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Trauma complicates 6-7% of all pregnancies.¹⁻³ Although not uncommon, many physicians have limited experience in managing the pregnant trauma patient. While many of the principles of trauma care remain the same, there are significant anatomic and physiologic changes during pregnancy that affect recognition and management of injuries. Maternal hypervolemia may disguise the early recognition of shock.^{3,4} Also, the detection of hemoperitoneum is difficult because of the anatomic changes that occur during pregnancy.⁴ While aggressive management of the gravid patient is the focus of efforts, signs of fetal distress may be the earliest indicator of inadequate resuscitation. In addition, even minor maternal trauma may cause significant fetal injury.

Selected aspects of the management of penetrating trauma may be altered due to pregnancy.⁴ Expectant, nonoperative management may be preferred in certain circumstances.^{5,6} Also, domestic violence may increase during pregnancy, with the fetus being the target of this violence.^{2,7,8}

This issue reviews the anatomical and physiologic changes of pregnancy, the management of blunt and penetrating injuries in the pregnant patient, and injuries unique to these patients.

— The Editor

Introduction

Trauma remains the leading cause of death in females ages 15 to 45 years and is the leading nonobstetric cause of maternal death. And while between 6% and 7% of all pregnancies are complicated by trauma, this percentage is probably underestimated since many

cases of minor trauma are not reported. About two-thirds of trauma cases during pregnancy are attributable to motor vehicle crashes.^{4,9} Falls and assaults account for the majority of the remainder of cases.⁹ Domestic abuse occurs in up to 20% of pregnancies, with the frequency and intensity of the violence increasing as the pregnancy progresses.^{7,8} Falls occur more often

in the third trimester.¹⁰ Any non-vehicular trauma in the gravid patient mandates a vigorous domestic violence screening.

Maternal mortality rates from blunt trauma correlate with the underlying injury and are similar to those of nonpregnant trauma patients.^{3,11} In addition, the maternal morbidity and mortality from penetrating trauma is lower in pregnant victims due to the protective effect of the gravid uterus.⁶ Fewer than 5% of maternal mortality incidents are caused by penetrating trauma; however, fetal mortality ranges from 40% to 70%.¹² Major trauma causes placental abruption in 40-66% of cases; however, placental abruption also may occur in up to 5% of minor traumatic events.

Current Concepts in the Management of the Pregnant Trauma Patient

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Due to the often directed nature of domestic violence against the gravid abdomen, domestic violence accounts for a disproportionate number of traumatic abortions. Regardless of the mechanism, maternal shock is associated with an 80% fetal mortality rate.² Similarly, the main cause of fetal death in the gravid trauma patient is maternal death.

Anatomical and Physiological Changes of Pregnancy

The anatomic and physiologic changes of pregnancy affect recognition of complications and management of the pregnant trauma patient. A thorough knowledge of these changes is essential for optimal management of such patients.

Cardiovascular System. The cardiovascular changes of pregnancy demand careful inspection and interpretation of vital signs. The pulse rate increases 15-20 beats per minute by the third trimester.^{2,3,14} Any increase beyond a slight tachycardia should not be attributed to pregnancy alone.

Maternal hypervolemia, due to an increase in plasma volume of 50% by the 34th week of pregnancy, is probably the most significant change. This increased plasma volume allows the pregnant patient to lose 30% of her blood volume before showing any signs of shock. Consequently, signs of shock often are not appar-

ent until plasma volume losses exceed 30%.^{3,14-16} The decreased peripheral vascular resistance of the first two trimesters may prevent the cool, clammy skin typically expected in patients with hypovolemic shock.¹⁷

Systolic and diastolic blood pressures decrease 15-20 mmHg in the first and second trimesters but return to near normal at term.¹⁶ Supine hypotensive syndrome occurs when the gravid uterus compresses the inferior vena cava, which causes a decreased preload and subsequent drop in cardiac output. This syndrome may cause a 20-25% drop in systolic blood pressure.^{13,16} Table 1 highlights the cardiovascular changes of pregnancy.

Pulmonary System

With a decreased functional reserve capacity, the pregnant patient has a decreased tolerance for hypoxia. Additionally, the fetus is more physiologically sensitive to maternal hypoxia than the mother. When intubating such patients using a rapid sequence induction technique, proper pre-oxygenation is essential. Minute ventilation and tidal volume increase by 40%, but the respiratory rate remains unchanged. An increase in minute ventilation, primarily due to increases in tidal volume, leads to a chronic compensated respiratory alkalosis, with pCO₂ in the 30 mmHg range.^{3,15,17} (See Table 2.)

Anatomically, the diaphragm is elevated by 4 cm or more due to the gravid state. Chest tubes, if indicated, should be placed 2 intercostal spaces higher than in the nonpregnant patient.

Hematology System. Plasma volume expands out of proportion to the increase in red blood cell mass, creating a dilutional anemia with a hematocrit of 32-34%. The hemoglobin nadirs between the 30th and 34th weeks.¹⁷ A leukocytosis also develops, and this increase is predominantly in the amount of neutrophils.¹⁷ White blood cell counts in the 12,000-18,000 range are within normal limits in the third trimester. A hypercoagulable state develops as fibrinogen nearly doubles and coagulation factors increase. This elevated fibrinogen level may decrease to normal nonpregnant levels with early disseminated intravascular coagulation (DIC).¹⁷ In one study, DIC was the most significant predictor of fetal mortality.¹¹

Abdominal Changes. Gastrointestinal changes of pregnancy decrease both the tone of the lower esophageal sphincter and gastrointestinal motility. These changes predispose to aspiration and can complicate the course of rapid sequence intubation.

