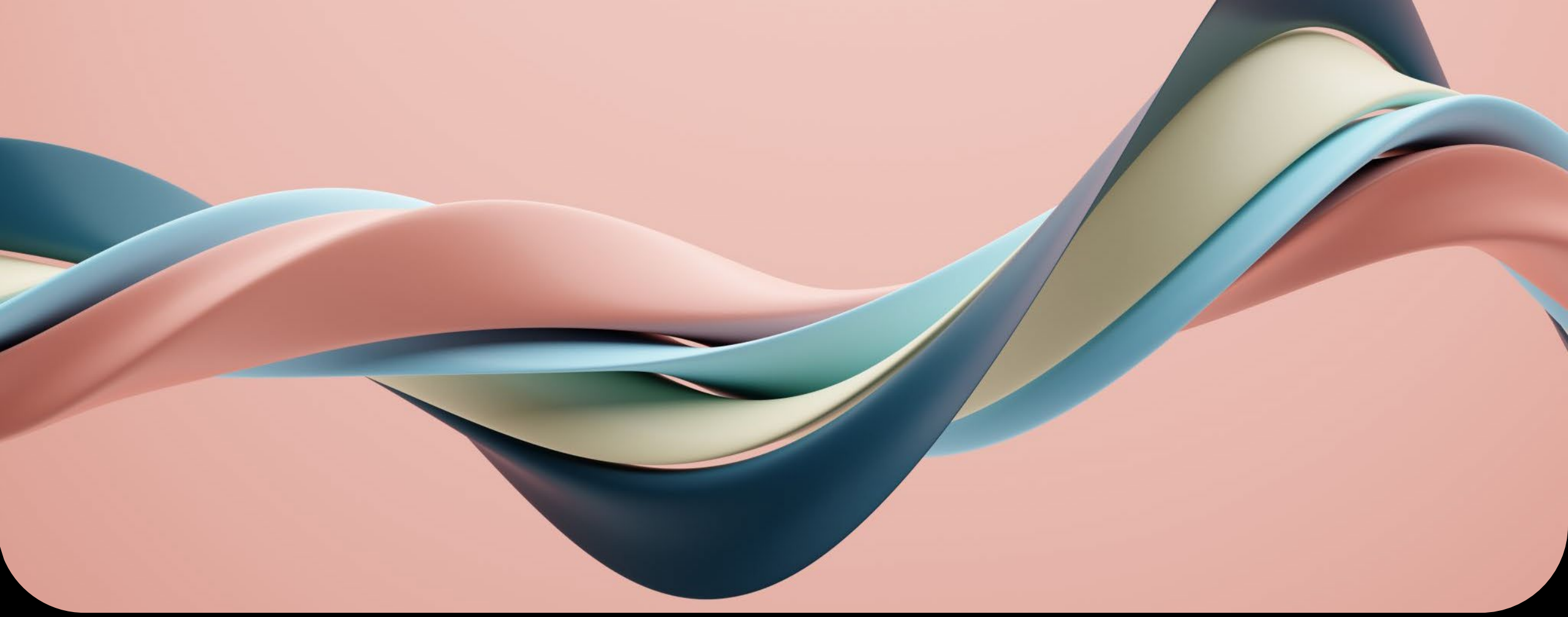
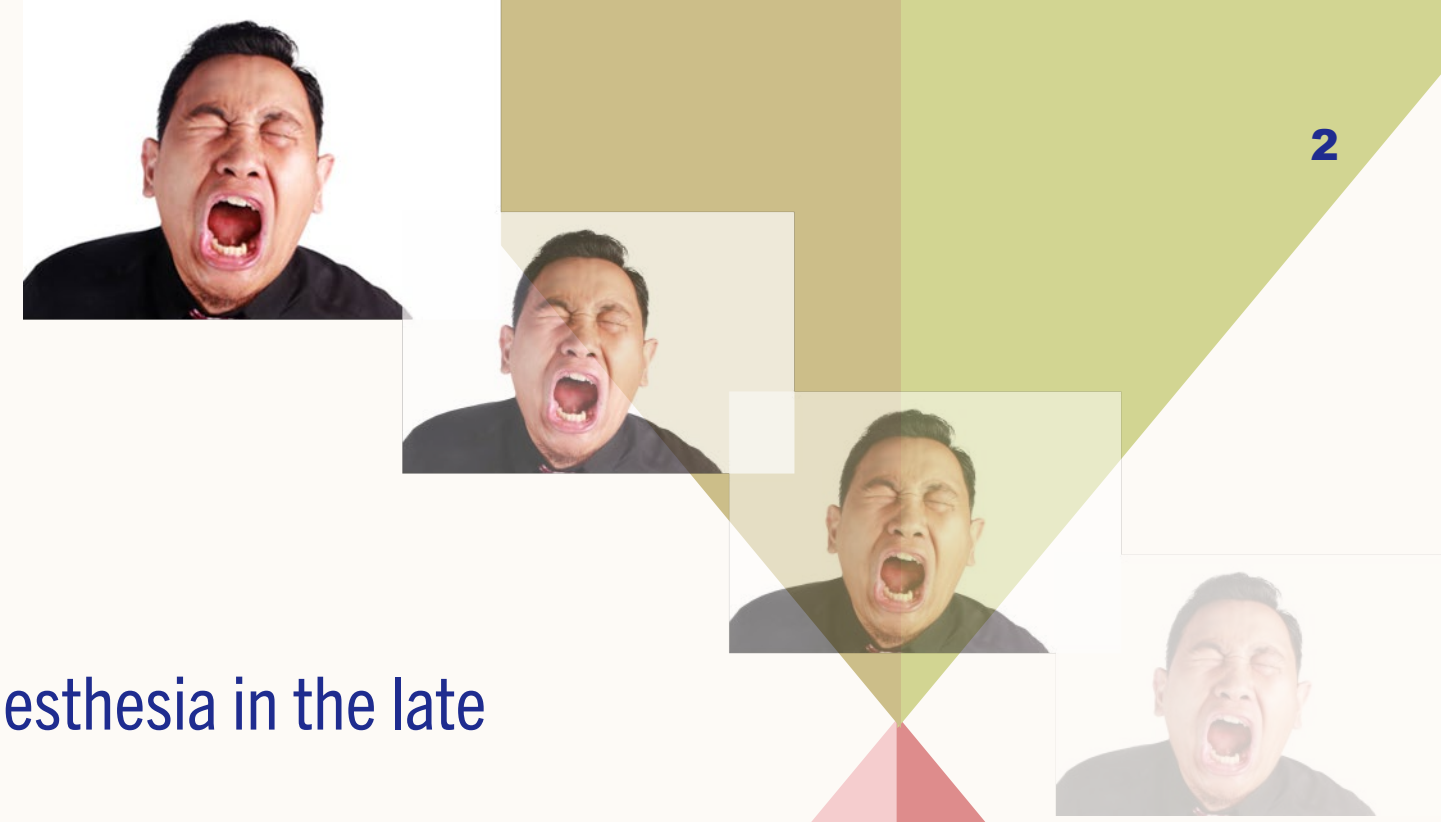


Intro to Regional Anesthesia

Sara Paraspolo, Cer. ATT

ASATT Region 6 Director & KPAT Clinical Director



THE HISTORY

Surgeons popularized regional anesthesia in the late

1900's. They used it to block

"surgical shock!"

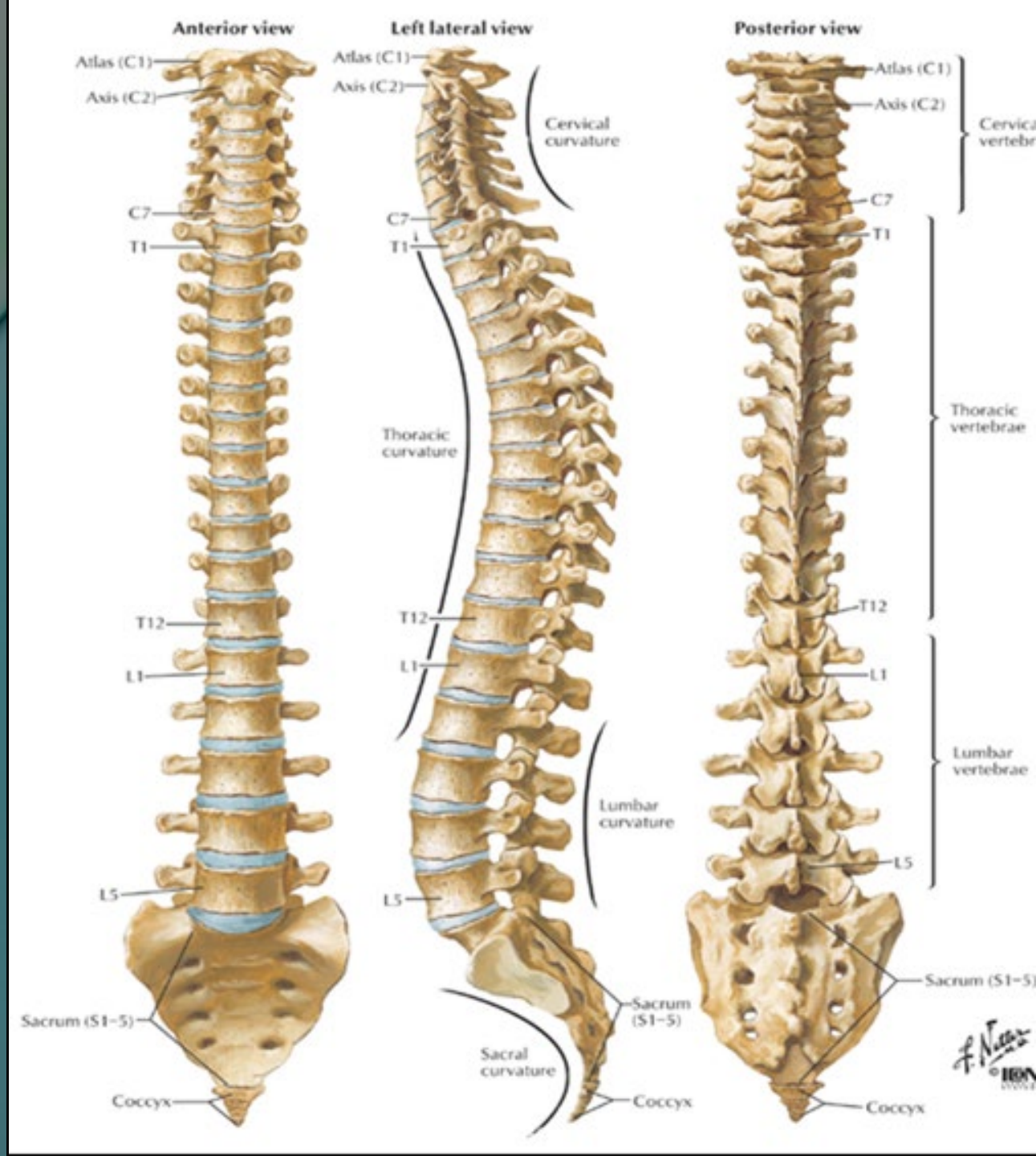
PAIN

Pain is:

- *Very subjective*
- *Complex*
    - multifactorial causes
- Requires a multimodal, multifaceted pharmacological approach

CENTRAL NEURAXIAL BLOCKADE

Involves the placement of local anesthetic solution onto or adjacent to the spinal cord.



VERTEBRAL COLUMN

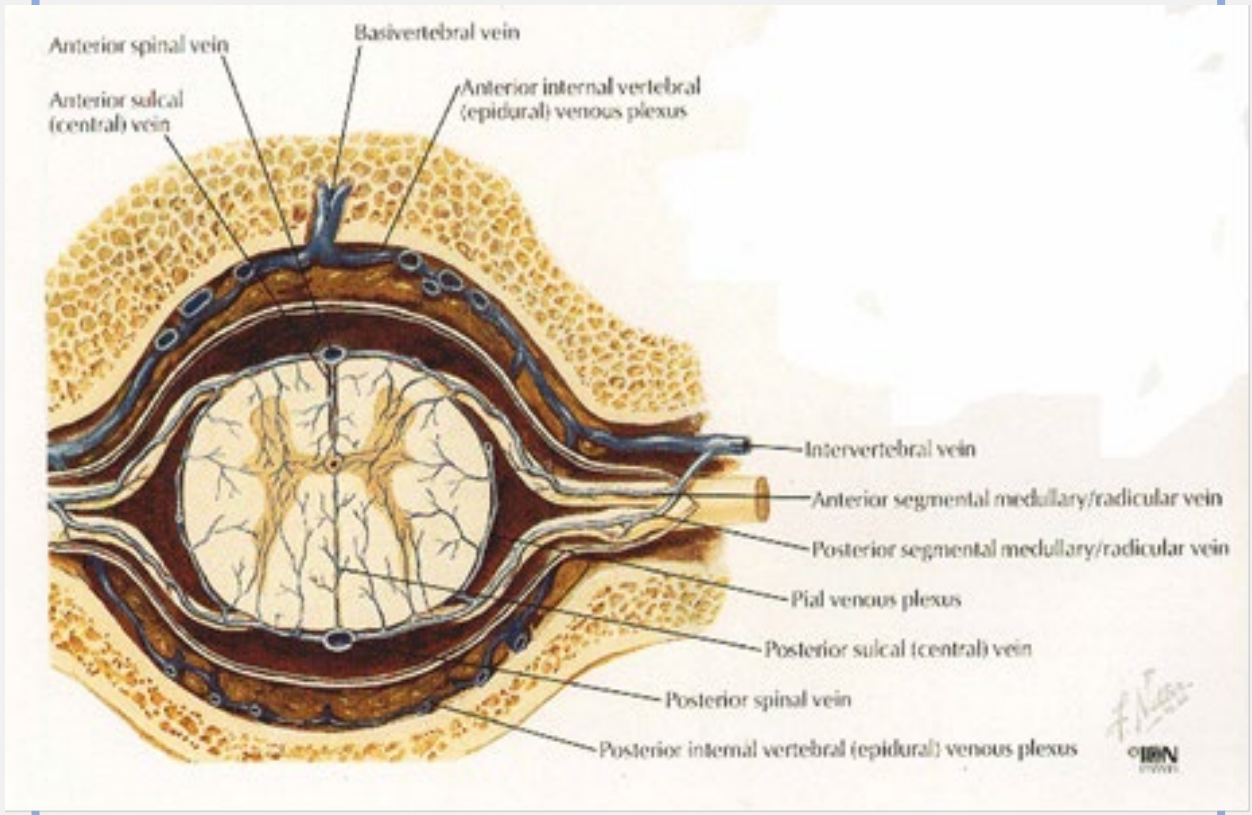
- Extends from the base of the skull to the tip of the coccyx.
- Includes vertebral bones and fibrocartilaginous intervertebral disks

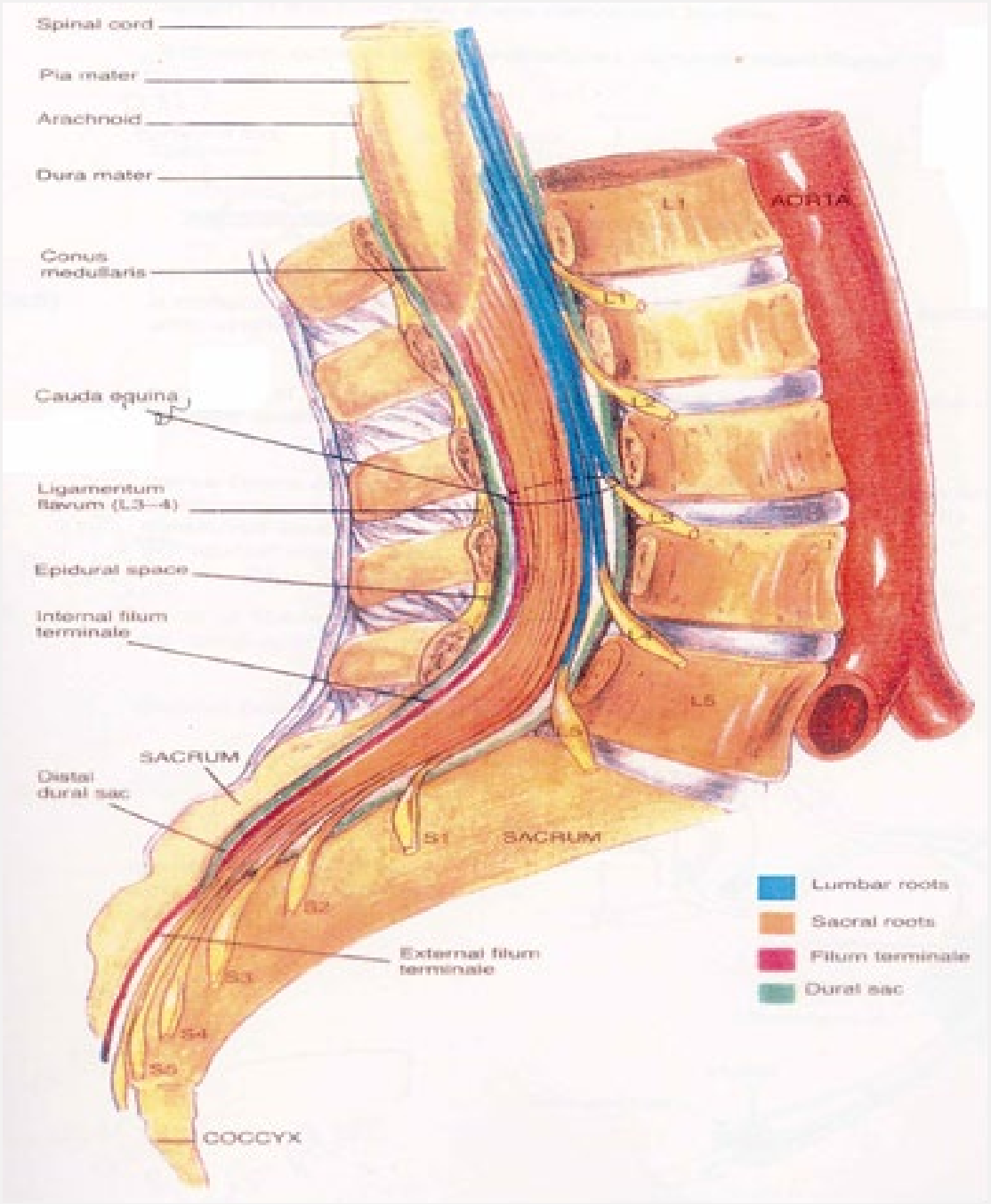
<u>33 vertebra:</u>

- Cervical-7
- Thoracic- 12
- Lumbar- 5
- Sacrum- 5 fused vertebra
- Coccyx- 4 fused vertebra

