Cesarean Section: Surgical Techniques that Work

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Learning Objectives

- Review different aspects of C/S technique
- Current basis in literature
- Evidence-based steps (according to me)
  - Cochrane, various years

The way Mother Nature intended....
Cesarean Rates Continue to Rise

Cesarean Section Technique
- Prophylactic Atbx
- Prep
- Abdominal Incision
- Bladder flap
- Uterine incision
- Placental delivery
- Exteriorization of uterus
- Uterine incision closure
- Peritoneal closure
- Irrigation
- Fascial closure
- Subcutaneous closure
- Staples/skin

Music Therapy
- RCT in Taiwan evaluating music to decrease anxiety at C/S
  - 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
- Chang 2005

Prophylactic Antibiotics
- Decrease infection?
- Side effects
- Single or multiple doses
- Which generation?
- When?
Prophylactic Antibiotics

- Cochrane Review
  - 4700 pts
  - RR 0.42 (95% CI 0.28-0.65) morbidity/death
  - Effect bigger in labored C/S
- Decreased fever, wound infxn, endometritis, UTI, LOS (RR ~0.4)
- Trend more mat. side effects

Small Cochrane 2002

Prophylactic Antibiotics Single vs Multiple Doses

- Review: Antibiotic prophylaxis regimens and drugs for cesarean section
- Comparison: 2 dose single dose systemic regimens (pre, post or intra-operatively) vs any multiple dose regimen
- Outcome: 1. Failure to Deliver

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment</th>
<th>Control</th>
<th>Odds Ratio (95% CI)</th>
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Total (55% CI): 210

Hopkins & Small The Cochrane Database of Systematic Reviews 1999

Prophylactic Atbx—Fever 1st Generation vs. 2nd or 3rd

- Review: Antibiotic prophylaxis regimens and drugs for cesarean sections
- Comparison: 1st generation vs 2nd or 3rd generation cephalosporins
- Outcome: 1. Failure to Deliver

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Total (55% CI): 520

Hopkins & Small The Cochrane Database of Systematic Reviews 1999

Prophylactic Atbx—Fever Amp vs Cephalosporin

- Review: Antibiotic prophylaxis regimens and drugs for cesarean sections
- Comparison: Ampicillin vs 2nd or 3rd generation cephalosporins
- Outcome: 1. Failure to Deliver

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Total (55% CI): 180

Hopkins & Small The Cochrane Database of Systematic Reviews 1999
Timing of cefazolin: Decreased SSI w/ Preop atbx vs After cord clamp

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Endometritis</th>
<th>Cellulitis</th>
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<tr>
<td>2005-2006 n= 800</td>
<td>8</td>
<td>6</td>
<td>2</td>
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<tr>
<td>After 2006 n= 516</td>
<td>4</td>
<td>2</td>
<td>1</td>
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</table>

\( p = 0.002 \)
\( p = 0.014 \)
\( p = 0.020 \)

Kaimal SMFM 2008

Abdominal Prep

- Sensible but little RCT data
- Several small RCTs: different solutions
  - No clear winner
- CHG better than povidone-iodine in G. Surg
  - Darioche 2010
- Bundled CHG cleanse + OR prep + other interventions \( \rightarrow \) decreased SSI rate
  - Rauk 2010

Vaginal Prep prior to C/S

- Povidone-iodine prep associated with decreased endometritis, esp with ROM
- No difference in fever or wound complications
- ? benefit if already chorio
- Possible effect on neonatal thyroid studies
- Risk of vaginal lac


Abdominal Incisions

Dox et al., Melloni’s Illustrated Dictionary of Obstetrics & Gynecology 2000
Pfannenstiel Incision

- Logical basis for strength
- Patients prefer aesthetically
- No RCTs vs. midline

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

Pfannenstiel vs Joel-Cohen/Misgav-Ladach

- 2 RCTs: Total 360 pts
- 1 & RC/S: Bladder Flap vs Not
  - No bladder flap:
    - Shorter incision time by 1 min in 1st C/S
    - +/- Shorter op time, Less Hgb drop, Microhematuria, Pain
  - Not powered for bladder injury (would need 40K pts)

