Trauma in the Obstetric Patient: A Bedside Tool

Trauma is the number one cause of pregnancy-associated maternal deaths in the United States. Concerns about the impact of tests and treatments on the unborn fetus can often cause misguided delays and alteration of management.

This article contains a tool (Figure 1: Prenatal Trauma Management) that condenses the key management guidelines allowing the user to make prompt, appropriate decisions.

The tool contains links to corresponding sections of this document for in depth information. However, it can stand alone, and users might consider posting it in ED trauma rooms as a quick guide and/or loading it onto a hand-held device.

Generally, medications, tests, treatments, and procedures required for the mother's stabilization should not be withheld because of pregnancy. A viable fetus should be promptly placed on continuous monitoring until under the care of an obstetrician.

Because it is often difficult to determine degree of force, significant trauma should be anticipated with any mechanism of injury that is more than very minor. Always evaluate for possible pregnancy-related cause of an accident, e.g., seizure secondary to eclampsia in 3rd trimester patient.

Pregnancy Modifications:

**Physiologic Changes**

Physiologic changes in pregnancy may affect the type of injury and the mother's response to trauma. Generally the mother's physiologic response is to maintain her own survival even if there are resultant adverse effects on the fetus.

**Pulse.** Increases to average of 80-95 by 3rd trimester. A pulse greater than 100 is still a sensitive marker of shock. Orthostatic vital signs may be a more sensitive indicator of hypovolemia.

**Blood Pressure.** Decreases to average of 105/60. After 20 weeks, a significant drop in supine BP can occur, usually caused by uterine compression of inferior vena cava. These effects may be relieved by turning the patient to the left lateral recumbent position.

**Cardiac Output.** Increased.
**Blood Volume.** Plasma volume increases by 50%, allowing patient to lose 30-35% of blood volume before a significant drop in blood pressure.

**Hemoglobin, hematocrit** - Dilutional physiologic anemia may lead to hematocrit in low 30% range by the 30th week.

**WBC.** Increased. During labor and the puerperium, normal white blood cell count may reach 20,000 or higher. Evaluate for other causes of elevated WBC. Elevation may be seen secondary to the stress of trauma.

**Coagulation.** Pregnancy is a hypercoagulable state that leads to increased risk of clot formation or DIC with certain kinds of trauma. Abdominal trauma may cause placental abruption or intrauterine death, leading to DIC. Average fibrinogen level in pregnancy is 450 mg/dl.

**Respiratory.** Functional residual volume is decreased. The apneic pregnant woman develops hypoxia more rapidly. PCO$_2$ is decreased to 30 with a compensatory drop in maternal serum CO$_2$ to allow a gradient for diffusion of fetal CO$_2$.

**Gastro-intestinal.** Abdominal wall may be less sensitive to peritoneal irritation because of stretching of abdominal muscles from uterine growth. Significant intra-abdominal injury may be present without significant symptoms or signs. General intestinal relaxation with slow gastric emptying may lead to an increased risk of aspiration.

**Genitourinary.** There is an increased risk of bladder injury because of the bladder rising out of pelvis.

**Diagnostic Tests**

**Lab Tests.** Basic trauma lab includes type and crossmatch, Rh status, and antibody test. Regardless of Rh status, a positive Kleihauer-Betke (KB) test may predict the risk of preterm labor. With a negative test, post-trauma electronic fetal monitoring may be limited to a shorter period. With a positive test, significant risk of preterm labor may require longer monitoring therefore K-B testing has important advantages to all maternal trauma victims. However, a positive test does not necessarily indicate pathologic fetal-maternal hemorrhage.

If placental trauma or abruption is suspected, add coagulation profile (fibrinogen and fibrin degradation products) with INR-PTT.

**Ultrasound.** FAST scan is a safe, rapid method to identify intra-abdominal free fluid. In addition, it can assess fetal viability and condition.

**Peritoneal Lavage.** Rarely done, generally based on surgeon's discretion or lack of imaging options.

**Imaging - Plain & CT.** Generally, a complete trauma exam with CT scanning will not approach levels that adversely affect the fetus. If possible, fetal exposure to radiation should be minimized by shielding abdomen/pelvis with a lead apron. Consider another study (e.g. ultrasound) if it will provide comparable information.

However, diagnostic techniques to evaluate potentially serious traumatic injury to the mother should not be withheld for fetal concerns.

