WHAT’S NEW IN OB ANESTHESIA 2018

(a sampler)

Richard Smiley, MD, PhD
Virginia Apgar MD Professor of Anesthesiology
Columbia University College of Physicians and Surgeons
Chief, Obstetric Anesthesia
Columbia University Medical Center
New York, NY , USA
Disclosures

- Spouse owns stock in Amgen, Abbott, Abbvie
- Consultation for multiple law firms
- Unapproved uses: I don’t think so, but this is a talk about pregnant women so maybe…
Topics

- **Bleeding and clotting**
  - Thromboprophylaxis and neuraxial anesthesia
  - TXA

- **CS**
  - PE, NE
  - Tilt/LUD
  - Oxytocin dosing

- **Labor analgesia**
  - PIEB
  - DPE
  - Use of US

- **ECV**
  - Therapeutic anesthesia—but does dose matter?
Topics I WISH we were discussing

- Preeclampsia prevention/treatment
- Fetal monitoring
- Real-time neuraxial procedure/placement visualization
- Preterm labor prevention/treatment
- Systemic labor analgesia
- New neuraxial drugs
20 women at high risk (previous early PEC with delivery ≤ 34 wks)
10 treated, 10 controls

0/10 versus 4/10
TXA
20060 women with diagnosis of PPH, 193 hospitals, 21 countries

1 g TXA or placebo; 2\textsuperscript{nd} dose if necessary

Death 1.5% v 1.9% (1.2% v 1.7% if given within 3 hours)

NO INCREASE IN ADVERSE EVENTS WITH TXA
Discussion of the structure of protocol (and addition of more subjects)

“Tranexamic acid reduces death due to bleeding in women with no adverse effects. When used as a treatment for post-partum haemorrhage, tranexamic acid should be given as soon as possible after bleeding onset”

But...many haemorrhage deaths happen at home or where IV TXA is unrealistic
Norepinephrine?
Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery


(Anesthesiology 2015; 122:736-45)

A

Systolic Blood Pressure (mmHg)

Measurement Number

Phenylephrine
Norepinephrine

P = .04

B

Heart Rate (beats/min)

Measurement Number

Phenylephrine
Norepinephrine

Area Under The Curve (mmHg)

Area Under The Curve (beats/min)

SBP

HR
Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

Shena W. Y. Lee, B.Sc.(Hons.), M.Sc., Ph.D., Flora F. Ng, R.N., B.A.Sc.,
Perpetua E. Tan, B.Sc., M.Phil., Kim S. Khaw, M.B.B.S., M.D., F.R.C.A., F.H.K.A.M.

(Anesthesiology 2015; 122:736-45)

**A**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Normalized Cardiac Output (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
</tr>
<tr>
<td>10</td>
<td>120</td>
</tr>
<tr>
<td>15</td>
<td>130</td>
</tr>
<tr>
<td>20</td>
<td>140</td>
</tr>
</tbody>
</table>

**Phenylephrine**

**Norepinephrine**

**P < .001**

**Area Under The Curve (%.min)**

- **N**
- **P**

**CO**
IF you use NE, can you BOLUS IT??

- 40 women received 3, 4, 5, 6, 7. 8 ug to maintain SBP > 80% baseline

- ED95 5.49 ug
180 patients
- NE doses from 4-12 ug
- PE 60-200 ug

How close to original SBP did BP get?

NE 8 ug ≈ PE 100 ug
Norepinephrine?

- Real (but probably small) improvement over PE as regards CO and HR
- Safety—overdose risk?
- Safety—acidosis? (Cooper A&A letter 2018)
- Administer via peripheral line?
- No obvious problem with PE that needs to be “cured”
- Has not yet met “Burden of Proof”
- Specific indications for now?
Left Uterine Displacement

“tilt”
150 cases
- 63 “study,” 87 “control” (no randomization?)

