Critical Care in Obstetrics: An Innovative and Integrated Model for Learning the Essentials
Myocardial Infarction in Pregnancy

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Society for Maternal-Fetal Medicine
I have no conflicts of interest to disclose

Please go to online video to view lecture without cases

Some items will not be discussed during this presentation
Physiology changes in pregnancy to:

- Increase perfusion into the placenta
- Improve oxygenation to the fetus
- Significant cardiovascular changes
- Increase myocardial oxygen demand
Case 1

- 39-year-old G2 P0010 at 31 3/7 weeks
- Dichorionic diamniotic twin gestation
- Presented with complaints of contractions every 4-7 minutes
Case 1

- Pregnancy result of IVF
- Prenatal course
  - Declined genetic screening
  - Gestational diabetes
    - 1 hour GCT = 167 mg/dl
    - 3 hour GTT = 87/205/172/151
Case 1

- OB/GYN history
  - Elective abortion without complication at age 20
  - Infertility for 3 years
Case 1

- Medical history
  - “Borderline” hypertension
  - Obesity with BMI of 37 kg/m²
  - Laparoscopic cholecystectomy at age 32
  - Smoker – quit with pregnancy (was 1ppd x 20 years)
Case 1

- Initial physical exam (significant findings)
  - Pulse 105 bpm; BP 136/84 mmHg
  - Cervix 3/75/-2/soft
- Toco – contractions every 3-5 minutes
- FHTs – A 130 bpm; B 135 bpm
  - Both with mod. variability, accelerations and no decelerations
Physiology

- Hemodynamics through gestation

Robson et al., 1989; Mabie et al, 1994; Whittaker et al, 1996
Physiology

- Left ventricle measurements through gestation

![Graph showing changes in left ventricular mass, diastolic dimension, systolic dimension, and ejection fraction through gestation.](image)

Robson et al., 1989; Mabie et al, 1994; Whittaker et al, 1996
Case 1 – Initial Plan

- IV fluids
- Betamethasone
- Magnesium sulfate for neuroprotection
- Terbutaline 0.25 mg sc
Case 1

- House officer called to see patient
- Patient with complaints of:
  - Nausea and vomiting
  - Abdominal / epigastric pain
  - Shortness of breath
Medical Conditions & Risk of AMI

- Hypertension
- Thrombophilia
- Anemia
- Diabetes Mellitus
- Obesity
- Migraine Headaches
- Alcohol & Substance Abuse
- Smoking

Case 1

- Interim examination
  - Pulse 140 BPM; BP 110/69 mmHg
  - Patient appeared diaphoretic and agitated.
  - Abdomen nontender (Heart and lungs were not assessed.)
Case 1

- **Assessment**
  - Anxiety second to “terb” effect
  - Reflux

- **Plan**
  - Reassurance
  - Antacid
Diagnosis

- **Diagnostic criteria same for pregnant as nonpregnant**
  - ECG changes
  - Biochemical markers
  - Symptoms of Ischemia
    - Dyspnea
    - Diaphoresis
    - Chest pain
    - Younger patients do not always have angina
    - Women often do not have retrosternal chest pain

Zimmerman et al.; Alexander, K. P. et al; Roth, A., et al
AMI in pregnancy may have atypical features
- Abdominal/epigastric pain
- Vomiting

Chest pain/Dyspnea in pregnancy
- Preeclampsia
- GERD
Diagnosis

- Severe Signs and Symptoms
  - Cardiogenic shock
  - Arrhythmias
  - Tamponade
  - Sudden cardiac death

- EKG signs/symptoms
  - ST Segment Elevations

- Echocardiography
  - Used for evaluating wall motion
  - Not definitive for ischemia


Case 1

- 25 minutes later
  - Nurse finds patient confused and agitated
  - Pulse 130 bpm; PB 89/57
- RRT called
ECG in pregnancy

