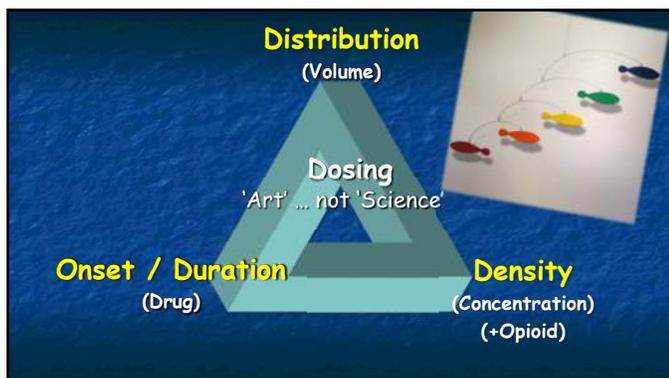


# CLINICAL APPLICATION: AN APPROACH TO DOSING THE LABOR EPIDURAL

Charles A. Reese, Ph.D., CRNA



## Speed of Onset

**Characteristics of L.A. (equipotent dose)**

- Chloroprocaine < Lidocaine < Bu/Ropivacaine
- 12-15 minutes

**Dose (mass) of L.A.**

- Total milligrams ... 'Concentration'

**Dose (volume) of L.A.**

- Volume = 'Distribution' / 'Spread'

## Intensity / Duration

- Type procedure ( tissues/organs, tq. )
- Surgeon's finesse
- Length of procedure
- Extent of motor block
- Post-operative analgesia

## Intensity / Duration

**Intensity ... 'Density'**

- Concentration (mass) of L.A.
- +Opioid (to L.A.)

**Duration**

- Characteristics of L.A.  
Bu/Ropivacaine > Lidocaine > Chloroprocaine
- +Vasoconstrictor (to L.A.)

*Analgesia*  
0.25% Bupivacaine

*Anesthesia*  
0.5% Bupivacaine

## Epidural Adjuncts

### Vasoconstrictor

**Epinephrine 0.2 mg (0.2 ml)**

- Probably adds to analgesic effect of all L.A.  
activates  $\alpha_2$  antinociceptive receptors in cord
- Lidocaine / Bu/Ropivacaine:  
• little/no effect on duration

**↓ Systemic Toxicity !!**

## Epidural Adjuncts

### Opioid

- Adds "quality" to block (substantia gelatinosa)
  - more dense
  - increased duration
- Fentanyl effects last 2-4 hr ... MSO, 18-24 hr
  - no residual effects
- Minimal short-term side effects (NOT = Complication)
  - Fentanyl: brief pruritus
  - Morphine: prolonged pruritus

## Distribution ( "Level" )



### DERMATOME

Cutaneous area innervated primarily by a single nerve root

- Assessment of anesthetic 'level'
- Estimation of 'level' of sympathetic nervous system block

## Distribution ( "Level" )



Dermatome ('Sensory') level needed ...  
• Type procedure ( tissues/organs, tq. )

**SPOTLER ALERT**

Only 2 Levels !!

T-10

T-4 ... involves peritoneum

## Distribution ( "Level" )

- Patient:
  - Age
  - Height
  - Weight
  - Intra-abdominal pressure ( tumor, obese, PG )
  - Anatomy of spinal column
- Level of injection: needle / catheter 'tip'
- Characteristics of L.A. solution
  - Baricity ( density L.A. / density CSF )

## Distribution ( "Level" )

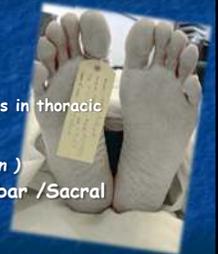
Volume: ( catheter @ 'L-2' )  
1.0 - 1.5 cc / dermatome  
... more in lumbar / less in thoracic

Pt. Position: ( 10-15" after injection )

Sitting: 10 - 15 cc ... Low lumbar / Sacral

Supine: 10 - 15 cc ... T-10

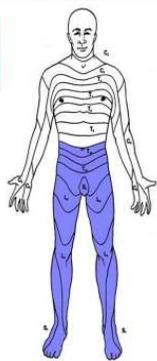
20 - 25 cc ... T-4



## Desired Level of Block

Anatomical "Benchmarks"

T-10: " Low Epidural "



## Desired Level of Block

Anatomical "Benchmarks"

T-4: " High Epidural "

T-10: " Low Epidural "



