TRAUMA IN PREGNANCY

- Fifth leading cause of death worldwide
- Death rate of women from unintentional injury is 24/100,000
- Most frequent form is motor vehicle accidents
- US 1.6 deaths per 10^6 miles
- Accidents: women 143, men 95 / 10^7 miles driven

TRAUMA IN PREGNANCY

- Fetal Mortality
  - 1300 to 3900 pregnancies in U.S. per year are lost due to trauma
- Life threatening maternal trauma 40%-50% fetal loss rate
- Minor Maternal trauma 1% - 5% fetal loss rate
- More than 50% of fetal losses occur with minor or insignificant maternal trauma
Etiology of Severe Trauma in Pregnancy

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle Accidents</td>
<td>63.9%</td>
</tr>
<tr>
<td>Falls</td>
<td>19.2%</td>
</tr>
<tr>
<td>Penetrating wounds</td>
<td>10.0%</td>
</tr>
<tr>
<td>Blunt Trauma</td>
<td>5.8%</td>
</tr>
<tr>
<td>Burns</td>
<td>1.0%</td>
</tr>
<tr>
<td>Maternal Mortality</td>
<td>1.9%</td>
</tr>
<tr>
<td>Fetal Mortality</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

Gestational Age Specific Survival Rates

not specifically trauma related

<table>
<thead>
<tr>
<th>Gestational age in week</th>
<th>Survival rate in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>1.0 %</td>
</tr>
<tr>
<td>24</td>
<td>9.9 %</td>
</tr>
<tr>
<td>26</td>
<td>54.7 %</td>
</tr>
<tr>
<td>28</td>
<td>77.4 %</td>
</tr>
<tr>
<td>30</td>
<td>90.6 %</td>
</tr>
<tr>
<td>32</td>
<td>96.5 %</td>
</tr>
<tr>
<td>34</td>
<td>98.7 %</td>
</tr>
<tr>
<td>36</td>
<td>99.5 %</td>
</tr>
</tbody>
</table>

Intentional Injury MS 1995

- MVA 43.4%
- Fall 25.1%
- Blunt assault 25.1%
- Shooting 3.9%
- Stabbing 2.5%
- Intentional injury 31.5%
- 5 of 8 fetal losses were without obvious signs of trauma externally
- Think interpersonal violence and abuse with defensive bruising and facial and neck injuries

Critical Physiologic changes of Pregnancy affect assessment of the injured gravida
PHYSIOLOGICAL CHANGES OF PREGNANCY AS THEY RELATE TO TRAUMA

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CHANGE</th>
<th>IMPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal blood volume</td>
<td>Attenuated initial response to hemorrhage</td>
<td>Increased metabolic demands</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td>Increased metabolic demands</td>
<td>Propensity for supine hypotension from aorto-caval compression</td>
</tr>
<tr>
<td>Uterine enlargement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PHYSIOLOGICAL CHANGES OF PREGNANCY AS THEY RELATE TO TRAUMA

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CHANGE</th>
<th>IMPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Residual volume</td>
<td>Down</td>
<td>Hypoxemia from atelectasis is more likely</td>
</tr>
<tr>
<td>Gastrointestinal motility</td>
<td>Down</td>
<td>Greater risk of aspiration</td>
</tr>
<tr>
<td>Minute ventilation</td>
<td>Up</td>
<td>Compensated respiratory alkalosis, diminished buffering capacity</td>
</tr>
</tbody>
</table>

Caveats in the Management of the traumatized gravida and her Fetus

The greater the severity of maternal trauma, the more likely a significant fetal insult will occur.
Retroperitoneal hemorrhage occurs more frequently with gestational trauma than in the presence of a nongravid uterus.
Bowel injuries are less frequent in gestational trauma.

ABG Differences

<table>
<thead>
<tr>
<th></th>
<th>Gravid</th>
<th>Non-Gravid</th>
</tr>
</thead>
<tbody>
<tr>
<td>pCO2</td>
<td>27-32</td>
<td>39-40</td>
</tr>
<tr>
<td>pO2</td>
<td>100-108</td>
<td>95-100</td>
</tr>
<tr>
<td>pH</td>
<td>7.40-7.45</td>
<td>7.40</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>18 - 21</td>
<td>24 - 29</td>
</tr>
</tbody>
</table>

For best fetal outcome, pO2 should be kept at greater than 60 mm Hg.
Caveats in the Management of the traumatized gravida and her Fetus

Pelvic fractures correlate with an increased frequency of placental abruption, retroplacental hemorrhage, urinary tract injuries, uterine rupture, and fetal head injuries

Pneumatic shock garments may compromise UBF

Maternal blood loss is often underestimated

Caveats in the Management of the traumatized gravida and her Fetus

Minor injuries can lead to placental abruption, fetal-maternal hemorrhage and premature birth

Abdominal complaints and abnormal findings may not present initially and diagnostic tests are not as definitive as in the nonpregnant patient

Caveats in the Management of the traumatized gravida and her Fetus

Maternal blood loss is often underestimated

Splenic rupture is the most common cause of intraperitoneal hemorrhage in pregnancy trauma

Rib fractures are associated with splenic and hepatic injury more so in pregnancy trauma

Caveats in the Management of the traumatized gravida and her Fetus

Tocolytic therapy must be used with discretion and sensitivity for side effects as well as potential hazards

Pregnancy should not be the rationale for compromise modification of the evaluation and treatment plan for the gravid trauma victim
Caveats in the Management of the traumatized gravida and her Fetus

Vaginal bleeding and uterine contractions are cardinal signs of placental abruption. Diagnostic tests (Radiography) and therapy should be directed primarily at the care of the mother and should not be delayed or compromised because of the pregnancy.

