Cesarean Section Technique: What’s New in the Evidence Base?

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Learning Objectives

• Review new techniques & literature re: C/S
  – “Gentle” cesarean
  – Infection prevention
  – (Pain control)
  – Abdominal entry, uterine closure
  – Hemorrhage
  – Sutures
• Evidence-base (according to me)

No Disclosures

Cesarean Rates Continue to Rise
**Family-Centered or “Gentle” Cesarean**

- **UCSF Family-Centered Cesarean**
  - Buy in from OB, Peds, Nursing, Anesthesia
  - Clear double drapes
  - Staffing (extra RN)
  - UCSF Protocol created by Dr. Robyn Lamar

**Music Therapy for C/S**

- RCT in Taiwan: music to decrease anxiety
  - 64 pts, planned C/S, nl babies
  - Headphones, low volume of classical, new age or Chinese religious music
  - Decreased anxiety scores
  - More satisfied with C/S experience
  - No difference in physiologic measures of anxiety

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**UCSF Family-Centered Cesarean**

- Mother may choose music to be played in the OR
- Double drape (with clear window) used
- Anesthesia places ECG leads away from mother’s chest
- Keep mother’s chest warm prior to skin-to-skin with instant hot pack
- Elevate head of bed, to facilitate viewing the birth & skin-to-skin
- After delivery of the head, OB delivers body slowly
- After delivery of the head, drape is dropped if mother desires to see the birth
- Consider delayed cord clamping for 30-60 seconds
- Pediatricians receive the baby as usual; 1 min APGAR on warmer; goal to be back to mom by 5 minutes for skin-to-skin
- At end of surgery, while drapes are removed & mother is cleaned, partner may help with weighing baby & observe other routine care
- Once mother is on the recovery bed, baby placed skin-to-skin again & the dyad are transported together to recovery

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Chang 2005
Family-Centered or “Gentle” Cesarean

Contraindications:
• Prematurity
• Emergency cesarean
• Anticipated resuscitation (ex: anomalies, nonreassuring FHR)

Protocol inappropriate in some situations & clinical judgment always takes precedence
• Ex: with vasa previa, slow delivery of body inadvisable
• Ex: increased BMI, elevating the head of the bed may impact surgical visualization
• Ex: insufficient nursing staff to remain with baby in OR

Pre-incision Atbx: Decreased SSI vs After Cord Clamp

Extended spectrum Prophylaxis

Prophylactic Atbx—Extended Spectrum Regimens

• RCT adding metronidazole vag gel
  – 224 pts; vaginal gel vs placebo gel
  – Less endometritis (7 vs 17%), trend towards less fever; no difference in wound infxn, LOS

Pitt 2001

• Ureasplasma increases risk for C/S SSI
  – Cephalosporin doesn’t cover
  – Post-cord-clamp cefotetan plus placebo or doxy+azithro

Andrews 2003

UAB studies over 14 years
• In 2000, IV cefotetan or cefazolin & IV azithro at cord clamp
• Decreased endometritis
• Decreased wound infections
### Extended spectrum Prophylaxis

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Azithromycin (N = 100)</th>
<th>Placebo (N = 100)</th>
<th>Relative Risk (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary composite outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endometritis</td>
<td>19 (19.0)</td>
<td>54 (54.0)</td>
<td>0.42 (0.22-0.80)</td>
<td>0.02</td>
</tr>
<tr>
<td>Wound infection</td>
<td>32 (32.0)</td>
<td>44 (44.0)</td>
<td>0.73 (0.35-1.53)</td>
<td>0.38</td>
</tr>
<tr>
<td>Necrotizing fasciitis</td>
<td>4 (4.0)</td>
<td>9 (9.0)</td>
<td>NA</td>
<td>0.06</td>
</tr>
<tr>
<td>Deep wound infection</td>
<td>6 (6.0)</td>
<td>8 (8.0)</td>
<td>0.73 (0.25-2.19)</td>
<td>0.56</td>
</tr>
<tr>
<td>Other infection</td>
<td>3 (3.0)</td>
<td>0 (0.0)</td>
<td>0.34</td>
<td></td>
</tr>
</tbody>
</table>

- **Multicenter RCT: C/S/OAP Trial**
  - 2013 pts, C/S in labor or ROM (chorio excluded)
  - Ave BMI 35 (>60% had BMI >30)
  - Std atbx + Azithro prior to incision
  - Fewer SSIs, fevers, PP readmits

### Vaginal Prep prior to C/S

- Povidone-iodine prep -> decreased endometritis, esp w/ ROM
- No difference in fever or wound complications
- ? benefit if already chorio
- Possible effect on neonatal thyroid studies
- Risk of vaginal lac
- Dahlke gives a “B”

Vaginal Cleansing prior to C/S

- New meta-analysis Sept 2017
- Povidone-iodine prep -> decreased endometritis, fever, esp w/ labor/ROM
- No difference in wound complications
- Only 6 of 16 specified pre-incision atbx
- ? benefit if already chorio