## Desired Level of Block

**Anatomical "Benchmarks"**

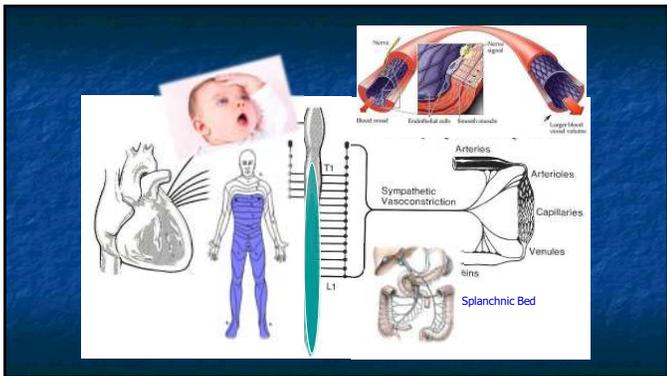
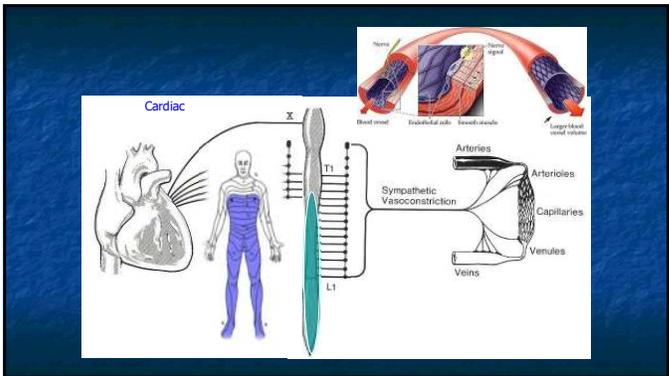
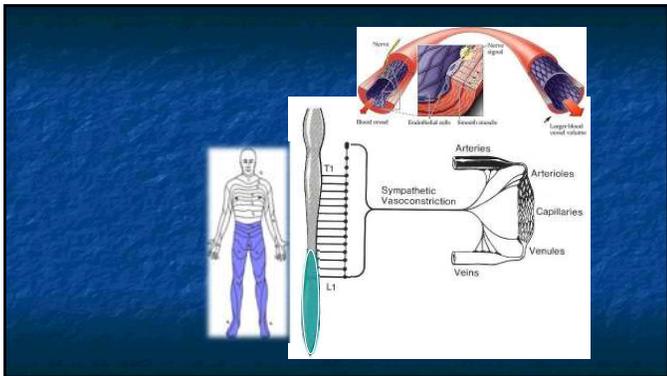
- C-8: "Total Epidural"
- T-4: "High Epidural"
- T-10: "Low Epidural"

## Who Cares ?

**Autonomic: (Sympathetic)**

**Motor:**

**Sensory:**



## T-10 "Low Epidural"

**Sympathetic: Moderate vasodilation ... no CO, HR changes**

- ✓ NPO deficit: 500-800 cc
- ✓ Pre/Co-load: 10-15 cc/kg (700-1000cc)

**Motor: Sacral / Lumbar Plexus**

**Sensory: (umbilicus)**

- ✓ GYN - 0.5% conc. bup
- ✓ OB - cardiac, vaginal delivery, forceps
- ✓ BU - cystic TUR
- ✓ Ortho - hip / lower extremity (w/o tourniquet)

## T-4 "High Epidural"

**Sympathetic:** Significant vasodilation

- ✓ NPO deficit: 500-800 cc
- ✓ Pre/Co-load: 20-25 cc/kg (1000-1500cc)

**Motor:** Sacral / lumbar plexus, abdominal ms

**Sensory:** ( nipples )

- Gen Surg - peritoneum / herniorrhaphy / appendectomy
- GU - renal pelvis, ureters, orchiectomy
- GYN - ovarian cystectomy, vaginal hysterectomy
- OB - Cesarean delivery
- Ortho - lower extremity ( w/ tourniquet )



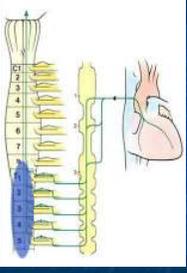
## >C-8 "Total Epidural"



**Sympathetic:**

- "Total" sympathectomy
- ... cardiac accelerators (T1-4)
- profound bradycardia / hypotension





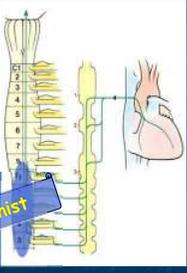
## >C-8 "Total Epidural"