The Radiation Safety Officer (physicist) for the diagnostic radiology center should keep records on dosimetry which allow for later calculations on fetal exposure. Ionizing radiation should be kept to the minimum in those situations when MRI or ultrasound will be just as helpful.

CARDIAC ARREST

- CPR is not particularly efficient in aiding cardiac output or organ perfusion.
- Combined with aortocaval compression in late pregnancy it is very inefficient.
- Lateral tilt diminishes the compressive force of closed chest massage (early use of open massage?)
- Bedside C/S within 5 minutes of unsuccessful CPR

ADDITIONAL FACTS REGARDING TRAUMA IN PREGNANCY

- In non-catastrophic injury there is a 9% incidence of pregnancy related complications.
- Maintenance of maternal physiologic equilibrium is the best assurance of fetal well-being.
- Head injuries and hemorrhagic shock are implicated in 85% of cases of maternal death.
- In life-threatening maternal injury, fetal loss rate may be as high as 41%.
LABORATORY EVALUATION OF THE OBSTETRIC TRAUMA VICTIM

COAGULATION PROFILE
HEPATITIS SCREEN
HIV SCREEN
ARTERIAL BLOOD GASES, AS NEEDED
SONOGRAPHY FOR FETAL AGE, ACTIVITY (BPP), PLACENTAL LOCATION
(subject to a two weeks error in EGA)
TOXICOLOGY SCREEN FOR SUBSTANCE ABUSE AND ALCOHOL
TRAUMA SPECIFIC RADIOGRAPHIC STUDIES

FETAL DEATH OCCURRING WITH MATERNAL TRAUMA

<table>
<thead>
<tr>
<th>Condition</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Utero-Placental Fetal Injury</td>
<td>100%</td>
</tr>
<tr>
<td>Maternal Shock</td>
<td>67%</td>
</tr>
<tr>
<td>Pelvic Fracture</td>
<td>57%</td>
</tr>
<tr>
<td>Severe Head Injury</td>
<td>56%</td>
</tr>
<tr>
<td>Maternal Hypoxia</td>
<td>33%</td>
</tr>
<tr>
<td>Maternal Death</td>
<td>67%</td>
</tr>
</tbody>
</table>

FETAL INJURY AND MATERNAL TRAUMA

Uncommon in first trimester without maternal pelvic fracture or shock

Most common direct fetal injuries are:
- Intracranial hemorrhage and skull fractures
- Care must be taken in administration of medications to the injured mother
- Legal consequences of maternal trauma to fetal outcome
- Postmortem cesarean Section

BLUNT TRAUMA

- Motor vehicle accidents
- Falls
- Aggravated Assaults
- Blast injury
- Crush injury
- In pregnancy increased frequency of spleen rupture and retroperitoneal hemorrhage; decreased frequency of bowel injury
BLUNT TRAUMA MANAGEMENT IN OB

- Treatment priorities to the injured mother
- Important aspect in initial management is deflection of the large uterus away from the great vessels to diminish their effect on decreased cardiac output
- Low maternal HCO₃⁻ associated with fetal death
- Aggressive approach to exploratory celiotomy, blunted clinical response to irritation of peritoneal lavage.
- Laparotomy itself is NOT an indication for Cesarean

Consider Cesarean if the large uterus hinders adequate treatment or evaluation of intra-abdominal injuries

Whereas exploration is mandatory for abdominal gunshot, some advocates use close observation for stab wounds

Ensure tetanus immunization (TIG 250 Units IV)

For contaminated wounds give Tetanus-diptheria toxoid 0.5 mL (if series was > 5 yrs ago)

GENERAL COMMENTS ON TRAUMA MANAGEMENT IN THE OB PATIENT

- Pressors/inotropes may reduce uteroplacental blood flow; however, their use may be necessary to save the mother's life
- The sensitivity of ultrasound evaluation in trauma is equivalent in the gravid and non-gravid abdomen
- Maximum recommended radiation dose of 0.5 cGy but 5-15 cGy is low risk

CT generally exposes the fetus to 3.5 cGy, above 20 cGy adverse effects have been seen

Intraoperative fetal heart rate monitoring can be performed with a transducer wrapped in a sterile bag, if this becomes a concern

Decision for Cesarean within four minutes of cardiorespiratory arrest for fetal survival
**MOTOR VEHICLE ACCIDENTS**

Most common cause of fetal death is maternal death

Maternal hypoxemia has adverse consequences for the fetus even when maternal condition is stable

Severe maternal head injury has a high fetal loss rate (56%)

**MOTOR VEHICLE ACCIDENTS**

Abruptio placenta is caused by shearing forces at abrupt stops

(neither physical signs nor severity of injury can rule out adverse outcome) ~ 48 hours

