# Trauma in Pregnancy

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#### Disclosures



# Talk Overview

- Epidemiology and risk factors
- Changes in pregnancy anatomy
- Changes in pregnancy physiology
- Fetal anatomy and physiology
- Primary and secondary survey
- Imaging and pregnancy
- C-section in trauma
- Special considerations
- Burn injuries in the pregnant patient
- Case presentations

## Incidence in Pregnancy

- 4 million births annually in the US
- 1 in 12 pregnancies will involve trauma
- ▶ 1.5% of all trauma patients are pregnant
- Leading cause of non-obstetric death in pregnant women
  - ▶ 20% of maternal death is traumatic
- 9/10 traumatic injuries in pregnancy are considered minor
- ▶ 60-70% of fetal loss in trauma is due to "minor" injuries
  - Minor injuries do not involve the abdomen, compression, deceleration, or shearing force; the patient does not complain of pain; and there is no vaginal bleeding or decrease in fetal movement



## Risk Factors for trauma during pregnancy

- Age less than 26 years
- African-American or Hispanic ethnicity
- Medicaid insurance
- Lower socioeconomic status
- Minimal or no prenatal care in the first trimester



Sakamoto et al. Trauma in Pregnancy. Emer Med Clin North Am. 2019 May;37(2):317-338. doi: 10.1016/j.emc.2019.01.009.



Traumatic injuries and Pregnancy

FANTUS AND THOMPSON. BABY ON BOARD, TRAUMAIN PREGNANCY. ACS BULLETIN 2018

### Most common injuries



- ► Fractures
- Dislocations
- Sprains and strains
- Poisoning

#### Patients that were delivered

- Superficial injuries
- Contusions<sup>1</sup>
- Crush injuries

\*In 2002, 16,900 pregnant women were hospitalized in the US due to trauma - 38% of them were delivered prior to discharge

#### Domestic/Intimate Partner Violence

#### Increased violent crime

- Violence against pregnant women is the leading causes of maternal trauma and death
- ▶ 16% of injuries to pregnant women are from violence
  - ► 7% GSW/stab wounds
  - ► 4% burns
- Intimate partner violence tends to increase during pregnancy
  - ► ~20% women will experience



#### Intimate Partner Violence

- ► Increases the risk of:
  - Spontaneous abortion and preterm birth
  - Low birth weight
  - Fetal injury and fetal death
- Abdomen most common target of violence
- GSW to the abdomen associated with direct fetal injury and fetal death after the third trimester

#### MVC

- > 2% of pregnant women will be in an MVC
- An estimated 368 pregnant women per year will die as a result of an MVC
- 45% of MVCs involve illicit drugs or alcohol
- ▶ 80% of injuries are related to motor vehicles
  - Working throughout the pregnancy
  - More likely than men to be involved in a car accident
- Airbags are considered safe
  - Move the seat back as the abdomen grows
  - Sternum of the woman should be 10 inches from the dashboard or steering wheel

#### The most common cause of fetal death in MVC is maternal death



## Seat belts and Pregnancy

Use decreases during pregnancy

- Moms fear harm to the fetus from the seat belt itself
- Incorrect use increases the risk of intrauterine injury and fetal death
- Pregnant women involved in MVAs were unrestrained 79% of the time





#### I'M PREGNANT. SHOULD I WEAR A SEAT BELT?

**YES**—doctors recommend it. Buckling up through all stages of your pregnancy is the **single most effective** action you can take to protect yourself and your unborn child in a crash.



#### WHAT'S THE RIGHT WAY TO WEAR MY SEAT BELT?



RIGHT

#### SHOULDER BELT

away from your neck (but not off your shoulder)

across your chest (between your breasts) be sure to remove any slack from your seat belt

#### LAP BELT

secured below your belly so that it fits snugly across your hips and pelvic bone





# Anatomy of Pregnancy

- Uterus/fetus is protected by the pelvis until 12 weeks
- The uterus reaches the umbilicus at 20 weeks
- By 34 weeks, the uterus is at the costal margins, and is starting to displace intra-abdominal organs

Sakamoto et al. Trauma in Pregnancy. Emer Med Clin of Nor Amer.