**Sympathetic:**

- "Total" sympathectomy
- ... cardiac accelerators (T1-4)
- profound bradycardia / hypotension

Anticholinergic  
Muscarinic Receptor Antagonist



## >C-8 "Total Epidural"

**Motor:** Lumbar / sacral plexus, abdominal / thoracic (expiratory) muscles ( SOB )

**Sensory:** ( little fingers )

Surgically acceptable, if physiologically stable



## Local Anesthetics

- 2-Chloroprocaine (Nesacaine®)
- Lidocaine (Xylocaine®)
- Mepivacaine (Carbocaine®, Polocaine®)
- Bupivacaine (Marcaine®, Sensorcaine®)
- Ropivacaine (Naropin®)




"equipotency" "equipotency"

2-Chloroprocaine	2%	3%
Lidocaine / Mepivacaine	1-1.5%	2%
Bupivacaine	0.25%	0.5%
Ropivacaine	0.2%	0.5%

Drugs, volumes, concentrations, timing, and adjuncts presented are 'experiential' ...

... clinical practice does not follow precise 'recipes' !

### Clinical Case

- Age: 21 year old female (G2, P1, ABO)
- Weight: 160 pounds
- Height: 64 inches (5'4")
- Analgesia/Anesthesia:
  - ✓ Labor
  - ✓ Vaginal delivery

### First Stage

KEEP CALM AND TRIAGE

Stage 1: 0-4 cm effacement, mucous "show"

5-10 MINUTES APART

Friedman Curve

Latent Phase: 2 Cm, 4 Cm, 6 Cm

2 CM, 4 CM, 6 CM FIRST STAGE

### First Stage

Visceral

- Cervical Dilatation: 4-8 Cm
- Cervical Effacement progressing
- Ischemia of myometrium
- Peripheral / central sensitization
- inflammatory tissue changes
- sympathetic hyperactivity

40-60 MINUTES PERIODS

3-5 MINUTES APART

'Active Phase'

2 Cm, 4 Cm, 6 Cm, 8 Cm, 10 Cm

1 CM, 3 CM, 5 CM

Inferior Hypogastric Plexus

Pain poorly localized

'Active Phase'

2 Cm, 4 Cm, 6 Cm, 8 Cm, 10 Cm

1 CM, 3 CM, 5 CM

Diagram illustrating labor progress with a cervical dilation curve. The y-axis shows cervical dilation from 0 to 10 cm. The x-axis shows time in hours. A red star marks the start of the 'Active Phase' at 4 cm. The diagram includes anatomical drawings of the inferior hypogastric plexus and a woman in labor. Text overlays include:

- MY PLAN**
  - Kid out
  - everyone healthy
- \* "Analgesia"
- \* Minimal Motor Block
- Baby Care Plan**

Diagram illustrating labor progress with a cervical dilation curve. The y-axis shows cervical dilation from 0 to 10 cm. The x-axis shows time in hours. A red star marks the start of the 'Active Phase' at 4 cm. The diagram includes anatomical drawings of the inferior hypogastric plexus and a woman in labor. Text overlays include:

- \* "Analgesia"
- \* Minimal Motor Block

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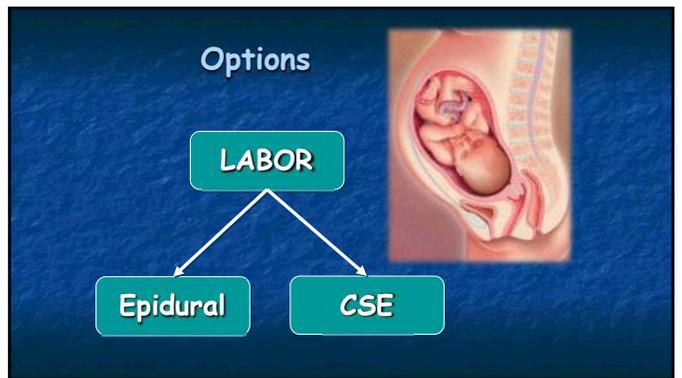
- \* "Analgesia"
- \* Minimal Motor Block

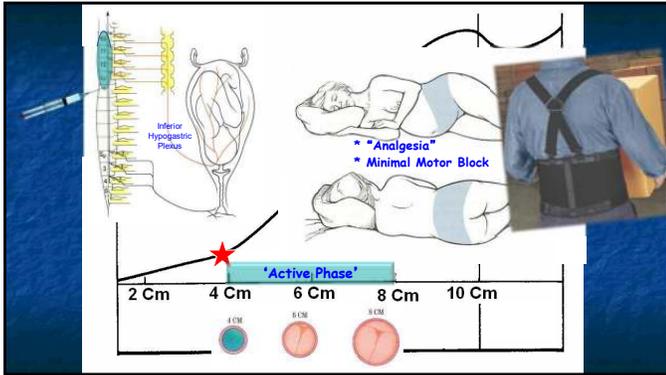
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- SAB
- CLE
- CSE
- KEEP CALM AND PAGE ANESTHESIA YOU CAN DO IT!**
- \* "Analgesia"
- \* Minimal Motor Block





## Establish Level (Labor)

'Test' dose

"Every Dose Is A Test Dose..."

