours maximum**.
- As for epidural, it's **catheter mediated**, meaning used for prolonged surgeries (anesthesia last for 4-5 days.)
- Ex: bilateral knee surgery. **You can use combined (spinal+epidural) if you want fast onset (spinal) and longer duration!** Note: combined spinal & epidural anesthesia is most commonly used.

Indication	Contraindications (same for epidural)	
<p>Operations below the umbilicus: 2-3 hours procedures</p> <ul style="list-style-type: none"> ● C/S (most commonly because it is fast and heavier) ● hernia repairs, ● gynaecological, urological operation, ● orthopedics, ● any operation on the perineum or genitalia. 	<p>⌘ Absolute:</p> <ul style="list-style-type: none"> ● Refusal ● Infection, seen in immobilized patients who develop bed sores or puss collection ● Coagulopathy & anticoagulated patient. aspirin use is not a contraindication for spinal anesthesia according to guidelines. ● Severe hypovolemia (bleeding), most common side effect of spinal anesthesia is hypotension due to sympathetic block which will lead to block in his compensatory mechanism! Thus not used in hypovolemia ● Increased intracranial pressure > herniation ● Severe aortic or mitral stenosis ● Nono-decidable origin of neurological deficit 	<p>⌘ Relative: Use your best judgment</p>

⁴ bc In the spinal you are going to penetrate the dura , while in the epidural you will not

★ Spinal Technique **IMP** very rapid onset

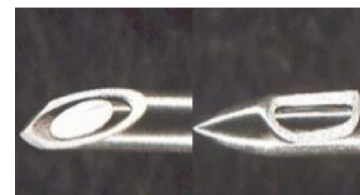
- **Sterility** (your OSCE)
- I.V cannula for 1 liter of crystalloid preloading and for the possible need for fluid resuscitation in case there was hypotension , monitoring: 5 or 3 ECG, piloxemiter, BP cuff,
- **Position: Sitting** (c-shaped position : raising his legs and flexing his back to increase the interlaminar space) or **Lateral decubitus**. In both cases their back must be curled forward in order to widen the intervertebral disc spaces.
- **Single shot technique**

Midline Approach OSCE	Paramedian or Lateral Approach	
Skin Superficial fascia Spinous ligament Interspinous ligament Ligamentum flavum Epidural space Dura Intrathecal space	≠ Same as midline excluding supraspinous & interspinous ligaments In thoracic epidural anesthesia we inject lateral to spinous process. or when there is ossifications making midline approach difficult .	 <p>Figure 1 Spinal needle placement (midline and paramedian)</p>

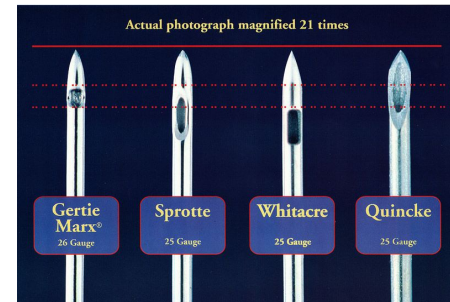
★ Spinal needles types: **IMP OSCE**

Pencil point (first three) and **quincke** both used in spinal.

- In young patients use pencil point.
- **What's the benefit of pencil point over quincke?**



Pencil point:	Quincke :
The tip: - blind end and side borde - and it will spread the fibers The size : smaller 27G	The tip: sharp edge > break the fibers causing leakage of CSF > PDPH The size : large diameter



big needle فقرروا < the tip of the needle + CSF leak أكثر hole كلما صار فيه CSF leak كلما كبرت ال
 ممنوعة فقروا ال quincke

→ **Post-dural puncture headache (PDPH): MCQs**

Occurs in young patients after spinal! Mostly occurs in young female or pregnant after C.S⁵.