In accommodating the necessary uterine enlargement, the chronic stretching of the peritoneum makes it less sensitive. Fifty percent of pregnant patients with massive hemoperitoneum do not demonstrate signs of peritoneal irritation.^{3,18} The uterus becomes the largest intra-abdominal organ, and its blood flow increases tenfold from 60 mL/min to 600 mL/min. In the second trimester, it moves out of the pelvis yet retains an amniotic fluid cushion. After week 12, the uterus exits the pelvis, becoming an intra-abdominal organ, and uterine blood flow increases from 60 cc/min to 600 cc/min. As the uterus enters the abdomen, the bladder attains an intra-abdominal position as well, making it more susceptible to injury. The uterus becomes large and thin-walled during the third trimester and crowds the intestines into

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Table 1. Cardiovascular Changes of Pregnancy^{2,3,14-17}

CHANGE	WHEN	IMPORTANCE
Cardiac output up 30-40%	By 20-24 weeks	Caution when attributing tachycardia to just pregnancy Delayed recognition of shock
Pulse increases 15-20 bpm	By third trimester	
Plasma volume increases 50%	Increase starts at 10th week, continues to 34th week	Returns to near normal at term Positioning in prehospital situation and the ED
Blood pressure drops 15-20 mmHg	First and second trimesters	
BP drops in supine position	After 20 weeks	

Volume resuscitation is extremely important since pregnant trauma patients can lose substantial amounts of blood before demonstrating signs of shock. Also, pregnant patients beyond the 20th week should be transported with the backboard tilted 15 degrees to the left to prevent supine hypotension syndrome.¹³ Additionally, undressing the patient as much as possible is important due to the possibility

Table 2. Laboratory Changes in Pregnancy^{3,13,15,17}

- Hemoglobin decreases to 10-14 g/dL
- Hematocrit decreases to 32%
- WBC 5,000–14,000 mm
- Bicarbonate decreases to 17-22 mEq/L
- pH increases to 7.41-7.46
- pCO₂ decreases to 27-32 mmHg
- pO₂ increases to 100-108 mmHg
- HCO₃ decreases to 19-25 mm/L

the upper abdomen, increasing the risk of bowel injury from penetrating trauma. However, the preponderance of literature indicates that the third trimester gravid uterus is somewhat “protective” for the mother in the setting of penetrating trauma. Fetal injury with penetrating trauma approaches 70% in the third trimester, while maternal visceral injury runs only 19%. Even then, the most common maternal organ injured from penetrating trauma is the liver, as is the case with the non-gravid state. However, these data do not exclude the possibility that the results are influenced by the targeting of the lower abdomen in the setting of violence involving gravida.

Initial Emergency Management

The basic principles of trauma care remain essentially the same, although the patient’s vital signs are less reactive to blood loss. The best way to promote fetal survival is to provide adequate maternal resuscitation. The most common cause of fetal death is maternal death; maternal shock is associated with an 80% fetal mortality.² In cases of major trauma, a multidisciplinary team consisting of emergency medicine physicians, trauma surgeons, obstetricians, and possibly neonatologists is optimal. With even minor trauma, however, significant injury may occur, with subsequent fetal loss.²⁻⁴ It’s important to remember that fetal distress will predate maternal distress since the maternal circulation is maintained at the expense of fetal oxygenation.

Prehospital Management. The immediate prehospital treatment priorities for the pregnant trauma patient remain the same. Airway management is unchanged, although oxygen therapy assists the fetus in distress, even if the mother is not hypoxic.¹⁶

of a precipitous delivery in the setting of trauma.

Emergency Department Management. The management priorities are the same for all trauma patients. As stated above, the ABCs (airway, breathing, and circulation) of trauma care apply with equal validity and importance. Assessment of the airway remains the same, with extra attention paid to preoxygenation when intubating due to the pregnant patient’s tendency to rapidly become hypoxic. Since pregnant patients have a decreased functional reserve, these patients are less tolerant of hypoxia.^{3,16,17} Minimal change in maternal pO₂ will result in large changes in fetal pO₂.¹⁶ Appropriate intravenous access is established it was not previously done in the prehospital arena. Similarly, the pregnant trauma patient is tilted 15 degrees to the left if she is beyond the 20th week of gestation. Fetal assessment begins with circulation and includes assessment of fetal heart tones if it’s a viable infant. Estimation of fetal age is performed by assessing the fundal height in the absence of obstetric ultrasound.

After the primary survey and any interventions needed to address life or limb threats, a directed history and complete exam are performed.

In addition to defining the mechanism of the traumatic event, the history should establish the last menstrual period, estimated date of confinement (EDC), prenatal care, and any complications of pregnancy. The possibility of domestic violence must be addressed. Any complaints of abdominal pain, back pain, contractions, vaginal bleeding, and vaginal discharge must be sought. Documentation should include time of last fetal movement.

The physical exam is directed at detecting any injuries caused by the traumatic event. Once again, vital sign abnormalities may be subtle due to changes of pregnancy.¹⁶ The abdominal exam is even less reliable than in the nonpregnant trauma patient due to the chronic stretching of the peritoneum and relative bowel atony.³ The fundal height can be used to estimate gestational dates, since the length in centimeters from the symphysis pubis to the uterine fundus equals the gestational age. Fetal heart tones should be obtainable with a Doppler stethoscope by 10-14 weeks of gestation. A pelvic exam should be performed, but may be deferred to an obstetrician if readily available. A cautious speculum exam will evaluate the presence of amniotic fluid or blood. Amniotic fluid will turn nitrazine paper blue and demonstrate a ferning pattern on a microscopic slide.

Laboratory Studies

Studies that would routinely be obtained in any trauma patient should be ordered. In addition, a type and screen should be obtained even in cases of minor trauma if the mother's blood type is unknown. The Kleihauer-Betke test estimates the amount of fetomaternal hemorrhage by an acid elution assay. The exact role of this test in the management of pregnant trauma patients is controversial.^{3,13,20} The amount of fetomaternal hemorrhage to sensitize the majority of Rh-negative women is below the 5 mL sensitivity of this test.^{16,20} Many authorities recommend all Rh-negative trauma patients beyond 12 weeks gestation receive 300 mcg of Rh immune globulin (Rhogam). The Kleihauer-Betke test is used in patients with catastrophic trauma who may require additional Rh immune globulin to prevent sensitization.

