Obstetric Hemorrhage: The First Thing You Should Think About at Every Delivery
Disclosures

• I have no financial disclosures.

• I picked the Shockers to go out in the Sweet Sixteen.
Objectives

• Identify common causes of postpartum hemorrhage

• Describe medical and surgical management of obstetric hemorrhage

• Review management of severe obstetric hemorrhage and resuscitative management.
Background
Incidence of Hemorrhage

- Hemorrhage - 4-6%*
  - SVD >500ml
  - Cesarean >1000ml

- Life threatening obstetric hemorrhage 1:1000**

- Second most common cause of maternal mortality in the US
  - 0.9/100,000***

*ACOG Practice Bulletin 76
**Drife J. BJOG (1997) 104:275–7
***CDC; NVSR, V 58:19, May 2010, tables 33 and 34
• State wide review in North Carolina
• 90% of Maternal Deaths Related to Hemorrhage considered PREVENTABLE
• Areas needed to improve?

Berg CJ, Obstet Gynecol 2005
Causes of Maternal Death

- Inadequate resources and personnel
- Failure to prepare- IV access
- Delay in recognition of hemorrhage
- Delay in treatment
- Treatment failure
Physiologic Changes

• 50% increase in plasma volume
  – Can be up to 100% in multiple gestations

• 30% increase in RBC mass
  – Anemia of pregnancy. Mean Hgb 11g/dL

• Average blood volume 5-6000 mL
Physiologic Changes

- Marked increase in Factors VII, VIII, X, XII and XIII
- Acquired Protein C resistance
- Increased thrombin generation
- Increased fibrinogen
- Decrease in Factor XI
- Decreased Protein S activity
### Physiologic Changes

#### Table 1

Coagulation parameters (mean±SD) in normal pregnancy and puerperium (n=117)

<table>
<thead>
<tr>
<th>Groups</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV Mean ± SD</th>
<th>V Mean ± SD</th>
<th>VI Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks</td>
<td>9.15±3.27</td>
<td>21.16±2.54</td>
<td>31.07±2.51</td>
<td>36.59±1.98</td>
<td>0.85±0.07</td>
<td>0.97±0.07</td>
</tr>
<tr>
<td>INR</td>
<td>0.97±0.08</td>
<td>0.91±0.06</td>
<td>0.88±0.07</td>
<td>0.87±0.07</td>
<td>27.52±2.78</td>
<td>26.93±3.34</td>
</tr>
<tr>
<td>PTT sec</td>
<td>27.04±2.70</td>
<td>26.87±2.70</td>
<td>27.10±2.89</td>
<td>25.32±2.78</td>
<td>26.93±3.34</td>
<td>26.3±2.9</td>
</tr>
<tr>
<td>FBG mg%</td>
<td>412.51±69.46</td>
<td>463.93±83.90</td>
<td>538.78±107.28</td>
<td>556.93±113.32</td>
<td>588.38±134.16</td>
<td>368±83.3</td>
</tr>
<tr>
<td>AT III %</td>
<td>101.50±12.66</td>
<td>101.36±10.33</td>
<td>104.17±12.50</td>
<td>102.80±13.50</td>
<td>103.66±14.36</td>
<td>107±9.8</td>
</tr>
<tr>
<td>PC %</td>
<td>99.40±21.28</td>
<td>107.53±24.91</td>
<td>99.25±25.99</td>
<td>94.87±25.46</td>
<td>119.73±30.81</td>
<td>110±24.1</td>
</tr>
<tr>
<td>PS %</td>
<td>64.14±15.8</td>
<td>62.05±14.17</td>
<td>54.02±13.26</td>
<td>51.73±17.88</td>
<td>54.41±18.47</td>
<td>107±24.6</td>
</tr>
<tr>
<td>F1+2 nmol/L</td>
<td>1.27±0.48</td>
<td>1.69±0.44</td>
<td>1.82±0.97</td>
<td>2.62±0.96</td>
<td>1.65±0.88</td>
<td>1.2±0.29</td>
</tr>
<tr>
<td>t-PA mg/ml</td>
<td>3.33±1.53</td>
<td>4.11±1.75</td>
<td>5.29±2.10</td>
<td>6.27±2.93</td>
<td>4.17±3.35</td>
<td>7.1±5.5</td>
</tr>
<tr>
<td>PAI AU/ml</td>
<td>10.25±4.72</td>
<td>11.26±5.07</td>
<td>20.45±7.25</td>
<td>22.41±7.52</td>
<td>10.11±4.25</td>
<td>15.6±7.5</td>
</tr>
</tbody>
</table>

