Trauma to the Gravid Uterus

Akram M Fayed, MD, ABIM

Associate Professor , Department of Critical Care Medicine,
Faculty of Medicine,
University of Alexandria, Egypt
amfayed@gmail.com

Overview

- Background
- Epidemiology
- What is Unique to Pregnancy?
- Evaluation and Management of Major Trauma in Pregnancy
- Outcome






BABY
BIG
BABY
CARTOONSTOCK
.com
Search ID: dren470
Reynolds

Background

- Trauma is a major contributor to maternal mortality, and is the leading cause of pregnancy-associated maternal deaths in the USA (1) .

- In 2002, there were 4.1 injury-related hospitalizations of pregnant women per 1000 deliveries in the United States (2)

- Motor vehicle crashes and domestic/intimate partner violence account for most cases of maternal trauma,

- Falls, burns, homicide, suicide, penetrating trauma, and toxic exposure account for the majority of the remainder (3)

(1) Am J Public Health. 2005;95(3):471.
(2) Am J Obstet Gynecol. 2007;196(2):161.e1
(3) Am J Obstet Gynecol. 2013;209(1):1.

Background

- In fact, pregnancy appears to be a risk factor for being assaulted.

- Between 1993 and 1998, homicide was the leading cause of death among pregnant or recently pregnant women in Maryland and accounted for 20 percent of these deaths, but it was only the fifth leading cause of death among non pregnant women (1)

(1) JAMA. 2001;285(11):1455.

Background

- In another American series, 5 percent of female homicide victims were murdered while pregnant (1)

- An epidemiologic study reported an increased risk of motor vehicle crashes in the second trimester compared with prepregnancy (6.5 versus 4.6 events per 1000 drivers annually; RR 1.42, 95% CI 1.32-1.53), but a causal relationship is unproven (2)

(1) Obstet Gynecol. 2002;100(1):27
(2) CMAJ. 2014 Jul;186(10):742-50. Epub 2014 May 12.

Background

- Pregnancy appears to increase the risk of falling (1)
  - Increased joint laxity,
  - Weight gain,
  - A change in the center of gravity, and
  - other anatomical changes

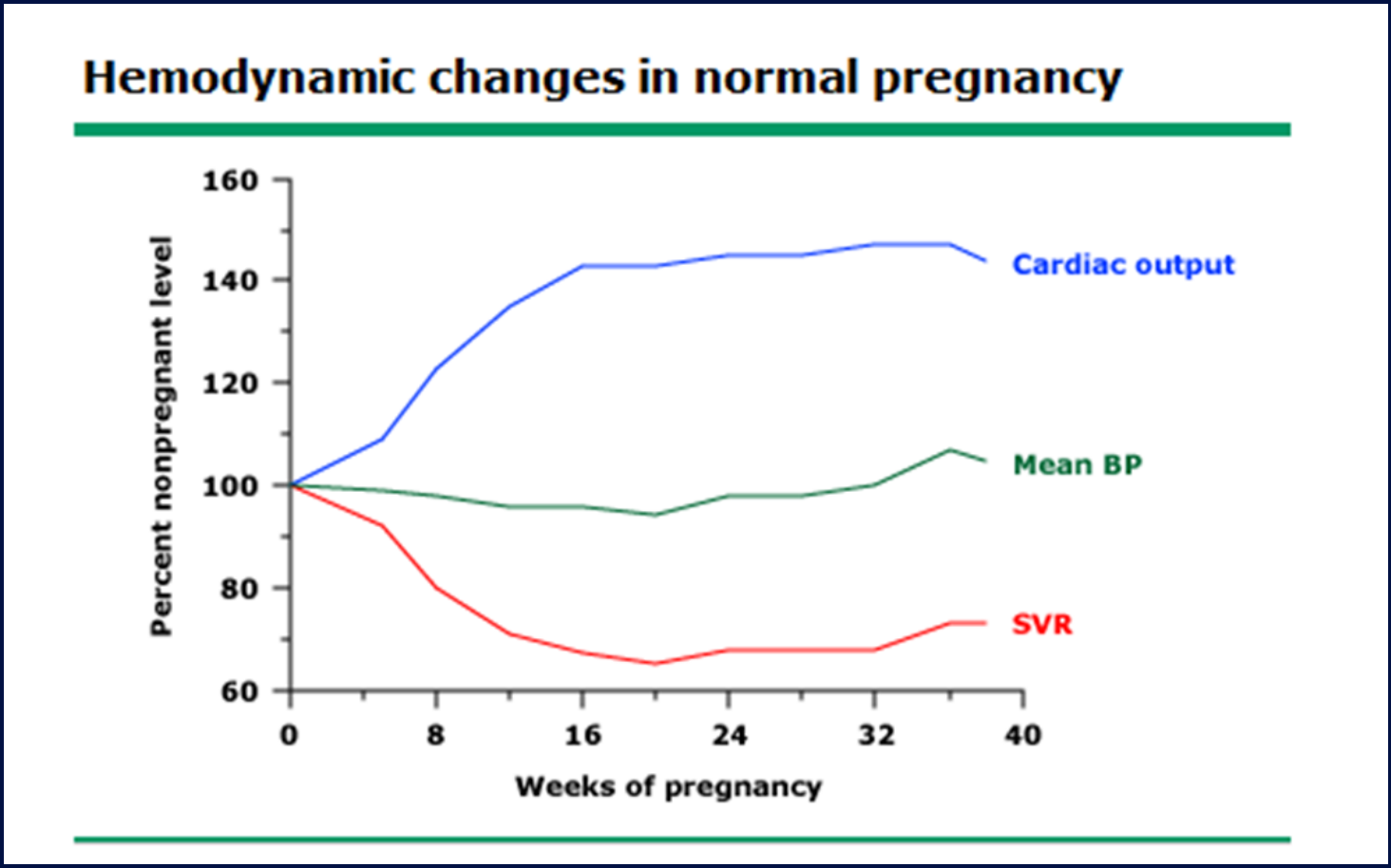
(1) J Biomech. 2010 Aug;43(12):2434-9

The Pyramids at night



Pregnancy- Specific Changes

- Cardiovascular



Pregnancy- Specific Changes

❑ Cardiovascular

❑ The heart is rotated toward the left, resulting in a 15 to 20º left axis deviation.

❑ Other EKG findings:

- Transient ST segment and T wave changes,
- Q wave and inverted T waves in lead III,
- An attenuated Q wave in lead AVF, and
- Inverted T waves in leads V1, V2 and, occasionally, V3.