Structure	Change	Clinical Significance
Airway	Edema and friability	Difficult intubation, may require smaller ETT (6.0 and 6.5) and additional airway adjuncts
Uterus	Extends beyond the pelvis after first trimester Gravid uterus> 20wks GA	Direct uterine injury Supine hypotension from IVC compression
Bladder	Physiologic bladder and ureter compensation Moves anteriorly and superiorly in the abdomen in the third trimester	Incorrect identification of renal obstruction - hydronephrosis and hydroureter can be physiologic Direct bladder injury

Structure	Change	Clinical Significance
Diaphragm	Elevates 4cm superiorly	Pneumothorax requires higher thoracostomy tube placement, 2-3 interspaces superiorly
Small bowel	Higher displacement into abdomen	Direct bowel injury with penetrating trauma to upper abdomen
Peritoneum	Abdominal wall stretches as pregnancy progresses	Underestimation of intra-abdominal bleeding or organ injury because of blunted response to peritoneal irritation
Ligaments of PS and SI joints	Loosening	Incorrect identification of pelvic disruption on xray because of baseline diastasis



# Physiology of Pregnancy

Sakamoto et al. Trauma in Pregnancy. Emer Med Clin of Nor Amer.

System	Physiologic Change	Clinical significance
CV	Increase plasma volume	Delayed recognition of hemorrhagic shock with large volume blood loss, physiologic anemia
	Increased HR and BP	Vital signs are a poor marker of hemodynamic stability
	Increased uterine and bladder blood flow	Increased risk of maternal hemorrhage with direct injury
	Increased vascular congestion	Increased risk of retroperitoneal hemorrhage or brisk lower extremity bleed

System	Physiologic change	Clinical Significance
Renal	Increased renal plasma blood flow, GFR and decreased serum creatinine	Caution with renally excreted drugs
	Increase bicarb excretion	Low HCO3 on ABG, increased susceptibility to acidosis
Pulmonary	Increased TV and MV	Compensated respiratory alkalosis, Maintain CO2 at 30-35
	Increased O2 consumption, Decreased RV and FRC	Requires preoxygenation with high flow oxygen before induction
GI	Decreased gastric emptying and LES tone	Increased risk of aspiration
Heme	Increased Fibrinogen, D dimer, decreased platelets, PT and PTT	Propensity to develop DIC

### Fetal anatomy and physiology



- Increased blood flow to uterus occurs by the 3<sup>rd</sup> trimester
- Baby/mom can exsanguinate through placenta if injured - without obvious external signs
- Uterine laceration -> rapid maternal exsanguination without impact on the fetus initially
- Blood flow in uterus directly proportional to maternal MAP
  - The uterus is extremely sensitive to drops in maternal blood pressure

# In the Trauma Bay

51

#### Evaluation in the trauma bay

 Pregnant women are really 2 patients however

#### MOTHER MUST COME FIRST

- All women should be considered pregnant until proven otherwise
  - 3% of admitted female trauma patients are pregnant
  - Of these, 11% didn't know they were pregnant





## Primary Survey -Airway

- Airway is more difficult in the pregnant patient
  - ▶ 1 in 250 failed intubations with pregnancy
  - Pressure from the gravid uterus -> more difficult for patients to maintain their ventilation
  - Decreased ventilation will increase fetal distress
  - Maternal hyperventilation or alkalosis will cause uterine vasoconstriction
  - Tips
    - Pre-oxygenate well
    - RSI Meds are safe
    - Cricoid pressure (aspiration risk)
    - Be prepared to use a smaller ETT (6-6.5)
    - Higher risk of nasal bleeding due to engorgement from estrogen in nasal passages



### Primary Survey -Breathing

- Reduced oxygen reserve in pregnant patients
- ▶ Need a slightly higher pCO2 (35-40 may be too low)
- The diaphragm may be displaced higher-be careful with chest tubes
- ► Maternal hypotension → fetal hypoxia
  MUST AVOID
- All pregnant patients need supplemental oxygen

## Primary Survey -Circulation

- Avoid femoral access (vascular congestion in pelvis, compression of IVC by uterus)
- Use O negative blood
- After 20 weeks, patient must be rolled off the IVC to allow adequate blood return to the heart (RIGHT SIDE UP)
  - Manually displace uterus if need to do chest compressions
- Transfusion ratio 1:1, avoid crystalloid and vasopressors



30 degrees

#### Secondary survey

#### Before 23 weeks:

- Bedside US of the fetus for heart rate (130-160bpm)
- Determine feto-maternal hemorrhage <del>></del> RhoGAM?
- Intimate partner violence screenings

After 23 weeks include
Fetal heart tones
Fetal monitoring and uterine contractions
Pelvic exam
Determine fetomaternal hemorrhage →

RhoGAM?

