


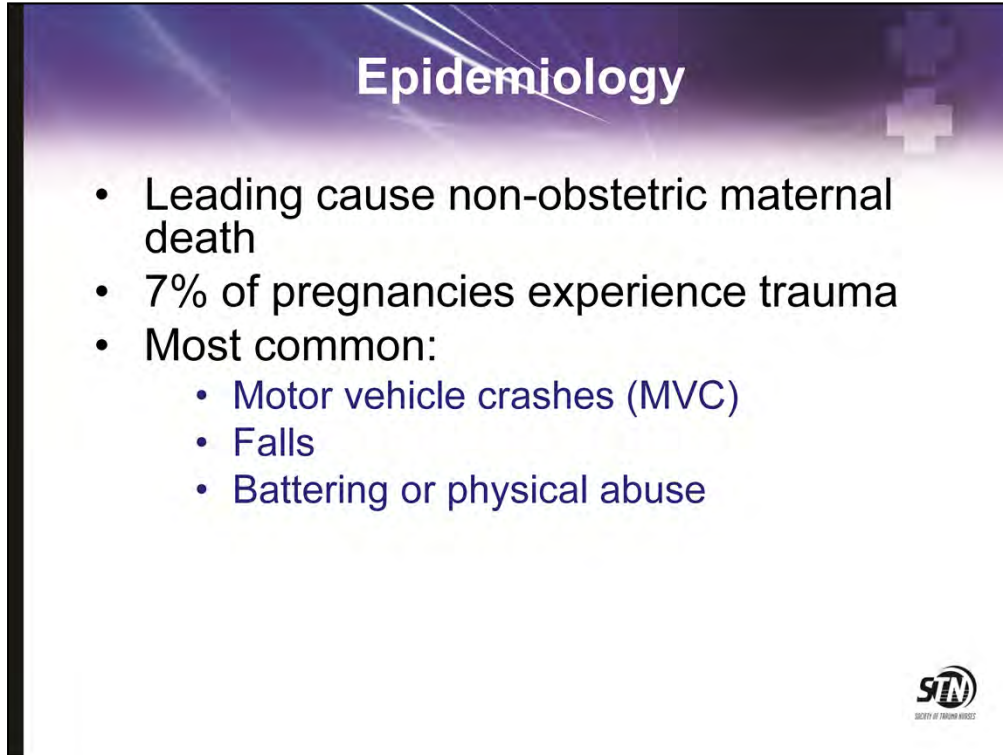
Objectives

At the conclusion of this presentation the participant will be able to:

- Discuss the epidemiology, incidence and prevention of trauma in pregnancy
- Identify physiologic & anatomic changes in pregnancy pertinent to trauma care
- Discuss resuscitative management unique to the pregnant trauma patient




Most unique about the pregnant trauma patient, is the fact that the provider is caring for two individuals, mother and fetus. Although the initial assessment and care of the pregnant trauma patient will follow the advanced trauma life support guidelines, there are variations to both assessment and treatment which will impact the outcome for both the mother and fetus. The knowledgeable trauma provider understands that care must focus on expedient resuscitative efforts for the mother, thus giving the fetus the best chance of survival.



Epidemiology

- Leading cause non-obstetric maternal death
- 7% of pregnancies experience trauma
- Most common:
 - Motor vehicle crashes (MVC)
 - Falls
 - Battering or physical abuse





Trauma poses a serious and preventable risk to the pregnant woman and her fetus. Although, the exact incidence remains uncertain, trauma accounts for approximately 46% of all maternal deaths. Many of these deaths are avoidable with education about proper safety restraint use and the avoidance of intoxicating substances and distracted driving.

It is estimated that between 34% and 64% of pregnant trauma patients involved in a motor vehicle crash (MVC) were unrestrained. Additionally, in one study 45% of pregnant trauma patients were found to be positive for an intoxicant.

Non-accidental trauma, such as domestic violence and suicide are common in pregnancy. Statistics are likely, grossly underreported by victims. Homicide rates of pregnant and post-partum women in New York City showed that homicide was the 2nd most common cause of death among pregnant and post-partum women. Further, suicide was responsible for 10% of all maternal deaths.

Who is at Increased Risk for Injury During Pregnancy?

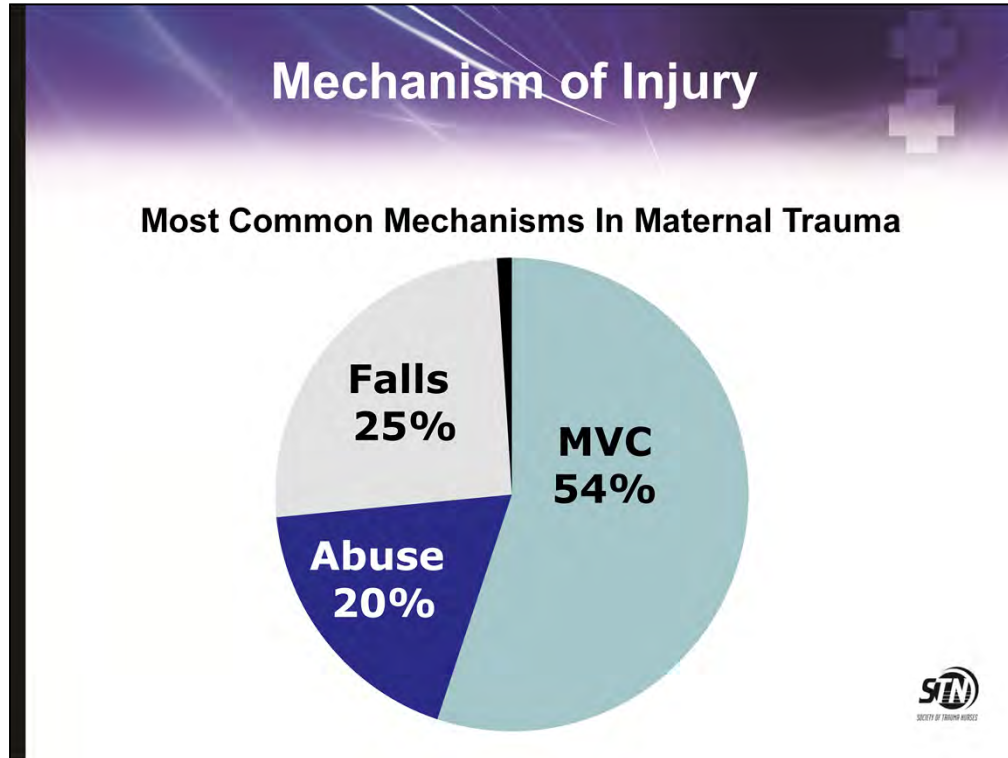
- Young
- Non-Caucasian
- Driving unrestrained
- Intimate partner abuse
- Drug and/or alcohol abuse
- Low socio-economic status
- Pregnancy alone - independent risk factor!



13-19% of trauma in pregnancy is related to alcohol or drug use.

Between 34 and 64% of pregnant patients involved in MVC, are unrestrained.

Substance abuse is a factor in traumatic injuries of pregnant patients. One institutional study showed that 45% of pregnant trauma patients were under the influence of an intoxicating substances. Further, intoxicant use lowers compliance with restraint usage. Education about the use of drugs and alcohol and their connection to trauma should be provided to women of childbearing age and during pregnancy. Additionally, social services should be offered to high risk women in particular to provide additional support during pregnancy.



The top 3 causes of injury in pregnant woman remain:

- 1) MVC
- 2) Falls
- 3) Abuse (intimate partner violence)

The CDC and WHO now use the term: Intimate Partner Violence (IPV) which is the same as Domestic Violence

Statistics vary among studies and geographic areas, yet motor vehicle crashes remain the number one cause of trauma in women of childbearing age.

Intimate partner violence is suspected to be under reported and may be significantly higher than 20%.

Mechanism of Injury: Motor Vehicle Crash

- Seatbelt Safety in Pregnancy Misinformation Common
 - Only 46% of pregnant trauma patients use restraints
- Airbags are supplemental
 - Protective if patient restrained
- Unrestrained Preg Trauma
 - 2.3 times more likely to give birth < 48 hours
 - Fetal death 4 times more likely



Providers should educate on the proper use of restraints. Many women are misinformed that seatbelts may harm the fetus. Further many women find seatbelts to be uncomfortable. Seat belt use has decreased maternal mortality from MVC from 33% to 5%.

Airbags detonate at 1200 lbs. of force with speeds approaching 230 mph and were designed for 5'8" males, weighing 180 lbs. Although not designed explicitly for pregnant women, studies demonstrate that they do provide a net protective effect for the woman, particularly when travelling at speeds over 32 mph.


Pregnant women should make an effort to have their sternum at least 10 inches from the steering wheel or dashboard.

No statistics were found regarding distracted driving in the pregnant population. However, of the general population, age 18 to 29, 52% report regularly texting and emailing while driving. This comprises a substantial portion of childbearing age women.


In 2009, over 5,400 people died in crashes where there was a distracted driver and 448,000 people were injured. Crash dynamics are important in evaluating maternal and fetal injuries and will assist one in anticipating injuries.

Proper use of seatbelts help to prevent ejection from vehicle, severe head injury, and lowers mortality for both the mother and the fetus.

