

TRAUMA IN PREGNANCY

TRAUMA IS THE LEADING CAUSE OF MATERNAL DEATH FROM NON-OBSTETRIC CAUSES

ESSENTIAL PRINCIPLES OF TRAUMA MANAGEMENT REMAIN UNCHANGED, BUT A NUMBER OF SPECIAL POINTS NEED TO BE CONSIDERED.

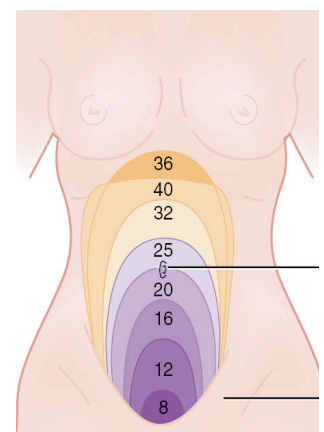
CHANGES OF PREGNANCY:

PHYSIOLOGY:

- **CARDIOVASCULAR CHANGES:**
 - Some alterations can MIMIC SHOCK
 - BP declines in the 1st and 2nd trimesters (esp. diastole)
 - Beware the SUPINE HYPOTENSION SYNDROME.
 - Due to IVC compression by the uterus after 20 weeks gestation
 - Diminishes cardiac preload, ↓ CO by 28%
 - Left lateral decubitus position, or push the uterus to the left (if other injuries preclude decubitus)
 - Blood volume ↑s (up to 45%) --> masking shock
 - Cardiac output is ↑'d by up to 40%
 - Blood flow to the uterus ↑'s to 600mL/min at term and is major source of haemorrhage when injured
 - Also note marked venous congestion in the pelvis --> hence brisk haemorrhage from leg wounds
- **PULMONARY CHANGES:**
 - Term pregnant woman has SIGNIFICANTLY REDUCED OXYGEN RESERVE
 - 20% ↓ in FRC caused by diaphragm elevation
 - 15% ↑ in oxygen consumption related to growing foetus
 - ↑'d minute ventilation --> hypocapnia is the norm, hence a CO₂ of 35-40 indicates inadequate ventilation and impending respiratory decompensation
 - Maternal hypoxia leads rapidly to foetal hypoxia
- **GASTROINTESTINAL:**
 - Reduced motility, ↑'g the chance of aspiration
 - ↑'d acidity makes aspiration more ominous
 - Early decompression the key

ANATOMICAL CHANGES:

- **UTERUS REMAINS A PELVIC ORGAN UNTIL 12TH WEEK**
 - Umbilicus by 20 weeks
 - Costal margin by 34-36 weeks
 - Vulnerable to direct injury after 12 weeks (see image)



- Diaphragm rises by extra 4cm
 - Pneumothorax may be exacerbated and tension can develop more quickly
 - Tube thoracostomies should be placed higher to allow for diaphragmatic elevation
- Abdominal viscera are pushed upwards by the uterus
 - Solid organs are protected
 - BOWEL INJURY MORE LIKELY with penetrating trauma to the upper abdomen
- Stretching of abdominal wall modifies the normal response to peritoneal irritation --> EXPECT LESS GUARDING

CHANGES IN LABORATORY VALUES IN PREGNANCY:

- PHYSIOLOGICAL ANAEMIA OF PREGNANCY:
 - Results from expanded plasma volume of 50%, but only ~20% increase in red cell volume
- Progesterone directly stimulates the medullary respiratory centre --> lower CO₂ levels with compensatory HCO₃ buffering, but this reduces capacity to cope with stress
- ECG --> left axis shift, flatter T waves, Q waves III

CLINICAL FEATURES OF TRAUMA IN PREGNANCY:

BLUNT AND PENETRATING TRAUMA:

- Risk factors for pre-term labour:
 - Gestation \geq 35 weeks
 - Assaults
 - Pedestrian collisions
- Foetal mortality ranges from 4-40%
- Likely causes of foetal death include:
 - Placental abruption
 - Maternal shock
 - Maternal death
- BEWARE IMPROPER PLACEMENT OF LAP BELT
 - Can case 3-4x \uparrow in force transmission through the uterus
- FALLS BECOME MORE FREQUENT AFTER 20 WEEKS

↓'g order of frequency

INTERPERSONAL VIOLENCE:

- Women experiencing abuse in the year prior to or during a recent pregnancy were 40-60% more likely to report:
 - High BP
 - PV bleeding
 - Severe nausea
 - UTI
 - Hospitalization
- Abused women were 37% more likely to deliver pre-term
 - Children of abused women were 17% more likely to be born underweight and were 30% more likely to require NICU

PENETRATING TRAUMA:

- ↑'d probability of harm to maternal bowel, liver or spleen if penetrating trauma to upper abdomen
- When entry site is anterior and below the uterine fundus, visceral injuries are less common, but foetal injury rates ↑

FOETAL INJURY:

- When the mother suffers a severe injury, poor foetal outcome is predicted by:
 - Maternal hypotension
 - Maternal hypoxia
 - Maternal acidosis
 - Foetal HR \leq 110
- If mum's injuries are life-threatening --> 40% rate of foetal demise
- For less severe trauma, the only useful tool in predicting outcome is 4 hours of CTG monitoring --> baby needs to be viable:

WEEKS' GESTATION	6-MONTH SURVIVAL (%)	SURVIVAL WITH NO SEVERE ABNORMALITIES (%)	*Fatal in utero
22	0	0	
23	15	2	
24	56	21	
25	79	69	

(Data from Morris JA Jr et al: Infant survival after cesarean section for trauma. Ann Surg 223:481, 1996.)

injuries from blunt trauma usually involve ICH/skull fracture from maternal pelvic fractures

PLACENTAL INJURY:

- In blunt trauma, 50-70% of all foetal losses result from **PLACENTAL ABRUPTION**
 - Results when the inelastic placenta shears away from the elastic uterus during sudden deformation of the uterus
 - Can occur with little or no sign of external injury
 - Leads to reduced oxygen/nutrient delivery to the foetus and hence leads to distress and death
- Placental abruption is associated with an 8.9 fold increase in risk of stillbirth and 3.9 fold increase in preterm delivery
 - Intervention advocated if baby \geq 32 weeks due to risk of further placental separation
- Women with abruption are more likely to suffer **COAGULOPATHIES** (e.g. DIC), with the rates of DIC directly related to degree of placental separation

UTERINE INJURY:

- The most common obstetric problem caused by maternal trauma is uterine contraction --> brought on by myometrial and decidual cells irritated by contusion releasing prostaglandins
 - 90% of contractions stop spontaneously

- Uterine rupture is RARE, often caused by pelvic fractures in severe trauma
 - Consider with maternal shock, abdominal pain and easily palpable foetal anatomy

DIAGNOSTIC STRATEGIES:

PLAIN RADIOGRAPHS:

- Adverse effects are unlikely at less than 5-10 rad
- First trimester is period of highest sensitivity
- Studies show that intrauterine exposure to 10rad does NOT cause an ↑ in malformations, IUGR or miscarriage, but is associated with a small ↑ in childhood malignancy
 - At 15 rad, 6% chance of mental retardation, 3% childhood cancer
- Should perform studies with regard for foetal protection but NOT WITHHELD out of concern for foetal radiation exposure

Table 34-2 Estimated Radiation Dose to the Unshielded Ovaries/Pelvic Uterus

IMAGING STUDY	UTERINE RADIATION DOSE (MRAD)*
Plain-film Radiography	
Cervical spine	Undetectable
Thoracic spine	<1
Chest (PA)	<1
Chest (AP)	<5
Extremities (femur)	<50
Hip	10–210
Lumbar spine	31–400
Pelvis	140–2200
KUB	200–503
Intravenous pyelogram	503–880
Urethrocytogram	1500
Computed Tomography	
Head	<50
Thorax	10–590
Abdomen	2800–4600
Pelvis	1940–5000
Angiography	
Cerebral	<100
Cardiac catheterization	<500
Aortography	<100

*mrad, millirad; dose increases as the fetus grows to occupy more of the abdomen.

- By comparison, the amount of naturally occurring radiation during 9 months gestation is approximately 50-100mrad.

ULTRASONOGRAPHY:

- Safe and effective
- Can obviate the need for more hazardous tests (eg. CT)

CT AND MRI:

- With appropriate shielding, CT of head and chest can be kept below 1rad
- Abdomen = 3rad, pelvis = up to 9rad
- CT can miss diaphragmatic and bowel injuries

MANAGEMENT OF TRAUMA IN PREGNANCY:

PRIMARY SURVEY FOCUSES ON THE MOTHER

AIRWAY AND BREATHING:

- Because of reduced oxygen reserve and increased oxygen consumption, HYPOXIA can occur quickly
- Mechanical ventilators need to be adjusted for ↑'d tidal volumes and respiratory alkalosis of pregnancy

CIRCULATION:

- Because of expanded circulating blood volume, the mother can be bleeding but not show early signs of hypotension
- Because the uterus is not a vital organ --> perfusion is shunted away in hypovolaemia (maternal BP may be normal but uterine blood flow 10-20% less than normal)
 - Hence when SHOCK appears, foetal compromise can be far advanced
 - Avoid vasopressors !!
- Beyond 20 weeks --> left lateral position (right hip elevated 30*)
- Vaginal bleeding suggests placental abruption

FOETAL EVALUATION:

- Part of the secondary survey
- Foetal distress can be a sign of occult maternal distress
- If the foetus is viable, continuous external monitoring should be initiated quickly and maintained throughout all diagnostic and therapeutic procedures:
 - *Loss of beat to beat variability, and long-term variability are indicators of foetal CNS depression*
 - Late decelerations are an indication of foetal hypoxia

