OB Trauma II: Anatomic and Physiologic Changes During Pregnancy

Hubble : OB Trauma, continued

EMC 420: Maternal & Child Emergency Care
D. Trigg, MD

Objectives

This lecture should enable you to discuss:

- How the anatomy and physiology of the pregnant patient differs from that of the nonpregnant patient
- How the differences in the anatomy and physiology of the pregnant patient are relevant to the assessment
- How these differences create potential pitfalls in:
  - Assessment
  - Treatment

Objectives

And let's begin to discuss:

- One pathophysiological (MOI) condition in the pregnant patient
- How this is assessed?

Normal Changes During Pregnancy

- Almost every organ system changes
- Do VS accurately reflect maternal and fetal well-being ?
- Do maternal respiratory physiological changes affect fetal and maternal oxygenation ?
- Do the normal cardiovascular changes affect maternal response to injury ?
- Is fetal physiology a consideration for management of trauma in pregnancy ?

Cardiovascular Changes

- High output / Low resistance
  - except in : IVC Compression; preeclampsia
- High output
  - Heart rate increases by 15-20 beats per minute
  - Maternal blood volume expands by 50 %
    - 35 % maternal blood volume may be lost before usual signs of shock
  - No increase in total hemoglobin [thus : faster HR]

Low Resistance CV Changes

- Low BP
  - Actually lower during the first 6 mo ; then returns to pre-pregnant baseline
  - Drop in SBP: up to 4 mmHg
  - Drop in DBP: up to 15 mmHg [widening pulse pressure]
- BP interpretation : BP is ***not*** a precise reflection of adequate perfusion and oxygenation

IVC Compression

- During the last half of pregnancy
  - After 8th mo
    - May be total obstruction of venous return
- May decrease SBP by 30 %
- Removal of compression
- CO may increase by up to 25 %

Is There Vasoconstriction Early in Maternal Blood Loss

- Peripheral vasoconstriction occurs late

  HOWEVER
- Uterine vasoconstriction occurs early
  - Before any changes HR, BP, or skin changes
  - Compromise of fetal O2 and perfusion may occur without other evidence of maternal shock
  - First indication of early maternal shock :
    - Abnormal fetal heart rate
      - Bradycardia or tachycardia

Respiratory Changes

- High resistance / High output / High O2 use
- 20 % reduction in FLC and RV
- Lowered O2 reserve
- 15 % increase in O2 expenditure (by placenta, fetus,…)
- Compensation
  - Increased RR
  - Increased TV

High Output Minute Ventilation

- Increase in minute ventilation
  (tidal volume x respiratory rate)
- Decrease in pCO2
- Normal pCO2 (last half of pregnancy):
  - 30mmHg
- Compensation for decreased pCO2
  - By increasing bicarbonate excretion
- pCO2 40mmHg in pregnant trauma patient :
  is ***not*** normal

Respiratory Alkalosis of Pregnancy

- Normal pCO2 : 30mmHg
- So: a pCO2 of 40mmHg
  - Improperly ventilated
    - Maternal acidosis
    - Fetal acidosis, and
    - Fetal hypoxia

Gastrointestinal and Intra-abdominal Changes

Altered anatomy

- Altered or even absent pain patterns
  - Hx and PE : less unreliable
    - Loss of usual peritoneal signs - tenderness, guarding, rigidity
- Increased risk for aspiration (esp in ALOC)

Fetal Physiology

Fetal Respiration and Circulation

- No uteroplacental autoregulation of its circulation
  - No fetal or placental method of increasing blood flow
  - Perfusion dependent upon maternal SBP

Pathophysiology

- Major life- threatening trauma (blunt; penetrating)
  - Motor vehicle accidents
  - Assaults, including domestic violence,
  - Falls, and
  - Burns
- Fatal MOI s :
  - Nearly the same for pregnant and the nonpregnant populations
  - Chief causes of maternal death: hemorrhagic shock and head injury

Injuries Unique or More Common in Pregnancy

- Uterine rupture
- Splenic rupture
- Retroperitoneal hemorrhage, occur more often during
- Premature rupture of membranes
- Premature labor
- Fetomaternal hemorrhage

Traumatic Causes of Fetal Death

In Major trauma

- 2 most common causes of fetal death:
  - Maternal death
  - Abruptio placentae

Abruptio Placentae

- Occurs in up to 50 % of major trauma
- More common cause of fetal death than combination of all :
  - Direct fetal injury
  - Penetrating abdominal injuries
  - Maternal burns