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Abdominal Incisions

Dox et al., Melloni's Illustrated Dictionary of Obstetrics & Gynecology 2000

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Pfannenstiel vs. Joel-Cohen

- Blunt entry, less dissection, fewer layers repaired
- J-C faster by 25-30% vs conventional Pfann
- Less blood loss, lower analgesia requirement

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Pfannelstiel vs. Joel-Cohen

- Caissutti ObGYN 2017
ZMG2  update with Green J article
Zlatnik, Marya G., 9/19/2017
CORONIS Trial Lancet 2016

- International, pragmatic trial 2x2x2x2x2
- 19 sites in S. America, Africa, India, Pakistan
- 1st or 2nd C/S, follow up at 3 yrs
- 15,633 women studied:
  - Blunt vs. sharp abdominal entry
  - Repair of uterus in or out
  - 1 vs. 2 layer closure of uterus
  - Closure vs. non-closure of peritoneum
  - Chromic vs. polyglactin-910 for uterus
- Outcomes of subsequent pregnancies, pain
Uterine Exteriorization

Closure of Uterine Incision: 1 vs. 2 Layers

- **Short term:**
  - OR time
  - Hemostasis/Blood loss
  - Endometritis

- **Long term:**
  - Scar strength/VBAC risk

Incision Type, Uterine Repair, Etc.

- No differences

<table>
<thead>
<tr>
<th></th>
<th>Single Layer</th>
<th>Double Layer</th>
<th>Adjusted Risk Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women's Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td>48.0%</td>
<td>48.1%</td>
<td></td>
</tr>
<tr>
<td>Infectious disease</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Subsequent pregnancy</td>
<td></td>
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<tr>
<td>Rate of women with a subsequent viable pregnancy*</td>
<td>35.5%</td>
<td>35.6%</td>
<td>1.02 (0.97 - 1.06)</td>
</tr>
<tr>
<td>INfection*</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hospital stay</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Length of stay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older patient age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perinatal survival</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>All-cause mortality</td>
<td></td>
<td></td>
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<tr>
<td>Mortality rate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CORONIS Trial 2016**

Uterine repair
Management of Hemorrhage

- CMQCC hemorrhage toolkit V2.0
  (revised March 2015)
  https://www.cmqcc.org/resources-toolkits/toolkits/ob-hemorrhage-toolkit

Every hospital will need to customize the protocol—but the point is every hospital needs one.

CMQCC OB Hemorrhage Emergency Management Plan

<table>
<thead>
<tr>
<th>Stage</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Assess every woman; determine level of hemorrhage, and mobilize help through protocol, initiate hemorrhage activation.</td>
</tr>
</tbody>
</table>
| 1     | For those who have already arrived: 
|       | - Administer O2 to maintain Sat >95%
|       | - Vigorous Fundal massage; Empty Bladder; Keep Warm
|       | - Rule out retained POC, laceration or hematoma
|       | - Determine availability of Transfuse 2 Units PRBCs per clinical signs – do not wait for lab values
|       | - NO Need to mobilize Massive Hemorrhage Team |
| 2     | For those who have not arrived yet: 
|       | - Type & Screen, Type & Crossmatch 2 Units PRBCs; Draw blood and hold specimen
|       | - Monitor for INCREASED BLEEDING: continue to follow the protocol
|       | - If in Postpartum: Move to OR
|       | - Social Worker/Phlebotomist/Fertility
|       | - Place intrauterine balloon
|       | - Inspect broad lig, posterior uterosacral ligaments
|       | - Mobilize team: May consider IR (if available & adequate experience) |
| 3     | For those who arrive already bleeding:
|       | - Administer Methergine; 
|       | - Place B-Lynch Suture
|       | - Use blood warmer for transfusing > 2u PRBCs (takes 35+min), use if not wait for lab values
|       | - Laceration/Hematoma: Packing, Repair as Required
|       | - Consider thawing 2 FFP if positive antibody screen on prenatal from Rhogam; Type & Crossmatch 2 Units PRBCs
|       | - Continued hemorrhage: Uterine Artery Ligation
|       | - Reduced D-dimers and fibrin-fibrinogen degradation products
|       | - Plasminogen activates plasmin with subsequent fibrin degradation and bleeding |
|       | - TXA fibrinolytic inhibition |

Continued heavy bleeding: 
- Increase IV fluid (LR) and Methergine (if not hypertensive)
- Consider rFactor VIIa risk/benefit analysis
- Consider IR (if available & adequate experience)
- Hypogastric Ligation (experienced surgeon only)
- Place uterine balloon
- Consider amnion fluid embolism
- May repeat if good response to first dose, BUT it needs one
- May repeat if good response to first dose, BUT it needs one |
Management of PPH: TXA

- **WOMAN trial**: 20,060 women with PPH after VD or CS
- **RCT**: 1g IV TXA or placebo
- **Outcomes**: death from hemorrhage, death from all causes, or hysterectomy
- **Funding**: London School of Hygiene & Tropical Medicine, Pfizer, UK Dept Health, Wellcome Trust, Bill & Melinda Gates Foundation

