Intrapartum and Postpartum Management of Severe Maternal Obesity

Mark Alanis, MD, MSCR
Maternal-Fetal Medicine
St. Luke’s Health System
Boise, Idaho
Disclosure

I have no relevant financial conflicts of interest with any commercial entity to disclose.

I will not discuss the off-label use of any pharmaceutical agent during this lecture.
Objectives

Improve recognition and management of labor abnormalities in the extremely obese parturient

Optimize cesarean delivery for extremely obese laboring and non-laboring women

Develop a plan to reduce postpartum complications in extremely obese patients
Nationally, 7.6% of reproductive age women are extremely obese.

Flegal et al. JAMA 2010;303:235 (online supplemental figure)
Contemporary Trends

CS Rates have stabilized since 2009
...but still > 1 in 3 women undergo CS
Contemporary Trends

Contemporary cesarean delivery practice in the United States

Jun Zhang, PhD, MD; James Troendle, PhD; Uma M. Reddy, MD, MPH; S. Katherine Laughon, MD, MS; D. Ware Branch, MD; Ronald Burman, MD; Helain J. Landy, MD; Judith U. Hibbard, MD; Shoshana Haberman, MD, PhD; Mildred M. Ramirez, MD; Jennifer L. Bailit, MD, MPH; Matthew K. Hoffman, MD, MPH; Kimberly D. Gregory, MD, MPH; Victor H. Gonzalez-Quintero, MD, MPH; Michelle Kominiarek, MD; Lee A. Learman, MD, PhD; Christos G. Hatjis, MD; Paul van Veldhuisen, PhD; for the Consortium on Safe Labor

206,969 prospectively abstracted and analyzed from 2002-2008

19 teaching and non-teaching representing all 9 ACOG US districts

<table>
<thead>
<tr>
<th>BMI group</th>
<th>Proportion of population, %</th>
<th>Overall C/S Rate, %</th>
<th>Primary C/S Rate, %</th>
<th>Intrapartum C/S Rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>All women</td>
<td>100</td>
<td>30.5</td>
<td>18.5</td>
<td>13.4</td>
</tr>
<tr>
<td>&lt; 25</td>
<td>13.5</td>
<td>22.3</td>
<td>14.0</td>
<td>8.6</td>
</tr>
<tr>
<td>25-29</td>
<td>37.7</td>
<td>25.6</td>
<td>15.8</td>
<td>11.1</td>
</tr>
<tr>
<td>30-34</td>
<td>27.6</td>
<td>32.6</td>
<td>19.3</td>
<td>14.3</td>
</tr>
<tr>
<td>35+</td>
<td>21.2</td>
<td>43.7</td>
<td>24.6</td>
<td>18.8</td>
</tr>
</tbody>
</table>
More Extreme Obesity

Cesarean Rate in Super-Obese Mothers

Obesity and Labor Dystocia

Obese women have a higher rate of cesarean because:

a) Soft tissue dystocia
b) Ineffective uterine contractions in early labor
c) Ineffective uterine contractions in late labor
d) Arrest in the 2nd stage of labor
Cervical Change in First Stage

Secondary analysis of standardized IOL protocol

- < 2 cm received Foley + EASI + IV oxytocin
- > 2 cm received IV oxytocin
- All underwent AROM or SROM within 24 hours
- I UPC + FSE placed in all women after ROM

Cesarean had to meet explicit criteria

- No cesarean before 4 cm unless 12 h after ROM
- 71% of the cohort was nulliparous
- Cesarean rate in this population was 20%

Cervical Change in First Stage

Increasing weight correlates with slower dilation

- 10 kg in weight = 25% increase in cesarean
- Obese women received more oxytocin
- Montevideo units actually higher in obese women

<table>
<thead>
<tr>
<th>Weight Quartile</th>
<th>Nulliparas Dilation (cm/hr)</th>
<th>Labor Duration (h)</th>
<th>Multiparas Dilation (cm/hr)</th>
<th>Labor Duration (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>1.0</td>
<td>12</td>
<td>1.7</td>
<td>7.4</td>
</tr>
<tr>
<td>2nd</td>
<td>0.94</td>
<td>13</td>
<td>1.5</td>
<td>8.1</td>
</tr>
<tr>
<td>3rd</td>
<td>0.83</td>
<td>14</td>
<td>1.5</td>
<td>8.4</td>
</tr>
<tr>
<td>4th</td>
<td>0.63</td>
<td>17</td>
<td>1.1</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Cervical Change in First Stage