- Develop **12-48 hours** (this variation depends on the needle type, the bigger the faster) after spinal anesthesia (not immediately) due to CSF leak. **Should not happen in epidural because dura should not be penetrated, Unless it is mistakenly punctured !** (don't skip the Ddx)

- **Headache should improve when lying supine and increase when stands up for sure**
 ★ **Not all posop headache is a (PDPH)** it should improve at least to call it like that

Differential Diagnosis

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

⁵ In vaginal pain free normal delivery we do epidural > bc it's a catheter

➤ **Mechanism:**

- Persistent **leakage of CSF, / pressure**.⁶ Leading to:
 1. **Decrease in CSF volume**> Shift of intracranial contents > stretching the meninges,
 2. **Decrease in CSF pressure**> Activating adenosine receptors > vasodilation (cause headache) of intracranial vessels.

➤ **Treatment:**

- **Conservative:** caffeine (vasoconstriction), paracetamol, bed rest (lying supine) . If dehydrated > Fluide > promote the CSF production
- **Epidural blood patch (رفع):** **only if headache did not respond to conservative treatment** (after 24h),
 - We go space above and perform epidural puncture, at the same under a sterile procedure my assistant will draw 20 ml of venous blood from patient's arm and injects it into the area of the lower back to plug (by coagulation factors) the leakage that happened.

★ **Factors affecting the level of spinal anesthesia:**

Most important factors:

1. Baricity (heaviness) of anesthetic solution (relative to CSF)

Baricity ⁷ (a concern only in spinal anesthesia)		
Hyperbaric (ثقل) MCQs	Hypobaric ⁸	Isobaric
⌘ Typically prepared by mixing <u>local</u> with dextrose	⌘ Prepared by mixing <u>local</u> with sterile water	
⌘ Flow is to most dependent area due to gravity (لما ينام المريض ينزل على تحت). Descends in the intrathecal space, so used for spinal. ⌘ Very predictable spread	⌘ Flow is to highest part of CSF column. Used in epidural anesthesia. If you use it in spinal it will go to the brain directly with no barrier	⌘ Neutral flow that can be manipulated by positioning ⌘ Increased dose has more effect on <u>duration</u> than dermatomal spread
Hyperbaric bupivacaine <ul style="list-style-type: none"> ● Sterile, clear ● Preservative free ⁹ ● 3 ml ampoules ● See the expiry date ● Be sure it is bupivacaine?? MCQ: the hyperbaric (heavy marcaine) Bupivacaine 0.5% is used in: Local block, <u>spinal block</u> , epidural block, brachial plexus		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

2. Patient positioning (during and immediately after injection)

3. Drug dosage

4. Site of injection.

Other factors:

- Age: **elderly patients tend to have decreased CSF volume and are prone to higher blocks,**

⁶ Depending on the amount of CSF leakage, according to the Monro-Kellie doctrine , the volume of the brain which is fixed (composed of volume of CSF, blood, and brain tissue) will try to compensate (the brain tissue can't increase in volume) when one of these component decrease with the increase of the other components (decreased CSF > compensated by increased blood flow > dilated vessels > headache)

⁷ Baricity is the density (like specific gravity) of a drug compared to CSF density.

⁸ When you put a drop of lipid inside water this drop will flow bc its specific gravity is less than water, the same concept with hyperbaric drugs

⁹ to avoid CNS toxicity

- CSF: volume correlates inversely with level of anesthesia (i.e., increased intra-abdominal pressure or conditions that cause engorgement of epidural veins (pregnancy, ascites, large abdominal tumors) decrease CSF volume and are associated with higher blocks)
- Curvature of spine,
- Drug volume,
- Intra-abdominal pressure (see CSF- point2),
- Needle direction: higher levels are achieved if injection directed cephalad
- Patient height: taller patients require more drug to achieve a given level
- Pregnancy: (see CSF- point2) , there are 2 points about spinal anesthesia in pregnant
 1. Progesterone increases local anesthetic sensitivity.
 2. also decreased dosage requirements for term parturient by 50% or even more.