CT scanning appears to be the best non-invasive method for evaluating certain internal injuries. Emergency departments should consider preparing guidelines with trauma specialists for a smooth approach, especially regarding CT
abdomen/pelvis. Generally consent is not needed for most ED imaging, including a trauma pan scan (head, c-spine, chest, abdomen/pelvis). However, it is prudent to have a form template prepared jointly by emergency medicine and radiology departments for higher dose CT, if the estimated dose is greater than 5,000 mrad and if contrast agents are used.

**MRI.** MRI may be required for certain trauma, such as spinal cord injuries. Generally it is considered safe in pregnancy. Paramagnetic contrast agents have not been studied in pregnant women. Use of these agents in pregnancy should be based on risk-benefit analysis with consultation from appropriate specialists.

**Management**

This section will not cover overall details of trauma management, but will focus on aspects that are unique to the pregnant trauma victim. Advanced Trauma Life Support principles will generally apply.

Maternal stabilization is the priority. After the mother is stabilized, attention is given to the fetus. Maternal physiologic changes may delay signs of shock. Therefore, close attention to urinary output and fetal heart tracing pattern may give an earlier warning of impending maternal cardiovascular collapse, rather than just monitoring maternal pulse and BP alone.

**Position**

If possible, place any patient over 24 weeks (or fundus 4 centimeters above the umbilicus) in left lateral decubitus position to avoid hypotension from uterine inferior vena caval compression. Turn the patient to the left side with her back angled 15-30 degrees from left lateral position. If the patient is on a backboard, tilt it leftward; alternatively, the uterus can be displaced to the left by placing a wedge under the right side. A patient with unstable BP and questionable c-spine status, not on a backboard, should be log-rolled with her neck stabilized or the uterus can be displaced to the left. Right lateral decubitus is an acceptable alternative.

**Airway, Oxygen and RSI**

To avoid fetal hypoxia, use high-flow oxygen.

In compromised respiratory settings, pregnant women have an increased tendency toward rapid development of hypoxemia. Anticipate higher potential for regurgitation of gastric contents and aspiration; thus, antiemetics and NG are strong considerations. Failed intubation is more common in pregnancy because of physiologic and anatomical changes that can lead to difficult intubation including:

- laryngeal edema from water retention
- lingual, nasal mucosa swelling from capillary engorgement
- increased facial adipose tissue affecting space for maneuvering laryngoscope handle
- increased abdominal contents elevating diaphragm with anterior shifting larynx
- morbid obesity (heavier than 300 pounds): mask ventilation may also be difficult due to increased intra-abdominal pressure and low chest compliance.
Neuromuscular blockade (e.g., succinylcholine, vecuronium, atracurium) can be used in conventional doses. Transplacental passage is insignificant at usual dose for intubation relaxation. If a paralytic agent is used, it crosses placenta in dose-dependent fashion and will cause fetal heart rate tracing to become non-reactive.\textsuperscript{12}

Induction agents such as thiopental, propofol, and etomidate appear to have a positive benefit vs. risk when used in the critical setting for pregnant women.

**Hypotension, IV Fluids**

Hypotension in pregnancy is sometimes difficult to identify because of physiologic lowering of blood pressure. Additionally, the mother's blood pressure may be maintained by shunting blood away from the uterus. Up to 25\% of maternal intravascular blood volume may be lost without change in maternal vital signs.

To prevent or correct hypotension, place the patient in the left lateral decubitus position. Avoid large loads of IV D5 solutions, as this will cause problems with glucose regulation in the neonate should delivery be imminent. Pregnant women have increased fluid requirements; thus, liberal amounts can be given as indicated. Also, a pregnant patient with hypotension is markedly volume depleted.

**Hypertension\textsuperscript{13}**

Drug treatment is usually reserved for patients with BP greater than 160 systolic and greater than 110 diastolic. Avoid lowering blood pressure below 140/90 because of possible uterine hypoperfusion. Labetalol IV is one recommended choice. If magnesium sulfate has been given, observe its effect on lowering blood pressure before adding antihypertensive medication. Nitroprusside is relatively contraindicated secondary to potential fetal cyanide poisoning.

**Blood Transfusion\textsuperscript{14}**

If uncrossmatched blood is indicated, group O Rh-negative blood should be used to prevent antibody development. Autologous transfusion (e.g., from chest tube) should be considered. The goal is to transfuse blood and crystalloid to maintain hematocrit at 25-30\% and urine output greater than 30 cc/hr.

Cytomegalovirus (CMV) infection is a concern with blood transfusion. Consider using CMV antibody-negative or leukocyte-reduced products, because CMV is transmitted only by leukocytes.

