Trauma and Considerations Unique to Pregnancy

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INTRODUCTION

Trauma complicates 6% to 7% of all pregnancies and requires multidisciplinary education and training for both trauma and obstetric (OB) teams to achieve the best outcome. The importance of this is emphasized by the statistics, which show trauma to be the leading cause of non-OB maternal death that also results in an annual loss of 4000 fetuses.1,2 Although the great majority of OB trauma is considered minor, this statement can be misleading, because 50% of fetal losses occur in what is often considered to be minor trauma. Only 4 per 1000 OB trauma cases lead to inpatient admission; however, the delivery rate after admission is 24% to 38%.2–6

Systems such as the Injury Severity Score and Revised Trauma Score exist in the trauma arena to categorize patients and attempt to quantify risk of adverse outcome. Higher scores reflect greater injury. However, these systems have not been found to be applicable to outcomes in OB cases. A population-based study of 10,000 pregnant women examined outcomes in relation to Injury Severity Score. Women were categorized by those who required delivery at the time of their trauma admission and those who were delivered at a later time. An Injury Severity Score of greater than 10 was

KEYPOINTS

• Fifty percent of fetal losses occur after “minor trauma.”
• Proper seat belt use in pregnancy reduces adverse fetal outcomes in motor vehicle crashes.
• Clinical signs of hemorrhage and shock are delayed in pregnant women.
• Prioritize maternal stability before fetal assessment.
• Displace the gravid uterus to prevent aorticaval compression.
associated with the highest risk of adverse outcome; however, those dyads with a score of less than 10 remained at increased risk of abruption, uterine rupture, and maternal and fetal death. Owing to the limitations of these scoring systems and trauma providers' lack of consistent OB experience, it is important to understand mechanisms for certain adverse maternal and fetal/neonatal outcomes incurred as a result of trauma, as well as caveats to pregnancy physiology that make some injuries more likely and detection of maternal compromise more difficult.

**MATERNAL AND FETAL RISK**

Common pregnancy-associated risks in trauma include preterm contractions, preterm labor, preterm delivery, abruption, fetal and neonatal death, and uterine rupture. Motor vehicle crashes (MVCs) are the most common source of OB trauma (two-thirds of all cases), followed by falls, intimate partner violence (IPV), assault, and suicide. Although the severity of the MVC is associated most strongly with adverse outcomes, even minor collisions can result in fetal demise. Correct seat belt use and air bag deployment decrease the risk of maternal injury and fetal loss. However, even with this, at a speed of 20 mph, the risk of adverse fetal event is still as high as 12%. IPV often escalates during pregnancy and is thought to exist in 20% of pregnancies. IPV can take many forms (falls, MVCs, gunshot wound, stabbing, strangulation, blunt trauma) and should be screened for in all trauma patients.

Blunt trauma can occur as a result of falls, MVC, or assault. Upper abdominal injuries include risks to the spleen and liver. The bowel is less often injured as a result of blunt trauma because it is shielded by the gravid uterus. Although rare, uterine rupture can occur (most often posterior and fundal) with a fetal mortality rate approaching 100%. Fetal injury can also occur and may not be perceptible until after delivery. Fetal–maternal hemorrhage occurs in up to 10% of blunt trauma cases. Penetrating abdominal trauma most often occurs as a result of gunshot, stabbing, assault, or attempted suicide. A larger uterus, owing to late gestational age or multiple gestation, is more likely to sustain injury. Bowel injury is somewhat prevented by the gravid uterus, but should be more strongly suspected in upper abdominal stab wounds. Gunshot wound injuries are variable and determined by distance from the gun, entry point, unseen visceral path, and exit point.

Pelvic fracture is most often seen as a result of MVC or serious fall. Open pelvic fracture is associated with increased risk for bowel injury, other maternal structural injury, and maternal and fetal death. Fetal head injuries can occur as a result of pelvic fracture when the fetus is vertex. If a fracture is deemed stable and the pelvic inlet and outlet are not compromised, vaginal delivery can still be attempted.

