# Trauma in Pregnancy: A Comprehensive Approach to the Mother and Fetus

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We present a standardized fetal trauma survey that seamlessly integrates with Advanced Trauma Life Support (ATLS; American College of Surgeons, Chicago, IL) in an effort to create a more reliable and collaborative experience in the trauma room. The process implements best practices in standardization and collaboration but deserves further investigation to determine how it might fit into a broader trauma in pregnancy bundle. Mounting concerns over the increasing maternal mortality rate in the United States over the past 30 years[1] have animated efforts at the organizational, state, and national levels to improve outcomes.[2–4] Protocols and checklists have emerged as essential components of those efforts,[5,6] with demonstrated benefits in a multitude of settings,[6] including obstetric hemorrhage,[3] hypertension-related intracranial hemorrhage, and postcesarean pulmonary embolism.[2] It is against this backdrop of improved outcomes through standardization of care that the approach to trauma in pregnancy deserves critical reappraisal. Unintentional injuries are the leading cause of death in women of reproductive age[7]; trauma affects 6–8% of all pregnancies.[8] General principles of the evaluation and management of trauma in pregnancy have been described in multiple recent reports with considerable consensus,[8-10] and the uniquely stressful, complex, and multidisciplinary nature of this environment makes it an ideal target for standardization.[11]

## Background

The first ATLS course was held 40 years ago with the mission of reducing unexplained clinical variance in the evaluation and treatment of injured patients.[12] Now in its tenth version under the authority of the American College of Surgeons Committee on Trauma, it continues to be the most widely accepted standard for the initial evaluation and treatment of trauma patients.[12] ATLS provides a common vocabulary and standardized processes that can be applied across multiple levels of care and resource settings. The initial hospital evaluation is divided into primary, secondary, and tertiary surveys with intermediate steps that may include resuscitation and imaging.[12] The primary survey is a quick assessment of vital functions (airway, breathing, circulation, disability, and exposure) and initial resuscitation.[12] Adjuncts to the primary survey are performed at the bedside and may include portable x-rays, focused assessment with sonography for trauma (FAST), and diagnostic peritoneal lavage.[12] FAST and diagnostic peritoneal lavage are used to detect intraabdominal blood and may trigger surgical intervention in the hemodynamically abnormal patient or more detailed imaging in the hemodynamically stable patient.[12] Once initial stability has been assessed and confirmed, the secondary survey is performed. This comprises a complete head-to-toe examination that includes evaluation of the back and spine along with a detailed history.[12] Adjuncts to the secondary survey may include computed tomography imaging or detailed x-rays.[12] Trauma patients are constantly reevaluated to ensure that subtle findings are not missed and that deterioration is recognized as it occurs.[12] If immediate surgery is not necessary, patients may be admitted for stabilization or observation. Patients with minor injuries might even be candidates for immediate discharge.

Pregnancy introduces significant complexity to the trauma evaluation with the addition of a second patient and at least 1 additional team. The obstetrician's role in this setting is to make decisions about delivery, provide readily available consultation to the trauma team, and coordinate ongoing care of the patient. Unfortunately, there is scant guidance for reliably fulfilling those responsibilities as a member of a multidisciplinary team. The ATLS Course Manual includes a chapter dedicated to pregnancy and intimate partner violence but leaves the details of the fetal evaluation to the consulting obstetrician, prescribing no break points for a fetal ultrasound scan or the initiation of electronic fetal monitoring (EFM).[12] Recent works on trauma in pregnancy have included excellent algorithms for the consultant,[8,9] but they do not specifically address the problem of coordinating and performing the fetal evaluation within the ATLS framework. This represents a standardization gap at the boundary of obstetrics and trauma. Recognizing that performing critical tasks the same way every time limits the impact of human error in complex environments,[5] we filled that gap at our trauma center by defining the obstetric evaluation as an extension of ATLS. In our experience, supplementary protocols for trauma in pregnancy are rare, even in designated trauma centers, and to our knowledge there has been no broader effort to develop and publish such a protocol before the one presented here. The checklist in the Table codifies an ATLS-compatible fetal survey that specifies when and how each step should be performed, relative to the primary and secondary surveys. It also addresses critical issues that may arise during briefing and debriefing. The fetal survey includes