Proper Seat Belt Positioning

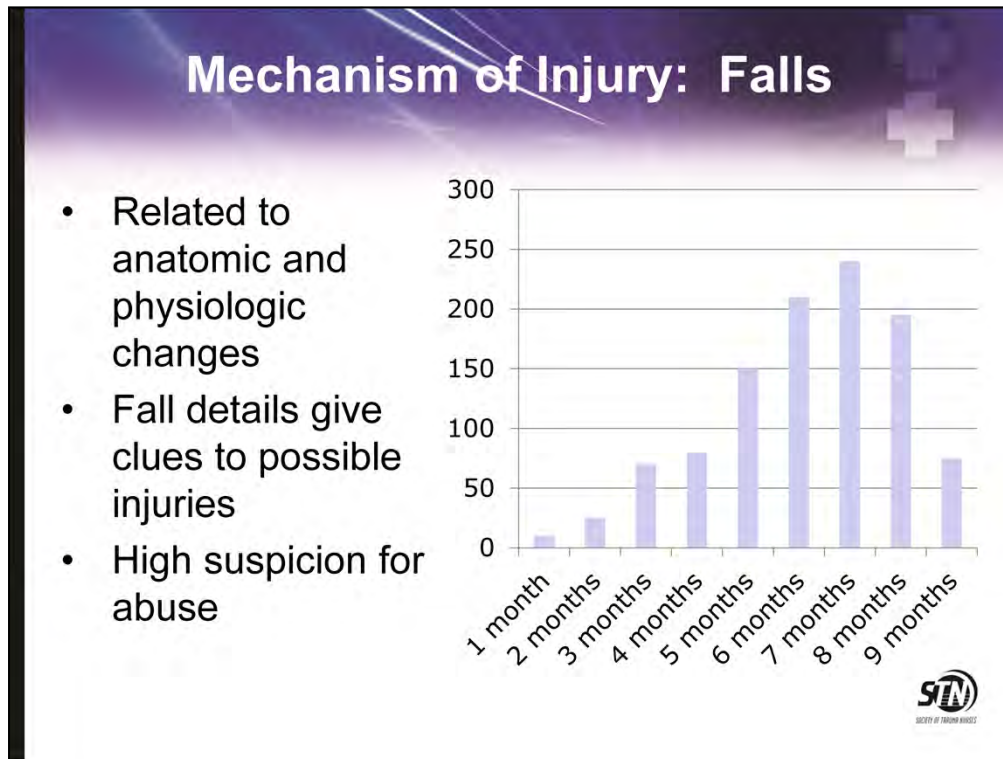


- **Shoulder belt-** mid-clavicular between breasts
- **Lap belt-** under abdomen



Proper seatbelt placement is vital to protecting the fetus and mother. The National Highway Traffic Safety Administration advises that the belt be placed between the breasts and mid-clavicular and positioned under the dome of the abdomen, low on the hips and across the upper thighs. Wearing the lap belt too high on the abdomen may be the cause of over half of fetal losses resulting from MVC.

- Ethnic minorities may be less likely to use restraints and thus education should be stressed among this population.
- Proper restraint use will be a primary predictor of survival of the mother and fetus, as ejection from the vehicle and head trauma are known to have likely bad outcomes.



Due to the physiological and anatomical changes of pregnancy, pregnant women are likely to be at higher risk for falls. Falls occur more in the second and third trimester, as the center of gravity shifts forward with the growing fetus. The increase in relaxin production and secretion, causes joint hypermobility in the pregnant woman to prepare her body for delivery, however this loosening of joints puts stability at risk. The nerve roots of the lumbar and sacral spine, which become the sciatic nerve, are stretched. This may result in some altered sensory to the pelvis and lower extremities. Finally, two recent studies have shown an increase in postural sway which further adds to instability.

27% of women reported falling at some time in their pregnancy, and younger women were twice as likely to fall as those over 35 years of age. Most falls occurred in the 6th through 8th gestational months and over 72.5% were found to have been caused by stairs and slippery floors.

A woman seeking medical care for a fall should be assessed for the possibility of domestic violence. Suspicious indicators are: healing bruises of different ages, injuries to the breasts, back, and thighs, story that is inconsistent with the injury pattern and an overly intrusive significant other.

Mechanism of Injury: Intimate Partner Violence (IPV) (Domestic Violence)

- Risk Factors:
 - Young
 - Single
 - Non-Caucasian
 - ↓ Socioeconomic Status
- Frequently underreported
- National Domestic Violence Hot Line
 - 1-800-799-SAFE (7233)
 - 1-800-787-3224 (TDD)



Intimate partner violence or domestic violence in pregnancy, is thought to be greatly underreported. No other time in a woman's life, is she more likely to be battered by an intimate partner. Domestic violence is about power and control. Be mindful for signs of the following: coercive behavior, intimidation, emotional abuse, economic abuse, and isolating the patient from friends and family.

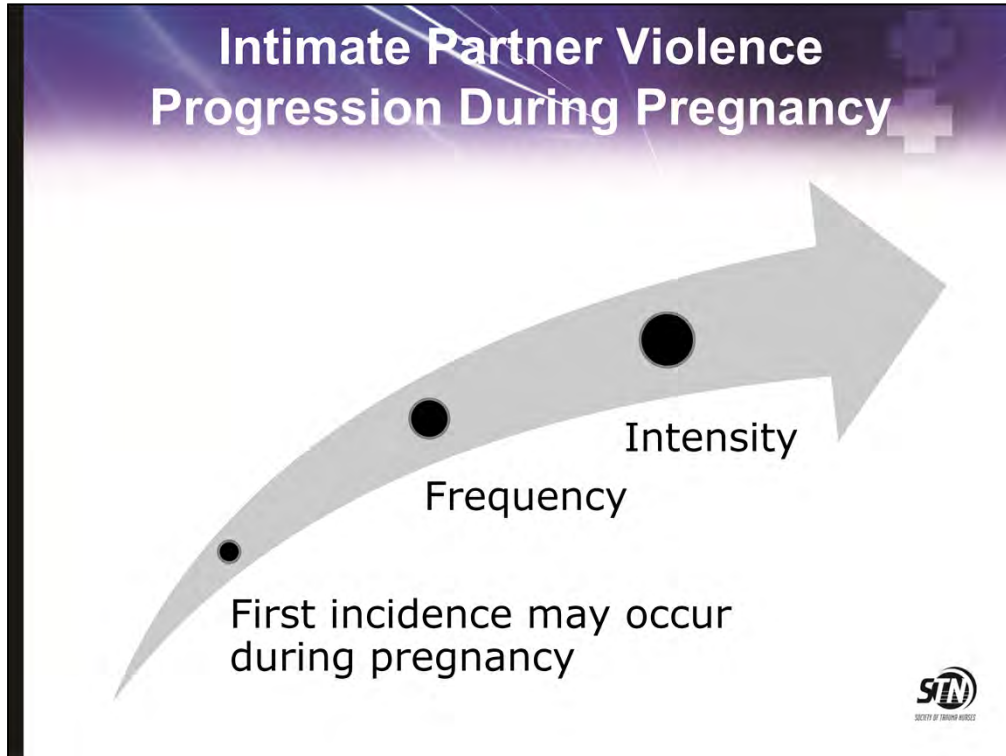
The patient may present for falls or other home related accidents. Examine breasts, abdomen, back and genitals and look for injuries at different stages of healing.

Abused women are significantly younger and single, lower income and with a lower level of education compared to those who are not abused.

Homicide resulting from intimate partner violence was then most common cause of maternal death in a statewide study in North Carolina, with non-whites being at much greater risk. Further, teens are shown to be at 2.6 greater risk of being the victim of homicide during pregnancy as compared to adult women

Most common fetal injuries are abruption, early delivery and low birth rate.

Pregnant women who are abused, suffer greater complications during their pregnancy. They tend to gain less weight and have a higher incidence of anemia, infections and bleeding. Also, rates of maternal depression, suicide, tobacco, alcohol and drug use are higher.

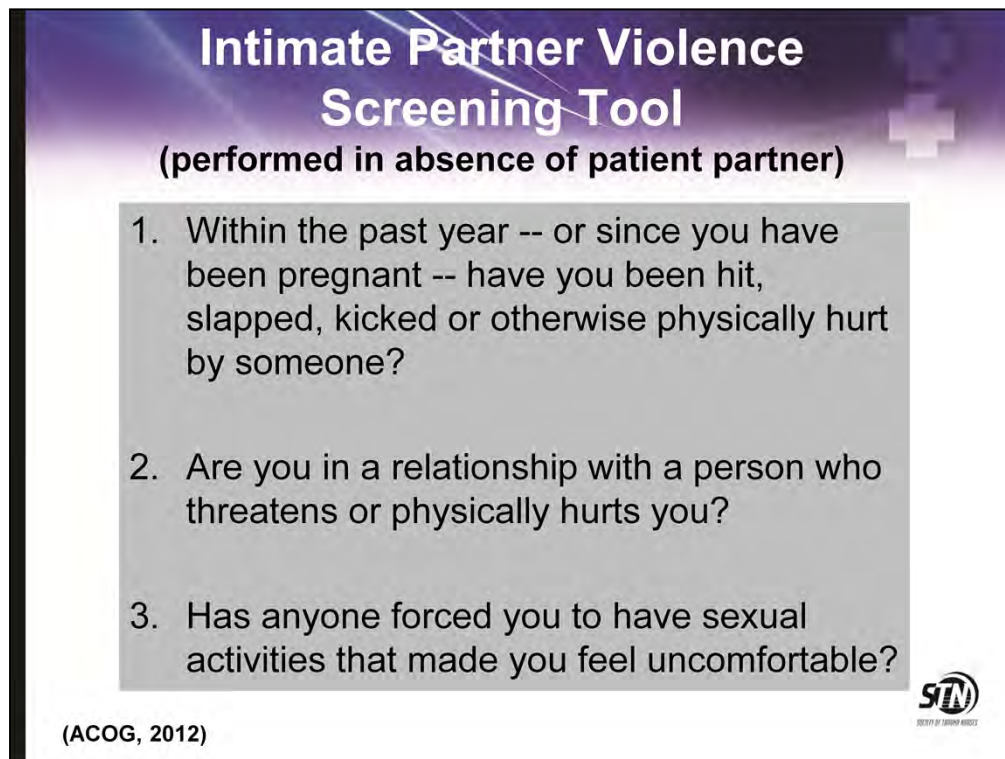


The first incidence of abuse may come during pregnancy. Further, an existing abusive relationship, will intensify and the incidents of abuse may become more frequent.

Nurses should encourage and guide women to create a safety plan, a personalized plan for getting to safety. Such a plan may include safekeeping of important documents, extra keys, telephone numbers, securing money and a physical plan for escape. A comprehensive safety plan, in the public domain can be found at:

<http://www.ncbi.nlm.nih.gov/books/NBK64443/> (Center for Substance Abuse Treatment. Substance Abuse Treatment and Domestic Violence. Rockville (MD): Substance Abuse and Mental Health Services Administration (US); 1997. (Treatment Improvement Protocol (TIP) Series, No. 25.) Appendix D— Sample Personalized Safety Plan For Domestic Violence Survivors.)


More information can be found at the National Domestic Violence Hot Line. (Phone number verified 9/12/12)



**Intimate Partner Violence
Screening Tool**
(performed in absence of patient partner)

1. Within the past year -- or since you have been pregnant -- have you been hit, slapped, kicked or otherwise physically hurt by someone?
2. Are you in a relationship with a person who threatens or physically hurts you?
3. Has anyone forced you to have sexual activities that made you feel uncomfortable?