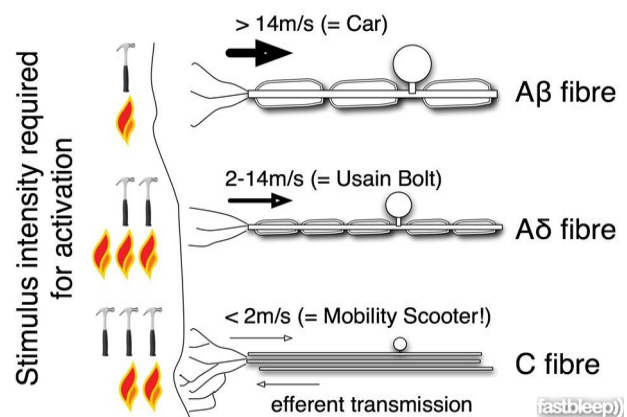
★ Differential block of local anesthetic ¹⁰: بلوك بدرجات مختلفة ومتفاوتة MCQs

Fiber type	Function according to fiber type (Lloyd and Hunt types I–IV)	Diameter (μm)	Conduction rate (m/s)
Aα	Skeletal muscle efferent, afferents in muscle spindles (Ib) and tendon organs (Ib)	11–16	60–80
Aβ	Mechanoafferents of skin (II)	6–11	30–60
Aγ	Muscle spindle efferents	1–6	2–30
Aδ	Skin afferents (temperature and "fast" pain) (III)		
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

(After Erlanger and Gasser)

Table 3: Types of neurons blocked with local anesthetics

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, postganglionic sympathetic, polymodal nociceptors	Unmyelinated	Second	Pain relief, loss of temperature sensation



- A delta (sensory): small, myelinated/ A alpha (motor): big, myelinated
- B fibers (sympathetic)/ C fibers: small, unmyelinated
- Block order: B> C=A delta > A beta>A alpha
- Note that Alpha is the last one to get blocked **but the first one that gets back!**
- B fiber is the first to be blocked and the last to get back (most sensitive)
- Increased temperature in B block is compensated by cold hands

¹⁰ When I inject spinal anesthesia in the spinal nerve (sensory, motor, sympathetic) the block in the erve will be different in each type of nerves (according to the sensitivity of the structures forming the nerve)

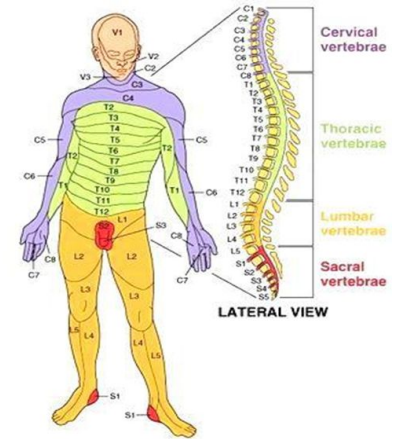
★ Sympathetic, Sensory & Motor Blockade very important (I have to determine my block and document it) !

→ 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).

- ما نقدر نحدد السيمبباتاتيك او الموتور < صعب تحديدهم

So if I bring an MCQ telling you after a spinal block, sensory block was at T4 level, what is the level of sympathetic block? T2
what about motor block? T6



Spinal Anesthesia Levels (You must know dermatomes)

Dermatome	Application
C ₄ (clavicle)	Chest surgery
T ₄ - T ₅ (nipples)	upper abdominal surgery
T ₆ - T ₈ (xiphoid)	intestinal surgery, appendectomy, gynecologic pelvic surgery, and ureter and renal pelvic surgery
T ₈ (lower border of ribcage)	Abdominal surgery
T ₁₀ (umbilicus)	transurethral resection, obstetric vaginal delivery, and hip surgery
L ₁ (inguinal ligament)	transurethral resection, if no bladder distension, thigh surgery, lower limb amputation
L ₂ - L ₃ (knee and below)	foot surgery
S ₂ - S ₅ (perineal)	perineal surgery, hemorrhoidectomy, anal dilation

- C.S > T6
- Nipples > T4
- Prostate > T10

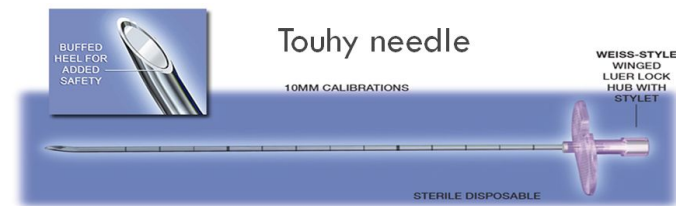
→ Complications (same for epidural) :

