OBSTETRIC HEMORRHAGE

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OB Hemorrhage

- In 2013 the reported medical maternal mortality rate in the U.S. was 17.3 per 100,000 live births.
- Pregnancy related deaths in the US (2011-2013):
  - Cardiovascular diseases - 15.5%
  - Other medical non-cardiovascular disease – 14.5%
  - Infection/Sepsis - 12.7%
  - **Hemorrhage – 11.4%**
Definition of Hemorrhage

- 10% decline in hematocrit between admission and discharge.
- EBL > 500 mL following vaginal delivery.
- EBL > 1,000 mL following Cesarean delivery.
- Primary PPH – within first 24 hours of delivery.
- Secondary PPH – between 24 hours and 6-12 weeks postpartum.
Baker in 1977 classified hemorrhage into four groups based on percent volume lost:

<table>
<thead>
<tr>
<th>Class</th>
<th>Blood loss (mL)</th>
<th>% loss</th>
<th>Clinical features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;900</td>
<td>&lt;15</td>
<td>Few signs</td>
</tr>
<tr>
<td>2</td>
<td>1,200-1,500</td>
<td>20-25</td>
<td>Orthostasis</td>
</tr>
<tr>
<td>3</td>
<td>1,800-2,100</td>
<td>30-35</td>
<td>Hypotension</td>
</tr>
<tr>
<td>4</td>
<td>&gt;2,400</td>
<td>&gt;40</td>
<td>Shock</td>
</tr>
</tbody>
</table>

## Hemorrhage Classification

<table>
<thead>
<tr>
<th>Sev</th>
<th>ACS Class</th>
<th>Signs/ symp</th>
<th>EBL</th>
<th>% Bld vol lost</th>
<th>Tx</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>I</td>
<td>none</td>
<td>&lt;750ml</td>
<td>10-15</td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>II</td>
<td>Tachy, hypoten</td>
<td>750-1500</td>
<td>15-25</td>
<td>vol</td>
</tr>
<tr>
<td>Mod</td>
<td>III</td>
<td>Pulse 100-120</td>
<td>1500-2000</td>
<td>25-40</td>
<td>Transfus prob</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SBP 80-100</td>
<td></td>
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<tr>
<td></td>
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<td>oliguria</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Pulse &gt;120-140</td>
<td>&gt;2000</td>
<td>&gt;40</td>
<td>Transfus,</td>
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<tr>
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<td></td>
<td>SBP &lt;80</td>
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<td>Massive trans</td>
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<td>anuria</td>
<td></td>
<td></td>
<td>protocol</td>
</tr>
</tbody>
</table>

*mod from Fuller AJ. Obstet Gynecol No Am 2007;34:443*
Hemorrhage in Pregnancy

- Pregnant women do not show signs of volume loss as early as non-pregnant women:
  - 30-40% expansion of blood volume.
    - Occurs by 30 weeks gestation.
  - Increased ability to compensate for early losses by increases in systemic vascular resistance.
  - Ability to shift a limited amount of their increased interstitial fluid to the intravascular space.
First Trimester bleeding

- Common - 20-40% of patients.
- Etiologies:
  - Ectopic pregnancy.
  - Spontaneous abortion, threatened abortion.
  - Implantation bleeding.
  - Pathologies associated with cervix, uterus, vagina.
- Associated with pregnancy complications:
  - Fetal loss.
  - PPROM/PTD.
  - Fetal growth restriction.
Antepartum Hemorrhage

- Usually refers to uterine bleeding after 20 weeks gestation that is unrelated to labor and delivery.

- Complicates approximately 4-5% of pregnancies.
Antepartum Hemorrhage

- Placental Abruption (30%)
- Placenta Previa (20%)
- Uterine rupture
- Vasa Previa
- Placenta Accreta
- AFE-DIC
- Coagulopathy
- HELLP/Preeclampsia
Triage Bleeding Patient - Sample Algorithm

- Evaluate the perineum/drape, if no blood on the bed, then any clot/blood in the vagina is usually less than 300 mL before it is expelled in the supine position.

- Have the patient cough, if no blood, you can hold off on the sterile spec exam for a few minutes, while you assess the fetal and maternal vitals.
Triage Bleeding Patient - Sample Algorithm

- On the other hand, if profuse vaginal bleeding is noted, evaluate immediately with a sterile speculum exam to rule out vaginal, cervical lacerations, and other etiologies.