ALL general anesthesia

D5 IV

15 degree “wedge”

NO vasopressors

Majority of study subjects tilted to RIGHT!
- Surgeon preference!!!
Comparison of measured and estimated angles of table tilt at Caesarean section

S. J. Jones¹, S. M. Kinsella² and F. A. Donald¹*

Our table was almost always 4–7°
Table 1. Patient Characteristics and Magnetic Resonance Imaging Measurements in the Pregnant and Nonpregnant Women

<table>
<thead>
<tr>
<th></th>
<th>Pregnant (n = 10)</th>
<th>Nonpregnant (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>34 ± 5</td>
<td>34 ± 4</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>160 ± 5</td>
<td>160 ± 6</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>57 ± 8*</td>
<td>49 ± 4</td>
</tr>
<tr>
<td><strong>Gestational age (week)</strong></td>
<td>39 (37–39)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Parity (0/1)</strong></td>
<td>6/4</td>
<td>8/2</td>
</tr>
<tr>
<td><strong>Level of aortic bifurcation</strong></td>
<td>L4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>L4–L5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Aorta volume (ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0°</td>
<td>12.7 ± 2.0</td>
<td>12.6 ± 2.1</td>
</tr>
<tr>
<td>15°</td>
<td>12.7 ± 2.1</td>
<td>12.6 ± 2.1</td>
</tr>
<tr>
<td>30°</td>
<td>12.9 ± 1.8</td>
<td>12.7 ± 1.8</td>
</tr>
<tr>
<td>45°</td>
<td>12.8 ± 2.0</td>
<td>12.8 ± 1.7</td>
</tr>
<tr>
<td><strong>Inferior vena cava volume (ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0°</td>
<td>3.2 ± 3.4‡</td>
<td>17.5 ± 7.8</td>
</tr>
<tr>
<td>15°</td>
<td>3.0 ± 2.1‡</td>
<td>19.7 ± 6.0</td>
</tr>
<tr>
<td>30°</td>
<td>11.5 ± 8.6†§</td>
<td>21.5 ± 6.2</td>
</tr>
<tr>
<td>45°</td>
<td>10.9 ± 6.8†§</td>
<td>20.6 ± 5.0</td>
</tr>
</tbody>
</table>

Values are mean ± SD, median (range), or number of women.

*P < 0.05, †P < 0.01, ‡P < 0.001 compared with each value in the nonpregnant women. §P < 0.05 compared with each value in the supine position (0°).
From the Department of Obstetrics and Gynaecology, Monash University, Queen Victoria Hospital, Melbourne, Australia.

Appreciation is expressed to the operating room staff, the obstetricians who performed the cesareans and especially to Dr. Virginia Apgar, who suggested it.

Submitted for publication Nov. 9, 1970.
“Tilt study”

- 100 patients /subjects
- Spinal anesthesia (12mg BUP/150 mcg MS/15 mcg FENT)
- SUPINE versus 15 DEGREE TILT OF TABLE
- PE infusion to maintain SBP

**PRIMARY OUTCOME: UA BASE EXCESS**

**SECONDARY OUTCOMES: UV BE, pH, PE use**
Left Lateral Table Tilt for Elective Cesarean Delivery under Spinal Anesthesia Has No Effect on Neonatal Acid–Base Status

A Randomized Controlled Trial


Fig. 2. Box plot of umbilical artery (UA) base excess (mmol/l) by group. Dots represent outlier values.
“Tilt study”—RESULTS

<table>
<thead>
<tr>
<th></th>
<th>TILT</th>
<th>SUPINE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA BE</td>
<td>-0.65 (1.5)</td>
<td>-0.50 (1.6)</td>
<td>.88</td>
</tr>
<tr>
<td>UA pH</td>
<td>7.28 (0.04)</td>
<td>7.28 (0.05)</td>
<td>.39</td>
</tr>
<tr>
<td>UV BE</td>
<td>-1.62 (1.48)</td>
<td>-1.66 (1.3)</td>
<td>.91</td>
</tr>
<tr>
<td>UV pH</td>
<td>7.33 (0.04)</td>
<td>7.33 (0.05)</td>
<td>.49</td>
</tr>
<tr>
<td>PE μg (15 min)</td>
<td>611 (228)</td>
<td>789 (321)</td>
<td>.002</td>
</tr>
</tbody>
</table>
“Tilt study”—RESULTS
Tilt study--conclusions