(Refer to the photo in the previous slide)

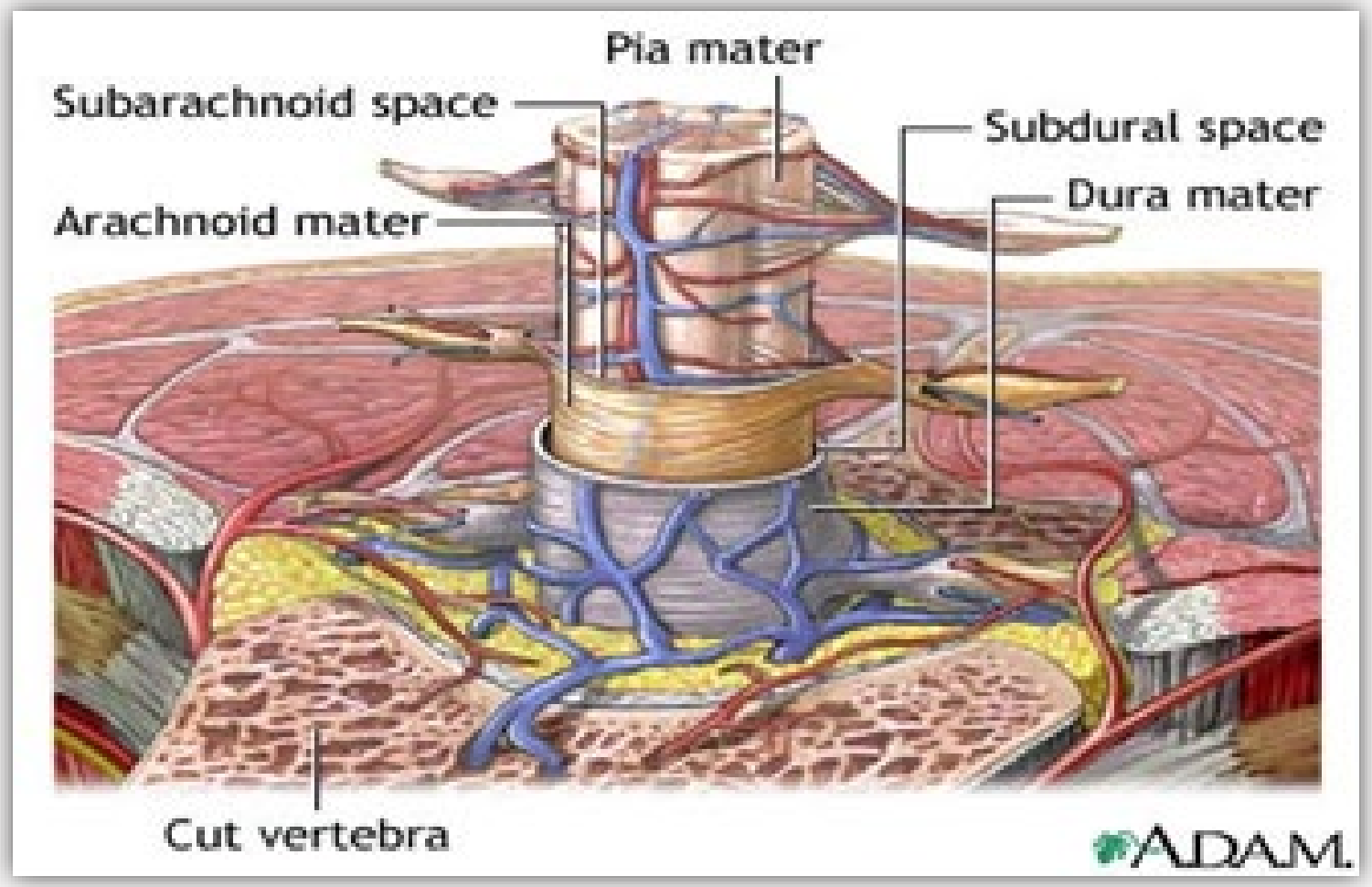
THE SPINAL CANAL



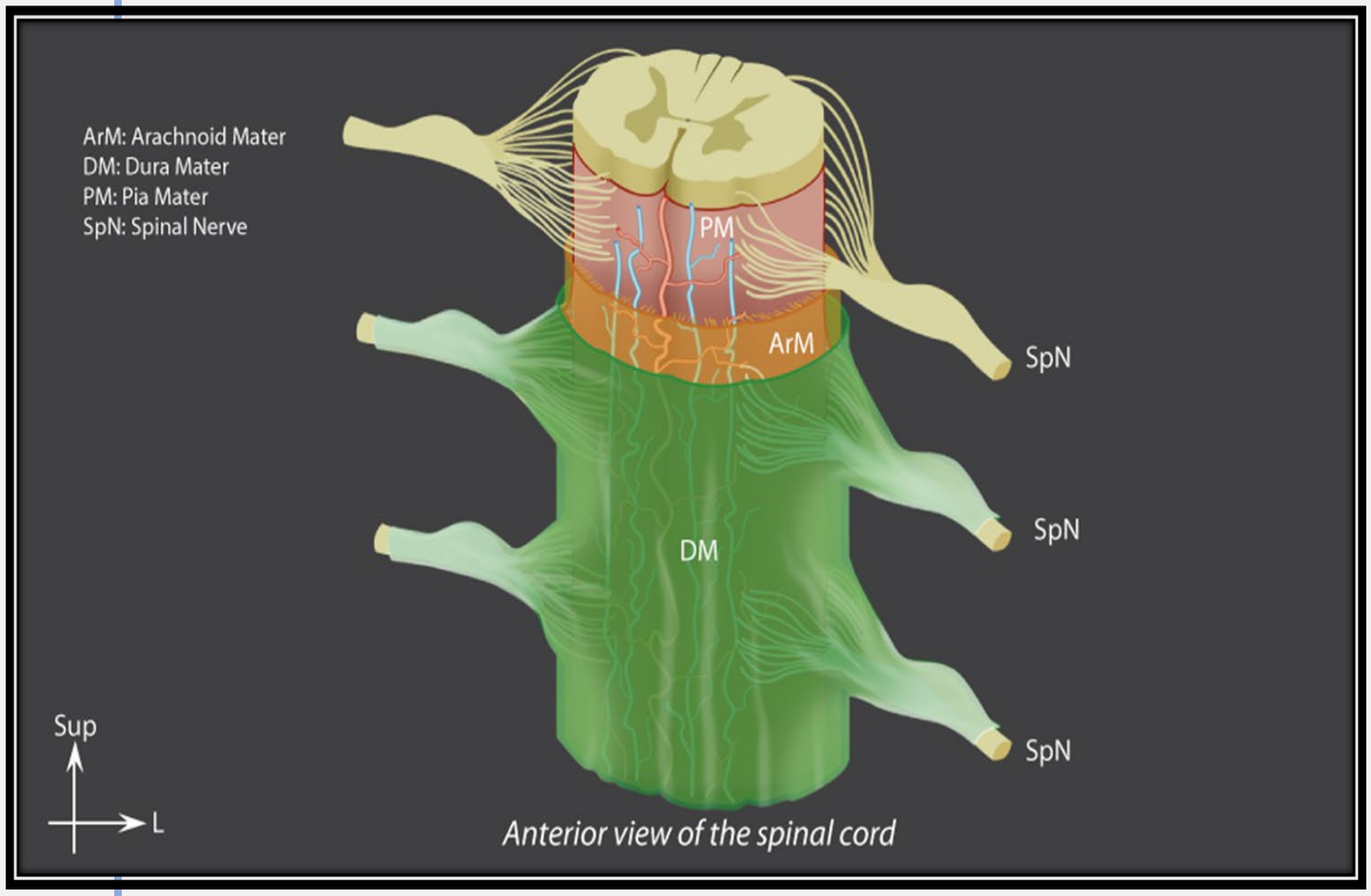


SPINAL CORD

The **spinal cord** is a long, thin, tubular bundle of nervous tissue and support cells that extends from the brain down to the to the space between the 2nd and 3rd lumbar vertebra.



SC, CONTINUED



Meninges:

1. Pia Mater: Directly covers the spinal cord
2. Arachnoid Mater: Contains the cerebrospinal fluid
3. Dura Mater: Directly attached to the arachnoid mater

Spaces:

Epidural Space

Subdural Space

Subarachnoid Space

SPINAL NERVES

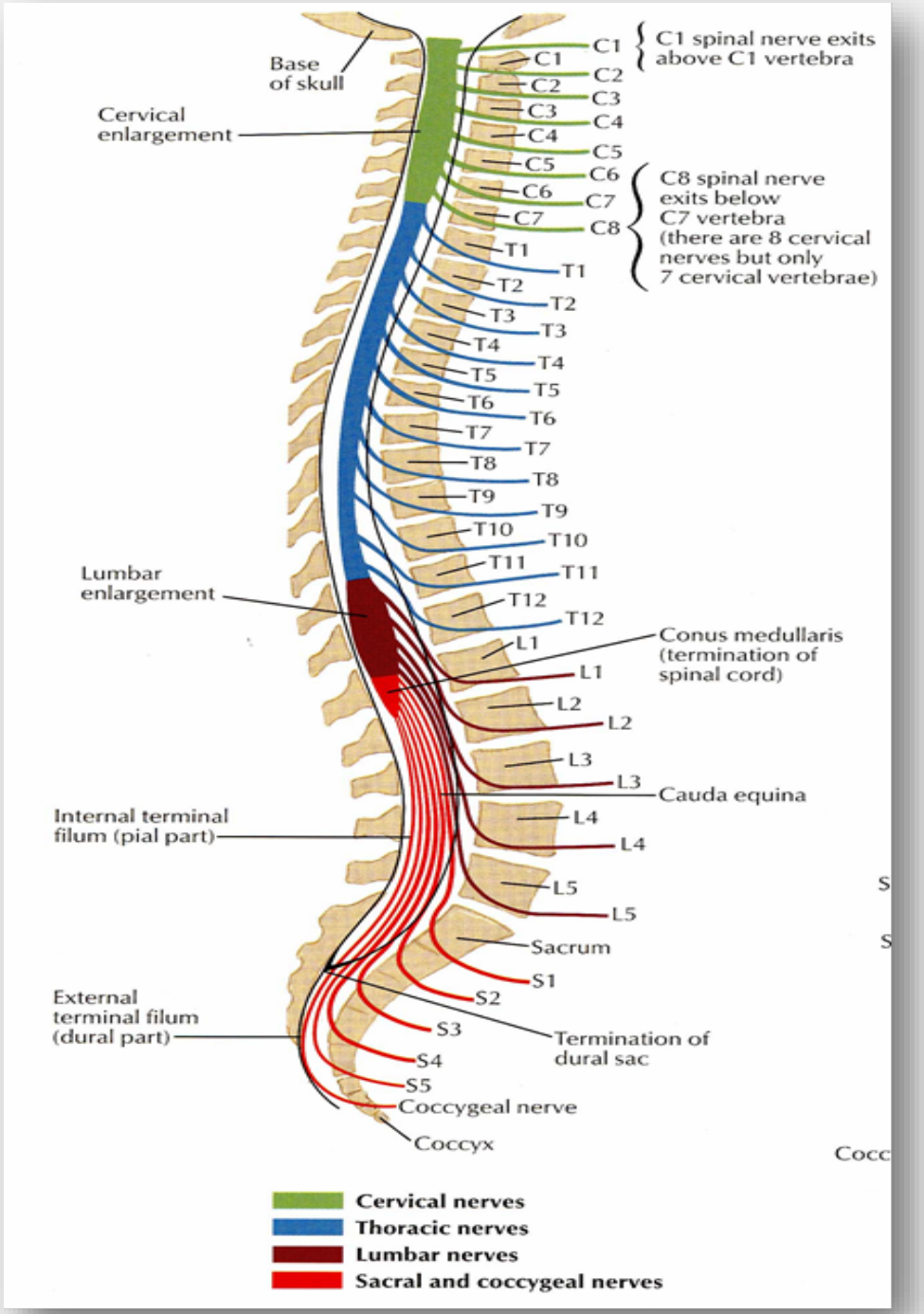
Cervical-8

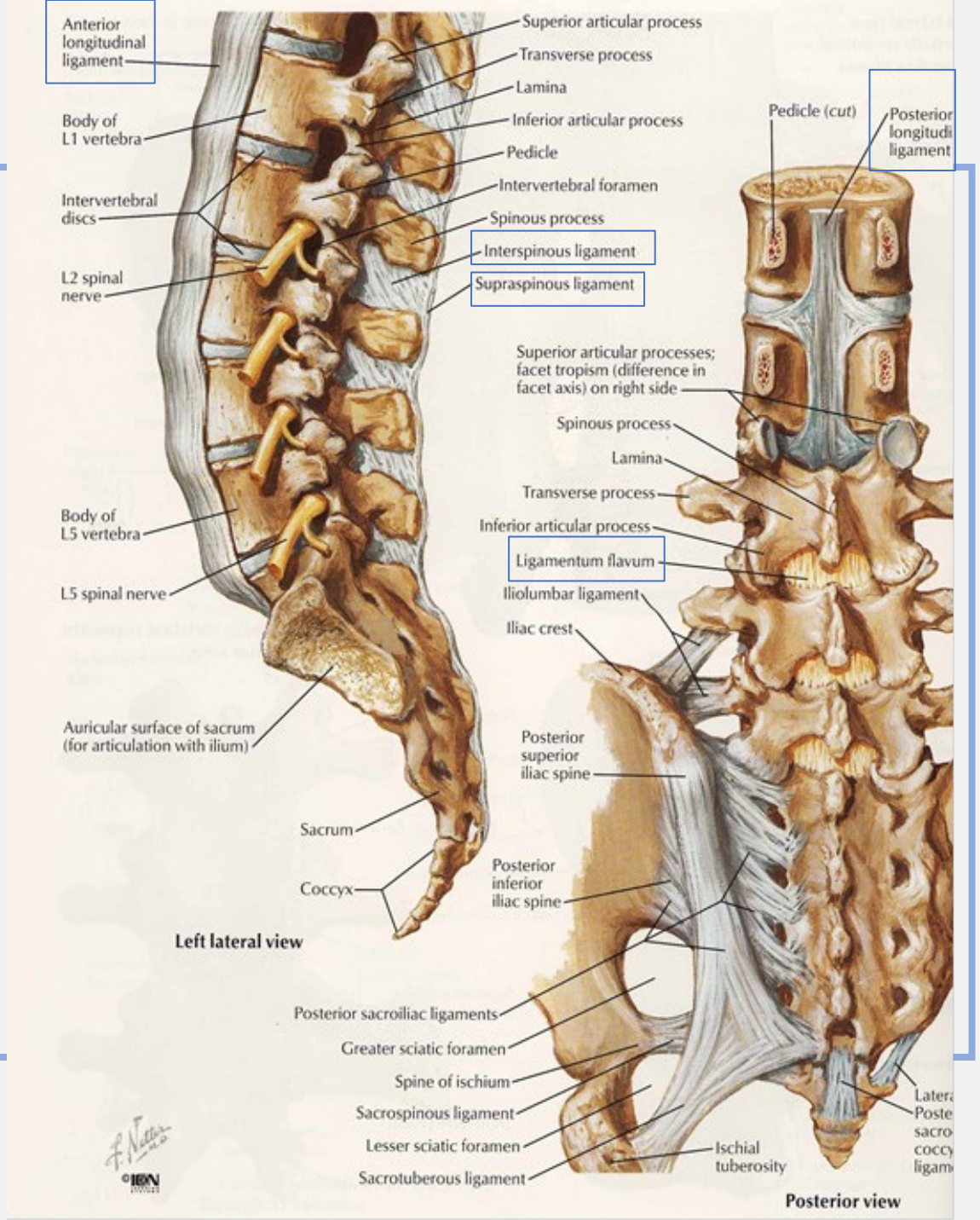
Thoracic- 12

Lumbar- 5

Sacral- 5

Coccygeal-1





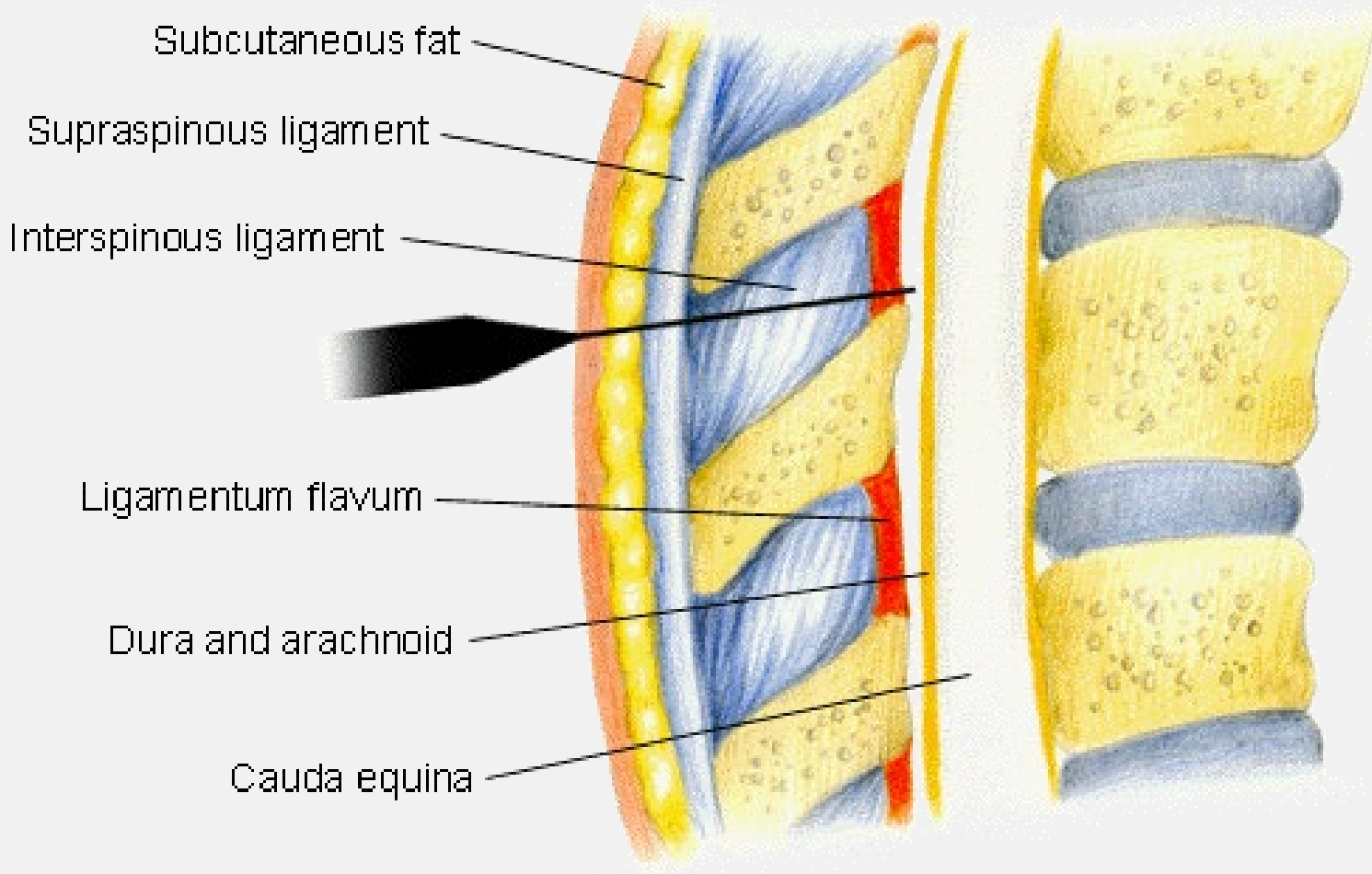
LIGAMENTS

1. Supraspinous Ligament
2. Interspinous Ligament
3. Ligamentum Flavum
4. Anterior/Posterior Longitudinal Ligaments

TISSUE LAYERS TRAVERSED BY A SPINAL NEEDLE

(In the Subarachnoid Space)

1. Skin
2. Fat
3. Supraspinous Ligament
4. Intraspinous Ligament
5. Ligament Flavum -EPIDURAL SPACE
6. Dura Mater
7. Arachnoid Mater-
   SUBARACHNOID SPACE



1. SPINAL ANESTHESIA

Subarachnoid block,

SAB,

Intrathecal Block

Local anesthetic injected into the subarachnoid space.

Indications:

- Operations of the lower abdomen, perineum, and lower extremities
- Anesthesia for a cesarean delivery
- Pt with a medical condition that requires consciousness
- Pt that is high risk for general anesthesia
- T4 level limitations

Procedure/Physiology:

- LA (Local anesthesia) is injected into the CSF and bathes the spinal nerves.
- Conduction of impulses are blocked
- Motor, Sensory, and Autonomic blocked.

MOTOR, SENSORY, & AUTONOMIC CLASSES

1. Motor- Conveys messages for muscles for muscles to contract, blocking results in paralysis.
2. Sensory- transmits sensations such as touch and pain between the spinal cord and the brain, blocking results in numbness
3. Autonomic- nerves control the caliber of blood vessels, heart rate, gut contraction and other functions not under conscious control

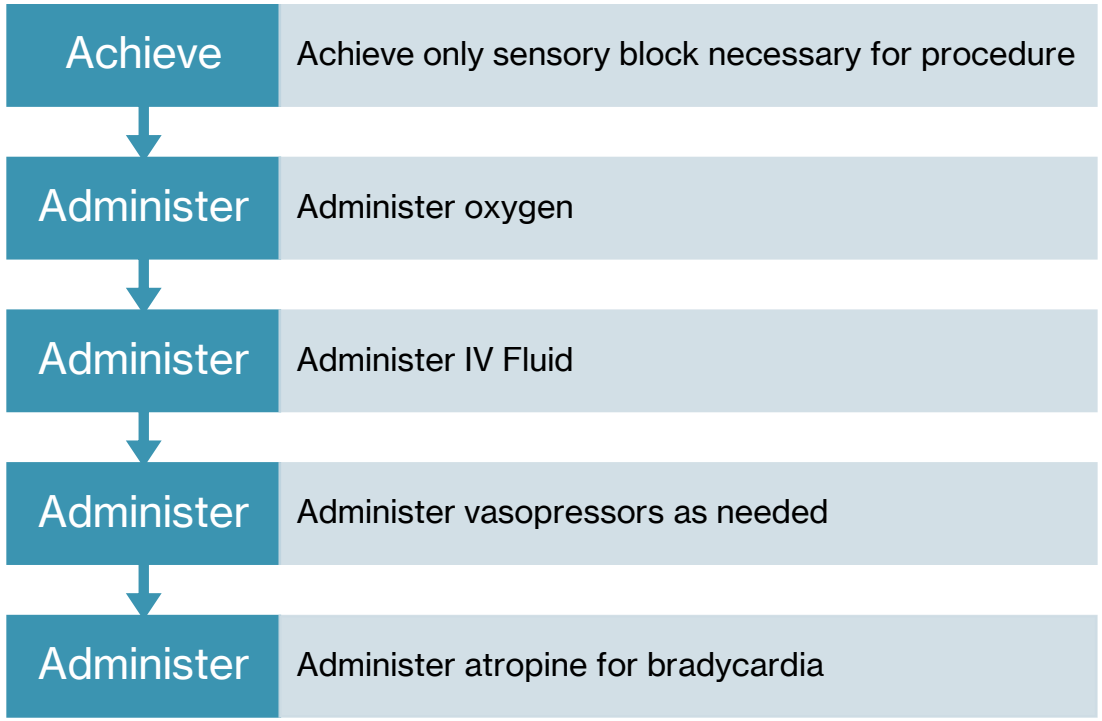
- Autonomic and pain fibers blocked first, then motor (generally)

Consequences Resulting from Spinal Anesthesia

PHYSIOLOGICAL

1. Hypotension
2. Bradycardia
3. Nausea and vomiting
4. Alteration in sensorium
5. Urinary retention

STRATEGIES TO MINIMIZE CARDIOVASCULAR EFFECTS



PATIENT CHARACTERISTICS

Age
Height
Weight
Gender
Intra-abdominal Pressure
Anatomic Configuration of the Spinal Column
Position (immediately following injection)

TECHNIQUE OF INJECTION

Site of Injection
Direction of injection (needle bevel)
Turbulence (rate of injection, barbotage)

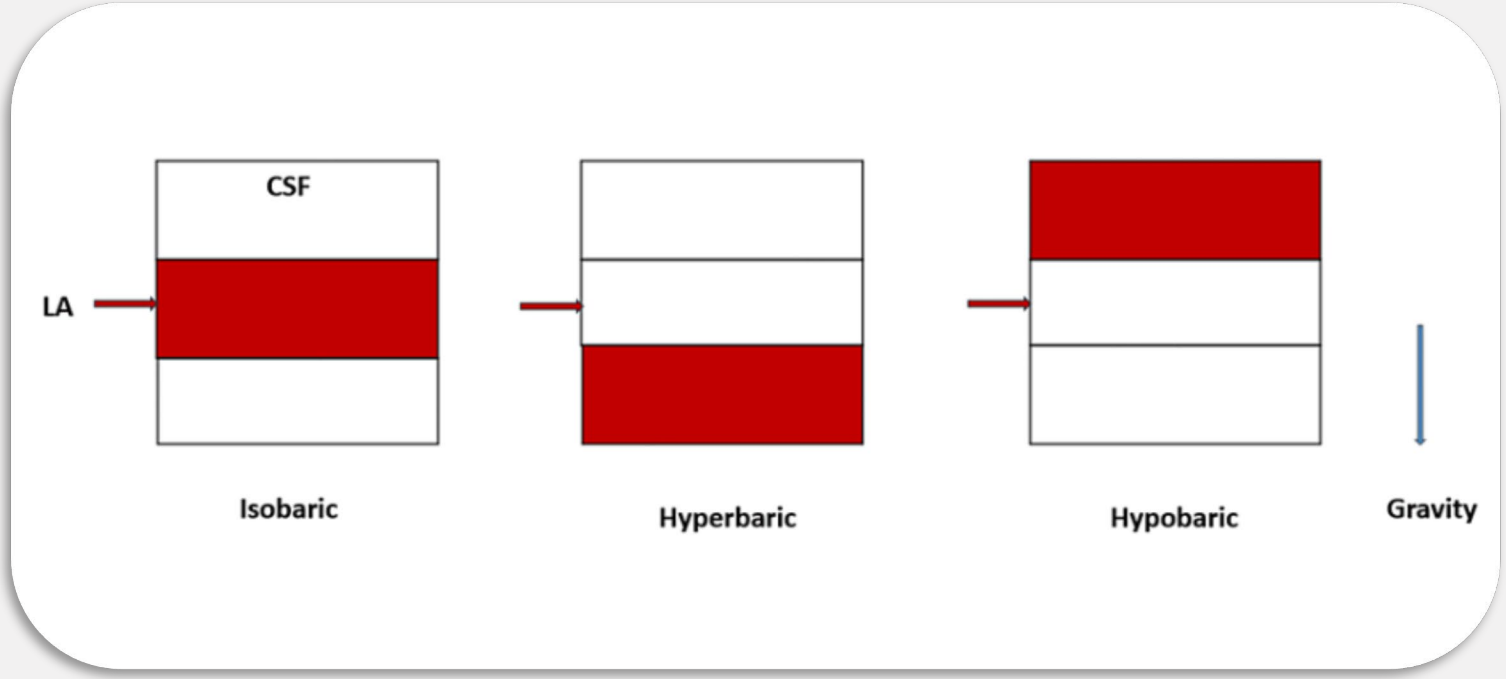
CHARACTERISTICS OF SPINAL FLUID

Baricity
Volume
Circulation
Pressure (Cough, Strain, Valsalva)

CHARACTERISTICS OF INJECTATE

****Baricity of Injectate*** (hyper, hypo, or isobaric)
Amount of Anesthetic (mass of injectate)
Concentration of anesthetic
Volume injected
Vasoconstrictors

FACTORS EFFECTING LA SPREAD WITHIN THE SUBARACHNOID SPACE



BARICITY

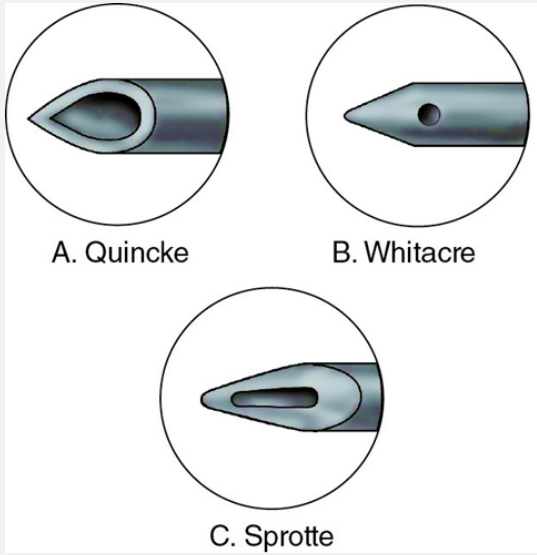
NEEDLES USED:

Introducer Needle- 18-20G ----1.5 in. long

Spinal Needle-

- Have a matching stylet in them
- Most are 3 – 3.5in long
- 22, 25, 27, 30 G
- Have a notch machined into one side of their hub with stylet fitting withing it; notch matches the bevel (notch is bevel up)

TYPES OF SPINAL NEEDLES:



Cutting Needles: Quincke, Tuohy, and Pitkin

Pencil Point (Spreading) Needles: Whitacre, Sprotte, and Greene

Quincke Whitacre Sprotte

Contraindications to Neuraxial Blockade

Absolute

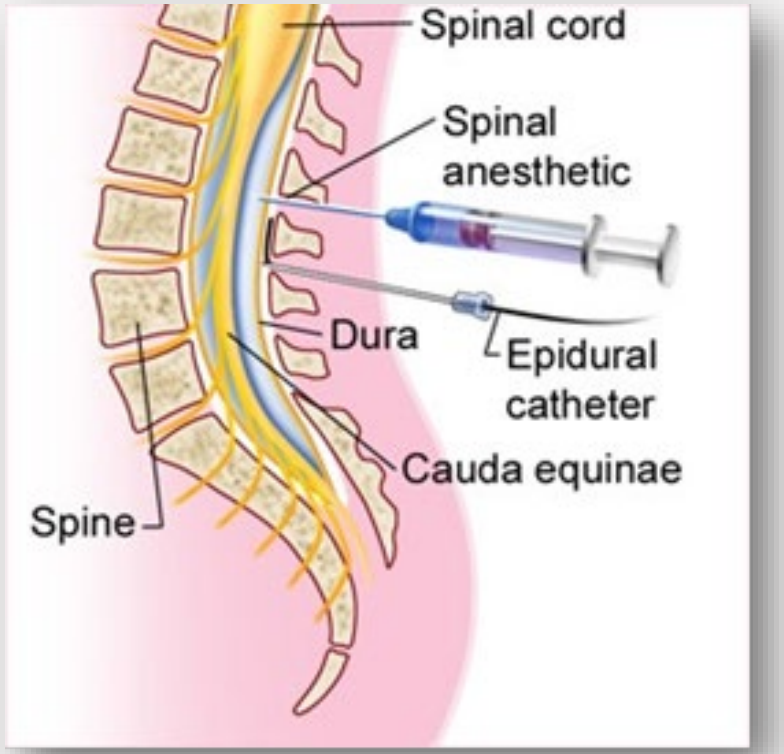
- Infection at the site of injection
- Patient Refusal
- Coagulopathy or other bleeding problems
- Severe hypovolemia
- Increased ICP
- Severe aortic stenosis
- Severe mitral stenosis