- The surrounding factors, medical history and current presentation would affect the order of evaluation.
Triage Bleeding Patient - Sample Algorithm

- As the nurse is taking vitals, starting IV access, if ultrasound available, perform transabdominal ultrasound if patient is clinically stable.
- Knowing the fetal BPD, AC, and FL and assessing gestational age (when not known) may help you determine whether an emergent C-section for non-reassuring fetal heart tones.
Any Bleeding Patient: The First Question is Why?

- Asking why will direct your therapy and decision making:
  - Previa
  - Abruption
  - Accreta
  - Vasa Previa–fetal blood, not maternal
  - DIC–the worst!!!
  - Underlying coagulopathy
  - HELLP/Preeclampsia
Abruption

- Premature separation of a normally implanted placenta prior to delivery.

- **Risk factors:**
  - Prior abruption
  - HTN
  - Cocaine use
  - Smoking
  - Trauma
  - PROM

- **Clinical features:**
  - Vaginal bleeding (80%)
  - Uterine tenderness (70%)
  - Contractions (35%)
  - Non-reassuring FHT
  - Couvelaire uterus
  - Sonographic evidence (2%)
Abruption

- Complicates ~ 2-4% of all pregnancies.
- Perinatal death rate: 10%.
- 40-60% occur prior to 37 weeks.
- Maternal consequences are related to severity of abruption.
- Fetal complications are related to severity of abruption and gestational age.
Abruption

Maternal complications

- DIC
- Shock
- Renal Failure
- ARDS
- Multi-organ failure
- Hysterectomy
- Maternal Death

Fetal complications

- Hypoxemia
- Asphyxia
- Low Birth Weight
- IUGR
- Prematurity
Grades of Abruption

Gabbe’s Classification:

- 1 - slight vaginal bleeding and uterine irritability, normal BP, normal fibrinogen/platelets, no fetal heart rate changes.
- 2 - mild to moderate visible bleeding, contractions usually present, normal BP but increased pulse rate, orthostatic changes, decreased fibrinogen (150-300mg/dL), fetal heart rate changes.
- 3 - moderate to severe bleeding but may be concealed, uterus tetanic and painful (if conscious), overt hypotension, fetal death generally occurs, fibrinogen less than 150mg/dL, other signs of coagulopathy developing.
PERIPLACENTAL AND PLACENTAL HEMATOMAS
1. MARGINAL
2. RETROPLACENTAL
3. SUBCHORIONIC
4. SUBAMNIOTIC
Subchorionic Hematoma
Abruption- Subamniotic Bleed
Abruption Management

- Rapid clinical assessment/close monitoring.
- Assess severity, gestational age, maternal/fetal status.
- Continuous fetal monitoring.
- Establish IV access.
- CBC, T&S, coagulation studies.
- Estimate blood loss.
- Transfuse:
  - Hematocrit < 30%
  - Platelet level < 20,000
  - Fibrinogen < 150 mg/dL
  - Planned cesarean
Placenta Previa

- Presence of placental tissue that extends over or lies proximate to the internal cervical os.
- Prevalence: 3.5-4.6/1,000 births.
- Clinical features:
  - Painless vaginal bleeding.
  - Ultrasound diagnosis.
- Management for asymptomatic placenta Previa:
  - Delivery via Cesarean section at 36-37 weeks.
Placenta Previa – Risk Factors

- Prior placenta Previa
- Previous Cesarean
- Multiple gestation
- Multiparity
- AMA
- Infertility treatment
- Previous termination/uterine procedures
- Smoking
- Cocaine use
Previa (complete)

FIGURE 15.1-1. Complete placenta previa. Sagittal mid-line view of the lower uterus performed transabdominally demonstrates the placenta (PL) completely covering the cervix (arrowheads).
Previa (marginal)

FIGURE 15.1-2. Marginal placenta previa. Sagittal views of the cervix and lower uterine segment done transabdominally (A) and transvaginally (B) demonstrate the placenta (PL) with its edge (arrow) extending over part of the cervix (CX), ending close to the internal cervical os (arrowhead).
Placenta Accreta

- The direct apposition of placental villi to the myometrium.

