The Problem

- 22% of women were obese before pregnancy in 2002-2003
- BMI > 30 = obese (NIH: 10% more than ideal body weight or 2x ideal body weight)
- BMI > 40 = morbidly obese
- Obesity increases the risk for cesarean section and thus the need for anesthesia
- C/S rate is 47.4% in morbidly obese
- Maternal and fetal morbidity is increased
OBJECTIVES

- Describe the implications of obesity during pregnancy.
- Describe the implications of Preeclampsia and the anesthetic management of these patients.

Physiologic Changes

Cardiovascular:
- Increase in Blood Volume
- Increase in Cardiac Output

Respiratory Changes:
- Elevation of the diaphragm
- Decreased FRC
- Increased ventilation and respiratory drive
- Respiratory alkalois and increased arterial O₂ tension

Pulmonary Changes

- Increase MV leads to:
  - Decreased CO₂ to ~ 30-32 mmHg
  - Increased PaO₂ to ~ 100 mmHg
- Uterine growth upward increases pressure on diaphragm causing:
  - Decreased FRC
  - Similar to Restrictive Lung Disease

Pulmonary Changes

- Progesterone is a direct respiratory stimulant
- Normally produced by the corpus luteum
- At 8 weeks gestation, production shifts to the placenta (ovarian-placenta shift)
- Essential hormone for uterine health and homeostasis
- Increased minute ventilation (MV) is initiated by a rise in progesterone
- Increased diaphragm use
Clinical Significance

Consider the normal lung where:

- MV = Minute Ventilation
- VT = Tidal Volume
- f = Frequency as Respiratory Rate (RR)

\[ MV = 500 \times 12 \text{ ml/min} = 6,000 \text{ ml/min} \]

Dead Space (V\textsubscript{D}): Anatomical + Alveolar = Physiologic Approx. 150 ml of VT is V\textsubscript{D}

\[ \frac{V_D}{V_T} = \frac{150}{500} = 0.3 \text{ or } 30\% \]

This means that only 70% of VT is available for gas exchange.

Recall that:

Alveolar ventilation (VA): the amount of fresh gas involved in gas exchange.

\[ VA = (V_T - V_D) \times f \text{ (respiratory rate)} \]

\[ VA = (500 - 150) \times 12 \]

\[ VA = 4,200 \text{ ml/min available for gas exchange after accounting for dead space} \]

Now consider the pregnant state, as the uterus grows to term:

- VT increases 40% to 700 ml (500 ml)
- f increases 10% to 14/min

Therefore:

\[ MV \text{ is increased 50\% to } 7,700 \text{ ml/min} \]

Clinical Significance

In the normal lung:

Denitrogenation (Preoxygenation)

\[ FRC \times FiO_2 \times 2,400 \text{ ml} = 2,400 \text{ ml stored O}_2 \]

O\textsubscript{2} Consumption = 250 ml/min

\[ \text{Time to desaturation} = \frac{2,400}{250} = 9.6 \text{ min} \]

In the parturient:

- Denitrogenation (Preoxygenation)
- FRC decreased 20% = 1920 ml
- O\textsubscript{2} consumption is increased 20% = 300 ml/min

At best, time to desaturation = 1920/300 = 6.4 min

\[ \approx 6 \text{ min} \]
Clinical Significance

WITHOUT DENITROGENATION (RAO₂ = 21%)

Normal lung:
FRC contains 2,400 ml x 0.21 = 504 ml O₂
O₂ consumption = 250 ml/min
Desaturation in 504/250 = ~2 minutes

Parturient lung:
FRC is 1920 x 0.21 = 403 ml O₂
Consumption is 300 ml/min
Desaturation in 403/300 = ~1 minute

Hypoxemia

Hypoxemia more common in obese parturient
Worse in supine position (such as in C/S)
Body weight increases O₂ consumption and CO₂ production
Work of breathing increased d/t chest wall weight = Restrictive Lung Disease
Prone to rapid oxygen desaturation
Obstructive sleep apnea is common
Use of CPAP to improve PaO₂

