

Trauma MedEd

Topic: Trauma in Pregnancy

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Introduction

Trauma in the pregnant patient is scary, but thankfully not very common. **About 1 in 15 pregnant women sustain some type of significant injury.** About half are from car crashes (most commonly if unrestrained), and 25% each are from assault (frequently domestic) and falls. Unfortunately, trauma is the leading cause of non-obstetric fetal death.

What makes this type of trauma problematic is two-fold, literally. First, you have two patients. And second, neither one has "normal" physiology. The mother has made numerous adaptations to accommodate the pregnancy, and the fetus is essentially a small parasite, totally dependent on her.

Let's look at the impact of some of the more important maternal adaptations:

- **Total blood volume increases by about one liter.** This would seem to be good, but since it is mainly dilutional with no real increase in total RBCs, and this is coupled with a lower mean blood pressure. Trauma professionals can easily underestimate blood loss.
- **Going into the third trimester, the uterus can compress the IVC when the mother is lying supine.** All of the textbooks mention this,

INSIDE THIS ISSUE

- 1 Introduction
- 2 Predicting Outcome After Trauma in Pregnancy
- 2 Tips & Tricks
- 3 Imaging The Pregnant Patient
- 3 Perimortem C-Section – When?
- 3 Perimortem C-Section – With What?
- 4 Perimortem C-Section - How?

TRAUMA CALENDAR OF EVENTS

DETROIT TRAUMA SYMPOSIUM

LOCATION: MGM GRAND HOTEL, DETROIT, MI

NOVEMBER 10-11, 2016

EASTERN ASSOCIATION FOR THE SURGERY OF TRAUMA

LOCATION: DIPLOMAT BEACH RESORT, HOLLYWOOD, FL

JANUARY 10-14, 2017

but it is quite frequently forgotten. One of the first maneuvers when you suspect an advanced pregnancy is to bump the patient to her left. **Do this even if the blood pressure is normal.**

- **The pelvic veins are huge.** Disruption from pelvic fractures or penetrating injury can lead to massive bleeding.
- **The stomach is probably full, and under pressure from below.** This increases aspiration risk in women who have decreased mental status or need intubation.

And don't forget the fetus:

- **The fetal/placental/uterine complex is one large, non-compressible unit** with multiple shear planes within it. Blunt force will stress those planes, and may result in disruption of the uterus from pelvic veins (massive bleeding), or separation of the placenta from the uterus (abruption).
- **The fetus is totally dependent on the mother for survival,** but the placenta will protect the mother first, shutting down fetal circulation if she becomes hypotensive or hypoxic.
- **The baby was designed to come into this**

world at full term. We have developed the technology to sustain life in smaller and more premature babies. The magic number of weeks keeps slowly decreasing, but preemie survival without complications is a challenge.

So let's move on and get to the fun stuff.

Predicting Outcome After Trauma in Pregnancy

The data on maternal outcome after trauma is mixed and somewhat confusing. Mortality after major trauma actually appears to be less. However, injury severity score (ISS) still correlates fairly well with overall mortality. But interestingly, other outcomes (complications) appear to be worse, even for relatively minor injuries. The reason behind this is not clear. Could it be a result of all of the physiologic changes noted above, hormonal factors, or something we don't fully understand?

Fetal outcome is a function of the mechanism of injury (blunt vs penetrating), and extreme injury severity in the mother. Penetrating injury is uniformly devastating to the fetus, with 70% mortality for gunshots and 40% for stabs. Fetal death from blunt injury is primarily a function of placental abruption. About two thirds of blunt fetal deaths are due to abruption, with 50% of them due to car crashes. Maternal ISS does not correlate with fetal death, except in cases of very high scores. These women most likely experience anatomic and physiologic injuries that lead to fetal demise.