Diagnostic Studies

Radiology. Necessary radiographic studies should not be withheld out of concern for fetal radiation.^{15, 20} The need for radiographs should be individualized, and protocol driven studies should be avoided. The uterus should be shielded when possible. Maternal radiation exposure to a cumulative dose of 5 rads or less is generally considered safe.^{2,21,22} The potential effects of ionizing radiation depends on the gestational age of the fetus.²² During the first two weeks, there may be loss of viability of the conceptus, but if implantation does occur, no teratogenic effects are expected.^{3,13} The effects of radiation exposure are greatest during the time of major organogenesis from 2 to 7 weeks of gestation.¹⁶ These major effects are congenital malformations, growth retardation, and potential childhood neoplasms.^{3,15,16,21} From 8 to 17 weeks of gestation, the developing brain appears vulnerable to high-dose radiation.^{21,22} For the remainder of pregnancy, there is little risk of teratogenesis, but concerns still include growth retardation, central nervous system dysfunction, and childhood neoplasms (primarily leukemias).^{3,21} Exposure to only 1-2 rads has an increased relative risk of childhood malignancies; however, the absolute increase of risk is only 1 in 10,000.²¹ It should be noted, however, that while limiting exposure to below 5 rads is the current recommendation, 15-20 rads commonly is recognized as the threshold for demonstrable radiation effects. The preponderance of information we have about radiation exposure in pregnancy comes from Hiroshima and Nagasaki. These data, however, are severely confounded by the presence of severe and widespread malnutrition in Japan at the time of and immediately following detonation. Malnutrition has known, profound teratogenic and developmental effects. The dosage exposure of common radiographic studies is listed in millirads in Table 3.

Evaluation of the Abdomen: Diagnostic Modalities. As with other major trauma patients, the abdomen must be effectively evaluated. Clinical exam, which is not completely reliable in the evaluation of the nonpregnant trauma patient, is even less sensitive due to the changes of pregnancy.⁴ The choice of diagnostic modality will result from the interplay of local resources, skills of the emergency physician, preference of the trauma surgeon, and the clinical condition of the patient.

Although some authorities consider pregnancy a relative con-

Table 3. Radiation Exposure in Common Radiographic Studies^{2,3,13,16,21}

STUDY	DOSAGE TO FETUS (MRADS)
C-spine	1-10
CXR	< 1-8
Pelvis	200-350
Extremity	< 1-3
Lumbar spine	200-1250
Head CT	50
Abdominal CT	1000-9000

traindication to diagnostic peritoneal lavage (DPL), this technique is well-studied and safe using an open, supraumbilical approach.^{13,23} The criteria for a positive study remain the same as in the nonpregnant trauma patient. DPL is very sensitive for diagnosing hemoperitoneum, but it does not assess retroperitoneal or intrauterine pathology.

Many authorities consider ultrasound the best test for combined assessment of mother and fetus. Often, ultrasound is considered a "noninvasive DPL." Ultrasound detects hemoperitoneum in more than 90% of cases.³ Also, it demonstrates fetal heart beat, fetal activity, and volume of amniotic fluid. Surprisingly, ultrasound has a low sensitivity for detecting acute placental abruption, only identifying up to 50%.^{3,24}

The major drawback to the use of an abdominal computed tomography (CT) scan is the substantial radiation exposure. This exposure can be limited by using a modified technique such as shielding the uterus and only viewing the upper abdomen. These changes will decrease the radiation exposure to fewer than 3000 millirads. CT scan identifies the site and extent of injury as well as any free fluid and evaluates the retroperitoneal space. By quantifying the injury, CT scanning may allow nonoperative management of splenic or liver injuries if the fetus is not in distress. In pregnancy, CT scan may be even more prone to miss injuries of the small bowel or mesentery due to the crowding of these structures secondary to displacement by the gravid uterus.¹³ In addition to evaluating, maternal injuries, CT scan can demonstrate separated, devascularized areas of placenta that may predict impending fetal loss after blunt abdominal trauma.²⁵ A knowledge of these modalities, the local availability, and the hemodynamic stability of the patient will form the basis for the study choice. (See Table 4.)

Fetal Heart Monitoring. Cardiotocographic monitoring is the most accurate means of detecting fetal distress. This monitoring should be initiated in all trauma patients who are beyond 20 weeks as soon as possible, although some authorities use 24 weeks gestation as the cutoff to initiate monitoring. The specific estimated gestational age at which cardiotocographic monitoring is initiated in the gravid trauma patient often is dictated by what the individual hospital's neonatologists have decided as the age for viability.²⁶ The presence of fetal distress may be the first indicator of occult maternal blood loss. In minor trauma, the patient may be rapidly evaluated and, if no major maternal injuries are discovered, sent to the labor and delivery suite for

Table 4. Diagnostic Modality for Abdominal Imaging

STUDY	PROS	CONS
Diagnostic Peritoneal Lavage (DPL)	Rapid Sensitive Well-studied	Invasive Does not assess retroperitoneum Not organ specific
Ultrasound	Excellent combined assessment of fetus and mother Sensitive for hemoperitoneum	Operator dependent Does not assess retroperitoneum Not organ specific
CT Scan	Identifies organs involved Evaluates retroperitoneum	Substantial radiation exposure May miss hollow viscus injury Difficult to resuscitate and monitor the patient

whether a cesarean section should be performed at the time of laparotomy will be made by the consulting obstetrician. A viable fetus in distress mandates an immediate cesarean section and exploratory laparotomy.⁶

Stab wounds also may be managed nonoperatively if the wound is anterior and below the level of the fundus. For wounds above the level of the fundus, the management is controversial. Some authorities recommend an aggressive approach with exploratory laparotomy if peritoneal penetration has occurred.³¹ Others recommend diagnostic peritoneal lavage to determine if operative intervention is needed, using a lowered threshold of 5000 red blood cells (RBCs) per mm³ for a positive

result.¹⁵ With stab wounds below the level of the fundus, nonoperative management may be considered.²⁶ These patients must be observed very closely. If the fetus is viable and in distress, an emergent cesarean section is indicated, along with simultaneous exploratory laparotomy.