Mechanism
Decreased FRC and
Increased Closing Capacity resulting in
Right to Left Shunt
High FIO₂ worsens shunt 1st contribution ofatelectasis
BMI correlates to atelectasis and shunting
Shunts > 30% = no improvement in PaO₂ with high O₂ concentrations

More Bad Stuff

Normal increase in CO₂ associated w/pregnancy is exaggerated in obese patient, as extra fat demands extra perfusion
Cardiac stress is greater in obese pts, who also have more cardiac risk factors, ie: HTN, Diabetes
Aortocaval Compression Syndrome: decreased cardiac output and placental perfusion due to large uterus
exacerbated by large panniculus
May result in CV collapse and sudden death in obesity
Fetal macrosomia is a risk factor for painful and complicated labor (greater need for analgesia).

Obese body habitus makes regional techniques more challenging:
- Midline difficult to determine
- Obese pts have difficulty assuming good position
- Epidural space is deeper
- Catheters tend to migrate when pt moves
**Labor Analgesia**

A study by Jordan showed 74% of morbidly obese pts required more than one attempt at epidural with 14% needing more than 3 attempts.

Accidental dural puncture: 4% for MO vs 0.5%-2.5% for normal weight (Jordan)

Epidural Failure: 42% failure rate versus 6% in normal weight (Hood)

**Regional Anesthesia / Analgesia**

Regional is strongly preferred over GA for C/S

In morbid obesity: consider early placement of epidural or spinal catheter before need arises
Anticipate difficult placement
Allows time for testing to confirm function
In case of emergency, catheter can provide immediate surgical analgesia
Decreases need for risky emergent GA
Must be prepared for rapid control of the airway

**General Anesthesia**

GA associated with much higher maternal mortality vs. regional anesthesia
Maternal death usually due to inability to secure an airway for general anesthesia
(Closed Claims)
As high as 0.35% (Samsoon and Young)
Incidence of difficult or failed intubation in the morbidly obese for C/S
High risk of aspiration due to increased abdominal pressure, lower gastric pH, slower gastric emptying assoc. w/ obesity

**In obese patients, it is essential to:**
Premedicate with antacids, metoclopramide, PPI
Pre-oxygenate for several minutes
Position patient with a ramp
Have an additional pair of experienced hands to assist anesthesia provider
Consider awake fiberoptic intubation
Not appropriate for emergency C/S
Empty stomach with OG tube prior to waking
Extubate when fully awake and cooperative
25-degree head-up position

Post-Partum Care
- Increased post-partum morbidity in obesity
- Hemorrhage, endometritis, infection, DVT, PE, atelectasis, respiratory depression, hypoxemia, cardiomyopathy are all more common in obese pts
- Monitor hourly for 24 hours after C/S is recommended
- Consider ICU admission post-op
- Increased need for narcotics post-op
- Respiratory insufficiency, circulatory collapse
- Need is decreased with neuraxial analgesia

Anesthesia Mgmt Considerations
- All morbidly obese pregnant patients should have an ante partum anesthesia evaluation
- All obese patients with concerning co-morbidities should also be evaluated well in advance of planned delivery
- Develop a multidisciplinary plan (OB, Peds, OR crew, consider transfer to tertiary if CAH)

Antepartum evaluation
- Airway
- Examine regional landmarks
- Review pt history for co-morbidities
- Review chart for prior anesthetic records
- Chart needs to be available with referral
- Discuss analgesia and anesthesia plans with patient and family
- Discuss risks and answer questions
Patient Transfer

The anesthesia departmental policy for transferring any obstetric patient is left to the discretion of the obstetric provider.

Simply being obese/morbidly obese is not grounds for automatic transfer from an anesthetic standpoint.

Anesthesia may recommend transfer for medical indications discovered during the antepartum evaluation.

