2 for 1: Trauma to Pregnant Women

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Case presentation

- 28 Y F, 35 wks pregnant, MVA
- PH : nil, Rh +ve,
- HPI : Driver, belted, rear ended by another car
- C/O: abdominal pain
- Unsure about fetal movements

- ABC stable, BP 100/50 HR 118 RR 22
- No signs of injuries on exam
- FHR 140, no uterine contractions palpable, no guarding, no lap belt sign, no PV bleeding

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- Anatomical alterations
- Unique problems
- Diagnostic studies
- Management

Physiological alterations

- Minute ventilation
- Heart rate
- Cardiac output
- Blood volume
- Glomerular filtration rate
- Gastric emptying time
- pCO2
- Hematocrit

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Hemodynamic Changes of Pregnancy (Mean Values)				
	Non P.	Trim. 1	Trim. 2	Trim. 3
HR	70	78	82	85
Systolic BP	115	110	102	114
Diastolic BP	70	60	63	70
Cardiac Output	4.5	4.5	6	6
CVP	9.0	7.5	4.0	3.8
Blood Vol (ml)	4000	4200	5000	5600
Hct (%)	40	36	34	36
WBC (cell/mm^3)	7200	9100	9700	9800

Fetus shock first

- With maternal blood loss, fetal distress precedes change in maternal vital signs

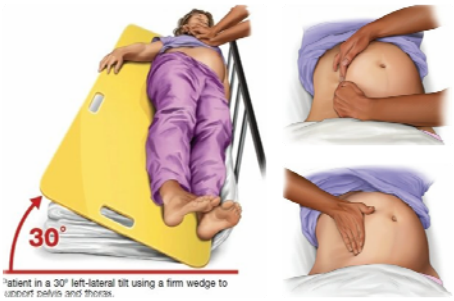
Mother shock later

- As much as 30% of the maternal blood volume may be lost with little change in maternal vital signs; however, there may be severe reduction in placental blood flow, causing fetal distress or death
- Maternal death is the most frequent cause of fetal death after trauma

Supine hypotensive syndrome

- At least 10% of women in late pregnancy will develop hypotension if placed in the supine position

Supine hypotensive syndrome



Coagulation studies

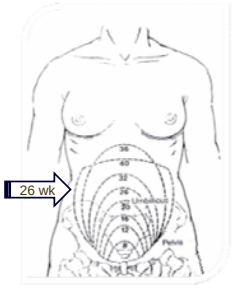
- During pregnancy, blood becomes hypercoagulable
  - Increased: factors VII, VIII, IX, X, XII, fibrinogen (double)
  - Decreased: plaminogen activator

Coagulation studies

- Normal concentrations of coagulation factors in critically ill pregnant woman → DIC
- Decreasing fibrinogen levels are the most sensitive indicator of DIC in pregnant woman with placental injury and are an indication for prompt induction of labor

Alterations in anatomy

- 12th week
  - Becomes abdominal organ
- 20th wk
  - At umbilicus
- 34~36 wk
  - At costal margin
- 38~40 wk
  - Head engages pelvis



Abdominal pain

- Peritoneum → decreased sensitivity during pregnancy → less pain and tenderness → more difficult to diagnose intraabdominal injury based on Hx and PE

Trauma risks

1st Trimester	2nd Trimester	3rd Trimester
1. Abortion 2. Isoimmunization	1. Abruptio placenta 2. Amniotic fluid embolism 3. Isoimmunization	1. Pelvic fractures 2. Maternal hemorrhage 3. Direct fetal injury 4. Abruptio placenta 5. Amniotic fluid embolism 6. Isoimmunization

Trauma risks

A **Aspiration risk**

B **Difficult ventilation**

C **Failure to recognize blood loss early**

D **Eclampsia**

Trauma risks

A **Aspiration risk**

A & B:
Marginal airway or ventilation must be rapidly intubated, ventilated, and oxygenated

B **Difficult ventilation**

C **Failure to recognize blood loss early**

D **Eclampsia**

Blunt trauma

- Injury types
  - Head injury - most common
  - Retroperitoneal hemorrhage
  - Abruptio placenta
  - DIC
  - Uterine Rupture

Traumatic death

Maternal death	Fetal death
1. Head trauma 2. Hemorrhagic shock	1. Maternal death / shock 2. Abruptio placenta