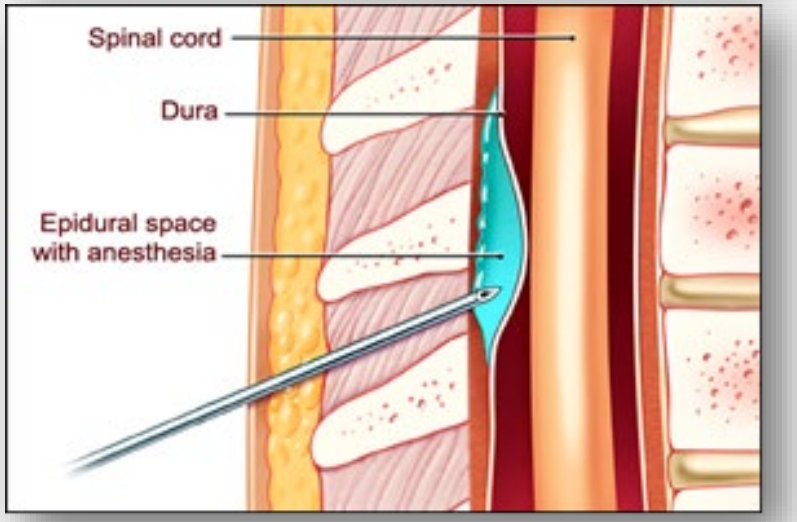
Relative

- Sepsis
- Uncooperative patient
- Preexisting Neurological deficits
- Stenotic valvular heart lesions
- Severe spinal deformity
- Complicated surgery

EXAMPLES OF WHERE THE NEEDLES GO

- Spinal Anesthetic
- Epidural Catheter



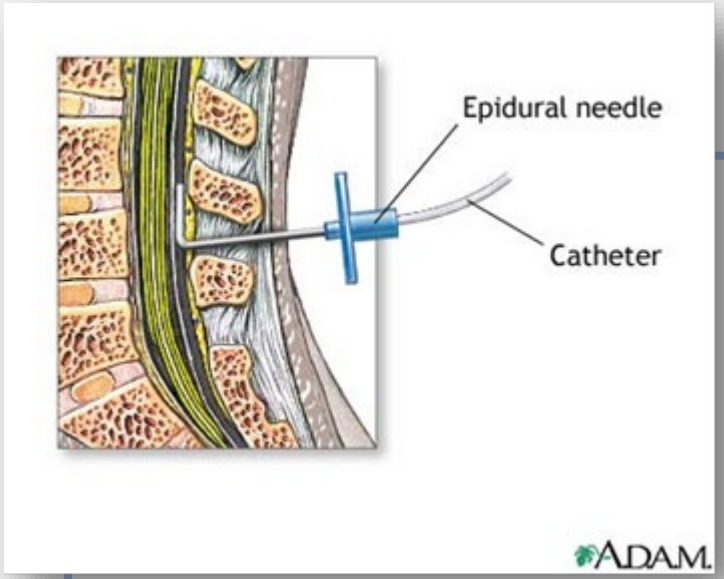


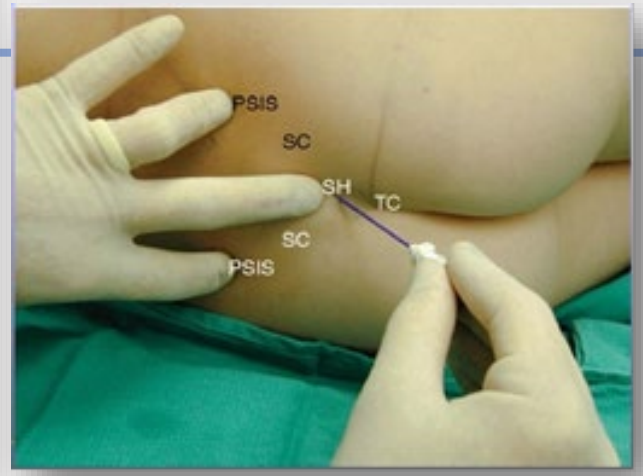
2. EPIDURAL/CAUDAL ANESTHESIA

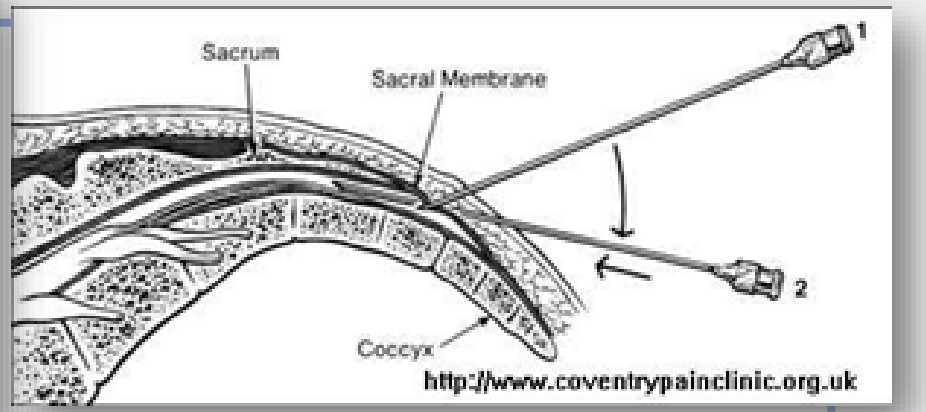
Local Anesthetic injected into the epidural space

Indications:

- Analgesia alone, where surgery is not contemplated (i.e., childbirth)
- As an adjunct to general anesthesia (i.e. AAA, GYN)
- Sole technique for surgical anesthesia (c-section, BKR)
- Post-operative analgesia (continuous infusion of LA or opioids)
- For the treatment of back pain (steroid injections)
- For the treatment of chronic pain or palliative care (terminal care)



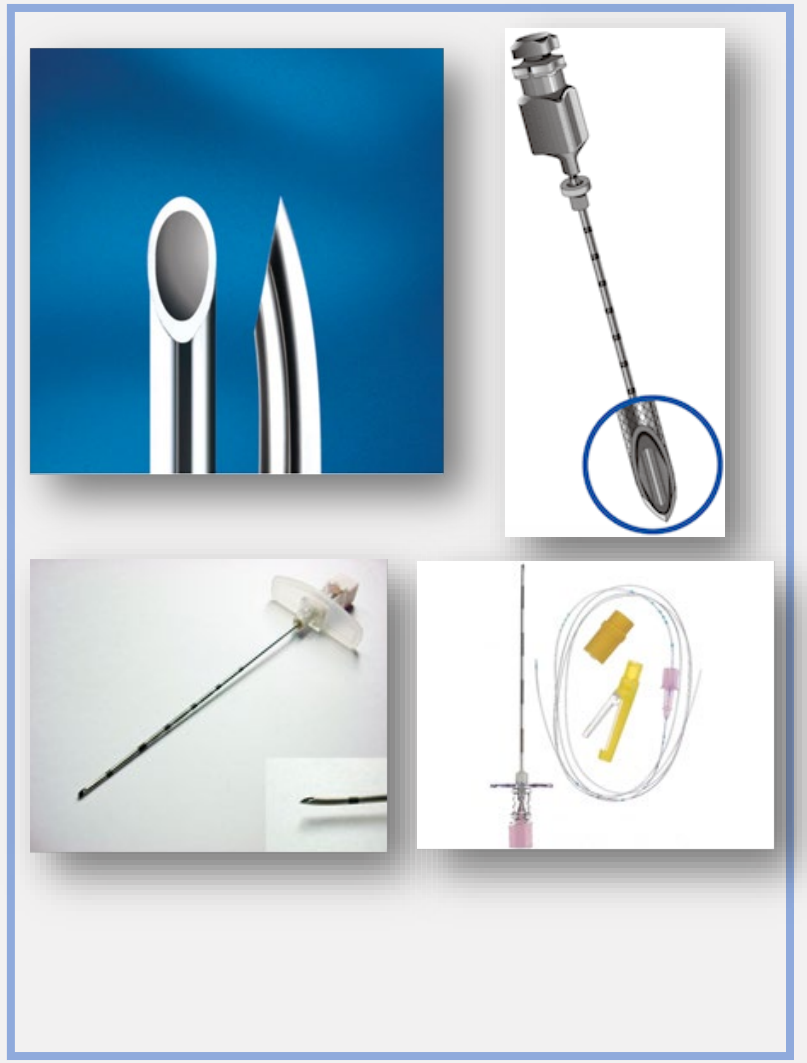


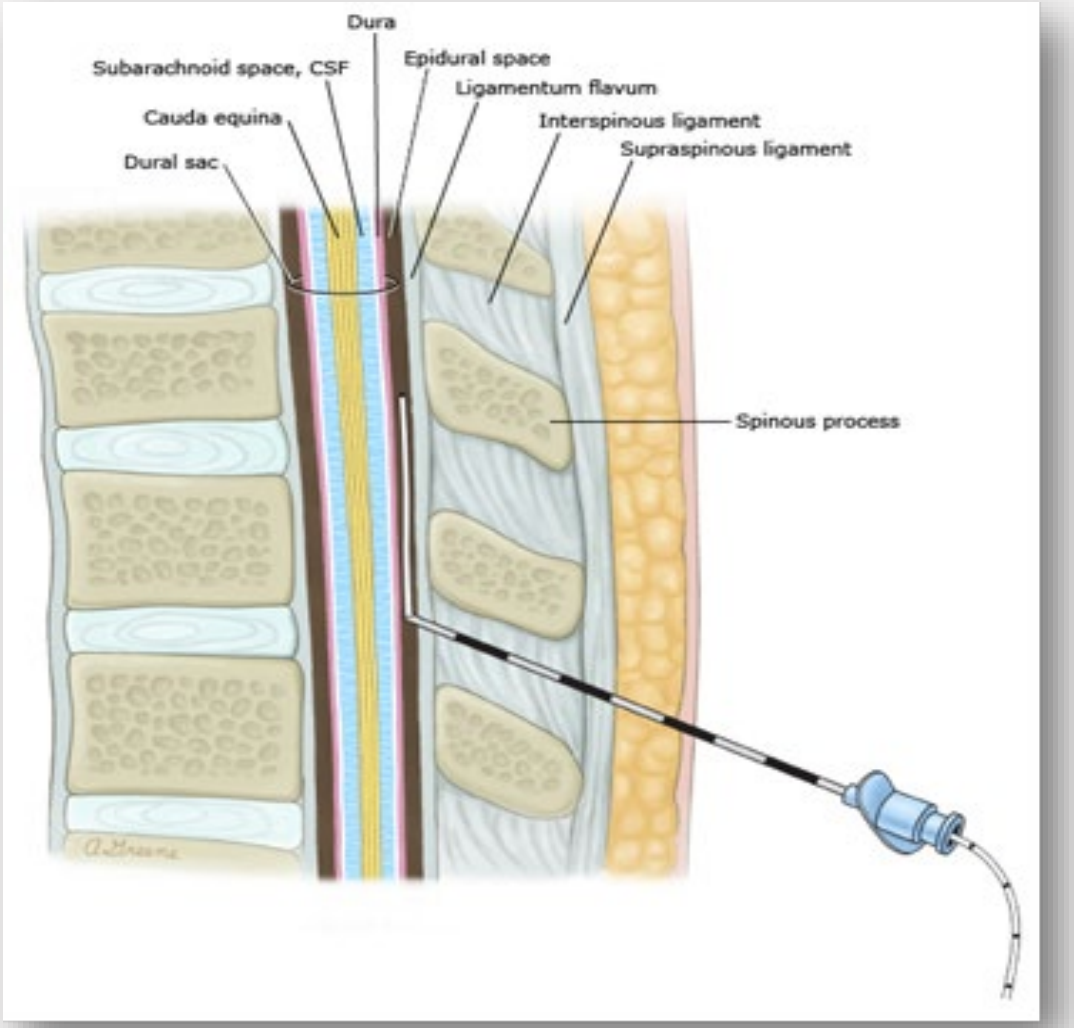


Procedure:

- LA is injected into the epidural space
- LA bathes the nerve roots in the epidural space
- The volume injected determines the spread of the block
- The site of injection also determines the spread/level of the block

NEEDLE USED:
TUOHY





POSITIONING: SITTING POSITION

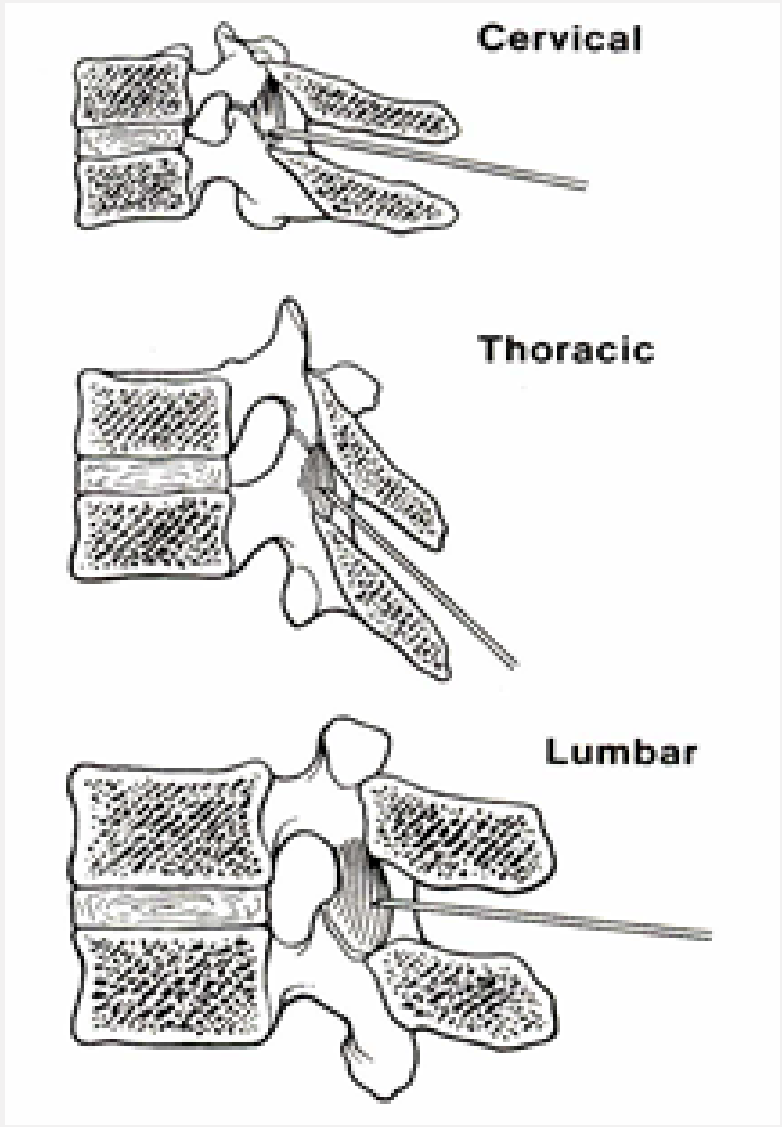
- No Torque
- Chin on chest
- Arms resting on knees
- “Mad Cat” or Shrimp Curve
- Footstool/Table to support feet