Pregnancy- Specific Changes

- **Pulmonary system**

- Lung volume changes occur by 20 weeks of gestation and include a decrease in functional residual capacity and an increase in tidal volume

- There is no change in FEV1 or in respiratory rate

- Respiratory alkalosis due to physiologic hyperventilation with a compensatory metabolic acidosis also occurs during pregnancy

Pregnancy- Specific Changes

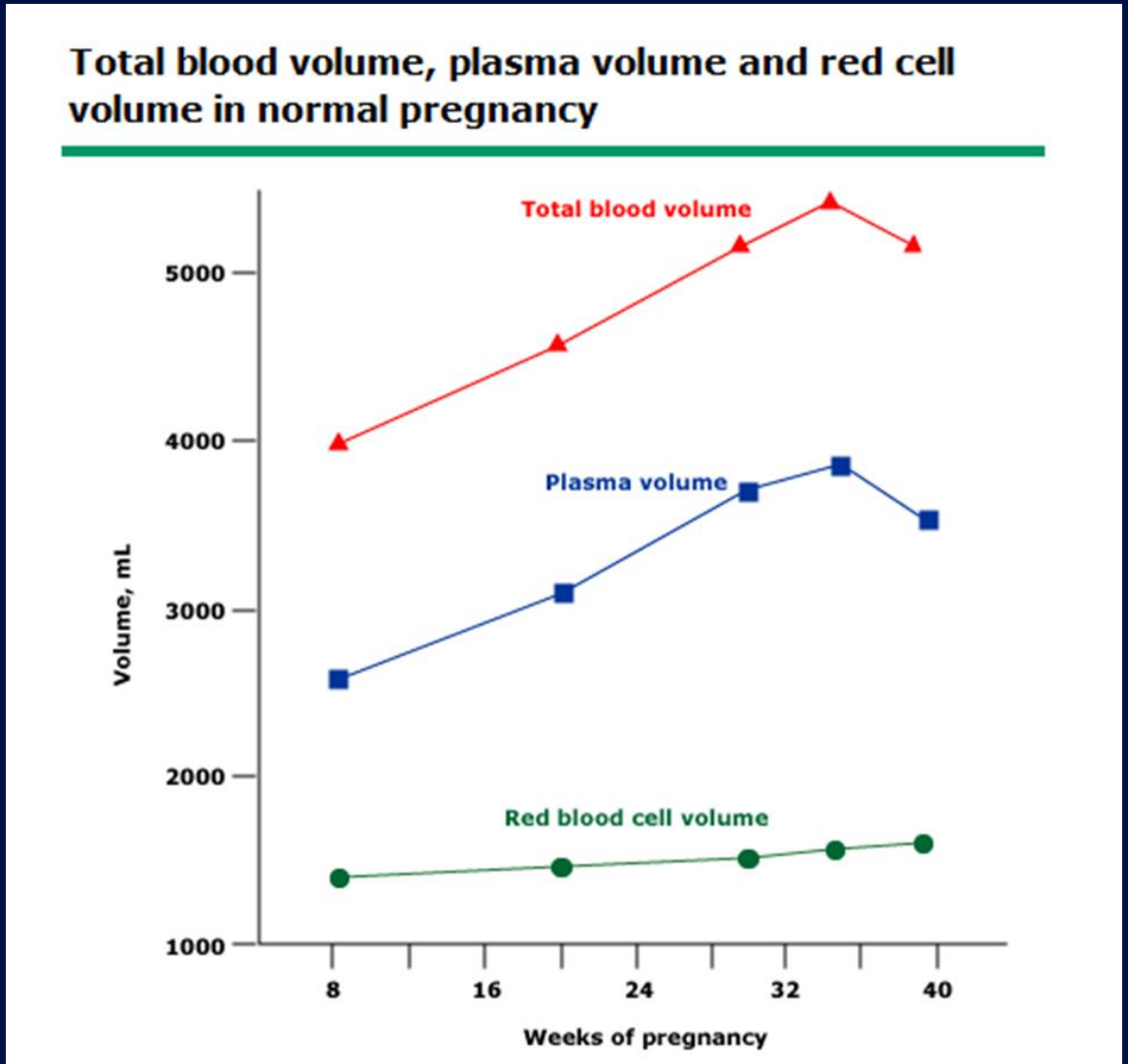
- **Pulmonary system**

Arterial blood gas values in pregnant and nonpregnant women

Parameter	Pregnant, mmHg	Nonpregnant, mmHg
pCO2	27 to 32	39 to 40
pO2	100 to 108	95 to 100
pH	7.40 to 7.45	7.40
Bicarbonate	18 to 21	24 to 29

Pregnancy- Specific Changes

- **Hematological system**



Pregnancy- Specific Changes

- **Hematological system**

- The normal pregnant woman's white blood cell count ranges from 6000 to 16,000 cell/mm3 in the first and second trimesters, and may rise as high as 20,000 to 30,000 cells/mm3 during labor.

- Thus, leukocytosis can be a normal finding in pregnant women

- A normal fibrinogen concentration in pregnancy is > 200mg/dL.

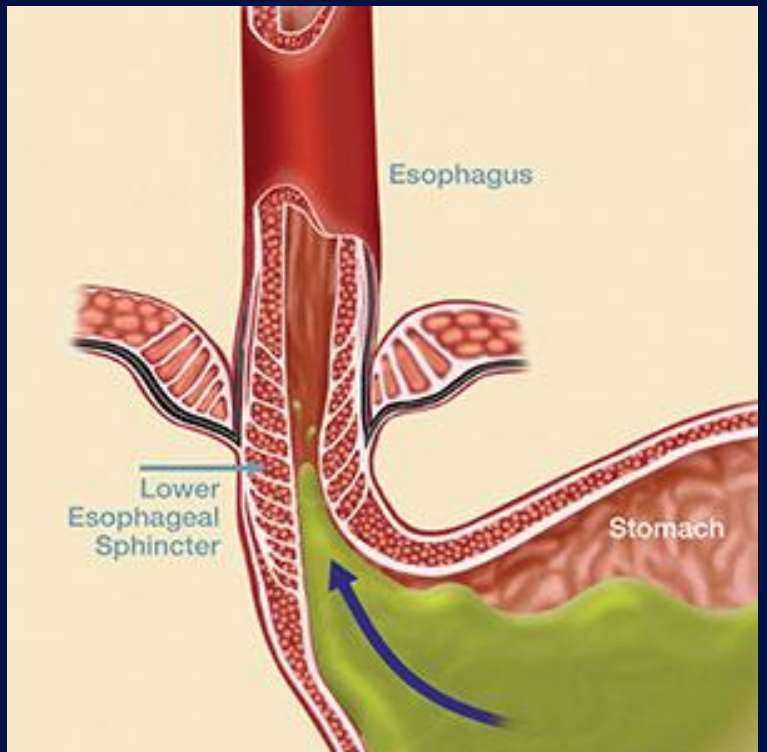
- A fibrinogen <200 mg/dL and thrombocytopenia suggest (DIC), a complication of severe abruption

Pregnancy- Specific Changes

- **Gastrointestinal system**

- Pregnant women are predisposed to gastric aspiration due to:





Pregnancy- Specific Changes

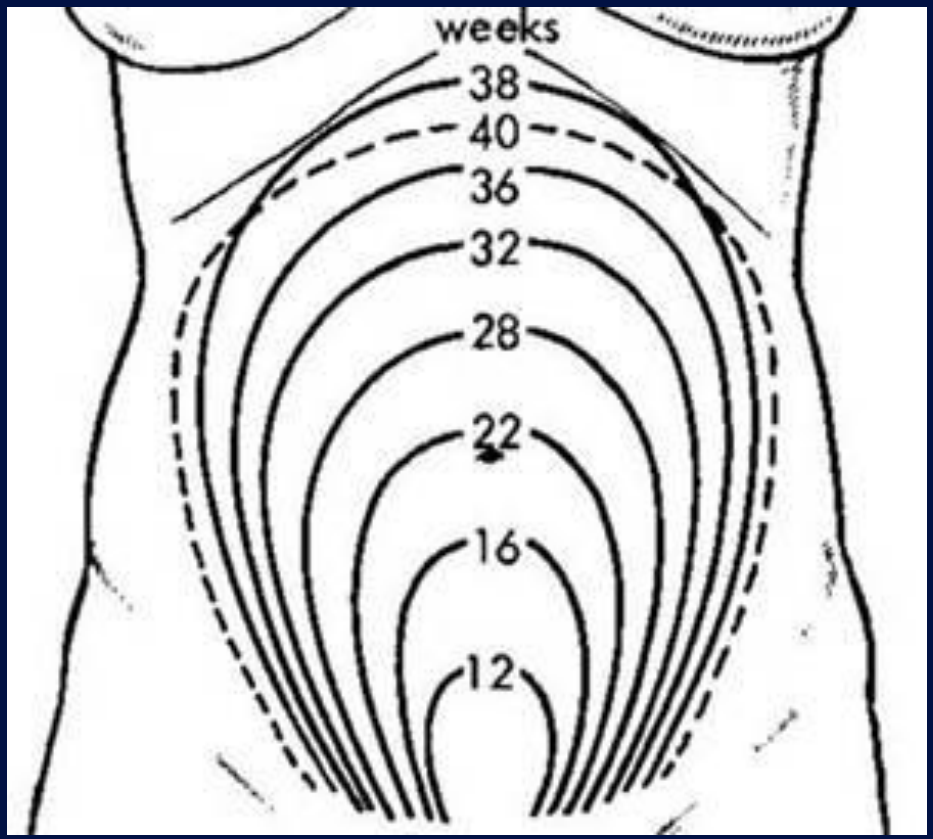
- **Renal system**

- The glomerular hyperfiltration results in a normal reduction in the plasma creatinine concentration to about 0.4 to 0.5 mg/dL

- A "normal" level of 0.8 mg/dL during pregnancy represents a mild decline in renal function

