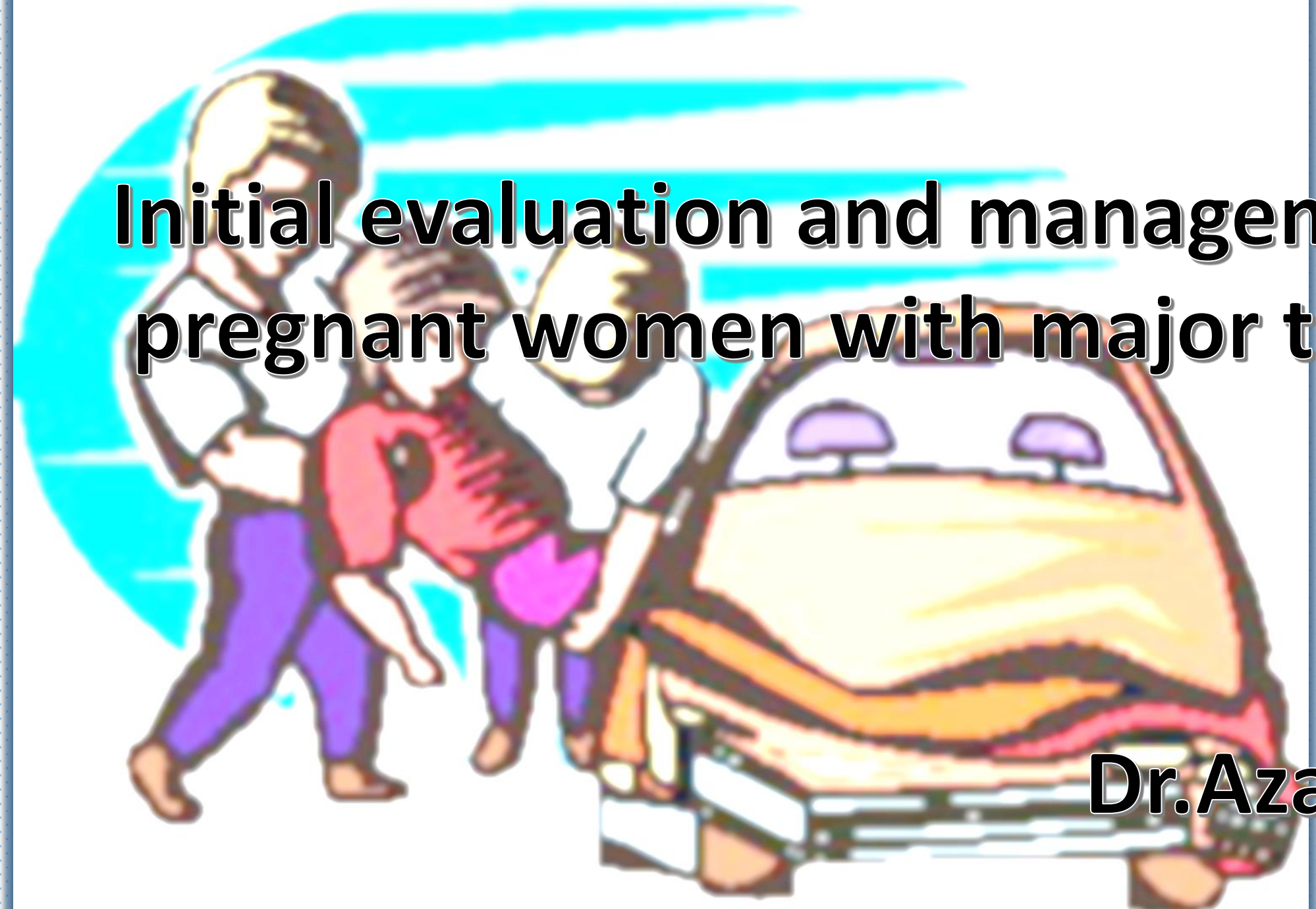


Initial evaluation and management of pregnant women with major trauma

Dr.Azar.nabati

•INTRODUCTION

- Motor vehicle accidents and domestic/intimate partner violence account for most cases of maternal major trauma, while falls, burns, homicide, suicide, penetrating trauma, and toxic exposure account for the majority of the remainder .

- Evaluation of the pregnant patient with major trauma presents unique challenges since the presence of a fetus means ***two patients are potentially at risk***, both of whom require evaluation and management.

- In the pregnant woman, compression of the abdomen from a fall, intentional violence, or a low-speed motor vehicle crash can be considered **major trauma**.

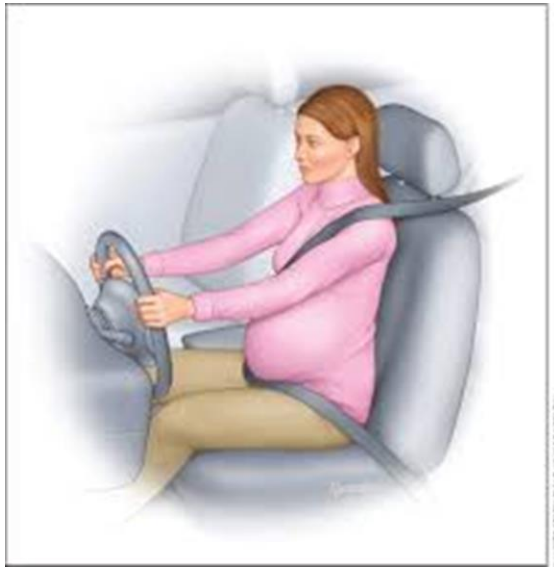
- Issues specific to the pregnant major trauma patient will be discussed here. Issues related to management of trauma in the nonpregnant population are reviewed separately.

