



Pregnancy and Trauma

Fall Trauma Nursing Conference

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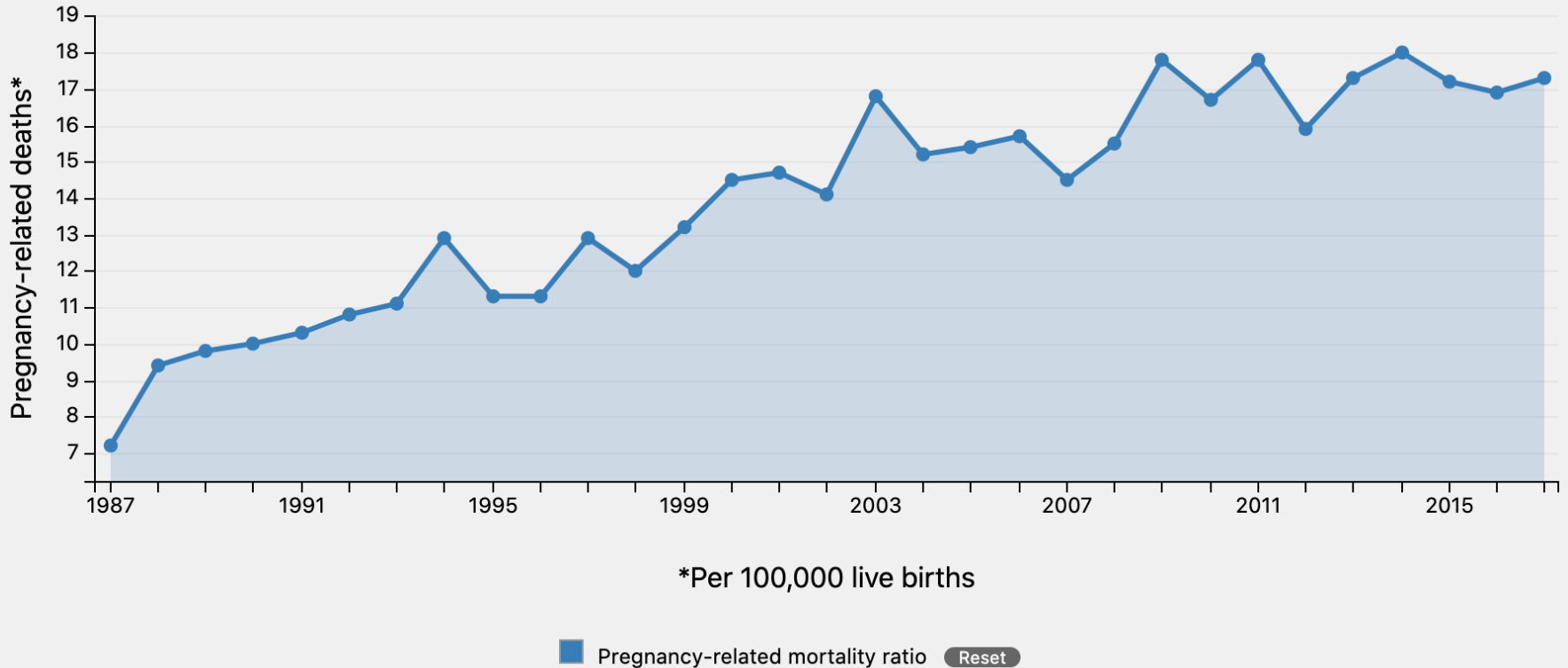
Disclosures

- None

Objectives

1. Review physiologic changes in pregnancy in the context of trauma evaluation
2. Discuss initial evaluation and management of trauma in the pregnant person
3. Review pregnancy evaluation and management after initial evaluation

Trends in pregnancy-related mortality in the United States: 1987-2017



Trauma is the leading non-obstetric case of maternal morbidity and mortality (~20%)

Most common mechanism in pregnancy include MVA (55%), falls (22%), assault (22%), burns/other (1%)

