Extreme 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

After today’s lecture, you will be better able to:

1. Counsel your patients on the risks of extreme obesity in pregnancy
2. Implement antepartum interventions in the extremely obese and post-bariatric patient to reduce maternal and fetal risks
3. Improve recognition and management of labor abnormalities in the extremely obese parturient
4. Optimize cesarean delivery and the postpartum care for extremely obese gravida

Obesity Increases Resources

Kaiser Permanente (N = 13,422)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Normal BMI 18.5-24.9</th>
<th>Overweight BMI 25.0-29.9</th>
<th>Obese I BMI 30.0-34.9</th>
<th>Obese II BMI 35.0-39.9</th>
<th>Obese III BMI ≥ 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Days</td>
<td>3.6</td>
<td>3.7</td>
<td>4.0</td>
<td>4.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Physician Visits</td>
<td>4.4</td>
<td>4.6</td>
<td>4.8</td>
<td>5.4</td>
<td>6.0</td>
</tr>
<tr>
<td>MLP Visits</td>
<td>4.9</td>
<td>4.8</td>
<td>4.6</td>
<td>4.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Ultrasounds</td>
<td>3.7</td>
<td>3.9</td>
<td>4.4</td>
<td>5.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Fetal Tests</td>
<td>1.6</td>
<td>1.8</td>
<td>2.1</td>
<td>2.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Medications</td>
<td>3.6</td>
<td>4.1</td>
<td>4.9</td>
<td>6.3</td>
<td>7.7</td>
</tr>
<tr>
<td>Phone Calls</td>
<td>4.8</td>
<td>5.2</td>
<td>5.4</td>
<td>6.5</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Extreme Obesity

World Health Organization, Geneva 1997

<table>
<thead>
<tr>
<th>Classification</th>
<th>Body Mass Index (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5-24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0-29.9</td>
</tr>
<tr>
<td>Obese Class I</td>
<td>30.0-24.9</td>
</tr>
<tr>
<td>Obese Class II</td>
<td>“severe” 35.0-39.9</td>
</tr>
<tr>
<td>Obese Class III</td>
<td>“extreme” 40.0 or more</td>
</tr>
</tbody>
</table>

Super Obesity

1938: 200 lb (Matthews and der Burke JAMA)
1969: 250 lb (Tracey and Miller, Obstet Gynecol)
1985: 200 lb (Kliegman and Gross, Obstet Gynecol)

Current: BMI ≥ 50 (various)
Reproductive Age Women

![Bar chart showing BMI distribution by race for reproductive age women.](Data from National Health and Nutrition Examination Survey 2011-2012, JAMA 2014; 311:806)

Obesity and Complications

**Antepartum**
- Miscarriage after ART
- Second trimester miscarriage
- Stillbirth
- Preeclampsia
- Gestational diabetes
- Fetal overgrowth
- Post-term pregnancy
- Neural tube defects
- Heart defects
- Preterm birth*

**Intrapartum**
- Labor dystocia
- Cesarean delivery
- Spinal hypotension
- Failed epidural
- General anesthesia complications
- Uterine rupture during TOLAC
- Failed VBAC
- Meconium-stained fluid

**Postpartum**
- Postpartum hemorrhage
- Pulmonary embolism
- Surgical site infection
- Wound breakdown
- Postpartum depression
- Breastfeeding failure
- Postpartum weight retention
- Infant death

**No or Little Effect**
- Miscarriage after spontaneous conception
- Shoulder dystocia
- Fetal growth restriction

**Decreased**
- Hyperemesis
- Small for gestational age infants
- Gastroschisis

*Data from National Health and Nutrition Examination Survey 2011-2012, JAMA 2014; 311:806*
Why are we obese?

* Reuters 2012 Poll N = 1,143
  Asked respondents to identify the main cause of the obesity epidemic:

- 61% "Personal choices about eating and exercise"
- 19% "Actions of the food manufacturers and the fast-food industry"
- 20% Other

---

**Fetal Origins of Disease**

- Systems biology suggests that fetal origins of disease involve epigenetic changes in metabolic pathways.
- Modulation of gene expression and metabolic pathways during fetal development is crucial.
- Changes in the fetal environment, such as maternal nutrition and exposure to stress, can alter gene expression and metabolism.
- Adult diseases, such as metabolic syndrome and cardiovascular disease, may be linked to fetal programming.