- **PREVALENCE**

- Trauma affects 6 to 8 percent of pregnancies .

- A 2013 systematic review of studies on trauma in pregnancy reported the following estimates of trauma prevalence by subtype of trauma :

- Domestic violence – 8307/100,000 live births
- Motor vehicle crash – 207/100,000 live births
- Falls – 49/100,000 live births
- Homicide – 3/100,000 live births
- Penetrating trauma – 3/100,000 live births
- Suicide – 2/100,000 live births
- Toxic exposure – 26/100,000 person-years
- Burns – 0.17/100,000 person-years



- **PREGNANCY-RELATED CHANGES IN PHYSIOLOGY**

- Physiological changes related to pregnancy occur in virtually all systems and are caused by both hormonal and mechanical factors.

- These normal changes need to be considered when evaluating the status of pregnant trauma victims.

- Pertinent changes in major organ systems are summarized below; in-depth reviews of each topic can be found separately

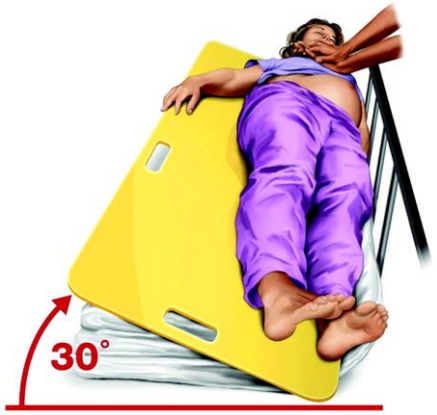
• *Cardiovascular*

Cardiac output (CO) increases by **20 percent** at eight weeks of gestation and continues to rise until 30 to 32 weeks, at which point it plateaus at approximately 50 percent above baseline until the beginning of labor. The rise in CO is due to:

- ● Increased preload from a rise in blood volume
- ● Decreased afterload from declining vascular resistance
- ● Increased maternal heart rate, by 15 to 20 beats per minute

- Supine position at term can lower CO by 25 to 30 percent compared with left lateral decubitus position, due to compression of the inferior vena cava by the gravid uterus (figure 3).

- Cardiac flow murmurs are extremely common in pregnancy secondary to increased cardiac output. Thus, an isolated murmur in the otherwise stable pregnant trauma patient is not likely to reflect an acute cardiac injury.
- Pregnancy related, normal ECG findings include:



15 to 20° left axis deviation.

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

• *Pulmonary*

- Beginning in the first trimester, increases in tidal volume and respiratory drive (due to the stimulatory effects of progesterone) cause hyperventilation and a chronic respiratory alkalosis (figure 4 and table 1).

- The compensatory fall in the plasma bicarbonate concentration diminishes its buffering ability.
- Pregnancy-related pulmonary changes include:

PaO may be slightly elevated at 104 to 108 mmHg as a result of the increase in CO and minimization of the ventilation-perfusion mismatch in the lung.

Beginning at approximately 20 weeks of gestation, upward displacement of the diaphragm leads to a 20 percent decrease in functional residual capacity.

Oxygen consumption increases by almost 20 percent.

• *Hematologic*

Pregnancy-related hematologic changes include:

- Plasma volume increases by 50 percent by 32 weeks of gestation.
- Total red cell mass increases only by 20 to 30 percent, resulting in hemodilution ("physiologic anemia of pregnancy"), with normal hemoglobin levels as low as 11 g/dL in the first and third trimesters, and 10.5 g/dL in the second trimester (figure 1).
- Mild leukocytosis (6000 to 16,000 cell/mm).
- Small reduction in platelet count, which typically remains within the normal range.
- Pregnancy is a procoagulant state. A variety of changes occur in procoagulant and anticoagulant pathways, which on balance increase coagulation potential on a background of reduced anticoagulation and fibrinolysis.

The normal fibrinogen concentration is **greater than 400 mg/dL.**

• *Gastrointestinal*

Pregnant women are at high risk of gastric aspiration, most likely

related to decreased lower esophageal sphincter tone and increased intraabdominal pressure.

Gastric emptying is not affected by pregnancy, though it is slowed by labor and opioid analgesics.

• *Renal*

Glomerular filtration rate and renal blood flow rise markedly during pregnancy, resulting in a physiologic fall in the serum creatinine concentration to:

0.4 to 0.5 mg/dL (35 to 44 micromol/L).

• *Uterus*

- Major changes to the uterus and its vascular supply occur in pregnancy:

  - For the first 12 weeks of pregnancy, the uterus is a pelvic organ and thus protected from external injury by the bony pelvis.
  - Further uterine enlargement into the abdomen after 12 weeks makes it more vulnerable to injury.

The enlarged uterus reduces the risk of visceral injury after lower abdominal penetrating injuries by displacing the bowel cephalad and laterally, whereas penetrating injuries above the uterine fundus are likely to damage the bowel for the same reason

The pelvic vasculature is dilated in pregnancy.

Injury to the dilated pelvic vasculature can result in rapid exsanguination.

Uterine blood flow is as high as 600 mL/minute in the third trimester and not autoregulated, thus a decrease in maternal systolic blood pressure can cause a significant fall in blood flow, and in turn, fetal oxygenation.

- **INITIAL EVALUATION AND MANAGEMENT OF MAJOR TRAUMA**

• *General principles*

- The approach to evaluation and management of trauma in pregnant women is dictated by its severity and influenced by the gestational age.

- The following discussion refers to pregnant women who have been subjected to more than minor trauma.

- Optimal care of these patients requires good communication among a multidisciplinary group of clinicians .

- Major trauma is defined in various ways, but typically takes into account the risk of death or impairment, need for hospital or complex resources for treatment, impact on quality of life, and need for prolonged recovery.