- Classified according to the degree in which the myometrium is penetrated by placental villi.
  - **Accreta**: Villi embed directly onto myometrium in the absence of decidua.
  - **Increta**: Villi are found deeper into the myometrium.
  - **Percreta**: Villi penetrate through the myometrium to or beyond the uterine serosa.
Abnormal placentation
Accreta – Risk Factors

- Two most important risk factors:
  - Previous Cesarean section:
    - Previous cesarean section increases risk of placenta accretta by up to 10%.
  - Placenta Previa:
    - Risk with no prior Cesarean section is 3%.

- Previous Cesarean + Previa compounds risk even further:
  - One prior C-section + Previa (11%).
  - Two prior C-sections + Previa (40%).
  - Three prior C-sections + Previa (61%).
US Diagnosis

- Ultrasound has been the primary diagnostic tool for identifying placenta accreta:
  - Can detect 50-80% of cases.
  - Ideal opportunity to screen patients is 18-20 weeks.
  - Targeted evaluation of anterior myometrium and bladder wall.
  - Highest frequency transducer that can produce adequate image (5-MHz).
  - Trans-abdominal exam should be performed with full bladder.
  - Trans-vaginal exam should be performed for low-lying or placenta Previa.
US Diagnosis

- PLACENTA PREVIA
- PLACENTAL LACUNAE
- ABNORMAL COLOR DOPPLER IMAGING PATTERNS
- LOSS OF RETROPLACENTAL CLEAR SPACE
- REDUCED MYOMETRIAL THICKNESS
- IRREGULAR BLADDER WALL
Percreta

![Image of ultrasound scans]

**FIGURE 15.3-1. Placenta accreta or increta.** A: Sagittal view of the lower uterus demonstrates that the myometrium is markedly thinned (arrow) beneath the placenta (PL). B: A normal sagittal scan of the lower uterus for comparison, with the myometrium (arrowsheads) appearing as a hyperechoic band under the placenta (PL).

The possibility of accreta or increta should be raised in one of two settings: (1) an anovulatory pregnancy is seen on ultrasound in a woman who has had one or more cesarean sections; or (2) ultrasound demonstrates the absence or thinning of the myometrium overlying the placenta. The diagnosis can be made with confidence when both (1) and (2) apply. Percreta is diagnosed sonographically when the placenta extends through the serosal surface of the uterus. This is seen most clearly when the placenta protrudes into the bladder (Figure 15.3-3).

Placenta accreta, increta, or percreta is most often diagnosed sonographically when it is located in the anterior lower uterine segment. The diagnosis, however, can also be suggested in other locations within the uterus when there is thinning or absence of the myometrium overlying the placenta (Figure 15.3-4).
Percreta
Placenta Accreta

- Maternal mortality rate: 5.6%.
- Average EBL = 3,000 - 5,000 mL.
  - 90% will require transfusion.
  - 40% require >10 units of PRBC.
- Associated morbidity:
  - Damage to surrounding organs
  - Severe blood loss, coagulopathy
  - Transfusion reactions
  - Amniotic fluid embolism
  - Thromboembolism
  - Infection
  - End organ failure
Preop Management

- Appropriate consultations/multidisciplinary approach
  - Blood bank
  - Anesthesiology
  - Surgery (general surgery, urology)
  - NICU/Pediatrics
  - Interventional radiology
Placenta Accreta - Summary

- Incidence of placenta accreta is rising.
- No randomized trials are available to formulate evidence based practice guidelines.
- Sonography remains the best modality for diagnosis in the antenatal period.
- A multidisciplinary approach to treatment will minimize complications.
- Management options vary from removal of placenta, hysterectomy, and conservative management.
- Pharmacologic, transfusion and interventional radiology embolic procedures can play a key role in minimizing morbidity and mortality.
Vasa Previa
Uterine Rupture

- Incidence from 1:100 to 1:2000
  - Rupture versus Dehiscence versus "Window."