- LUD probably does not do much
- The historical evidence FOR LUD is surprisingly weak
- Most women probably do not need tilt or LUD
- 15 degrees is a LOT of tilt—RARELY ACHIEVED
- If BP maintained with PE, no evidence that tilting is necessary

Surgeons HATE TILT
Aortocaval Compression Syndrome: Time to Revisit Certain Dogmas

Allison J. Lee, MD, and Ruth Landau, MD

Oxytocin: The great facilitator of life

Heon-Jin Lee¹, Abbe H. Macbeth¹, Jerome H. Pagani¹, W. Scott Young 3rd*  
Section on Neural Gene Expression, NIMH, NIH, DHHS, Bethesda, MD 20892, United States

The REAL facilitator of life

Caffeine!

- After delivery, inject 20 units into whatever was left in IV bag
  - Same if 700 ml or 100 ml left in bag
- Open IV (what rate IS that??)
- Add more to bag if OB asks for it
  - “is it wide open?”
  - “put more in the bag”
  - “double the dose”
  - “how much Pitocin are you giving?”
ED90 = 0.3 U
Figure 2. The “Rule of Threes” protocol for oxytocin and uterotonic agent administration during cesarean delivery. Adequate or inadequate refers to the strength of the uterine tone as measured by the obstetric provider at time of cesarean delivery. Cytotec indicates misoprostol; hemabate, carboprost tromethamine; IM, intramuscular administration; IMM, intramyometrial; IV, intravenous administration; methergine, methylergonovine maleate.
- 60 women, “rule of threes” or “wide open oxytocin”
Up-Down Sequential Allocation Dose-Response Study

Hypothesis: ED$_{90}$ in laboring women will be higher than ED$_{90}$ in women undergoing an elective cesarean

Starting Infusion: 18U/Hour (Current ‘Low’ Dose Infusion)

Outcome: Satisfactory uterine tone @ 4 Minutes

Success: Infusion maintained at 18U/Hour

Next Case: 9:1 biased-coin (10% chance to ➤2U/Hour)

Failure: 36U/Hour ± additional uterotonic

Next Case: ➤2U/Hour
The $ED_{90}$ of Prophylactic Oxytocin Infusion After Delivery of the Placenta During Cesarean Delivery in Laboring Compared with Nonlaboring Women: An Up-Down Sequential Allocation Dose-Response Study

$ED_{90} = 16.2$ (95% CI 13.1-19.3)

$ED_{90} = 44.2$ (95% CI 33.8-55.6)

P < 0.001
Double blind RCT, 51 subjects

All subjects got 1 U oxytocin after delivery, then 2 U/hr versus 15 U/hr infusions until PACU discharge

“Adequate tone” by OB assessment every 2 minutes 2-20 min

1-2U oxytocin for inadequate tone

> 5U rescue –alternative uterotonic

PRIMARY OUTCOME : EBL

Secondary outcome: uterine tone
- EBL 634 v 512 ml (NS)
  - (slightly underpowered)
- No difference in rescue boluses (most got none)
- 1 subject in each group got 2\textsuperscript{nd} uterotonic
- More nausea and flushing in LOW DOSE
  - ? Significant?

