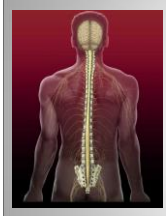

NEURAXIAL ANESTHESIA FOR THE PARTURIENT: SPINAL & EPIDURAL

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ANPA 31st Annual Conference
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OBJECTIVES

- Neuraxial anesthesia defined
- History of neuraxial anesthesia
- Why in OB?
- CNS anatomy
- Local anesthetics
- Spinal & epidural advantages, limitations & complications
- Spinal & epidural placement techniques
- Management of neuraxial anesthesia in the parturient

NEURAXIAL ANESTHESIA DEFINED

The placement of local anesthetics and/or additives around the spinal cord to produce anesthesia/analgesia in the chest, abdomen, pelvis & lower extremities

- spinal (intrathecal)
- epidural
- caudal

NEURAXIAL ANESTHESIA HISTORY

- James Leonard Corning (1885) - Cocaine btw lower lumbar vertebrae of a dog & a healthy man (?epidural)
- August Bier (1899) - 1st surgery under spinal
- Nicolae Racoviceanu-Pitești (1901) - 1st intrathecal opiod
- Fidel Pagés (1921) - 1st lumbar epidural injection
- Eugen Aburel (1931) - first epidural in early labor
- Robert Andrew Hingson (1941) - first continuous infusion (caudal)
- Pío Manuel María Martínez Curbelo (1947) - first continuous epidural catheter infusion

WHY REGIONAL ANESTHESIA IN OBSTETRICS?

- Why not?
- Decrease the discomfort & pain of labor & delivery
- Improved relaxation, leading to dilation & descent
- Helpful in controlling hypertension of PIH
- A more pleasant experience

TYPES OF REGIONAL ANESTHESIA UTILIZED IN THE PARTURIENT

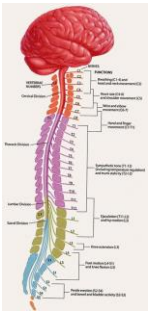
- Epidural
- Intrathecal
- Combined Spinal Epidural (CSE)
- Subarchnoid Block (SAB) - "spinal"
- Continuous Spinal
- Caudal
- Paracervical Block
- Pudendal Block

MYTHS ABOUT THE EPIDURAL

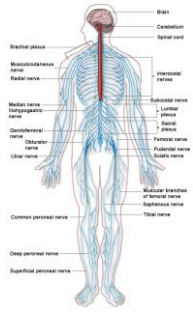
- "It's going to take the pain away"
  - Wrong…
    - Pressure
    - Rapid Descent
    - Hot spots
    - The "ring of fire"
- "I'm not supposed to be feeling this!"
  - Wrong…
    - Pressure is ok…in fact it's good!
    - The best pushers
- "Don't they slow down labor?"
  - Wrong…
    - Not shown to with lower doses
- "It makes it all go faster!"
  - Wrong…
    - No promises!

THE NERVOUS SYSTEM

CNS



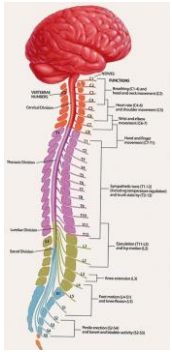
PNS

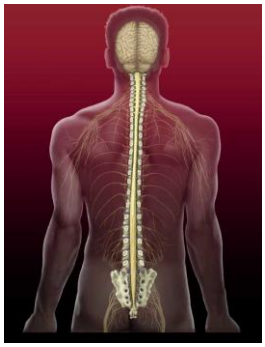


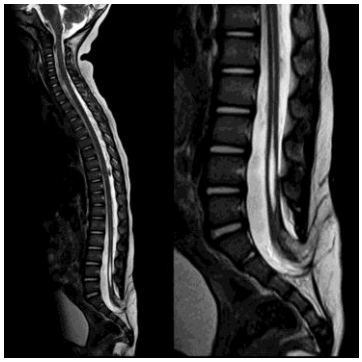
THE NERVOUS SYSTEM

- **Central nervous system (CNS) –** integrates information received from body & coordinates & influences activities in all parts of the body
  - Brain (protected by skull)
  - Spinal cord (protected by vertebrae, meninges & CSF)
- **Autonomic nervous system –** involuntary control
  - **Sympathetic NS (T1-12)** "fight/flight" - incr HR, constrict vessels, dilate pupils
  - **Parasympathetic NS (brainstem)** "digestion" - decr HR, constrict pupils, dilate vessels
- **Peripheral Nervous System (PNS) –** connects CNS to limbs/organs - "communication relay system"