—Charles A. Reese, CRNA, PhD

## Local Anesthetics

<u>Esters</u>	<u>Amides</u>
• Cocaine	• Lidocaine
• Benzocaine	• Mepivacaine
• Procaine	• Bupivacaine
• Chlorprocaine	• Prilocaine
• Tetracaine	• Ropivacaine

## "Test Dose"

3cc ...  
1.5-2% Lidocaine w/epi

## "Test Dose"

3cc, 1.5%-2% lidocaine (w/ epi 1:200,000)

**Intravascular !! ...**

< 2 minutes

**CV symptoms**

- ↑ heart rate (~15-20 bpm)
- β blocker ... no change
- Contraction
  - pain
  - autotransfusion ...
  - ... transient ↑ rate

**CNS symptoms**

- "dizzy"
- "metal taste in mouth"

## "Test Dose"

3cc, 1.5%-2% lidocaine (w/ epi 1:200,000)

**Intrathecal !! ...**

**SAB symptoms**

- "... legs warm, going to sleep" (1-2')
- rapid, bilateral

Less contraction pain !! (2-3')

Motor block (3-5')

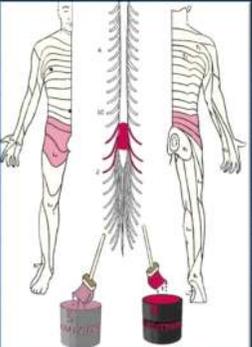
- ... least reliable

... fast onset =

**"Too Fast ... Too Numb ... Too Bad!"**

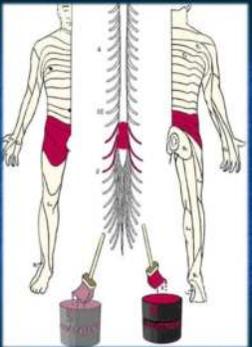
**"Test Dose"**  
 3cc ...  
 1.5-2% Lidocaine  
 w/epi

3-5 minutes after  
 injection

**"Test Dose"**  
 3cc ...  
 1.5-2% Lidocaine  
 w/epi

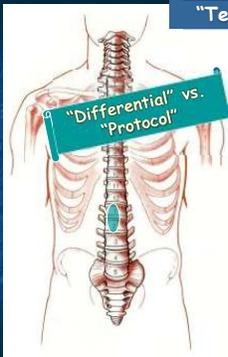
10 minutes after  
 injection



**"Test Dose"**

"Differential" vs.  
 "Protocol"

TARGET ORGAN ?  
 NEUROANATOMY ?  
 SENSORY LEVEL ?  
 LATERALITY ?  
 VOLUME ?  
 3cc  
 DRUG/DENSITY ?  
 Lidocaine: 1.5-2% (epi 1:200k)  
 Fentanyl: N/A

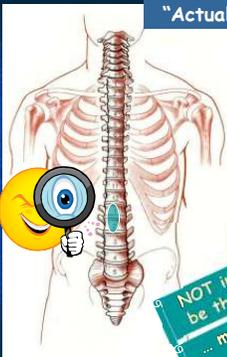



**"Actual Dose"**

VOLUME  
 6 cc (NS+Local)

DRUG/DENSITY  
 Lidocaine 0.75-1%  
 Epi: 1:400,000

NOT intended to  
 be therapeutic II  
 ... may be therapeutic  
 ... early labor





Establish Level (Labor)