- The obstetric service should be consulted simultaneously with other specialties to help with the evaluation and to determine whether emergency cesarean delivery is indicated.

- A simple, quick, and crude method for estimating gestational age is to determine the location of the uterine fundus:

  If below the umbilicus, the pregnancy is likely less than 20 weeks of gestation;

  if at or above the umbilicus, the pregnancy is likely greater than 20 weeks.

- This is important because:

  - Consideration of cesarean delivery for maternal resuscitation is only warranted if the uterus is above the umbilicus because a uterus this large can compress the vena cava and impede maternal resuscitation.

  - Cesarean delivery for fetal indications is only warranted if the uterus is above the umbilicus because 22 to 23 weeks is the lower limit of neonatal viability, thus cesarean delivery before 23 weeks almost never benefits the neonate

- Any diagnostic test or treatment required to save the mother's life or treat her critical status should be undertaken, even if such intervention is potentially disadvantageous to the fetus.
- In most cases, short- and long-term morbidity in surviving fetuses are related to the direct and indirect consequences of maternal trauma (eg, hypotension, hypoxemia, abruptio placentae, preterm birth), so accurate maternal diagnosis and appropriate maternal treatment can significantly impact the fetus.
- However in cases of direct fetal injury, the fetal injury may be more serious than the maternal injury .

- <u>The initial goal is</u>

assess the maternal airway, breathing, and circulation and establish maternal cardiopulmonary stability

• *Airway, breathing, and ventilation*

Oxygen supplementation should be used liberally, as anoxia develops more quickly in pregnant women.

Maternal oxygen saturation (SaO) should be maintained at **>95 percent** during pregnancy, which is in excess of the oxygen delivery needs of the mother.

If SaO2 falls below 95 percent, an arterial blood gas is obtained to measure PaO : Maternal PaO greater than 70 mmHg is desirable to maintain a favorable oxygen diffusion gradient from the maternal to the fetal side of the placenta.

If adequate maternal oxygenation has not been achieved, preoxygenation and early intubation are recommended.

- Assume a difficult airway as airway edema is more common in pregnant women and can contribute to difficult intubation

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

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

- The value of **cricoid pressure** has been questioned in nonpregnant individuals because of some evidence that it may impair gas exchange and ventilation; however, no randomized trials have assessed the efficacy of cricoid pressure in pregnant women.

- Modifying or releasing cricoid pressure should be considered if there are any problems with ventilation or intubation.
- If intubation is performed, a nasogastric or orogastric tube should be placed for gastric decompression and mitigation of continued aspiration risk

- If a chest tube is placed, the clinician should keep in mind that the **diaphragm is elevated in pregnancy**.
- Some experts suggest placing the **thoracostomy tube** one to two intercostal spaces above the usual landmark of the **fifth intercostal space**

• *Cervical spine immobilization*

- Spinal precautions are indicated for all patients who may have a spinal cord injury.

- If a patient is on a spinal board, it should be removed as soon as is safely possible.

• *Circulation*

- Circulation is restored/maintained via uterine displacement (if the uterus is at or above the umbilicus), aggressive infusion of crystalloids, and transfusion, when indicated.

- Uterine displacement

- If the uterus is at or above the umbilicus, displacing the uterus to the left, off the aortocaval vessels, is critical to maximizing cardiac output and should be done as soon as possible.

- This is best accomplished by placing the woman on her left side, but if this is not possible then putting a wedge or rolled towel under her right hip (or the spinal board) or adjusting her platform to achieve a 30° left lateral tilt is also useful.

- Volume replacement

- We place one or two large bore (eg, 14 or 16 gauge) intravenous lines in women who may have been seriously injured.

- Fluid replacement should be aggressive as substantial changes in vital signs may not occur until 15 to 20 percent of total blood volume has been lost, because of the physiologic hypervolemia of pregnancy .

- Volume replacement is preferable to vasopressors for blood pressure support since vasopressors can reduce uterine blood flow .

- Vasopressors can be administered to treat persistent hypotension refractory to fluid administration.

- Transfusion

- If transfusion is indicated, transfusion protocols and targets are similar to those in nonpregnant individuals, except a fibrinogen level >200 or even 300 mg/dL is desirable because ***pregnant women have higher baseline fibrinogen levels.***

- A fibrinogen level >200 mg/dL in a pregnant woman is considered the minimum level necessary for adequate coagulation.

- Fibrinogen levels **<100 mg/dL** are suggestive of **disseminated intravascular coagulation**, which can be a complication of placental abruption

- Cardiopulmonary resuscitation

- External chest compression is more difficult during pregnancy because of reduced chest compliance .

- It also may not be effective in the late second and third trimesters because aortocaval compression in the supine position significantly reduces cardiac output, even with uterine displacement .

- Emptying a uterus that is at or above the umbilicus by performing a cesarean delivery increases the effectiveness of cardiopulmonary resuscitation and can save the mother's life, even if the fetus will not benefit because it is previable or at the limit of viability

- Reviews of perimortem cesarean delivery suggest optimum newborn and maternal survival are obtained when cesarean delivery is initiated within four minutes of maternal cardiac arrest and the fetus is delivered within five minutes of unsuccessful resuscitation attempts.

- Fetal survival rates fall to 5 percent after 15 minutes and neonatal survivors are at risk for developing adverse neurologic sequelae.

- The principle of cesarean delivery if maternal resuscitative efforts have not been successful after four minutes (***the "five-minute rule***") has been adopted by the American Heart Association.