- Normal ECG findings in pregnancy
  - Atrial and ventricular ectopies
  - QRS axis leftward shift
  - Q-wave (small) and inverted T-wave in lead III
  - ST segment depression and T-wave inversion inferior and lateral leads
Case 1
Case 1
ECG Findings

- Confusing ECG findings in pregnancy
  - Ectopic beats
  - ST segment depression and T-wave inversion inferior and lateral
    - Confused with NSTEMI (Troponin I would be normal)
  - 25% of cesarean patients have ST depression during and within 30 minutes post procedure
    - Independent of anesthetic
    - ? oxytocin related


Case 2

- 25-year-old G1 at 39 weeks undergoing cesarean delivery secondary to arrest of dilation with chorioamnionitis
  - 4 to 8 cm – 13 hours
  - At 8 cm for 6 hours
- During surgery
  - Atony
  - EBL 4000 ml
  - Massive Hemorrhage Protocol activated
ECG Findings

Incidence Of ST Depression In Patients Undergoing Cesarean Delivery

- Epidural
- Spinal

S=Skin Incision
D=Delivery of Infant
C=Skin Closure

ST depression thought secondary to all the oxytocin given

During hemorrhage protocol, patient intubated (could not voice complaints)

In PACU ST depressions converted to ST elevations

Work up for MI started and MI diagnosed
OB Complications & Risk of AMI

*Preeclampsia, Eclampsia, and Gestational Hypertension

Significant Risk Factors

- Multivariable analysis of significant risk factors

Biochemical Markers

- Creatinine kinase (CK) and myoglobin creatinine kinase (CK-MB)
  - High concentration in uterus and placenta
  - Increase 2-fold within 30 minutes of delivery
  - Level peak 24 hrs post delivery

- Cardiac troponin I
  - Only slight increase (0.03) after delivery (still in nl range)
  - Rises within 3 hours of MI
  - Increase in PE & pericarditis
  - False positive with heterophile antibodies

Causes of Pregnancy and Postpartum Associated Myocardial Infarction

- No Abnormality Identifiable (10)
- Coronary Artery Spasm (5)
- Thrombus (15)
- Coronary Dissection (39)
- Atherosclerosis (41)

Coronary dissection

Prevalence Of Coronary Artery Dissection As Cause of Acute Myocardial Infarction Related To Pregnancy

- Antepartum: 11%
- Peripartum: 50%
- Postpartum: 39%

## Frequency Pregnancy-Related AMI

<table>
<thead>
<tr>
<th>Timing of AMI</th>
<th>Population Size, n</th>
<th>No. With AMI</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnancy Admission*</td>
<td>13,687,131</td>
<td>626</td>
<td>73</td>
</tr>
<tr>
<td>Postpartum Readmission†</td>
<td>114,368</td>
<td>233</td>
<td>27</td>
</tr>
</tbody>
</table>

AMI = Acute myocardial infarction

*Defined as any discharge record with a pregnancy-related or delivery code

†Defined as any discharge record included a postpartum diagnosis

Case 1

- Patient initially taken to CCU
- Nurses in the CCU concerned about the “baby”
- After initial stabilization, patient with persistent pain
Case

- Cardiologists reluctant to catheterize patient because of their concerns for fetus.
Radiation Dosages

- Chest x-ray: 0.05 mSv
- Mammogram: 0.7 mSv
- Calcium scoring test: 1-2 mSv
- Cardiac catheterization: 7 mSv
- Chest CT: 10 mSv
- Coronary CT angiography: 3-14 mSv
- Radionuclide sestamibi stress test: 10-12 mSv
- Radionuclide dual isotope myocardial perfusion imaging: 25 mSv

Catheterization

- Safe during pregnancy with adequate shielding
  - Emergency
  - Other strategies non-diagnostic
- Considering stenting, etc
- Consider brachial or radial artery approach
- Cardiologist often reluctant
  - 859 cases in pregnancy & postpartum
  - 45% were reported to have undergone cardiac catheterization
  - Of those, 81% underwent angioplasty, stent placement or cardiopulmonary bypass