Burns. Most burns that occur during pregnancy are minor and require little change from standard management. Silver sulfadiazine cream should be avoided near term due to the risk of kernicterus in the infant.

Maternal outcome is similar to that of the nonpregnant patient.^{32,33} For burns involving 20-40% total body surface area (TBSA), fetal complications occur in about 40% of cases.³² For burns involving more than 60% TBSA, researchers report 100% fetal mortality.³²

The principles of burn therapy are essentially unchanged. Diligent supportive care with attention directed to oxygenation and fluid status is necessary for optimal management.³³ Cardiotocographic monitoring is recommended for hospitalized patients with burns of greater than 30% TBSA, as the risk of preterm labor increases as the size of the burn increases.³³ As a general rule, most fetuses survive when the mother survives. Pregnancy does not appear to alter maternal outcomes. Important maneuvers include: aggressive assessment of hydration status due to the sensitivity of the fetus to even mild hypovolemia; more attention to hypoxia due to the decreased functional residual capacity of the mother combined with fetal sensitivity to hypoxia; and left lateral decubitus positioning.

Electrical Injuries. Electrical injuries in pregnant patients are not well studied. Two small studies provide conflicting results.^{34,35} In one study, fetal mortality was 73%, despite almost all of the 15 patients being shocked by household current.³⁴ In another, 28 of 31 pregnant patients who suffered an electric shock had normal births.³⁵ Theoretically, the low resistance of amniotic fluid make the fetus susceptible if the current path involves the uterus.³⁶ A period of fetal monitoring is recommend-

monitoring under the care of the obstetrician. The duration of monitoring should be 4-6 hours if the patient is asymptomatic and there are no significant contractions. The patient could be discharged with outpatient follow-up. If the patient develops abdominal pain, cramping, vaginal bleeding, or more than 4-8 contractions an hour over the first four hours, this monitoring must be extended.⁹ With major trauma, portable fetal heart monitoring must be performed while the patient is being resuscitated and evaluated. Signs of fetal distress may indicate inadequate resuscitation of the mother. (See Table 5.) Personnel well versed in interpreting fetal heart monitoring must be available.

Specific Mechanisms of Injury

Penetrating Abdominal Trauma. The principles of management remain the same as in the nonpregnant patient, although the expanding uterine size increases the likelihood of bowel injury with upper abdominal wounds and uterine injury with wounds below the uterine fundus.^{27,28} Gunshot wounds are the most common cause of penetrating abdominal trauma, while stab wounds generally have a better prognosis.¹³ Penetrating trauma usually is more damaging to the fetus than the mother.^{12,13} While fetal mortality is 40-70% with penetrating abdominal trauma, maternal mortality is between 5% and 10%.^{12,29} Fetal survival depends on the severity of maternal injuries, extent of placental injury, fetal age, and severity of fetal injury. The management of these injuries is not without controversy.

Most authorities recommend operative intervention for gunshot wounds with peritoneal penetration.¹³ Associated visceral injuries and blast effect often are cited. One group suggested that selective laparotomy may be considered in anterior gunshot wounds below the level of the fundus, although they stated exploratory laparotomy remains the safest approach.⁶ A nontherapeutic laparotomy is well tolerated in pregnancy and preferred over potentially missed injuries or delayed diagnosis.¹³ The decision for non-operative management will be made by the trauma surgeon. Criteria for non-operative management are listed in Table 6. The decision of

Table 5. Fetal Heart Monitoring and Signs of Distress²

- Fetal bradycardia
- Fetal tachycardia
- Absence of beat to beat variability
- Persistent decelerations
- Late decelerations

Table 6. Criteria for Nonoperative Management of Penetrating Abdominal Trauma^{3,6,26,30}

- Wound below fundus
- Mother and fetus stable (or fetus dead)
- Normal abdominal and rectal exams
- Absence of hematuria
- Radiographic visualization of bullet if gunshot wound present

ed, although the optimal duration is not known. If even minor trauma has occurred, four hours of cardiocographic monitoring are indicated.³⁶ This period is extended if abnormalities are noted. If the patient has an abnormal electrocardiogram, loss of consciousness, or underlying cardiovascular disease, then both the patient and the fetus should be monitored for 24 hours.³⁶

Injuries Unique to Pregnancy

Placental Abruptio. Placental abruptio occurs as a result of shearing forces between the elastic uterus and the relatively inelastic placenta. It occurs in 1-5% of cases of minor trauma and in 20-50% of major trauma to pregnant patients.^{12,27} Placental abruptio is the leading cause of fetal death not related to maternal death.^{2,13} If the degree of placental separation exceeds 50%, then the fetal mortality approaches 100%.¹³ The classic triad of vaginal bleeding, abdominal pain, and uterine irritability is present in only 50% of cases.¹³ Other signs and symptoms may include abdominal cramps, backache, uterine tenderness, expanding fundal height, or maternal shock.