#### Statistical significance t-test

<table>
<thead>
<tr>
<th></th>
<th>I vs. VI</th>
<th>II vs. VI</th>
<th>III vs. VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INR</td>
<td>NS</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>PTT</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>FBG</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>AT III</td>
<td>p&lt;0.01</td>
<td>p&lt;0.01</td>
<td>NS</td>
</tr>
<tr>
<td>PC</td>
<td>p&lt;0.01</td>
<td>NS</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>PS</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>F1+2</td>
<td>NS</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>t-PA</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>PAI</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

**NS=not significant.**
Physiologic Changes

• Result of all these changes are prothrombotic state
  – Decreased INR
  – Decreased fibrinolytic potential
    • Due to increase PAI 1 and 2
• 10-15% of CO to gravid Uterus
  – 600-700ml/min
    • Up to 1L/min in multiple gestation

• Primary mechanism for hemostasis post delivery is mechanical
  – Blood vessels travel through interwoven muscle fibers, involution results in cessation of blood flow.
Consequences of PPH

- Obstetric and non-obstetric rabbits
- Hemorrhagic shock and resuscitation
- Obstetric rabbits (within 2 hours postpartum)
  - Shorter survival
  - More severe systemic inflammatory response
    - Increased TNF alpha, decreased IL-10
  - More severe lung injury
    - Alveolar and interstitial fluid accumulation
    - Increased markers for lung injury (myeloperoxidase, tumor necrosis factor, etc.)

Sheng C, Crit Care Med 2012; (40)
Consequences of OB Hemorrhage

- ICU patients admitted with PPH and hypovolemic shock
- Incidence of myocardial ischemia = 50%
  - Troponin ↑ and ↓ tissue oxygen delivery
- Risk factors include:
  - Hgb <6g/dL
  - Systolic BP <88 mmHg
  - Diastolic BP <50 mmHg
  - HR >115 bpm
  - Use of catecholamines

Karpati PC. Anesthesiology 2004; (100):30-36
The patient is a 29 y/o female status post NSVD low-transverse 6 week postpartum visit.

Weight today is questionable as patient does not agree with the scale.

Documentation of phone message left for patient after x-ray for arm pain

“Hooray! No fracture.”
Etiology
Etiology

- Atony
- Abruptio placentae
- Laceration (cervical/vaginal/perineal)
- Placenta accreta
- Retained placenta
- Uterine rupture
- Hematoma
Etiology

Placental

- Accreta
- Accessory Lobe
- Retained placenta

Previa
Uterine Surgery
Prior CD
Etiology

Other

- AFE
- Laceration
- Hematoma-
  Operative delivery, pudendal or uterine artery injury
- Uterine Rupture
- Uterine Inversion
Etiology of Maternal Death

Hemorrhage is 30% of all maternal mortality

Abruption 19%
Uterine Rupture 19%
Atony 15%
Coagulopathy 14%
Previa 7%
Accreta 6%

Chichaki et al, 1999
A 24 y/o patient only bled onto these 4 laparotomy sponges at the time of cesarean. What is her estimated blood loss?
Emphasis on *Estimated*

- Ability to estimate blood loss only exceeded by our ability to estimate fetal weight.
- Underestimate by 30-50%
  - Error persists regardless of volume.*


- Activate hemorrhage protocol
  - *Notify* appropriate services
    - Anesthesia
    - NICU/Pediatrician if still pregnant
    - Blood bank
    - Laboratory
      - (37 types of Stat labs)
    - Main OR
      - Supplies/Instruments
    - Pharmacy
    - Back-up/Surgical assistant
    - House supervisor
    - Interventional Radiology
18 Week impending atony
Management of Atony

- Bimanual massage
- Drain the bladder
- Uterotonics
  - Oxytocin
  - Hemabate (up to 4 doses 15 min apart)
    - Not in asthma.
    - Low on priority list but give lomotil once patient is stable.
  - Methergine (up to 4 doses 30-60 min apart)
    - Not in hypertension.
  - Rectal cytotec (800-1000 mcg)
    - 600 mcg Buccal
    - This doesn’t get absorbed for 10-20 minutes. Good for maintaining uterine tone but not ideal if there is ongoing bleeding.
Management of Atony

- Rule out other causes
  - Physical exam should be the first step!
    - Thorough examination of vagina, cervix and bimanual massage.
  - Examination of placenta
  - Ultrasound
  - Manual exploration
- Tamponade Balloon
Tamponade Balloon

- Foley first!
- +/- Curettage- Move to the OR if planning curettage.
- Manual placement of balloon under ultrasound guidance
- Inflation of balloon- 500ml capacity
- Hold base in place with ring forceps/hand.
- Begin packing moistened Kerlex with other hand while partner/assistant inflates balloon.
  - Continue to monitor balloon with Ultrasound
    - Frequently migrates into vagina after a vaginal delivery.
- Remove in 24 hours.
- Best for lower uterine segment atony
Impending Surgical Intervention
Transverse
Surgical Management

- Curettage

- Uterine compression suture
  - B-Lynch
  - Cho technique
  - U-Suture

- O’leary- uterine artery ligation
  - Place **below** level of bleeding.