Skull Fractures and internal bleeds lead to stillbirth

PRETERM LABOR: tocolytic therapy in question

Intraperitoneal Hemorrhage: Diagnostic tests are obscured by late pregnancy (such as diagnostic peritoneal lavage)

---

**THE SEAT BELT**

- Unbelted women are 4 X more likely to have a fetal demise and 2.5 X more likely to give birth within 2 days of the injury compared to belted pregnant women

- Correct placement is to wear the lap portion of the belt across the pelvis, below the pregnant abdomen, with the shoulder harness placed over the midpoint of the clavicle, between the breasts to the side of the gravid abdomen. Instruction by health care workers increases compliance by patients 83% vs. 65%

**THE USE OF AUTOMOBILE RESTRAINTS AND PREGNANCY**

<table>
<thead>
<tr>
<th>OUTCOME</th>
<th>NO RESTRAINT</th>
<th>RESTRAINT USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Death</td>
<td>33%</td>
<td>5%</td>
</tr>
<tr>
<td>Fetal Death</td>
<td>47%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Deployment of airbags have not been widely studied in pregnancy but preliminary results are promising
THE USE OF AUTOMOBILE RESTRAINTS AND PREGNANCY

Deployment of airbags have not been widely studied in pregnancy but preliminary results are promising. (ongoing study in Wisconsin)

It is recommended that there be 10 inches between the pregnant woman and the airbag before deployment for least complications and maximum effect.

There is no data on side impact bags.

THE IMPACT SEQUENCE

- IMPACT all increase
- UPPER BODY EXTENSION only belt tension increases
- JACKNIFE ABDOMINAL COMPRESSION uterine pressure increases
- REBOUND all return to normal

IMPACT AND ABRUPTION

Illustration of the gravida hitting the steering wheel with deformation of the uterus and separation of the placenta from the underlying decidua basalis.

TRAUMATIC PLACENTAL ABRUPTION

- Caused by deformation of the elastic myometrium around the relatively elastic placenta
- 1% to 6% of minor injuries
- 50% of major injuries
- Deceleration and increased intrauterine pressure.
TRAUMATIC PLACENTAL ABRUPTION
- More likely when speed > 30 mph
- Occult without tenderness or bleeding
- Higher % of DIC
- Contractions, FHR abnormalities
- Tocolytics obfuscate findings

Additional notes on lethal intrauterine trauma
- Lethal placental or direct fetal injury can occur though maternal injuries are minor or insignificant
- Live birth is not the total story as some babies die in the neonatal period from cerebral contusions, lacerations and skull fractures
- Where there is abruption or fetal death observe mother for DIC

UTERINE RUPTURE
- < 1% of all severe cases of blunt trauma
- Associated with a direct impact of substantive force
- Findings identical to abruption with maternal and fetal deterioration
- Factors that predispose: prior uterine scar, multiple gestation, hydramnios
- Relative resistance in early pregnancies

UTERINE RUPTURE
- Complete disruption of the myometrial wall with or without extrusion of the fetus, placenta, or umbilical cord into the abdominal cavity
- Avulsion of the uterine vasculature with intraperitoneal or retroperitoneal hemorrhage
- Less than full thickness injury to the myometrial wall, serosal hemorrhage or abrasions
- Complete uterine avulsion (from an improperly placed lap belt)
**UTERINE RUPTURE**

- > 75% of full thickness ruptures occur in the fundus
- Peritoneal irritation: guarding, rigidity, distention and rebound tenderness
- Abnormal fetal lie
- Sonography
- Peritoneal lavage
- CT and MRI
- A primary repair soon after rupture may yield a salvageable uterus

**PELVIC FRACTURES**

- Associated with significant morbidity and mortality
- May cause problems at delivery
- Retroperitoneal bleeding which extends to the broad ligament and simulates uterine vascular injury
- Disruption of the bladder and urethra with hematuria and inability to urinate
- < 10% will have a large healing callus, severe dislocation, or unstable pelvis precluding vaginal delivery

---

**FETAL ASSESSMENT IN TRAUMA**

**FETAL VIABILITY > 24 WEEKS**

- FETUS ALIVE
- FETAL MONITORING

**CONTINUE MONITORING**

- Minimum of 4-6 hrs for minor trauma
- Minimum of 24 hrs for severe trauma
- Throughout period of maternal instability

- Secondary evaluation of the fetus by ultrasound
- Rh immunoglobulin in Rh negative mother

---

**FETAL INJURY**

- FDIU from direct injury, maternal shock, pelvic fracture, maternal head injury or hypoxia
- Skull and brain injuries most common if the head is engaged in the pelvis
- Contrecoup injuries also occur
ELECTRONIC FETAL HEART RATE MONITORING

- Another ‘VITAL SIGN’ of the mother
- Predictive of placental abruption
- Contractions more than 1 every 10 minutes within 4 hours of trauma, 20% abruption
- Duration of post trauma monitoring is unknown
- Logical to continue if clinical condition warrants (contractions, vaginal bleeding, tenderness, non-reassuring FHR, serious maternal injury, ROM)

Fetal Monitoring at Surgery

- Prior to 24 weeks just preoperative and postoperative checks of FHR
- After 24 weeks intraoperative FHR monitoring may be performed when feasible. However, a plan must be agreed upon prior to surgery as to what to do if the FHR is abnormal and the patient and family must concur. Most OBs do not want to perform a CS intraoperative of a thoracic case for abnormal FHR
**FETOMATERNAL HEMORRHAGE**