Ultrasound is only up to 50% sensitive for detecting placental abruptio.¹⁵ Cardiocographic monitoring is very sensitive in assisting the diagnosis, but it is nonspecific. Despite its shortcomings, this monitoring should be done for a minimum of four hours.⁹ This period should be extended to 24 hours if significant uterine contractions (> 4-6/hr), abdominal or uterine tenderness, significant maternal injuries, vaginal bleeding, ruptured membranes, or signs of fetal distress are observed.^{2,3,9,13} Placental abruptio in the setting of trauma usually occurs within the first four hours, with the vast majority occurring within the first two. While there are reports of delayed abruptio greater than 24 hours after the accident, these isolated incidents have not been seen in large trials. The treatment, under the direction of an obstetrician, will depend upon the gestational age of the fetus and the stability of the mother's condition. If the fetus is pre-viable, the care of the mother is supportive with close monitoring. Emergent cesarean section is indicated if DIC develops.¹⁴ If the fetus is viable, generally beyond 23 weeks, and the mother is stable, then an emergent cesarean section is indicated. If the mother is unstable from suspected intrabdominal injuries, then cesarean section will be performed during exploratory laparotomy.¹⁴

Amniotic Fluid Embolus. An uncommon but catastrophic event, the pathophysiology of amniotic fluid embolus remains poorly understood.³⁷ The release of amniotic fluid into the maternal circulation produces transient spasm of the pulmonary artery leading to hypoxia.^{37,38} Pulmonary capillary injury and left ventricular injury lead to left ventricular failure and adult respiratory

distress syndrome. Also, a coagulopathy develops. The definitive etiology and exact roles of various cellular mediators have yet to be determined.³⁷ This uncommon syndrome most often occurs during labor, during cesarean section, after labor or cesarean section, or during dilation and evacuation procedures, although it has been associated with blunt abdominal trauma.³⁷

The classic presentation of amniotic fluid embolism consists of the sudden onset of dyspnea, altered mental status, cyanosis, and hypotension.³⁸ These symptoms may be attributed to another cause in the multiple trauma patient. Cardiorespiratory arrest may follow.³⁸ Surviving patients then develop a coagulopathy, acute respiratory distress syndrome, and multiple organ system failure.³⁷ The diagnosis is made clinically and supported with documented hypoxia. Chest radiography demonstrates pulmonary edema in 70% of cases.

The management of amniotic fluid embolism is primarily supportive.^{37,38} These patients generally require intubation, and 100% oxygen should be provided. Hypotension is treated with adequate volume replacement and then inotropic support if the patient is persistently hypotensive. Coagulopathy is corrected with the necessary blood components. Unfortunately, maternal outcome is poor, and fetal outcome remains dismal despite aggressive management.^{37,38}

Uterine Rupture. Uterine rupture is a rare complication of trauma with an incidence of 0.6%.^{9,39} It occurs most often in the third trimester and often is associated with pelvic fractures and bladder injuries. The site of rupture often is a previous cesarean section scar or the posterior uterine wall.¹³ The fundus is involved in 75% of cases.⁴

The clinical presentation often is dramatic, with severe abdominal pain and distention, palpable fetal parts, and shock. Signs of peritoneal irritation may be less pronounced during pregnancy. On occasion, the presentation may be subtle with uterine tenderness or nonreassuring fetal monitoring as the only clues.³⁹

The diagnosis of uterine rupture may be made clinically. Ultrasound and diagnostic peritoneal lavage have been used to diagnose this entity.³⁹ Plain radiography also has confirmed the diagnosis by demonstrating a displaced fetal skeleton. Emergency department management consists of fluid resuscitation, transfusion if needed, and most importantly, early recognition. The definitive treatment is exploratory laparotomy. True uterine rupture occurs only in very high energy collisions. Maternal mortality is less than 10%, but fetal mortality approaches 100%.

Premature Rupture of Membranes. Premature rupture of membranes presents as an amniotic fluid leak with variable amounts of vaginal bleeding. There is concern of increased risk

of infection and subsequent fetal loss.

The possibility of ruptured membranes should be addressed during the sterile pelvic exam. Any fluid noted in the vaginal canal should be tested for pH and ferning with nitrazine paper.² Vaginal secretions have a pH less than 5-6 while amniotic fluid has a pH greater than 7.¹³ Also, amniotic fluid has a distinctive ferning pattern when placed on a microscopic slide. Amniotic fluid will turn nitrazine paper blue.³ The accurate diagnosis of premature rupture of the membranes is the emergency physician's goal, while the management of this entity will be directed by the obstetrician. Direct digital vaginal exams, with a sterile glove or otherwise, should be avoided if rupture of the membrane is suspected. Even single vaginal exams have been associated with an increased incidence of chorioamnionitis.

Fetomaternal Hemorrhage. Fetomaternal hemorrhage (FMH) is the transplacental hemorrhage of fetal blood into the maternal circulation. Its estimated incidence after trauma is 8-30%. Patients who are Rh-negative may become sensitized by very small amounts of blood. Fetomaternal hemorrhage of 0.01-0.03 mL will sensitize 70% of Rh-negative patients.¹⁴ The volume of FMH correlates with the severity of abdominal trauma; however, the incidence of FMH does not. Uterine tenderness and anterior placental location are associated with an increased risk of FMH.^{9,14}

FMH can be detected by the Kleihauer-Betke test, which is an acid elution assay performed on the maternal blood. Most laboratories have a threshold of 5 mL, which is significantly more than the amount needed to cause sensitization. Previously, many authors had advocated performing a Kleihauer-Betke test on all pregnant trauma patients beyond 12 weeks gestation. Now, many authors recommend treating all Rh-negative women who present with abdominal trauma with a 300 mcg dose of Rh immune globulin.^{4,19} This dose will provide protection from sensitization for up to 30 mL of FMH. The Kleihauer-Betke test is then reserved for patients at risk for large FMH such as those patients presenting with major injuries, uterine tenderness, uterine contractions, vaginal bleeding, or fetal distress.^{4,19} Fewer than 1-3% of pregnant trauma patients will require additional protection;¹⁶ 300 mcg of Rh immune globulin should be given for every 30 mL of FMH.^{10,16}

It's important to understand that 300 mcg of Rhogam prevents sensitization by 15 cc of fetal red cells (30 cc of fetal blood). Therefore, the main role of the Kleihauer-Betke test in Rh-negative patients is to determine the accurate amount of Rhogam required to prevent sensitization. Rh immunoglobulin effectively prevents Rh isoimmunization if given within 72 hours of exposure. Complications of FMH include Rh sensitization of the mother, fetal arrhythmias, neonatal anemia, and even fetal death from exsanguination.