'Test' dose

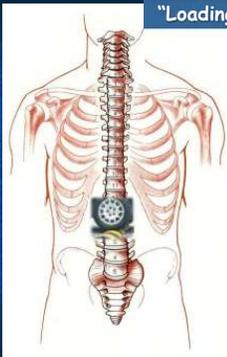
'Loading' dose

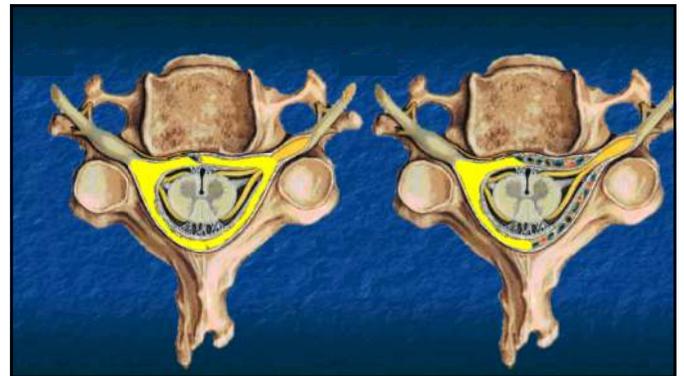
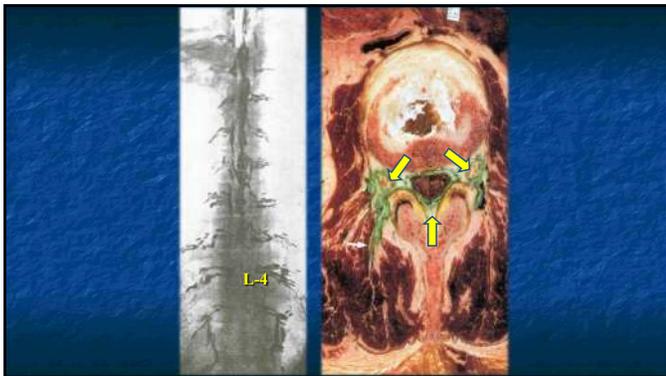
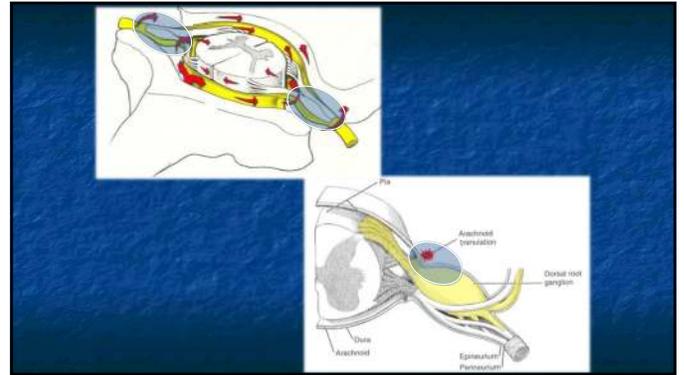
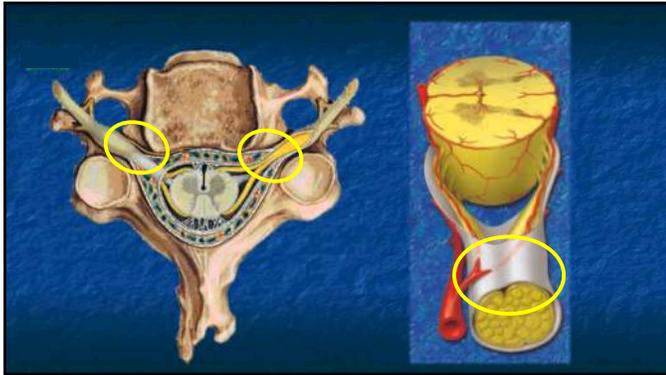



**"Loading Dose"**

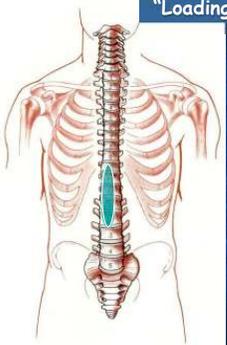
Goal:

- "Analgesia"
  - sensory block 😊
  - motor block 😊
- Establish usability of catheter
  - Vaginal delivery
  - Instrument delivery
  - Cesarean section



**"Loading Dose"**



**TARGET ORGAN ?**  
Cervix

**NEUROANATOMY ?**  
T10-L1

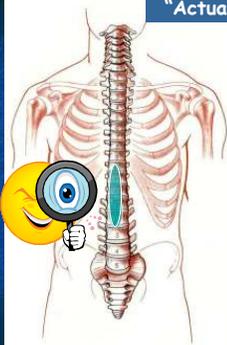
**SENSORY LEVEL ?**  
T10

**LATERALITY ?**  
Bilateral

**VOLUME ?**  
~5-8 cc

**DRUG/DENSITY ?**  
Bupivacaine: 0.125% (pump) \*  
Fentanyl: 2 mcg/cc (pump)  
\*  
Fentanyl: 100 mcg (+/-)  
\* Bupivacaine 0.25% (cath)... advanced labor