CDC 2021

Hill; Surg Clin NA 2008

El-Kady; AMJOB 2004

Fildes; J Trauma 1992

Sachs; NEJM 1987

Connolly; Am J Perinat 1997

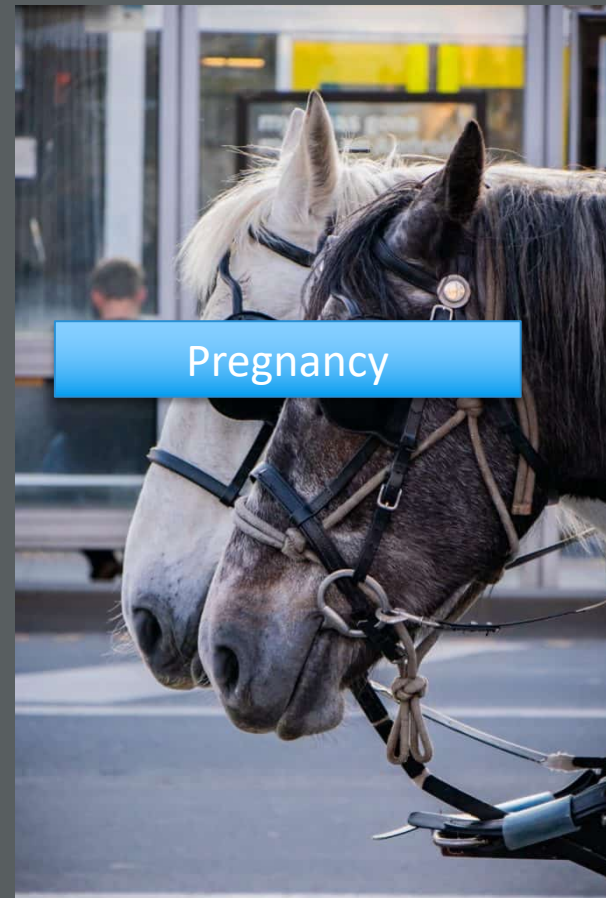


Underappreciated cause of maternal death

- Pregnant or postpartum women 2 X more likely to die from trauma than non-pregnant women
- Trauma increases risk of obstetric complications including placental abruption, preterm labor, preterm rupture of membranes, cesarean delivery and fetal death

Most common reasons cited:

- Delayed diagnosis
- Delayed response
- Ineffectual care



General Principles

- Changes begin early
 - Even before pregnancy recognized
- Most are hormonally driven
 - Progesterone, estrogen, renin/aldosterone, cortisol, insulin
- Some 'mechanically' driven
- Designed to optimize conditions for fetus & prepare for delivery
 - Delivery of oxygen & nutrients

Cardiovascular & Hematologic

- Vascular
 - Decreased tone / vaso-relaxation
 - SVR decreased 20%
 - Positional effects
 - Placenta – low resistance shunt
- Hematologic
 - Blood volume increases 50-100%
 - RBC increases 25-40%
 - Relative anemia (“physiologic”)
- Hypercoagulable