Seatbelt use

- 3 points restraints
- 1/3 ~1/2 improperly or don't use belts
  - 2.3 x give birth <48 h
  - 4.1 x fetal death

Management

A **Same as nonpregnant**

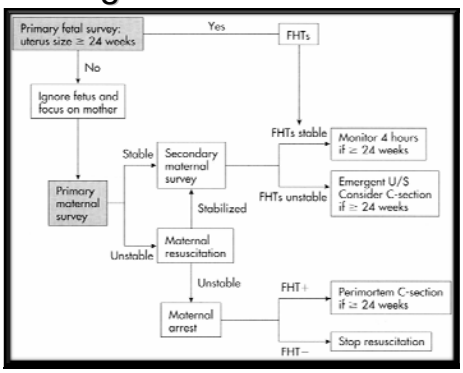
B **Same as nonpregnant**
Caution – chest tube placement

C **Displace uterus and volume infusion**
Caution – fetal shock

D **Eclampsia vs brain injury**
Caution – CT to exclude hematoma

E **Same as nonpregnant**

Management



Cardiotocographic monitoring

- Essential for all pregnant women with trauma
- At least 4 h
  - Rate (120-160); if <100 → severe hypoxia
  - Beat-to-beat variability
  - Baseline variability
  - Decelerations, esp. late

Cardiotocographic monitoring

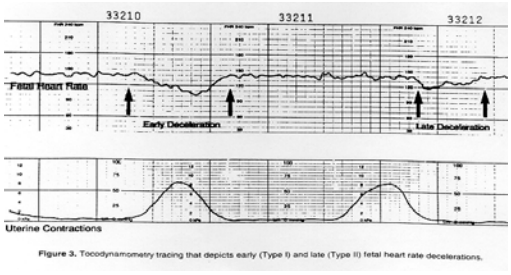


Figure 3. Tocodynamometry tracing that depicts early (Type I) and late (Type II) fetal heart rate decelerations.

Cardiotocographic monitoring

- Monitor >24 h if:
  - Vaginal bleeding
  - Spontaneous rupture of membrane
  - Fetal heart tone abnormality
  - Uterine contractions for at least four hours
  - High-risk mechanism of injury (automobile vs. pedestrian injury, high-speed MVA)
  - Uterine tenderness
  - Abdominal pain
  - Maternal anesthesia

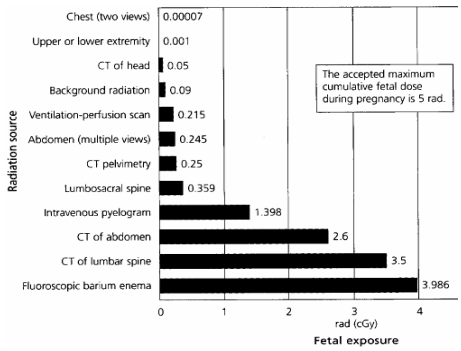
When to consider fetal injury

- Vaginal bleeding
- Abruption placenta
- Uterine tenderness
- Uterine rupture
- Labor

Increased fetal mortality

Maternal hypotension
High maternal Injury Severity Score†
Ejection from a motor vehicle
Maternal pelvic fracture
Automobile versus pedestrian accidents
Maternal history of alcohol use
Young maternal age
Motorcycle crashes
Maternal smoking history
Uterine rupture

Radiographic studies



Radiation risk

- American College of Obstetricians and Gynecologist (ACOG):
  - exposure to x-rays during a pregnancy is not an indication for therapeutic abortion
- Risk of spontaneous abortion, major malformations, mental retardation and childhood malignancy
  - Adverse effects are unlikely at less than 5~10 rads
  - It takes 50-100 rads to double the baseline mutation rate
  - Greatest risk at 10-17 wk of gestation (neurodevelopment)

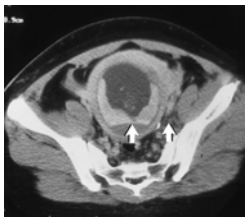
Estimated Fetal Exposure for Various Diagnostic Imaging Methods