**Uterine tone**

*Figure 2.* Bar chart depicting the proportion of women with adequate uterine tone at each study time point after commencing study infusion.
Oxytocin 2018

- We really don’t know how much or for how long to give oxytocin
- Oxytocin has significant hemodynamic effects when given in an uncontrolled manner.
- Women undergoing elective CD require less oxytocin than those exposed to oxytocin for labor induction/augmentation
- A couple of 2-4 U boluses, or low dose infusions in the range of 2-20 U/hr will work for most

- **IF OXYTOCIN ISN’T WORKING—CHANGE DRUGS!!!**
- The role, dose and duration of oxytocin infusions after the immediate postpartum period (1-2 hours) is unclear.
"The object being to relieve the patient without diminishing the strength of uterine contractions and the auxiliary action of the respiratory muscles, or with diminishing it as little as possible...

It may be remarked that complete anesthesia is never induced in midwifery, unless in some cases of operative delivery."

Snow J: On Chloroform and Other Anesthetics, 1848
CSE v EPI and the “unproven catheter”
“untested catheter?”

Combined Spinal Epidural Technique for Labor Analgesia Does Not Delay Recognition of Epidural Catheter Failures

A Single-center Retrospective Cohort Survival Analysis

Jessica M. Booth, M.D., Joshua C. Pan, B.S., Vernon H. Ross, M.D., Gregory B. Russell, M.S., Lynne C. Harris, B.S.N., Peter H. Pan, M.D., M.S.E.E.

FAILURE RATE

EPID  11.6 %
CSE   6.6 %

Anesthesiology 2016; 125: 516-24
Catheter failure rates and time course with epidural versus combined spinal-epidural analgesia in labor

J. Groden, A. Gonzalez-Fiol, J. Aaronson, A. Sachs, R. Smiley

Department of Anesthesiology, Columbia University College of Physicians and Surgeons, New York, NY, USA

FAILURE RATE

EPI D 3.9%

CSE 2.1%

IJOA 2016; 26: 4-7
RCT of CSE v EPID

- EPID: 15 ml 0.125 + 30 mcg fentanyl
- CSE: spinal 3 mg bup + 5 mcg fentanyl
- All then received PCEA with 0.125% with 2 mcg fent/ml

CSE faster, lower pain scores, ↓ top-ups

Catheter replacement

- CSE 1.2%
- Epid 2 % (ns)

Failure at CS: 0/63 v 2/56 (ns)
DPE—best of both?

- CSE without a spinal dose
- Confirm placement location
- Med transfer via dural/arachnoid hole?
  - Faster analgesia?
  - Sacral coverage

*Or dural puncture risk for no benefit?*
- EPI v CSE v DPE (CSE without a spinal dose)
  - 40 subjects per group
  - EPI and DPE: 20 ml 0.125% BUP + 40 mcg fent
  - CSE: BUP 1.7 mg, fentanyl 17 mcg

- 25G Whitacre needle
  - Thomas et al Anesthesiology 2005; 103: 1046.

- Onset time CSE < DPE < EPI
- Better analgesia and fewer sided blocks with DPE versus EPI
  - 10% v 50%
- Better sacral coverage at 30 min with DPE v EPI (and beyond?)
- No failures (only 40 per group)

- DPE v CSE
  - Less pruritus, hypotension, top-ups, combined tachysystole/hypertonus, conversion from Cat 1 to Cat 2 FHR
But CSE really is faster than DPE or EPI (lots of unhappy women at 30 min?)
- **Will a 26G needle do the trick?**
- **40 subjects per group, DPE v EPI**
- **Epi test dose, then 12 ml 0.125% with 50 mcg FENT**
- **No difference in analgesia at 10 min (45-55%)**
- **Slightly faster onset with DPE?**
  - (one of 6 secondary outcomes, p=0.042)
Labor Analgesia Onset With Dural Puncture Epidural Versus Traditional Epidural Using a 26-Gauge Whitacre Needle and 0.125% Bupivacaine Bolus: A Randomized Clinical Trial

Sylvia H. Wilson, MD, Bethany J. Wolf, PhD, Kayla Bingham, BS, Quiana S. Scotland, MD, John M. Fox, MD, Erick M. Wolfz, BS, and Lathia Heesbar, MD, FRCAn