L&D Tasks

When a morbidly obese patient presents in labor:

- Ensure OR table can handle the patient’s weight
- Notify anesthesia immediately upon arrival
- Early neuraxial catheter may be placed
- OR may be prepared
- Difficult airway cart, ramp, etc

Sources

- Obesity and obstetric anesthesia. Saravanakumar et al. Anesthesiology 2008; 109:50-58
Preeclampsia

The leading cause of maternal and neonatal morbidity and mortality

Characterized by:
- Hypertension: SBP ≥ 140 mmHg and DBP ≥ 90 mmHg
- Proteinuria: ≥ 30 mg/day
- Edema
- Progression mainly affects the brain, kidney and liver.

Preeclampsia

Epidemiology:
- Multisystem disorder complicating 3-8% of pregnancies.
- When eclampsia is included, it is directly associated with 10-15% of maternal deaths.
- Higher in women with a maternal history of the disorder.
- Incidence ranges from 3%-7% in healthy nulliparas and 1%-3% in multiparas.

Preeclampsia

Risk Factors:
- Antiphospholipid Antibody Syndrome
- Renal Disease
- Prior preeclampsia
- Nulliparity
- Chronic HTN
- DM
- High Altitude

- Multiple gestations
- Strong FmHx of CV disease (≥ 2 first degree relatives)
- Obesity
- FmHx of preeclampsia in 1st degree relative
- Age > 35
**Pathophysiology**

Normal trophoblast formation does not occur.

- Normal spiral arteries invade myometrium, losing their endothelium and most muscle fibers becoming low resistance vessels.
- Normal processes do not occur in preeclampsia.

**Preeclampsia**

- Difficult to differentiate among hypertensive disorders
- Difficult to predict adverse outcomes and pre-term delivery
- Complex pathophysiology: abnormal placentation.
- Genetic and immunologic interaction are the most common theories.

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From: Cold Spring Harb Perspect Med, doi: 10.1101/cshperspect.a006585

From: Indian J Med Res, July 2013
### HELLP Syndrome

- Occurs in 0.5%-0.9% of all pregnancies
- Occurs in 5%-10% of cases of severe PE

**Characteristics:**
- Thrombi in the microvasculature of several organs.
- Thrombocytopenia
- Mechanical hemolytic anemia
- Various organ failure

### Morbidity and Mortality

**Maternal Complications:**
- Placental Abruption/hemorrhage
- Eclampsia
- Cerebral Vascular Accidents
- Organ Failure
- DIC

**Maternal Deaths:**
- Intracranial Hemorrhage
- Cerebral Infarction
- Acute Pulmonary Edema
- Respiratory Failure
- Acute Hepatic Failure/Rupture

### Morbidity and Mortality

**Fetal Complications:**
- Fetal Growth Restriction
- Intrauterine Fetal Demise
- Preterm Birth

### Maternal/Child Risks

**Maternal:**
- Hypertension
- Premature Ischemic Heart Disease
- Cerebrovascular Accidents

**Child:**
- Stroke
- Coronary Heart Disease
- Metabolic Syndrome in Adult Life
Anesthesia Management

Regional technique vs. GA
Avoid fluid overload
Manage hypertension
Magnesium administration

Anesthetic Management

Treatment:
Control Hypertension
- Labetalol-first line choice
- Hydralazine- up to 15 minutes to take effect
- Esmolol- may cause fetal bradycardia
- Sodium Nitroprusside- cyanide metabolite crosses placental barrier
- Nifedipine- associated with cerebral infarct, MI, complete heart block and death.

Magnesium

Prevent/control seizures with MgSO4
Eliminated by renal excretion
Interaction with non-depolarizers- prolonged relaxation
Effect uterine tone- tocolysis
Interact with CCBs- severe hypotension and prolonged relaxation. Non-reassuring FHR
Potentiate vasodilation and negative inotropic effects of anesthetics

Sources

Uzan, Jennifer, et al., Preeclampsia: Pathophysiology, Diagnosis and Management. Vascular Health and Risk Management, 2011; 7:
497-514
Sources


Norwitz, ER., Repke, JT. Preeclampsia: Management and prognosis. In UpToDate, Lockwood, CJ (Ed), UpToDate, Waltham, MA. (Accessed April 24, 2014.)