- Labor prolonged 2 h in obese women
- Dystocia occurs <7 cm
- Rate of cervical change after 7 cm is normal in obese women
- Second stage is unchanged
- Cesarean is done earlier with increasing BMI

Uterine Forces in Second Stage

<table>
<thead>
<tr>
<th>IUPC Variable</th>
<th>Lean</th>
<th>Obese</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal amplitude (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contraction</td>
<td>64.5</td>
<td>81.4</td>
<td>0.77</td>
</tr>
<tr>
<td>Pushing</td>
<td>95.9</td>
<td>90.3</td>
<td>0.91</td>
</tr>
<tr>
<td>Tone (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contraction</td>
<td>20.8</td>
<td>20.8</td>
<td>0.60</td>
</tr>
<tr>
<td>Pushing</td>
<td>26.3</td>
<td>24.4</td>
<td>0.70</td>
</tr>
<tr>
<td>Montevideo units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractions per 10 min</td>
<td>4.9</td>
<td>5.0</td>
<td>0.79</td>
</tr>
</tbody>
</table>

No difference in stage II of labor uterine forces of any kind

Duration of Second Stage

Proportion undelivered

Second stage labor duration (hours)

Normal
Overweight
Obese

Robinson BK et al. Obstet Gynecol 2011;118:1309
Fyfe et al. 2011

N = 2,629 Laboring Women

Cesarean (%)  

First Stage  
Second Stage

Normal  
Overweight  
Obese

Fyfe et al. 2011

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight</td>
<td>2.3</td>
</tr>
<tr>
<td>Obesity</td>
<td>1.4</td>
</tr>
<tr>
<td>Maternal age</td>
<td>1.4</td>
</tr>
<tr>
<td>Gestation</td>
<td>1.3</td>
</tr>
<tr>
<td>LGA</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Delivery outcomes in 2nd stage

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVD</td>
<td>71%</td>
</tr>
<tr>
<td>OVA</td>
<td>21.1%</td>
</tr>
<tr>
<td>Cesarean</td>
<td>7.6%</td>
</tr>
</tbody>
</table>
# Labor Dystocia

**Induction of labor with an unfavorable cervix**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>BMI &lt; 30</th>
<th>BMI 30-40</th>
<th>Odds Ratio</th>
<th>BMI ≥ 40</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reached active labor (%)</td>
<td>96.4</td>
<td>92.1</td>
<td>0.42</td>
<td>91.5</td>
<td>0.40</td>
</tr>
<tr>
<td>Time in active labor (h)</td>
<td>14.9</td>
<td>16.0</td>
<td>-</td>
<td>19.3</td>
<td>-</td>
</tr>
<tr>
<td>Delivery &lt; 24 hours (%)</td>
<td>54.6</td>
<td>47.5</td>
<td>0.68</td>
<td>41.7</td>
<td>.52</td>
</tr>
<tr>
<td>Time to delivery (h)</td>
<td>22.7</td>
<td>24.9</td>
<td>-</td>
<td>27.0</td>
<td>-</td>
</tr>
<tr>
<td>Cesarean in first stage (%)</td>
<td>61.8</td>
<td>74.0</td>
<td>1.7</td>
<td>83.1</td>
<td>2.87</td>
</tr>
<tr>
<td>Cesarean indications (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrest</td>
<td>37.1</td>
<td>37.5</td>
<td>-</td>
<td>36.4</td>
<td>-</td>
</tr>
<tr>
<td>Failure to progress</td>
<td>12.4</td>
<td>12.0</td>
<td>-</td>
<td>22.1</td>
<td>-</td>
</tr>
<tr>
<td>Fetal distress</td>
<td>33.7</td>
<td>38.6</td>
<td>-</td>
<td>27.3</td>
<td>-</td>
</tr>
</tbody>
</table>

Odds ratios comparing obese groups to BMI < 30 group

Why is obese labor slower?