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**TABLE**
**Maternal-fetal trauma checklist**

| Trauma team | Obstetric team |
|---|---|
| **Before the patient arrives (if possible)** | |
| ❑ Notify obstetrician and share known details of event<br>❑ Verify that the obstetric trauma bed is ready<br>❑ Ensure that ultrasound machine is immediately available | ❑ Introduce the obstetric team to the trauma team<br>❑ Huddle with the obstetric team to review roles<br>❑ Place monitoring belts on the bed |
| **Primary survey** | |
| ❑ Airway: secure airway and cervical spine<br>❑ Breathing: supplemental oxygen as needed<br>❑ Circulation: intravenous access, distal pulses<br>❑ Disability: GCS, pupil size, and response<br>❑ Exposure/environment: warm blanket<br>❑ Resuscitation as needed | ❑ Ensure that the uterus is displaced<br>❑ Observe at the bedside (mental status, leaking, bleeding, abdominal tenderness) |
| **Adjuncts** | |
| ❑ Consider focused assessment with sonography for trauma (FAST) or diagnostic peritoneal lavage:<br>→Fetal FAST<br>❑ Consider laboratory tests: ABG, lactate<br>❑ Consider portable imaging: chest, pelvis | ❑ Fetal FAST<br>Number: 1/2/3+<br>Position: cephalic/breech/transverse<br>Placentation: low/fundal/anterior/posterior<br>Fluid volume: normal/low/high<br>Cardiac activity: normal/abnormal/absent<br>Femur length: __ cm (consider viable if ≥4 cm) |
| **Secondary survey** | |
| ❑ Head to toe examination<br>❑ Head<br>❑ Cervical spine<br>❑ Neck<br>❑ Chest<br>❑ Abdomen<br>❑ Back/spine<br>→Initiate monitoring<br>❑ Pelvis<br>❑ Lower extremities<br>❑ Upper extremities<br>❑ History: allergies, medications, past illnesses and surgeries, last oral intake, events leading up to injury (AMPLE)<br>→Obstetric history | ❑ Initiate electronic fetal monitoring after spine and abdomen examination<br>❑ Focused history (CODE)<br>**C**omplications of pregnancy<br>**O**bstetric history and prenatal care provider<br>**D**ating method and estimated due date<br>**E**vent details, including leaking, bleeding, contractions, and fetal movement |
| **Adjuncts** | |
| ❑ Consider computed tomography or x-ray imaging<br>→Continue fetal monitoring | ❑ Electronic fetal monitoring for 6 hr, reflex to 24-hr electric fetal monitoring, if ≥6 contractions/hr in any single hour<br>❑ Abruption laboratory tests (complete blood count, fibrinogen, Kleihauer Betke, type and screen)<br>❑ Give Rh IG if Rh-negative<br>❑ Obstetric ultrasound scan: placentation, estimated fetal weight, amniotic fluid index<br>❑ Obtain prenatal records |
| **Debriefing and disposition** | |
| ❑ Designate where exploratory laparotomy or cesarean delivery will occur and who will be responsible for the incision.<br>❑ Summarize the findings and initial plan of care, including immediate disposition of the patient.<br>❑ Exchange contact information and update both teams with any change in maternal or fetal status. | |

*ABG, arterial blood gas; GCS,* Glasgow Coma Scale.

*MacArthur. Fetal trauma survey. Am J Obstet Gynecol 2019.*

bedside fetal ultrasound scanning, EFM, and a focused obstetric history.[8,9]

Beyond the fetal evaluation, many of the principles that guide the management of trauma in pregnancy have an excellent evidence base with broad consensus. Experts agree that pregnant trauma patients should be transferred to a trauma center with obstetric services,[8,9,12] that necessary maternal imaging and interventions should not be withheld

in pregnancy,[8-10,12] that leftward displacement of the uterus during resuscitation improves cardiac output,[8,9,12] that EFM is a mainstay of detecting abruption,[8-10,12] that some procedures, like chest tube placement and diagnostic peritoneal lavage, should be modified in pregnancy,[8,9,12] that Rh-negative patients should receive a dose of Rh immune globulin,[8,9,10] that a pelvic fracture is not a contraindication to vaginal delivery,[8,9] that intimate partner violence is a significant contributor to trauma in pregnancy,[8-10,12] and that immediate delivery should be considered under special circumstances, such as unsurvivable maternal injuries, maternal cardiac arrest, widespread burns, or massive abruption.[9]

For those clinical decisions that are supported by a less robust evidence base or consensus, we have chosen sensible defaults in the interest of standardization.[5] Our checklist includes at least 6 hours of EFM after the injury, but 2- and 4-hour minimum monitoring windows can also be justified.[8,9,10] Additionally, there is good evidence to support refraining from many tests in cases of minor trauma,[13] but we send the same laboratory specimens on every pregnant trauma patient and monitor them for the same duration. The Kleihauer Betke test is of limited utility in the timely identification of acute abruption and reasonably could be reserved for Rh-negative patients[8-10], but it remains on our standard trauma panel. We use the term *fetal FAST* for our focused obstetric ultrasound scanning for a few reasons: it was suggested by our trauma surgery colleagues; it concisely encapsulates the concept and its priority in the protocol; and it is consistent with the meaning of FAST.