- FMB in 10% to 30% of trauma cases
- Bleed < 15 mL in 90%
- Placental ‘fractures’ or ‘tears’ may occur
- Administer Rh immunoglobulin to Rh negative women unless the KB is negative

**Laparoscopy in Pregnancy**

- **Benefits**
  - lessened depression from narcotic requirements
  - lower risk of wound complications
  - diminished postoperative maternal hypoventilation
  - more rapid maternal recovery
- **Risks**
  - uterine injury from placement of gas infusion needle or the trocar
  - increased intrabdominal pressure having an effect on vascular flow
  - fetal or unknown effects from a CO₂ pneumoperitoneum (in animals this does not occur with N₂O)

**Endoscopy in Pregnancy**

- EGD is not a problem and may be very beneficial
- Sigmoidoscopy is not a problem
- Panendoscopy is not contraindicated
  - ECG, pulse oximetry, stabilization of VS all are mandatory
    - Transfusion and oxygen may be needed
PENETRATING TRAUMA IN THE OBSTETRICAL PATIENT
- Knife and gunshot are the most common penetrating injuries
- Associated with aggravated assault, suicide or attempts to cause abortion
- Visceral injury 15-40% (non OB 80-90%)
- Disparate risk for the fetus and the mother
  - Uterus size protects maternal organs
  - The uterine mass and contents ‘shield’ maternal organs, reducing velocity and deflecting path

PENETRATING ABDOMINAL TRAUMA IN THE OBSTETRICAL PATIENT
- Maternal death rate from gunshot wounds to the abdomen is two thirds less than in nonpregnant victims 3.9% vs. 12.5%
- The maternal death rate from abdominal stab wounds is also diminished by the so-called protective effects of the gravid uterus

HIGH VELOCITY PENETRATING WOUNDS IN GRAVID WOMEN IN THE Lebanese Civil war
- Visceral injuries present when: entrance wound is in upper abdomen or the back
- Entry wound is anterior and below the fundus, no visceral injuries
- Perinatal death in 50% from maternal shock, uteroplacental or direct fetal injury

PENETRATING WOUNDS
- **GUNSHOT**
  - Internal injuries 82%
    - 12.5% mortality
  - Pregnant abdomen 71% fetal mortality
    - 3.9% maternal mortality
- **STABBING**
  - Pregnant abdomen 42% fetal mortality
    - 0% maternal mortality
**SHARP TRAUMA AND PREGNANCY**

**AIRWAY**
**BREATHING**
**CARDIAC**
**DRUGS**
  - Electronic Fetal Heart Monitoring
  - Assess for Labor
  - Assess for Rupture of Membranes

**SHARP TRAUMA AND PREGNANCY**

- Check on tetanus status
- Kleihauer-Betke stain (Fetaldex) – Rh immune globulin
- Diagnostic radiologic studies for foreign bodies
- Open Peritoneal Lavage
- Cesarean section for: Cardiac arrest, Abruptio placenta, Fetal distress, abdominal or Uterine exploration and repair

**Fetal Status**
- Abdominal gunshot wound during pregnancy
  - Entrance wound below fundus OR Bullet in uterus
    - Observation
    - Explore if necessary
  - Entrance wound Above fundus OR Bullet not in uterus
    - Celiotomy Repair of Injuries
    - No fetal Injuries OR compromise
  - Fetal Status DEAD

**ALIVE**
- Fetal injuries OR compromise
  - Exploration, Cesarean Section
  - Await Spontaneous Delivery

**FAST**

Focused Assessment for the Sonographic examination of the Trauma patient

The fourth operation is to place the transducer 4 cm superior to the symphysis pubis and sweep inferiorly as in a transverse section to obtain a coronal view of the full bladder and both sides of the pelvis.

Helpful in determining volume and location of intra-abdominal fluid and for peritoneal lavage
**DIAGNOSTIC GUIDELINES FOR PERITONEAL LAVAGE**

- **ASPIRATE**
  - Blood: > 10 ml
  - 5 ml is equivocal
  - Fluid: enteric fluid
- **LAVAGE**
  - RBC’s > 100,000/mm³
  - 50,000 is equivocal
  - WBC’s > 500/mm³
  - 200 is equivocal
- Amylase > 20 IU/L
- Bile confirmed biochemically

**KNIFE WOUNDS**

- Prognosis is better than gunshot
- Decision to perform laparotomy – individualized
- Explore upper abdominal sites
- In gyn stabs do not penetrate the peritoneum in 1/3 of cases, more common with pregnancy
- Fistulogram or detection of bowel spillage
- IVP for bladder or ureteral injury
- Amniocentesis for blood and bacteria
- Uterine vessels are lateral

**KNIFE WOUNDS**

- The violent nature of the crime is demonstrated by the numerous stab wounds. The number and location of the stab wounds suggests extreme anger with a sexual motivation. The assailant in this case was a former boyfriend

**Burns**

- A burn injury usually results from an energy transfer to the body. There are many types of burns caused by thermal, radiation, chemical, or electrical contact.