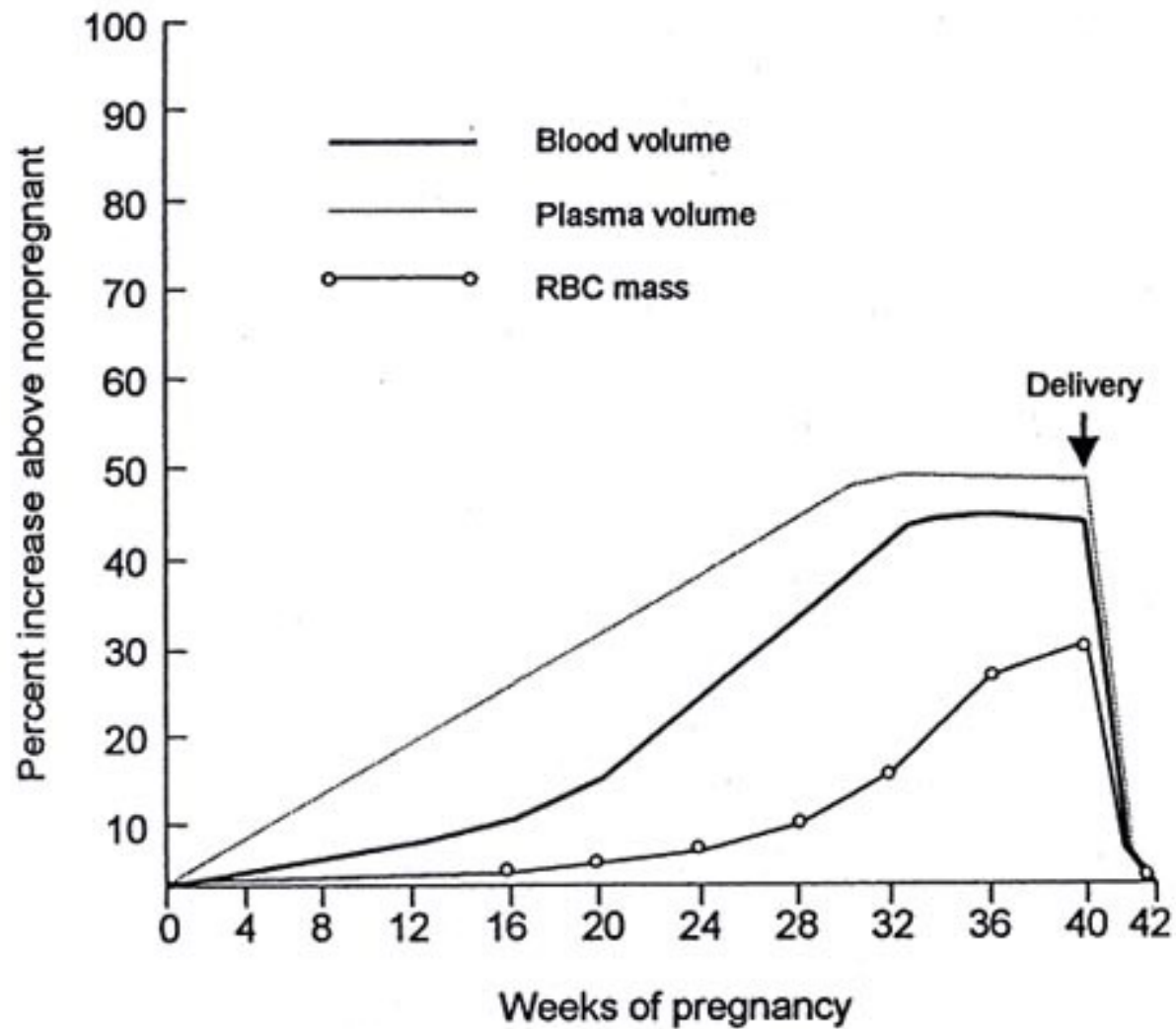


Figure 3-11. Blood volume changes during pregnancy. (From Scott D: Anemia during pregnancy. *Obstet Gynecol Ann* 1:219, 1972.)

Cardiac Output – Positional Effects

- Aorto-caval compression
 - <23 wks - No change
 - 24-28 wks - Decrease by 8%
 - 29-32 wks - Decrease by 14%
 - 33-term - Decrease by 25%

"We just laid her down, and she suddenly lost her vital signs."

Smith KA. Traum in the Pregnant Patient: An Evidence-Based Approach to Management. Emergency Medicine Practice April 2013



Initial evaluation

- Same as non-obstetric patient
- Additional labs
 - CBC, type and screen, Kleihauer-betke (KB), PT/PTT/Fibrinogen
- Multidisciplinary
 - Call OB team
- OB ultrasound position, fluid, fetal heart rate, femur length
- Physical exam:
 - Abdominal exam, fundal height, uterine palpation
 - Cervix if vaginal bleeding, leaking amniotic fluid, contractions, abdominal pain (US first)
 - Fetal monitoring?
- Imaging

Diagnostic Imaging

"She was worried about radiation risks, so we didn't do the imaging studies I would have normally done."

Smith KA. Traum in the Pregnant Patient: An Evidence-Based Approach to Management. Emergency Medicine Practice April 2013

To image or not to image.....

- Most of what we know about radiation in pregnancy is from disasters
- Provider discomfort sometimes leads to delay in ordering
- Patient sometimes decline based on perceived risk to pregnancy
- Don't order imaging unless you need it to make management decisions -> true for pregnant AND non-pregnant individuals



Hiroshima Atomic Bomb, 1945

<https://veterans.nv.gov/august-marks-atomic-bomb-anniversary/>

Non-ionizing radiation

- US
 - No documented adverse fetal effects
 - Theoretical risk of tissue temperature elevated
 - “ALARA”
- MRI
 - Deep soft tissue structures
 - Theoretical concerns but no evidence of actual harm

Ionizing Radiation

- X-ray and CT scan
- Deterministic: Threshold exists
 - Depends on radiation dose and trimester of pregnancy
 - Examples: pregnancy loss, malformations, neurobehavioral abnormalities, fetal growth restriction
- Is there a dose below which NO deleterious effects on fetus may occur?
 - ICRP suggests < 100 mGy (10 rad)
 - ACOG suggests < 50 mGy (5 rad)

Fetal Radiation Doses Associated with Common Radiologic Examinations

Procedure	Fetal Dose (mGy)
2 view Chest X-ray	< 0.01 mGy
CT Head	0.001-0.01 mGy
X-ray extremity	<0.001 mGy
Abdominal X-ray	0.1-3.0 mGy
CT Chest/CT Pulm Angiogram	0.01-0.66 mGy
VQ scan	0.1-0.37 mGy
CT Abdomen	1.3-35 mGy
CT Pelvis	10-50 mGy
US	Non-Ionizing
MRI	Non-Ionizing
Background Radiation	1 mSv
Commercial Flight	0.1 mSv