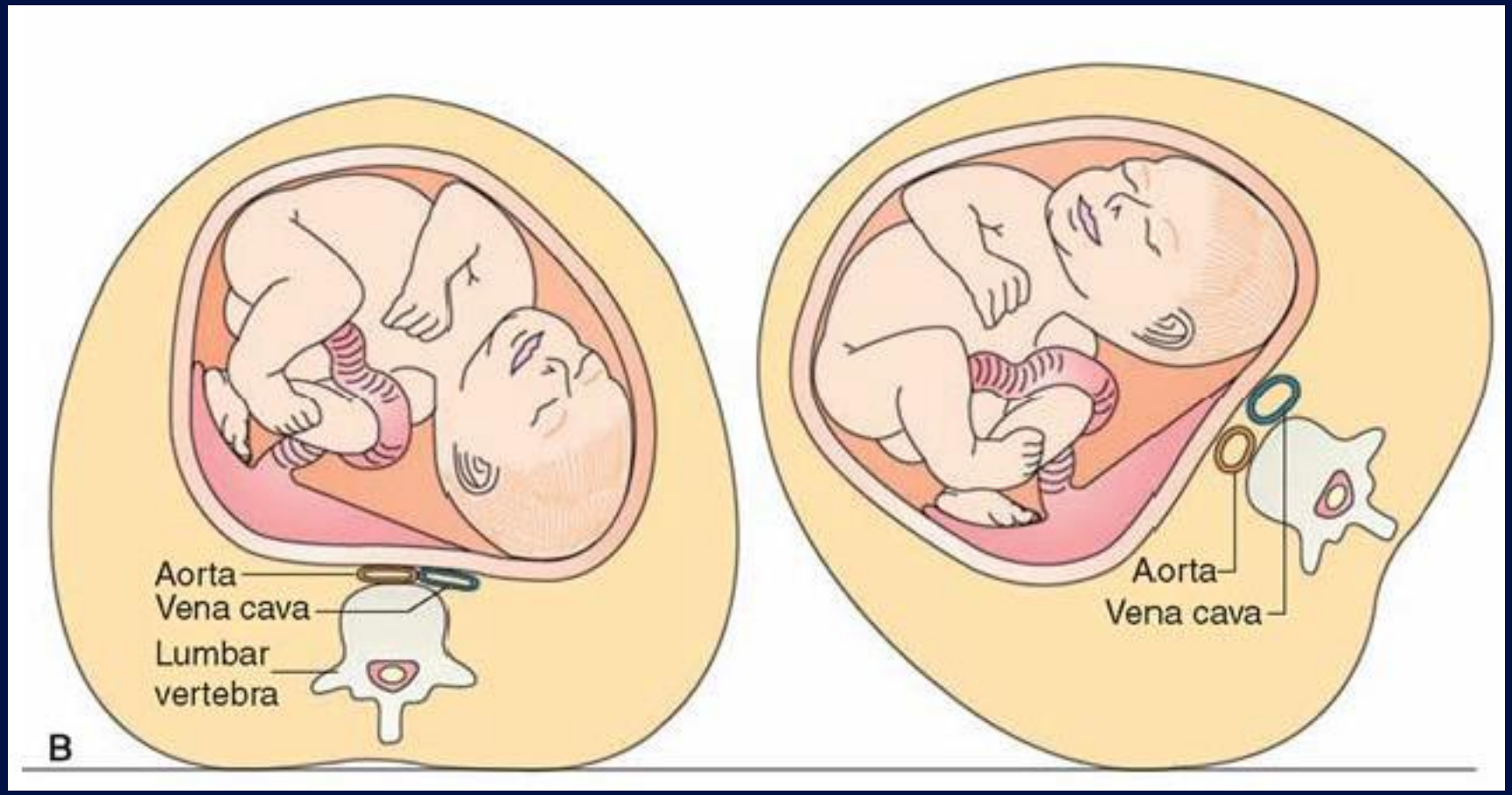
Pregnancy- Specific Changes

- **Increased risk of IVC compression**



Pregnancy- Specific Changes

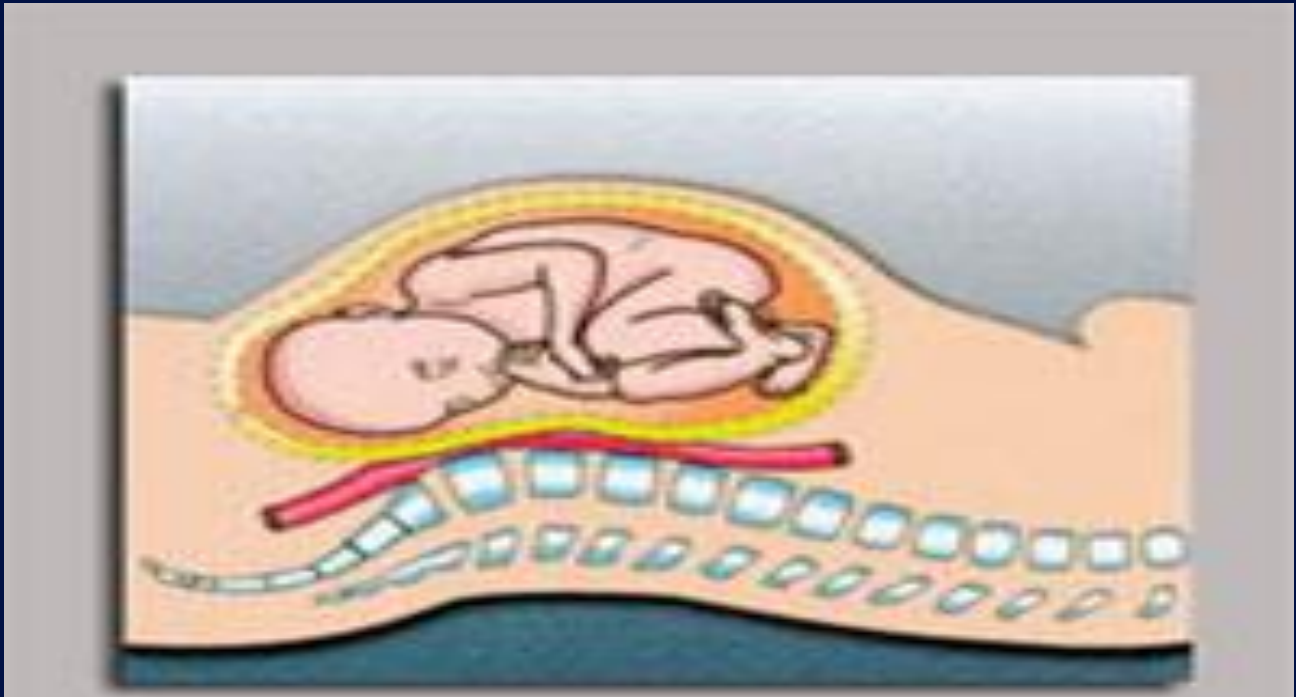
- **Increased risk of IVC compression**



Pregnancy- Specific Changes

- **Cardiopulmonary resuscitation**

- External chest compression is more difficult during pregnancy because of reduced chest compliance in pregnant women



Pregnancy- Specific Changes

- **Cardiopulmonary resuscitation**

- In some instances, emptying the uterus by performing a cesarean delivery is required to perform effective cardiopulmonary resuscitation and save the mother's life (1)

- Several studies have suggested that the best fetal and maternal outcomes are achieved if a cesarean delivery is performed within four to five minutes of a cardiac arrest if maternal resuscitation has not been successful (2)

(1) Obstet Gynecol. 1986;68(4):571.
(2) Am J Obstet Gynecol. 2005;192(6):1916.

Pregnancy- Specific Changes

- **Increased vascularity and blood flow**

- The dilated pelvic vasculature increases the risk of retroperitoneal hemorrhage from abdominal or pelvic injury (1)

- Rapid exsanguination can occur since blood flow to the uterus is as high as 600 mL/min.

(1) Obstet Gynecol Clin North Am. 1999;26(3):459.

Pregnancy- Specific Changes

- **Increased vascularity and blood flow**

- Fetal oxygenation is dependent, in part, upon uterine blood flow.

- Uterine blood flow is not autoregulated, thus a decrease in maternal SBP can cause a significant fall in uterine blood flow, and in turn, fetal oxygenation

- Uterine blood flow can also be reduced from vasoconstriction related to drugs or maternal hypercarbia or hypocarbia