(ACOG, 2012)



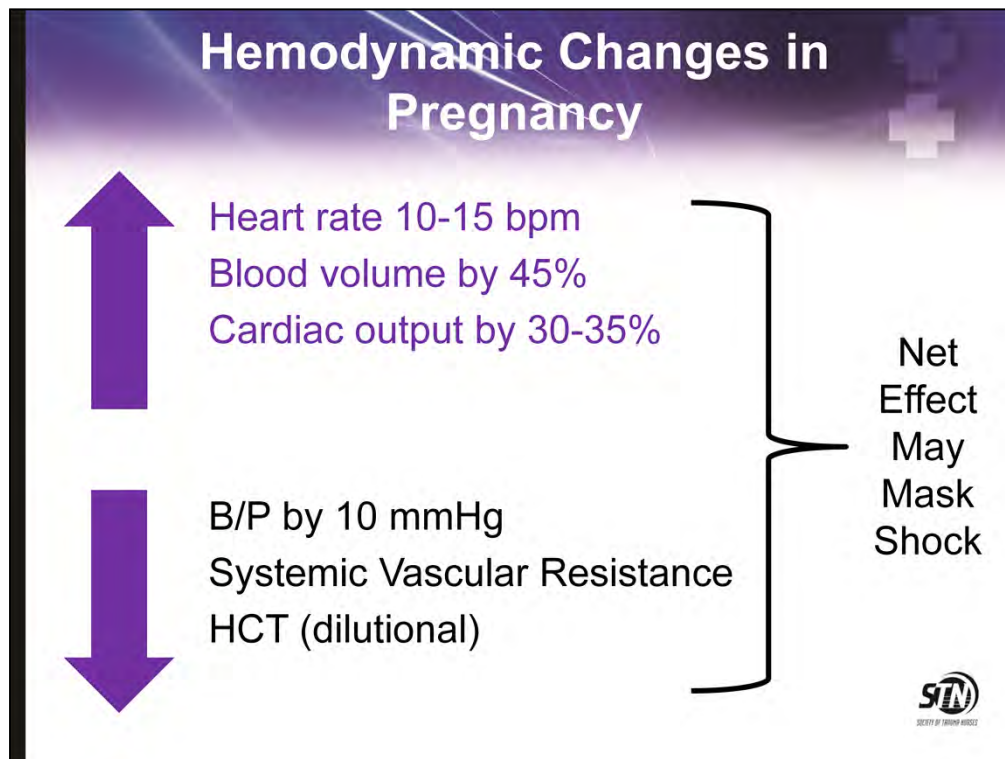
When patients present with trauma during pregnancy, nurses must maintain a high index of suspicion.

One recent study found that 3 screenings throughout pregnancy, with a single direct question (“Have you been hit, slapped, kicked or otherwise physically hurt during this pregnancy?”), were statistically significant, in increasing the reporting of prenatal violence. Reporting rose from 6.3 to 14.1 percent compared to routine screening. It is also recommended that the physical exam and DV screening be done in absence of the partner.

Be prepared to provide referrals for women and seek assistance from social work.

The ACOG recommends use of the following questions:

1. Have you ever been emotionally or physically abused by your partner or someone important to you?
2. Within the last year, have you been hit, slapped, kicked or otherwise physically hurt by someone? If yes, by whom and number of times.
3. Since you’ve been pregnant, have you been hit, slapped, kicked, or otherwise physically hurt by someone? If yes, by whom and number of times.

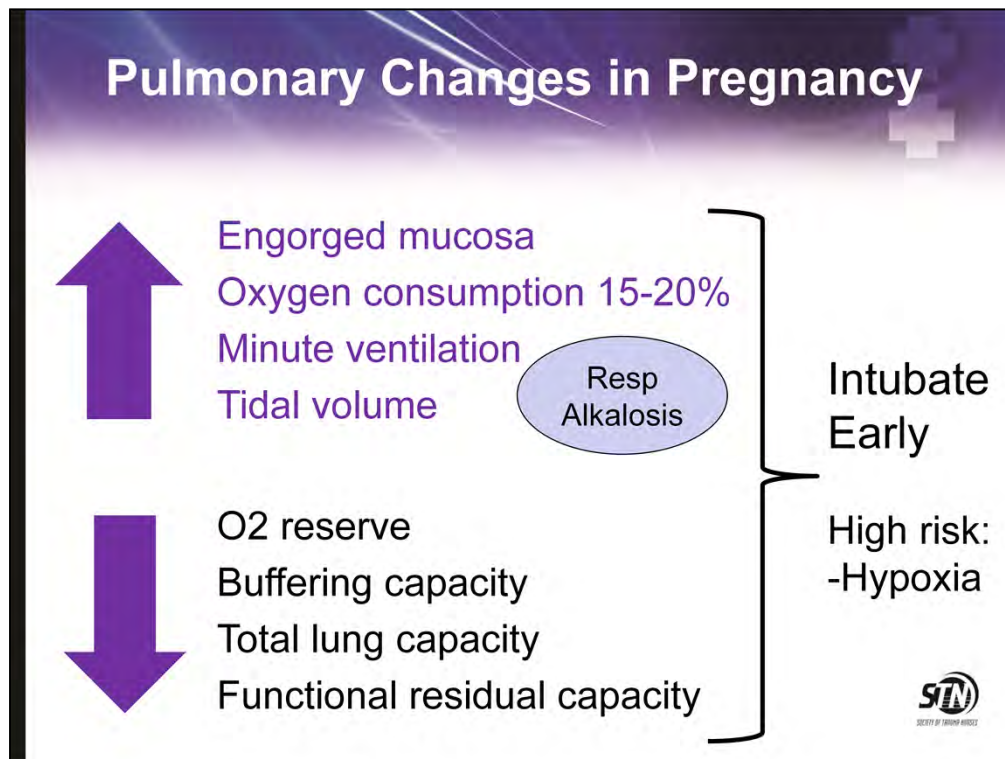


The growth of the fetus increases the demand for oxygen delivery and tissue perfusion. An increase in blood volume (40-50%) occurs, yet RBC only increase by 30% resulting in a dilutional anemia (average hct 35%).

HR increases 10-15 over baseline, CO increases by 30-50% and plateaus in the 2nd trimester. There is a decrease in the SVR and PVR from progesterone release, this results in a gradual decrease in B/P in 1st and 2nd trimester with an increase in the 3rd to pre-pregnancy level. These mechanisms help cope with the blood loss of 500-1000 which occurs during delivery.

During pregnancy the uterine arteries are maximally vasodilated, to provide adequate blood supply for the maintenance of the placenta and growth of the fetus. The weight of the uterus and growing fetus will cause aortocaval compression, compromising blood flow to the fetus and abdominal and pelvic organs. Use the left lateral tilt position (shown later) to reduce this effect.

Due to the increase in blood volume, there may be little change in vitals with a blood loss of up to and exceeding 2000ml.




The mucosa of the nasal passages, oral pharynx, larynx and trachea become engorged. This can result in SOB, epistaxis, and a difficult intubation. The airway should be secured early in a pregnant trauma patient. It has been recommended that an endotracheal tube 0.5 to 1 mm smaller than in a comparable non-pregnant patient. This will allow easier tube passage and avoid possible intubation trauma.

Oxygen consumption increases 15-20% and there is a diminished O₂ reserve and buffering capacity. This results in rapid hypoxia and inability to compensate for the acidosis which follows. As acidosis can cause life threatening derangements in trauma, it is vital that the practitioner recognize and treat the increased risk of acidosis in the pregnant trauma patient.

Total lung capacity is decreased by the expanding uterus and will peak during the 3rd trimester of the pregnancy. Decrease in functional residual capacity can increase the risk of hypoxia. Hypocapnia (Paco₂ 30mmHg) is common in late pregnancy due to increased minute volume. A Paco₂ of 35-40mmHg should be considered abnormal for a pregnant patient in late pregnancy.

Neurological Changes in Pregnancy

Normal Changes <ul style="list-style-type: none">• Dizziness• Syncope• Balance changes• Gait changes	Neurologic Complications <ul style="list-style-type: none">• Pre-eclampsia / Eclampsia<ul style="list-style-type: none">• Hypertension• Headaches• Vision changes• Hyperreflexia• Seizures
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Can mimic head injury! 

Vasodilation may cause postural hypotension in the pregnant woman. This may lead to feelings of dizziness and possibly fainting.

A change in center of gravity may alter balance and gait as the pregnancy progresses. This alteration adds to the risk of falls during pregnancy.

The presentation of pre-eclampsia and eclampsia can mimic a traumatic brain injury. Thus it is important to quickly distinguish between the two. Pre-eclampsia, an abnormal condition in pregnancy, presents as acute hypertension, proteinuria, and edema.

In its severe form, eclampsia, the disease progresses to grand mal seizures, loss of consciousness and can be fatal. Imaging of the head should be used to rule out a head injury in the mother. A team which can manage the prenatal complication of preeclampsia should be assembled.



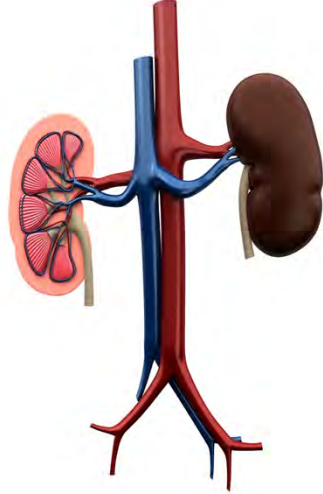
The increased release of progesterone decreases gastric mobility which relaxes esophageal and gastric sphincters. This leads to an increase risk in aspiration. Care should be taken to protect the airway and decompress the stomach.

As the uterus becomes an abdominal organ in the second trimester, it displaces the bowel towards the upper and anterior portion of the abdominal. This decreasing space in the abdominal cavity also places increases pressure on the hollow viscous organs, placing them under more risk for rupture. Additionally, solid organs are at greater risk for fracture.

This stretching and increase in intrabdominal pressure can result in a de-sensitivity to peritoneal irritation, which occurs from free fluid or blood in the cavity. Thus the physical exam may show a lack of tenderness, rebound tenderness or guarding.