Abruption occurs in 7% of trauma cases, most of which are considered “minor.” When the uterus decelerates owing to a sudden stop, the continued inertia of the amniotic fluid can create negative pressure on the uteroplacental interface. This inertia, along with shearing force and stretching at the uteroplacental interface, can create separation and resultant retroplacental bleeding. Abruption most often occurs as the result of an MVC, but can occur in any setting with the right combination of intrauterine inertia and shearing force. It may not be apparent clinically until more than 24 hours after trauma. Abruption is associated with worse neonatal outcomes than gestational age–matched controls, including death, cerebral palsy, intraventricular hemorrhage, asphyxia, and periventricular leukomalacia. Classically, an abruption presents as vaginal bleeding with abdominal or back pain, although 10% may be concealed (no vaginal bleeding). The amount of vaginal bleeding is not necessarily predictive of the size of the abruption. Coagulopathy can develop in 10% of
Abruptions, with other bleeding from trauma further increasing that risk. Abruptions may be challenging to detect. The absence of pain or bleeding does not exclude abruption. Ultrasound imaging will detect a relatively small portion of abruptions. This is addressed later in the article.

Preterm labor is also commonly associated with trauma. Multiple etiologies include direct uterine injury, maternal hypoxia, or bleeding, which stimulate contractions. Morbidity and mortality from preterm delivery increases as gestational age decreases. Stillbirth risk is increased in trauma and may be a result of undetected or delayed abruption, fetal distress, or fetal–maternal hemorrhage. Some fetuses may be at higher risk of this, including those with preexisting uteroplacental insufficiency. If a stillbirth is encountered at initial evaluation, there is typically no urgency for delivery, and maternal stabilization should occur first.

**PHYSIOLOGY CAVEATS**

The physiologic adaptations to pregnancy are important to understand when evaluating and treating pregnant trauma patient (Table 1). Many of these adaptions are detectable as early as the first trimester. It is the obstetrician’s role to relay this information to the trauma team both in education, simulation, and in actual trauma scenarios.

Cardiovascular adaptations are summarized in Fig. 1. These include a 20% to 50% increase in blood volume with resultant increase in stroke volume and cardiac output and decrease in systemic vascular resistance. Clinical signs of hemorrhage and shock can be delayed in pregnant women owing to these cardiovascular adaptations. Once a pregnant patient develops tachycardia and hypotension in response to hemorrhage, at least 20% of her blood volume has been lost. Mortality is increased in pregnant women with blood loss so great as to cause tachycardia and hypotension. Postpartum trauma patients are at increased risk for pulmonary edema owing to the immediate increase in cardiac output (80%) with autotransfusion of uterine/placental blood flow and mobilization of extravascular fluid compounded with any injuries sustained as a part of their trauma. Plasma volume increases to a greater proportion than red blood cell mass, resulting in a dilutional anemia in 20% to 60% of pregnant women. This dilutional anemia leads to a decreased in hemoglobin relative to the nonpregnant states. However, it does not generally result in a true anemia. Anemia in pregnancy is defined by the

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**Table 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pregnant</th>
<th>Nonpregnant</th>
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<tbody>
<tr>
<td>Fibrinogen (mg/mL)</td>
<td>400–650</td>
<td>150–400</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>&gt;11</td>
<td>14 ± 2</td>
</tr>
<tr>
<td>AST (U/L)</td>
<td>10–30</td>
<td>7–40</td>
</tr>
<tr>
<td>ALT (U/L)</td>
<td>6–32</td>
<td>0–40</td>
</tr>
<tr>
<td>pH</td>
<td>7.4–7.46</td>
<td>7.38–7.42</td>
</tr>
<tr>
<td>Pco2 (mm Hg)</td>
<td>26–32</td>
<td>38–45</td>
</tr>
<tr>
<td>Po2 (mm Hg)</td>
<td>75–106</td>
<td>70–100</td>
</tr>
<tr>
<td>HCO3 (mmol/L)</td>
<td>18–21</td>
<td>24–31</td>
</tr>
<tr>
<td>O2 saturation (%)</td>
<td>95–100</td>
<td>95–100</td>
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</table>

*Data from Refs. 28–31*
Centers for Disease Control and Prevention as a hemoglobin of less than 11 g/dL in the first and third trimesters, and less than 10.5 g/dL in the second trimester. Anemia results in a lower arterial O₂ content; however, O₂ delivery is maintained owing to increased cardiac output. Pregnant women, therefore, depend on cardiac output for O₂ delivery more so than nonpregnant women. If there is compromise of O₂ delivery (decreased gas exchange, respiratory illness, blood loss) then a pregnant woman can become compromised quickly, particularly surrounding the time of labor and delivery. O₂ delivery must be optimized before proceeding with delivery in a compromised patient.