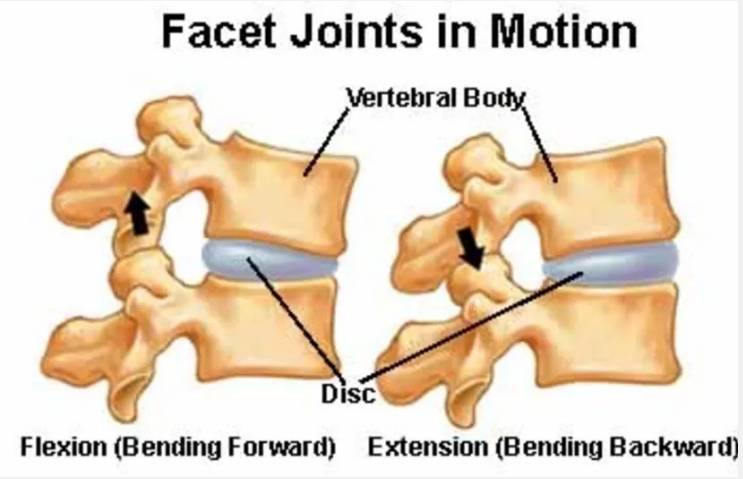
NEEDLE POSITION

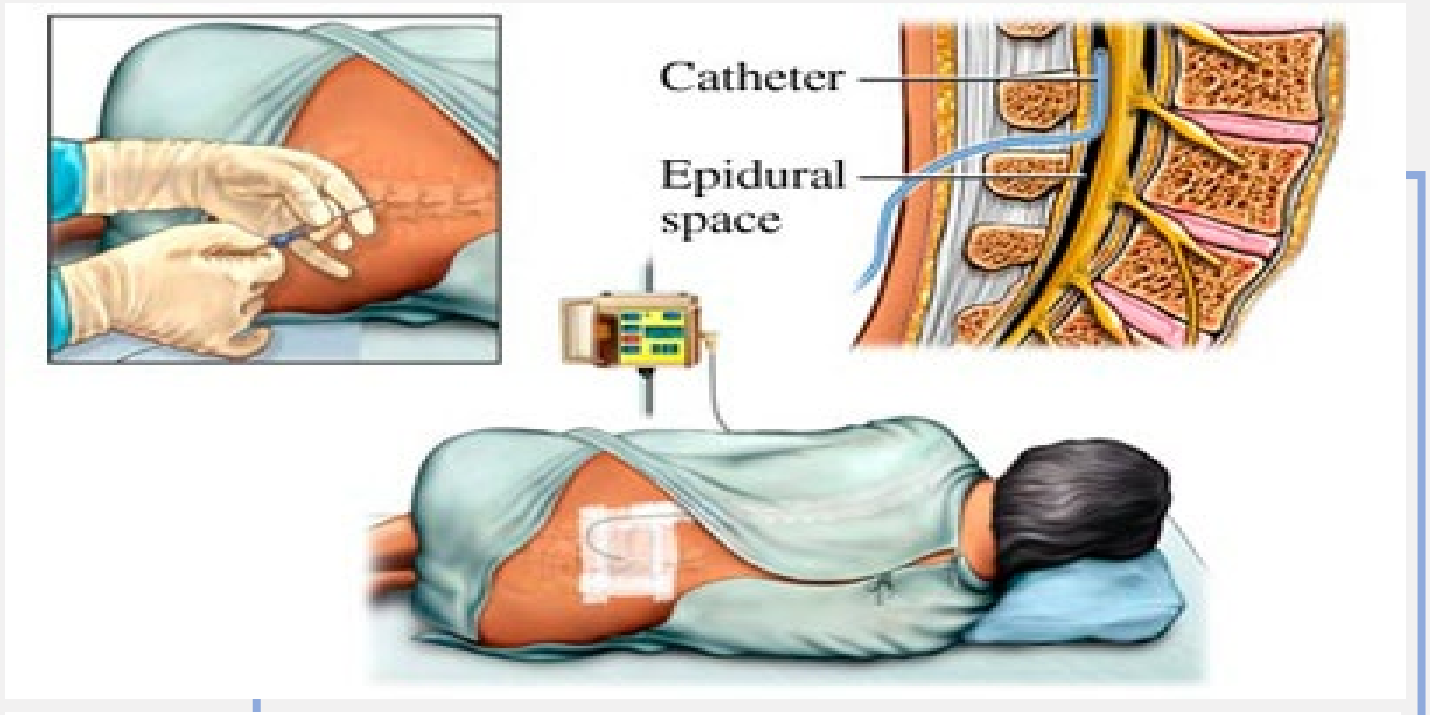
If the patient curls forward,

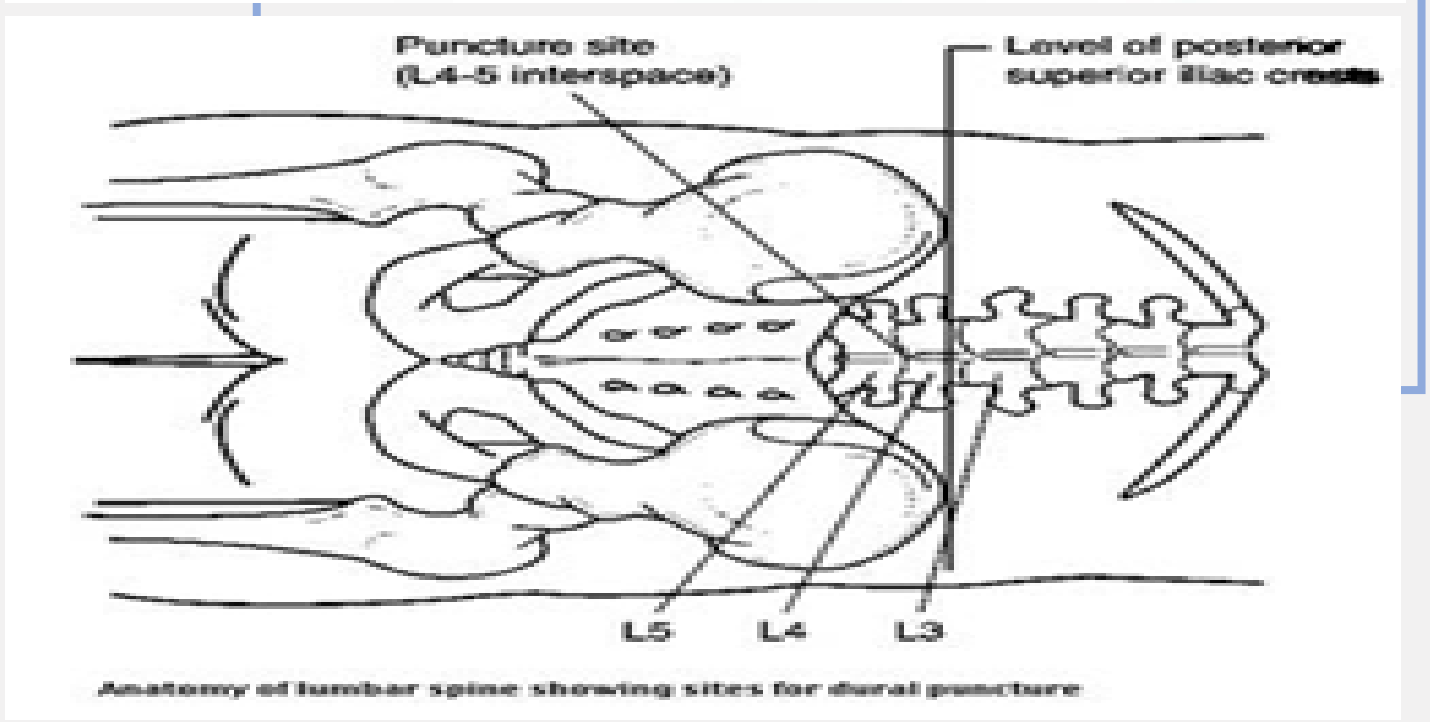
more room is made for a needle

to pass through.









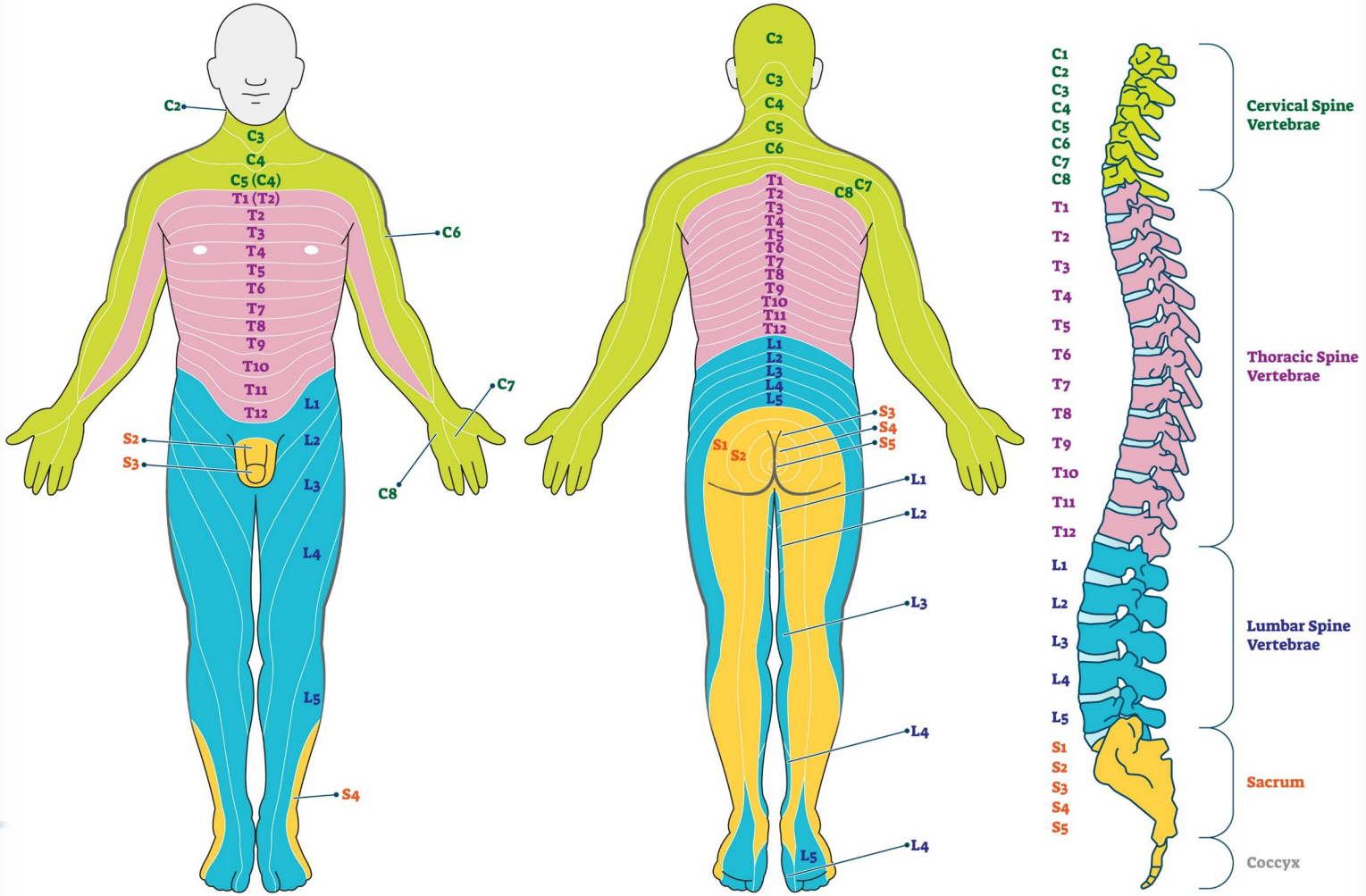
Anatomy of lumbar spine showing sites for dural puncture

LATERAL POSITION:

- Shoulders perpendicular to bed
- Positioned with hips on edge of bed
- Hugging pillow/knee chest position
- Knees curled up into the body

- Areas of the skin that connect to a specific nerve root on the spine

DERMATOMES



POTENTIAL COMPLICATIONS:

Spinal/Epidural Anesthesia

1. **High Spinal-** Unintentional subarachnoid injection when attempting an epidural, too much LA improper position

2. **Post Dural Puncture Headache (PDPH)**- caused by a decrease in the CSF available in the subarachnoid space through a leak created by the dural puncture with a needle.

3**. Neurologic Injury-** caused by direct needle trauma, infection, drug-related toxicity, hematomas

4. **Backache**-debatable

5. **Vascular Injury**

6. **Local Anesthetic Toxicity-** because of an overdose of LA or an unintentional vascular injection

7. **Meningitis/Sepsis**

CLINICAL PRACTICE TIPS/ISSUES

- ❑ Don’t inject if blood is present
- ❑Don’t inject if the patient exhibits paresthesias
- ❑Don’t allow the patient to position themselves or strain after placing the spinal
- ❑Be vigilant in choice of LA and dose
- ❑Maintain sterile technique
- ❑Monitor patient closely

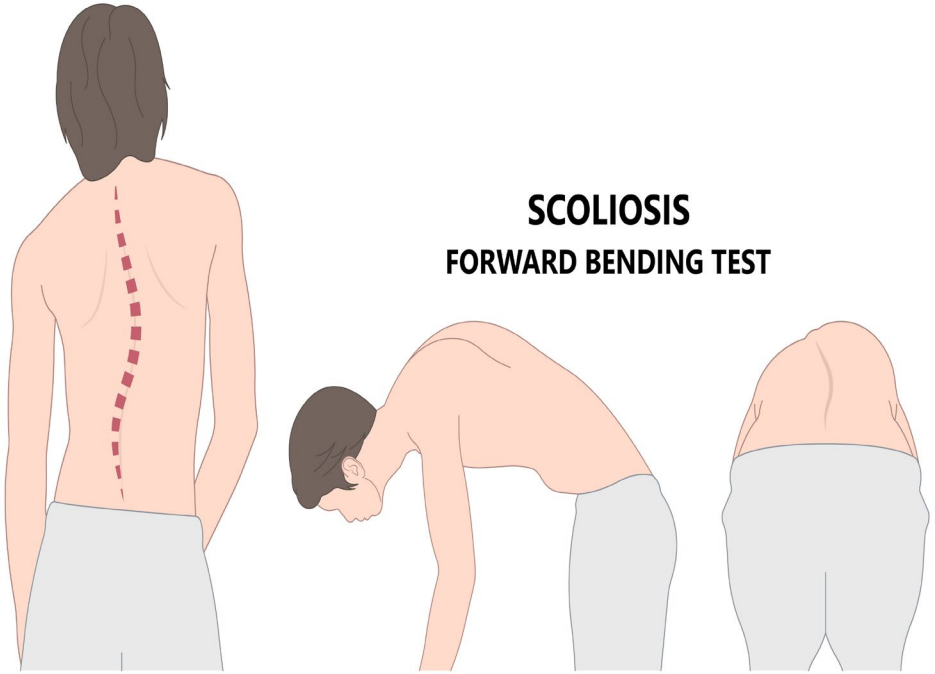
DIFFICULTY IN PLACING REGIONAL ANESTHESIA

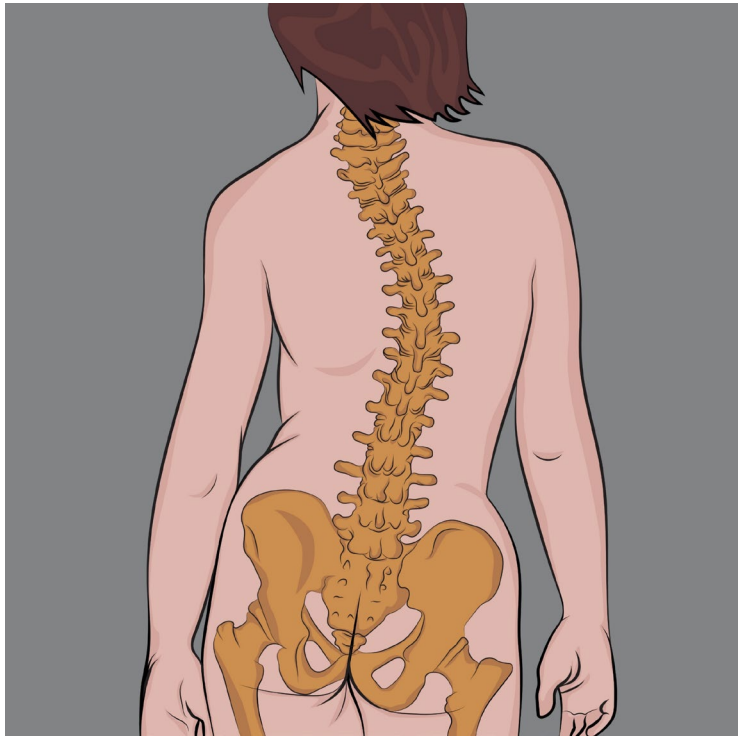
ELDERLY/ARTHRITIC PATIENTS

OBESITY

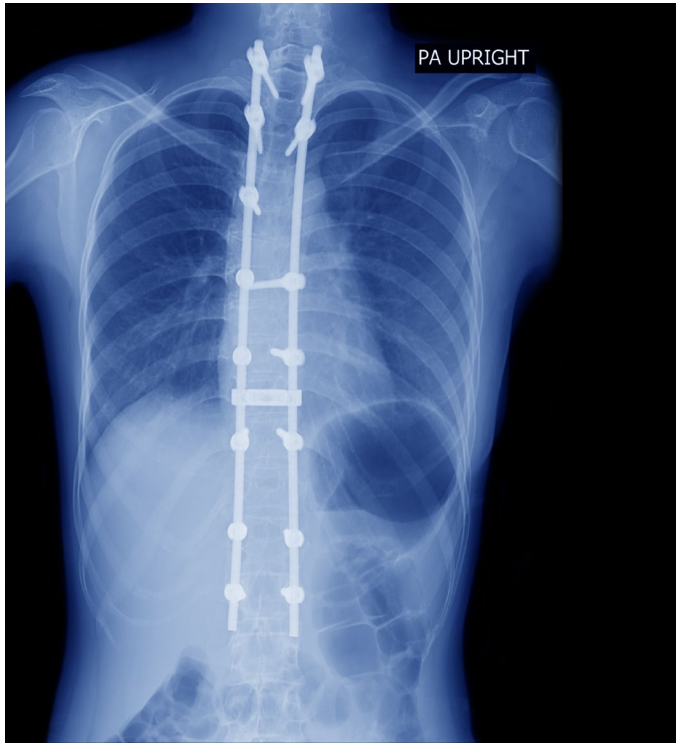
Difficulties, cont.