Urologic Changes in Pregnancy

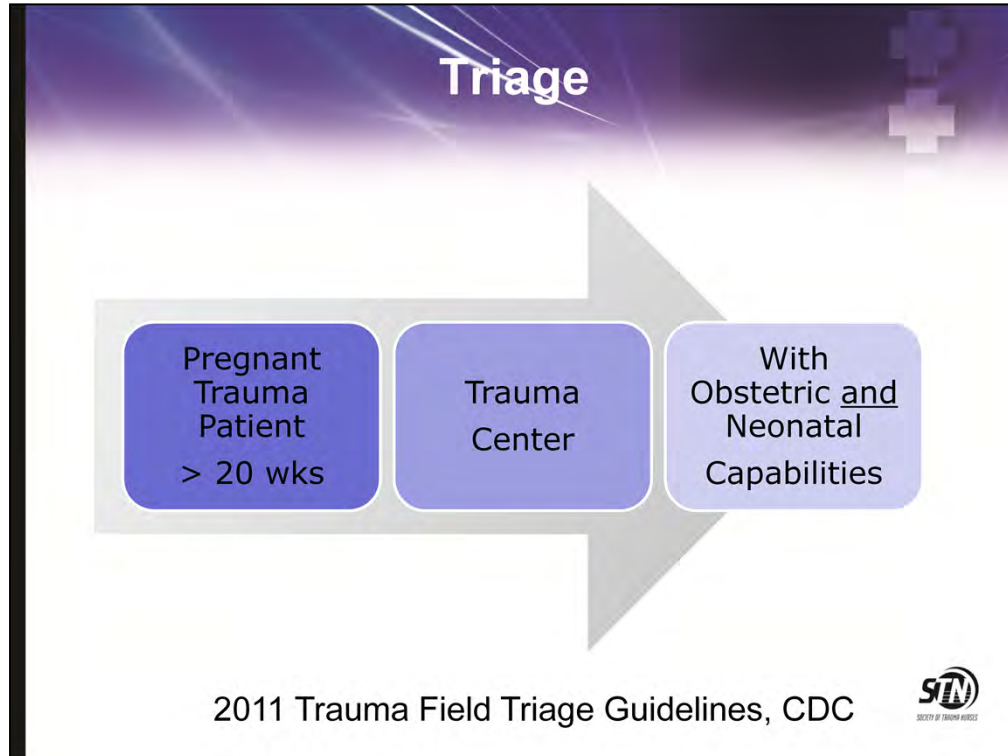
- Increased pelvic blood flow
- Bladder
 - Displaced anterior and superior (> 12 wks)
- Increased glomerular filtration rate
- Low: BUN
creatinine, calcium
and magnesium



During pregnancy there is an increase in pelvic blood flow to the pelvis thus pelvic fractures are more likely to result in hemorrhage.

Due to the position of the uterus, the bladder is placed anteriorly and superiorly. This position in the pelvis placed the bladder at higher risk for injury.

Because of the higher GFR and decreasing room for the bladder in the pelvis, the bladder is likely under more tension and more vulnerable to rupture. Creatinine and blood urea nitrogen (BUN) will decrease to about half the normal pre-pregnancy rate. Additionally, glycosuria is often considered physiologic during pregnancy.



Pregnant trauma patient > 20 weeks gestation should be preferentially transferred to a trauma center equipped to diagnose and manage obstetric **and** neonatal emergencies.

EMS should provide:

- Oxygen
- Anticipate shock
- Notify the ED early
- Transport the injured mother in left lateral position to avoid supine hypotension.



This section begins the assessment and management of the pregnant trauma patient

Team Work



- Trauma Team
- Obstetrician
- L&D Nurse
- Consult radiologist for radiation exposure
- Neonatologist
 - imminent delivery



Trauma is a team sport. With 2 patients to take care of there is even a greater need for teamwork. The trauma team must work in coordination with the obstetrician, L&D nurse, as well as radiologist and possibly the neonatologist and NICU nurse if delivery is imminent. Planning ahead for this event is necessary for the rare times that it will be needed.

Initial Assessment

- Transport to trauma center
- ATLS management
- Assess and stabilize mother FIRST
- Identify pregnancy
- Assess during secondary survey



Any trauma patient, who has been identified as pregnant, should be transported to the closest recognized trauma center.

Upon arrival to the trauma center, the mother's condition should be assessed and stabilized before moving to assessing the fetus. Primary maternal assessment--assess fetus—secondary maternal assessment.

Aggressive care for the mother gives the fetus the greatest chance of survival.

All women of child bearing age should be tested for pregnancy.

Optimize cardiac output by displacing the uterus to the left, by left lateral tilt or manual displacement, thus decreasing pressure on the inferior vena cava.

A trauma surgeon and obstetrician should be available at the initial assessment stage.

Pregnancy Test



- All female trauma
- Childbearing age

Treatment decisions based on gravid status




All women presenting for traumatic injury should be administered a pregnancy test.

Females between the ages of 10 and 60 have the potential to become pregnant.


As trauma centers are making an effort to avoid indwelling urinary catheters, a serum HCG may be required to determine pregnancy in a timely manner.

Primary Survey

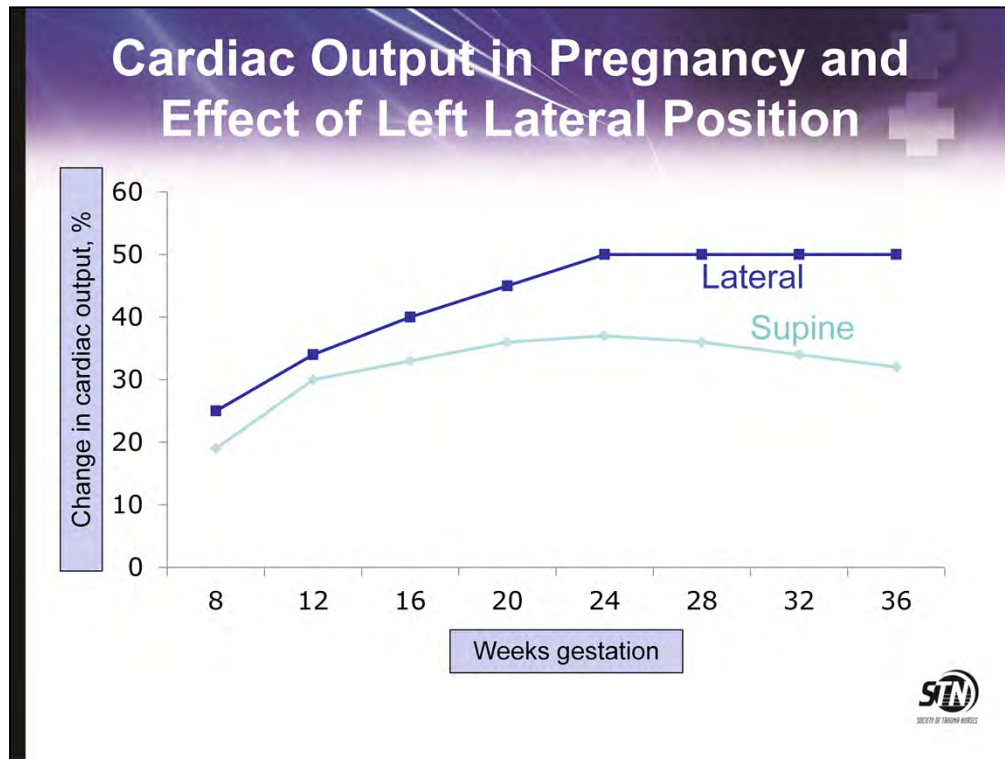


- Airway/breathing
- C-spine control
- Oxygen
- Prevent aorto-caval compression
- If bleeding, aggressive volume resuscitation

Displace uterus to left - Log roll
15-30 degree tilt




Uterine compression of the vena cava presents an obstacle to the resuscitation of the pregnant trauma patient. The weight of the fetus reduces venous return to the heart and thus decreased cardiac output, worsening shock. Maintain spinal precautions as is indicated by mechanism of injury. However, ensure patient is immobilized with a 15 to 30 degree tilt (4 to 6 inches) to the left. Use a towel or blanket under long spine board and bolster to support left side. Ensure side rail is up on left to maintain patient safety, as able. Reassure patient as position may be unsettling.




This slide demonstrates the incremental change (increase) in cardiac output in the pregnant patient and illustrates the benefit of displacement of the uterus through use of the left lateral position. In the pregnant trauma patient, maximizing cardiac output is vital to the wellbeing of both patients.

Resuscitation Tube Tips



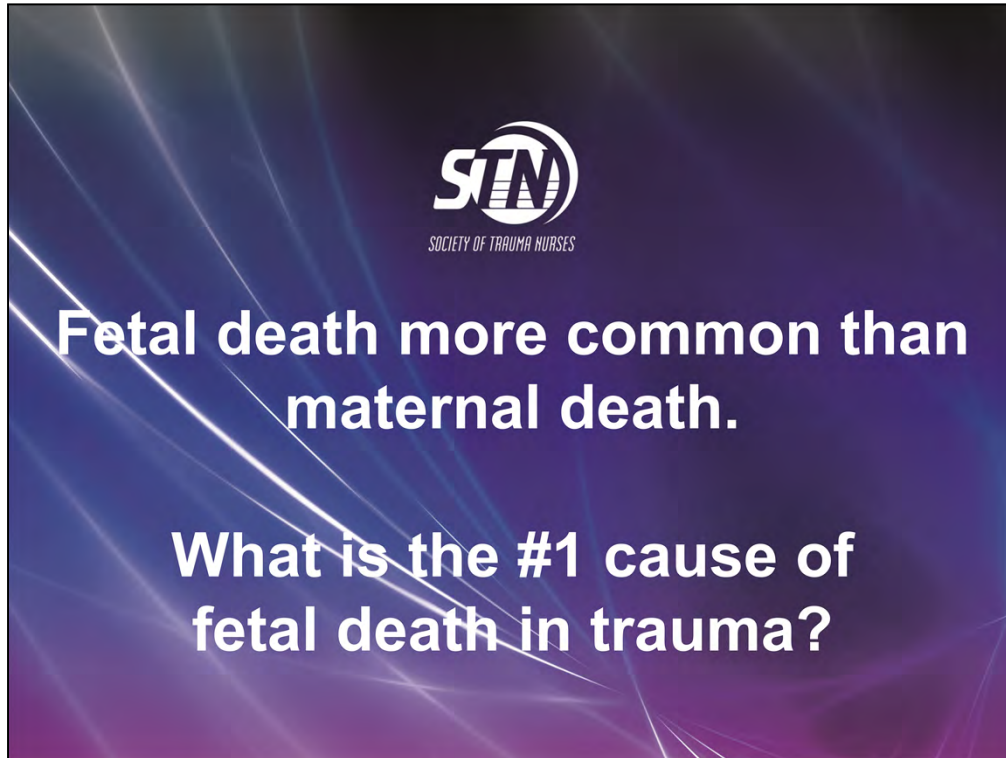
- Airway edema common → difficult Intubation
 - Consider smaller ETT
- Delayed gastric emptying ↑ risk of aspiration →
 - Consider early NGT
- Elevated diaphragm
 - Consider higher Chest tube placement



- Clear airway per standard ATLS. However remember that airway edema is more common in the pregnant trauma patient and therefore intubation may be difficult. Some authors recommend intubating with one size smaller endotracheal tube.
- Early NGT placement may be required because of increased risk of aspiration due to more relaxed lower esophageal sphincter and delayed gastric emptying.
- Chest tube placement should be 1-2 interspaces higher than usual, because of elevation of the diaphragm.