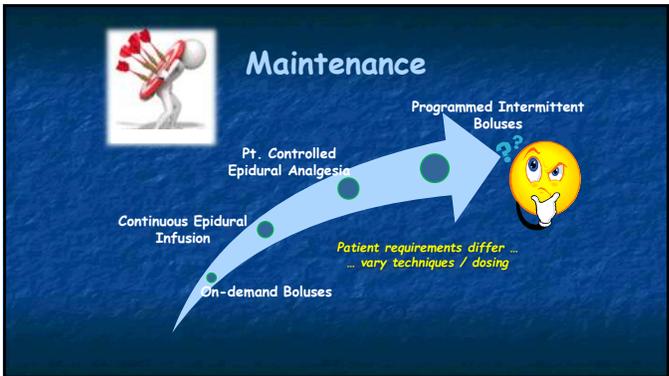
**"Actual Dose"**

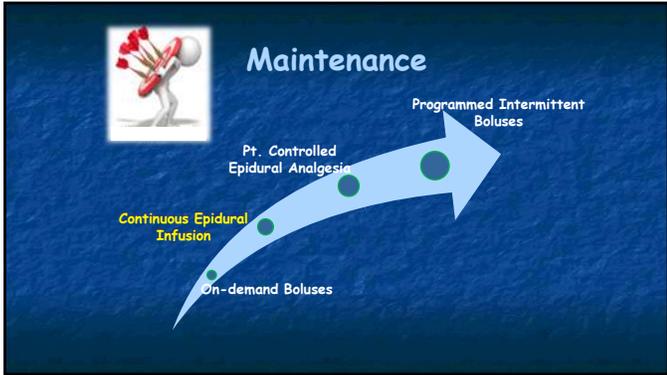


**VOLUME**  
10-16 cc (NS+Local+Fentanyl)

**DRUG/DENSITY**  
Local anesthetic:  
Lidocaine ~0.35%  
Epi. ~1:850,000  
Bupivacaine ~0.05%  
Fentanyl: (100 mcg)







**Continuous Infusion**

~8-12 cc/hr  
 { 0.125% Bupivacaine + 2mcg/cc Fentanyl }

+ PRN: "Top Up" ... ~5cc (via epidural cath.)

- ✓ From pump
- ✓ Separate injection

**Continuous Infusion**

Single/Multi-orifice ... NO difference

- ... Unilateral block, missed segments
- ... Ø flow distal orifice
- ... + flow proximal orifice

**q 2 hr**

- Evaluate/document **level** ... (laterality)
- Evaluate/document **density** ... (laterality)
- Evaluate/document **changes in labor** ... (quality / quantity)

\* Cervical dilation, ROM, oxytocin augmentation, morbidity

**"Breakthrough Pain"**

**OB INFORMATION**

- ✓ ROM/augmentation
- ✓ Relationship to contractions
- ✓ Quality of contractions
- ✓ Quantity of contractions
- ✓ Dilation
- ✓ Effacement
- ✓ Station
- ✓ Presentation
- ✓ Morbidity: chorioamnionitis, abruption

**"Breakthrough Pain"**

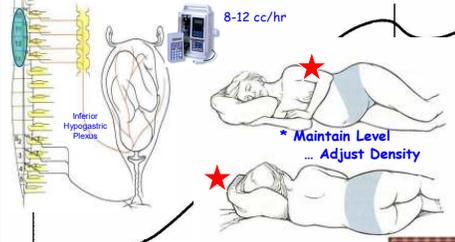
**ANESTHESIA INFORMATION**

- ✓ Time since last dose
- ✓ Volume/Quality of last dose
- ✓ Sensory Level
- ✓ Laterality
- ✓ Density
  - Lidocaine 0.00%
  - Epi 0
  - Bupivacaine 0.125%
  - Fentanyl 16-24 mcg /hr
- ✓ Catheter integrity

### "Top-up Dose"



TARGET ORGAN ?  
 Cervix  
 NEUROANATOMY ?  
 T10-L1  
 SENSORY LEVEL ?  
 T10  
 LATERALITY ?  
 Bilateral  
 VOLUME ?  
 ~5-8 cc  
 DRUG/DENSITY ?  
 Bupivacaine: 0.125% (pump)  
 Fentanyl: 2 mcg/cc (pump)  
 -----  
 Fentanyl 100 mcg ?? +/- (~4hr)