SCOLIOSIS/CURVATURE OF SPINE



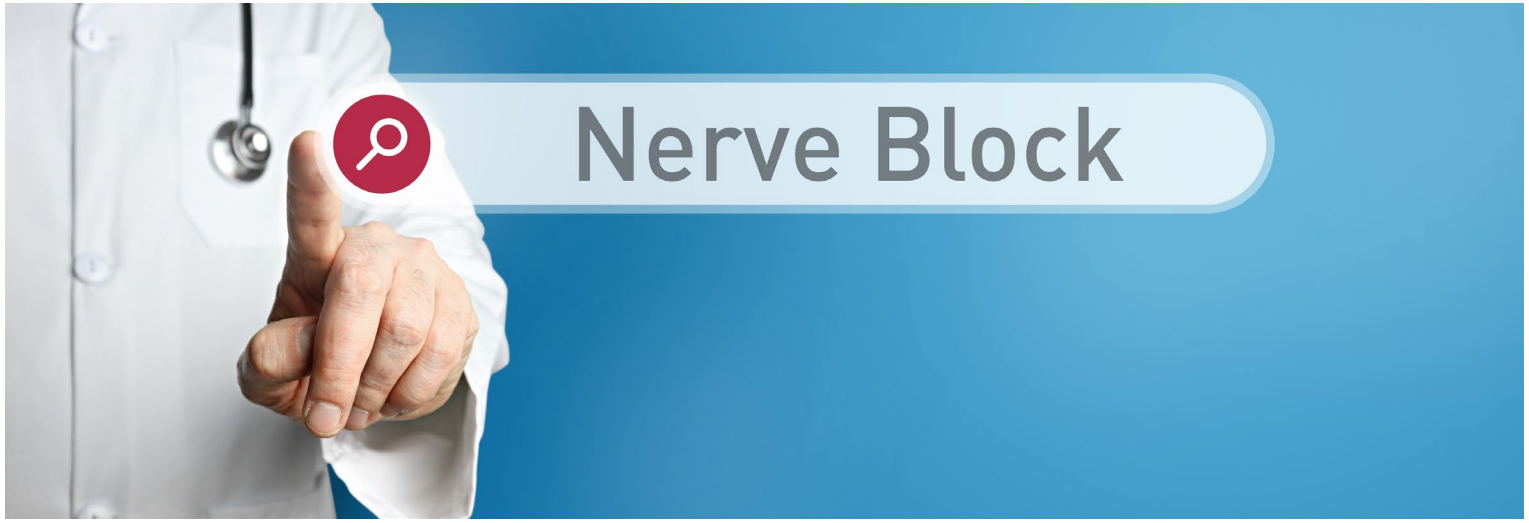


IMPLANTED HARDWARE



PERIPHERAL NERVE BLOCKS

- are a great tool for an anesthesia provider
  - provides intraoperative anesthesia
  - provides intraoperative analgesia
  - also provides postoperative analgesia
- the interest and use of peripheral nerve block regional anesthesia has grown over the past decade



Peripheral Nerve Blocks

- Local anesthesia injected into a nerve sheath or near peripheral nerves

PNB Indications:

Used as an adjunct to general anesthesia

Total anesthesia for a limb

Postoperative pain management

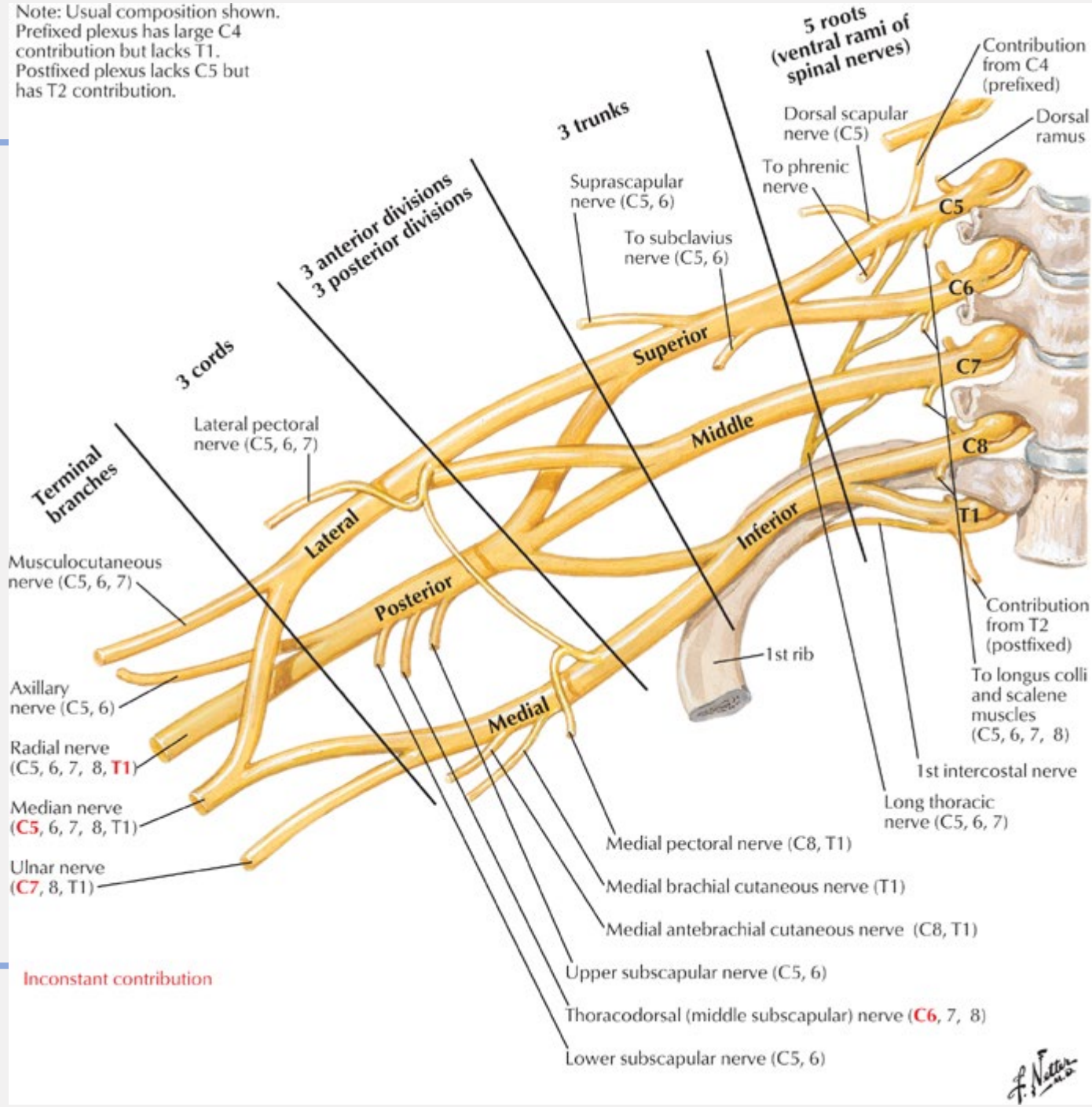
PNB Physiology:

- A nerve bundle is identified by:
  - Eliciting a paresthesia
  - Using a nerve stimulator
  - Using ultrasound guidance
- LA is injected either into a peripheral nerve sheath or around nerve bundles
- Anesthesia/analgesia

NERVE BUNDLES

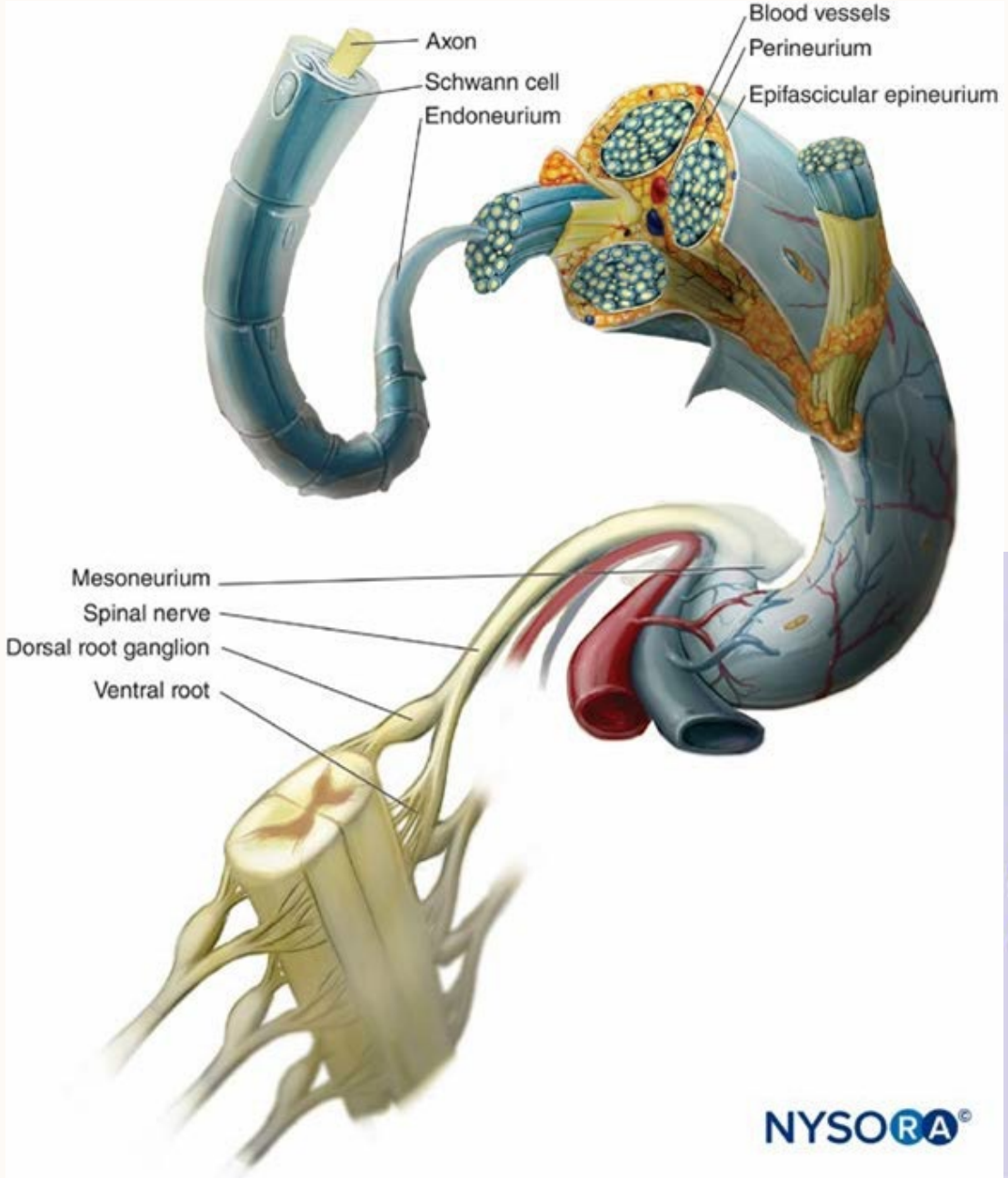
EXAMPLE:

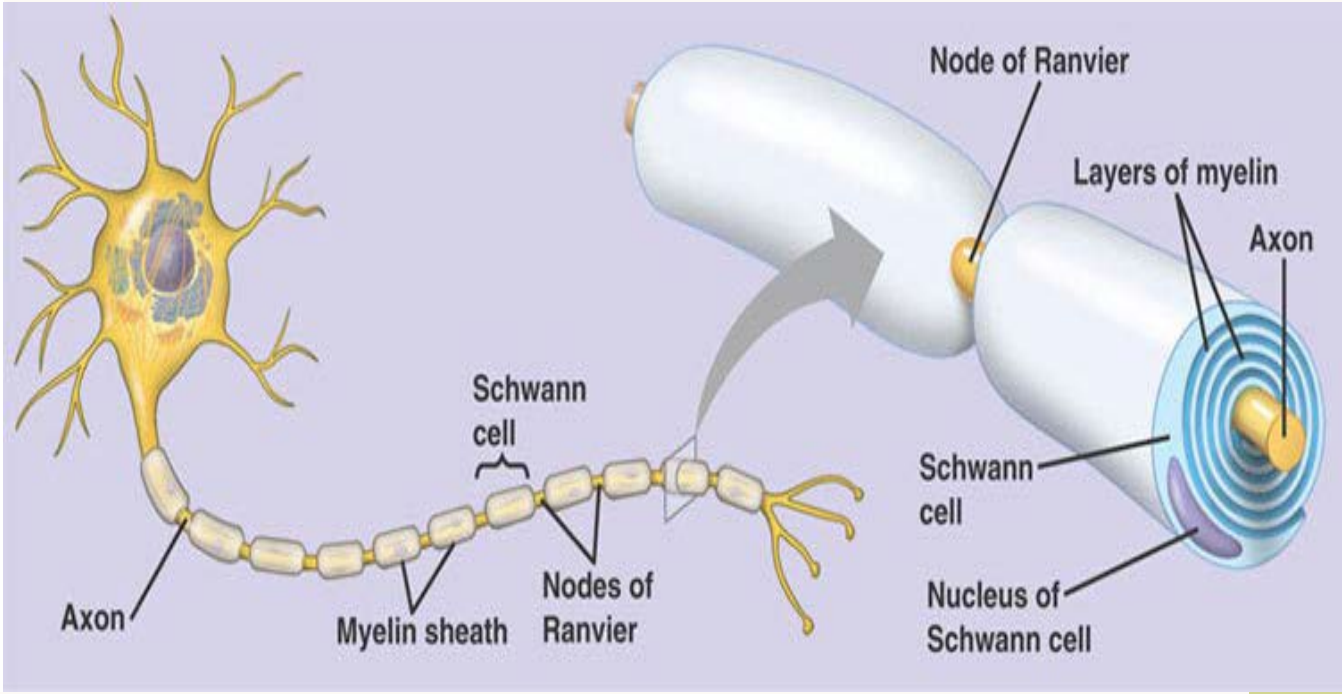
CERVICAL PLEXUS



Ultrasound-guided Peripheral Nerve Blocks

THE PERIPHERAL NERVE





ANATOMY OF A PERIPHERAL NERVE

- Nerve fiber is composed of an axon enclosed by a myelin sheath and a Schwann cell
- Nodes of Ranvier are nonmyelinated junctional regions between adjacent Schwann cells
  - 3 successive Nodes must be blocked for effect in myelinated fibers (easier)
  - 5-6 mm coverage for unmyelinated fibers
- Perineurium covers a group of nerve fibers to form fascicles
- Epineurium holds fascicles together to form peripheral nerve

LOCAL ANESTHETICS (LA)

- Drugs that reversibly inhibit the conduction of electrical impulses along nerve fibers (halt impulse traffic along nerves).
- The degree of inhibition is influenced by:
  - Anatomy of the nerve being blocked (length, diameter, if myelinated)
  - Local tissue conditions
  - Physicochemical properties of the local anesthetic agent
- Sodium channel blocking drugs
- Interrupt conduction in excitable tissue
- Prevents depolarization by inhibiting passage of sodium ions
- Dull sensation distal to the site of blockade

BASIC PROPERTIES

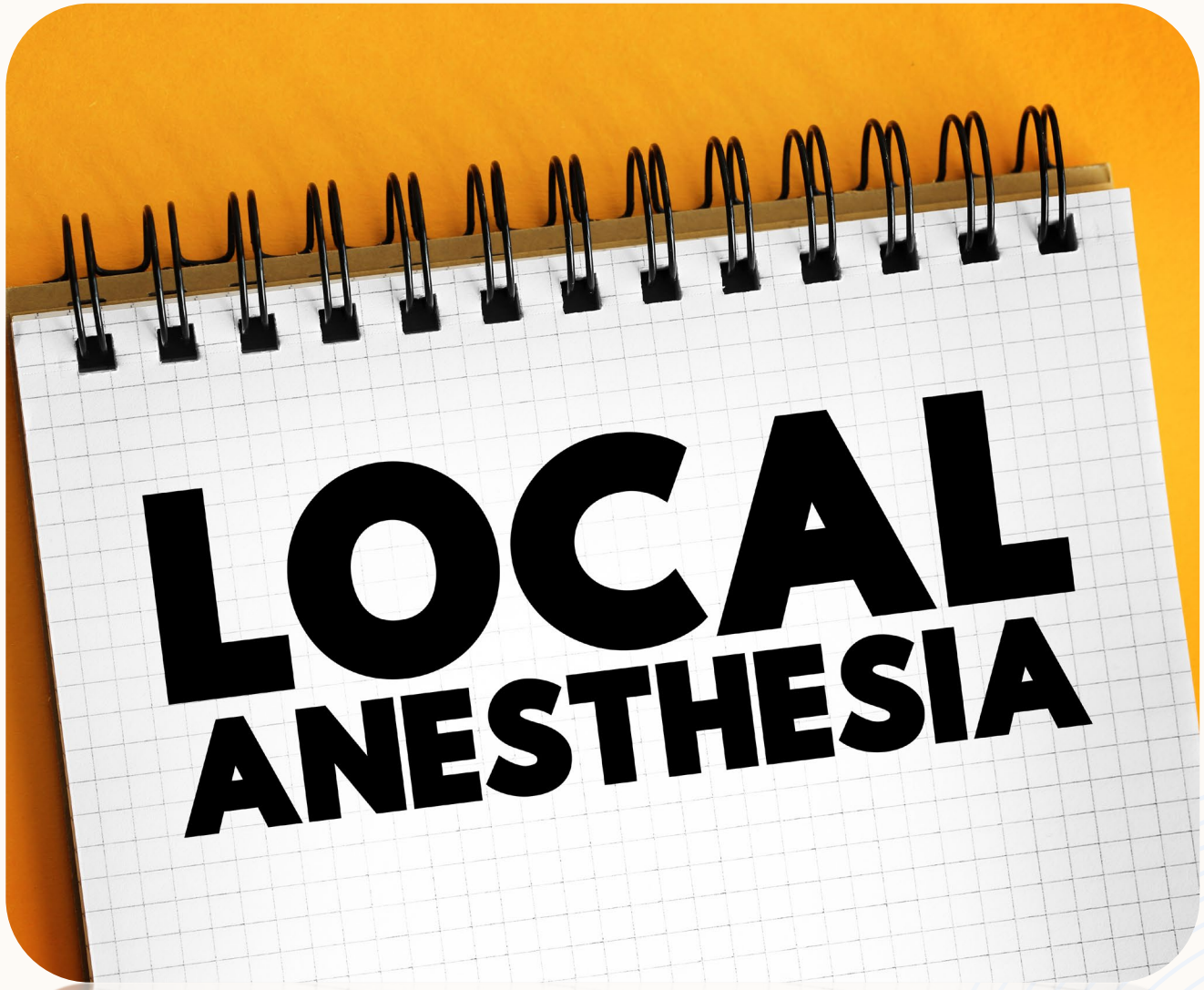
Weak bases

(proton acceptors)