CENTRAL NERVOUS SYSTEM (CNS) BRAIN & SPINAL CORD

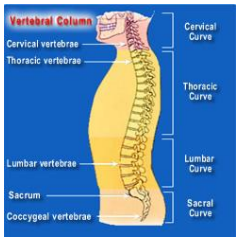




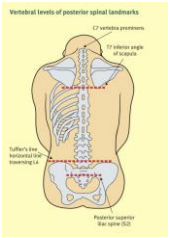


VERTEBRAL ANATOMY

- 33 vertebrae (7C, 12T, 5L, 5S, 4C)
- 5 ligaments



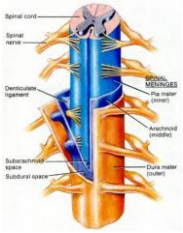
VERTEBRAL ANATOMY



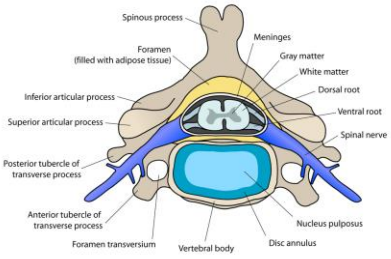
C7 = back of neck
T4 = nipple line
T7 = bottom of scapula
T10 = umbilicus
T12 = 12th rib
L5 = iliac crest
S2 = iliac spine

SPINAL CORD ANATOMY

- **Spinal cord ends about L1-2**
- **Dural sac surrounds the brain, tapers off at L4-5, & is anchored to the sacral hiatus**
- **Average depth from skin to epidural space is 4.5-5.5 cm but can vary from 3-9cm**



SPINAL COLUMN IN CROSS-SECTION

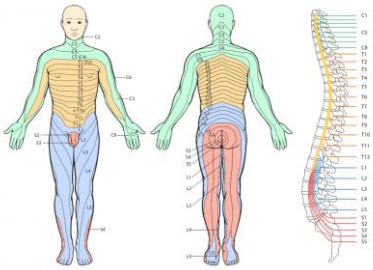


CEREBRAL SPINAL FLUID (CSF)

- **Clear fluid found in the brain & spine**
- **Produced in the choroid plexus of the brain**
- **Actions**
  - Buoyancy – brain floats (not hindered by weight)
  - Protection - cushions the brain & cord
  - Chemical stability – rinses CNS waste
  - Prevention of brain ischemia – amount regulated
- **Vital to autoregulation of cerebral blood flow**
- **Brain produces approximately 500ml/day**
  - constantly being reabsorbed with 100-160ml present at any given time

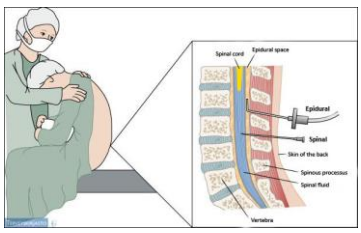
DERMATOMES

- **Skin area innervation**



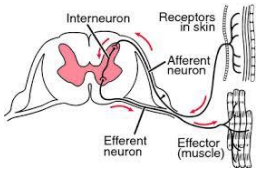
NEURAXIAL ANESTHESIA ANATOMY

- **Spinal & epidural spaces**

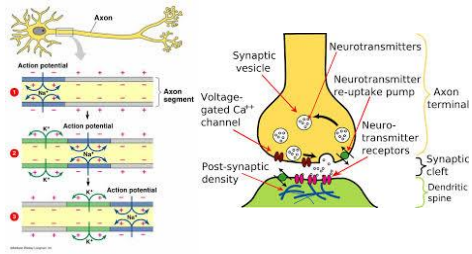


CNS NERVE TRANSMISSION

- **31 Spinal nerves (to & from spinal cord)**
- **Information relayed to/from the brain - processed & interpreted**
  - Efferent ("exit") - motor nerves (motion)
  - Afferent ("arrive") - sensory nerves (signals & stimuli)



NERVE TRANSMISSION - CELLULAR LEVEL



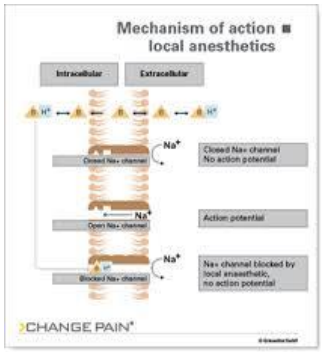
LOCAL ANESTHETIC (LA)