- No difference in stereological smooth muscle content
- No difference in contraction strength in first stage
- In vitro models report adipokines, increased with obese states, inhibit myometrial contraction
- Higher IOL rates and oxytocin use in obese women

Should we adopt “an obese labor curve”?

Obese Labor Curve

Nulliparous

Multiparous

“6 cm is the new 4 cm”

First Stage Arrest = 6 cm, and:

Ruptured Membranes
4 hours with MVU > 200
6 hours with MVU < 200

VBAC

Obese women undergoing a TOLAC cesarean:

a) have a greater chance of death compared to obese women undergoing a repeat cesarean

b) have a greater rate of uterine rupture compared to women with a normal BMI

c) are less likely to have a vaginal delivery compared to women with a normal BMI

d) both b and c above
Obesity and TOLAC

MFM Units Network

Obesity and TOLAC

For BMI ≥ 40, C/S rates were:
- Nulliparous = 43%
- Multiparous + TOLAC = 53%
- Multiparous + no TOLAC = 11%

The predicted probability of successful TOLAC greater for women with BMI > 40 than for nulliparous women

Extreme obesity dramatically increases the incidence of persistent systolic and diastolic hypotension and resultant prolonged and late FHR decelerations.

It is Time to Operate

- Anesthesia considerations
- Positioning of the patient
- Antibiotic prophylaxis
- Skin preparation
- DVT prophylaxis
- Choice of incision
Cesarean Delivery

Have a plan

Anesthesia evaluation
- Failed regional anesthesia more common
- Airway assessment
- Cardiac assessment (if appropriate)

Cesarean techniques

Venothromboembolism prophylaxis
The Anesthesiologist's View
The Obstetrician’s View
Airway Access

Courtesy of Latha Hebar, MD
Positioning Consequences

20°
Mobilizing the Panniculus
Mobilizing the Panniculus
Securing the Panniculus
Final Positioning
Anesthesia Complications

Increasing BMI and Regional Anesthesia at Scheduled Cesarean

<table>
<thead>
<tr>
<th></th>
<th>BMI 40+</th>
<th>OW + OB</th>
<th>Normal BMI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complicated placement</td>
<td>5.6%</td>
<td>2.8%</td>
<td>0%</td>
<td>.007</td>
</tr>
<tr>
<td>Insufficient duration</td>
<td>2.0%</td>
<td>0%</td>
<td>0%</td>
<td>.047</td>
</tr>
<tr>
<td>Failure to establish</td>
<td>4.0%</td>
<td>0%</td>
<td>0%</td>
<td>.02</td>
</tr>
<tr>
<td>General anesthesia</td>
<td>6.0%</td>
<td>0%</td>
<td>0%</td>
<td>.003</td>
</tr>
<tr>
<td>Intraoperative hypotension</td>
<td>3.0%</td>
<td>0%</td>
<td>0%</td>
<td>.01</td>
</tr>
<tr>
<td>Overall complication</td>
<td>8.4%</td>
<td>0%</td>
<td>0%</td>
<td>.001</td>
</tr>
</tbody>
</table>

Antibiotic Prophylaxis

Cefazolin tissue level at cesarean

- **Opening adipose**
- **Myometrium**
- **Closing adipose**

BMI categories:
- BMI < 30
- BMI 30-39.9
- BMI ≥ 40

Antibiotic Prophylaxis

Study details

* Healthy subjects (co-morbidities excluded)
* Scheduled cesarean (women in labor excluded)
* Cefazolin 2 g IV prophylaxis given to all subjects 30-60 minutes before incision

Rates of sub-therapeutic adipose levels (< 4 mcg/g)

* BMI < 30: 0%
* BMI 30-39.9: 40%
* BMI ≥ 40: 45%

Follow-up: 2/5 BMI ≥ 40 had wound infection

Operative Characteristics

- **Skin-to-delivery**: 15.0 (10-19) min
- **Skin-to-skin**: 64.0 (55-85) min
- **Estimated blood loss**: 1000 (800-1200) mL

![Pie charts showing anesthesia distribution and priority levels](https://example.com/charts.png)