Prepared as water-soluble HCL salts that are strongly acidic (pH < 6)

PROFILE OF LA DEPENDS ON:

1. Lipid solubility
2. Protein binding
3. pKA
4. Vasodilator activity



ESTERS:

THERE IS ONLY ONE "I" TO EACH NAME

- Hydrolyzed by plasma esterases
- Potential allergy due to para-amino benzoic acid (PABA)
  - **Procaine (Novocain)**
  - **Chlorprocain (Nesocaine)**
  - **Tetracaine (Pontocaine)**
  - **Cocaine**
  - **Benzocaine**

One-eyed (i) Ester

AMIDES:

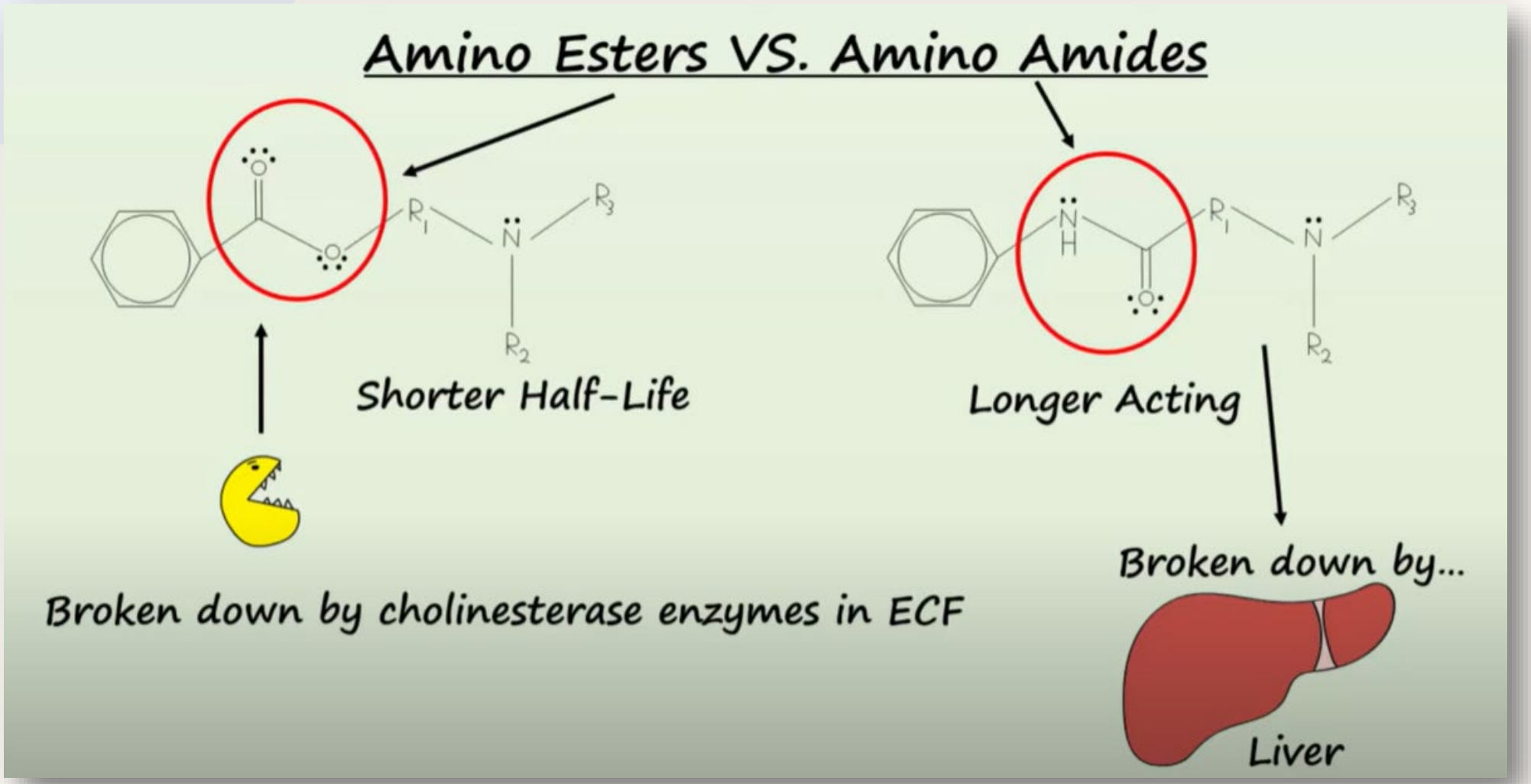
Bio-transformed by hepatic enzymes

Very rarely provokes an allergic response

- Lidocaine (Xylocaine)
- Prilocaine
- Etidocaine
- Mepivacaine (Carbocaine)
- Bupivacaine (Marcaine)
- Levo-bupivacaine (Chirocaine)
- Ropivacaine (Naropin)

ESTERS VS. AMIDES

Locals are separated into two categories based on their chemical structures. The Esters have a shorter half life because they are broken down by cholinesterase enzymes in extracellular fluid break them down (less than 3 minutes). Amino Amides are longer acting because they are broken down by the liver which of course is a longer metabolizing process. –About 1-3 hours.



LIPID SOLUBILITY

- The free base, lipid soluble fraction is what penetrates the nerve
- Solubility is defined by the Oil/H_2O Partition Coefficient
- The higher the lipid solubility, the more potent the local anesthetic

Lipid Solubility = Potency

PROTEIN BINDING

- LA's that are poor protein bound have a shorter duration
- LA's that are highly protein bound have a longer duration
- Local blood flow washes the local anesthetic from the receptor site (if it clings on stronger, it elicits its effect longer). Epinephrine also influences this.

Protein Binding = Duration of Action*

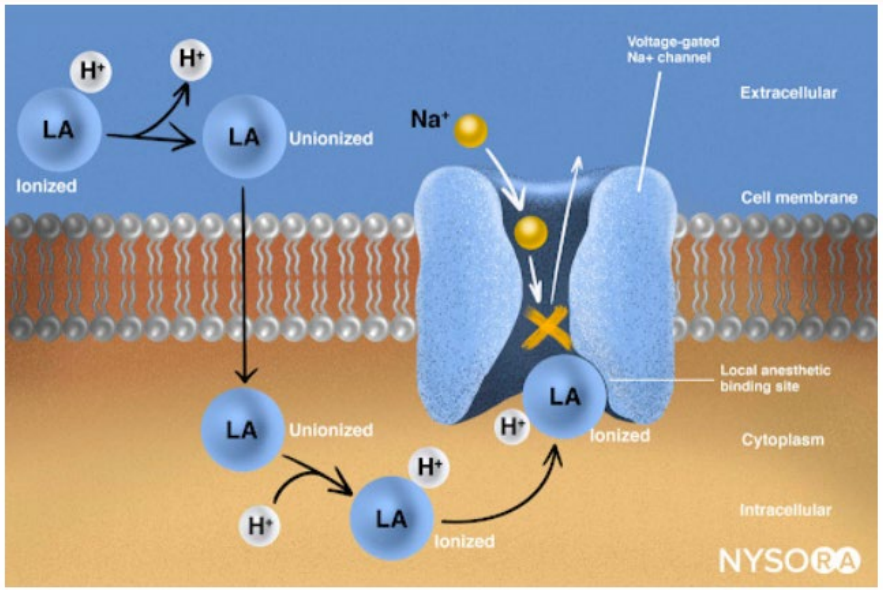
PKA

Vocabulary:

- pK^a is the negative base-10 logarithm of the acid dissociation constant (Ka) of a solution. The quantitative behavior of acids and bases in a solution can only be understood if their pKa values are known.
  - The free base, lipid soluble, unionized fraction is what penetrates the nerve
  - The drugs pKa determines the unionized drug fraction available
  - pKa is the pH at which 50% of the LA will remain in the uncharged (basic) form and 50% will exist in the charged (cationic) form
  - The amount of unionized drug determines the onset time
  - The closer the drugs pKa is to physiology pH, the quicker the onset
  - Chlorprocain is an exception

pKa = Speed on Onset

MECHANISM OF ACTION OF LA'S



From the Compendium of Regional Anesthesia: Mechanism of action of local anesthetics. Local anesthetics work by binding to the α subunit of the voltage-gated Na+ channels, thus preventing the generation and conduction of nerve impulses. Subsequently, Na+ ions cannot flow into the cell, thereby halting the transmission of the advancing wave of depolarization down the length of the nerve. The fraction of local anesthetic molecules are in the ionized form. Local anesthetic molecules change from ionized to unionized in a fraction of a second.

Sequence of Events:	Injection of LA into area with a local pH
	The pKa determines % ionization
	The Unionized form crosses the membrane
	Binding of Ionized for to Na^+ channel
	Failure to achieve Threshold—conduction blockade

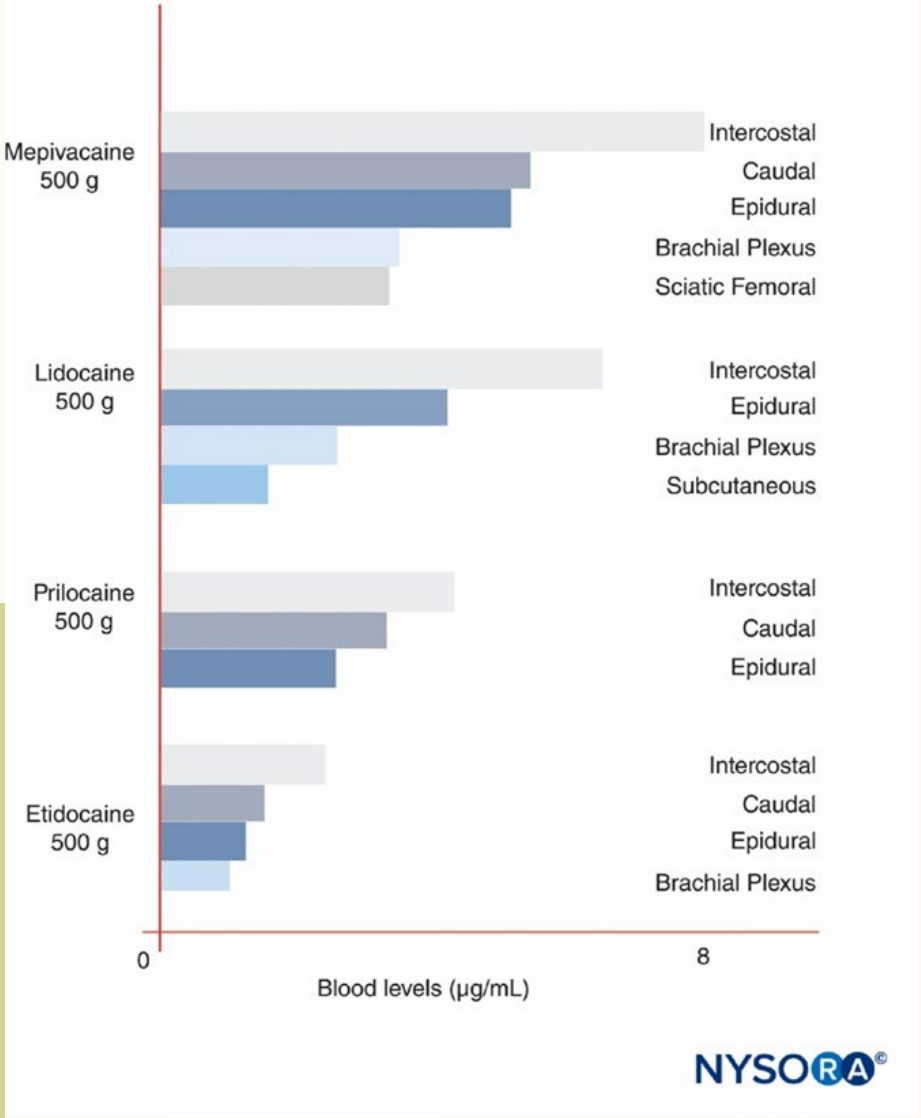
VASODILATOR ACTIVITY

1. Intrinsic vasodilator activity influences the apparent potency and duration of action
2. Following injection, some LA is taken up by the nerve and some is absorbed in the bloodstream
3. The rate of systemic absorption is proportionate to the vascularity of the site of injection (the higher the vascularity, the quicker the absorption).

Blood > Intercostal > Caudal > Epidural> Brachial Plexus > Sciatic > Subarachnoid > Subcutaneous

(Absorption from greatest to least)

B-I-C-E-P-S



AMIDES IN THE BLOOD

ADDITIVES

Various additives can be added to LA to accelerate the onset time, reduce the systemic absorption (thus the risk of LA-related toxicity), and prolong the duration of nerve block or pain relief.

Examples…

ADDITIVES:
CLONIDINE

Main Effects:

- Prolonged duration of anesthesia and analgesia that follows neural blockade. Improve quality

Other Effects:

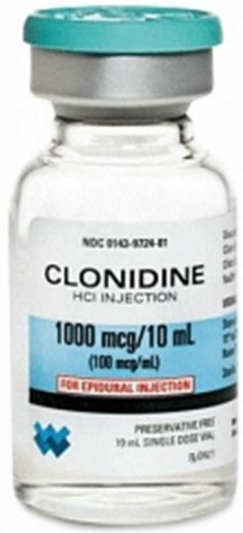
- Unlike opioids, does not produce resp. depression, nausea or vomiting.

Adverse Effects:

- Sedation, orthostatic hypotension

Dose: 1-2 mcg/kg

Use: Epidurals, Spinals, Peripheral nerve blocks



ADDITIVES:
DEXAMETHASONE

Main Effects:

- Prolonged duration of block

Other Effects:

- Potential increase in blood glucose

Dose: 4 -10mg

Use: PNBs, Spinals, Epidurals (not FDA approved for perineural administration)

ADDITIVES:
OPIOIDS

Main Effects

- Analgesia lasting several hours

Other Effects:

- Reduction of onset time of the block with highly lipid soluble drugs

Adverse Effects:

- Nausea and vomiting, pruritis

Dose: 0.1 mg/kg morphine, Buprenorphine 0.3 mg, Tramadol 200mg

***Use*:** Primary opioid use is in spinals and epidurals

ADDITIVES:

SODIUM BICARBONATE

Main Effects:

- 30-50% reduction in onset time

Other Effects:

- Ineffective in acidotic tissue

Dose: 1 mEq Bicarb to 10 mL of LA (Lidocaine or Chlorprocain)

Use: Epidural, controversial in peripheral nerve blocks, precipitates with Bupivacaine and Ropivacaine

ADDITIVES:

EPINEPHRINE

Vasoconstrictors = Decreased absorption = Decreased Systemic Toxicity = Increased Duration of Action

Main Effects:

- Prolonged duration of the block. Duration may be increased from 30-50% depending on the potency of LA and the vasculature of the site of injection.

Other Effects:

- Reduction of the inherent toxicity of LA's (vascular marker)

Adverse Effects:

- Hemodynamic effects if massive blood absorption or intravascular injection

Dose: 2.5 mcg/mL (1/400,000)

Use: All peripheral blocks except those in the vicinity of extremities die to terminal arterial blood flow (penis, fingers, nose, toes). Local anesthetics with epinephrine (commercially prepared) should NOT be used for blocks (add your own epi).