• *Fetal heart rate*

- Measurement of the fetal heart rate is the minimum initial fetal assessment to determine whether the fetus is alive, and if alive, whether it is compromised.
- The normal fetal heart rate is 110 to 160 beats per minute.
- ***It is important to compare the maternal and fetal heart rates to make sure that the fetal heart rate, not the maternal heart rate, is being determined***

- If the gestational age is less than 22 or 23 weeks, documentation of the *fetal heart rate* alone is adequate.

- At ≥24 weeks, and especially if emergency delivery and neonatal resuscitation would be considered, continuous electronic fetal heart rate monitoring for assessment of both the heart rate and pattern is preferable, if feasible.

• *Neurologic evaluation*

- A focused neurologic examination is performed after problems related to the airway, breathing, and circulation are addressed, as in nonpregnant women.

- **Although *seizures* may occur as a result of head trauma, assessment for *eclampsia* should also be done as part of the evaluation of seizures in this population.**

- **Eclampsia** is a clinical diagnosis typically based upon the occurrence of new-onset generalized tonic-clonic seizures in a woman with preeclampsia (table 2).

•*Diagnostic laboratory tests*

- Laboratory testing should be performed **based upon clinical suspicion** and should be limited to those tests that may alter management

- Toxicology screening is appropriate when indicated for forensic purposes or when results might alter acute management

- **RhD status** should be determined in pregnant women.

- In RhD-negative women, we obtain a Kleihauer-Betke test (or flow cytometry) to quantitate fetomaternal bleeding and guide anti-D immune globulin dosing.

• *Diagnostic imaging*

- Diagnostic imaging should be performed, as medically appropriate.

- When techniques involving ionizing radiation are required, the information obtained nearly always outweighs the radiation risk to the fetus since fetal radiation exposure from diagnostic studies is generally small and without serious fetal effects .

- The levels of radiation and the risks associated with diagnostic imaging procedures in pregnant women are discussed in detail separately.

- **Ultrasound**, when appropriate, is the preferred imaging modality because of its safety in pregnancy.

- Bedside ultrasound is an integral component of trauma management, and used primarily to detect free intraperitoneal blood after blunt trauma.

- The trauma ultrasound examination focuses on dependent intraperitoneal sites where blood is most likely to accumulate:

  - ♠ *the hepatorenal space (Morison's pouch),*
  - ♠ *the splenorenal recess, and the*
  - ♠ *inferior portion of the peritoneal cavity (including pouch of Douglas).*

- These studies, when combined with evaluation of the pericardium, are referred to as the FAST exam (Focused Assessment with Sonography for Trauma).

- Focused Assessment with Sonography for Obstetrics (FASO) is a similar examination for pregnant women that is limited to intraperitoneal sites .

- In some cases, magnetic resonance imaging is the preferred diagnostic modality because it provides better images than ultrasonography, while avoiding the ionizing radiation of computed tomography (CT).

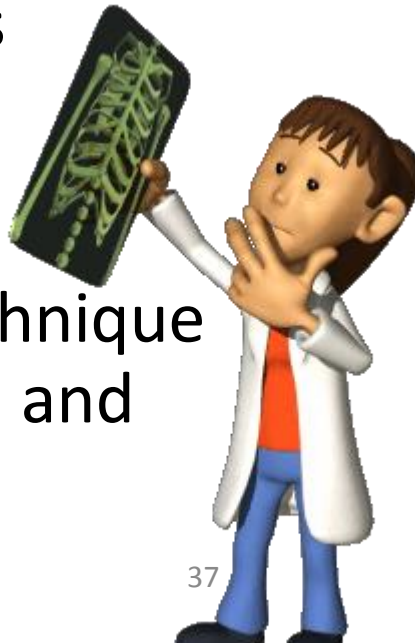
- If CT or magnetic resonance imaging of the abdomen or pelvis is necessary to evaluate the maternal condition, these studies may identify intrauterine pathology, such as a fetal fracture or abruptio placenta, as well.
-

• *Diagnostic procedures*

- Among patients with abdominal trauma, diagnostic peritoneal lavage has been almost entirely replaced by **ultrasound and multidetector helical CT** scanning.

- The procedure may be necessary in some cases, such as in hypotensive patients with equivocal results on FAST examination and multiple potential sources of blood loss, and in resource-poor settings where advanced imaging is unavailable.

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



- **PREGNANCY EVALUATION AND MANAGEMENT AFTER INITIAL MATERNAL STABILIZATION**

• *History*

- A mnemonic for the focused history in pregnant trauma patients is CODE:

Complications of pregnancy, **O**bstetric history and provider, **D**ating method and estimated due date, and **E**vent details (eg, leaking, bleeding, contractions, fetal movement, uterine pain/tenderness) .

• *Physical examination*

- The goal of the physical examination is to identify maternal and fetal injuries.

- Specific considerations in pregnant women are discussed below

- Determining gestation age
- After, or simultaneous with, stabilizing the gravida, the gestational age should be determined by physical examination, and history/obstetric records if available. This information is crucial when making decisions about management of both the mother and fetus.

- In singleton pregnancies, the uterus is a pelvic organ for the first 12 weeks of pregnancy. The top of the uterine fundus is palpable above the symphysis pubis at approximately 13 weeks of gestation, halfway to the umbilicus by approximately 16 weeks, at the level of the umbilicus by approximately 20 weeks, halfway between the umbilicus and costal margin at approximately 24 to 28 weeks, and at the costal margin at >34 to 36 weeks

- Once the top of the uterus reaches the umbilicus, the formula for estimating gestational age by physical examination is:

- Gestational age (weeks) = Distance from the top of the symphysis pubis to the top of the fundus (cm) This measurement is called the fundal height.