- **Anesthesia**
  - Epidural
  - Spinal
  - GETA
  - CSE

- **Priority**
  - Routine
  - Urgent
  - Emergent

*Alanis et al. unpublished data*
Wound Closure

- Subcutaneous closure?
- Subcutaneous drain?
- Skin: staples or suture?
- Retention sutures?
- Delayed closure?
- Anticoagulation?
Infectious Complications

- BMI < 30
- BMI 30-44.9
- BMI ≥ 45

% with endometritis or wound infection

Stamilio DM and Scrifes CM. Obstet Gynecol 2014;124:227
Wound Outcomes – BMI ≥ 50

Rate of wound complications = almost 3 per 10

- Definition = cellulitis or wound disruption
- 90% wound disruptions

Seroma: 58%
Hematoma: 15%
Abscess: 15%
"Wound Infection": 12%

Subcutaneous Closure

> 2 cm depth decrease in wound disruption

Level – 1 evidence: meta-analysis of RCTs

* RR 0.66 (0.48-0.91)
* NNT: 16.2

Chelmow et al. Obstet Gynecol 2004;103:974
Subcutaneous Closure

![Bar chart showing the comparison of wound complications between SQ Closed and SQ Not Closed]

Wound Complication: Wound Disruption, Seroma, Hematoma, Abscess, Readmission, Endometritis

Alanis et al. unpublished data
Wound Outcomes Over Time

Operative Trends

Alanis et al. unpublished data
Factors **NOT** associated with wound complications

* **Labor**
  * Wound comp 28% in labored versus 35% in non-labored
  * Duration of labor also insignificant

* **Rupture of membranes**
  * Wound comp 33% in ROM versus 38% in non-ROM
  * Duration of ROM also insignificant

* **Chorioamnionitis**

* **Number of cesareans** (repeat versus primary)

* **Priority** (emergent versus urgent versus routine)

* **Operative time** (63.5 min versus 65.0 min)

Wound Complications

### Diagnosis and Treatment

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate/Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosed after discharge</td>
<td>86%</td>
</tr>
<tr>
<td>Median POD wound disruption</td>
<td>8.5 (6.0 - 11.5)</td>
</tr>
<tr>
<td>Median POD wound cellulitis</td>
<td>10.0 (7.0 - 12.5)</td>
</tr>
<tr>
<td>Readmission</td>
<td>24%</td>
</tr>
<tr>
<td>Reoperation</td>
<td>14%</td>
</tr>
</tbody>
</table>

### Predictors

**Bivariable**
- Age
- Smoking
- Diabetes
- Vertical skin incision
- SQ drain
- EBL > 1000 mL

**Multivariable**
- Smoking: OR 2.9 (1.1-7.4)
- SQ Drains: OR 2.4 (1.2-4.3)

# Vertical Skin Incisions and Drains

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vertical Skin</th>
<th>Transverse Skin</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index</td>
<td>56.1 kg/m²</td>
<td>52.8 kg/m²</td>
<td>.002</td>
</tr>
<tr>
<td>Diabetes</td>
<td>39.4%</td>
<td>18.9%</td>
<td>.002</td>
</tr>
<tr>
<td>Incision-to-delivery</td>
<td>16 min</td>
<td>12 min</td>
<td>.06</td>
</tr>
<tr>
<td>Vertical Hysterotomy</td>
<td>42.3%</td>
<td>8.9%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SQ Drain</td>
<td>54.8%</td>
<td>11.1%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SQ Closure</td>
<td>68.3%</td>
<td>37.8%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Operative time</td>
<td>71 min</td>
<td>58 min</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>EBL &gt; 1000 mL</td>
<td>44.2%</td>
<td>25.6%</td>
<td>.007</td>
</tr>
<tr>
<td>Wound Complication</td>
<td>37.5%</td>
<td>21.1%</td>
<td>.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drain (67)</th>
<th>Vertical</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound Comp</td>
<td>26/57</td>
<td>2/10</td>
</tr>
<tr>
<td>Wound Opened</td>
<td>23/57</td>
<td>1/10</td>
</tr>
<tr>
<td>Infection</td>
<td>17/57</td>
<td>1/10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No Drain (127)</th>
<th>Vertical</th>
<th>Transverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound Comp</td>
<td>13/47</td>
<td>17/80</td>
</tr>
<tr>
<td>Wound Opened</td>
<td>12/47</td>
<td>16/80</td>
</tr>
<tr>
<td>Infection</td>
<td>6/47</td>
<td>9/80</td>
</tr>
</tbody>
</table>