- TOLAC confers highest risk.
Uterine Rupture

Risk factors for rupture:
- Hysterotomy and type (i.e. low transverse, vertical).
- 1 vs 2 layer closure
- Number of Cesarean deliveries
- Oxytocin for induction or augmentation
- Cervical ripening with prostaglandins
- Maternal age/Multiparity
- Short interpregnancy interval
- Fetal EFW >4,000g
- Post-term pregnancy
- Thickness of lower segment
- Uterine anomalies
Uterine Rupture

- Clinical features of rupture:
  - Non-reassuring fetal heart tracing
  - Pain
  - Loss of station
  - Vaginal bleeding
  - Hypovolemia
  - Hypotension
Post Partum Hemorrhage

- **Initial criteria was:**
  - EBL >500 mL for vaginal delivery
  - EBL >1000 mL for cesarean delivery

- **Recent ACOG criteria include:**
  - 10% drop in hematocrit
  - Need for blood transfusion

- **Early (<24h) vs late (24h – 6 to 12 weeks)**
Post Partum Hemorrhage

- Common cause of maternal mortality in developed countries.
  - ~11% of all maternal deaths in the U.S.
- Most common cause of maternal mortality worldwide and in developing countries:
  - Mortality ↑↑ when blood unavailable.
- Associated with 4-fold ↑ in perinatal mortality and morbidity due to iatrogenic prematurity.
Post Partum Hemorrhage

- Occurs in 4-6% of pregnancies.

- Primary/Early
  - Less than 24 hours post-partum.

- Secondary/Late
  - Greater than 24 hours to 6-12 weeks post-partum.

- Blood loss is underestimated clinically by 30-50%.
Intrapartum/Post-Partum Hemorrhage

- **Uterine atony**
- Retained products
- Trauma (episiotomy, vaginal, sulcus/perineal tears, Cesarean)
- Infection
- Uterine rupture
- Uterine inversion
Uterine Atony

- IV Access
- Uterotonic agents
  - Pitocin
  - Methergine
  - Prostaglandin F2-alpha
  - Misoprostol

- Know contraindications to meds**
Management: Atony

- Anticipate risk factors for atony:
  - Polyhydramnios
  - Multiple pregnancy
  - General endotracheal anesthesia
  - Pitocin augmentation
  - Macrosomia
  - Chorioamnionitis
Management: Atony

- Inspect placenta
- Manual exploration of the uterus
- Vigorous uterine massage
- Uterotonic agents
Oxytocin

- **Dose:** 10-40 U in 1,000-mL NS or LR
- **Routes:** IV, IM
- **Frequency:** continuous infusion
- **Side effects:**
  - Nausea and vomiting
  - Water intoxication
Methergine

- Methylergonovine Dose: 0.2 mg
- Routes: IM (never IV)
- Frequency: q 2-4 hours
- Side effects:
  - Nausea and vomiting
  - Vasospasm (hypertension, myocardial ischemia)
- Contraindications:
  - Hypertension
  - Coronary insufficiency
Hemabate

- **Carboprost** (15-methyl-PGF$_{2\alpha}$)
- **Dose**: 0.25 mg
- **Routes**: IM
- **Frequency**: q 15-90 min (max 8 doses)
- **Side effects**: Nausea/vomiting, diarrhea, flushing, fever, Vasospasm, bronchospasm
- **Contraindications**: Asthmatic (pulmonary) cardiac, renal, or hepatic disease
Cytotec

- Misoprostol (PGE1)
- Dose: 800-1,000 μg rectally
- Not FDA approved for hemorrhage
- Failed oxytocin and methylergogonovine
Additional things to consider

- Surgical management
- Ultrasound-guided D&C
- Uterine packing
- Selective arterial embolization
- Exploratory laparotomy and conservative surgery
  - Uterine/hypogastric artery ligation
  - B-Lynch suture
- Exploratory laparotomy and aggressive surgery
- Puerperal hysterectomy
B-Lynch – easy to do, and good to document that you tried it!!!!
B-lynch

- Never, Never, Never reach in and curette a uterus after a B- Lynch suture has been placed.
- Use the ultrasound machine to tell you if the uterus is full of blood, ultrasound can tell you if the rectus sheath is bleeding, the abdomen is full of blood etc.
Uterine Inversion

- Incidence: 1:2500 deliveries.

- Usually iatrogenic
  - Excessive traction on cord when delivering placenta.