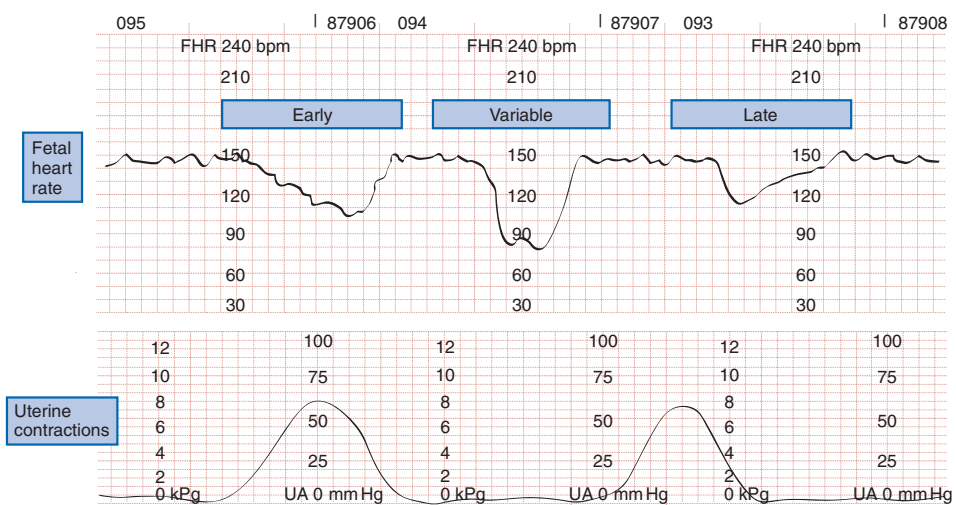


Figure 34-4. Types of fetal heart rate decelerations. bpm, beats per minute; FHR, fetal heart rate; UA, uterine activity.

LABORATORY ANALYSIS:

- ROUTINE:
 - GROUP AND HOLD
 - Bicarbonate level
 - Coagulation studies
- KLEIHAUER-BETKE TEST:
 - Indicates presence of FOETO-MATERNAL HAEMORRHAGE (transplacental bleeding of foetal blood into the normally separate maternal circulation)
 - Rates post-trauma approach 30%
 - Can cause alloimmunisation in Rh incompatibility
 - Kleihauer-Betke identifies foetal cells in maternal blood samples
 - MOST LABS SCREEN 5ML, but the amount required to sensitise Rh-negative women is MUCH LOWER
 - *THUS all Rh-negative mothers who have a history of abdominal trauma should receive on prophylactic dose of anti-D*
 - **DOSE:** First trimester = 50 microg, 2nd/3rd = 300 microg

MOTHER STABLE, FOETUS STABLE:

- Even in minor trauma, there are rates of foetal loss of 1-3%, most due to placental abruption
 - For the viable foetus, MONITORING is the next step, even if no obvious abdominal trauma
 - Four hours minimum, extended to 24 hours if any evidence of foetal distress noted
 - On release from the hospital --> advise mum to note foetal movements over the next week

MOTHER STABLE, FOETUS UNSTABLE:

- Foetal death rates following maternal trauma are three to nine times higher than maternal death rates
- If baby remains distressed despite optimization of maternal physiology, LSCS should be performed
- Besides foetal distress, other indications for LSCS include uterine rupture, placental rupture with significant bleeding

MOTHER UNSTABLE, FOETUS UNSTABLE:

- Repair of mum's wounds is the best course, as the best initial action on behalf of the foetus is early restoration of normal maternal physiology

Table 253-1 Critical ED Interventions for Trauma in Pregnancy

Attend to maternal airway, breathing, and circulation as a priority for both mother and fetus.
Maintain patient in the left lateral decubitus position.
Include blood typing and Rh status in laboratory studies.
Attempt to establish fetal age.
Determine if Rh0 (D) immunoglobulin administration is indicated.
Perform imaging as for nonpregnant patients.
Initiate fetal monitoring as soon as possible and continue for at least 4–6 h even if patient is apparently uninjured.
Have a low threshold for admitting the pregnant trauma patient.
Screen for potential intimate partner violence.

PERIMORTEM CAESAREAN SECTION:

- Restoration of maternal and thus foetal circulation is the ultimate goal
- Optimize with maternal position (30 degrees), oxygenation and fluid loading first --> if no improvement, consider perimortem LSCS if:
 - Uterine size exceeds the umbilicus
 - Foetal heart tones are present
- Time since maternal circulation ceased is also critical:
 - Aim prior to 4 minutes
- In the event of maternal arrest --> emergent perimortem C-section is indicated
 - While continuing CPR, a vertical incision is made from the epigastrium to the symphysis through to the peritoneum
 - When uterus exposed, vertical incision is then made in the anterior uterus from the fundus to the bladder reflection
- Maternal revival has been reported in a few perimortem circumstances, presumably due to vena caval compression being relieved.