Pregnancy- Specific Changes

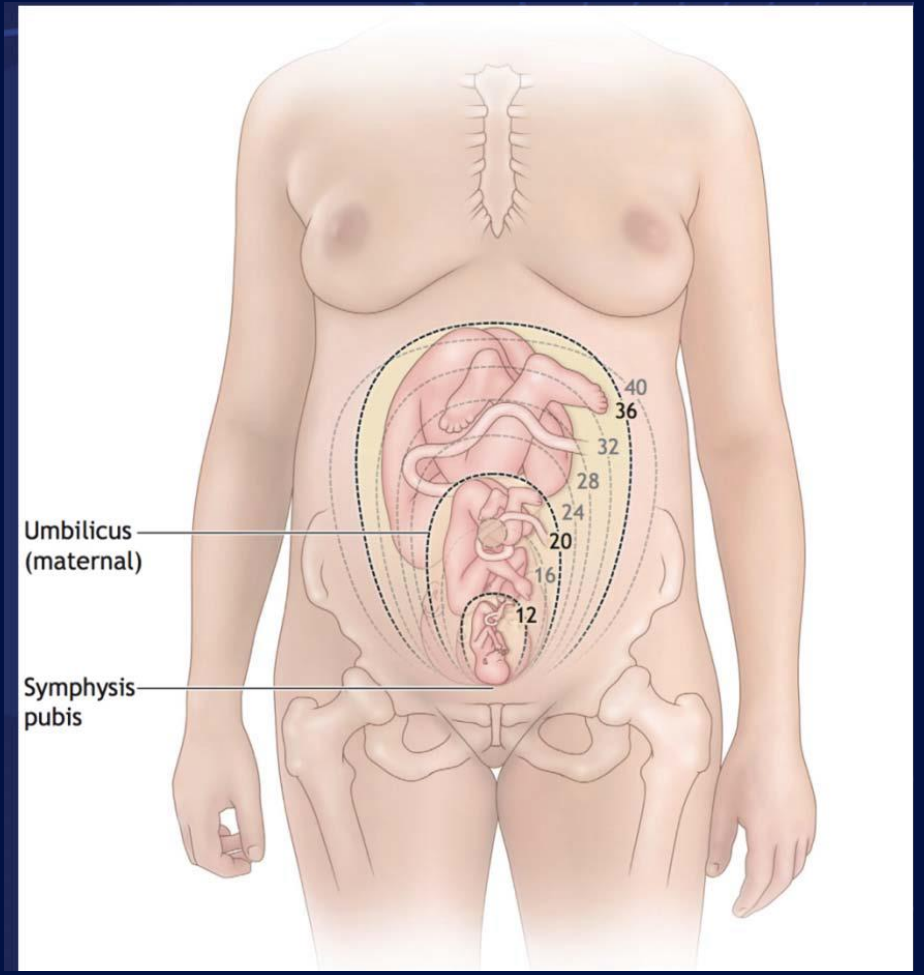
- **Uterine size changes**

First Trimester

- Intrapelvic and thick walled Uterus

- Fetus is protected from direct Injury

- Abortion and Isoimmunization

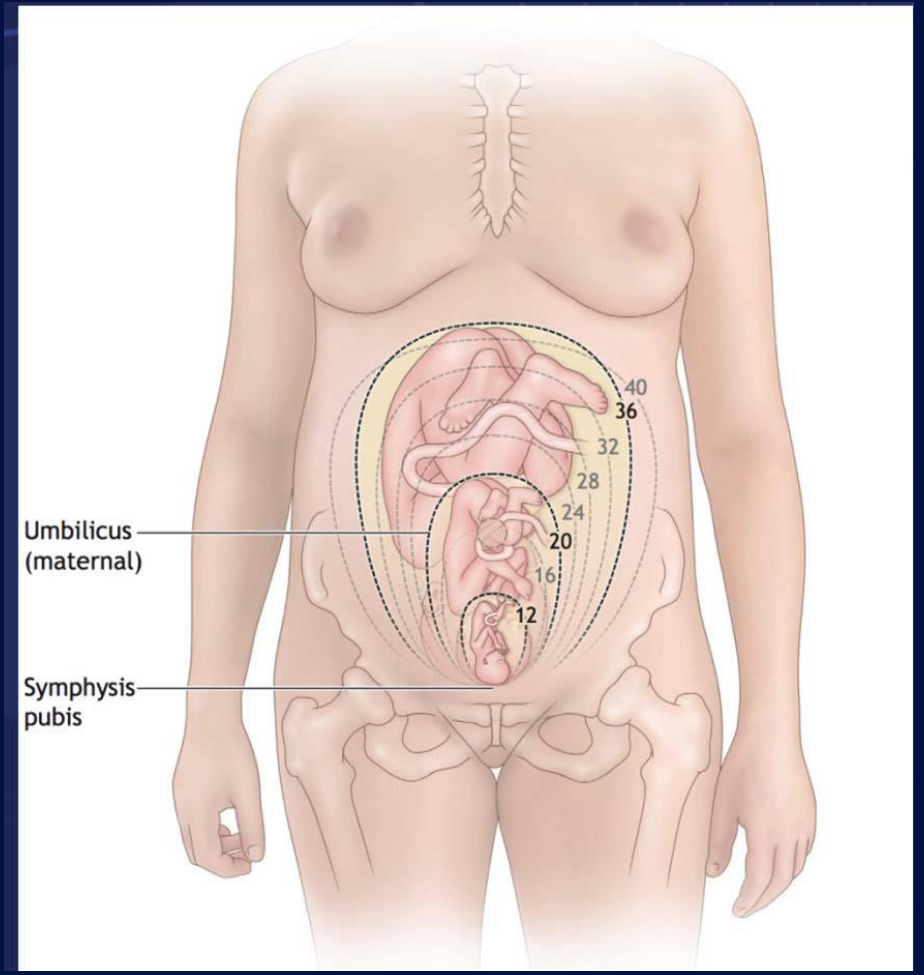


Pregnancy- Specific Changes

- **Uterine size changes**

Second Trimester

- Extrapelvic uterus
- Large volume of amniotic fluid
- Placental Abruption
- Amniotic fluid embolization
- Isoimmunization



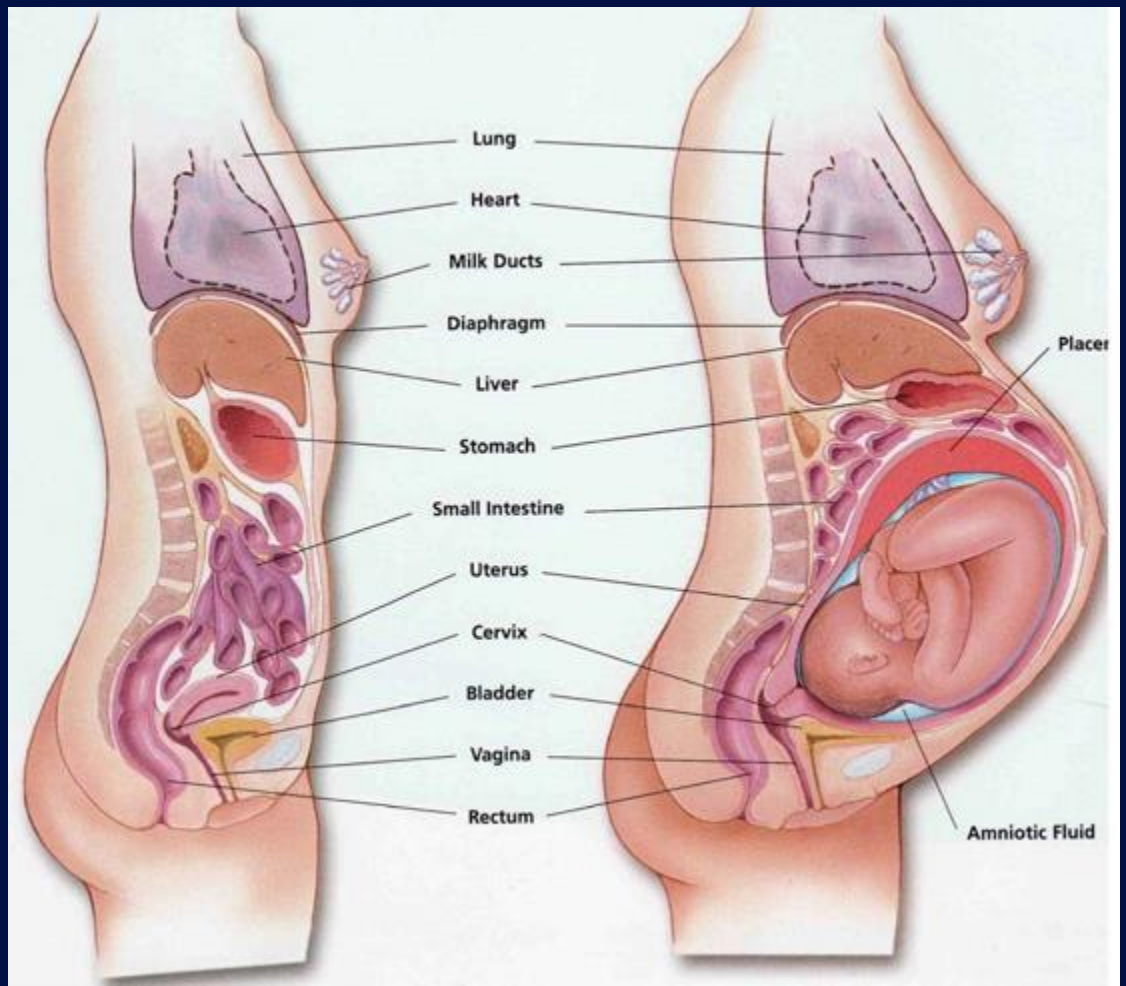
Pregnancy- Specific Changes

❑ Uterine size changes

Third Trimester

- Thin walled uterus
- Displacement of maternal abdominal viscera
- IVC compression

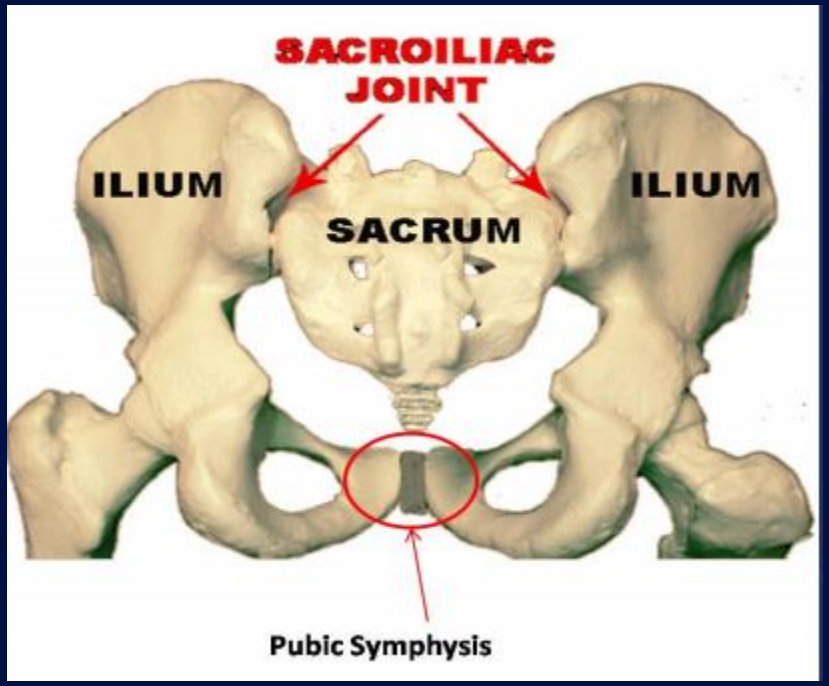
- Pelvic fractures with maternal Hemorrhage and direct fetal injury
- Amniotic fluid embolization
- Placental abruption
- Isoimmunization