- Failed block
 - (the needle go through) bc. Of that when you are midway aspirate to see the CSF.
- Back pain (debated, bc most of women after delivery she will have by 40% back pain,)
- Spinal headache (PDPH)
 - More common in women ages 13-40
 - Larger needle size increase severity and the shape of the tip of the needle
 - Onset typically occurs first or second day post-op
 - Treatment: Bed rest, Fluids, Caffeine, Blood patch
- Epidural hematoma (by puncturing vessel , not usual)
- Epidural abscess (not following clean technique, or in immunocompromised pt. Having bed sore)
- Meningitis, using unsterile technique or in immunocompromised patients
- Cauda equina if injected into the nerve itself.
- Neurological deficit
- TNS (transient neurologic symptoms)
- Bradycardia--- Cardiac arrest
- Hypotension **most common**: لا تقولون أكثر شيء الصداغ لانه لازم يحصل انخفاض الضغط في كل حالة ولا يكون السباينال مو شغال
- **Best way to treat is physiologic (1st line) not pharmacologic MCQs**
 - Primary Treatment: Increase the cardiac preload (through increased vasodilation) using large IV fluid bolus within 30 minutes prior to spinal placement, minimum 1 liter of crystalloids (maximally 1.5 L then stop if it wasn't effective to avoid edema and other complications)
 - ^ In the OR

- **Secondary Treatment:** Pharmacologic vasopressor agents (**Ephedrine**) if the primary failed (maintain the the systolic bp above 90)
 - Ephedrine have alpha + beta effects used in bradycardiac pt.
 - Phenylephrine have only alpha effects used in tachycardic pt.
- ★ The heavy gravida uterus press the IVC against the spinal column > no preload and cause severe hypotension.
 - Left lateral uterine displacement maneuver “ make the uterus go away from the IVC” → is a life saving during **IVC Syndrome** “ Supine hypotensive syndrome.

Epidural anesthesia (NO LIMITATION with Epidural¹¹)

- Administered with patient in C-shaped position (30 minutes)
 - **Loss of resistance technique** is the END point in epidural anesthesia: loss of resistance = epidural space (due to the change in pressure), **using saline or air**¹².
 - **Catheter technique:** Epidural catheter has series of special markings to guide the anesthetist on the length inserted into epidural space.¹³
- **The needle that is used is called "Touhy needle"** its tip is facing up with 8 cm length (skin to epidural space is 5 cm), it has wings to oriente your needle precisely.
 - It has a specialized syringe used for LOR technique.
 - Epidural is preferred to use in **vaginal delivery anesthesia**.
 - **Use urinary catheter, because the block of sympathetic and activation of parasympathetic cause urination.**
 - **Isobaric bupivacaine** (20 ml), **Slow onset (30 min)**, less dense block.



→ Epidural Test dose: ¹⁴ **MCQs**

To avoid systemic local anesthetic toxicity

- After checking the catheter > Careful aspiration, NO blood or CSF > **no danger**
- **3 ml Lidocaine 1.5% mixed with epinephrine 5 micg/ml** “ 0.5 % = 5 ml (x10) “to determine evidence of accidental intravenous or intrathecal catheter placement “
- With careful monitoring, give the epidural injection **15-20 ml** bupivacaine in allequete.
 - Tachycardia > in the intrathecal space ,
 - If no tachycardia and no HTN > not in the intrathecal space
 - within 1-2 minutes (bc if we injected it intrathecally it will have rapid onset) ask the pt. to move his leg: motor block (can't move his leg) confirm the intrathecal injection.

In summary: no tachy, no HTN and pt. **can move his leg** > I am in the epidural space

¹¹ It could be even in the cervical area

¹² loss of resistance to saline technique (LORS) or loss of resistance to air technique (LORA) use, respectively, saline or air to identify the epidural space. The LORS technique is generally favoured due to the increased complication risk with the LORA technique such as pneumocephalus or air embolism

¹³ 2 dashes = 10 cm / 3 dashes = 15 cm / 4 dashes = 20cm.