Multidisciplinary Approach

- **Cardiology**
  - Follow recommendations of cardiologist
  - Acute phase primarily directed toward the mother - treat similar to the nonpregnant patient

- **Maternal-Fetal Medicine**
  - Encourage team to use medications that have been shown to be successful
  - Be prepared for perimortem cesarean

- **Anesthesia**
Subacute/Chronic Management

- Similar to nonpregnant
  - More concern of fetal tolerance to maternal medications

- Medications of possible concern
  - Statins
  - Clopidogrel
  - Angiotensin-converting enzyme inhibitors
  - Angiotensin II receptor blockers
  - Direct renin inhibitors
Thrombolysis

- Some consider pregnancy relative contraindication
  - Case by case basis
  - Clinical experience limited
  - Most evidence in PE and valve patients
- Do not withhold just because of pregnancy
- Pregnancy associated complications
  - Maternal hemorrhage (8.1%)- higher near delivery
  - Non-lytic associate death (1.2-7%)
  - Preterm delivery (2.9%)
  - Fetal death (5.8-8%)

Stenting & Intra-Aortic Balloon Pump

- **Stenting**
  - Same risk as nonpregnant
  - Less bleeding risk

- **Intra-aortic balloon pump**
  - Documented as being safe

Bredy PL, et al., 2008; Wilson AM, et al., 2004; Garry D, et al., 1996
Coronary Artery Bypass Grafting

- Well-established as therapy for AMI
- Maternal mortality similar to nonpregnant (1.7%-3%)
- Fetal considerations
  - Mortality 9.5% to 19%
    - Related to maternal condition
    - No relation to gestational age
  - Left lateral recumbent
  - High-flow extracorporeal circuits normothermic/mildly hypothermic
  - Fetal monitoring- not to proceed with cesarean but to maximize placental perfusion

Case

- After 1 week in CCU
  - Transferred to OB floor
  - Shared management
- Plan delay delivery (if possible)
  - 34-36 weeks
  - Labor induction
Labor & Delivery

- If possible, delay ≥ 2 weeks post MI
  - High mortality
- Vaginal delivery usually preferred
  - Decreased hemodynamic burden
- Avoid ergots
- Intensive care for 48 hours postpartum

Hankins GD, et al; Roth, A et al; Dufour et al
Labor & Delivery

- Supplemental oxygen
- Left tilt
- Continuous ECG
  - ± Arterial catheter
  - ± Pulmonary catheter
- Anesthesia - early epidural
  - Avoid tachycardia
  - Avoid hypotension
  - Ephedrine vasopressor of choice

Hankins GD, et al; Roth, A et al; Dufour et al
Case 3

- 41-year-old G2P1011 presents for prepregnancy consultation
- History of MI
  - 15 years ago
  - Secondary to coronary artery dissection (cocaine induced hypertensive crisis)
- Currently
  - Normal exercise tolerance
  - No CP or SOB
Next Pregnancy

- Risk assessment includes
  - Left ventricular function
  - Coronary anatomy
  - Ongoing ischemia
  - Elapsed time - at least 1 year


Case 3

- Cardiology consultation
  - EKG stress test
  - Echocardiogram
    - EF at 50%
    - Slight hypokinesia of inferior lateral wall
- Catheterization - normal
Summary
Summary - AMI in pregnancy

- Pregnancy physiology increases cardiac strain
- Medical and pregnancy complications increase the risk of AMI in pregnancy
- AMI may have atypical features
- Diagnostic criteria same for pregnancy
- Treatment similar and should not be withheld
Evidence
Evidence

- Bernal JM, Miralles PJ. Cardiac surgery with cardiopulmonary bypass during pregnancy. Obstet Gynecol Surv 1986;41:1-6. (Level II-3)
Evidence

Evidence

Evidence

Evidence

Thank You for Your Attention!

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