8-12 cc/hr

\* Maintain Level ... Adjust Density

'Active Phase'

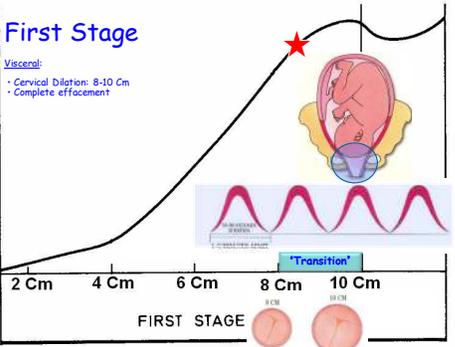
2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

Evaluate / Document q 2 hr

"Top Up" (PRN ~5cc) From Pump -OR- 0.25% Bupivacaine

### First Stage

Visceral:  
 - Cervical Dilatation: 8-10 Cm  
 - Complete effacement



2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

FIRST STAGE

Transition



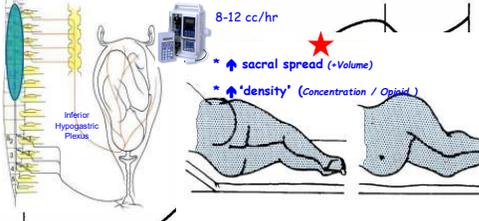
Pain more localized may involve L2-3

? Oxytocin Augmentation

? Rupture of Membranes (spontaneous / artificial)

2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

STAGE



8-12 cc/hr

\* ↑ sacral spread (+Volume)

\* ↑ 'density' (Concentration / Opioid)

2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

FIRST STAGE

Transition

"Top Up" (PRN ~5-8cc) From Pump -OR- 0.25-0.375% Bupivacaine



8-12 cc/hr

\* ↑ sacral spread (+Volume)

\* ↑ 'density' (Concentration / Opioid)

2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

FIRST STAGE

Transition

Optional + 100 mcg Fentanyl (epidural)



### Second Stage ('delivery')

**Somatic:**

- Cervical dilation 10 Cm-to-delivery
- Fetal descent
- Stretching of vagina & perineum
- Pressure on bladder & rectum
- Tension on pelvic ligaments, fascia, muscles, joints
- Urge to "push"
- May last ~2 hours !!

8-12 cc/hr

Pain intense - highly localized

Pudendal Nerve/ Sacral Plexus

2 Cm 4 Cm 6 Cm 8 Cm 10

FIRST STAGE

"Top Up" (PRN ~8-10cc) From Pump

" Room 9 ... Sign Out "