Adapted from Groen. Ionizing radiation and pregnancy. Am J Obstet Gynecol 2012 and ACOG Committee Opinion 723: Guidelines for Diagnostic Imaging During Pregnancy and Lactation (October 2017)



Table 1: Summary of Suspected In-Utero Induced Deterministic Radiation Effects* [3,4]

Menstrual or Gestational age	Conception age	<50 mGy (<5 rad)	50-100 mGy (5 - 10 rad)	>100 mGy (>10 rad)
0 - 2 weeks (0 - 14 days)	Prior to conception	None	None	None
3 rd and 4 th weeks (15 - 28 days)	1 st - 2 nd weeks (1 - 14 days)	None	Probably none	Possible spontaneous abortion.
5 th - 10 th weeks (29 - 70 days)	3 rd - 8 th weeks (15 - 56 days)	None	Potential effects are scientifically uncertain and probably too subtle to be clinically detectable.	Possible malformations increasing in likelihood as dose increases.
11 th - 17 th weeks (71-119 days)	9 th - 15 th weeks (57 - 105 days)	None	Potential effects are scientifically uncertain and probably too subtle to be clinically detectable.	Increased risk of deficits in IQ or mental retardation that increase in frequency and severity with increasing dose.
18 th - 27 th weeks (120 - 189 days)	16 th - 25 th weeks (106 - 175 days)	None	None	IQ deficits not detectable at diagnostic doses.
>27 weeks (>189 days)	>25 weeks (>175 days)	None	None	None applicable to diagnostic medicine.

American College of Radiology Practice Guidelines for Imaging Potentially Pregnant Patients, 2008



Stochastic Effects

- No defined threshold and amount of radiation does not predict severity of disease
- Multiple studies showed high dose radiation did not lead to increased risk of childhood cancer
- Fetal exposure of > 10 mGy (5 rad) *may* increase risk for childhood leukemia (RR 1.5-2.0)
 - Perspective important
 - Baseline risk of childhood leukemia is 1 in 3000

Contrast agents

- Oral contrast
 - No real or theoretical harm
- IV contrast
 - Commonly iodinated media
 - Can cross placenta, animal studies report not teratogenic or mutagenic effects
- ***Breastfeeding should NOT be interrupted after IV or PO administration***

Contrast agents

- Gadolinium use in pregnancy is controversial
- Uncertain risk
- Water soluble and crosses placenta, length of exposure is unknown
- Limited prospective studies on 1st trimester exposure, no red flags
- Retrospective data demonstrate concern for adverse events
- Limited data, theoretical concerns and animal data = use should be LIMITED to situations where clear benefit outweigh risk
- Breastfeeding should NOT be interrupted after gadolinium administration

Additional evaluation after stabilization

- Fetal monitoring continued
 - Duration to be determined by OB team
- Monitoring for contractions and vaginal bleeding
- Monitor pain symptoms
 - Labor pain versus trauma pain
- Betamethasone administration
- Determine when to repeat cervical exam
- Rh (D) Immunoprophylaxis (Rhogam)

Going to the OR

- Left lateral tilt position
- Consider lithotomy
- Collaborate with OB team
 - Will determine if intervention for fetal distress and intra-op monitoring is warranted
- Notify NICU team

Cardiac arrest

- Prioritize high quality CPR with lateral uterine displacement
- Defibrillation when indicated
 - Remove fetal monitors!
- Other ACLS interventions as indicated (eg epinephrine)
- Difficult airway is common
- Place IV above diaphragm
- Perimortum cesarean at 5 minutes if > 20 weeks
 - Goal maternal resus