Resuscitation with packed cells is preferred over crystalloid in the continued hemodynamically unstable patient. Vasopressors should be avoided as they decrease blood flow to the uterus and placenta. If vasopressors are necessary to save the mother's life: levophed and epinephrine compromise uterine perfusion, while ephedrine and mephentermine do not.

If resuscitation of the mother looks unlikely, the decision to do a peri-mortem C-section must be expedited. Initiate peri-mortem C-section within 4 minutes of malignant maternal rhythm for the greatest chance of fetal survival. A midline, vertical incision allows the greatest exposure, while minimizing bleeding. The procedure from skin to fetus should take no longer than 1 minute to perform. Neonatology should be at the bedside.

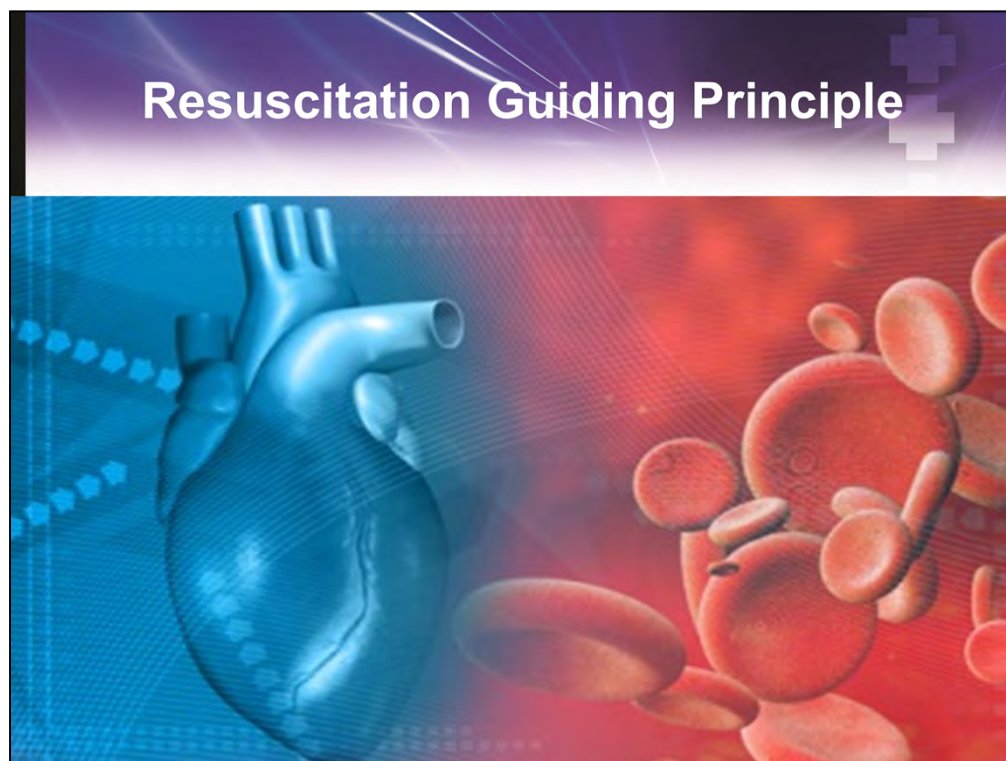


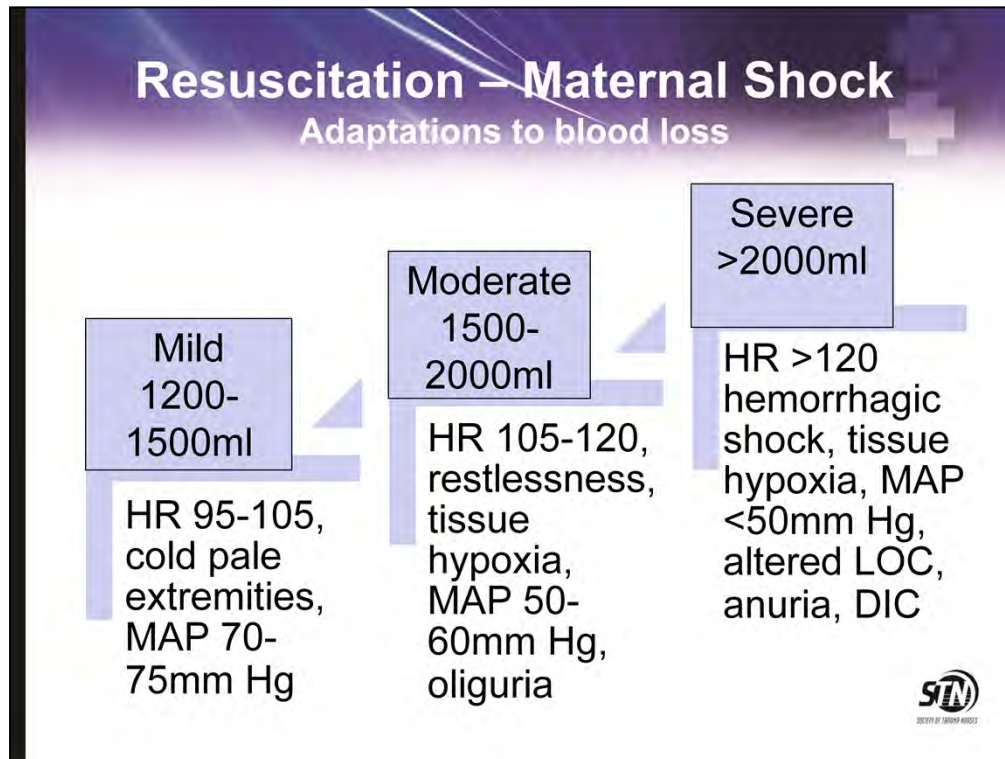
Trauma is the leading cause of maternal death, accounting for up to 46% of cases. Fetal death, however, is a more common occurrence than maternal death.

Direct fetal injury is relatively uncommon because of the maternal soft tissues, uterus, placenta, and amniotic fluid all tend to absorb and distribute the energy of the blow.

The most common cause of fetal death is maternal shock, which is associated with a fetal mortality rate of 80%.

This explains why efforts to assess fetal well-being are secondary to resuscitation of the mother.





Maternal physiologic adaptations to blood loss:

Mild: 20-25% of maternal blood volume (1200-1500ml) tachycardic with HR 95-105, peripheral vasoconstriction – cold pale extremities, MAP drops 10-15% (70-75mm hg)

Moderate: 25-35%, (1500-2000ml) tissue hypoxia will occur, tachycardia with HR 105-120, restlessness, MAP drop 25-30% (50-60), oliguria.

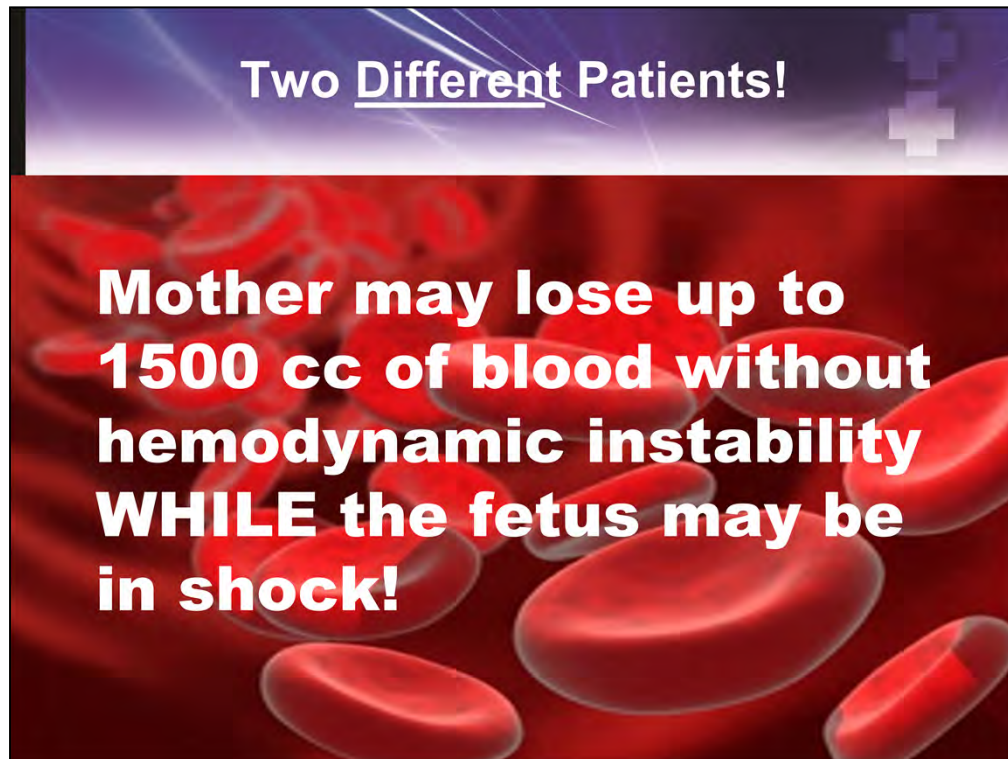
Severe: >30% (>2000ml) hemorrhagic shock, tissue hypoxia continues, tachycardic with HR >120, hypotension with a MAP <50, altered LOC, anuria, disseminated intravascular coagulopathy (DIC).

Uterine arteries are typically vasodilated, however during a shock state, vasoconstriction and decreased MAP may result in decreased uterine blood flow. Maintaining maternal mean arterial pressure is vitally important to both mother and fetal survival.