The catheter should be advanced 3-5 cm in addition to skin to epidural space distance. For example skin to epidural space = 5 cm, catheter should be inserted = 8-10 cm. (skin to catheter)

- ¹⁴- In spinal I inject only 3-2 ml > so if it goes anny where it will not be that significant
- In epidural I am injecting 20 ml:
 1. if it goes by mistake intrathecally > total spinal anesthesia (big issue)
 2. If it was injected into the batson vein > local anesthetic (systemic toxicity)

→ Caudal epidural anesthesia (MCQ):

is one of the most commonly used (**low epidural**) regional anesthesia in **pediatrics!** In almost all cases **below the umbilicus.**

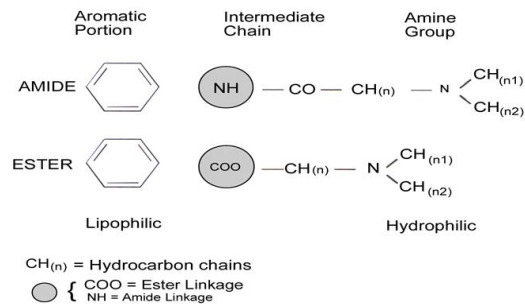
- Caudal space is the sacral portion of epidural space (sacral hiatus that is created by unfused s4-s5 lamina).
 - (posterior superior iliac spine = 2 dimples = level of S2 where the dura ends) if I put 2 fingers in these dimples the 3rd one (like triangle) will be in S4-5.
- in adult for pain management

Local anesthetics:

We have to type of local anesthetic:

- **Ester** = one I (first used "cocaine", degrade by cholinesterase)
- **Amide** = two I (lidocaine "1st used, most used world wide in local filtration till now")
 - ★ Most commonly used amide are lidocaine and Bupivacaine (Marcaine) → hyper-spinal
 - ★ The benzene ring > lipid solubility —ESTER or AMINE— Amine group > blockage effect.

AMIDE GROUP	ESTER GROUP
Lidocaine	Cocaine
Mepivacaine	Procaine
Bupivacaine	Chloroprocaine
Etidocaine	Tetracaine
Prilocaine	

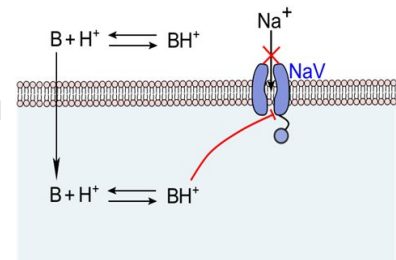


Prilocaine: is mixed with Lidocaine → & called Imlocaine → Superficial or venous puncture

Mechanism of Action:

- Blockage of Na channels > prevents depolarization and action potential.

Un-ionized (lipid soluble depends on the pH it will dissociate and enters the cell) local anesthetic diffuses into nerve axon > ionized form > binds the receptors of the Na channel in the inactivated state > Inhibit the nerve conduction.



Duration of Action: the weaker the drug, the faster onset, the shorter duration!

⌘The degree of protein binding is the most important factor

⌘Lipid solubility is the second leading determining factor

- The more lipid solubility > the stronger effect (by more protein binding) > the longer duration > more toxic effect

★ Eg. Bupivacaine 0.5% : 240 minutes duration of action

- Lidocaine 3% = Bupivacaine 0.5%

⌘Greater protein bound + increase lipid solubility = longer duration of action

Toxicity & Allergies

- **Esters:** stopped due to BAPPA highly allergic: Increase risk for allergic reaction due to para-aminobenzoic acid produced through ester-hydrolysis (metabolized by acetylcholinesterase)
- **Amides:** Greater risk of plasma toxicity due to slower metabolism in liver. rare allergy. (more common use)

→ Local Anesthetic Systemic Toxicity (LAST)

➤ Causes:

- **Exceeding the maximum safe dose:**

- Bupivacaine (2mg/kg),

- Pt. weight 50kg > you should give her 100mg , if give her 200mg she will absorb it slowly within 15-20 min and then she will show signs of toxicity.