## Briefing

It will not always be known in advance that a pregnant trauma patient is en route; however, when such warning is available, a briefing should be performed. Before the patient arrives, the obstetrician should introduce the obstetric team to the trauma team, identify the point of contact for coordinating care, and review the elements and timing of the fetal survey. Fetal monitoring belts should be positioned on the empty bed as the obstetric team huddles to review their roles and the potential triggers for immediate delivery.

## Primary survey

Because maternal shock and death are the leading causes of fetal death in cases of trauma,[12] the fetal survey should not delay the primary survey or resuscitation.[10] In the stable trauma patient, the primary survey can be completed in as little as 10 seconds.[12] In the unstable trauma patient, resuscitation of the mother is critical to the survival of the fetus, and delivery would not be considered unless resuscitation failed.[9] Even in such cases, fetal status may be irrelevant to the decision to deliver. During this phase, the obstetrician may be positioned nearby, observing for leaking and bleeding during exposure and answering any questions the surgeon may have.

Thus stationed, the obstetrician is ready to perform the fetal FAST as an adjunct to the primary survey. In cases in which a maternal FAST or diagnostic peritoneal lavage is indicated, the fetal FAST immediately follows. Otherwise, it is performed as the first adjunct to the primary survey. Ultrasound scanning provides critical information that can weigh heavily on management decisions, such as gestational age, placental location, fetal presentation, and viability.[9] Because of that, the fetal FAST comprises confirmation of fetal number and cardiac activity along with position, placentation, subjective assessment of fluid volume, and femur length, which is the best single measurement for estimating gestational age in the third trimester.[14] Palpation with the probe can also be used to assess uterine tenderness. The efficiency of this routine can be enhanced by visualizing the femur as the final step so that the ultrasound machine can be removed from the bedside before calculating the estimated gestational age. When biometric calculations are unavailable, every fetus with a femur length $>4$ cm is considered viable.[15] If the fetus is measuring $<23$ weeks gestation, then the fetal trauma survey can be concluded. The findings are communicated immediately to the patient. If a maternal FAST is being performed strictly for teaching purposes, the fetal FAST should take priority to avoid delays in ascertaining fetal viability.

## Secondary survey

Abruption is the second leading cause of fetal death in cases of trauma,[12] and EFM provides the most immediately available means of detecting it.[8-10] Significant fetal compromise may exist even in cases of minor injury,[8,9,12] so it is critical that no unnecessary delays are introduced into the process until EFM is initiated. This urgency is balanced by the idea that EFM should not be initiated until it would be feasible to perform an immediate cesarean delivery.[9] Therefore, the monitoring belts are secured immediately after the abdomen and spine examinations if fetal viability has been confirmed. Monitoring continues for 6 hours and is not interrupted except when it would interfere with indicated physical examination or imaging.[12] It is extended for a total of 24 hours in cases of severe maternal injury, nonreactive fetal heart rate tracing, and repetitive contractions ($\geq$6 in any single hour of monitoring).[10]

The obstetrician follows the surgeon's history with additional questions that include complications of the current pregnancy with special emphasis on fetal anomalies and abnormal placentation, obstetric history with attention to previous modes of delivery and adverse pregnancy outcomes, dating method and estimated due date, and event details, such as presence and mechanism of abdominal trauma, along with relevant symptoms, like leaking, bleeding, contractions, and decreased movement.

## Conclusion

Clear communication and predictable behavior lay the foundation for interdisciplinary collaboration when the secondary survey is completed and the initial disposition of the patient is determined. The system presented here represents a step toward a more collaborative approach to trauma in pregnancy. We would like to see broader investigation and

discussion of this topic in terms of multidisciplinary standardization, education, and simulation with the goal of developing a trauma-in-pregnancy bundle that includes a checklist as one of its components. ■

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ABSTRACT

# Trauma in Pregnancy: A Comprehensive Approach to the Mother and Fetus

Trauma is a significant contributor to maternal and fetal morbidity and death in the United States. The nature of the evaluation of the pregnant trauma patient is intense and multidisciplinary. Although it invites unique opportunities for collaboration with our surgical colleagues, it also increases the risk of misunderstanding and conflict. We present in this Viewpoint a standardized fetal trauma survey that seamlessly integrates with Advanced Trauma Life Support (American College of Surgeons, Chicago, IL) in an effort to create a more reliable and collaborative experience in the trauma room.

**Key words:** checklist, fetal focused assessment with sonography for trauma (FAST), trauma