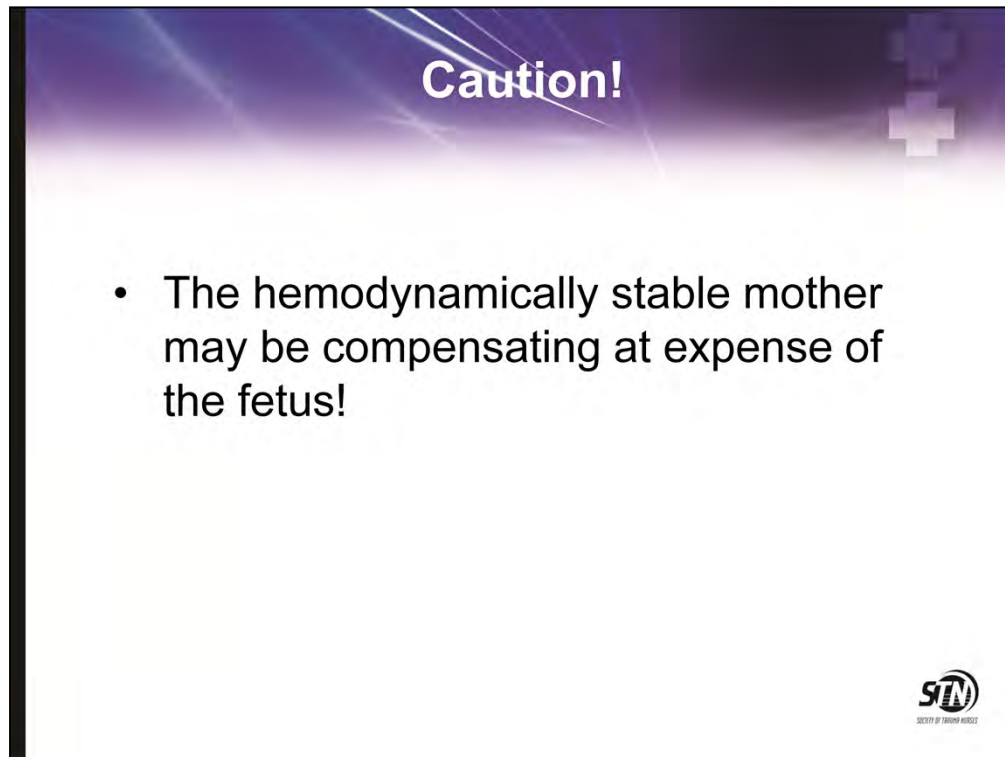
Signs of fetal compromise: bradycardia, tachycardia, loss of beat to beat variability, or recurrent decelerations. When mother hemorrhages the body will shut blood from the placenta. FHT instability may be the first sign of impending maternal hemodynamic instability.

Evidence links maternal acidosis to decreased fetal survival.

Some fetal physiology may protect against hypoxia. In third trimester the fetus may shunt blood distribution to the heart, brain and adrenals. Additionally, fetal hemoglobin has a greater affinity for oxygen than adult hemoglobin therefore fetal oxygen consumption does not decrease until oxygen delivery decreases by 50%.



With a 40% increase in blood volume and 25% increase in red cell mass, the mother may lose significant blood without any signs of hemodynamic instability BUT the fetus may be in shock!




Caution!

- The hemodynamically stable mother may be compensating at expense of the fetus!


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Caution, just because the mother is stable does not mean the fetus is not at risk! Initiate fetal monitoring immediately.

Secondary Survey



- Head to toe assessment
- Obtain obstetrical history:
 - Last menstrual period (LMP)
 - Due date
 - Previous pregnancies:
 - miscarriages
 - premature deliveries
 - abortions
 - Delivery history
 - type, complications



Definitions of childbearing age vary among trauma centers, but a common rule is ages 10-50.

Obstetric history includes parity which indicates any previous abortions or premature deliveries.

Dating the pregnancy will assist in directing the management of care, once the mother has been stabilized.

Further, prior pregnancy and delivery histories will alert team to potential problems with the current pregnancy and also may raise concern regarding rare complications, such as uterine rupture, which is more common with prior cesarean section.

Special attention will need to be given to women who are known to be Rh positive. This issue will be addressed in a future slide. All pregnant women involved in trauma should be tested for their Rh status.

Parity and Gravidity Review

Parity: # births to fetus > 24 weeks

Gravidity: # of times pregnant

5 Digit System	A-B-C-D-E Example: 3-2-0-1-3
A	Times the uterus is pregnant (3)
B	Number of deliveries (2)
C	Number of premature deliveries (0)
D	Number of abortions (spontaneous & therapeutic) (1)
E	Number of living children (3)

A 5 digit system is used to clearly communicate the number of pregnancies and births.

Fetal Assessment	
Fetal heart tones	<ul style="list-style-type: none"> • 120-160 • Continuous >24wks
Abdominal exam	<ul style="list-style-type: none"> • Gestational age • Contractions
Vaginal exam	<ul style="list-style-type: none"> • Bleeding • Ruptured membranes

Fetal heart tones should be assessed as soon as possible after the primary assessment. 120-160 normal. They should be audible by Doppler at 10-14 weeks. Only use a Doppler designed for obstetric evaluation as an Adult Doppler used for vascular studies has insufficient range. The FHR will not be heard even though the fetus is viable and the clinical picture will be confused.

Fetal monitoring should be continuous for any fetus age greater than 23 weeks. Even if no significant maternal injury is identified, fetal monitoring should be continuously monitored for 4-6 hours. Bradycardia, tachycardia, loss of beat to beat variability, or recurrent decelerations are all examples of non-reassuring patterns in fetal heart tones. When the mother is actively hemorrhaging, her body will shut blood from the placenta to supply her vital organs (brain, heart, lungs). Thus FHT instability may be the **first sign of impending maternal hemodynamic instability**.

The abdomen should be examined for gestational age, the presence of contractions or rigidity, and any signs of bruising. Fetal viability typically occurs when the fundus is 3-4 cm above the umbilicus. Contractions of the uterus may indicate preterm labor. A rigid uterus/abdomen may indicate a placental abruption.

Some resources recommend a sterile speculum exam to look for ruptured membranes or bleeding. At least, a visual exam of the external perineum and the introitus should be done to look for frank bleeding or the presence of amniotic fluid. If there is any concern for ruptured membranes, sterile gloves should be used for the exam. If preterm labor is suspected, the cervix should be examined for changes (effacement and dilation)

Fetal Monitoring

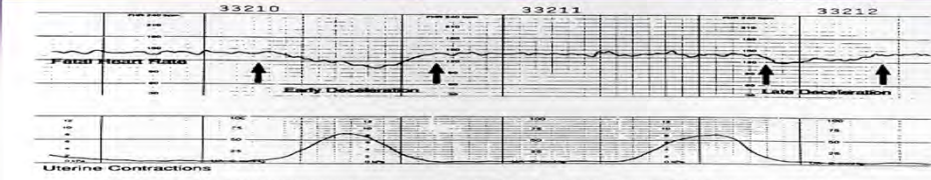


Figure 3. Tocodynamometry tracing that depicts early (Type I) and late (Type II) fetal heart rate decelerations.

- All pregnant trauma > 20 weeks' gestation
- Minimum of 6 hours continuous fetal monitoring
- Further continuous monitoring and evaluation if:
 - uterine contractions
 - non-reassuring fetal heart rate pattern
 - vaginal bleeding
 - significant uterine tenderness or irritability
 - serious maternal injury
 - rupture of the amniotic membranes

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- The electronic fetal heart monitor is primarily used to detect fetal hypoxia (lack of sufficient oxygenation) in hopes of catching it early enough to prevent neurological damage in the unborn baby. Indications of fetal hypoxia are represented by prolonged deviations from a normal baseline pattern of the fetal heart rate. The normal fetal heart rate range is between 120 and 160 beats per minute.
- FHT can be heard with conventional stethoscope at about 20 weeks gestation. With doppler they can be detected between 12-14 weeks gestation.
- The fetal heart rate is controlled by the autonomic nervous system, with an inhibitory influence coming from the vagus nerve, and an excitatory influence coming from the sympathetic nervous system.
- Stimulation of the peripheral nerves of the fetus by its own activity (such as movement) or by uterine contractions causes acceleration (rise) of the fetal heart rate.
- A deceleration (drop) of the fetal heart rate usually indicates that the fetus is under some sort of stress, which may be a good healthy sign if it corresponds with movement or uterine contractions, but may be a bad sign if it happens apart from movement of uterine contractions.
- Assess for:
 - Rate (120-160 Beat to beat variability)
 - Baseline variability Decelerations, esp. late

Unit Placement


- Admit to the most appropriate unit
- Matched to patients needs
- Standard of care must be maintained regardless of unit selected




Place the patient where the resources best meet the patients needs the most (both mother and fetus).

The standard of care must be maintained for both mother and fetus.

Who Admits & Where?

<u>To Trauma ICU</u>		<u>To Obstetric Unit</u>
<ul style="list-style-type: none">• Mother severely injured & viable fetus• Admit to trauma• Double teamed<ul style="list-style-type: none">• Trauma Nurse• L & D Nurse• At minimum remote continuous fetal monitoring		<ul style="list-style-type: none">• Mother less injured, stable & viable fetus• Initially admitted to trauma surgeon with OB on consult• Care may be transferred to OB after 24-48 hrs



The trauma surgeon and obstetrician should consult on the best place for the patient.

If the mother is severely injured the best place is the trauma intensive care unit with OB nurses in attendance.

If the mother has minor injuries, the patient can be admitted safely to the obstetric unit with frequent checks by the trauma nurse.

Will vary by hospital protocols. Have protocol established in advance.

Labs Specific to Pregnancy

Blood & Antibody Status

- Mother Rh neg & no antibodies:
give Rh immunoglobulin therapy (Rhogam)

Kleihauer-Betke (KB) Test

(detects feto-maternal hemorrhage)

- Draw in all pregnant trauma patients > 12 weeks gestation (EAST, 2005)
- Guides Rhogam dosage Rh- mothers
- Controversial as correlate to risk for preterm labor





Rh immune globulin contains antibodies to the Rh factor in blood. The antibodies come from donors who have become sensitized to the Rh factor. Giving these Rh antibodies to an Rh-negative pregnant woman prevents her immune system from producing its own Rh antibodies, which would attack her Rh-positive fetus's red blood cells. When introduced into an Rh-negative mother's bloodstream, Rh immune globulin antibodies locate any Rh-positive fetal red blood cells that are present. The antibodies attach to the Rh-positive red blood cells, masking their presence from the mother's immune system. Although the Rh immune globulin antibodies destroy fetal red blood cells, not enough are destroyed to harm the fetus.

Rh immune globulin is given by injection into a muscle (intramuscular, or IM). Rh immune globulin is given to all Rh-negative women who may be carrying an Rh-positive fetus. While it **prevents** Rh sensitization, Rh immune globulin cannot prevent damage to an Rh-positive fetus if the mother is already sensitized to the Rh factor. Rh immune globulin should be given to all Rh-negative woman to prevent sensitization.