Premature Labor

Premature labor is defined as pregnancy of less than 36 weeks that is associated with significant contractions, which also involve cervical changes.²⁸ In the setting of trauma, hypoxemia and hypovolemia should be corrected.¹³ Cardiotocographic moni-

toring must be initiated. The management will be directed by the obstetrician. Placental abruption should be considered present until proven otherwise.^{9,28} Uterine rupture and intrabdominal hemorrhage must be considered. Preterm labor can complicate even minor abdominal trauma. While preterm contractions may be felt in up to 40% of gravid trauma patients, only 11% of trauma cases were associated with true preterm labor. Only 25% of this 11% go on to deliver prematurely. Any patient with preterm labor must be observed for progression, preferably in the labor and delivery suite.

Tocolysis is controversial in the setting of trauma.²⁸ It is contraindicated in cases of suspected placental abruption. Nontraumatic contraindications include preeclampsia, eclampsia, uncontrolled diabetes, coronary artery disease, hyperthyroidism, and cervical dilation greater than 4 cm. Ninety percent of uterine contractions resolve on their own.⁹ The remaining 10% of cases are either near term or have underlying abruptions.

Direct Fetal Injuries. Direct fetal injury is an uncommon complication of blunt trauma. The most common injuries are intracranial hemorrhage and skull fracture, which often are associated with maternal pelvic fractures.¹³ Obviously, these injuries are associated with a poor fetal outcome which correlates with the severity of maternal injury.

Perimortem Cesarean Section

In Ancient Rome, King Numa Pompilus (715-673 BC) decreed that if any pregnant woman died, the neonate should be immediately cut from her abdomen.^{14,16} The procedure became known as a cesarean section since Julius Caesar was reportedly delivered through an abdominal incision. Although one of the oldest and most dramatic surgical procedures, there are no clear guidelines regarding perimortem cesarean section. The American College of Obstetrics and Gynecology states there are insufficient data on which to base conclusions on when to perform this procedure.⁴ Most authors recommend that perimortem cesarean section be considered for a pregnant trauma patient with a fetus of 24 weeks or more gestational age who is in cardiac arrest.^{2,13,41} The decision also must consider staff preparedness and neonatal intensive care support.¹³ Adequate resuscitation of the fetus often requires expedient delivery of the fetus. The large amount of blood pooled in the uteroplacental circulation and the physical hindrance of a large gravid uterus can frustrate resuscitation efforts. Therefore, perimortem section is part of the maternal resuscitation and *not* the pursuit of fetal well-being at the expense of maternal well-being.

Once the decision is made to perform a perimortem cesarean section, the procedure should be performed rapidly, preferably by an obstetrician, but often by the trauma surgeon or emergency physician. Time from maternal death until the delivery of the fetus is the single most important factor for successful resuscitation.^{3,41} This procedure should not be delayed to assess fetal heart tones. Viable infants have been delivered despite lack of fetal heart tones.⁴¹ Table 7 lists the correlation between survival and time from maternal death.^{15,41} These survival statistics may be inflated since many successful reported cases were nontraumatic

Table 7. Perimortem Cesarean

TIME FROM MATERNAL DEATH (MINUTES)	SURVIVAL (%)	NEUROLOGICALLY INTACT SURVIVORS (%)
< 5 min	70%	100%
5-10 min	13%	13%
11-15 min	12%	17%
16-20 min	1.7%	< 1%
> 20 min	3.3%	< 1%

arrests in the operating room.²⁶ Most physicians feel that a healthy fetus can be delivered if the period of asphyxia is limited to 4-6 minutes.

Other important factors favoring successful resuscitation include fetal age greater than 28 weeks, aggressive and continuous maternal resuscitation, neonatal intensive care support, and staff preparedness.¹⁶ Furthermore, all resuscitation efforts should take place with the patient in the left lateral decubitus position.

The procedure is not complicated. An incision is made from the xiphoid to the symphysis pubis through all layers of the abdominal wall.^{15,41} Another vertical incision is made from the upper uterine fundus toward the bladder, which should be retracted manually and previously decompressed with a Foley catheter.^{15,41} The fetus is then delivered bluntly from the uterus; after the head is delivered, nasal and oral suctioning should occur. Next, clamp the cord and cut it, and then neonatal resuscitation should begin. In the United States, no physician has ever been found liable for performing this procedure.⁴²

Prevention

Despite extensive attempts at public education, many people are concerned that seat belts, particularly lap belts, will harm the fetus. In one study, almost one-half of pregnant trauma victims in motor vehicle crashes were unrestrained.⁴³ The American College of Obstetricians and Gynecologists states that although the use of seat belts cannot guarantee protection against fetal loss or injury, risks are increased for mothers who do not wear them.⁴ The shoulder portion should be worn across the chest, and the lap belt should be worn low below the uterus.^{3,4} The leading cause of fetal death is maternal death.²⁻⁴ Seat belts reduce maternal mortality and morbidity by preventing ejection.³

The data on airbags and trauma in pregnancy are limited. Airbag deployment does not appear to cause an increased number of maternal or fetal injuries, so disabling airbags is not recommended.⁴

Summary

The pregnant trauma patient must be evaluated aggressively with a knowledge of the anatomic and physiologic changes of pregnancy. (See Table 8.) Prehospital personnel must recognize the supine hypotensive syndrome. For major trauma, optimal care is best provided using a multidisciplinary team approach. The best treatment for the fetus is to stabilize the mother since the main cause of fetal death is maternal death. The physiologic