- Internal iliac artery ligation
  - Often impractical/difficult to perform in face of hemorrhage.

*Cho, Obstet Gynecol, 2000 96:1, 129-131*
- **Hysterectomy**

<table>
<thead>
<tr>
<th></th>
<th>Subtotal %</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder Injury</td>
<td>7.2</td>
<td>10.2</td>
</tr>
<tr>
<td>Reoperation</td>
<td>5.0</td>
<td>3.6</td>
</tr>
<tr>
<td>GI complications</td>
<td>6.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Transfusion</td>
<td>52</td>
<td>43</td>
</tr>
<tr>
<td>LoS</td>
<td>7.8</td>
<td>9.2</td>
</tr>
<tr>
<td>Perioperative death</td>
<td>1.4</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Wright, Obstet Gynecol, 2010;6, 1187-1193
• Subtotal unless history of carcinoma/severe dysplasia or inordinately stable.

• Widely spaced skin staples
  – No suture, no glue.

• If coagulopathic
  – Subfascial pelvic drain
  +/- Subcutaneous drain, I place in morbidly obese pt.
• Hemodynamically stable patient

• Placental bed +/- uterine artery +/- internal iliac artery.

• Most useful for continued/postoperative bleeding or hematomas.

• Risks
  – Procedural complications, ovarian embolization, fistula formation, bowel injury.
Always Read Your Dictation

DISCHARGE DIAGNOSIS:

- 1. Term intrauterine pregnancy.
- 2. Precipitous delivery.
- 3. Postpartum hemorrhage.
- 4. History of sexual thoughts.
Resuscitation

- Vital signs
- Lethal Triad
- Fluids and Blood products
**VS Changes with PPH**

<table>
<thead>
<tr>
<th>EBL (ml)</th>
<th>% Blood Volume Lost</th>
<th>Physiologic Changes</th>
<th>Hear t Rate (bpm)</th>
<th>Blood Pressure (mmHg)</th>
<th>Urine Output (ml)</th>
<th>Mental Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-1000</td>
<td>10-15</td>
<td>↑ circulating catecholamines; fluid shifts compensate for blood loss</td>
<td>&lt;100</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>1000-1500</td>
<td>15-25</td>
<td>↑ circulating catecholamines; peripheral vasoconstriction</td>
<td>100-120</td>
<td>NC or ↓ pulse pressure</td>
<td>Slight ↓</td>
<td>Anxiety</td>
</tr>
<tr>
<td>1500-2000</td>
<td>25-40</td>
<td>Hypoperfusion, moderate shock</td>
<td>120-140</td>
<td>SBP 80-100; ↓ pulse pressure</td>
<td>↓ (5-15 ml/hr)</td>
<td>Anxiety, confusion</td>
</tr>
<tr>
<td>&gt;2000</td>
<td>&gt;40</td>
<td>Extreme hypoperfusion; severe shock</td>
<td>&gt;140</td>
<td>&lt;80 mmHg; ↓↓ Possible complete anuria</td>
<td></td>
<td>Lethargy; loss of consciousness</td>
</tr>
</tbody>
</table>

Devine PC. Semin Perinatol 2009; 33: 76-81
Beware the Cliff

• While helpful…..

Due to changes in volume, multiple compensatory mechanisms and rapid blood loss, patients tend to “fall off the cliff” rather than progress stepwise through stages of hypovolemic shock.
Lethal Triad

Coagulopathy

Acidosis ↔ Hypothermia
Goals of Resuscitation

1. Maintain perfusion
2. Maintain oxygenation
3. Maintain body temperature
4. Prevent or treat coagulopathy
Laboratory Evaluation of Postpartum Hemorrhage Patient

- Complete blood count
- Protime/Prothrombin Time and INR
- Fibrinogen
- Comprehensive metabolic panel
- Crossmatch blood or call for trauma blood
Resuscitation Management

• Two peripheral IV’s
• Arterial line
• Central line depending on cause or if maternal condition warrants
  – AFE, sepsis, shock, maternal cardiac or pulmonary disease
• Level 1 transfuser/infuser
  – Warms fluid/blood administered.
• Bear hugger
• Sequential compression devices
Fluid Resuscitation

• Lactated ringers vs Normal Saline vs Albumin
  – No difference in outcomes based on trauma literature
  – Transfusion of large volumes can lead to dilutional coagulopathy. Cochrane Database 2007
  – Crystalloid - 3:1 resuscitation