In maternal trauma, the Kleihauer-Betke (KB) test has traditionally been used to detect transplacental hemorrhage (TPH), so that Rh-negative women could receive appropriate Rh immune prophylaxis. Kleihauer-Betke testing accurately predicts the risk of preterm labor (PTL) after maternal trauma. Clinical assessment does not. With a negative KB test, posttrauma electronic fetal monitoring duration may be limited safely. With a positive KB test, the significant risk of PTL mandates detailed monitoring. KB testing has important advantages to all maternal trauma victims, regardless of Rh status.

Radiology in Trauma and Pregnancy



**Benefits to the mother outweigh small
risks to the fetus!**




While caution is necessary to reduce radiation exposure, it should never be done at the expense of the mother's welfare. All injuries should be identified during the primary and secondary assessment with the use of radiography when necessary.

Radiation Exposure Risks

Greatest risk first 25 weeks

- Week 1-3: embryo death
- Week 8-25: CNS effects (↓ IQ)
- Week > 25: childhood cancer

- CT highest rad dose
- Weigh risks & benefits

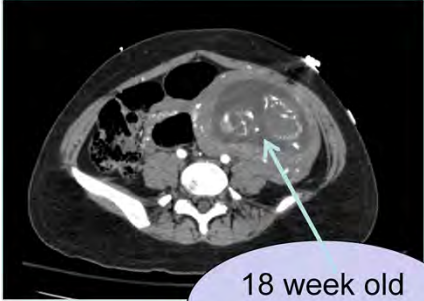


Multiple injured trauma patients receive a substantial dose of radiation. Radiation exposure is cumulative. The low individual risk of cancer becomes a greater public health issue when multiplied by a large number of examinations and over the life time of the patient.

Though CT scans are an invaluable resource and are becoming more easily accessible, they should not replace careful clinical examination and should be used only in appropriate patients.

Radiologic Studies

- Ultrasound
 - Preferred test for mom & fetus
- Plain films
 - useful
 - exposure low
- CT
 - ↑ radiation dose
- Provide shielding when possible



18 week old fetus on CT

No needed study should be deferred if the mother's life is at risk

Ultrasound is safe, but has fairly poor sensitivity for diagnosing abruption. However, if a clot is visualized, prediction of abruption is high. The FAST exam becomes less accurate with increased gestational age, as the uterus crowds the abdominal cavity.


Use of plain films typically outweigh the risks of radiation exposure and

In mid to late pregnancy there is no single study that carries enough radiation to harm a fetus. The highest radiation dose occurs with CT, thus only indicated studies should be ordered. CT scan is noninvasive and provides additional information related to the retroperitoneum and GU tract. More specific uterine and fetal injuries can be determined.

Magnetic resonance imaging has not been associated with adverse fetal effects.

Other than a brain flow study, there is little indication for nuclear medicine imaging.

Medications FDA Pregnancy Categories	
Risk Description	
A	Safety established by human studies
B	Presumed safe established by animal studies
C	Uncertain safety: animal studies show risk, weigh benefits of use
D	Unsafe: human studies show risk, weigh benefits of use
X	Highly unsafe: positive evidence of harm



FDA pregnancy categories should be noted for every medication given

Few medications are known to be safe

Weigh the risks and benefits

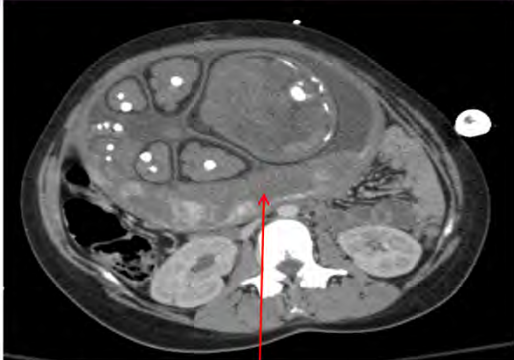
Tetanus is NOT contraindicated, administer as appropriate

Do not withhold analgesics

Anesthesia drugs fall in Category C

Placental Abruption

- Placental uterine separation
- Blood Loss:
 - External: vaginal bleeding
 - Occult: accumulates behind placenta, bleeding may not be seen



Case study: Hypo-perfused regions of placenta = abruption. No vaginal bleeding, normal fetal heart tones, frequent uterine contractions. C-section performed. Fetus survived.

Placental injury is a threat to both patients. The early separation of the placenta deprives the fetus of oxygen, leading to hypoxia and death if the fetus is not delivered quickly. Further, the uterus is unable to contract to constrict bleeding vessels in the uterine wall, as the fetus remains within the uterus. Thus the mother is at risk for significant blood loss. Additionally, the thromboplastin which is released as a result of the abruption can cause or worsen disseminated intravascular coagulopathy (DIC).

*The uterine cavity can hold the entire blood volume of an adult.

***If abruption is occult, the first signs of fetal and maternal compromise may be non-reassuring fetal heart tones. Thus early fetal monitoring is important.**

Abruption is the cause of at least 50% of fetal death.


Even without outward signs of trauma a sudden deceleration can create a shearing force which may result in abruption.

Placental Abruption

- 3% of minor trauma
- 50% of severe trauma
- Cannot predict based on ISS

- Signs and Symptoms: rigid abdomen, abdominal tenderness, tetanic contractions, fetal distress, may or may not have vaginal bleeding

- *Fetal monitoring* → *early warning system!*



The placenta does not have the ability to contract and expand, and thus cannot vasoconstrict to control bleeding like the uterus. With deceleration and acceleration injuries, a shearing will occur within the tissues of the placenta. This shearing causes separation of the placenta from the uterine wall. **In severe blunt trauma, abruption is very common, occurring in 40% of cases. Of these cases, fetal death occurs 60% of the time.**

Of all fetal deaths from trauma, abruption is the cause of at least 50%.

Although there is a greater likelihood of abruption with severe blunt trauma, the occurrence of abruption can not be predicted with use of severity of injury measures, such as ISS.


In patients beyond 23 to 24 weeks ***tocodynamometry (measuring uterine contractions), is the most sensitive predictor of abruption. Monitoring should begin as soon as the mother is stable.***

Most cases of abruption will exhibit frequent contractions, >8/h and will normally occur within the initial 4 hours after the trauma. Thus 4-6 hours of FHT and tocodynamometry monitoring has become standard as a minimum for pregnancies greater than 23 weeks.

If there is no uterine tenderness, bleeding, fetal distress, serious maternal injuries **and** fewer than 1 contraction every 10 minutes the risk of abruption is small. However, the literature shows rare cases of abruption occurring up to 6 days post trauma. Pregnant women involved in a trauma should be educated on what to look for after they are discharged. (vaginal bleeding, abdominal pain and/or rigidity, frequent contractions).

Uterine Rupture

- Rare and catastrophic
- High maternal and fetal death
- May result from: uterine avulsions, disruptions of placenta, fetus or umbilical cord
- Presents with: shock, poor FHT, distention, rigidity, guarding, peritoneal irritation




The slide features a purple gradient background with a white cross in the upper right corner. The title 'Uterine Rupture' is centered at the top in a white, bold font. Below the title is a bulleted list of four points. In the bottom right corner, there is a small logo for 'STN' with the text 'SOCIETY OF TRAUMA NURSES' underneath it.

Uterine rupture: Uterine rupture may result from a serosal hemorrhage, uterine avulsions, disruption of the uterine wall, placenta, fetus, or umbilical cord. 75% of uterine ruptures involve the fundus. Signs and symptoms of uterine rupture are: uterine tenderness, nonreassuring fetal heart tones, rapid hypovolemic shock, peritoneal irritation, distention, rebound tenderness, guarding and rigidity.

Risk factors: prior cesarean section, other uterine surgeries or malformations, uterine over-distention (polyhydramnios) and multiple gestation.

Direct Fetal Injury

- Rare - 1% of blunt trauma
- Maternal tissues protective for the fetus
- Fetal head injury
 - most common
- CT scan to assess fetus
- Prepare for cesarean section if indicated



3D reconstruction of 37 week fetus after MVC

Fetal head injury most common occurs with maternal pelvic fractures, especially if the head is engaged in the pelvis

For blunt trauma, the injury pattern will differ depending on gestational age.

Because of increased vascularity increase in splenic and retroperitoneal injury.


In blunt trauma: most frequent injuries are head trauma, intraabdominal bleeding, visceral rupture and pelvic fractures. Higher incidence of hepatic, splenic and uterine. Gastro less common.

Direct fetal injury = less than 1% of severe blunt trauma. Maternal tissue is protective. Most common is head injury, more common when engagement has occurred and there are pelvic fractures.


Maternal and fetal deaths were highest with internal injuries to the thorax, abdomen and pelvis.

Don't embolize vessels which feed the uterus. But useful with pelvic fractures. Use with caution due to radiation exposure but use if indicated.

Pelvic Fractures



- Most common in MVC
- Anticipate hemorrhage from engorged pelvic vessels
- Fetal mortality 35%
Maternal mortality 9%
- Associated bladder or urethral trauma



Pelvic fractures: Maternal mortality is approximately 9% compared to a fetal mortality rate of 35%. Fetal deaths are more common with maternal vascular injuries, due to the high risk of disrupted blood flow to the uterus.

Outcomes depended on DEGREE OF INJURY, unlike in abdominal trauma.


Fetal head and clavicle injuries are more common in pelvic fractures.

Due to the close association between pelvic fractures and urethral and bladder injuries, care should be taken to observe for blood at the urethral meatus before inserting a urinary catheter.


In the diagnosis of pelvic fractures CT can be used sparingly, plain x-rays are often sufficient.

Pelvic Fractures

- Management :
 - internal fixation
 - non-operative approach
- Angiography & Embolization:
 - may be used with caution
- Vaginal delivery:
 - not completely contraindicated



Repair after birth by cesarean section



Care should be used with angiography due to the high levels of radiation associated with the procedure. Additionally, embolizing vessels feeding the uterus will compromise the fetus. However, to save the mother's life, no therapy should be withheld. Provide lead shielding for fetus.

Pelvic fractures are not a complete contra-indication to a vaginal delivery, but severely dislocated fractures or large areas of healing bone, may prevent it

One study showed that 75% of women who had pelvic fractures in their 3rd trimester, were able to give birth vaginally.

Penetrating Abdominal Trauma



- Uterus is the dominant organ and likely target
- Fetal demise 40-70% due to:
 - direct fetal injury and early birth
- Risk for massive hemorrhage from uterine injury



Penetrating trauma: Depending on source and type of injury there is a 40-70% fetal demise rate and 5-10% maternal death rate. Pregnancy may be protective for the mother due to the displacement of internal organs, deflecting injury to the fetus. If the upper abdomen is injured there is more likely to be a bowel injury and lower abdomen is more likely to injure the fetus.