Pregnancy- Specific Changes

- **Changes in the pelvis**

- Pelvic ligaments soften
  - Pelvic widening
  - Lordosis
  - Shift in the center of gravity



Nile River in Aswan



Mechanism of injury

- Most mechanism of injury are similar to those in the nonpregnant patient
- However, certain differences must be recognized in the pregnant patients
- As pregnancy progresses, the chance of accidental injury increases by the end of third trimester
- Minor trauma occurs more frequently than at any other time during female adulthood
- Alterations of the centre of gravity caused by the enlarged uterus, as also the pelvic ligament laxity are responsible for the gait instability which causes pregnant women to be more susceptible to injury by falls

Types of trauma

- Blunt abdominal trauma
  - 40% >>> Motor vehicle accidents
  - 30% >>> Falls
  - 20% >>> Interpersonal violence

Types of trauma

Blunt abdominal trauma

- As pregnancy progresses, the enlarged uterus looses the protection of the bony pelvis, but the amniotic fluid provides some protection for the fetus by absorbing the thrust of blunt trauma, dissipating the force of the blow by transmitting it equally in all directions.

- However, the pelvic vessels are engorged due to increased intravascular volume in pregnancy and thus there may be increased chances of retroperitoneal hemorrhage as a result of blunt abdominal trauma

Types of trauma

- Blunt abdominal trauma

- The rate of fetal mortality after maternal blunt trauma is 3.4 to 38% mostly from:

  - Placental abruption,
  - Maternal shock, and
  - Maternal death

- Regardless of the apparent severity of injury in blunt trauma, all pregnant women should be evaluated in a medical setting

Grossman NB. Am Family physician 2004; 70: 1303-10

Types of trauma

Penetrating trauma

Gunshot and stab wounds

- ❑ Fetal and maternal morbidity and mortality are significantly different
- ❑ Maternal mortality occurs in < 5% of cases of penetrating trauma
- ❑ During the progress of pregnancy, intra-abdominal organs change their positions

Stone IK. Obst and Gynecol Cl N Am 1999; 26: 459-67

Types of trauma

Penetrating trauma

- Because the bowel is pushed upward by the enlarged uterus, penetrating injury to the upper part of the abdomen is more likely to be associated with multiple gastrointestinal injuries

- During the third trimester, injuries to the lower quadrants of the abdomen almost exclusively involve the uterus

- This may be advantageous to the women because the uterus and the amniotic fluid absorb most of the energy of the penetrating object, resulting in less destruction of other organs

Grossman NB. Am Family physician 2004; 70: 1303-10

Types of trauma

The head injured patient

The most frequent causes of trauma- related maternal death in pregnancy

- Head and neck injuries,
- Respiratory failure, and
- Hypovolemic shock

Types of trauma

The head injured patient

Increased likelihood of suffering from:

- Elevated ICP
- Cervical fracture(s)
- Difficult airway
- Hypovolemia; IVC compression
- Decreased level of consciousness
- Full stomach; aspiration
- Hypoxemia

Types of trauma

Burns

Thermal injury:

❑ About 5-10% of pregnant women suffer from thermal injury

❑ The rule of nine is used to determine the percentage of total body surface area (TBSA) involved, keeping in mind that the large abdominal surface in near term patients counts for a large percentage of TBSA

❑ The fetal death depends upon the general physical condition of the woman and the TBSA involved

Types of trauma

Burns

Direct inhalational injury

❑ Upper airway edema, which can lead to life threatening airway obstruction

❑ However, lower airways can also be injured by exposure to smoke or toxic products of combustion

❑ Major burn can alter pulmonary function even in the absence of direct lung injury

Types of trauma

Burns

Electrical injury:

- Physical damage to the woman is caused by direct effect of heat generated by the current as well as associated trauma

- The type of current, its path through the body, and voltage also affect the type of injury.

Types of trauma

Burns

Electrical injury:

- Most victims of electrical injury have multisystem trauma due to violent muscle contraction, skeletal fractures due to fall, and neurologic damage

- The fetus is immersed in amniotic fluid, which is an excellent conductor of electrical charge

- Thus, the fetus is at greater risk than the mother.

Severity of injuries

- Severity of maternal injuries determines not only maternal but also fetal outcome

- Therefore, the method of treatment also is dependent on the severity of maternal injuries

- All traumatized pregnant women with major injuries require admission to a hospital where surgical as well as obstetric facilities are available due to high rate of mortality

Severity of injuries

- Even, the pregnant woman with minor injuries should be carefully observed since occasionally even minor injuries are associated with such complications as feto-maternal hemorrhage (the presence of fetal RBCs in the maternal circulation)

- Direct fetal injuries usually tend to occur in late pregnancy, and are typically associated with serious maternal trauma

Management

Volume replacement



Management

Respiratory support



Management

Respiratory support

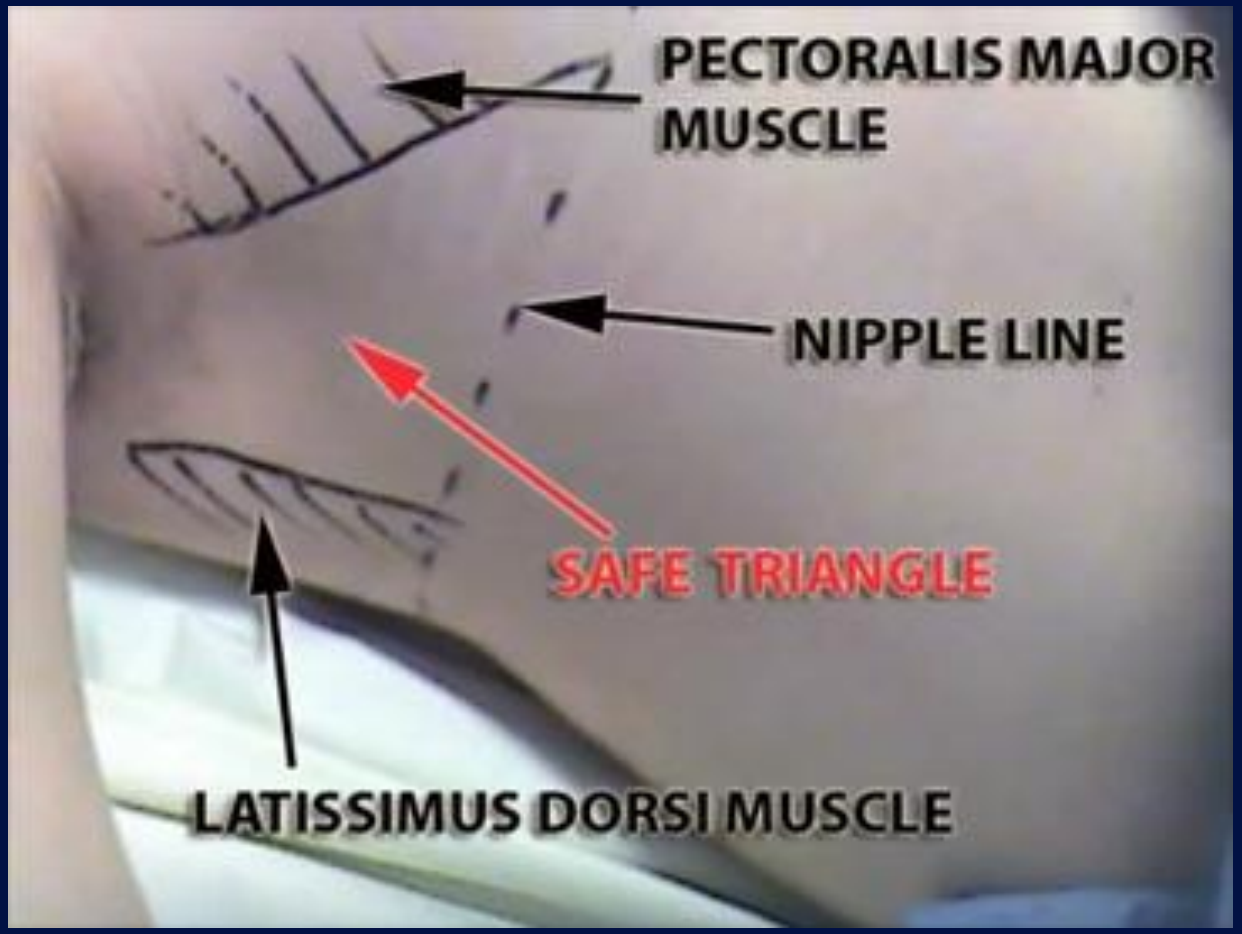
- Airway edema is more common in pregnant women and can contribute to difficult intubation.