- Gestational age can be estimated by fetal biometry (eg, biparietal diameter, femur length) via ultrasound examination.
- On fetal Focused Assessment with Sonography for Trauma (fetal FAST), a femur length ≥4 cm is consistent with fetal viability (ie, 4 cm suggests fetus is between 22 and 24 weeks of gestation

- Abdominal examination after abdominal trauma

- Rebound tenderness and guarding secondary to intraabdominal injury may be less prominent than in nonpregnant women because the gravid uterus lifts and stretches the anterior abdominal wall, potentially impeding contact between areas of inflammation and the parietal peritoneum.
- The uterus is examined for size, which correlates with gestational age tenderness and rigidity, which can be signs of abruption; and intermittent firmness, which can be a sign of labor.

- Uterine rupture is not typically detectable on abdominal examination, but the uterus may be tender and fetal parts may be easily palpable.
- Detailed discussions of the physical examination after abdominal trauma can be found separately.

- Vaginal examination

- Vaginal examination is performed to assess for bleeding from the vagina or uterus, leakage of amniotic fluid, and cervical change consistent with labor.

- Digital vaginal examination should be avoided in pregnancies over 20 weeks of gestation until placenta previa has been excluded by ultrasound examination because disturbing the placenta can provoke massive hemorrhage

- BLOOD
- A speculum is performed to look for the source of bleeding (vaginal, cervical, or uterine), if present.
- Before 20 weeks of gestation, uterine bleeding can be a sign of miscarriage.
- After 20 weeks of gestation, uterine bleeding is a key finding with abruptio placenta and placenta previa, and also may occur with labor Vaginal bleeding can also be due to vaginal trauma.
- When examining the vagina, take care to avoid injury from bone fragments if a pelvic fracture is known or suspected.

- **AMNIOTIC FLUID**
- The diagnosis of rupture of membranes is based on visualization of amniotic fluid in the vagina (amniotic fluid is clear or slightly yellow and odorless).
- In the absence of obvious amniotic fluid pooling in the posterior fornix, ultrasound examination, and sometimes laboratory testing, are used to confirm or exclude the diagnosis, as shown in the algorithm (algorithm 1)

- LABOR

- A digital cervical examination is performed to evaluate for labor in women with regular uterine contractions or vaginal bleeding (after ultrasound has ruled out a placenta previa).

- The cervix is normally closed and long (3 cm thick) in pregnancy.

- A woman over 20 weeks of gestation with cervical dilation and effacement (thinning) and uterine contractions with/without bleeding may be in labor; tocolytic therapy may be indicated.

- Similar signs and symptoms before 20 weeks suggest inevitable miscarriage

• *Fetal assessment*

- Fetal status is optimally assessed by continuous fetal heart rate monitoring in pregnancies in which an emergency delivery for fetal indications would be considered.
- This is usually at ≥24 weeks of gestation, but the lower limit of viability is 22 to 23 weeks of gestation and some patients may consider intervention and neonatal resuscitation at this age.
- This is a complex decision that must be individualized.
- In pregnancies below the limit of viability, documentation of the fetal heart rate alone is generally adequate for fetal assessment.

- At or above the limit of viability, fetal well-being can be formally assessed by one or more of the following:
  - **Nonstress test**
  - **Contraction stress test**
  - **Biophysical profile**

- Fetal heart rate monitoring

- Maternal trauma can compromise the fetus as a result of maternal hypotension or hypoxemia, placental abruption, uterine rupture, or direct fetal injury.

- We suggest continuous fetal heart rate and uterine contraction monitoring for pregnancies ≥24 weeks of gestation, when feasible.

- The fetal heart rate pattern should be monitored by a clinician or nurse experienced in fetal heart rate interpretation.

- The minimum duration of post-trauma fetal monitoring has not been validated; we suggest a minimum of four hours; others have suggested two to six hours .

- Monitoring is extended to a minimum of 24 hours if any signs of abruption are present.

- The importance of prompt fetal evaluation and appropriate intervention after major maternal trauma was illustrated by a study of 441 pregnant women presenting to level 1 trauma centers; 91 percent had blunt trauma and 9 percent had penetrating trauma

- Major findings of this analysis were:

Thirty-two women (7 percent) had an *emergency cesarean delivery* for fetal distress. Fetal and maternal survival were 45 and 72 percent, respectively,in this group.

No fetus with absent fetal heart tones survived emergency delivery, while 75 percent of those with fetal heart tones and gestational age ≥26 weeks survived.

Five infants with fetal heart tones at presentation did not survive; three of these infant deaths may have resulted from delayed recognition of nonreassuring fetal heart rate patterns.

The three women had minor injuries (maternal injury severity score <16) and had been under observation for more than 2.5 hours before the cesarean delivery was performed for fetal distress

- Role of ultrasound examination

- Ultrasound examination of the fetus and placenta is useful to determine ***gestational age and placental position*** (if not already determined by prior ultrasound) and to evaluate and document fetal status.

- An abruption is likely if a subchorionic hematoma is observed, but many abruptions are not visualized sonographically.

- Fetal Focused Assessment with Sonography for Trauma (fetal FAST) consists of:
  - ► assessment of the number of fetuses and their position (eg, cephalic, breech),
  - ► placental location (previa/no previa; anterior, posterior, or fundal),
  - ► amniotic fluid volume (low, normal, high),
  - ►fetal cardiac activity (present/absent; rate normal [110 to 160 beats/minute] or abnormal),
  - ►femur length (4 cm suggests gestational age between 22 and 24 weeks of gestation) .

- Ultrasound is indicated to confirm fetal cardiac activity when fetal heart tones cannot be detected by usual methods.

- Whether an obstetric ultrasound should be performed on all pregnant trauma patients is controversial.

- We believe this decision should be individualized based on factors such as the extent of the trauma, the patient's condition, gestational age, and pregnancy history.