---

Antepartum Counseling on the maternal and fetal complications of maternal obesity

Birth Defects
Obesity and birth defects


Ultrasound Detection of Anomalies

Obesity increases chance of not detecting a major anomaly by 30%
Preeclampsia

Preeclampsia Rate in Obese Women

Garabedian et al. m J Perinatol 2011;28:729

Preeclampsia Risks

<table>
<thead>
<tr>
<th>Preeclampsia Odds Ratios</th>
<th>All Preeclampsia</th>
<th>Severe Preeclampsia</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI 30-34.9</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>BMI 35-39.9</td>
<td>3.6</td>
<td>3.4</td>
</tr>
<tr>
<td>BMI &gt; 40</td>
<td>6.0</td>
<td>5.8</td>
</tr>
<tr>
<td>BMI &gt; 50</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Obesity + IVF</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>Obesity + GDM</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

Obesity accounts for 15% for preeclampsia < 37 weeks' and 30% of preeclampsia > 37 weeks.

Increasing weight in between pregnancies increases risk of preeclampsia in 2nd pregnancy.

Alanis MC et al. Acta Obstet Gynecol 2010;89:924
Dayan N et al. Obesity;2015;23:200
Pare E et al. Obstet Gynecol 124:763
Gestational Diabetes

* 50% of GDM is attributable to obesity
  * Overweight OR = 2.1
  * Obesity OR = 3.6
  * Extreme Obesity OR = 9.0

* Arbitrary diagnosis (HAPO trial)

* Like type 2 diabetes mellitus, the cause is insulin resistance

Obesity and Glucose

Non-obese vs. Obese Non-diabetic Women

Obese women plasma glucose 5-20 mg/dL higher at every period

Harmon et al. Diabetes Care 2011;34:2398
Fetal Overgrowth

Prevalence of Large for Gestational Age Infant N = 660,396

Kim SY et al. Obstet Gynecol 2014;123:737

Stillbirth

- Nearly linear dose-response relationship
- RR 1.24 for every 5 BMI units over 20 kg/m²
- Linear dose-response relationship
- Absolute stillbirth rates:
  - BMI 20: 40/10,000
  - BMI 30: 59/10,000
  - BMI 40: 88/10,000

Aune D et al. JAMA 2014;311:1536
Infant Mortality

Meehan S et al. Pediatrics 2014;133:863

Spontaneous Preterm Birth

California Births 2007-2009, N = 989,687

Antepartum Management
Screening, counseling, and lifestyle interventions that can make a difference

Speculative Interventions

- **Diet**
  - Appropriate caloric intake
  - Standards for gestational weight gain
  - Low glycemic index diets

- **Nutrition**
  - Source and type of macronutrients
  - Micronutrient supplements
  - Use of probiotics

- **Physical activity**
  - Exercise

- **CPAP for sleep apnea**

- **Pharmacologic Therapies**
  - Aspirin
  - Metformin

Evidence?
Diet Counseling

General Principles

* Balanced intake of macronutrients
  * Carbohydrate 40-50%, Protein 20-30%, Fat 20-30%
  * Avoid fad diets, including high-protein diets

* Reduce or eliminate bad dietary behaviors
  * Added sugars
  * Calorie dense foods
  * Trans fats
  * Limit saturated fat to 10% of calories

* Add 2 servings of low-mercury fish per week

2009 IOM GWG Guidelines

<table>
<thead>
<tr>
<th>Classification</th>
<th>Pre-pregnancy BMI</th>
<th>IOM Recommended Gestational Weight Gain (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>28-40</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5-24.9</td>
<td>25-35</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0-29.9</td>
<td>15-25</td>
</tr>
<tr>
<td>Obese I</td>
<td>30.0-34.9</td>
<td>11-20</td>
</tr>
<tr>
<td>Obese II</td>
<td>35.0-39.9</td>
<td></td>
</tr>
<tr>
<td>Obese III</td>
<td>40.0+</td>
<td></td>
</tr>
<tr>
<td>Super-obese</td>
<td>50.0+</td>
<td></td>
</tr>
</tbody>
</table>
GWG Restriction