>20 weeks gestational size or uterus is palpable or visible



Left Uterine Displacement
One handed Technique



Left uterine Displacement
- 2 Handed Technique

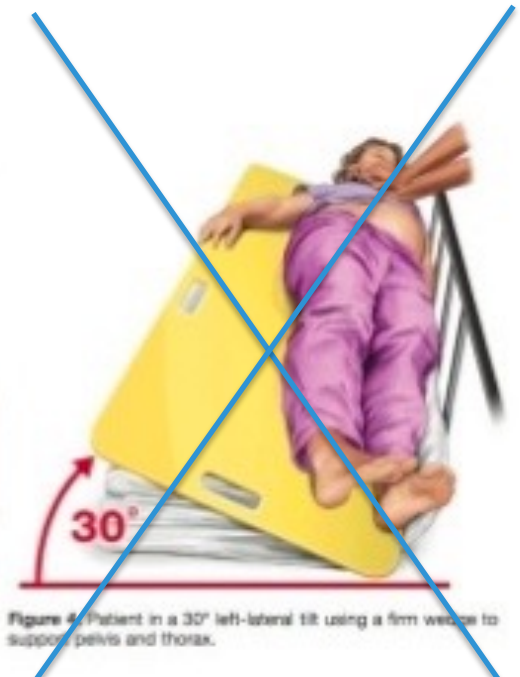
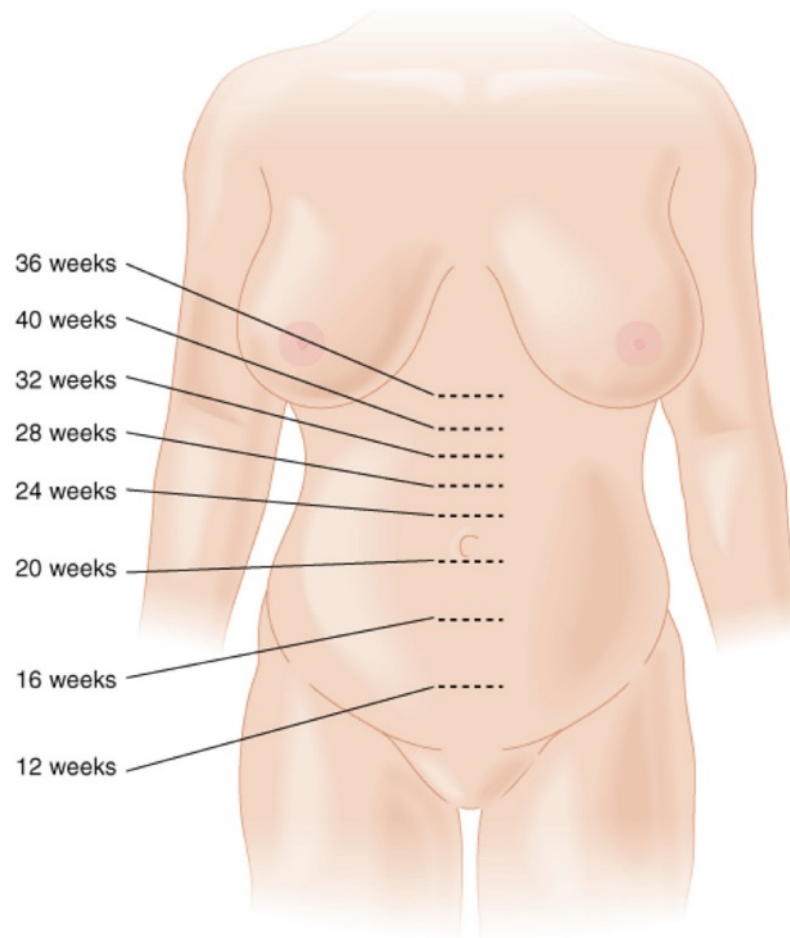


Figure 4. Patient in a 30° left-lateral tilt using a firm wedge to support pelvis and thorax.

Figure 1. Fundal Height And Estimated Gestational Age



Tintinalli J, Stapczynski JS, Ma OJ, Cline DM, Cyduka RK, Meckler GD. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*, <http://www.accessmedicine.com>. Copyright © The McGraw-Hill Companies, Inc. Used with permission.

Thank you!
Questions?

Additional Resources

- <https://www.uptodate.com/contents/initial-evaluation-and-management-of-major-trauma-in-pregnancy>
- [https://www.jogc.com/article/S1701-2163\(15\)30232-2/pdf](https://www.jogc.com/article/S1701-2163(15)30232-2/pdf)
- <https://pubmed.ncbi.nlm.nih.gov/23333541/>
- ACOG Committee Opinion 723: Guidelines for Diagnostic Imaging During Pregnancy and Lactation (October 2017)
- American College of Radiology Practice Guidelines for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation, 2008 (Res. 26).
- Groen et al. "Fear of the unknown: Ionizing radiation and pregnancy." Am J Obstet Gynecol (June 2012).
- HPS Specialists in Radiation Protection. "Pregnancy and Radiation."
- <http://hps.org/publicinformation/ate/cat4.html>
- Kruskal et al. "Diagnostic Imaging in Pregnant and Nursing Women." Up to Date. Last updated June 24, 2021.
- https://www.uptodate.com/contents/diagnostic-imaging-in-pregnant-and-nursing-women?search=radiation%20exposure%20in%20pregnancy&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1
- Kwan et al. "Trends in Medical Imaging During Pregnancy in the United States and Ontario, Canada, 1996-2016." JAMA Network Open. 2019; 2(7).