- An anatomic fetal survey is indicated if the clinician believes the fetus may have been injured.
- For example, blunt or penetrating trauma to the maternal abdomen could result in direct fetal injury, such as fracture or internal bleeding.

- Rarely, a fetal skull fracture with acute intracranial hemorrhage has been reported in women with pelvic fractures or as a result of deceleration injury after a motor vehicle crash

- The fetus whose head is deep in the pelvic is probably most at risk for this complication since the uterus, amniotic fluid, and maternal abdominal wall tend to protect an unengaged fetal head from external trauma.

- A displaced fetal fracture may be noted on fetal ultrasound examination.

- Fetal fractures may be detected as an incidental finding on computed tomography (CT) performed for maternal evaluation.

- If a fetal fracture is noted, evaluation of fetal well-being by nonstress testing and/or biophysical profile and consultation with a neonatologist are advised.

• Evaluation and management of obstetric complications

- The clinician must also determine whether the woman has any potentially life-threatening obstetric complications.

- The likelihood of obstetric complications is related, in part, to the gestational age and the severity and type of trauma.

- The majority of women who develop adverse obstetric outcomes have symptoms such as contractions, vaginal bleeding, and abdominal pain upon initial presentation

- **Abruptio placentae**

- The uterus is thought to change its shape slightly when subjected to strong acceleration-deceleration forces, such as those experienced during a motor vehicle crash.

- Since the placenta is not elastic and amniotic fluid is not compressible, uterine distortion related to acceleration-deceleration or direct trauma can result in shear stress at the utero-placental interface, which can lead to abruptio placentae.

- The reported incidence of abruptio placentae after trauma varies, but is consistently higher than the rate in the general obstetric population, which is 0.4 to 1.3 percent.

- In one large series, the frequency of abruption after a motor vehicle accident with severe injury, nonsevere injury, or no injury was 13, 7.4, and 8.5 percent, respectively

- However, the rate can be much higher (40 to 66 percent) in women who sustain severe trauma to the abdomen.

- Significant direct abdominal trauma, abdominal or uterine tenderness, or vaginal bleeding are suggestive of an abruption and warrant fetal and uterine monitoring and laboratory assessment.

- **Diagnosis**

- The diagnosis of abruption is based upon the presence of characteristic clinical features: vaginal bleeding, abdominal pain, contractions, uterine rigidity and tenderness, and possibly a nonreassuring fetal heart rate (FHR) tracing.

- However, a significant abruption can be asymptomatic or associated with minimal maternal symptoms, including the absence of vaginal bleeding.

- Sonographic and laboratory assessments (eg, platelet count and fibrinogen concentration) support the diagnosis if abnormal, but may be normal despite mild to moderate placental separation.

- Ultrasound examination is of limited usefulness in diagnosing abruption; an abruption is likely if a subchorionic hematoma is observed, but many abruptions are not visualized sonographically.

- CT and magnetic resonance imaging are never used clinically for evaluation of abruption, but if performed as part of a maternal trauma evaluation, they may show findings consistent with abruption .

- **Fetal monitoring**

- For pregnancies that have been subjected to more than minor abdominal trauma and have reached the stage of fetal viability, we suggest continuous fetal and uterine monitoring with an external fetal heart rate monitor and tocodynamometer to assess for preterm labor and abruption

- The importance of fetal heart rate and uterine contraction monitoring lie primarily in their negative predictive value for abruptio placentae.

- As an example, one study reported no adverse outcomes directly related to trauma when monitoring was normal and early warning symptoms (bleeding, abdominal pain) were absent (negative predictive value 100 percent).

- In contrast, the presence of vaginal bleeding, uterine contractions, abnormal fetal heart rate monitoring, and/or abdominal pain or uterine tenderness was not highly predictive of either preterm delivery or adverse pregnancy outcome (sensitivity and specificity 52 and 48 percent, respectively).

- However, identification of a category III tracing and timely delivery can be lifesaving in individual cases .

- The amount of time the fetus should be monitored is controversial, with recommendations ranging from 4 to 48 hours .

- The rationale for a prolonged period of monitoring is concern about delayed abruption, which has been reported up to six days after a traumatic event . However, the risk of a delayed abruption is extremely low.

- In the study described above , repetitive monitoring over several days did not uncover any patients whose fetal heart rate tracings evolved from normal to abnormal.

- Maternal management — Abruption is managed according to usual obstetric protocols.

- Uterine rupture or penetrating injury — Sharp or blunt abdominal trauma can lead to uterine rupture or penetrating injury.

- Signs and symptoms include shock, an abnormal fetal heart rate tracing or fetal death, uterine tenderness, peritoneal irritation, and vaginal bleeding.

- We suggest discontinuing continuous monitoring after **four hours** if all of the following criteria are met :

- • Uterine contractions less frequent than 1 in 10 minutes (<6/hour)
- • Absence of vaginal bleeding
- • Absence of abdominal/uterine pain
- • Category 1 fetal heart rate tracing
- • Maternal vital signs stable and within acceptable range/baseline

- The woman may be discharged if there are no maternal conditions requiring attention.
- We suggest a minimum 24-hour period of monitoring for women with any of the following:

    - Abdominal bruising or other obvious abdominal injury
    - Regular contractions (≥1 in 10 minutes [6/hour])
    - Vaginal bleeding
    - Abnormal fetal heart rate tracing
    - Abdominal/uterine pain
    - Coagulopathy (eg, low platelets or fibrinogen <200 mg/dL)

- These patients should not be discharged until the clinician is reasonably sure that they
- do not have an abruption or preterm labor.

- Maternal management

- Abruption is managed according to usual obstetric protocols

- **Uterine rupture or penetrating injury**

- Sharp or blunt abdominal trauma can lead to uterine rupture or penetrating injury.