Maternal and Fetal Trauma Management

- First priority: stabilization of the pregnant woman
- Anatomic and physiologic changes of pregnancy will modify the patient's assessment and treatment
  - Changes ***do not*** diminish the need for usual aggressive ventilatory and circulatory interventions
- Fetal injury minimized by recognizing and treating
  - Maternal hypoventilation and
  - Maternal shock

Major Trauma

May result in:

- Maternal hemorrhagic shock
- Placental abruption
- Maternal hemorrhagic shock
  - Fatal and nonfatal

Major Trauma with Life Threatening Injury

Fatalities rare in pregnancy

- Maternal deaths most frequently:
  - Hemorrhagic shock
- *Maternal* survival rate : very high (90 %)
  - Even in multisystem trauma, with the presence of shock

Major Trauma and Fetal Survival

In contrast to maternal survival

- Fetal survival is low
- Adverse pregnancy outcome:
  - 50 % of all major trauma
- In maternal hemorrhagic shock:
  - Fetal mortality rate is 80 %
- Management of maternal hypovolemia: fetus' best chance for survival is:
  - Vigorous volume resuscitation of the mother
  - Followed by definitive surgical intervention

Placental Abruption

- Complete abruptio placentae
  - Universally fatal for the fetus
    - Unless immediate caesarian section is performed
- Potentially lethal maternal risks of traumatic abruptio placentae:
  - Hemorrhage
  - Coagulation disorder (DIC)

Frequency of Abruptio Placentae

Occurs in:

- up to 6 % of <u>minor</u> trauma
- up to 50 % of <u>major</u> maternal injury

Mortality from abruptio:

- 2nd most common cause of traumatic fetal death
- Only maternal death is a more frequent cause than abruptio

Pathophysiology of Abruptio

MOI :

- Deceleration or direct uterine deformation
- Impacts both the uterus and placenta
  - Movement of elastic uterus becomes greater than that of relatively stiff and inflexible placenta ("potato chip inside of a balloon")
  - Creates shearing separation of placenta from uterus

Shearing MOI in Abruptio

MOI causes :

- Shearing injury occurs with :
  - Major (MVA, domestic violence, assault), or
  - Minor (fall, lap belt injury) maternal trauma

Placenta separation results :

- Fetal hypoperfusion (shock) leading to:
  - Hypoxia
  - Acidosis, and eventually death

Maternal Complications of Abruptio

- Bleeding from uteroplacental separation site
- DIC (rare)
  - Release of placental or intrauterine material into maternal circulation
  - Thromboplastic material (tissue factor): a rapid consumption of maternal clotting factors
  - Mortality of this bleeding disorder: 85 %
  - Incidence of DIC is higher if partial abruptio goes unrecognized

Recognition of Possible Abruptio

- Begins with clinical suspicion based on MOI / presentation
- ***The*** single most important out of hospital finding:
  - A mechanism of injury compatible with abruptio placentae, no other information is as valuable
- Typical abruptio placentae signs and symptoms (dark blood; rigid fundus,…)
  - May be difficult to assess or
  - May even be totally ***absent***

Recognition of Possible Abruptio

Signs and symptoms (if they occur !):

- Vaginal bleeding (“dark”)
- Uterine tenderness
- Uterine rigidity, and
- Fetal distress (tachycardia or bradycardia)

Pitfalls in Recognition of Life-Threatening Conditions

- Typical signs and symptoms
  - Relatively inaccurate even in the hospital setting
- Most accurate assessment:
  - In-hospital electronic monitoring for uterine contractions [***NOT*** primarily for FHT]
    - Highly sensitive in detecting abruptio
    - Highly predictive for ruling out abruptio and adverse pregnancy outcomes

Management Pitfalls in Possible Abruptio

- Delay in diagnosis (2):
  - Delay in the field
  - Transport to the wrong facility
- Abruptio usually occurs ***early*** after trauma
  - Electronic monitoring should begin as soon as the mother’s condition is stabilized

Implications for the Paramedic

- First, transfer for electronic monitoring (L+D)
  - ***All*** pregnant patients (more than 20 weeks) with ***any MOI*** consistent with possible abruptio
- Secondly, in pregnant trauma patients, any medications that alter uterine contractions are contraindicated:
  - Magnesium and terbulaline
    - Cause uterine contractions to stop: therefore interfere with uterine monitoring

Summary

We have discussed of trauma in pregnancy with respect to:

- Some of the potential pitfalls of assessing the pregnant trauma patient
- Greatest number of pregnancy losses are due to: "minor" injuries [abruptio placentae]
- As with the PE for other abdominal emergencies of pregnancy:
  - Signs and symptoms of abruptio relatively inaccurate
    - Even in the hospital setting
    - Electronic monitoring for uterine contractions
- Medications to avoid in trauma in pregnancy