- Difficulty securing the airway, along with the decreased lower esophageal tone, are the primary factors that increase the risk of aspiration.

- Applying cricoid pressure to prevent aspiration of gastric contents until the airway has been protected with a cuffed endotracheal tube

Management

Respiratory support



Management

Indications for urgent cesarean delivery

(1) Imminent maternal death,

(2) CPR that has not been effective within four minutes, or

(3) A stable mother with a non reassuring fetal heart rate tracing

(4) A cesarean delivery may also be necessary during laparotomy for repair of maternal injuries if the gravid uterus prevents adequate surgical exposure

Management

The rationale for urgent cesarean delivery

- Irreversible brain damage can occur in non pregnant individuals after four to six minutes of anoxia
- Pregnant women become anoxic sooner than nonpregnant women because of decreased functional residual capacity
- If the uterine fundus ≥4 fingerbreadths above the umbilicus, ineffective resuscitation efforts may become effective when the uterus is no longer gravid and potentially causing aortocaval compression
- Intact fetal survival diminishes as the time between maternal death and delivery lengthen

Management

Blunt abdominal trauma

- If the patient is awake, alert, hemodynamically stable, and free of abdominal pain or tenderness and signs of external trauma, intraabdomina injury is highly unlikely

- In other patients, ultrasound examination to look for free fluid in the pelvis/abdomen appears to be useful in determining whether blunt trauma caused intraabdominal bleeding

- If peritoneal lavage is performed, an open technique superior to the uterine fundus has been recommended after placement of a nasogastric tube and bladder catheter

Management

Burns

- Burns are managed as in non pregnant women

- Prompt aggressive fluid resuscitation,
- Early supplemental oxygen with a low threshold for MV support,
- Early delivery of the fetus if the pregnancy is in the third trimester and total body surface area is >50 percent, and
- High suspicion for venous thrombosis and sepsis with early and aggressive treatment

Management

Obstetrical issues

Uterine rupture

- Sharp or blunt abdominal trauma can lead to uterine rupture
- Rare (0.6%) – severe trauma

- Signs and symptoms include:

  - Shock,
  - Non-reassuring fetal heart rate tracing or fetal death,
  - Uterine tenderness,
  - Peritoneal irritation, and
  - Vaginal bleeding

Management

Obstetrical issues

Penetrating abdominal trauma

- In contrast to nonpregnant victims of abdominal penetrating trauma where immediate surgical exploration is the most common management approach

- In pregnancy, the decision to proceed immediately to surgical exploration is based on:

  - Location of the injury (upper or lower abdomen) and
  - The uterine size,
  - Maternal and fetal vital signs.

Management

Obstetrical issues

Penetrating abdominal trauma

- If the injury is in the upper abdomen, then surgical exploration is generally the best approach

- If the injury is in the lower abdomen and mother and fetus are stable, then a more conservative approach, including observation, laparoscopy and wound exploration, is reasonable

Management

Obstetrical issues

Placental Abruption

- Most common blunt injury
- Up to 50% in severe trauma, 3% minor trauma
- Shearing effect and separation between placenta and the uterus
- Flexible myometrium / inflexible placenta
- May have vaginal bleeding and tenderness
- Fetal monitoring most sensitive for fetal distress
- U/S specific but not sensitive, detects 50% of the cases

Management

Obstetrical issues

- Maternal-Fetal Hemorrhage
  - Increases with trimester (3%, 12%, 45%)
  - 4-5x more common in injured pregnant women
  - Causes isoimmunization and fetal death
  - Rhogam for Rh- mother

Management

Obstetrical issues

Preterm labor and premature rupture of membranes:

- The possibility of preterm labor or premature rupture of membranes should also be considered in the evaluation of these patients

Vaginal delivery:

- Pelvic fractures do not necessarily preclude vaginal delivery, unless displacement obstructs fetal descent

OUTCOME

Potential consequences of major trauma during pregnancy include:

- Maternal injury or death
- Fetal injury or death
- Pregnancy complications: abruption, preterm delivery, premature rupture of membranes
- Any of the complications of major trauma in the nonpregnant woman