Intimate partner violence screen



### Imaging and pregnancy

- ► If imaging is indicated → do it, regardless of the pregnancy
- MOTHER MUST COME FIRST
- ACOG and EAST: radiation less than 50mGy poses no risk
- Highest risk if prior to 12 weeks
- US is generally safe

Imaging Study	<u>Fetal Dose (mGy)</u>
Head or neck CT	0.001–0.01
Radiography of any extremity	<0.001
Chest radiography (two views)	0.0005–0.01
Abdominal/pelvic radiography	0.1–3.0
Chest CT	0.01–0.66
Lumbar spine radiography	1.0–10
Abdominal CT	1.3–35
Pelvic CT	10–50

#### C-section

- Maternal hemorrhage
- Fetal hemorrhage
- Fetal hypoxia
- Placental abruption
- Uterine rupture
- Concerning fetal heart tones after resuscitation
  - Perimortem C-section (AHA, ACOG, EAST)
    - Unsuccessful maternal resuscitation after 4 minutes
    - Gestational age over 23 weeks
    - Fundal height above the uterus

#### Special considerations in pregnancy



# Hemolytic disease of fetus and newborn (HDFN)

- Rho-gam should be given to all RH-negative patients
- Must be given within 72 hours of traumatic event
- 300mg of Rho-gam covers 30mL of fetal blood. More fetal blood may require more doses
- If there is concern about early delivery, give steroids to help fetal lung development

#### How HDFN develops:



#### How RhoGAM works:



### Placental Abruption

- Leading cause of fetal death after blunt trauma
- Placental abruption → most common complication of trauma in the third trimester
  - ▶ 3.5% incidence, 54% fetal mortality
  - Presents 2-6 hours after the initial trauma
  - ► Signs:
    - Poor fetal heart tones
    - Vaginal bleeding
    - Tenderness
    - ► Contractions
    - DIC and hemorrhagic shock



### Uterine Rupture

- ▶ Rare, 0.7% incidence
- Very high fetal mortality
- ► Signs:
  - Peritonitis
  - Maternal instability
  - Irregular uterine contractions
  - Palpable fetal parts
  - ► FAST will show intra-abdominal fluid



# Burns in the pregnant patient

#### Special considerations

- Anesthetic risks with multiple surgeries/procedures
- Medication risks narcotics, sedatives, oxandrolone
- Increased risk for thromboembolic events
- ► Increased CO/decreased SVR → more prone to extravasation → may require more than ABA consensus formula or Parkland formula predictions
- Pregnant burn patients will require higher minute ventilation (increased RR or TV)
- Early enteral nutrition; may have delayed gastric emptying
- Consider delivery in >50% TBSA burns
- High rate of fetal demise/miscarriage

#### When do I need a trauma center?

Follow NOTS guidelines as if the patient wasn't pregnant

Have a low threshold for referral to trauma center in low speed MVCs, short falls or if patient complains of any abdominal pain

# When does OB need to be involved?

- Above 23 weeks
- Concern for preterm labor
- ACOG and EAST both recommend at least 6 hours of monitoring after MVCs, traumatic injuries for women with viable pregnancies

21yo female had a syncopal event on the stairs at 37 weeks gestation. Her husband heard a "thud" and found her at the bottom of the stairs. She had been having high blood pressure for the last several days.

- Does this patient need a trauma center?
- Does this patient need a hospital with OB capabilities?
- What are the considerations for possible injuries?

She presents to the hospital as a Level 2 trauma and suffers a witnessed tonic-clonic seizure in the trauma bay

- She received Ativan, Magnesium and a trauma workup
- Head CT was negative and she was taken up to the birthing center for immediate delivery

► Diagnosis?

32yo female is brought to the ER at 33 weeks gestation after an MVC where she was hit on the driver's side, airbags deployed. No LOC, she walked at the scene. She is hemodynamically stable, but with lower abdominal pain. She was called a Level 2 trauma.

- Did she need a trauma center?
- What imaging would be suitable for her?

Patient receives a CXR, FAST exam, both of which are normal. Labs are normal. Patient is admitted for observation on fetal monitoring.

She continues to have abdominal pain and cramping, concerning for preterm labor

There is concern for placental abruption and she undergoes an emergent C section within 1 hour of arrival to the hospital

- Mother comes first, but don't forget you have 2 patients
- ✤ 23 weeks is a very important number
- CT Scans are generally safe in pregnancy
- \* Roll to left to avoid compression on IVC
- Evaluating OB trauma at trauma centers important
  - even for minor injuries due to the risk of abruption

#### QUESTIONS?

#### THANK YOU!