Table 8. Key Points

TRAUMA IN PREGNANCY

- The best treatment for the mother is to stabilize the fetus.
- Approach should be more aggressive, not less aggressive.
- Physiologic changes of pregnancy may delay early recognition of hemorrhagic shock.
- Fetus may be in distress despite stable mother.
- Fetal heart rate abnormality may be first indicator of inadequate resuscitation.
- Abdominal exam: Trauma during pregnancy may result in delayed or absent peritoneal findings.
- Respect minor trauma in the third trimester.
- Don't forget Rh immune globulin when indicated.

changes of pregnancy may delay the early recognition of shock. With minor trauma, the evaluating physician must remain aware that fetal death may occur without significant maternal injury. Ultrasound has a low sensitivity for detecting placental abruption. Cardiocotographic monitoring must be used expeditiously in patients beyond 20-24 weeks gestation. Fetal heart rate abnormalities, or fetal distress, may be the first indicator of inadequate resuscitation. Even with the asymptomatic patient with minor trauma, cardiocotographic monitoring must be done for four hours; this period is extended if symptoms or frequent contractions develop. Rh-negative women must receive 300 mcg of Rh immune globulin. In cases of the moribund or dying pregnant trauma patient, perimortem cesarean section should be considered if gestational age suggests a viable fetus.

References

1. Bocka J, Courtney J, Perlman M, et al. Trauma in pregnancy. *Ann Emerg Med* 1988;17:829-834.
2. Henderson SO, Mallon WK. Trauma in pregnancy. *Emerg Med Clin North Am* 1998;16:209-228.
3. Colucciello SA. The challenge of trauma in pregnancy: Guidelines for targeted assessment, fetal monitoring, and definitive management. *Emergency Medicine Reports* 1995;16:171-182.
4. Committee on Educational Bulletins of American College of Obstetricians and Gynecologists. Obstetric aspects of trauma management. *Int J Gynaecol Obstet* 1998;64:87-94.
5. O'Shaughnessy MJ. Conservative obstetric management of a gunshot wound to the second-trimester gravid uterus: A case report. *J Reprod Med* 1997;42:606-608.
6. Awwad JT, Azar GB, Seoud MA, et al. High-velocity penetrating wounds of the gravid uterus: Review of 16 years of civil war. *Obstet Gynecol* 1994;83:259-264.
7. Gazamarian JA, Lazorick S, Spitz AM, et al. Prevalence of violence against pregnant women. *JAMA* 1996;275:1915-1920.
8. Straughn JM Jr. The battered gravida. *Resident and Staff Physician* 1996;42:23-28.
9. Pearlman MD, Tintinalli JE, Lorenz RP. A prospective controlled study of outcome after trauma during pregnancy. *Am J Obstet Gynecol* 1990;162:1502-1510.

10. Stone IK. Trauma in the obstetric patient. *Obstet Gynecol Clin North Am* 1999;26:459-467.
11. Ali J, Yeo A, Gana TJ, et al. Predictors of fetal mortality in pregnant trauma patients. *J Trauma* 1997;42:782-785.
12. Hill DA, Lense JJ. Abdominal trauma in the pregnant patient. *Am Fam Physician* 1996;53:1269-1274.
13. Esposito TJ. Trauma during pregnancy. *Emerg Med Clin North Am* 1994;12:167-217.
14. Wilson RF. Gynecologic and Obstetrical Trauma. In: Wilson RF, ed. *Handbook of Trauma: Pitfalls and Pearls*. Philadelphia: Lippincott Williams and Wilkins; 1999: 449-463.
15. Neufeld JDG. Trauma in pregnancy, what if...? *Emerg Med Clin North Am* 1993;11:207-220.
16. Neufeld JDG. Trauma in Pregnancy. In: Rosen P, Barkin R, eds. *Emergency Medicine: Concepts and Clinical Practice, 4th ed*. St. Louis: Mosby; 1998:368-381.
17. Sherman HF, Scott LM, Rosenmurgy AS. Changes affecting the initial evaluation and care of the pregnant trauma victim. *J Emerg Med* 1990;8:575-582.
18. Rothenberger DA, Quattlebaum FW, Zabel J, et al. Diagnostic peritoneal lavage for blunt trauma in pregnant women. *Am J Obstet Gynecol* 1977;129:479-481.
19. Johnson KH. Kleihauer-Betke test for pregnant trauma patients. *Am Fam Physician* 1997;55:781-782.
20. Goldman SM, Wagner LK. Radiologic ABCs of maternal and fetal survival after trauma: When minutes may count. *Radio Graphics* 1999;19:1349-1357.
21. Toppenberg KS, Hill DA, Miller DP. Safety of radiographic imaging during pregnancy. *Am Fam Physician* 1999;59:1813-1818.
22. Goldman SM, Wagner LK. Radiologic management of abdominal trauma in pregnancy. *AJR* 1996;166:763-767.
23. Esposito TJ, Gens DR, Smith LG. Evaluation of blunt abdominal trauma occurring during the pregnancy. *J Trauma* 1989;29:1628-1632.
24. Sugrve M, Kolkman KA. Trauma during pregnancy. *Aust J Rural Health* 1999;7:82-84.
25. Lowdermilk C, Gavant ML, Qaisi W, et al. Screening helical CT for evaluation of blunt traumatic injury in the pregnant patient. *Radio Graphics* 1999;19:5243-5255.
26. Kass LE, Abbott JT. Trauma in Pregnancy. In: Ferrera PC, Colucciello SA, Marx JA, et al, eds. *Trauma Management: An Emergency Medicine Approach*. St. Louis: Mosby; 2001:489-503.
27. Moise KJ Jr, Belfort MA. Damage control for the obstetric patient. *Surg Clin North Am* 1997;77:835-851.
28. Lavery JP, Staten-McCormick M. Management of moderate to severe trauma in pregnancy. *Obstet Gynecol Clin North Am* 1995;22:69-90.
29. Buschbaum HJ. Penetrating injury of the abdomen. In: Buschbaum HJ, ed. *Trauma in Pregnancy*. Philadelphia: WB Saunders; 1979: 82-100.
30. Franger AL, Buschbaum HJ, Peaceman AM. Abdominal gunshot wounds in pregnancy. *Am J Obstet Gynecol* 1989;160:1124-1128.
31. Sakala EP, Kort DD. Management of stab wounds to the pregnant uterus: A cause report and a review of the literature. *Obstet Gynecol Surv* 1988;43:319-324.
32. Rayburn W, Smith B, Feller I, et al. Major burns during pregnancy: Effects on fetal well-being. *Obstet Gynecol* 1984;63:392-395.
33. Polko LE, McMahan MJ. Burns in pregnancy. *Obstet Gynecol Surv* 1998;53:50-56.
34. Fatovich DM. Electrical injury in pregnancy. *J Emerg Med* 1993;11:175-177.
35. Einarson A, Bailey B, Inocencion G, et al. Accidental electric injury in pregnancy: A prospective cohort study. *Am J Obstet Gynecol* 1997;176:678-681.
36. Fish RM. Electric injury, part III: Cardiac monitoring indications, the pregnant patient, and lighting. *J Emerg Med* 2000;18:181-187.
37. Judich A, Kuriansky J, Engelberg I, et al. Amniotic fluid embolism following blunt abdominal trauma in pregnancy. *Injury* 1998;29:475-477.
38. Locksmith GJ. Amniotic fluid embolism. *Obstet Gynecol Clin North Am* 1999;26:435-444.
39. Ditrlich KC. Rupture of the gravid uterus secondary to motor vehicle trauma. *J Emerg Med* 1996;14:177-180.
40. Williams JK, McClain L, Rosemurgy AS, et al. Evaluation of blunt abdominal trauma in the third trimester of pregnancy: Maternal and fetal considerations. *Obstet Gynecol* 1990;75:33-37.
41. Lanox R, Akkapeddi V, Goldfeder B. Perimortem cesarian section: Case reports and recommendations. *Acad Emerg Med* 1995;2:1063-1067.
42. Katz VL, Dotters DJ, Droegemueller W. Perimortem cesarean delivery. *Obstet Gynecol* 1986;68:571-576.
43. Shah KH, Simons RK, Holbrook T, et al. Trauma in pregnancy: Maternal and fetal outcomes. *J Trauma*.