**Vertical Incision**

**MFM Units Network Study**
- Secondary Analysis of Women with BMI ≥ 40
- **Vertical incision** n = 597
  - Mean BMI 47.2
  - Wound complication rate 4.2%
- **Transverse incision** n = 2603
  - Mean BMI 45.3
  - Wound complication rate 1.7%
- **Vertical incision OR 0.32 (95% CI 0.17-0.62)**

**Criticisms of this Study**
- Retrospective, unplanned secondary analysis
- 15 year-old data
- Does not define “wound infection”
- Follow-up limited
- No information on closure techniques (subcutaneous layer closure, etc.)
- Statistical analysis (12 covariates for only 68 wound complications)

Fetal Distress and Obesity

Incision to Delivery

<table>
<thead>
<tr>
<th>Variable</th>
<th>BMI &lt; 30</th>
<th>BMI 30-39</th>
<th>BMI 40-49</th>
<th>BMI 50+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incision to delivery (min, ± SD)</td>
<td>9.4 (5.9)</td>
<td>11.0 (6.8)</td>
<td>13.0 (8.0)</td>
<td>16.0 (11.3)</td>
</tr>
<tr>
<td>Cord pH &lt; 7.1 (%)</td>
<td>2.6</td>
<td>3.5</td>
<td>4.4</td>
<td>6.6</td>
</tr>
<tr>
<td>Composite neonatal morbidity (%)</td>
<td>23</td>
<td>25</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

Composite neonatal morbidity based on cord pH, Apgar scores, and NICU admission only

Post-Surgical VTE Risk

- Low-Risk: 44%
- Moderate-Risk: 15%
- High-Risk: 24%
- Highest-Risk: 17%

- 38 million discharges
- 20% surgical inpatient
- 150,000-200,000 deaths from VTE/year
- two-thirds preventable

VTE Risk in Pregnancy

![Graph showing VTE risk in different delivery types.]

- General: 1
- Vaginal Delivery: 4
- Cesarean Delivery: 13
- Emergent Cesarean: 26

ACCP Evidence Based Clinical Practice Guidelines, 8th Edition; Chest 2008;133:844S
Class III obese women have > 2-fold risk of atonic postpartum hemorrhage

Obesity and Anticoagulation

Odds Ratio of Transfusion

<table>
<thead>
<tr>
<th>BMI</th>
<th>Odds Ratio</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.5</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>18.5-24.9</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>25.0-29.9</td>
<td>1.2*</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>30.0-34.9</td>
<td>1.5*</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>34.9-40.0</td>
<td>1.8*</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>40.0+</td>
<td>2.3*</td>
<td>&lt; .05</td>
</tr>
</tbody>
</table>

Obese Women with PP Hemorrhage While on Anticoagulation

<table>
<thead>
<tr>
<th>Comparison group</th>
<th>Odds Ratio</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal BMI + anticoagulation</td>
<td>1.15 (NS)</td>
<td></td>
</tr>
<tr>
<td>Obese BMI + no anticoagulation</td>
<td>1.05 (NS)</td>
<td></td>
</tr>
</tbody>
</table>

Blomberg M. Obstet Gynecol 2011;118:561
Anticoagulation Use

Alanis et al. unpublished data
Potential interventions

* Supplemental intra-operative oxygen
  * Oxygen is toxic to microbes
  * Conflicting results in trials using 80% FiO2
    2 colorectal trials ~50% reduction in SSI
    1 general intra-abdominal surgery trial increased risk of SSI
    2 RCT double-blinded cesarean trials with no effect

* Normothermia (colorectal literature)

* Peri-operative euglycemia (trauma and general surgery literature)

* No pre-operative shave

Wound Care

Management is VOID OF EVIDENCE

- Daily saline-soaked gauze versus enzymatic debridement
- Negative pressure dressings ("wound vac")
  - No RCTs
  - 2 systematic reviews

Delayed Closure

- 81% success rate
- 16-23 vs. 61-72 days to heal
- Requires healthy, pink tissue
- Not a good idea for patients with purulent wounds