- Signs and symptoms include shock, an abnormal fetal heart rate tracing or fetal death, uterine tenderness, peritoneal irritation, and vaginal bleeding.

- Abdominal pain, intraabdominal bleeding, and shock are common after a pelvic fracture and/or rupture of the liver or spleen, and may complicate the diagnosis of uterine rupture or penetrating injury.

- Imaging studies can help in differential diagnosis, but emergency laparotomy is often required for diagnosis and management

- Fetomaternal bleeding

- Fetomaternal bleeding has been reported in 2.6 to 30 percent of pregnant trauma patients .

- It is more common in women with an anterior placenta or tender uterus .

- Complications associated with fetomaternal bleeding include fetal anemia, fetal death, and maternal alloimmunization .

- The occurrence of fetomaternal bleeding is determined by a Kleihauer-Betke test, which measures the percent of red cells containing fetal hemoglobin in maternal blood.

- We obtain a Kleihauer-Betke test in RhD-negative women who have undergone significant abdominal trauma to determine whether additional doses of anti-D-immune globulin are needed due to a large fetomaternal infusion of blood.

- Although some experts suggest performing a Kleihauer-Betke test in all women with significant abdominal trauma, we do not believe this is necessary since the only purpose in RhD-positive women would be for diagnosis of life-threatening fetal blood loss, which would be detected sooner by fetal heart rate monitoring

- In a series of over 300 pregnant women experiencing minor trauma (motor vehicle accidents, falls, assault), no test including the Kleihauer-Betke performed well in predicting the composite adverse outcome (abruption, preterm delivery, or intrauterine growth restriction at delivery).

- The only abruption in this series occurred six weeks after the motor vehicle accident.

- **Antenatal corticosteroids for patients at risk for preterm birth**

- Women at increased risk for preterm birth should receive a course of antenatal glucocorticoids, according to standard guidelines (typically pregnancies from 23 to 34 weeks, but occasionally through 36+6 weeks of gestation).

- **Management of nonobstetric surgery**

- Management of nonobstetric surgery in pregnant women is reviewed separately.

- **Delivery**

- Emergency cesarean delivery is performed in an attempt to:

- Save the fetus in the setting of imminent maternal death or an abnormal fetal heart rate tracing.
- Cesarean delivery for fetal indications is generally avoided before fetal viability.

- However, deciding upon a threshold of viability is challenging, as it remains uncertain which extremely preterm infants, particularly those born at 23 and 24 weeks of gestation, have a reasonable chance of survival without severe deficits.
- Save the mother if cardiopulmonary resuscitation has not been effective within four minutes

- Cesarean delivery is also performed to provide adequate surgical exposure for management of maternal injuries during laparotomy and when a displaced pelvic fracture precludes vaginal delivery.

- In pregnant burn patients, delivery is recommended if the pregnancy has reached the third trimester and total body burn surface area is >50 percent .

- The route of delivery is based on standard obstetric considerations.

- Fetal death is not an indication for cesarean delivery, except in some cases of abruptio placentae resulting in maternal coagulopathy and hemodynamic instability.

- **Immunization**

- Anti-D immune globulin

- RhD-negative women with abdominal trauma or vaginal bleeding (who are not already alloimmunized) should receive anti-D immune globulin, per standard protocols.

- Documentation of a large fetomaternal infusion may require additional doses

- **Tetanus toxoid**

- Tetanus toxoid is not contraindicated in pregnancy and should be administered as part of wound management, when indicated

- **OUTCOME**

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

- Trauma is a major contributor to maternal mortality and is the leading cause of pregnancy associated maternal deaths in the United States.

- Severity of injury is the major factor predictive of maternal death.

- Trauma in the first trimester does not usually cause pregnancy loss because the uterus is protected by the maternal pelvis.

- Exceptions are cases complicated by:

  (1) profound maternal hypotension, which leads to reduced uteroplacental blood flow, or

  (2) serious maternal pelvic injuries (eg, gunshot wounds, pelvic fracture), which can directly injure the fetus, fetal membranes, uterus, placenta, or uterine vessels.

- Factors predictive of poor fetal outcome are maternal hypotension, category II or III fetal heart rate tracing, direct injury to the uterus/fetus, maternal death, and a high maternal Injury Severity Score (ISS) .

- The highest risk of fetal loss (40 to 50 percent) is among women who sustain life-threatening trauma (eg, with hypovolemic shock, coma, or necessitating emergency laparotomy).

• Overall outcome

- In a population-based study, one in four pregnant women admitted during the third trimester because of trauma were delivered.

- Immediate and delayed outcomes after maternal trauma have been evaluated in several large series

- One retrospective cohort study used an obstetric database in California to obtain a population-based estimate of pregnancy outcomes in over 10,000 women hospitalized due to trauma
- Motor vehicle accidents were the most common mechanism of injury, followed by falls and assaults.

- One-quarter of these patients delivered during the hospitalization for the traumatic event; the remainder were discharged and delivered during a subsequent hospitalization.
- Women who delivered remote from their trauma episode still had significantly increased rates of preterm birth, low birth weight, and abruption.
-

- The authors hypothesized that late morbidity might have resulted from subclinical chronic abruption. Another retrospective cohort study evaluated the risk of adverse pregnancy outcome following motor vehicle collisions (n = 582) during pregnancy in Washington State from 1989 to 2001 .

- The authors compared 84 severely injured (ISS 9), 309 nonseverely injured (ISS 1-8), and 189 uninjured (ISS 0) pregnant women with pregnant women who had not been hospitalized for a motor vehicle collision (n = 17,274).

- Twothirds of the women were in their third trimester.