**Fetal & Uterine Monitoring\textsuperscript{21}**

Institute monitoring for viable fetus (see "Viable Fetus" later in article) as soon as the mother's status allows, preferably in the emergency department. Fetal morbidity or mortality can occur in mothers without significant injury. Abnormal fetal heart rate pattern may not be apparent during initial evaluation and may be the first sign of impending maternal deterioration, especially shock. Continuous monitoring can be discontinued after 4 hours if there are no fetal heart rate abnormalities, uterine contractions, bleeding, or uterine tenderness.
Electronic fetal heart and uterine monitoring in pregnant trauma patients after 20 weeks gestation may detect placental abruption. Multiple studies have shown that placental abruption was not seen if less than 6 contractions per hour over a 4-hour period of observation, and no uterine tenderness.

**Eclamptic Seizures (Acute or Impending).** If eclampsia is a concern in the trauma patient, it is best treated with magnesium sulfate.\(^{15}\)

**Tetanus Booster.** If indicated, tetanus or tetanus-diphtheria booster is safe to administer.\(^{16}\)

**Antibiotics.** Usual antibiotics for open wounds are generally safe for pregnant women; e.g., ceftriaxone or, if cephalosporin allergic, clindamycin.

**Anesthesia.** There are no problems with local anesthesia.

**Analgesia.** Acute trauma pain control with narcotics can be given in any trimester as required to provide comfort to the injured mother. Communicate doses and times to OB so the effect on the fetus can be anticipated if delivered while medications are in the system.

**Rh immune globulin (RhIG).** 40% of trauma victims will have fetal-maternal bleed. All Rh-negative trauma victims should be considered for 1 vial of RhIG (300 ug IM), which will provide complete protection for most of these patients. Even with negative Kleihauer-Betke (KB) test, these patients may become sensitized, as the test may not have adequate sensitivity to detect very small quantities of fetal blood. It should be given as soon as possible, and within 72 hours of the accident.

The use of additional RhIG should be discussed with an OB consultant and is based on initial and serial KB tests.\(^{18}\)

**Vaginal Bleeding**\(^{19}\)

Vaginal bleeding indicates a potentially fatal condition, although timely and proper treatment can prevent adverse outcomes. Massive, continuing vaginal bleeding may require emergency Cesarean delivery. Treat heavy vaginal bleeding as you would for hypovolemic shock. Arrange transfer if appropriate and condition allows.

When vaginal bleeding is not severe enough to require immediate C-section but occurs in the late 2nd trimester or 3rd trimester, rule out placental abruption. Diagnosis is supported by presence of abdominal pain and tenderness, uterine contractions, or fetal heart rate abnormalities. Although ultrasound exam may show retro-placental clot if an abruption occurs, normal ultrasound exam does not exclude the diagnosis. If vaginal bleeding is associated with placenta previa, as established by ultrasound, the patient needs to be hospitalized.

**Fetal Death**

If the mother's condition is stable, Cesarean delivery is not required in the event of fetal death. Method and timing of delivery can be planned with the OB consultant. If a laparotomy will be performed anyway, the OB should be notified immediately. Cesarean delivery is probably still not indicated but might be if it is critical to prevent labor or vaginal delivery (e.g., pelvic fractures) or to control bleeding from uterine injury. An obstetrician should make these decisions.

**Penetrating Trauma**
Consider a laparotomy on all gunshot wounds or stab wounds to the upper abdomen. Stabs to lower abdomen can receive non-surgical management if the mother and fetus are free of significant injury.

**Indications to Consider Cesarean Delivery**

- control of maternal hemorrhage
- viable fetus in distress
- gunshot to abdomen with viable fetus
- a peri-mortem Cesarean may be indicated for fetus considered viable

If small uterine wound is present and delivery is not otherwise indicated, a less than 36 week pregnancy can be managed with uterine repair and delay of delivery until 36 weeks. If the fetus is dead and Cesarean section is not otherwise indicated, vaginal delivery should be considered.

Maternal Arrest or Death Consider immediate Cesarean delivery for a viable fetus in any patient who cannot be resuscitated. Immediate Cesarean should be considered in those cases of a brain dead mother with intact cardiovascular system if there is any evidence of fetal compromise. Consider maintaining life support management until the fetus is at an acceptable level of maturity for delivery. It is usually preferable to allow the fetus to remain in utero based on maturity and evidence of fetal compromise.

**CPR ACLS Summary**

Effective CPR is difficult in near-term pregnant woman because of a limited ability to perform chest compressions and displace the uterus.