• Hetastarch (Hextend/Hespan)- 1:1 resuscitation
  – Transfusion of >1000ml (20ml/kg) independently associated with coagulopathy. Stump et al 1985
  • I prefer to avoid in OB hemorrhage b/c of contribution to coagulopathy and rapid availability of blood products.
• Packed Red Blood Cells
  – 250-350 ml
  – Should raise Hgb 1 g / Hct 3%
  – Citrate preservative

• Trauma Blood
  – Typically will at least be type specific
    • Type and hold or screen should be in BB
    • Will get crossmatched after it has been sent!
• Fresh frozen plasma (FFP)
  – 200 ml
  – 400-800 mg Fibrinogen
  – Deficient in Factor V and VIII
  – First line for coagulopathy (INR>1.7) +/- hypofibrinogenemia

• Cryoprecipitate
  – 10-15 ml
  – 200-300 mg Fibrinogen
  – Rich in vWF, Factor VIII and XIII
  – Useful for isolated hypofibrinogenemia, volume overload or volume sensitive cardio/pulmonary disease.
  – Not appropriate for vWF or Factor VIII (Hemophilia A) deficiency
• Apheresis pack – equivalent to older “6 pack” platelets
  – Single donor
    • Lower risk of infection
  – Increase platelets 25-50K
  – Indication
    • Bleeding with count <50 K or within 24 hours surgery
    • Post op/delivery with no bleeding with count <25 K
    • Spontaneous bleeding occurs at <10 K
PPH complicated by coagulopathy

- 1877 patients with PPH
- Almost universal (97%) transfusion >2500ml EBL
- Only coagulopathic patients required massive transfusion
- 43% risk of coagulopathy in patients with EBL >3000ml
Post Hemorrhage Management

- Laboratory values will frequently fluctuate
  - Trends are important
  - Vital signs are critical

- Maintain uterine tone

- Magnesium should be continued in severe preeclamptic patients.

- Consider ICU admission if there is significant hemorrhage (2500+ ml EBL) or there are comorbidities - chorioamnionitis, extensive surgery, preeclampsia, general anesthesia, coagulopathy.
• Trust your clinical judgement.
  – If she’s behaving coagulopathic start transfusing.
• Labs should guide additional transfusion not the initiation of transfusion.

• Ampule of Calcium for every 4-6 units pRBC
  – Critical to coagulation cascade and platelet function
  – Blood product preservative (citrate) binds free calcium in vivo.

• Type and cross patients with positive antibody screen on admission to L and D for delivery.
  – Usually 2 units. If they have other risk factors- 4 units pRBC
**Pearls**

- **Detection of hemolysis**
  - Haptoglobin
  - UA dip (lysed hemoglobin)
  - Peripheral smear
  - LDH is frequently used but acute liver injury can also elevate LDH (Preeclampsia, AFLP, HELLP, etc.)

- **Red top**
  - Tape to the wall or put in the Anesthesiologist’s pocket
  - Should clot in 6 minutes and should not lyse for 30 minutes.

- **Preeclamptics don’t tolerate blood loss**
  - Vasoconstricted and volume depleted so they are likely to decompensate at lower blood loss.
Pearls

• Restore euvolemia and tissue perfusion.
  – Young healthy patients can maintain normal heart rates and BP’s when it’s not appropriate.
  – Remember the Lethal Triad ➔ Tissue hypoxia secondary to loss of oxygen carrying capacity and vasoconstriction will worsen acidosis ➔ worsen coagulopathy ➔ further bleeding ensues

• We typically have young healthy patients who do not decompensate slowly but SUDDENLY.
Pearls

• Re-dose antibiotics

• Lab results tell you how she was doing 30 minutes ago.

• Fibrinogen is elevated in pregnancy
  – Low normal represents DEPLETION/CONSUMPTION
    • 150 is not normal

• More blood products do not fix the problem.
  – If you reconstitute blood products in equal parts the result is anemic, thrombocytopenic and coagulopathic.
Always Read Your Dictation

• EBL: 1000ml  Fluids: 28000ml crystalloid

• Preop Diagnosis:
  – Arrest of dilation.
  – Feels intolerant of labor

• Patient pushed me to do vacuum. It actually worked with 3 pulls!
  – (I did not add the exclamation point)
• Think about how you are going to manage each patient before they have a complication.

• Challenge yourself as you work through it in your head- always try to have a next step in mind
Advice for those leaving the nest

• Get to know your new institution
  – How long do labs take?
  – What about blood products?
  – How easily can nursing staff obtain medications?
  – What instruments do they have immediately available in or near the OR? Where do they get additional instruments if you need them?
  – Does L&D have dedicated anesthesia?
    • How quickly can you or the anesthesiologist get help?
Thank You