Cord saturated from continuous infusion ... NO "top off" needed

Vaginal delivery

Pudendal Nerve/ Sacral Plexus

2 Cm 4 Cm 6 Cm 8 Cm 10 Cm

FIRST STAGE

Second Stage

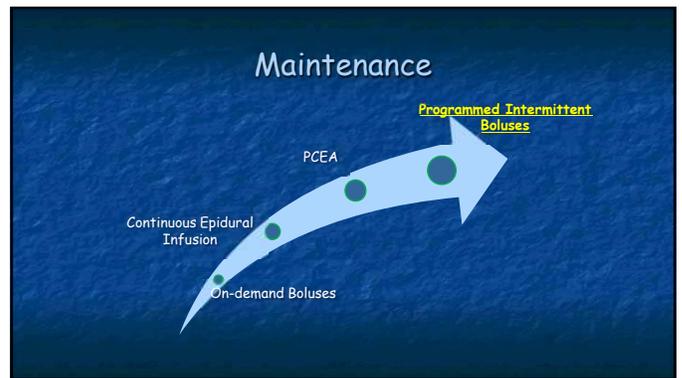
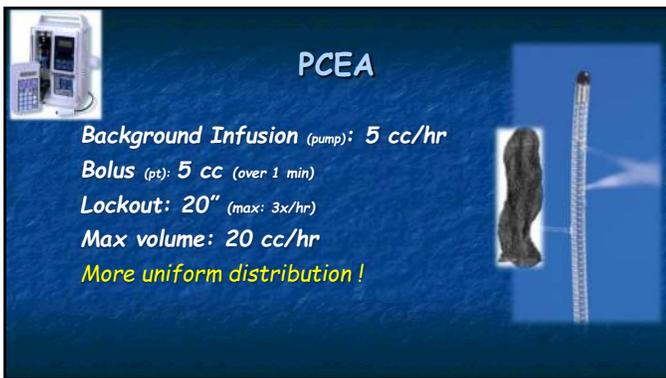
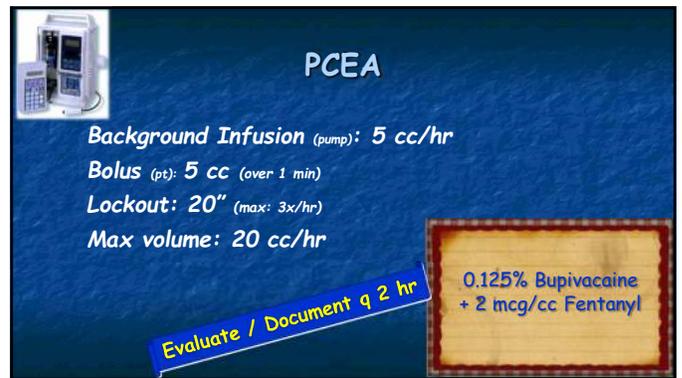
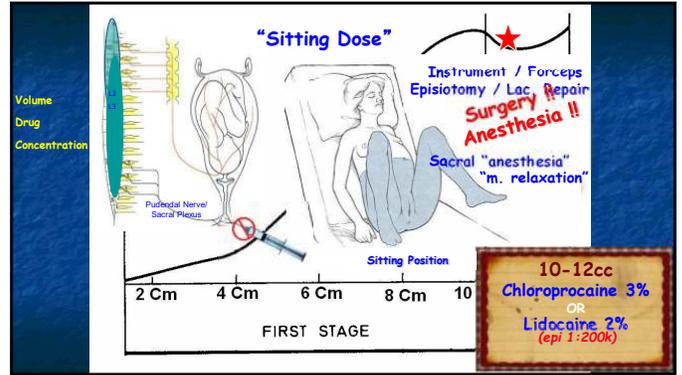
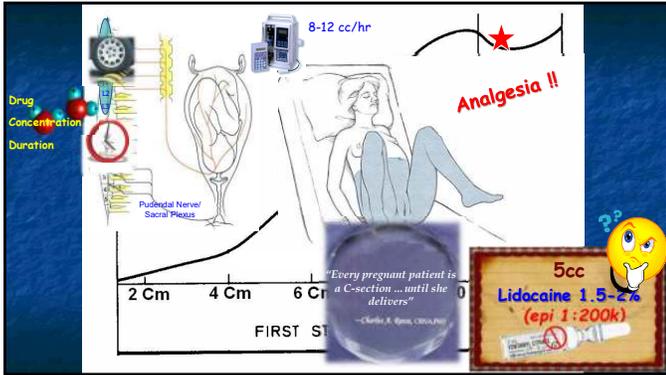
" Room 4 ... Delivery "

### Delivery

Stage II: Perineal Analgesia

Stage II: "Operative Delivery"

- ✓ Instrument Assisted
- ✓ Episiotomy / Lac Repair
- ✓ C-Section





## Programmed Intermittent Bolus

More uniform distribution of L.A.  
 Bolus: 3-5 cc (over 1 min)  
 Programmed ... q 15"

Evaluate / Document q 2 hr

0.125% Bupivacaine  
 + 2 mcg/cc Fentanyl



## Programmed Intermittent Bolus

More uniform distribution of L.A.  
 Bolus: 3-5 cc (over 1 min)  
 Programmed ... q 15"




## Programmed Intermittent Bolus

Less:

- L.A. consumption
- CRNA interventions
- Lower extremity motor block
- Instrumented delivery

Shorter Stage II (avg. 22 minutes)  
 Improved maternal satisfaction




Coming Soon...

? Hybrid ... PIB + demand dose  
 ? Algorithm ... based on demand use



## Cesarean Section



## Cesarean Section

"Elective"  
 "Emergent" ?  
 "Emergency"  
 ... General Anesthesia (?)

**"Initial Dose"**  
 20cc ...  
 2% Lidocaine w/epi

5 minutes after injection

**"Initial Dose"**  
 20cc ...  
 2% Lidocaine w/epi

15 minutes after injection

**"Initial Dose"**  
 20cc ...  
 2% Lidocaine w/epi

60 minutes after injection

**"Top Off Dose"**  
 15cc ...  
 2% Lidocaine w/epi

10 minutes after re-injection

**- Summary -**

- Determine onset / intensity / duration of block needed
  - Choice of L.A.
  - 'Dose' L.A. (concentration / volume / rate)
  - +/- Adjunct: vasoconstrictor
- Determine level needed
  - Volume of L.A.
  - Patient position