- **thermal burns** - burns due to external heat sources which raise the temperature of the skin and tissues and cause tissue cell death or charring. Hot metals, scalding liquids, steam, and flames, when coming in contact with the skin, can cause thermal burns.
### Burns

- **radiation burns** - burns due to prolonged exposure to ultraviolet rays of the sun, or to other sources of radiation such as x-ray.
- **chemical burns** - burns due to strong acids or alkalis coming into contact with the skin and/or eyes.
- **electrical burns** - burns from electrical current, either alternating current (AC) or direct current (DC).

### BURNS

- < 4% are pregnant women
- Pregnancy does not alter the incidence of burns
- Complications: SAB, preterm labor, fetal death
- When TBSA 70-80% - maternal mortality is 50-90%
- Fluid loss is greatest in the first 12 hours
- When TBSA > 50% - fetal survival is negligible

### BURN TYPES

Management is based on depth of burn and size of area burned

- **Partial-Thickness burn (old 1<sup>st</sup> and 2<sup>nd</sup> degree)** with sufficient epithelials for spontaneous repair
- **Full-Thickness burn (old third degree)** total destruction of skin does NOT allow spontaneous repair

Minor burn: partial thickness < 10% BSA
Major burn: partial or full thickness > 10% BSA

### Fetal Loss

- Fetal loss occurs within the first week after the burn
- Fetal loss in 1<sup>st</sup> trimester
- Fetal survival tied to maternal survival in the 2<sup>nd</sup> trimester
- Fetal outcome related to gestational age in the 3<sup>rd</sup> trimester
Crude Mortality rates following maternal burn injuries

- **% Body surface** | Maternal Mortality | Perinatal Mortality
---|---|---
- **Injured**
  - 20-39% | 3% | 11-27%
  - 40-59% | 27-50% | 45 – 53%
  - > 60% | 92-100% | 100%

THERMAL INJURY

- Women with 2nd or 3rd trimester burns over 50% of their body should be delivered immediately because maternal death otherwise is almost certain and fetal survival rate is not improved by waiting
- First trimester SAB is common, it is caused by septicemia
- Adequate shock management and early excision with grafting reduces maternal mortality figures

TBSA CALCULATION

<table>
<thead>
<tr>
<th>Body Part</th>
<th>TBSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>9%</td>
</tr>
<tr>
<td>Upper Extremity (each)</td>
<td>9%</td>
</tr>
<tr>
<td>Lower Extremity (each)</td>
<td>18%</td>
</tr>
<tr>
<td>Anterior Trunk</td>
<td>18%</td>
</tr>
<tr>
<td>Posterior Trunk</td>
<td>18%</td>
</tr>
<tr>
<td>Neck</td>
<td>1%</td>
</tr>
<tr>
<td>Moderate burn</td>
<td>10-19%</td>
</tr>
<tr>
<td>Severe burn</td>
<td>20-39%</td>
</tr>
<tr>
<td>Critical burn</td>
<td>&gt; 39%</td>
</tr>
</tbody>
</table>
**THERMAL INJURY**

- Labor is usually spontaneous with delivery of a stillborn
- Contributory factors are: hypovolemia, pulmonary injury, septicemia and intensely catabolic state
- Skin contracture may be painful subsequently and necessitate surgical decompression and split skin autografts
- Loss or distortion of the nipples may cause breast feeding difficulties

**BURN MANAGEMENT**

- Fluids and Electrolytes – sufficient for maintenance of blood pressure and urinary output of 30-50 ml per hr.
- Hemodynamic and ventilatory stability, prevent hypoxia or hypotension
- Evaluate fetus – if possible, minimize fetal compromise
- Sepsis prevention, debridement, topical antibiotics, early ambulation

---

**Hospital Admission for an OB**

Smoke inhalation
Electrical burns
Burns of both hands or both feet,
Partial-thickness burns that cover more than 10% of the surface area
Full-thickness burns on more than 2% of the surface area. The depth of the injury is estimated by appearance and sensation.

**Smoke Inhalation**

- A major cause of morbidity and mortality in burn patients.
- In pregnancy, the fetus is at special risk because of its relatively hypoxic state (i.e., normal umbilical vein PaO2 = 27 mm Hg).
- The pathophysiology of inhalation injury relates to impaired maternal ventilation (e.g., upper airway obstruction from edema), increased diffusion distance (e.g., interstitial alveolar edema), and acute functional anemia from carbon monoxide poisoning. Carbon monoxide binds more efficiently to hemoglobin than does oxygen.
Smoke Inhalation

- In addition to displacing oxygen, carbon monoxide impairs the release of oxygen from oxyhemoglobin. Very little carbon monoxide is needed to cause serious hypoxia. One part carbon monoxide per 1500 parts air can result in blood concentrations of carboxyhemoglobin of 5-10%. Car exhaust is 5-7% carbon monoxide. Carboxyhemoglobin values less than 15% usually are well tolerated, whereas values greater than 30% cause severe maternal syncope and fetal death.

