Maternal Cardiopulmonary Arrest and The Role of Resuscitative Hysterotomy

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Learning Objectives

- Understand maternal and fetal mortality rates
- Describe initial evaluation steps to evaluate trauma in pregnancy including primary and secondary surveys
- State the importance of fetal monitoring and recommendations for duration of evaluation
- Describe maternal cardiopulmonary arrest management principles including consideration for use of resuscitative hysterotomy
Conflict of Interest/Disclosure Statement

- I do not have financial interest or other relationships with the industry relative to the topics being discussed.

Mortality in Pregnancy

- Doubled between 1990-2013 (12 to 28 per 100,000 LB)
- 48 of 50 US states had an increase between 1990-2013
- Leading causes:
  - Cardiovascular disease (23-28% preventable)
  - Trauma (affects 7% of all pregnancies) with overall mortality 7%
    - Penetrating trauma < 4%
    - Non-pregnant penetrating trauma 13%
- Fetal mortality resulting from cardiopulmonary arrest is 60-80%

### Physiologic Changes in Pregnancy

- **Cardiac**
  - CO increases 45-50%
  - HR increases 17-20%
  - SVR decreases 20%
  - PVR decreases 35%
  - COP decreases 15%

- **Respiratory**
  - Edematous oropharynx
  - Elevated diaphragm
  - FRC decreases 25%
  - TV increases 40%
  - Compensated respiratory alkalosis
  - Diminished buffering capacity during hypoxia and acidemia

- **Hematologic**
  - Blood volume increases 50%
  - Mild anemia
  - “Hypercoagulable state”

### Maternal Cardiac Arrest (MCA)

- Rare but clinically challenging
- 1 in 12,000 admissions annually
- Pregnancy-related mortality 18/100,000 live births
- By contrast, pediatric-related mortality from cardiac arrest is 12/100,000 (ages 5-14)
- Problem: Wide variation in pregnancy-related cardiac arrest management and knowledge

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Initial Evaluation

- Multi-disciplinary
- Centered on maternal condition following BLS, ACLS and ATLS guidelines/algorithms
- Do not withhold medications, tests or treatments due to pregnancy (including radiographic imaging)
- Fetal morbidity is directly related to indirect sequelae of MCA and/or trauma
- Assessment of gestational age

Multi-system Trauma or Significant Mechanism of Injury?

- NO – treatment based on:
  - Hemodynamic stability
  - Gestational age
  - Obstetric evaluation
- YES – begin primary survey
Primary Survey

- Airway and c-spine stabilization
- Breathing and ventilation
- Circulation/control hemorrhage
- Disability (neuro assessment)
- Exposure
- If >20 weeks: fetal ultrasound (gestational age, placental location, cardiac activity and fetal heart rate)
- If >24 weeks: also begin continuous fetal heart rate monitoring

Ultrasound: FASTCAPE

- Focused Assessment and Sonography for Trauma (FAST)
- In addition to FAST, continue ultrasound examination for fetal Cardiac Activity and Placental Evaluation (CAPE)
Early Fetal Monitoring

- Retrospective review of 441 pregnant trauma patients
- Maternal/Fetal survival rates 72%/45% respectively
- Five fetal deaths due to delayed recognition of non-reassuring FHR
- 60% (3/5) had no significant maternal injuries
- Recommend 6 hour monitoring (minimum)


Secondary Survey

- Full set of vital signs
- Five interventions of primary survey (A-E)
- Fetal heart rate (initial assessment if less than 20 weeks and reassessment if >20 weeks)
- Give comfort
- History/head-to-toe assessment
- Inspect posterior surfaces
Maternal Cardiopulmonary Arrest

- Hemodynamic effects of resuscitation
  - To tilt or not to tilt, that is the question
  - Maximum 10-30% of normal cardiac output
- Cesarean delivery within 4 minutes and completed within 5 minutes if initial maternal resuscitative attempts are unsuccessful (The “4-5 Rule”)
- Return of spontaneous circulation (ROSC) following “perimortem” cesarean delivery?
  - 60% increase in maternal cardiac output following delivery
- Published data suggests 67% of cases have ROSC

“Perimortem” Cesarean Delivery

- What is the priority during a maternal cardiopulmonary arrest?
- “Perimortem” implies a last-chance effort to save the fetus (as maternal death is immanent).
- Is the “4-5 Rule” optimal timing?
- Is the indication primarily fetal or maternal?
- Is it really a maternal “Resuscitative Hysterotomy”?

MCA Management Principles

- Immediate request for OB and neonatal teams
- Rapid assessment of gestational age
- Left displacement of gravid uterus
- Immediate chest compressions
- Consider early intubation
- Timely/appropriate delivery of meds (no exclusions)
- IV access above uterus
- Evaluate for primary etiology to direct therapy
- Resuscitative hysterotomy early


Summary – Trauma

- Primary Survey – ABCDE plus:
  - If >20 weeks: fetal ultrasound (gestational age, placental location, cardiac activity and fetal heart rate)
  - If >24 weeks: also begin continuous fetal heart rate monitoring
- Secondary Survey – Five interventions of primary survey plus:
  - Fetal heart rate (initial assessment if less than 20 weeks and reassessment if >20 weeks)
Summary - MCA

- Resuscitative Hysterotomy for MCA
  - Dramatic improvement in likelihood of maternal survival (60-65% chance of ROSC)
  - Perform early in the evaluation if >20 weeks with a non-shockable cardiac rhythm
  - Perform regardless of likelihood of fetal survivability or presence of fetal CA