- **Reversible local analgesia (absence of pain)**
- **Techniques** - topical, IV, filtration, plexus or peripheral nerve blocks, epidural, & spinal
- **Other senses & functions affected**
  - Temperature
  - Proprioception
  - Motor control
  - Autonomic control
- **2 Classes**
  - Amino<u>amide</u>
  - Amino<u>ester</u>

LA MECHANISM OF ACTION

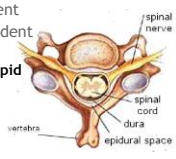
- **Inhibit Na influx by blocking Na voltage-gated channels** (membrane stabilizing)
  - Decrease rate of depolarization/repolarization
  - Reversible - effect dissipates with metabolism
- **Action potential cannot arise & signal conduction is inhibited**
  - Pain sensations are blocked
  - Unable to follow motor commands
- **All nerve fiber sensitive to LA**
  - Extent depends on cell diameter & myelination
    - **Type B, C, A (Δ,Γ, B, α)**
- **Weak bases - Water soluble**
  - "ion-trapping"
  - acidosis

LA MECHANISM OF ACTION



LOCAL ANESTHETIC: ACTION IN THE SPINAL & EPIDURAL SPACE

- **Site of action**
  - **Spinal** - directly on spinal nerves as they exit the cord (faster onset, denser block)
  - Epidural - unknown
    - **Majority absorbed by rich venous plexus**
    - **Small amount absorbed into fat**
    - **Remainder reaches spinal nerves & nerve roots**
- **Local anesthetic spread - volume dependent**
  - **Spinal** - <u>position</u> & baricity dependent
  - **Epidural** - <u>volume</u> & position dependent
    - **6-8X volume of LA as with SAB**
    - **Must penetrate dura & arachnoid, lipid soluble, large amounts absorbed by veins**



RISKS WITH LOCAL ANESTHETIC

- **Allergic reaction (aminoesters)** - 1:1250-1:10,000
  - Para-Aminobenzoic acid (PABA)
  - Paraben derivatives (preservative)
  - No cross reactivity with aminoamides
- **Nerve damage (1/5,000 - 1/30,000)**
  - 92- 97% recover within 4-6 weeks, 99% in 1 yr
- **Toxicity** - central effects if intravascular (1:10,000)
  - Can be severe & fatal - rare with appropriate technique
    - **CNS**
    - **Cardiovascular**
- **Methemoglobinemia - (prilocaine)**

CNS TOXICITY

- **Low concentrations**
  - Depression of inhibitory neurons - CNS excitation
    - **Tinnitus, circumoral numbness, metallic taste agitation, seizures**
- **High concentrations**
  - Profound depression of brain function
    - **Coma, respiratory arrest, death**
  - Large dose inadvertently intravascular
  - Direct to CNS through CSF - overdose spinal or inadvertent epidural injection into subarachnoid space

CARDIOVASCULAR TOXICITY

- **Disrupt cardiac function by shortening the myocardial refractory period by blocking Na channels**
  - Bupivacaine poses greatest risk
  - Levobupivacaine & ropivacaine still harbor potential
- **CV Effects**
  - Hypotension
  - Atrioventricular conduction delay
  - Idioventricular rhythms
  - Cardiovascular collapse

TREATMENT OF LA TOXICITY

- **Supportive**
  - Treat arrhythmias
  - CPR
- **Intralipid** - 1998 (1st published rescue 2006)
  - "lipid rescue" - lipid sink that increases clearance from cardiac tissues
    - **Dose: 20% intralipid**
      - 1.5ml/kg bolus (repeated 1-2X for persistent arrhythmias)
      - Infusion of 0.25ml/kg/min for 30-60 min
      - Increase infusion to 0.50ml/kg/min for persistent hypotension

NEURAXIAL - LOCAL ANESTHETICS

- **Short acting**
  - Chloroprocaine (2% & 3%) - epidural only
    - **Onset 10-15min**
    - **Duration 45-60min (60-90min with epi)**
- **Intermediate acting**
  - Lidocaine (1.5% & 2%)
    - **Onset 15min**
    - **Duration 80-120min (120-180 with epi)**
  - Mepivacaine (1% & 2%) - epidural only
    - **Onset 15min**
    - **Duration 90-140min (140-200 with epi)**
- **Long acting**
  - Bupivacaine (0.25% & 0.5%)
    - **Onset slow**
    - **Duration 165-225min (180-240 with epi)**
  - Ropivacaine (1% & 2%)
    - **Onset slow**
    - **Duration 140-180min (150-200 with epi)**