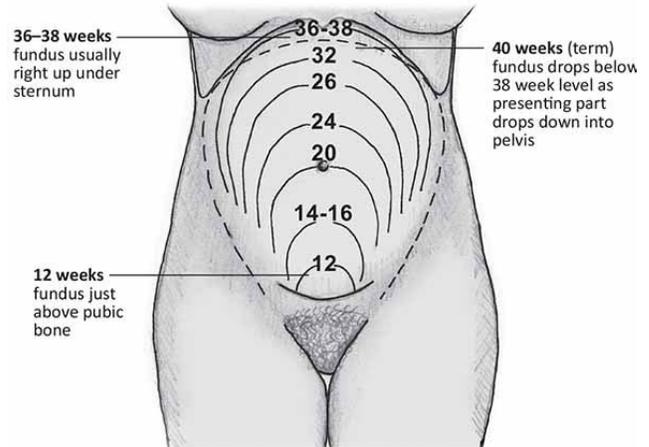
Tips & Tricks

Here is a list of practical tips for trauma professionals from prehospital and beyond:

- **Apply supplemental oxygen** from the get-go, in the field if possible
- **Start an IV or IO and begin crystalloid infusion immediately**
- **Bump the patient to her left.** This is most easily done with the spine board in place. Just put a rolled up towel under the right side of the board.
- **Quickly estimate how pregnant the patient is** if she can't tell you. Use the fundal height

diagram below. Key measurements to remember:

- **Umbilicus = 20 weeks:** entering the possible viability range if delivered emergently
- **Xiphoid = approaching full term**



- **If the patient is 20 weeks+ pregnant, *only transport to a trauma center (Level I or II).***
- **At the hospital, reassess fundal height to more accurately estimate viability**
- **If the fetus may be viable (23-24 weeks), call OB to the resuscitation area.** But remember, *they have nothing to offer* until the trauma team secures the safety and stability of the mother. **So don't let them in the room until you have finished your *entire* assessment.** Nothing they can do (e.g. monitor) is helpful during the acute phase of the resuscitation.
- **Once the mother is stabilized, assess fetal heart tones and apply monitors for fetal heart rate and maternal contractions.**
- **Add coag studies to your lab panel.** Fetal and placental injury can cause clotting problems.
- **Consider giving Rhogam in all major trauma cases if the mother is Rh negative**
- **Obtain a KB test to look at the amount of fetal blood in the maternal circulation.** Why do this if you are going to give Rhogam anyway? Answer: sometimes the amount of fetal blood leakage is greater than that covered by a single vial of Rhogam.

- **Plan your imaging intelligently.** The next section covers this topic in more detail.
- If needed, **chest tubes should be inserted 1-2 intercostal spaces higher** than usual.
- **The life-saving tetanus shot is safe** in pregnant patients.

Imaging The Pregnant Patient

Everyone worries about imaging pregnant patients. As with most medical tests, it always boils down to risks vs benefits. What are the chances of causing mutations or cancers or a spontaneous abortion, and what is the risk of missing a critical injury? In general, reasonable studies involving a fetus at just about any point in gestation won't cause major problems. At least as far as we know. What is not clear are the longer term, hard to measure effects. So the general philosophy should be to order just what you absolutely need, and shield the fetus during any studies other than of the abdomen/pelvis.

Menstrual	<50 mGy (<5 rad)	50-100 mGy (5-10 rad)	>100 mGy (>10 rad)
>27 wk	None	None	None at diagnostic doses
18th and 27th wk	None	None	IQ deficits not detectable at diagnostic doses
11th and 17th wk	None	Potential effects are uncertain and likely minimal	Increased risk of deficits in IQ or mental retardation that increase in frequency and severity with increasing dose
5th and 10th wk	None	Potential effects are uncertain and likely minimal	Possible malformations increasing in likelihood as dose increases.
3rd and 4th wk	None	Likely none	Possible spontaneous abortion
0-2 wk	None	None	None

Now, to put these numbers into perspective, have a look at this list of delivered doses from common studies. The table above is listed in milliGrays, and this one is in milliSieverts. These are roughly comparable, except that the former is a measure of radiation dose absorbed, and the latter measures radiation delivered.

Test	Dose (mSv)
Chest x-ray	0.1
Pelvis x-ray	0.1
CT Head	2
CT Cervical spine	3
Plain c-spine	0.2
CT Chest	7
CT Abdomen/pelvis	10
CT T&L spine	7
Plain T&L spine	3

Bottom line: Think hard about the imaging you really need. If you generally do this for all patients, you probably won't change your practice in pregnant women. Don't worry about chest and pelvic x-rays. Shield the fetus for anything not involving the abdomen/pelvis. For major torso trauma, you probably will need CT of the chest/abdomen/pelvis. If so, do it right. Order with contrast so you don't get substandard images that need to be repeated.