- Lidocaine (5mg/kg).

- **Intravascular injection**

Most dangerous! You don't necessarily need to exceed the dose.

BOX 1 Manifestations of Systemic Toxicity	
Minor (Associated With Low Plasma Levels)	Major (Associated With High Plasma Levels)
■ Perioral numbness	■ Sudden loss of consciousness
■ Facial tingling	■ Tonic-clonic seizures
■ Restlessness	■ Cardiovascular collapse
■ Tinnitus	■ Cardiac arrest
■ Metallic taste	
■ Vertigo	
■ Slurred speech	

➤ Manifestations:

★ (when we exceed the dose , the level of the anesthetic will build up in the plasma slowly > CNS toxicity “ minor in box 1” > CVS toxicity “ major in box 1)

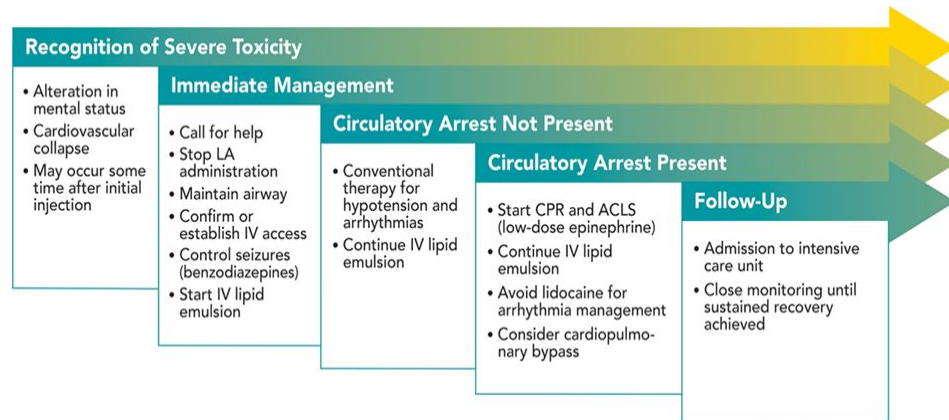
- In each we start with the activation symptoms of that system and ends with depression symptoms.

★ (if it was intravascular ما حدا هيلحق على حدا > you won't see manifestations the pt. Will arrest immediately)

➤ Management:

ABC : bc if he had acidosis , hypoventilation, hypoxemia > increase the local anesthetic dissociation from protein > free anesthetic > **more toxicity** .

- Not responding ventilate > still > call for help and intubate
- If cardiac arrest > do compression > epinephrine > defibrillator “shock”



★ We give intralipid (for all lipid soluble drug toxicity) to create acutely the lipid phase in the plasma to detach from the active site. (the anesthetic will dissociate from the tissue into the plasma) > can reduce the systemic toxicity consequences “ at least on the heart”



Q1: Which one of the following is suitable local anesthesia for spinal block?

- A-Procaine
- B-Cocaine
- C-Bupivacaine
- D-Tetracaine

Answer: C

Q2: Which one of the following is considered as an absolute contraindication in spinal anesthesia?

- A- Patient refuses
- B- Patient uncooperative
- C- Unmyelinated lesion
- D- Spinal deformity

Answer: A

Q3: which is the most vascular layer during passage of a spinal needle ?

- A- epidural space
- B- ligamentum falvum
- C- intrathecal space
- D- subdural space

Answer: A

Q4: which of the following is true regarding to the epidural space?

- A- 3-6 mm potential space
- B- extend from foramen magnum to lower border L1
- C- surrounded by the meninges
- D- laterally is bounded by the ligamentum-flavum

Answer: A

Q5: what is the factor affecting local anaesthesia drug duration ?

- A- aka of the drug
- B- protein binding
- C- lipid solubility
- D- rate of diffuse across the dura

Answer: B

Q6: A 29 y/o patient booked for elective low segment CS , which one of the following is the best anaesthesia technique ?

- A- caudal anesthesia
- B- general anesthesia
- C- spinal anesthesia
- D- thoracic epidural anesthesia

Answer: C