Most (95%) pregnant women will demonstrate a systolic flow murmur of aortic or pulmonic origin. Any murmur greater than 2/4 or any diastolic murmur is abnormal. Owing to the superior, latera, and anterior displacement of the heart in the thorax, pregnant women can falsely seem to have cardiomegaly on chest radiography.

Uterine blood flow represents a large portion of maternal cardiac output. Trauma teams need to be aware of the potential for massive blood loss via the uterus, placenta, and engorged uterine and ovarian veins. The gravid uterus can rest on
the great vessels as they return to the heart, creating aortocaval compression in the supine position as early as 20 weeks’ gestation (sooner in multiple gestations). This can reduce cardiac output by 25% to 30%, leading 8% of pregnant women to develop hypotension, bradycardia, and syncope/presyncope.40,41

Respiratory changes are summarized in Fig. 2. These include an increased O₂ consumption of 20% to 30%, increased tidal volume, decreased functional residual capacity, and decreased CO₂ levels. As gestation advances, there is continued upward displacement of the diaphragm (up to 4 cm) decreasing the functional residual capacity (air left in the lungs after exhalation).42 The decreased functional residual capacity allows for more alveolar collapse and decreased gas exchange. The chest diameter increases by 2 cm.42 Pregnant women are at increased risk for pulmonary edema owing to increases in plasma volume and cardiac output in the setting of decreased oncotic pressure. Owing to compensated respiratory alkalosis, a high normal or slightly elevated carbon dioxide level is a much more concerning finding in a pregnant woman.

The liver has not been shown to be enlarged as a result of pregnancy, and therefore hepatomegaly in a pregnant trauma patient should be considered abnormal and undergo evaluation. Estrogen and pregnancy increase fibrinogen and coagulation factor synthesis in the liver. Fibrinogen levels double in pregnancy.43 There is a 20% to 100% increase in factors VII, VIII, IX, and X, and von Willebrand factor.43 Factor XI decreases slightly, and the free protein S levels show a 60% to 70% decrease.44 Low or low normal fibrinogen typically signals consumptive coagulopathy and must be addressed rapidly.

Alkaline phosphatase levels are highly elevated in pregnancy owing to placental production and reach 2 to 3 times baseline by the third trimester.30 Glomerular filtration rate is increased by 50% after conception, whereas blood urea nitrogen and serum creatinine decrease as a result. Owing to pregnancy physiology, accurate calculation of the glomerular filtration rate via the Cockcroft-Gault and Modification of Diet in Renal Disease formulas is limited.45 Values of 0.9 mg/dL for creatinine and

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Fig. 2. Respiratory changes in pregnancy.
14 for blood urea nitrogen are suspect for underlying pathology in pregnant women, although they may not be outside the normal laboratory reference ranges.

**MANAGEMENT OF TRAUMA**

Core Advance Trauma Life Support protocols should be followed in the evaluation of a pregnant trauma patient, because these steps are proven to improve outcomes. Better maternal outcomes increase the chance of fetal survival and well-being. However, there are several modifications and additions to these protocols to allow for the simultaneous care of 2 patients (a mother and a fetus). See Fig. 3 for a summary. If there is advance warning of an OB trauma arrival, a member of the OB team can save valuable time for the patient and fetus by obtaining as much information as possible before their arrival. Quick access to accurate records to determine gestational age, amount of prenatal care, fetal number, and other comorbidities is invaluable. Activation of an OB trauma alert also gives the team time to ready the OB ultrasound equipment, a precipitous delivery pack, a cesarean delivery (CD) pack, ...

**Fig. 3.** Obstetric (OB) modifications to trauma protocol (*dark blue*). EFM, external fetal monitoring; EGA, estimated gestational age; EMS, emergency medical services; TOCO, tocodynamometer.
and mobilize the neonatal intensive care unit (NICU) team. If indicated, the trauma team can place an operating room (OR) on hold for any anticipated maternal injuries. En route, the emergency medical services (EMS) transport team can update everyone involved with maternal vital signs, airway status, Glasgow coma score, and other measures as available.