LOCAL ANESTHETIC ADDITIVES

- **Spinal**
  - Narcotics
    - **Fentanyl**
    - **Sufentanil**
    - **Duramorph**
  - Non-opiods
    - **Glucose**
    - **Epinepherine**
    - **Sodium bicarbonate**
    - **Clonidine**
- **Epidural**
  - Narcotics
    - **Fentanyl**
    - **Sufentanil**
    - **Duramorph**
  - More effective with less LA potency
  - Less motor blockade

DURAMORPH

- Spinal morphine (preservative free)
- One time dose added to spinal or placed in epidural catheter to produce up to 24hr of very effective pain relief
- Caveats (side effects)
  - Itching
  - N/V
  - Delayed Respiratory Depression (close monitoring for 24hr)
    - Q 1hr respiratory checks
    - Continuous pulse oximetry
  - Narcan & Nubain

ANTICOAGULATION

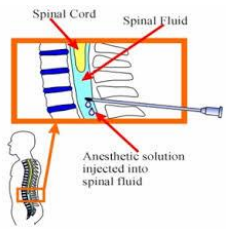
- 2010 guidelines developed by American Society of Regional Anesthesia (ASRA)
- VERY IMPORTANT to the timing of epidural & spinal placement & removal of epidural catheters
- Ever changing anticoagulant formulary

SPINAL/EPIDURAL CONTRAINDICATIONS

- Patient refusal
- Severe hypovolemia
- Refractory hypotension
- Increased ICP
- Coagulopathy/Thrombocytopenia *(<100K)*
- Active hemorrage
- Sepsis or infection at puncture site
- Neurologic disease/deficit
- Severe aortic or mitral stenosis
- Severe/Uncorrected anemia
- Allergy to local anesthetic
- Aortic Stenosis
- Anticoagulants within 12hr of placement

SPINAL ANESTHESIA (SUBARACHNOID BLOCK - INTRATHECAL)

- A "one-shot" injection of a small amount of local anesthetic/narcotic in the lower lumbar area into the cerbral spinal fluid (CSF), providing rapid onset & profound sensory anesthesia by blocking sensory signals thus eliminating pain



- •Sensory & motor block
- •More concentrated 0.75% vs. 0.125%
- • Surgical anesthesia

SPINAL ADVANTAGES

- Alternative to general anesthesia
- Medications sequestered in CNS
  - Less alteration in LOC
  - Less N/V
  - More effective pain control
  - Little transfer across placenta to fetus
- Reliable

SPINAL LIMITATIONS

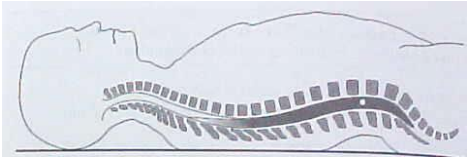
- Limited to procedures below the upper abdomen
- Time limits - "one time" shot
  - Lasts 1 - 3 hrs depending on local anesthetic & additives (narcotics, epinepherine, other)
- Failed block - rare
  - False CSF
  - Placed outside the dura
  - Medication failure
- Urinary retention

SPINAL COMPLICATIONS

- **Hypotension** - "sympathectomy" - 33%
  - Common but usually easily treated
    - Prevention (500-1000ml IV fluid before placed)
    - intravenous fluid & sympathomimmetic drugs
      - Ephedrine or Phenylephrine
  - Nausea (18%), vomiting (7%)
- **Back Ache** (11%)
- **Post dural puncture headache** (1-2%)
- **High spinal** - resp & cardiac
- **Infection**
- **Hematoma**
- **Severe neurologic complications (0.012%)**

SPINAL SETUP

- **Volume of injectate**
- **Rate of injection**
- **Positioning**
- **Sets up in ~ 5min**
- **Lasts 1 - 3 hrs**