Table 1: Effect of tranexamic acid on maternal death

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>Placebo group</th>
<th>PPH (95% CI)</th>
<th>p-value (trend)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bleeding</td>
<td>163 (1.1%)</td>
<td>161 (1.3%)</td>
<td>0.31 (0.85 - 2.09)</td>
</tr>
<tr>
<td>PPH exclusive</td>
<td>10 (0.7%)</td>
<td>11 (0.7%)</td>
<td>0.96 (0.36 - 2.52)</td>
</tr>
<tr>
<td>Organ failure</td>
<td>19 (0.6%)</td>
<td>16 (0.2%)</td>
<td>1.03 (0.35 - 3.32)</td>
</tr>
<tr>
<td>Supine</td>
<td>15 (0.4%)</td>
<td>9 (0.2%)</td>
<td>1.73 (0.79 - 3.86)</td>
</tr>
<tr>
<td>Endometrial</td>
<td>2 (0.2%)</td>
<td>3 (0.1%)</td>
<td>0.40 (0.05 - 3.10)</td>
</tr>
<tr>
<td>Other</td>
<td>26 (0.5%)</td>
<td>26 (0.5%)</td>
<td>1.00 (0.34 - 2.80)</td>
</tr>
</tbody>
</table>

Any cause of death: 237 (2.1%) vs 205 (1.5%) (p = 0.51)

Management of PPH: TXA

**Laparotomy** for bleeding by subgroup

Figure 3: Death from bleeding by subgroup
Management of Hemorrhage

Tranexamic Acid (TXA) Protocol

Management of Hemorrhage

- Topical recombinant activated Factor VII
  - Case series, 5 pts with previa, 5 controls, Denmark
  - "swab" soaked in saline containing recombinant activated Factor VII (1 mg in 246 ml) applied to placental bed, repeated x1 prn
  - Median EBL 490 ml (300-800 ml)
  - No changes in thrombin, fibrinogen, PTT, INR, plts

Skin Closure

Skin Closure: Re-approximation of subQ

- A few meta-analyses
  - Some included all pt, others included those with ≥ 2cm subQ fat
  - 3-0 plain gut, 2-0 polyglactin, 3-0 polyglycolic mostly running stitches
  - Decreased wound complications, NNT = 16

Schjoldager AJOG 2017

Pergialiotis BJOG 2017, Chelmow 2004, Cochrane 2006
Skin Staples, Suture, or Glue?

**Staples vs. SubQ Suture**
- A few RCTs, 2 meta-analyses
- Staples quicker (by ~5-9 min)
- Pts often prefer suture
- Sutures fewer wound infections/breakdowns
  - NNT 16
- Sew if there is time

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**Suture vs. Suture**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Polygrip (n=25)</th>
<th>Polyglactin 910 (n=25)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome: wound composite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSI</td>
<td>8% (2)</td>
<td>17% (4)</td>
<td>0.48 (0.17-0.99)</td>
</tr>
<tr>
<td>Wound complications</td>
<td>1% (1)</td>
<td>1% (1)</td>
<td>1.00 (0.25-3.68)</td>
</tr>
<tr>
<td>Seeping</td>
<td>2% (0)</td>
<td>13% (5)</td>
<td>0.15 (0.03-1.41)</td>
</tr>
<tr>
<td>Separations</td>
<td>7% (2)</td>
<td>13% (5)</td>
<td>0.41 (0.14-1.18)</td>
</tr>
<tr>
<td>Classification of SSI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superficial</td>
<td>7% (2)</td>
<td>9% (2)</td>
<td>0.79 (0.37-1.81)</td>
</tr>
<tr>
<td>Deep</td>
<td>5% (1)</td>
<td>10% (2)</td>
<td>0.50 (0.12-2.06)</td>
</tr>
<tr>
<td>Deep plus</td>
<td>7% (2)</td>
<td>13% (5)</td>
<td>0.45 (0.14-1.43)</td>
</tr>
</tbody>
</table>

SSI, surgical site infection; OR, odds ratio.

- **Comparison of Subcuticular Suture Type for Skin Closure After Cesarean Delivery: A Randomized Controlled Trial**
- **RCT:** Monocryl vs Vicryl
- Composite wound measure: 8.8% vs 14.4%
- No difference when analyzed by actual suture used


doi: 10.1097/AOG.0000000000002200

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**SubQ Suture vs Skin Glue**
- A few small studies, 1 RCT (107 pts)
- No difference:
  - OR time
  - wound disruption (?)
  - scar scores
- NOT POWERED

Daykan AOG 2017
Conclusions

• **Yes:**
  – Prophylactic Atbx (pre-incision, add azithro if risk mod-high)
  – Blunt or sharp abdominal entry
  – Repair of uterus in or out
  – 1 or 2 layer closure of uterus
  – TXA for PPH
  – Monocryl for skin

• **Maybe:**
  – Add azithro
  – Prep vagina
  – Family-friendly
  – ERAS

• **No:**
  – Not ready for aF7
  – Gluing, stapling skin

Thank You!