**Initial Evaluation**

If the patient is brought to a trauma bay in the emergency department for major trauma evaluation, the trauma team should be allowed to perform the initial assessment and determination of stability. This typically includes the ABCDEs (airway and c-spine protection, breathing and ventilation, circulation and hemorrhage control, disability, and exposure). Do not perform a fetal assessment if the maternal airway is not secure or the patient is not hemodynamically stable. A low threshold for early intubation should be considered given the fetal dependence on maternal oxygenation. If not ventilated, supplemental O₂ should be provided. If maternal spinal injury is not a concern, place the backboard on a slight leftward tilt (15°) or place wedge under the right hip. Initial efforts of the OB team should focus on displacing the uterus and obtaining gestational age information while maternal stability is assessed.

Once initial stability is ensured by assessment of the airway, ventilation, and circulation, the obstetrician can quickly assess the fetus with bedside ultrasound imaging. Meanwhile, the trauma team can continue to assess the patient and secure intravenous lines. If respiratory and hemodynamic stability cannot be confirmed before the Focused Assessment with Sonography in Trauma scan or chest/pelvis radiographs, these should be performed before OB ultrasound. Although the viability and well-being of the fetus is important to determine, the team cannot act on any information gained by ultrasound examination if the mother is not fit for intervention such as emergent CD. Communication between the trauma team leader and the OB team leader will be key in determining this timing. If the estimated gestational age is known and viability is assumed, then an initial quick determination of viability and heart rate via ultrasound is sufficient.

**Monotonous**

If the estimated gestational age is not known, then a quick assessment with biometry (head circumference, biparietal diameter, abdominal circumference, and or femur length; Figs. 4–7) or cerebellar measurement can assist in making this determination. After this, if the maternal clinical scenario permits, further assessment of fetal number, presentation, placentation, and amniotic fluid is indicated.

If the fetus is nonviable (owing to stillbirth or by early estimated gestational age), allow the trauma team to complete maternal stabilization and resuscitative efforts. It is important to recognize that, if the fetus is demised, the precipitating factor may be owing to concealed intraterine or retroperitoneal hemorrhage. If the fetus is viable and the clinical scenario is appropriate, work with trauma team to set up external fetal monitoring (EFM) and tocodynamometer (TOCO) monitoring while they continue their evaluation. EFM can also act as a supplemental maternal vital sign during the secondary evaluation. Adequate uterine perfusion is required to provide fetal oxygenation and a gestational age–appropriate EFM tracing. A decrease in uterine perfusion owing to maternal hypotension, hemorrhage, and so on could be signaled by an increase in uterine contractions or fetal heart rate decelerations. A member of the OB team should be with the patient while on EFM/TOCO at all times.
**Fig. 4.** Correct determination of fetal head measurements to estimate gestational age. Bi-parietal diameter (BPD): Section through the fetal head containing the thalamus and third ventricle. Calvarium must be smooth and symmetric. Place calipers from outside to inside of calvarium. Head circumference (HC): BPD requirements in a plane that contains the cavum septum pellucidi and the tentorial hiatus. Place ellipse to calvarial edges, not skin edges.

**Fig. 5.** Correct determination of fetal abdominal circumference (AC) to estimate gestational age. Section where the right and left portal veins are continuous with one another. Lower ribs are symmetric. Ellipse measures skin edge. Avoid significant transducer pressure to keep AC round. Stomach is almost always seen.

**Fig. 6.** Correct determination of fetal femur length (FL) to estimate gestational age. Obtain long axis view of the femur by viewing the cartilaginous femoral head, greater trochanter, and lateral condyle. Place calipers at junction of cartilage and ossified bone.
Operating Room Monitoring

Often trauma patients will require continued evaluation and emergent treatment in the OR. If the fetus is known to be viable or OB assessment has not occurred, the obstetrician should accompany the team to the OR to perform fetal assessment there when feasible. This information will be valuable to the trauma and anesthesia teams. Intermittent fetal heart rate and viability monitoring can be performed (pending patient positioning) in the OR with sterile ultrasound probe cover. Again, monitoring should only occur if there is a safe opportunity for fetal intervention. Surgical intervention including exploratory laparotomy should not be avoided or delayed if indicated. The patient should be positioned to allow for uterine displacement.