Specific Pregnancy Concerns

- Iodine absorption from povidone-iodine
- Diuretics for hypertension because of uterine blood flow
- Silvadene use because of sulfonamide absorption and hyperbilirubinemia
- Liberal use of but careful choice of antibiotics
- Body positioning to avoid aortocaval compression
- Local or regional anesthesia, nondepolarizing muscle relaxant

Tocolytic Therapy in Burn management

- Tocolytic therapy is unwise, Indomethacin may be used for a limited time
- Betamimetics may cause myocardial ischemia, pulmonary edema, hyperglycemia and hypokalemia
- Magnesium may be better tolerated
- No specific recommendations on steroid therapy for fetal lung maturity
- Vaginal birth is preferred

Burn Scar

- Burn scar during pregnancy undergoes considerable softening and therefore can stretch
- Skin contracture following abdominal burn scar may be painful during subsequent pregnancy and may necessitate surgical decompression and split scar autograft
- Loss or distortion of the breast nipple may cause a problem in breast feeding only if both nipples are involved; if one is affected the other breast should be sufficient
Electrical Accidents

ESSENTIALLY AN “ALL OR NONE’ PHENOMENON FOR THE FETUS AND THE MOTHER
There is anecdotal information and small studies indicating higher spontaneous abortion rates and increased stillbirths after electrical accidents in pregnancy.

ELECTRICAL INJURIES
- Depends on entry and exit points of the current
- Serious maternal injury results from cardiac dysrhythmias or respiratory arrest
- Serial ultrasound for amniotic fluid volume is recommended in cases of lightning injuries where some babies have been IUGR with oligohydramnios
- North American 110 V is likely safer than European 220 V

ELECTRICAL INJURIES
- Thermal or conductive in nature
- Unsuspecting deep tissue necrosis, cardiac injury, and rhabdomyolysis
- Tetanic muscle contractions with skeletal fractures
- Respiratory arrest

PERIMORTEM CESAREAN
- Immediate Maternal survival is in question
- Attempts at delivery of the viable fetus should be begun within 4 minutes after maternal cardiac arrest
- CPR should be continued during and after the procedure when the potential for maternal survival exists
- Staff should not waste time preparing a sterile field
PERIMORTEM CESAREAN

- Attempts at delivery usually should be undertaken at any time after maternal death if signs of fetal life are present
- Cesarean delivery will further compromise maternal stability secondary to blood loss
- C/S should NOT be performed in an unstable mother in anticipation of cardiac arrest
- If maternal CPR is successful, stop the C/S attempt as in utero resuscitation is likely

BRAIN DEATH DURING PREGNANCY

- Prolonging gestation in an attempt to salvage neonatal survival is possible
- Aggressive maternal hemodynamic, respiratory, metabolic and tocolytic support is required
- Delivery when maternal condition dictates or fetal maturity established
- Complex ethical issues for the family, healthcare providers and community require individualization of considerations

ABUSE AND DOMESTIC VIOLENCE

- Physical Violence (does not include psychological, verbal, sexual or rape)
  U.S. 1998 1.3% in the past 12 mo 22.1% ever
- Sexual Violence (sexual assault, attempted or completed forced sex)
  U.S. 1995 0.2% in the past 12 mo 5.5% ever
ABUSE AND DOMESTIC VIOLENCE

- 154 acts of violence per 1000 pregnant women in the first 16 weeks of pregnancy
- 170 acts of violence per 1000 pregnant women in the last 6 months of pregnancy
- Further increases noted in the first several months postpartum
- < 10% seek medical attention

INCREASED RISK FOR ABUSE

- Social instability
  - youth, single, separated, divorced, limited education, unemployed, unplanned pregnancy
- Unhealthy Lifestyle
  - poor diet, emotional problems, substance abuse
- Physical Problems
  - acute and chronic medical problems, use of prescription drugs
DOMESTIC ABUSE

- Generally, abuse decreases early in pregnancy and picks up again later in pregnancy
- Risk of chorioamnionitis and preterm delivery is increased
- Late onset prenatal care is most common
- Tend to stay with the abuser
- Location of abuse to head, face, extremities
- Should be considered to be emotionally abused

DOMESTIC ABUSE

An Abuse Assessment System will be more productive in identifying all forms of abuse than the standard history and physical examination:
- 41% versus 14% for any abuse
- 15% versus 3% for recent abuse
- 10% versus 1% for during pregnancy
- 4% versus 0% for sexual abuse

WHAT CONSTITUTES ABUSE?

- Abrasions
- Bruises
- Lacerated Wounds
- Bites
- Intercrural intercourse
- Genital injury
- Anal intercourse
- Signs of restraint

- Signs of direct violence
- Asphyxia
- Necrophilia
- Bestiality
- Sadism
- Masochism
- Forced transmission of disease
Rates for genital injury are similar for consensual (74%) and non-consensual first intercourse (78%).

- For consensual – lacerations of the hymen or fossa navicularis
- For non-consensual – erythema of the fossa navicularis and labia minora
- For forced digital penetration 93% with lacerations and erythema of the fossa navicularis, vagina, cervix, fourchette, and labia minora.

Placement of objects into the vagina:
- Light bulbs
- Bottles
- Hairbrush
- Vegetables
- Wooden structures
- Illegal abortions

Only 10-20% of instances are reported.