- Can occur with fundal placental location, abnormal placentation, uterine atony, short umbilical cord.
Uterine Inversion

Management:

- Discontinue uterotonics.
- Leave placenta in situ until inversion is corrected.
- Uterine relaxants:
  - Nitroglycerin (50mcg IV, up to 4 doses)
  - Terbutaline (0.25mg IV or SQ)
  - Magnesium sulfate (4-6g IV over 15-20min)
  - Inhaled anesthetics (halothane, enflurane)
- Replace uterus, then deliver placenta.
- Administer uterotonotics to control hemorrhage.
- Aggressive IV hydration, blood products if needed.
- Consider antibiotics.
Uterine Inversion

- Johnson Maneuver (manual replacement).
- Vaginal Procedures:
  - Spinelli Procedure (anterior)
    - Risk of cystotomy
  - Cascarides Procedure (posterior)
- Laparotomy
  - Huntington Procedure
    - Clamping and traction
  - Haultain Procedure
    - Incision in posterior wall, clamp, traction
A “Practical” Clotting Cascade

Calcium, Thromboplastin, 7
(CAT - 7)

(Thromboplastin is “GUNK” from IUFD, AFE, Abruption, tissue injury, endotoxins, etc.)

Common Pathway

Calcium, 5, 10
“Calcium Five and Dime”

Prothrombin

Thrombin

Fibrinogen → FIBRIN → FSP

Plasminogen → Plasmin (Clipper)
“What Happens Normally”

Endothelial Disruption ("injury")

Platelet Activation ("plugs hole")

Clotting Cascade

Fibrin Meshwork ("cover hole")

Plasmin

Fibrin split products
DIC

Disseminated (systemic)

Intravascular

Coagulopathy

“Systemic rather than local generation of Thrombin and Plasmin”
DIC

- An acquired syndrome.
- Intravascular activation of coagulation.
- Physiologic result of pathologic overstimulation of the coagulation system.
“What Problems Arise from DIC?”

- Damage endothelial lining of pulmonary capillary bed (acute Lung Injury)
- Damage Surface of RBC’s (Hemolysis)

- Leads to PLTS Dysfunction, & Prevents Fibrin Polymers
- Bleeding

- Plugs the Microcirculation

- Tissue Necrosis (Organ Injury) Kidney, Liver, etc.
Causes of DIC in Obstetrics

1) Amniotic fluid embolism
2) Severe preeclampsia & eclampsia
3) Placental abruption
4) Intrauterine fetal death
5) Gram positive and gram negative septicemia
6) Acute fatty liver of pregnancy
7) Massive blood loss
8) Massive transfusions secondary to blood loss
Causes of DIC

1) Amniotic fluid embolism:

2) Severe preeclampsia and eclampsia:
   - Endothelial cell damage with activation of intrinsic & extrinsic pathways.
     - Increased: TAT, soluble fibrin, fibrin degradation products, α2 anti-plasmin.
     - Decreased: platelets due to consumptive thrombocytopenia
Causes of DIC

3) Abruption:
- *Release of procoagulants & thromboplastin-like material in circulation.*

4) IUFD:
- *Necrotic tissue and thromboplastin are released into maternal circulation. Serum fibrinogen levels decrease, fibrin degradation products circulate.*
Causes of DIC

5) Gram+ and gram- septicemia:
- Release of TNFα causes endothelial injury, releasing Tissue Factor, producing thrombin. Protein C system is activated. TNFα increases PAI-1, decreasing fibrinolysis.

6) Acute fatty liver of pregnancy:
- Decreased antithrombin, thrombocytopenia & consumptive coagulopathy lead to decrease in circulating coagulation factors.
DIC

- **Presentation:**
  - Hemorrhagic (acute)
  - Thrombotic (chronic activation of clotting cascade)

- **Hemorrhagic DIC:**
  - Involves skin, mucous membranes, results in ecchymosis, petechiae, bleeding from venipuncture sites & gums, hematuria, GI bleeding.

- **Thrombotic DIC:**
  - Involves neurologic, renal & pulmonary systems. Usually seen with chronic, compensated DIC, as with IUFD or malignancy.
DIC

- **Deposition of fibrin microthrombi**, causing organ dysfunction
- **Brain**: microvascular cerebral thrombosis causes organ dysfunction, altered consciousness.
- **Kidneys**: Acute tubular necrosis and renal failure,
- **Peripheral veins & veins**: phlebitis and gangrene.
“Laboratory Diagnosis of DIC”

“Basics” of Abnormal Labs:
- Low Fibrinogen ($< 150$ mg/dL)
- Prolonged PT (Then PTT)
- Thrombin time (increased)
- Low Platelets ($< 150$ K)
- Elevated FSP (or D-Dimer)
- Hemolysis on peripheral smear
- Antithrombin activity (decreased)
DIC Management