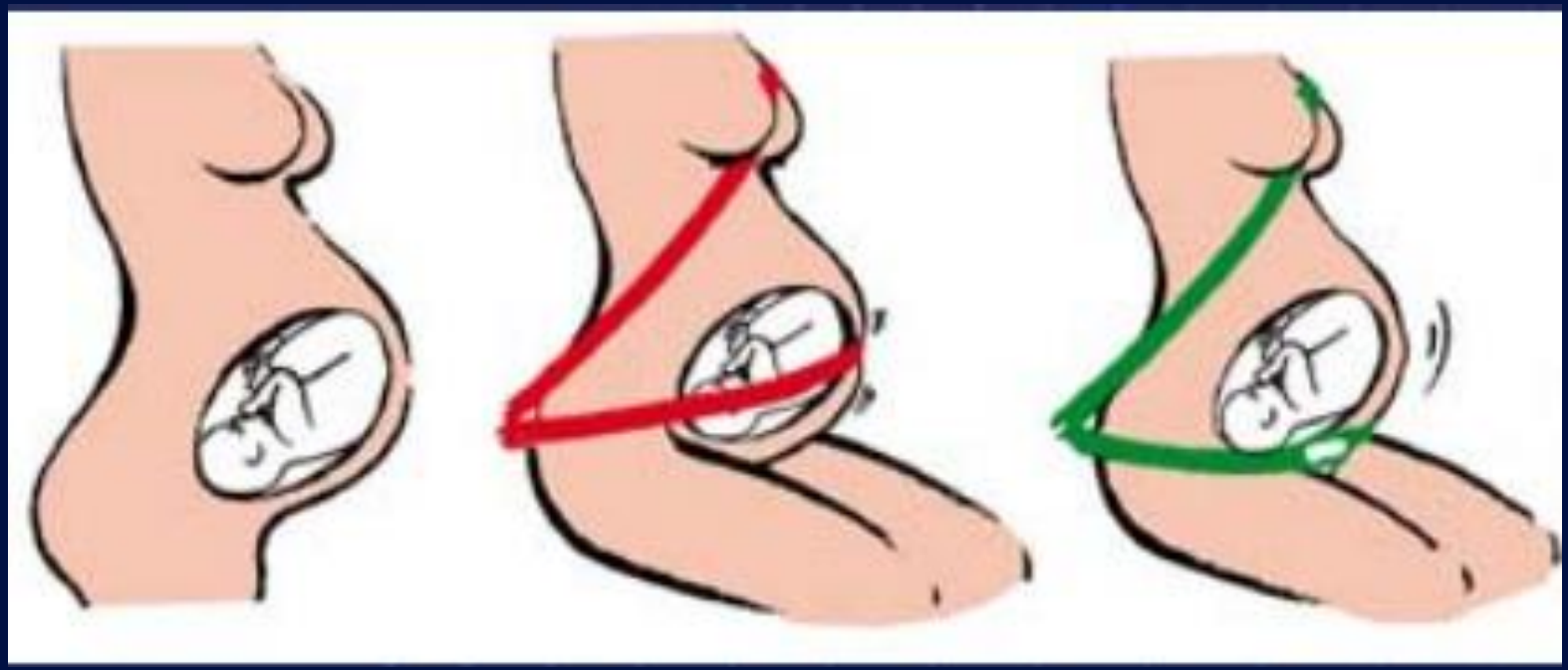
- Maternal mortality as a result of trauma is not increased by pregnancy,

- Mortality is less compared to non pregnant women of similar age with equivalent injuries

PREVENTION

Prenatal care should incorporate education about:

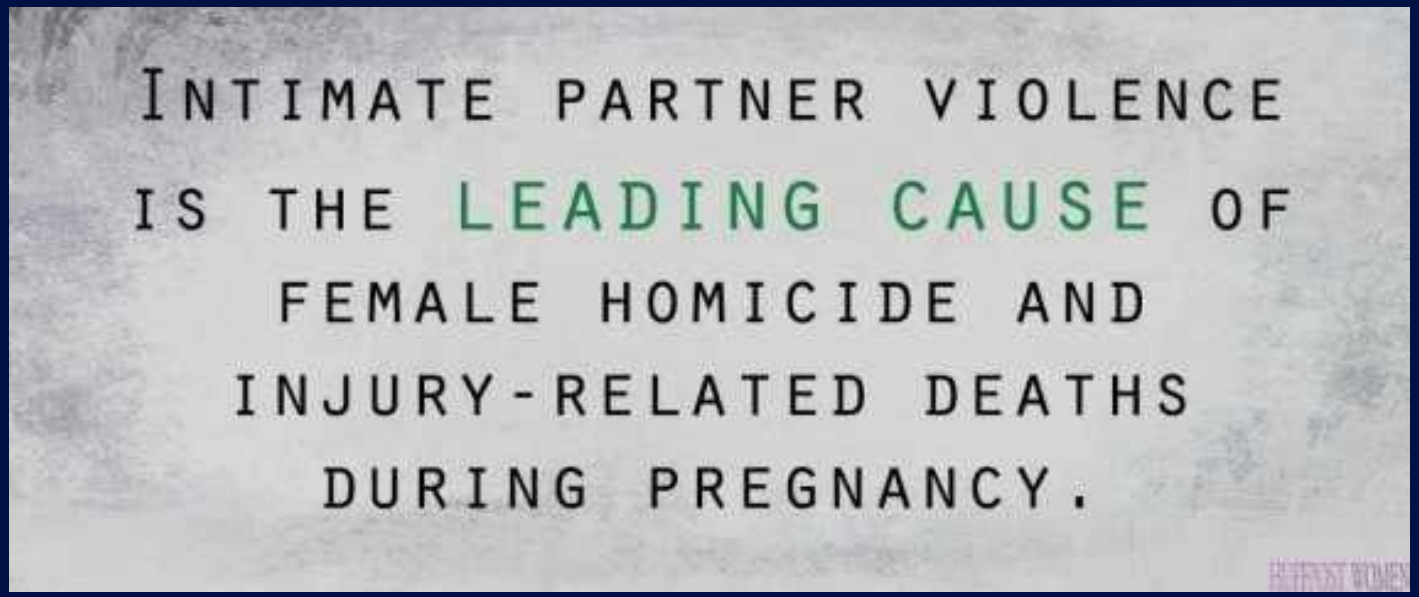
- ❑ Correct seat belt use in pregnancy



PREVENTION

Prenatal care should incorporate education about:

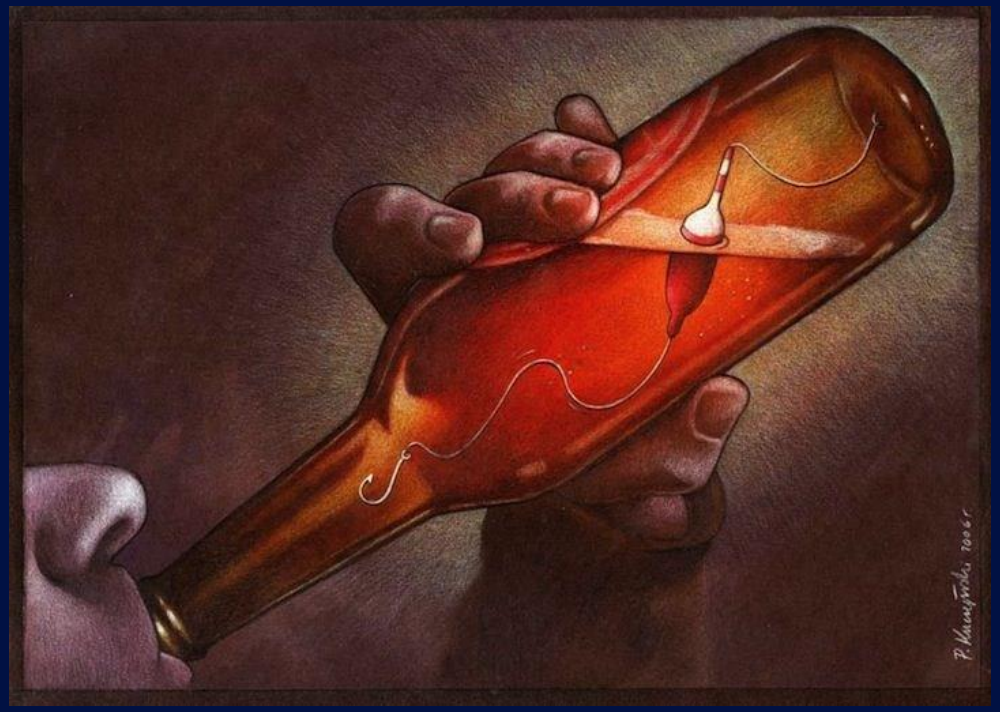
- ❑ Evaluation for the presence of domestic violence





PREVENTION

- Drugs and Alcohol Abuse





Thank You