Bladder Flap

- 2 RCTs: Total 360 pts
- 1 & RC/S: Bladder Flap vs Not
  - No bladder flap:
    - Shorter incision time by 1 min in 1st C/S
    - +/- Shorter op time, Less Hgb drop, Microhematuria, Pain
  - Not powered for bladder injury (would need 40K pts)

Hohlagschwandtner 2001
Tuuli 2012
Uterine Incision—Blunt vs. Sharp Extension

- **RCTs:** Blood loss greater with sharp
  - More transfusions
- **Cephalad to caudad extension?**
  - Less blood loss, fewer extensions
  - Cromi 2008

Uterine Incision: BABEL

- **B: Breathe.** Pause before making the hysterotomy
- **A: Allis clamps.** Use Allis clamps, if needed, to help elevate the hysterotomy
- **B: Blunt.** Use a single digit to sweep over hysterotomy bluntly between each scalpel pass
- **E: Extend.** Extend hysterotomy bluntly (stretch laterally or vertically)

Delivery of Fetal Head

- Case reports of various instruments
  - Murless head extractor
  - Kielland’s, Barton’s
  - Vacuum
- **RCT:** Vacuum vs Forceps vs Hand
  - 44 pts
  - No difference in extensions, blood loss but underpowered
  - Vacuum less pain
  - Underpowered for safety

Encarnacion 2012, in press

Bofill 2000
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

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

Extended spectrum Prophylaxis

- UAB study over 14 years
  - In 2000, IV cefotetan or cefazolin & IV azithro at cord clamp
  - Decreased endometritis
  - Decreased wound infections

Tita ObGyn 2009
Tita AJOG 2008

Extended spectrum Prophylaxis

- UCSF rate much lower
- Hesitant to extend atbx spectrum for all C/S pts
  - Concerns re atbx resistance
- Selectively extend atbx spectrum
  - eg, pt w/ DM/obesity
  - Cefazolin 2g IV preop + azithro 500mg IV after cord clamp (mix in 250mL/give over 1 hr)
- Looking at silver dressings

Placental Delivery
Manual Removal of Placenta

- Intended to speed up procedure, thereby less blood loss?, decreased risk of retained POC?, decreasing risk of endometritis?
- Long suspected of having adverse consequences
  - McCurdy 1992
  - Magann 1995
  - Queenan & Nakamoto 1964

Placenta: Manual Removal

Cochrane 2008: bigger Hct drop, more endometritis w/ manual extraction

Uterine Exteriorization

Exteriorization of Uterus for Repair

- Easier repair (easier to teach)
- ? Infection, bleeding risk
- Anesthesiologist blames you for emesis
Exteriorization of Uterus

- Cochrane review— >1000 pts
- No real differences in complications, including emesis!

Opening the cervix

- To let out evil humours in unlabored C/S
- Cochrane review—> no decrease in febrile morbidity

Closure of Uterine Incision: 1 vs. 2 Layers

- Short term:
  - OR time
  - Hemostasis/
    Blood loss
  - Endometritis
- Long term:
  - Scar strength/VBAC risk

Short Term Outcomes: 1 vs. 2 Layer Closure

- Hauth’s RCT, UAB + 9 other studies
- No difference in use of extra hemostatic stitches
- A little less blood loss
- Less post-op pain
- 5-7 min shorter OR time
1 vs. 2 Layer Closure: Scar Strength

- Follow-up from Hauth’s RCT
- 906 pts in RCT → 164 preg again
- 83 previous 1-layer, 81 previous 2-layer
- 56/70 vs 64/75 successful VBACs
- No difference in PPH, infxn, LOS
- One dehiscence in 1-layer group, no ruptures (power only .07)

Chapman 1997

1 vs. 2 Layer Closure Scar Strength for TOLAC

- Retrospective data conflicting whether rupture risk increased or not
- Risk of uterine rupture after 1-layer closure not significantly different from 2-layer closure overall (OR 1.71; 95% CI 0.66-4.44)
  - risk increased after locked 1-layer closure (OR 4.96) but not after unlocked 1-layer closure (OR 0.49) compared w/ 2-layer closure
- Need RCT!
  Bujold 2002, Dumwald 2003, Roberge 2011