(Anesth Analg 2018;126:545–51)

Figure 3. Kaplan-Meier curves for time to achieving adequate analgesia by neuraxial technique. LE indicates lumbar epidural; DEPE, dural puncture epidural.
DPE—my current opinion

- DPE may improve drug entry to CSF but only if 25G needle used
- 25G needle slightly increases PDPH risk
- DPE WILL decrease "failed" blocks
- Probably NOT better analgesia than EPI, but probably more reliable (i.e., you are IN the epidural space)
Columbia faculty member: “Jim, you’ve studied all kinds of drugs and techniques—doses of local anesthetics, spinals, neostigmine, clonidine, various opioids. If you needed labor analgesia, what would you want?”

JE, after a pause: “I think I’d want the catheter to be in the epidural space”
CSE or DPE!
Decisions...
Epidural infusions versus bolus

1980s (at least at my place): Don’t use pumps for epidural dosing, they are unreliable and you will overdose unmonitored women

1990s-2000s: Use pumps for continuous infusion epidurals; more stable, no breakthrough pain ➔ lower dose requirements (and maybe we can sleep more?)
Programmed Intermittent Epidural Bolus--PIEB

- Instead of giving 12 ml/hr continuously, give 6 ml BOLUS every 30 min
- Or 9 ml every 45 min
- Or 12 ml every 60 min
Programmed Intermittent Epidural Bolus--PIEB

- Better spread of anesthetic in epidural space
- Moderately better analgesia and ↓ top-ups
- Program allows for PCA doses
Systematic review—9 RCTs
340 pts with CEI, 350 with PIEB
ROP 0.1-0.2%, BUP/LEVO 0.0625-0.125% (w FENT/SUF)
NO EFFECT
- CS rate (no study showed this)
- Instrumental delivery (one study powered for this showed decrease 7% v 20%)
- Labor duration (maybe second stage shorter)

? Effect
- Anesthetic intervention (OR 0.56 (95% CI 0.29-1.06))

Small decrease in BUP usage (-1/2 mg/hr)
↑ patient satisfaction
Intermittent Epidural Bolus Compared with Continuous Epidural Infusions for Labor Analgesia: A Systematic Review and Meta-Analysis

Ronald B. George, MD, FRCPC, Terrence K. Allen, MBBS, FRCA, and Ashraf S. Habib, MB, ChB, MSc, MHS, FRCA

Interventions

Instrumental delivery

Maternal satisfaction

(Anesth Analg 2013;116:133–44)
Practical issues with PIEB

- PIEB interval
  - ~ 9 ml q 45 min?
- Lockout intervals
  - PIEB after PCEA dose
  - PCEA dose after PIEB
- Flow rate for PIEB bolus
  - Faster is better, but tubing/catheter need to work
- What if PIEB dose is intrathecal?
# Implementation of Programmed Intermittent Epidural Bolus for the Maintenance of Labor Analgesia

Brendan Carvalho, MBChB, FRCA, MDCH,* Ronald B. George, MD, FRCPC,† Benjamin Cobb,* Christine McKenzie, MD,* and Edward T. Riley, MD*

(Anesth Analg 2016;123:965–71)