Perimortem C-Section – When?

The perimortem C-section (PMCS) is a heroic procedure designed to salvage a viable fetus from a moribund mother. Interestingly, in some mothers, delivery of the fetus results in return of spontaneous circulation.

The traditional teaching is that PMCS should be started within 4-5 minutes of the mother's circulatory arrest. The longer it is delayed, the (much) lower the likelihood that the fetus will survive.

The reality is that it takes several minutes to prepare for this procedure because it is done so infrequently in most trauma centers. Recent literature suggests the following management for pregnant patients in blunt traumatic arrest (BTA):

- Cover the usual BTA bases, including securing the airway, obtaining access and rapidly infusing crystalloid, decompressing both sides of the chest, and assessing for an unstable pelvis
- Assess for fetal viability. The fundus must measure at least 23 cm.
- Assess for a shockable vs non-shockable rhythm. If shockable, do two cycles of CPR before beginning the PMCS. If non-shockable, move straight to this procedure.

Bottom line: Any time you receive a pregnant patient in blunt arrest, have someone open the C-section pack while you assess and try to improve the mother's viability. As soon as you complete the three tasks above, start the procedure! You don't need to wait 4 minutes!

Perimortem C-Section – With What?

Most emergency departments do not have a separate

perimortem C-section pack sitting on the shelf. And when you finally need it, that is not the time to make one up. Most emergency departments have some type of major cutdown or mini-laparotomy tray available. Here is the absolute minimum required. Make sure these are on your existing tray.

- Large scalpel – note that this should be a disposable type that is opened and dropped onto the tray
- 3 large retractors for the helpers
- Toothed forceps
- Metzenbaum scissors
- Heavy scissors
- Multiple large clamps and hemostats

Perimortem C-Section – How?

Your preparation. You should already have full personal protective gear on, right? Right? Your existing gear is just fine. You do not need to change to sterile gown and gloves. The time wasted is probably not worth the low risk of infection in the rare event that the mother survives.

You need at least one assistant, preferably two. They will pass you instruments and provide retraction. Continue CPR throughout the procedure.

At the same time, call your OB and neonatal colleagues, if you haven't already. If you don't have any at your hospital, don't sweat it. If you do, don't wait for them to arrive.

Patient preparation. Have someone quickly insert a foley catheter. **Do not use sterile technique.** It just slows things down. The bladder needs to be empty so you can quickly and easily get to the uterus.

The procedure. Here's the blow by blow:

- **Splash some betadine on the skin.** The mother is probably not going to survive, so infection is not a concern.
- **Make a midline, vertical incision from mid-epigastrium to pubis.** Extend down to the midline fascia.

- **Enter the peritoneal cavity near the umbilicus.** Extend the incision along the full length of the skin incision using scissors.
- **Use the scalpel to make a 4cm vertical incision near the top of the uterus.** Insert your 2nd and 3rd fingers into the uterus, directed downwards. Use them to protect the fetus from the scissors as you use them to extend the uterine incision downwards.
- **Rupture the membrane with a clamp and deliver the baby.** Remember, the membrane is tough! Insert your hand deep into the lower uterus under the baby's head. Flex the body as you gently push upwards to deliver the head first. Suction the mouth and nose, then deliver the shoulders and body.
- **Cut and clamp the cord.** Hand off the baby to another team for suctioning and resuscitation.
- **Continue to try to revive the mother.** If circulation is restored, move immediately to an OR for delivery of the placenta, control of the bleeding that was killing her in the first place, and hopefully, closure.

References

1. *Trauma during pregnancy. OB Clinics of North America 40:47-57, 2013.*
2. *Challenging the 4- to 5-minute rule: from perimortem cesarean to resuscitative hysterotomy. AJOG 653-656, Nov 2015.*
3. *Perimortem C-section. Atlas of Emergency Medicine Procedures. Springer Science+Business Media, 2016.*

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