Uterine Replacement After Exteriorization

Irrigation of Incision
Wound Irrigation
- RCT in cattle
  - Pseudo-randomized
  - C/S for macrosomia
  - Wounds irrigated with betadine vs nothing
  - No difference in wound infections - de Kruif 1987
- Only a couple RCTs in humans
  - Study design flaws
  - Saline vs nothing
  - No difference in wound complications
    Bamigboye, Harrigill 2003
    Cochrane 2006

Peritoneal Closure vs. Not
- Short term outcomes vs. long term outcomes
- Short-term: Non-closure better
  - Shorter OR time
  - Less fever
  - Shorter LOS
  - Trend less analgesia need & wound infection
  Bamigboye, Cochrane 2010

Long Term Outcomes: Non-Closure of Peritoneum
- Cohort & retrospective studies mixed on what causes fewer adhesions
- 2 pseudo RCT suggest nonclosure better
  Weerawetwat 2004, Komoto 2006
- 1 RCT non-closure \(\Rightarrow\) fewer adhesions
  Kapustian 2012

Failure of Wound
- Suture breaks
- Knot slips (unties)
- Viscera protrudes between stitches
- Suture tears through fascia (most common)
Knot Slips/Types of Knots

- **Square**
- Surgeon’s square (least likely to slide undone, but can’t tighten after 2nd throw)
- **Square slip** (can slip, even after 5 throws; inadvertently tied by one-handed technique)
- **Granny** (not a bad knot, but easy to accidentally make granny slip knot)
- **Granny slip** (not secure)

![Slipped square knot](image)

Tying Fascial Sutures: Loop-to-Strand Knots

- e.g. when tying fascia suture in midline
- 120 knots tied by one OBGYN
- 0 & 2-0 Monocryl attached to tensiometer
  - Loop-to-single strand, sliding knot, 6 throws
  - Loop-to-single strand, flat square knot, 6 throws
  - Strand-to-single strand, flat square knot, 6 throws
- Stretched until failure (breakage or slippage)

Hurt 2004

Tying Fascial Sutures: Loop-to-Strand Knots

- Loop-to-single strand, sliding knot
  - 55-85% untied
  - 112 newtons to break knot
- Loop-to-single strand, flat square knot
  - 5-15% untied
  - 117 newtons to break knot
- Strand-to-single strand, flat square knot
  - NONE untied
  - 132 newtons to break knot

Hurt 2004

Failure of Wound Type of Suture Material

- Metaanalysis from General Surgery lit.
- Nonabsorbable vs. absorbable
  - NNT = 50 for incisional hernia
- Risk of hernia not increased with PDS, is increased with Vicryl
  - Hodgson 2000
- Monocryl & Chromic no good for sheep C/S
  - Greenberg 2011
Failure of Wound: Fascial Suturing Technique

- No RCT data in human C/S
- Suture tears through fascia = most common cause
- Fascia tears—less likely with 1 cm wide suture bites based on lab data, general surgery literature
  - Stitches 1 cm back from edge (SL/WL ratio)
  - Not strangulating
  - Mass closure

  Adamsons 1966, Hogstrom 1985

Skin Closure

- Re-approximation of subQ tissue
- A few meta-analyses
  - Most included ≥ 2cm subQ fat
  - 3-0 plain gut, mostly running stitch
  - Decreased wound complications (fewer hematomas & seromas), NNT = 16
- SubQ Drains: a few RCTs
  - Probably no benefit to routine use

  Chelmow 2004, Cochrane 2006
  Ramsey 2005, Al-Inany 2002
Staples vs. SubQ Suture

- A few RCTs, 2 meta-analyses
- Staples quicker (~5 min)
- Sutures fewer wound infections/breakdowns
  - NNT 16
- Sew if there is time

Frishman 1997, Tuuli 2011, Clay 2011

Conclusions

Yes:
- Prophylactic Atbx (pre-op)
- Joel-Cohen or Pfannenstiel
- Placental delivery—Spontaneous
- Subcutaneous closure—yes if ≥ 2cm fat
- Sew skin if you have time

Surgeon’s choice:
- Bladder flap—may skip on low risk cases
- Exteriorization of uterus for repair

Awaiting data:
- Skin prep (just do it!)
- Uterine incision closure—Jury’s still out
- Peritoneal closure—Jury’s still out
- Irrigation?

No:
- Uterine incision—sharp dissection
- Multi-dose or high-powered atbx prophylaxis
- Granny or slip square knots
- Loop-to-strand knots

Thank You!