Maternal Code

Typically, in a maternal code situation, the OB provider can delegate responsibility of running the maternal code to the trauma team. However, the obstetrician and their understanding of pregnancy physiology plays a very significant role. The obstetrician supports the resuscitative team in not deviating from appropriate advanced cardiac life support algorithms simply because the patient is pregnant. Even cardioversion indications are the same for pregnant and nonpregnant patients; therefore, pregnancy should not alter this or any portion of the advanced cardiac life support algorithm. Cardiopulmonary resuscitation can only provide 30% of cardiac output with a patient in the supine position. However, aorto caval compression from the gravid uterus (>20-week size) limits effective circulation. Unfortunately, placing the patient in tilt to relieve this compression makes chest compressions even more ineffective. Providing manual displacement of the uterus should be considered.

In the setting of a viable fetus or multiple gestations with suspected deleterious aorto caval compression, once a code is called, CD (perimortem CD) should be initiated if possible within 4 minutes. This timing balances opportunity to revive the mother without delivery, increase neonatal survival, and improve likelihood of effective perfusion with cardiopulmonary resuscitation. A sterile field and OR are not required, and attempts to obtain these will only delay delivery. A resuscitation team for the neonate should be notified of impending delivery at the time of code. Clear, efficient communication among the multidisciplinary team involved in the code is key before
proceeding with perimortem CD. Complete discussion of this topic occurs elsewhere (See Bennett T, Katz VL, Zelop CM: Cardiac Arrest and Resuscitation Unique to Pregnancy, in this issue).

Indications for delivery based on maternal respiratory compromise are not as clear cut. Most of what we know comes from ventilated patients critically ill with pneumonia. Delivery has been shown to decrease FiO₂ requirement, but not necessarily improve maternal outcomes.⁴⁸ However, maternal mortality may be increased by CD.⁴⁹–⁵¹ Therefore, if there is concern that CD would increase immediate mortality, then consideration should be given to no fetal monitoring until this risk is improved.

**Secondary Evaluation**

The secondary evaluation can typically continue in a simultaneous maternal and fetal fashion, with EFM of the fetus while the maternal evaluation continues. Secondary evaluation continues to assess for maternal and fetal injury as well as abruption, preterm labor, and fetal-maternal hemorrhage.

Radiologic diagnostic testing will almost always be indicated after significant trauma. Abdominal evaluation can initially be assessed via Focused Assessment with Sonography in Trauma scan or diagnostic peritoneal lavage. These do not rule out retroperitoneal, diaphragmatic, or solid organ injury that may be detected on computed tomography (CT) scanning. Radiographs may also be indicated to fully assess maternal injury. Diagnostic testing, including ionizing radiation, should proceed as indicated despite pregnancy. Attempts can be made to limit exposure, such as avoiding a pelvic plain radiograph if there is no tenderness or hip girdle instability or if a CT scan of the pelvis is already planned.

Theoretic fetal risks associated with ionizing radiation include cell death, teratogenesis, carcinogenesis, and induced genetic changes in germ cells lines. Cell death is thought to be an “all or none phenomenon” that occurs in early embryonic development.⁵² Microcephaly and mental retardation risks increase after exposures of 10 to 20 rad.⁵³ Adverse pregnancy outcomes (anomalies, growth restriction, pregnancy loss) have not been seen with exposure of less than 5 rad. This is far below the exposure of an abdominal or chest CT (Table 2).⁵² Radiographs carry a far lower radiation dose than CT. Carcinogenic risk to the fetus is difficult to

<table>
<thead>
<tr>
<th>Table 2 Estimated fetal radiation exposure</th>
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<tbody>
<tr>
<td><strong>Radiology Exam</strong></td>
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<tr>
<td>Thoracic spine radiograph</td>
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<tr>
<td>Chest (posteroanterior/lateral)</td>
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<tr>
<td>CT head</td>
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<tr>
<td>Hip radiograph</td>
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<tr>
<td>Pelvis radiograph</td>
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<tr>
<td>Abdominal radiograph</td>
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<tr>
<td>Lumbar spine radiograph</td>
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<tr>
<td>CT abdomen/pelvis</td>
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estimate, but is thought to increase from a baseline childhood leukemia risk of 1 in 3000 children to 1 in 2000.\textsuperscript{52}