**Summary of CPR in pregnant patients over 20 weeks gestation:**

1. Before starting compressions, turn the woman to lateral position.
2. Defibrillation as in non-pregnancy. No significant shock is transferred to fetus. Remove fetal/uterine monitors prior to shock. Establish advanced airway early with C-spine stabilized.
3. Breathing: Ventilation volumes may need to be reduced because of elevated diaphragm.
4. Closed-chest compressions: 100 per minute using 30:2 ratio with ventilations.
5. IV: avoid femoral or other lower extremity lines, as flow may be affected by vena caval compression.
6. ACLS drugs as indicated.
7. If no maternal response after 4 minutes of ACLS, immediate Cesarean delivery should be performed in the emergency department by a qualified physician, with proper support and resources, who has determined the viability of the fetus. Thoracotomy and open cardiac massage may be considered at this time if the patient or fetus is believed to be viable.
   a. Age greater than or equal to 24 weeks: attempt to save life of both mother and fetus.
   b. Age 20-23 weeks: primary attempt to save life of mother by improving aortocaval blood flow and cardiac output. Fetal survival is unlikely.
   c. Age less than 24 weeks: urgent Cesarean unnecessary as aortocaval compromise unlikely.
8. Assessment of fetal heart tones should be done throughout, as allowed by circumstances.

**Admission and Monitoring**

**Viable Fetus**

Viability is assumed in patients who are well into their 2nd trimester or beyond. Check with the OB consultant for recommended age of assumed viability. Remember, dates may be inaccurate. When in doubt, presume viability.
Continuous fetal monitoring should be instituted as soon as the mother’s status allows, preferably in the emergency department for patients not promptly going to labor and delivery. Fetal morbidity or mortality can occur in mothers without significant injury. Fetal compromise may not be apparent during initial evaluation, but should abruptio placentae occur, it will do so generally by 24 hours. This can be effectively screened for by 4 hours of monitoring of the potentially viable fetus.  

Trauma Complications

- Vaginal bleeding
- Preterm rupture of membranes
- Placental abruption
- Maternal pelvic fractures
- Fetal death
- Fetal fractures, especially skull, clavicles, and long bones
- Intracranial hemorrhage
- Indirect injury is generally due to fetal hypoxia secondary to: maternal hypotension, fetal hemorrhage, placental abruption or other injury, cord injury, uterine injury
- Other: spontaneous abortion, preterm delivery, and RBC isoimmunization

Summary

In order to translate the knowledge available for trauma in pregnancy in a rapidly usable format, this article provides an accessible tool for emergency physicians. A key goal is to avoid unnecessary delays in management caused by the uncertainty of applying accepted principles to this population.

Generally, medications, tests, treatments, and procedures required for a mother’s stabilization should not be withheld because of pregnancy. The viable fetus should be promptly placed on continuous monitoring until under the care of an obstetrician.

Figure 1: Prenatal Trauma Management

<table>
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<th>Vitals</th>
<th>Hypotension treatment and prophylaxis &gt; 20 wks, left lateral decubitus</th>
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<td>Position</td>
<td>See Treatments</td>
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<tr>
<td>Hypotension</td>
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<td>Hypertension</td>
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<td>Hypertension Criteria</td>
<td>&gt;140 s, &gt;90 d</td>
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<tr>
<td>Hypertension Treated</td>
<td>&gt;160s, &gt;110d</td>
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<tr>
<td>Fetal Uterine Monitoring</td>
<td>&gt; 20 weeks, initiate ASAP</td>
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<tr>
<td>Fetal Uterine Monitoring</td>
<td>If unable to offer OB intervention, stabilize &amp; arrange prompt transfer</td>
</tr>
<tr>
<td>Vaginal Bleeding</td>
<td>Treat hypotension as above, OB consultation, Rh negative gets RhIG</td>
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<tr>
<td>LAB [in addition to usual trauma studies]</td>
<td>Low hematocrit</td>
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<tr>
<td>Type screen Kleihauer-Bettek</td>
<td>Rh negative</td>
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<tr>
<td>Coagulation Profile</td>
<td>INR, PTT, fibrin degradation, fibrinogen, i-Coombs</td>
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<td>Diagnostic Imaging</td>
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Ordered for the same general indications as in non-pregnancy.
Coordinate with radiologist; consider ultrasound to replace x-ray where possible
Shield abdomen-pelvis and neck when possible

<table>
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Source; Dr. Roemer, Dr. Katz, Dr. Becerra, Dr. Ogburn, Jr., Dr. Bowes, Jr., and Dr. B. Roemer

References

8. American College of Surgeons Committee on Trauma. "Chapter 11, Trauma in Women" Advance Trauma Life Support (ATLS) for Doctors, 8th ed.

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