Examination type	*Estimated fetal dose per examination (rad)**	*Number of examinations required for a cumulative 5-rad dose†*
Plain films		
Skull[4]	0.004	1,250
Dental[5]	0.0001	50,000
Cervical spine[4]	0.002	2,500
Upper or lower extremity[4]	0.001	5,000
Chest (two views)[6]	0.00007	71,429
Mammogram[6]	0.020	250
Abdominal (multiple views)[6]	0.245	20
Thoracic spine[4]	0.009	555
Lumbosacral spine[6]	0.359	13
Intravenous pyelogram[6]	1.398	3
Pelvis[4]	0.040	125
Hip (single view)[6]	0.213	23

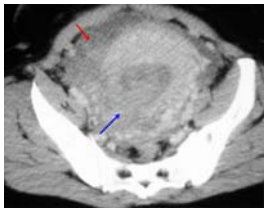
Estimated Fetal Exposure for Various Diagnostic Imaging Methods

Examination type	Estimated fetal dose per examination (rad)*	Number of examinations required for a cumulative 5-rad dose†
CT scans (slice thickness: 10 mm)		
Head (10 slices)[6]	< 0.050	> 100
Chest (10 slices)[6]	< 0.100	> 50
Abdomen (10 slices)[6]	2.600	1
Lumbar spine (5 slices)[6]	3.500	1
Pelvimetry (1 slice with scout film)[6]	0.250	20
Fluoroscopic studies		
Upper GI series[6]	0.056	89
Barium swallow[6]	0.006	833
Barium enema[6]	3.986	1
Nuclear medicine studies		
Most studies using technetium (^{99m}Tc)[7]	< 0.500	> 10
Hepatobiliary technetium HIDA scan[6]	0.150	33
Ventilation-perfusion scan (total)	0.215	23
• Perfusion portion: technetium[6]	0.175	28
• Ventilation portion: xenon (^{133}Xe)[6]	0.040	125
Iodine (^{131}I), at fetal thyroid tissue[6]	590.000	‡
Environmental sources (for comparison)		
Environmental background radiation (cumulative dose over nine months)[8]	0.100	N/A

CT scan



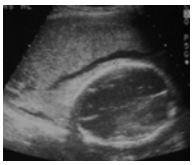
Placental separation in a pregnant patient after trauma.
CT scan shows submembranous and subchorionic hemorrhage.



Contrast-enhanced CT: large discontinuity representing uterine rupture (blue arrow). There is a considerable amount of blood (red arrow) in the pelvis.

Ultrasound

- Indicated for all pregnant women with moderate-to-severe abdominal trauma
  - Abdomen (FAST)
  - Uterus / placenta
  - Fetus



Uterine rupture

Bandl's ring - a constriction located at the junction of the thinned lower uterine segment with the thick retracted upper uterine segment, resulting from obstructed labour; this is one of the classic signs of impending rupture of the uterus

Chemical dependency

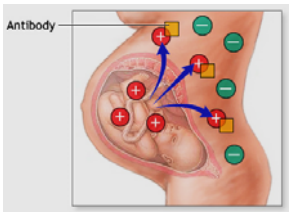
- For all injured pregnant women, the possibility of chemical dependency must be considered in the initial assessment
- Screen for alcohol and illicit drugs

Kleihauer-Betke test

- Used to measure the amount of fetal hemoglobin transferred from a fetus to a mother's bloodstream
- Performed on Rh-negative mothers to determine the required dose of Rho(D) immune globulin (RhoGAM®)

RhoGAM for every trauma

- Rh-negative mothers receive immunoglobulin therapy, unless injury remote from uterus



RhoGAM® Ultra-Filtered PLUS $Rh_0(D)$ Immune Globulin (Human) is latex-free and thimerosal-free (contains no mercury)

Rho(D) immune globulin

RhoGAM® 300 µg: For antenatal and postpartum use, second- and third-trimester pregnancy terminations, or transplacental hemorrhage

MICRhoGAM® 50 µg: For use immediately after first-trimester pregnancy termination

Kleihauer-Betke test

- RhoGAM® dose if KB test negative
  - Gestation under 13 wk: 50 ug
  - Gestation over 13 wk: 300 ug
- RhoGAM® dose based on KB test
  - 300 ug per 30 ml fetal whole blood
  - 300 ug per 15 ml pRBC

Take home message

1. Fetus shock first
2. Ultrasound and fetal monitoring >4 h
3. X-rays and CT if needed (~5 rads)
4. Fibrinogen level if placental injury
5. RhoGAM / KB test

What is best for the mother is best for the fetus!