- Cornerstone of DIC Management
  - 1) Remove Etiologic Agent
  - 2) Restore Fluid Balance
  - 3) Adequately Perfuse Tissue
  - 4) Avoid Tissue Hypoxia
## Component Therapy

**Blood Component Therapy (Santoso JT. Obstet Gynecol Surv 2007)**

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<thead>
<tr>
<th>Component</th>
<th>Indication</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRBC</td>
<td>Improve O2 carrying capacity</td>
<td>Raise Hb 1g/dL</td>
</tr>
<tr>
<td>FFP</td>
<td>Replace clotting factors PT &amp;/or PTT &gt;1.5x upper normal</td>
<td>2 U FFP, or 15-20ml/kg ideal BW</td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td>Fibrinogen &lt;75-100mg/dL</td>
<td>1U/10kg BW with fibrinogen &lt;75/dL</td>
</tr>
<tr>
<td>Platelets</td>
<td>Platelets &lt;50,000/mm³</td>
<td>1 unit: increase platelets 5000-10000/mm³</td>
</tr>
<tr>
<td>Albumin</td>
<td>Volume replacement</td>
<td>Use 5% albumin</td>
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</table>
**Indications for PRBC**
- Severe anemia (to ↑ oxygen carrying capacity).
- Orthostatic hypotension secondary to blood loss.

**Comes in 200-250 mL with HCT 70%**.
- Can be frozen, shelf life is 21-35 days.
- 1 unit PRBC ↑ Hb 1 g/dL, HCT 2-3%.
FFP

- **Indications:**
  - Known clotting factor deficiency
  - Especially useful for multiple factor deficiency (e.g., DIC, liver disease, massive transfusion).

- Prepared in 200-250 mL volumes.
- Not to be used prophylactically.
Cryoprecipitate

- **Indication**
  - Known clotting factor deficiency.
  - Esp. hypofibrinogenemia.

- 35-40 mL per unit.
- Dose: 1 unit per 5 kg body weight.
- Will increase fibrinogen levels by 100 mg/dL.
- Not to be used prophylactically.
Platelets

- **Indications**
  - Prophylactic: consider if <20,000/mm³
  - Therapeutic: <50,000/mm³ with bleeding, preop.

- **Dose**: 1 unit per 10 kg body weight

- 1 unit “pooled” (40-mL) $\uparrow$ platelets by 5,000-10,000
  - “6 Pack” $\uparrow$ platelets by 30-60,000.

- **Single donor** one unit $\uparrow$ platelet count by 30-60,000.

- **Shelf life** is 3-5 days.

- **RhoGAM** if platelets are not Rh negative.
Recombinant Activated Factor VII: A New Weapon in the Fight Against Hemorrhage

- Vit K dependent protein $\rightarrow$ approved (Hemophilia)
  Promotes clotting through extrinsic pathway (tissue factor) (Complexes with tissue factor $\rightarrow$ activates Factor IX and X, and generates thrombin).

- Dose 60-80 micrograms/Kg IV bolus.

- Controls bleeding rapidly – 10 minutes!

- Initially, very few adverse effects reported – TED is a clear risk (7% in ICH tx study, Mayer 2005).

- Short $\frac{1}{2}$ life (2 hours).

- High cost.

Bouwmeester FW. Obstet Gynecol 2003

Danilos J. Obstet Gynecol 2003
Additional Agents

- **Aprotonin**: Directly inhibits Plasmin.

- **Transexamic acid**: Like aminocaproic acid but 10x stronger (prevents plasmin binding to fibrin).

- Both may reduce blood transfusion by 30%.

- Primarily used in cardiac surgery.

- Cochrane review—Data from Henry, et al 2001
Amniotic Fluid Embolism

- **DIC**
  - 10-15% present with DIC alone.
- 10-20% present with **Seizure Activity**.
- **Fetal Bradycardia** is a common presenting finding.
- Maternal **mortality** is approximately 80%:
  - 50% within first 60 minutes of AFE
Published Human Data

Reveals that Left Heart Failure is the major physiologic aberration seen in humans with amniotic fluid embolism.