MRI does not carry the risk of radiation exposure. Studies have shown no detrimental effects to pregnancy at 1.5 T or lower magnetic field. Unfortunately, there are no data for 2.5 T or higher fields.\textsuperscript{54} Gadolinium-containing contrast is typically avoided unless necessary for an accurate diagnosis. Gadolinium crosses the placenta and remains in the amniotic fluid; however, no studies have shown adverse fetal or neonatal effects.\textsuperscript{53}

Once the mother is stabilized, or perhaps even released from the emergency department or trauma care, continued OB evaluation will likely be indicated. Patients with minor trauma often undergo initial evaluation in OB triage and do not require assessment in the emergency department or activation of a trauma response team. For these patients and for those that have been released from the emergency department, this evaluation includes monitoring for abruption, preterm labor, and fetal distress. Abruption is not predicted by the severity of maternal injury and is difficult to detect in the absence of vaginal bleeding.\textsuperscript{1,9,23–25} Abruption in the setting of MVC may not be clinically apparent until more than 24 hours after the event.\textsuperscript{23,26} Ultrasound imaging, while often performed after trauma to rule out abruption, actually has a very low sensitivity (25%–50%) to detect abruption. If seen, a retroplacental bleed may seem to “jiggle” when the transducer moves it, a “Jello sign.”\textsuperscript{28} A normal ultrasound examination cannot rule out an abruption.\textsuperscript{55–57} Detection must rely on clinical suspicion and examination. Contractions as a result of abruption, particularly in the setting of trauma, may not be noted on clinical examination, highlighting again the need for TOCO monitoring.\textsuperscript{58}

EFM and TOCO have been studied extensively in their usefulness for detecting adverse outcomes in a trauma setting and, based on this analysis, the common 4-hour window of monitoring was established. In multiple studies, all adverse pregnancy outcomes were detected in those women with clinical evidence of abruption in the initial 4 hours of monitoring.\textsuperscript{5,18,23,59} Stated differently, in 1 study, no adverse outcomes were seen in those patients without clinical evidence of abruption, or contractions less than every 15 minutes, during the 4-hour monitoring window.\textsuperscript{9} The literature is less clear on the next step if there are contractions or other concerning findings in the initial four-hour window, but a 24-hour period of monitoring is generally accepted. During this time, betamethasone administration can also be initiated. Given the risk of preterm delivery and adverse outcomes in even cases of minor trauma, betamethasone administration should be considered in all patients admitted with trauma between 24 and 36 6/7 weeks.

If the patient is Rh negative, rho (D) immune globulin should be provided to the patient, even the setting of a negative Kleihauer-Betke test (KB). KB may be required to help calculate rho (D) immune globulin dose in those women with significant fetal–maternal hemorrhage. Outside of rho (D) immune globulin dose calculation, KB has not been shown to alter management because it has been found positive in the absence of abruption and negative in proven abruption.\textsuperscript{23,26,60} Fetal anemia related to fetal–maternal hemorrhage can manifest as fetal tachycardia, fetal heart rate decelerations, or sinusoidal tracing on EFM. Therefore, EFM is much more likely to allow for appropriate fetal intervention over that of a KB.

Tetanus injection is safe in pregnancy and should be administered after the same indications as those for nonpregnant trauma patients. Pregnant women are at increased risk for venous thromboembolism, and if immobilized as a result of injuries sustained in trauma, prophylaxis with heparin or low-molecular-weight heparin should be considered.
**Prevention**

Certainly, the best treatment of trauma in pregnancy is primary prevention. Two of the largest contributors to trauma cases are MVC and IPV. As OB providers, we can initiate screening, education, and intervention toward prevention. One-third of women often stop wearing a seatbelt or wearing 1 correctly in pregnancy owing to discomfort, inconvenience, or fears of harming the pregnancy. Study of seatbelt use in pregnancy has shown an 84% reduction in adverse fetal outcomes in those dyads protected by proper seat belt restraint. All adult passengers, pregnant or not, are best protected by a 3-point restraint applied with shoulder belt across the shoulder and chest with lap belt low across the hip girdle and thighs (Fig. 8). Air bags are safe to use for pregnant women.