## Table 3. Institutional PIEB Parameters

<table>
<thead>
<tr>
<th></th>
<th>Stanford University</th>
<th>IWK Health Centre Dalhousie University</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epidural initiation</strong></td>
<td>Bupivacaine 0.125% + sufentanil 10 μg (15 mL)</td>
<td>Ropivacaine 0.2% + fentanyl 100 μg (10 mL)</td>
</tr>
<tr>
<td><strong>CSE initiation</strong></td>
<td>Bupivacaine 2.5 mg + sufentanil 5 μg (30%–35% initiated with CSE)</td>
<td>Bupivacaine 2 mg + fentanyl 10 μg (15%–20% initiated with CSE)</td>
</tr>
<tr>
<td><strong>Epidural maintenance solution</strong></td>
<td>Bupivacaine 0.0625% + sufentanil 0.4 μg/mL</td>
<td>Ropivacaine 0.1% + fentanyl 2 μg/mL</td>
</tr>
<tr>
<td><strong>Epidural catheter</strong></td>
<td>19-gauge wire reinforced, single-orifice catheter (Perifix FX Springwound; B. Braun Medical Inc, Bethlehem, PA)</td>
<td>19-gauge wire reinforced, multiple-orifice catheter (DuraFlex; Smiths Medical, St. Paul, MN)</td>
</tr>
<tr>
<td><strong>Prior CEI/PCEA settings</strong></td>
<td>CEI: 12 mL/h/PCEA: 12 mL bolus, 15-min lockout interval</td>
<td>CEI: 6 mL/h/PCEA: 6 mL bolus, 10-min lockout interval</td>
</tr>
<tr>
<td><strong>Initial PIEB/PCEA settings</strong></td>
<td>PIEB: 8 mL every 45 min (first bolus 45 min)/PCEA: 10 mL, 15-min lockout</td>
<td>PIEB: 6 mL every 30 min (first bolus 15 min)/PCEA: 6 mL, 10-min lockout</td>
</tr>
<tr>
<td><strong>Current PIEB/PCEA settings</strong></td>
<td>PIEB: 9 mL every 45 min (first bolus 30 min)/PCEA: 10 mL, 10-min lockout</td>
<td>PIEB: 8 mL every 45 min (first bolus 15 min)/PCEA: 6 mL, 10-min lockout</td>
</tr>
</tbody>
</table>

**Abbreviations:** CEI, continuous epidural infusion; CI, confidence interval; CSE, combined spinal–epidural; MD, mean difference; OR, odds ratio; PCEA, patient-controlled epidural analgesia; PIEB, programmed intermittent epidural bolus.
Magnesium (for PEC) during CS-
“to continue or not to continue, that is the question”

- **Continue**
  - HEY, it IS being given for a reason!
  - Need to re-start post-CS—what dose/rate?
  - Easier to just continue it
  - Level won’t change that much anyway in 20 minutes

- **STOP IT**
  - “Interferes with anesthesia”
  - Uterine atony increased
  - Potentiates muscle relaxants
  - It’s an extra drug/line that could be messed up
“For women with preeclampsia undergoing cesarean delivery, the continued intraoperative administration of parenteral magnesium sulfate to prevent eclampsia is recommended”

Quality of evidence: Moderate
Strength of recommendation: Strong
- 77 laboring women, req analg ≤ 7 cm
- Randomized to CSE v EPID
- CSE: 2.5 mg BUP + 2.5 μg SUF
  EPID: 10 ml 0.125% BUP, 10 μg SUF
- FHR/toco analyzed for ↑ uterine tone and FHR abnormalities
- Maternal hypotension (↓ 20% or <100 mm)
CSE v EPID and uterine tone

- CSE results in ↑ uterine tone compared to EPID
- FHR abnormalities are associated with ↑ tone
- Hypotension not that important
- FHR correlates with SPEED of analgesia (support for “epi withdrawal” hypothesis?)
- NO STAT CS

Recommendations:
- monitor, maybe don’t do CSE when fetal compromise, maybe adjust oxytocin…

Table 2. Evaluation of Uterine Tone, Fetal Heart Rate Abnormalities, and Maternal Hypotension in the First 15 Minutes After Analgesia According to Group