- Needs antimicrobial prophylaxis and pregnancy prevention (if not pregnant)
- The need for psychological counseling for the rape victim and her family cannot be overemphasized
- Associated physical trauma is less in the gravid rape victim
- One third of sexual assaults in pregnancy occur after 20 weeks.
PROPHYLAXIS FOR ADULT VICTIMS OF SEXUAL ASSAULT

**ANTIBIOTIC PROPHYLAXIS**
- Ceftriaxone 125 mg IM
- Spectinomycin 2g IM
- OR Cefixime 400 mg po
- Azithromycin 1 g po + Metronidazole 2 g po
- OR Erythromycin-base 500 mg po qid x 7

**PREVENTION OF PREGNANCY**
- 2 OC tabs (50 microg EE) q 12 hr x2 OR
- 3 OC tabs (35 microg EE) q 12 hr x2 + antiemetic

PREGNANT SEXUAL ASSAULT VICTIMS

- Lifetime prevalence of forced sexual contact is 5%
- Rape victims have higher incidence of: STDs, UTIs, vaginitis, drug use, multiple hospitalizations
- 8% of adolescents report sexual assault: Family member 46%, Spouse or boyfriend 33%

RAPE

- 80-90% are not reported to authorities
- One every 6-7 minutes in the U.S. 260,000 in 2000
- 33% of women will have been sexually assaulted
- Victim 16-24 years old woman
- Assailant 25-44 years old male
- Usually same race as the assailant
- 50% of assailants are known to the victim
- 33% involve alcohol
### RAPE
- 50% occur in the victim’s home
- Generally a violent act of man to woman
- Increasing numbers of woman to man
- Rape is not a sexual act; it is an act of anger or rage
- Same sex rape occurs where access to the opposite sex is limited
- People targeted for discrimination are at higher risk

### RAPE AND TRAUMA
- Confusion
- Social withdrawal
- Tearfulness
- Nervousness
- Numbness
- Hostility
- Fear
- Inappropriate laughter

### RAPE EVALUATION
- Too extensive a subject to discuss here
- Engage rape crisis services
- Sexual Assault Nurse Examiner
- Forensic specimens
- Prophylactic therapy – remember Hep B and HIV
- Pregnancy prophylaxis
- Post traumatic stress disorder
- Legal aspects

### Criteria for identification and assessment of self-inflicted trauma
- Adolescents
- Single
- Emotionally immature
- Lacking a strong support system

Half are in their first pregnancy
Fatality rate much lower than in the non-pregnant about 1:6
<table>
<thead>
<tr>
<th>Maternal Condition</th>
<th>Maternal no trauma</th>
<th>Trauma after hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm labor</td>
<td>7.1%</td>
<td>14.4%</td>
</tr>
<tr>
<td>PROM</td>
<td>1.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Abruption</td>
<td>0.9%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Death</td>
<td>0.01%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>0.06%</td>
<td>0.06%</td>
</tr>
<tr>
<td>Transfusion</td>
<td>0.3%</td>
<td>4.2%</td>
</tr>
</tbody>
</table>
### Violence against women figures

<table>
<thead>
<tr>
<th></th>
<th>Maternal</th>
<th>No trauma</th>
<th>Trauma after hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm labor</td>
<td>5.4%</td>
<td>16.4%</td>
<td>10.5%</td>
</tr>
<tr>
<td>PROM</td>
<td>1.5%</td>
<td>2.5%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Abruption</td>
<td>0.9%</td>
<td>5.4%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Death</td>
<td>0.01%</td>
<td>0.7%</td>
<td>0.17%</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>0.07%</td>
<td>0.7%</td>
<td>0.11%</td>
</tr>
<tr>
<td>Transfusion</td>
<td>0.3%</td>
<td>2.5%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

### MVA trauma figures

<table>
<thead>
<tr>
<th></th>
<th>Maternal</th>
<th>No crash</th>
<th>Uninjured</th>
<th>Not severe</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm labor</td>
<td>6.6%</td>
<td>51.3%</td>
<td>24.6%</td>
<td>13.1%</td>
<td></td>
</tr>
<tr>
<td>PROM</td>
<td>2.0%</td>
<td>2.7%</td>
<td>2.3%</td>
<td>1.2%</td>
<td></td>
</tr>
<tr>
<td>Abruption</td>
<td>1.4%</td>
<td>8.5%</td>
<td>7.4%</td>
<td>13.1%</td>
<td></td>
</tr>
<tr>
<td>Preterm Birth</td>
<td>8.0%</td>
<td>13.9%</td>
<td>12.1%</td>
<td>5.0%</td>
<td></td>
</tr>
<tr>
<td>Fetal distress</td>
<td>9.4%</td>
<td>12.2%</td>
<td>12.0%</td>
<td>20.2%</td>
<td></td>
</tr>
</tbody>
</table>

### Prehospital care of the injured gravida

**AIRWAY**
- Increased oxygen consumption

**BREATHING**
- Watch for tachycardia, air hunger, vasoconstriction, perspiration

**CIRCULATION**
- Stabilize the C-spine and tilt the uterus

**DISABILITY**

**EVALUATE**

### Prehospital Care of Road Traffic Casualties

- At some time in their career many doctors will have to deal with a road traffic crash
- Safety for yourself at the incident scene is the first priority
- Doctors untrained in prehospital care should concentrate on giving good first aid, working under the direction of ambulance service staff
Prehospital Care of Road Traffic Casualties