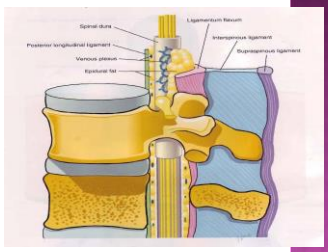


DIFFERENCES BTW SAB & EPIDURAL

- **Volume Injected -**
  - 10-20 mL epidural vs. to 1.5-3.0 mL spinal
- **Epidural - indwelling catheter (additional injections later)**
- **Spinal - "one-shot" only**
- **Onset of analgesia 10-30 minutes with epidural vs. 5 minutes with spinal**
- **Epidurals placed cervical, thoracic, or lumbar sites**
  - spinal must be injected below L2 to avoid piercing the spinal cord
- **Motor Block - SAB profound, epidural varies**
  - Depends on LA type, concentration & level

EPIDURAL SPACE

- **"Potential Space"**
  - Spinal nerve roots
  - Fat
  - Blood vessels
    - **Anterior & posterior arteries**
    - **Veins & venous plexus**
  - Air
  - Lymphatics



EPIDURAL ADVANTAGES

- **Alternative to general anesthesia**
- **Reliable**
- **Increased duration of anesthesia**
  - As long as needed (up to 3-5 days)
- **Medication is sequestered in CNS**
  - Less alteration in LOC
  - Less N/V
  - More effective pain control
  - Little transfer across placenta to fetus

EPIDURAL LIMITATIONS

- **Failed block - rare**
  - False CSF
  - Placed outside the dura
  - Medication failure
- **Prolonged motor blockade**
  - Prevents ambulation
- **Urinary retention**

EPIDURAL COMPLICATIONS

- **Hypotension** (sympathectomy) & bradycardia (cardiac accelerators)
- **Failed block**
- **Backache** (30% - tissue trauma & LA)
- **Postdural Puncture Headache (PDPH)** – (1-2%) <1% - spinal needle, 50-80% - epidural needle
- **Intravascular migration - CNS/CV toxicity**
- **Intrathecal injection/migration** - high spinal
- **Neurologic complications (0.03-1.0%)**
  - Neuralgia (pain)
  - Parasthesia (N/T)
- **Infection**
- **Hematoma**

EPIDURAL COMPLICATIONS

- **Hypotension:** Most frequent, early
  - Lightheaded & N/V
  - Affected by type & concentration of LA injected
  - Treatment: (Check BP q 2min, call anesthesia)
    - **O2 by FM**
    - **Open fluids**
    - **Supine with LLT or LLD** (aortavenacaval compression)
    - ***Ephederine (vasoconstriction/incr HR)**
    - ***Phenylepherine (vasoconstriction)**

*Given by anesthesia provider or rapid response team

EPIDURAL COMPLICATIONS

- **Failed Block**
  - Just doesn't work - replace it
  - Asymmetrical block ("One Sided")
    - **Multipore catheters**
    - **Position changes**
  - Patchy block ("Hot Spot")
    - **Assess catheter for placement - pull back slightly**
    - **Live with it or try to replace it**
- **"Top Up" Doses**
  - Acute changes in pain
    - **Catheter disconnect**
    - **Drip turned off or empty (the myth about air!)**
    - **Change in stimulation (labor progression)**
  - Progressive changes in pain
    - **Catheter migration**

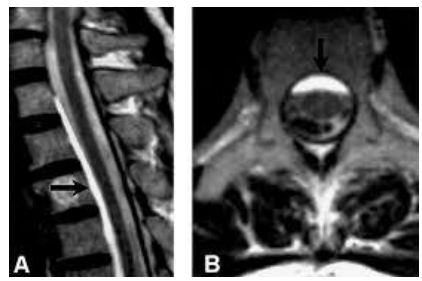
POST DURAL PUNCTURE HA (PDPH)

- **Risk -** <1% with SAB, 50-80% with epidural puncture
- **Incidence** (1-2%)
- **Will resolve spontaneously in 3-10days**
- **Characteristics** (symptoms generally in 24hrs)
  - Positional HA (frontal & occiptal)
    - **worse when up right, relieved when supine**
  - Photosensitivity, blurred vision
  - N/V
  - Nucal Rigidity
- **Treatment**
  - Conservative (24hr)
    - **PO & IV fluids, caffeine (PO & IV)**
    - **Analgesia (tylenol or motrin)**
    - **Leave catheter infusing with saline**
  - Epidural Blood Patch

EPIDURAL BLOOD PATCH

- **Lateral position**
- **Sedation**
- **Procedure**
  - Place epidural needle in space
  - 20ml of blood from patient (betadine/gloves)
  - Inject 15-20ml into the space - until patient feels a significant "pressure" in back
- **Often immediate relief (99%)**
- **Flat x 1hr, BR x 24hrs**
- **Back pain**
- **Continue IV/PO fluids & pain meds**
  - Nonsteroidals
  - Caffeine