<table>
<thead>
<tr>
<th>Outcomes After Analgesia</th>
<th>CSE Group (n=41)</th>
<th>EPI Group (n=36)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine tone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>24 (58.5)</td>
<td>30 (83.3)</td>
<td>.018*</td>
</tr>
<tr>
<td>Elevated</td>
<td>17 (41.5)</td>
<td>6 (16.7)</td>
<td></td>
</tr>
<tr>
<td>Fetal heart rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>28 (68.3)</td>
<td>34 (94.4)</td>
<td>&lt;.01†</td>
</tr>
<tr>
<td>Abnormal</td>
<td>13 (31.7)</td>
<td>2 (5.6)</td>
<td></td>
</tr>
<tr>
<td>FHR abnormalities with hypertonus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>30 (73.2)</td>
<td>35 (97.2)</td>
<td>&lt;.01†</td>
</tr>
<tr>
<td>Yes</td>
<td>11 (26.8)</td>
<td>1 (2.8)</td>
<td></td>
</tr>
<tr>
<td>FHR abnormalities with hypertonus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>39 (95.1)</td>
<td>36 (100)</td>
<td>.49†</td>
</tr>
</tbody>
</table>

CSE, combined spinal–epidural; EPI, epidural; FHR, fetal heart rate.
Data are n (%).
* P values from the χ² test.
† P values from the Fisher exact test.
Absent history (and the work of setting up a pump) we would choose PE infusions based on current evidence.
<table>
<thead>
<tr>
<th></th>
<th>Tilt (63)</th>
<th></th>
<th>Non-tilt (87)</th>
<th></th>
<th>Signif. of diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>SD</td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>MA pH</td>
<td>7.455</td>
<td>0.005</td>
<td>0.038</td>
<td>7.459</td>
<td>0.006</td>
</tr>
<tr>
<td>MA Pco₂</td>
<td>26.94</td>
<td>0.57</td>
<td>4.52</td>
<td>26.86</td>
<td>0.71</td>
</tr>
<tr>
<td>MA BE</td>
<td>3.18</td>
<td>0.28</td>
<td>2.23</td>
<td>3.17</td>
<td>0.28</td>
</tr>
<tr>
<td>UA pH</td>
<td>7.309</td>
<td>0.005</td>
<td>0.039</td>
<td>7.270</td>
<td>0.010</td>
</tr>
<tr>
<td>UA Pco₂</td>
<td>26.68</td>
<td>0.91</td>
<td>7.23</td>
<td>26.37</td>
<td>1.31</td>
</tr>
<tr>
<td>UA BE</td>
<td>-4.26</td>
<td>0.30</td>
<td>2.39</td>
<td>-4.82</td>
<td>0.37</td>
</tr>
<tr>
<td>UV pH</td>
<td>7.309</td>
<td>0.005</td>
<td>0.040</td>
<td>7.340</td>
<td>0.009</td>
</tr>
<tr>
<td>UV Pco₂</td>
<td>41.16</td>
<td>0.82</td>
<td>6.52</td>
<td>46.72</td>
<td>1.10</td>
</tr>
<tr>
<td>UV BE</td>
<td>-3.47</td>
<td>0.29</td>
<td>2.34</td>
<td>-3.66</td>
<td>0.38</td>
</tr>
<tr>
<td>(MA–UA) BE</td>
<td>1.08</td>
<td>0.23</td>
<td>1.85</td>
<td>2.32</td>
<td>0.27</td>
</tr>
<tr>
<td>(MA–UV) BE</td>
<td>0.29</td>
<td>0.25</td>
<td>2.02</td>
<td>1.19</td>
<td>0.25</td>
</tr>
<tr>
<td>I-D (MIN)</td>
<td>15.65</td>
<td>0.59</td>
<td>4.67</td>
<td>16.46</td>
<td>0.64</td>
</tr>
</tbody>
</table>

NOTE: NO DIFF in UA or UV BE
CUMC Protocol 2015-18

- After CD, infusion of oxytocin is started at 15U/hr (250 ml/hr of the 30U/500 ml solution).

- If tone is not acceptable in 3-10 minutes, infusion rate doubled to 30 U/hr.
  - Sometimes 60 U/hr for a while

- If tone still inadequate, second uterotonic drug added.