OB provider visits may be the only opportunity a victim isolated by IPV has to reach out for or receive help. Often the perpetrator is with the victim in the examination room; therefore, attempts should be made to speak with a patient alone when screening for IPV. However, confrontation of a perpetrator can cause escalation of violence or retribution toward the victim. Therefore, other intervention options can be made available such as palm or shoe cards from the National Domestic Violence Hotline in the women’s restroom (Fig. 9). Women can obtain these when providing routine prenatal urine sample. All OB patients should be screened for IPV or other abuse at prenatal care visits as well as trauma evaluations.

**Preparation**

Prevention is not always possible; therefore, preparation is tantamount to success in caring for pregnant trauma patients. All trauma centers with OB services should consider establishing an OB trauma protocol that involves team members from EMS, trauma, the emergency department, OB, NICU, and the OR (Fig. 10). Protocol

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**Fig. 8.** Proper seat belt placement in pregnancy. Strap should lay across shoulder, between breasts, along the side of abdomen. Lap belt should be low across upper thighs and hip bones.
should be developed as a collaborative effort among those on the team and regular cross-specialty education and multidisciplinary simulation instituted. Simulation helps to trouble shoot logistical problems with the protocol and an institution’s handling of OB trauma in a no risk scenario. It also improves communication across and within specialties on the team and increases comfort level when in a real trauma scenario.61

**Suggested Roles for Each Team**

- **EMS**
  - Mechanism to activate OB trauma alert ahead of arrival.
  - Continued notification of all team members of estimated time of arrival, patient hemodynamic and respiratory status, pregnancy information including due date if known, fetal number, and pertinent patient history.
- **Emergency department**
  - Staging area large enough to accommodate EMS; trauma, OB, and NICU teams; portable ultrasound equipment, precipitous delivery and CD packs, and NICU warmer and supplies.
  - Team and capacity for handling nonpregnant trauma victims.
  - Access to blood bank and massive transfusion protocols.
- **Trauma team**
  - Advance Trauma Life Support trained with expertise in assessing and treating trauma victims.
- **OB**
  - Team of obstetrician, labor and delivery nurse(s), and an OB scrub technician.
  - Obstetrician capable of limited ultrasound assessment including fetal heart rate, fetal presentation, and limited biometry.
  - Ability to place and interpret EFM and TOCO, nurse staffing capable of one-on-one care while patient is not on the labor floor.
  - Ability to perform emergent CD.

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Fig. 9. National domestic violence hotline palm card. (Courtesy of National Domestic Violence Hotline, Austin, Texas. Available at: www.thehotline.org; with permission.)
• NICU team
  ○ Neonatal intensivists and/or neonatal nurse practitioners capable of immediate neonatal resuscitation/stabilization including intubation.
  ○ Expertise in assessment of gestational age if not known before delivery.
• OR with team and space large enough to accommodate:
  ○ Polytrauma patient,
  ○ Trauma team,
  ○ Diagnostic imaging equipment,
  ○ OB team (physician, nurse, scrub technician, portable ultrasound and/or fetal monitor), and
  ○ NICU team (neonatal intensivists, nurse, respiratory therapist, NICU warmer, isolette for neonatal transport).

Fig. 10. Obstetrics (OB) trauma team components. EMS, emergency medical services.

SUMMARY

Trauma complicating pregnancy requires a multidisciplinary approach to provide the highest quality trauma care to 2 patients simultaneously. Care must incorporate knowledge of physiologic changes of pregnancy as well as risks unique to pregnancy.

Summary points
• Fifty percent of fetal losses occur in what if often considered to be minor trauma.
• Proper seat belt use in pregnancy reduces adverse fetal outcomes by 84% in MVC.
Clinical signs of hemorrhage and shock are delayed in pregnant women, and mortality is increased when blood loss is sufficient to result in tachycardia and hypotension.

- Only perform fetal assessment if the mother has a secure airway and is hemodynamically stable.
- Have a low threshold for early intubation or supplemental oxygen.
- Displace the gravid uterus to prevent aortocaval compression.
- Diagnostic testing, including ionizing radiation, should proceed as indicated despite pregnancy.
- EFM/TOCO monitoring is indicated in most cases, when the fetus is viable, for 4 to 24 hours.
- Screen all trauma and pregnant patients for IPV.

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