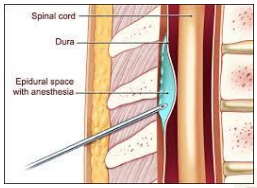
EPIDURAL BLOOD PATCH

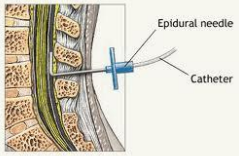


EPIDURAL COMPLICATIONS

- **Hematoma**
  - Incidence
    - 1:150,000 to 1:190,000
  - Increased risk with anticoagulants
    - 33:100,000
    - Specific timing for placing & removal
      - Place/Remove 12 hrs after last dose
      - Next dose not for 12 hrs after place/remove
  - Signs & Symptoms
    - low back pain (sharp/radiates)
    - sensory & motor loss
    - numbness & tingling
    - bowel/bladder dysfunction
    - paraplegia

EPIDURAL TECHNIQUE





EPIDURAL PLACEMENT

CATHETER TEST DOSE

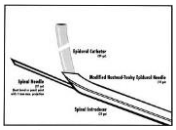
- Ensure the catheter is NOT
  - Epidural blood vessel (intravascular)
  - Subarchnoid space (intrathecal)
- 3ml 1.5% lidocaine with 1:200 epinepherine
- Positive intravascular (<30sec)
  - HR increase (always use pulse ox)
    - Generally >25 bpm for >15sec
    - CONTRACTIONS can be false positive
  - Tingling lips
  - Tinnitus
  - Metalic taste
  - Lightheaded/Anxious
- Positive for subarachnoid (5min)
  - Legs/feet become heavy/tingle as with SAB
  - High level
  - Change in level of consciousness
- False negative & false positive

EPIDURAL DOSING

- Pump settings
  - Lumbar (8-16 ml/hr)
  - Thoracic (4-8 ml/hr)
  - Patient Controlled Epidural Analgesia (PCEA)
- Beware of catheter migration
  - Intravascular or subarachnoid
- Anesthesia will…
  - ALWAYS ASPIRATE!
  - ALWAYS DOSE INCREMENTLY
  - Consider additional test doses if effect changes or catheter goes unused
    - increased motor block
    - BP trending down
    - signs of toxicity

COMBINED SPINAL/EPIDURAL (CSE)

- Find epidural space with epidural needle
- 24-27g long spinal needle through epidural
- Look for CSF
- Aspirate CSF (swirl) & inject
  - Dosing varies
    - LA only
    - Narcotic only
    - Mixture



- Remove spinal needle & place catheter
- Dosing the catheter/Starting the gtt
- Caution:
  - at increased risk for CS
  - potential difficult anesthetic management

EPIDURAL EFFECT ON LABOR

- **Transient decrease in uterine activity for 10-15min after placement**
  - Intensity of contractions more than frequency
  - Usually returns to baseline within 30 min
  - Subsequent injections cause progressively less
- **Generally, first stage of labor shorter**
- **Generally, second stage prolonged**
  - Laxity of pelvic musculature
  - Loss of "bearing down" reflex
    - **Counteracted by effective coaching**
- **Increased incidence of instrumental delivery**
  - This risk is decreased by using less concentrated LA with narcotic

EPIDURAL EFFECT ON LABOR

- **Turning the gtt off ("wear off")**
  - Rate of forcep delivery/CS may be increased dt ineffective pushing related to perineal pain
- **When epidural is placed**
  - Early (before 5cm) vs. Late (after 5cm)
    - **Generally no increase in instrumental delivery, CS, or prolongation of stage 2**
- **CS Rate**
  - Generally, no difference

WHEN WE CAN'T HELP

- **Epidurals designed for labor**
  - Light local anesthetic
    - **Prevents motor block & loss of all sensation**
      - Enables patients to push effectively
  - Light narcotic (fentanyl)
    - **Synergistic effect with local anesthetic**
    - **Slight euphoria (vascular absorption)**
- **Epidural analgesia less effective with**
  - Malpresentation (OP)
  - Anterior lip (reason unknown)
  - Rapid descent (light)

ANESTHESIA & C-SECTION

- **Scheduled**
  - Spinal unless contraindicated
- **Emergent**
  - Epidural in place - (5-10min)
  - If FHT recover in the OR - SAB
  - GA - last resort
    - **aspiration risk**
    - **fetal effects**
    - **family**