Controversial

Benefits: reduced gestational diabetes, reduced preeclampsia, reduced macrosomia, reduced cesarean rate

Risks: increase in small for gestational age, and unknown and theoretical neurological and cognitive risks to the fetus, secondary to nutrient or calorie restriction, which may be irreversible

GWG Restriction

Observational Data

Cedegren, Obstet Gynecol 2007;110:759
GWG Restriction
Randomized Clinical Trial Data

- Numerous RCTs
  - Mixed quality of studies
  - No standardized interventions between studies
  - Different primary and secondary outcomes
  - Numerous meta-analyses with mixed conclusions
    - Quinlivan et al. 2011: supports GWG restriction policy
    - Cochrane review 2012: does not support GWG restriction policy

Consistent trend: dietary counseling is not enough
Low Glycemic Index Diets

### Rhodes RCT
- Overweight/obese women
  - 2 Diet arms
  - 25 in low glycemic index diet group
  - 21 in low-fat diet (25% of calories) group
  - Primary outcome: no difference in birth weight
  - No difference in GWG
  - Slightly increased fiber, gestational duration, maternal CV markers

### Moses RCT
- All women, stratified by BMI (obese or non-obese)
  - 2 Diet Arms
  - 354 in low glycemic index group
  - 337 in healthy diet group
  - Primary outcome: no difference in birth weight
  - No difference in GWG
  - No differences in neonatal outcomes or GDM

**Probiotics**

- Microorganisms that confer health benefits on the host
- Most are food items or dietary supplements
- Products vary in microbial composition and dosage
- The gut microbiome varies considerably between obese and lean people and associated with insulin sensitivity

**RCTS performed in Finland, Ireland, Iran**
- Finnish Study (N = 256): improvement in plasma glucose and insulin sensitivity
- Iranian Study (N = 70): improved markers of inflammation (CRP) and cholesterol
- Irish Study (N = 175 obese women): 2nd trimester did not reduce plasma glucose or affect any outcome

Laitinen K et al. Br J Nutr 2009;101:1679

**Metformin**

- **2 randomized clinical trials in PCOS women**
  - early, small study was positive for neonatal outcome
  - larger, better study was negative for neonatal outcome
  - metformin associated with less gestational weight gain

**Conclusion**
There is no evidence that empiric metformin reduces the risk of gestational diabetes, preeclampsia, delivery of a large-for-gestational age infant, or other obstetric or neonatal outcomes among obese women with or without PCOS.

Vanky et al. J Clin Endocrinol Metab 2010;95:E488
Exercise Recommendations

ACOG, CDC, American College of Sports Medicine, and US Department HHS

- **30 minutes of moderate physical activity daily**
  - Sedentary women: walking, swimming exercises
  - Active women: continue as non-pregnant
  - Strenuous Exercisers: evidence poor, consider decreasing intensity to moderate levels

- **Relative contraindications**
  - Uteroplacental insufficiency (preeclampsia, IUGR)
  - Preterm labor or cervical insufficiency

Lifestyle Interventions

ACOG Committee Opinion Number 267: Exercise in Pregnancy, Reaffirmed 2009

Thangaratinam et al. BMJ 2012;344:e2088
Bariatric Surgery

Restrictive

- Gastric Band: 15-20%
- Vertical Sleeve Gastrectomy: 25-30%

Restrictive + Malabsorptive

- Purely malabsorptive procedures are rarely done
- Roux-en-Y: 50%

Diet and exercise improve pregnancy outcomes

Thangarathinam et al. BMJ 2012;344:e2088
Bariatric Surgery Status

- 200,000 cases done per year
  - Rapid weight loss
  - Return to ovulatory menses in 80%
  - Clinically important complications
- Implications for pregnancy: risks and benefits
  - Reduction in GDM, preeclampsia, LGA births
  - Increase in SGA births and possibly spina bifida
  - Post-surgical risks may be increased in pregnancy
  - Micronutrient deficiencies
  - Dumping syndrome and GDM screening