- Providing excellent medical treatment at a road crash requires specific training and experience
- Patients with airway and breathing problems may need immediate (prehospital) advanced medical intervention
- Treatment should be aimed at promoting oxygenation and preserving clot, with rapid patient movement to a hospital with the appropriate facilities to provide definitive care

THE TRAUMA CHAIN FOR TRAFFIC CASUALTIES

1. BYSTANDER FIRST AID
2. EMERGENCY SERVICES
3. ROADSIDE CRITICAL INTERVENTION
4. TRANSPORT TO APPROPRIATE UNIT
5. EARLY RESUSCITATION
6. RAPID DIAGNOSIS
7. EARLY SPECIALIST INTERVENTION
8. INTENSIVE CARE
9. REHABILITATION

INITIAL IN HOSPITAL THERAPY OF THE TRAUMATIZED GRAVIDA

- Oxygen
- Fluid infusions
- Central line
- Foley drainage
- Stomach decompression
- Uterine displacement
- Fetal monitoring and ultrasound assessment

LABORATORY EVALUATION OF THE OBSTETRIC TRAUMA VICTIM

- CBC
- Urinalysis
- Type and crossmatch
- Electrolytes
- Glucose
- BUN
- Creatinine
- Amylase
- Kleihauer-Betke stain
<table>
<thead>
<tr>
<th>Critical Physiologic changes of Pregnancy affect assessment of the injured gravida</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CARDIOVASCULAR</strong></td>
</tr>
<tr>
<td>supine position reduces venous return</td>
</tr>
<tr>
<td>Relative tachycardia is normal</td>
</tr>
<tr>
<td>Blood loss will exceed 30% TBV before hypotension is manifest</td>
</tr>
<tr>
<td>retroperitoneal bleeds may not be readily manifest</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<tbody>
<tr>
<td><strong>ECG</strong></td>
</tr>
<tr>
<td>Flattened T waves</td>
</tr>
<tr>
<td>Possible inversion in lead III</td>
</tr>
<tr>
<td>Possible Q waves in III and AVF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Critical Physiologic changes of Pregnancy affect assessment of the injured gravida</th>
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</thead>
<tbody>
<tr>
<td><strong>GASTROINTESTINAL</strong></td>
</tr>
<tr>
<td>Risk of aspiration increased with anesthesia or unconsciousness</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Critical Physiologic changes of Pregnancy affect assessment of the injured gravida</th>
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</thead>
<tbody>
<tr>
<td><strong>PULMONARY</strong></td>
</tr>
<tr>
<td>Persistent respiratory alkalosis</td>
</tr>
<tr>
<td>Mild tachypnea</td>
</tr>
<tr>
<td>Shorter anesthesia induction time plus loss of consciousness at sedative dosages</td>
</tr>
<tr>
<td>Diaphragm rises 4 cm and chest diameter increases 2 cm; there is an increase in the substernal angle of 50%</td>
</tr>
<tr>
<td>Thoracostomies must be performed 1-2 interspaces higher than usual</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>CNS</strong></td>
</tr>
<tr>
<td>Increased emotional lability, decreased seizure threshold</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Critical Physiologic changes of Pregnancy affect assessment of the injured gravida</th>
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</thead>
<tbody>
<tr>
<td><strong>HEMATOLOGIC</strong></td>
</tr>
<tr>
<td>False dilutional anemia</td>
</tr>
<tr>
<td>False diagnosis of infection based on increased WBC and decreased platelet count</td>
</tr>
<tr>
<td>Change in coagulation factors increases the risk for thromboembolic problems, especially with immobilization</td>
</tr>
</tbody>
</table>
**Critical Physiologic changes of Pregnancy**

**affect assessment of the injured gravida**

**GENITOURINARY**

- Ureteral and calyceal dilation on radiographic studies with the Right greater than the Left
- Risk of infection increased with stasis and catheterization
- BUN and Creatinine normally are decreased in pregnancy with increased creatinine clearance

---

**SUMMARY OF PHYSIOLOGIC CHANGES IN PREGNANCY**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Effect (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilutional anemia</td>
<td>BP decrease 15-20%</td>
</tr>
<tr>
<td>As a result: clinically, blood loss of up to 2,000 ml (30%) may not be readily apparent in the gravid trauma patient</td>
<td></td>
</tr>
<tr>
<td>Peripheral vascular resistance and Pulmonary vascular resistance both decrease by 20-30% AV shunt produced by the low-resistance placental circuit (accessory spleen effect)</td>
<td></td>
</tr>
</tbody>
</table>

---

**Underlying acid-base situation is compensated respiratory alkalosis; therefore, titratable buffering capacity is diminished**

Less tolerant of apnea with hypoxemia occurring more quickly compared with non-pregnant controls

Renal blood flow increased Creatinine clearance increased

Mild physiologic hydronephrosis

---

**SUMMARY OF PHYSIOLOGIC CHANGES IN PREGNANCY**

Fibrinogen markedly increased therefore, a low normal non-pregnant value for fibrinogen is actually depressed for pregnancy

Moderate decrease in platelet count

Moderate leukocytosis

After the 12th week, the uterus becomes abdominal

Prior to 12 weeks, the uterine location in the pelvis makes it relatively resistant to injury