- Although 83 percent of the women were hospitalized and discharged without

delivering, they still bore a high risk of adverse pregnancy outcomes compared with the women who were not in accidents.

Women with severe injuries were more likely to have had fractures, dislocations, sprains, intracranial injuries, open wounds, and internal injuries, but ISS was a poor predictor of adverse pregnancy outcomes

- Similarly, a third retrospective cohort study from a Texas trauma center reported that women who had experienced traumatic injury, but were discharged from the hospital undelivered, had a significant increase in risk of preterm delivery and low birth weight compared with women who experienced no injury from their trauma .

- By comparison, a population-based cohort study from Australia reported no increase in adverse pregnancy outcome among women admitted to the hospital following a motor vehicle accident but who remained undelivered compared with women not involved in motor vehicle accidents.

- These differences may be due to chance or to differences between studies in the severity of maternal trauma.

- Finally, a study comparing over 1100 pregnant trauma events with over 43,000 trauma events in nonpregnant women reported that mortality was significantly higher in pregnant women and that pregnant women were significantly more like to experience violent trauma then non pregnant women

• MENTAL HEALTH AND COUNSELING

- Pregnancy-related complications with possible poor fetal outcomes after trauma can have continued and serious impacts on the injured mother and larger family unit.

- An early mental health referral should be considered to help provide support

- **PREVENTION**

- Prenatal care should incorporate education about reducing the risk of injury from a motor vehicle crash (correct seat belt use, not turning off airbags) and evaluation for domestic violence, since the majority of maternal trauma is related to these two entities.

- Maternal bleeding and fetal death rates are reported to be significantly more likely in women with unbelted or poorly applied seatbelts.

- Evaluation for misuse of drugs and alcohol and referral for treatment are also indicated, as these are risk factors for trauma in pregnancy and other adverse outcomes.

- **SUMMARY AND RECOMMENDATIONS**

- Normal anatomic and physiologic changes related to pregnancy need to be considered when evaluating the status of pregnant trauma victims.

- Any diagnostic test/procedure or treatment required to save the mother's life or treat her critical status should be undertaken, even if potentially disadvantageous to the fetus.

- Morbidity and mortality in offspring are usually related to the direct and indirect consequences of maternal trauma (eg, hypotension, hypoxemia, placental abruption, preterm birth), but direct fetal injury sometimes occurs.

- The initial evaluation of the pregnant trauma patient should focus on establishing maternal cardiopulmonary stability.

- Maternal oxygen saturation (SaO2) should be maintained at ≥95 percent.

- Early intubation after preoxygenation is recommended if adequate maternal oxygenation has not been achieved; assume a difficult airway and high risk for gastric aspiration.

- The diaphragm is elevated in pregnancy so if a thoracostomy tube is needed, some experts suggest placing it one to two intercostal spaces above the usual landmark of the fifth intercostal space

- Displacing the uterus approximately 30 degrees to the left, off of the vena cava, is critical to maximize effectiveness of cardiopulmonary resuscitation when the uterus is at or above the umbilicus.

- In some instances, emptying the uterus by performing a cesarean delivery is required to save the mother's life.

- Measurement of the fetal heart rate is the minimum initial fetal assessment to determine whether the fetus is alive, and if alive, whether it is compromised (normal fetal heart rate is 110 to 160 beats per minute).

- It is important to compare the maternal and fetal heart rates to make sure that the fetal heart rate, not the maternal heart rate, is being monitored

- In singleton pregnancies, the uterus is a pelvic organ for the first 12 weeks of pregnancy.

- The top of the uterine fundus is palpable:

- ***above the symphysis pubis at approximately 13 weeks,***
- halfway to the umbilicus by approximately 16 weeks,
- at the level of the umbilicus by approximately 20 weeks of gestation,
- halfway between the umbilicus and costal margin at approximately 24 to 28 weeks,
- and at the costal margin at >34 to 36 weeks.

- Once catastrophic trauma has been excluded, the clinician should determine whether the patient has any obstetric complications (eg, abruption, uterine rupture, fetomaternal bleeding, preterm labor, premature rupture of membranes).

- The majority of women who develop adverse obstetric outcomes have symptoms such as contractions, vaginal bleeding, or abdominal pain upon initial presentation.

- Digital vaginal examination should be avoided in pregnancies over 20 weeks until placenta previa has been excluded by ultrasound examination because disturbing the placenta can provoke massive hemorrhage.

- Vaginal examination should include assessment for bleeding, rupture of membranes, and labor.

- Ultrasound examination of the fetus is indicated if the clinician believes the fetus may have been injured. It is also useful for determining placental position, gestational age, and possibly whether rupture of membranes or abruption has occurred.

- In pregnancies that have reached ≥24 weeks of gestation, we suggest continuous rather than intermittent fetal and uterine monitoring, when feasible. The lower limit of viability is 22 to 23 weeks of gestation, and some patients may consider continuous monitoring with intervention and neonatal resuscitation at this age.

- This is a complex decision that must be individualized. We monitor patients for at least 4 hours, and up to 24 hours, after even mild abdominal trauma to look for signs of preterm labor and abruption (algorithm 2).

- In RhD-negative women, a Kleihauer-Betke test should be obtained to quantitate fetomaternal hemorrhage. RhD-negative women should be given anti-D immune prophylaxis after major trauma or after minor trauma with vaginal bleeding.

- Women at risk for preterm birth should receive a course of antenatal glucocorticoids, according to standard guidelines (typically pregnancies from 23 to 34 weeks, but occasionally through 36+6 weeks of gestation)

زندگی صحنه یکتای هنرمندی ماست
هرکسی نغمه خود خواند و از صحنه رود
صحنه پیوسته بجاست
خرم ان نغمه که مردم بسپارند به یاد