Clark – Am J Ob Gyn 1985, 1988
Dolynuik – Obstet Gynecol 1983
Duff – Am J Ob Gyn 1993
Girard – Anesth 1986
Data-based hypothesis- biphasic response

Release of AF
↓↓
“Intense”
↓
Pulmonary Vasospasm (transient)

Phase 1  ›  Pulmonary HTN (cor Pulmonale)
↓
Hypoxia

Phase II  ›  LV Dysfunction: Pulmonary capillary injury
↓
LV Failure and ARDS
Classic management AFE- call for help!!!!!

I – CPR; ACLS if indicated

II – Oxygenate/Ventilate – anticipate ARDS
   A. Non Rebreathing Mask
   B. CPAP
   C. Intubation
Classic Management

III. – Treat Hypotension
   A. Volume
   B. Pressors
   C. Expect LV Failure

IV. – Coagulopathy – anticipate and treat
   A. FFP, cryoprecipitate
   B. Packed RBC

*New treatment steroids and H1 and H2 blockers
Management with Maternal Cardiac Arrest

Recommendations: Management of the Pregnant Patient with Cardiac Arrest:

- Institute interim resuscitative measures during **first 4 min.** – assess viability and EGA with ultrasound.
- Be prepared for perimortem delivery.
- Be prepared for neonatal resuscitation.
Maternal Benefit- Prompt Cesarean Delivery

- Improves survival by improving response to resuscitative measures.
- Should be initiated within 4 minutes of cardiac arrest to prevent anoxic brain injury (occurs within 4-6 minutes).

“Four – Five Rule”
Perimortem cesarean delivery from time of death of mother to delivery (1900-1985 Katz et al.)

<table>
<thead>
<tr>
<th>Cases</th>
<th>N</th>
<th>%</th>
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<td>0-5 minutes:</td>
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<td>Normal</td>
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<td>(69%)</td>
</tr>
<tr>
<td>6-10 minutes:</td>
<td></td>
<td></td>
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<tr>
<td>Normal</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Mild neuro seq</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>8</td>
<td>(13%)</td>
</tr>
<tr>
<td>11-15 minutes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Severe neuro seq</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>7</td>
<td>(11%)</td>
</tr>
<tr>
<td>16-20 minutes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe neuro seq</td>
<td>1</td>
<td>(2%)</td>
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<tr>
<td>&gt; 21 minutes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Severe neuro seq</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>3</td>
<td>(5%)</td>
</tr>
</tbody>
</table>
How does the fetus handle this?

- Fetus “holds it‘s own:”

  High O2 affinity of fetal RBC combined with high rates of perfusion compensate for an ineffective placental exchange system.
  Redistribution of blood flow to vital organs (brain, heart, placenta) - irreversible anoxic brain injury (> 10 minutes).
  Decreased O2 consumption – up to 50% in stress states.
  Placental “Safety Factor” – tolerates 50% reduced umbilical blood flow before fetal O2 uptake declines and fetal acidosis becomes evident.
Perimortem C/S

- Continue CPR
- Midline incision
  - Follow linea nigra
  - Umbilicus to pubis
- Speed important
  - Desirable to avoid bladder/bowel
- Classical uterine incision
  - Give yourself plenty of room for safe and rapid delivery.
Planning for any Surgery in Obstetric Hemorrhage

- Adequate blood products
- Appropriate consultations
  - Blood bank
  - Anesthesiology
  - Surgery (general surgery, urology, oncology)
  - NICU / pediatrics
  - Interventional radiology
- Consent for surgery (loss of fertility)
Planning for any Surgery in Obstetric Hemorrhage

- Maintain HCT at 25-30%.
- Maintain platelet count >80,000/mm3.
- Maintain fibrinogen >150 mg/dL.
- Consider DVT prophylaxis, if indicated (such as Lovenox 40-mg subcutaneously daily).
- Broad-spectrum antibiotic coverage.
Hemorrhage Cell Saver

- Cell saver- perfectly acceptable to use.
- After amniotic fluid and vernix is removed from field use cell saver suction.
  - Well documented that it is safe.
  - Continuous circuit, therefore some Jehovah’s witnesses may find acceptable.
  - If doing Cesarean-hysterectomy, it is “OK” if bladder entered, can still utilize cell saver.
  - Switch to alternate suction if entering vagina at time of Cesarean-hysterectomy, due to bacterial contaminants.