Bariatric Surgery Status

- Micronutrient deficiencies
  - Far worse with Roux-en-Y
  - Fat-soluble and water-soluble vitamins
    - Water-soluble: folate, vitamin B1 (thiamine) and B12
    - Fat-soluble: vitamins A, D, E, and K
  - Minerals: iron, calcium, zinc, copper, selenium
- Initial Screening and Management
  - Check CBC, iron studies, calcium, vitamin D, B1, B12, and folate levels
  - Prescribe: Prenatal vitamin + B12 + calcium + iron
- Ongoing laboratory surveillance each trimester
Bariatric Surgery Status

- **GDM Screening**
  - If patient tolerates sugar: traditional screening
  - If patient has dumping syndrome:
    - 50% of patients with Roux-en-Y
    - Check A1c at first visit
      - If A1c < 5.7%: do nothing
      - If A1c 5.7-6.4%: check home BG x 1 week
      - If A1c ≥ 6.5%: the patient has type 2 diabetes
    - At 24-28 weeks of gestation, check BG with home glucometer x 1 week 3-4 times daily

Bariatric Surgical Status

- **Risks**
  - Still high risk for pregnancy complications
  - Post-surgical risks may be increased
    - Intussusception*
    - Volvus
    - Internal herniation through surgical windows
    - Band erosion and slippage
    - Anastomotic leaks
    - All are higher with Roux-en-Y
    - **MUST HAVE LOW THRESHOLD FOR DIAGNOSIS**
Intrapartum Management of labor and cesarean

More Extreme Obesity

Cesarean Rate in Super-Obese Mothers

Cervical Change in First Stage

- Labor prolonged >2 hours 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>.77</td>
</tr>
<tr>
<td>Pushing</td>
<td>95.9</td>
<td>90.3</td>
<td>.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>.60</td>
</tr>
<tr>
<td>Pushing</td>
<td>26.3</td>
<td>24.4</td>
<td>.70</td>
</tr>
<tr>
<td>Montevideo units</td>
<td>221.2</td>
<td>295.5</td>
<td>.31</td>
</tr>
<tr>
<td>Contractions per 10 min</td>
<td>4.9</td>
<td>5.0</td>
<td>.79</td>
</tr>
</tbody>
</table>


No difference in stage II of labor uterine forces of any kind
Duration of Second Stage

Fyfe et al. 2011

N = 2,629 Laboring Women

Cesarean (%)
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


Obese Labor Curve

Nulliparous
Multiparous

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


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


It is Time to Operate

- Anesthesia considerations
- Positioning of the patient
- Antibiotic prophylaxis
- Skin preparation
- DVT prophylaxis
- Choice of incision
The Obstetrician’s View

The Panniculus
Mobilizing the Panniculus

Mobilizing the Panniculus
Securing the Panniculus

Final Positioning
Infectious Complications

% with endometritis or wound infection

- BMI ≥ 45
- BMI 30-44.9
- BMI < 30

Stamilio DM and Scifres 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
- Hematoma
- Abscess
- "Wound Infection"

**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**

![Graph showing wound complications with SQ Closed and SQ Not Closed](Alanis et al. unpublished data)
Wound Complications – BMI 50+

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 – BMI 50+

**Diagnosis and Treatment**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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**

<table>
<thead>
<tr>
<th>Bivariable</th>
<th>Multivariable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Smoking: OR 2.9 (1.1-7.4)</td>
</tr>
<tr>
<td>Smoking</td>
<td>SQ Drains: OR 2.4 (1.2-4.3)</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Vertical skin incision</td>
<td></td>
</tr>
<tr>
<td>SQ drain</td>
<td></td>
</tr>
<tr>
<td>EBL &gt; 1000 mL</td>
<td></td>
</tr>
</tbody>
</table>

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

Walsh et al. Obstet Gynecol 2009;113:411

VTE Risk in Pregnancy

<table>
<thead>
<tr>
<th></th>
<th>General</th>
<th>Vaginal Delivery</th>
<th>Cesarean Delivery</th>
<th>Emergent Cesarean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fold Change</td>
<td>1</td>
<td>4</td>
<td>13</td>
<td>26</td>
</tr>
</tbody>
</table>

ACCP Evidence Based Clinical Practice Guidelines, 8th Edition; Chest 2008;133:844S
Prophylactic anticoagulation does not increase wound complications

Alanis et al. unpublished data