The decision to take the patient to surgery should depend on the location of the injury, size of the uterus and maternal and fetal vitals. Injuries in the upper abdomen will usually be handled with surgery. If both mother and baby are stable and the injury is in the lower abdomen a conservative approach may be appropriate.



Massive hemorrhage can occur from uterine injuries due to the blood that is shunted to uterus. Quick control of bleeding must be achieved. With GSW this requires exploratory surgery almost exclusively.

Administer antibiotics for anaerobic and gram negative if bowel involvement.

Perimortem Cesarean Section

Indications:

- Fetus > 23 weeks gestation
- Reasonable certainty of maternal demise
- Knowledge of operative technique
- Available resources to resuscitate neonate
- Presence of fetal heart activity



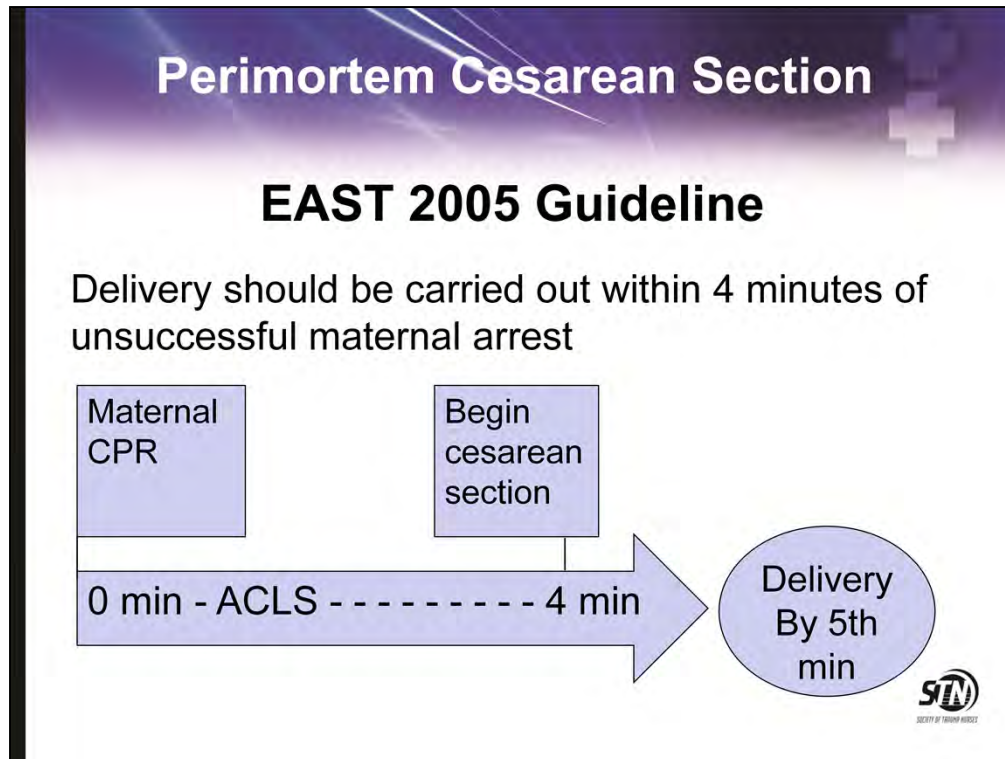
In the event of a cardiac arrest in a gravid patient, a perimortem cesarean section should be considered as a potential lifesaving procedure for the mother and fetus. Despite the attempt to displace the uterus and decrease aortocaval compression, attempts to restore circulation may be unsuccessful. Both obstruction of the abdominal aorta and decreased compliance of the thoracic cavity, make CPR inadequate in the pregnant patient. A cesarean delivery may be the best option for saving both patients.

The minimal gestational age for a perimortem cesarean is a controversial issue. Compression of the aorta can occur as early as 20 weeks, it is unclear whether it is truly an impact of perfusion until 24 weeks. Further, viability of the fetus typically occurs around 23-24 weeks. Although there are some facilities that will care for a fetus as young as 22 weeks. Thus a perimortem cesarean section could be done at 22-24 weeks of gestation and above.

Quick rule of thumb: If fundus is greater than or equal to 4 fingerbreadths above the umbilicus the fetus is likely 24 weeks old.

That patient should not be transported to the OR. An emergency C-section delivery kit should be available for immediate use in the emergency department. Neonatal resuscitation supplies and equipment (suction, intubation equipment, warmer, Braselow tape etc.) should be in the resuscitation room.

Team should include trauma team, obstetrician, neonatologist and neonatal ICU nurse.



Case reports of perimortem cesarean sections, show that neonatal neurological outcomes are better if delivery occurs within 4 minutes of arrest.

Further, maternal return of circulation was found to improve when the uterus is emptied.

EAST recommends that a perimortem cesarean section be performed within 4 minutes of maternal arrest.

Rationale:

- Brain damage occurs in nonpregnant patients in 4 -6 minutes of anoxia.
- Pregnant women become anoxic sooner, due to decreased functional residual capacity.
- If the fundus is 4 fingerbreadths above the umbilicus, CPR is ineffective for resuscitation. Emptying the uterus will improve chance of maternal survival.
- Fetal survival diminishes in the time between maternal death and delivery.

Chest compressions should be continued throughout and broad spectrum antibiotics should be given to decrease the risk of postpartum infection.

Family Support

- Keep informed
- Explain treatment
- Control pain
- Support services early (social work, chaplain)



Provide comfort to the mother and family by allowing them to be together at every opportunity

Allowing patient to hear the fetal heart beat and see ultrasound images may lessen anxiety.

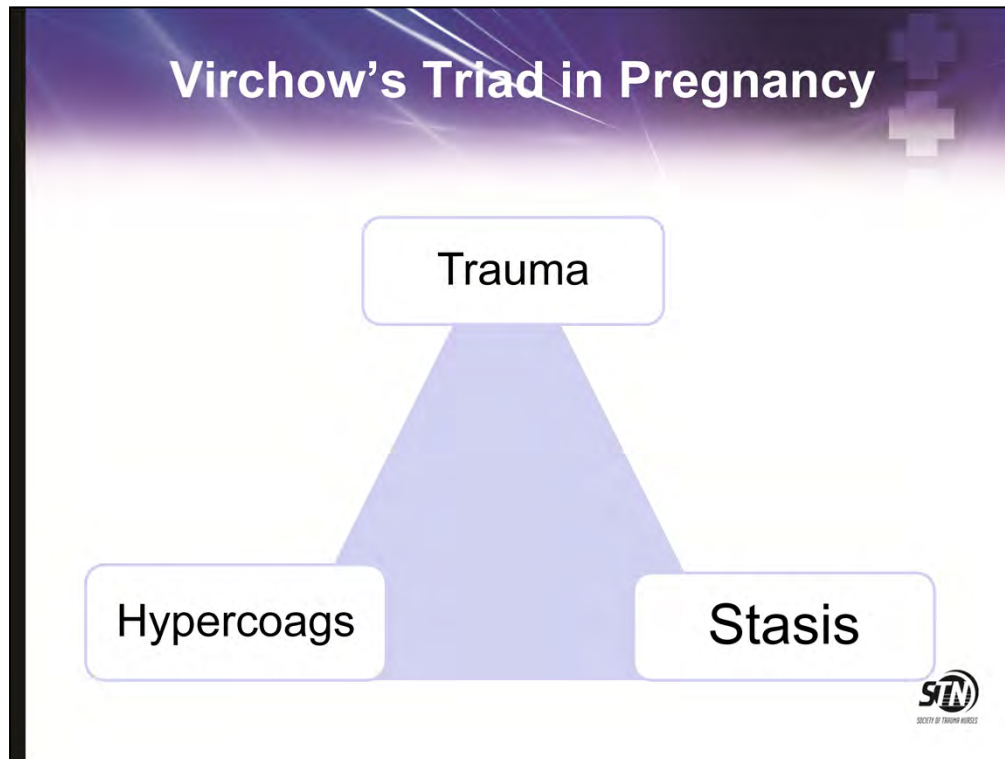
In addition to concerns about the baby, the patient and/or family may be experiencing guilt about events leading to the injury.



Recommendations for fetal monitoring after trauma vary. However, a minimum of 6 hours is the current recommendation by EAST although some research suggests that 4 hours is acceptable.

Domestic violence is epidemic in this population of patients and is often under reported. Further investigation of effective screening methods in the pregnant population should be a priority.

Because airbags were designed to protect an average sized male who is restrained, further research and development should be conducted to ensure that the pregnant woman and her fetus are protected and not harmed by airbags. Research is ongoing in this area.



Virchow's Triad refers to the three factors which play a role in thrombus formation.

Stasis: In pregnancy venous stasis occurs from compression of the iliac veins as a result of the right iliac artery overlying the left iliac veins, the gravid uterus, hormonally mediated venous dilation and decreased activity.

Hypercoagulability: Changes in procoagulant factors and anticoagulant and fibrinolytic activity, from the release of estrogen, result in more thrombin generation and less clot dissolution activity.

Trauma: A trauma leading to endothelial injury, is the final factor of Virchow's triad. Thus traumatic injury in pregnancy puts the pregnant patient at an even greater risk for venous thrombus and it's sequela.

Thrombotic Disease in Pregnancy

- Pregnancy → hypercoaguable state
- Incidence of DVT of 0.1-0.2%
- Recommended treatment:
 - Sequential compression devices
 - Heparin
 - Low molecular weight Heparin
- CONTRAINDICATED:
 - Coumadin (severe fetal malformations)



Pulmonary embolism is the main cause of death of pregnant women in developed countries. An increased prothrombotic activity is observed during pregnancy. Moreover, the risk of venous thromboembolic disease can be elevated in cases of inherited thrombophilia, antiphospholipid syndrome or previous venous thromboembolic events.

According to presented guidelines of The American College of Chest Physicians, the risk stratification of venous thromboembolic disease during pregnancy and puerperium is a vital condition and proper antithrombotic prophylaxis should be implemented.

Summary

- A&P changes greatly impact assessment and management of the pregnant trauma patient
- Initial evaluation & treatment should focus on the mothers hemodynamic stability
- Implement widespread domestic violence screening
- Injury severity is not a predictor for abruption, it can occur with mild injury.
- Education regarding substance abuse, restraints and distracted driving can save lives