MAX DOSES OF LOCAL ANESTHETICS

Drug	Concentration (%)	Dose (mg /kg)
Chlorprocaine	3	11 (14)
Lidocaine	1,2	4.5 (7)
Mepivacaine	2	4 (7)
Bupivacaine	0.25, 0.5, 0.75	2 (2.5)
Ropivacaine	0.75	3 (3.5)

LOCAL ANESTHETIC SYSTEMIC TOXICITY (LAST)

Detection:

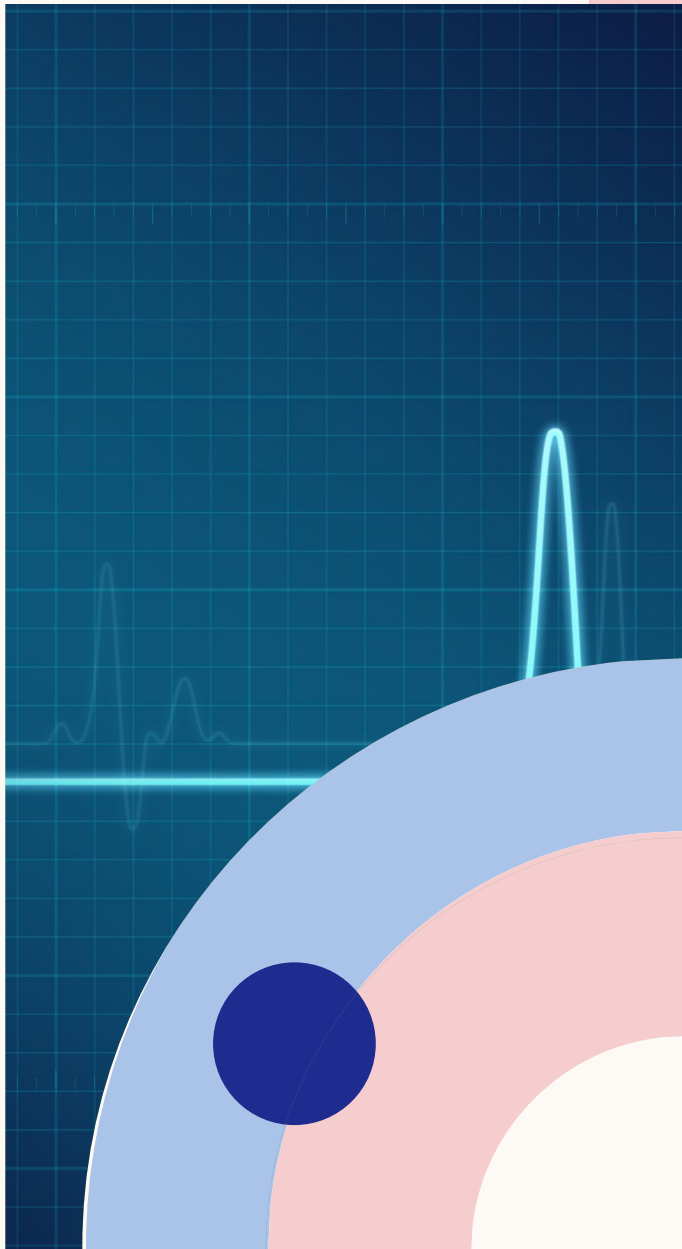
1. Use ASA Monitors when performing blocks
2. Monitor the patient during and after completing injection
3. Communicate frequently with the patient to check for symptoms of toxicity
4. Central nervous system signs (may be subtle or absent)
    - Excitation (agitation, confusion, muscle twitching, seizure)
    - Depression (drowsiness, obtundation, coma, or apnea
    - Non-specific (metallic taste, circumoral numbness, dizziness)

LAST- DETECTION

5. Cardiovascular signs

- Initially may be hyperdynamic (hypertension, tachycardia, ventricular arrhythmias) then;
- Progressive hypotension
- Conduction block, bradycardia or asystole
- Ventricular arrhythmias (Vtach, Vfib, Torsades de Pointes)

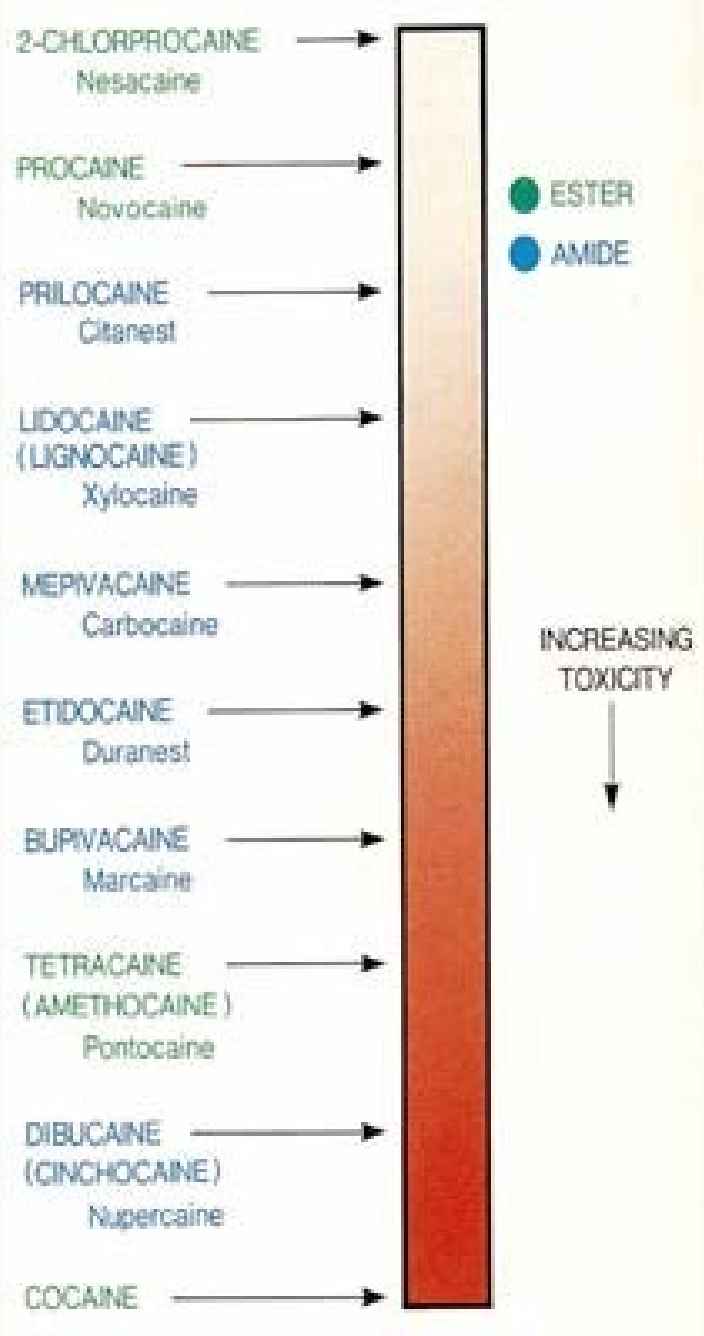
6. Sedative hypotonic drugs reduce seizures risk, but even slight sedation may abolish the patient's ability to recognize or report symptoms of rising LA concentration.



LAST
RISK REDUCTION:

- Use the ***least*** dose amount of LA necessary to achieve the desired block
- LA blood levels are influenced by site of injection and dose
- Factors that increase the likelihood of LAST include:
    1. Advanced age
    2. Heart failure
    3. Conduction abnormalities
    4. Metabolic disease
    5. Liver disease
    6. Meds that inhibit sodium channels

- Consider using a pharmacologic marker and/or test dose
- Aspirate the syringe prior to each injection while observing for blood
- Inject incrementally, while observing for all symptoms of toxicity

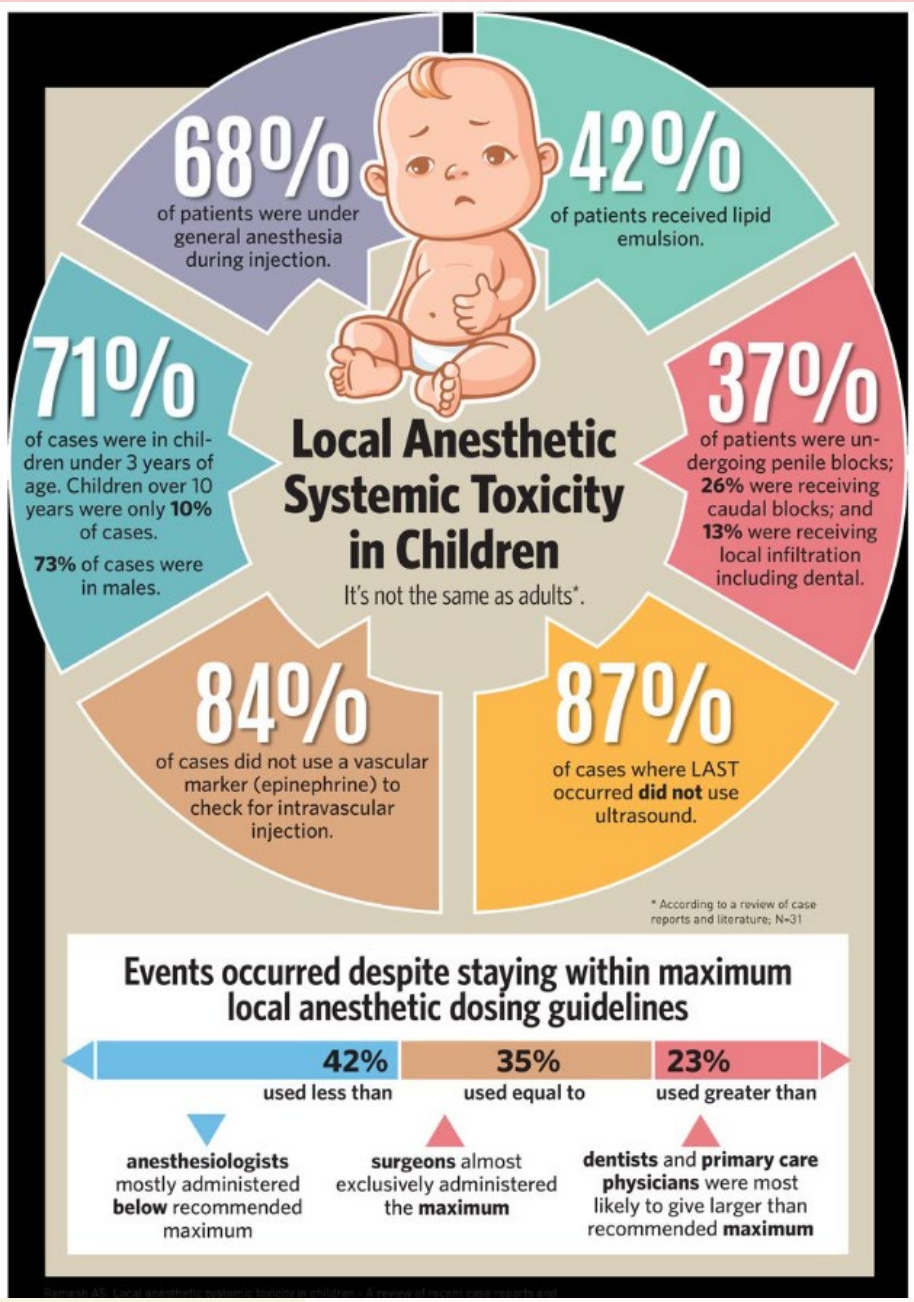


TOXICITY SCALE

PEDIATRIC TOXICITY

Just for your information!

- Pediatric blocks are not uncommon & the statistics of toxicity are alarming!



Jim Snively, artist, of Pittsburgh, PA

TREATMENT FOR LAST

✓ **Get help**

✓ **Initial Focus:**

- Airway management- ventilate with 100% oxygen
- Seizure suppression- benzos are preferred; AVOID propofol in patients having signs of CV(cardiovascular) instability (small dose for seizure suppression is ok)
- **Alert** the nearest facility that has cardiopulmonary bypass capability

✓ **Management of Cardiac Arrhythmias**

- BLS and ACLS will require adjustment of medications and perhaps prolonged effort

✓ **Lipid Emulsion (20%) Therapy**

- **Bolus 1.5 mL/kg** (lean body mass) IV over 1 min (~100mL)
- **Continuous infusion 0.25 mL/kg/min (~18 min)**
- Repeat bolus once or twice for persistent cardiovascular collapse
- Double the infusion rate to 0.5 mL/kg if blood pressure remains low
- Continue infusion for at least 10 min. after attaining circulatory stability

INTRALIPID 20% FAT EMULSION

- There should always be a 500mL bag available in block areas or wherever blocks are done!

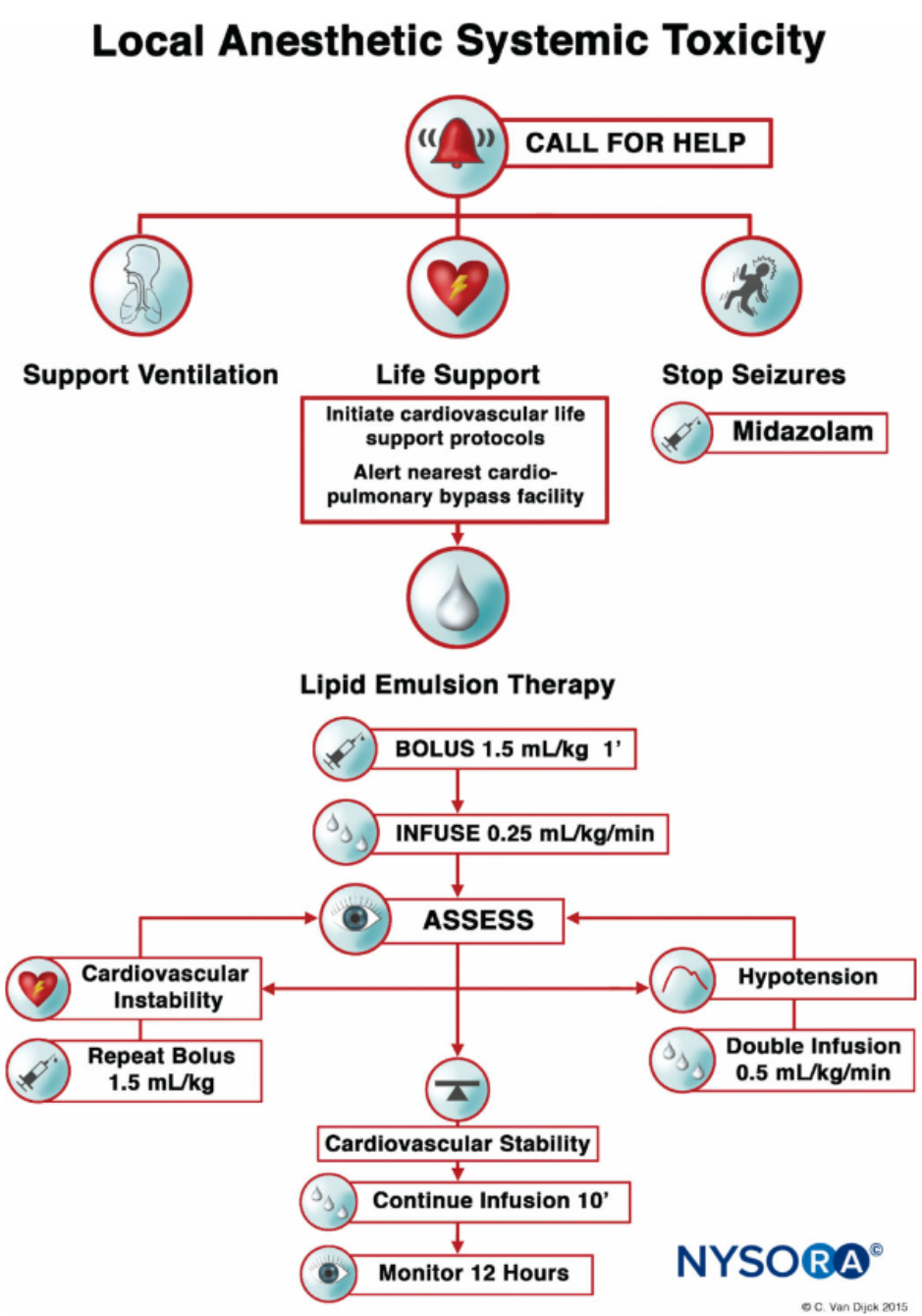


FIGURE 1. Checklist for management of local anesthetic systemic toxicity.

LOCAL ANESTHETIC SYSTEMIC TOXICITY ALGORITHM

IF YOU'RE EVER APART OF A LAST EVENT:

POST YOUR LAST EVENTS ON :

HTTP://LIPIDRESCUE.SQUARESPACE.COM/POST-YOUR-CASES/

THANK YOU

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