CME Questions

To earn CME credit for this issue of Trauma Reports, please refer to the enclosed Scantron form for directions on taking the test and submitting your answers.

1. Which of the following is the leading cause of fetal death not related to maternal death?
 - A. Fetal maternal hemorrhage
 - B. Direct fetal injuries
 - C. Placental abruption
 - D. Uterine rupture
 - E. Amniotic fluid embolism
2. Which of the following often is the earliest indicator of inadequate maternal resuscitation?
 - A. Maternal tachycardia
 - B. Abnormality fetal heart rate
 - C. Increased maternal cardiac output
 - D. Maternal hypoxia
 - E. Maternal hypotension
3. Which of the following statements about placental abruption is most accurate?
 - A. It does not occur with minor trauma.
 - B. Cardiotocographic monitoring is the most sensitive diagnostic tool.

- C. Ultrasound almost always identifies abruption.
 - D. The classic triad almost always is present.
 - E. It rarely causes fetal death.
4. Which of the following statements is correct concerning the cardiovascular changes of pregnancy?
- A. Pulse increases 15-20 beats per minute by the third trimester.
 - B. Blood pressure drops throughout pregnancy.
 - C. Cardiac output remains steady.
 - D. Central venous pressure increases throughout pregnancy.
 - E. Plasma volume only increases slightly.
5. Which factor is the most important determinant of fetal outcome in a woman who receives a perimortem cesarean section?
- A. Severity of maternal injury
 - B. Gestational age
 - C. Time from maternal death
 - D. Neonatal intensive care support
 - E. Maternal comorbidity
6. The Kleihauer-Betke test is used to quantify fetomaternal hemorrhage. Which of the following statements best describes its optimal use?
- A. To determine who receives an initial dose of Rh immune globulin
 - B. To screen prior to ultrasound
 - C. To evaluate for abruption placenta
 - D. To identify patients for extended cardiocotographic monitoring
 - E. To determine which patients require additional Rh immune globulin
7. A 31-year-old who is 34 weeks pregnant slipped and fell from a standing position. She denies abdominal pain but wants to make sure there are no problems. The most appropriate management is?
- A. Reassure the patient and arrange follow-up with her obstetrician.
 - B. Perform a sterile speculum exam and discharge home if there is no bleeding.
 - C. Order an urgent ultrasound and discharge to home if negative.
 - D. Order cardiocotographic monitoring for four hours.
 - E. Admit for observation.
8. Which of the following statements most accurately reflects the expected changes of pregnancy?
- A. Increased tidal volume and decreased residual volume results in increased buffering capacity.
 - B. Signs of peritoneal irritation are less reliable in the gravid patient.
 - C. There is decreased risk of aspiration.
 - D. Bladder is less susceptible.
 - E. Maternal blood pressure decreases early to reflect blood loss.
9. Which of the following radiographic studies has the greatest radiation exposure for the fetus?
- A. C-spine
 - B. Chest radiograph

- C. Extremity radiograph
- D. Head CT
- E. Pelvic radiograph

10. Which of the following is true regarding the use of DPL in pregnancy?
- A. An open supraumbilical approach shouldn't be used.
 - B. DPL assesses retroperitoneal injury.
 - C. DPL assesses intrauterine injury.
 - D. Criteria for a positive DPL are the same for pregnant and non-pregnant trauma patients.
 - E. DPL is not sensitive for hemoperitoneum.

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