Obstetrical Hemorrhage! Red is the new Black

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“When determining a course of action, it often helps to know what you’re up against”

Henry Kissinger

Objectives

- Define and classify postpartum hemorrhage (PPH)
- Briefly review OB physiology
- State the common etiologies of PPH
- Discuss therapeutic interventions and management of PPH
- Review use of blood products
**Definition?**

- Lack of agreement on blood loss
  - Blood loss greater than the “normal” estimates (Pritchard in 1962)
    - Vaginal delivery > 500cc
    - CD > 1,000cc
    - C-hysterectomy > 1,500cc
  - A 10% decrease in Hgb/HCT level
  - Need for blood transfusion

**Definition?**

- Excessive bleeding that makes patient symptomatic
  - Lightheadedness, vertigo, syncope
  - Results in signs of hypovolemia
    - Hypotension, tachycardia, or oligouria

Key: These changes will only occur after the patient has lost a significant amount of blood

**Incidence**

- Hemorrhage is the single most important cause of maternal mortality worldwide
  - Accounts for 25-30% (PPH – 150,000 lives daily)
  - Of these, roughly half are ectopic-related
- Developed regions <1%
  - Recent studies identified worrisome trends
  - US rate of PPH has increased steadily
    - 3% of all births complicated by PPH
Preventable Deaths (Clark et al 2008)

- Retrospective study 1.5 mill. deliveries 2000-06
  - Examine the etiologies of maternal death
  - Preventable factors regarding the same
- 95 maternal deaths (6.5/100,000) in the cohort
- Leading causes of death were due to complications
  - Preeclampsia
  - AFE
  - PPH
- 73% of postpartum hemorrhage deaths preventable

Clark et al. AJOG 2008

Preventing Maternal Death
10 Clinical Diamonds
Clark and Hankins 2012

- Angiographic embolization is not meant to be used for acute, massive postpartum hemorrhage
- If more than a single dose of medication is necessary to treat uterine atony, go to the patient's bedside until the atony has resolved
- In the postpartum patient who is bleeding or who recently has stopped bleeding and is oliguric, furosemide is not the answer

Never treat “PPH” without simultaneously pursuing an actual clinical diagnosis.

Any woman with placenta previa and one or more CD should be evaluated and delivered in a tertiary care medical center.

If your L&D unit does not have a recently updated massive transfusion protocol based on established trauma protocols, get one today.

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Any woman with placenta previa and one or more CD should be evaluated and delivered in a tertiary care medical center.

If your L&D unit does not have a recently updated massive transfusion protocol based on established trauma protocols, get one today.

The average pregnant woman increases blood volume by ~1200cc.
Hemodynamics of PPH

PPH Classification

<table>
<thead>
<tr>
<th>Hemorrhage class</th>
<th>Acute blood loss</th>
<th>% Last</th>
<th>Physiologic response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000 cc</td>
<td>15</td>
<td>Dizziness, palpitations, minimal blood pressure change</td>
</tr>
<tr>
<td>2</td>
<td>1500 cc</td>
<td>20:35</td>
<td>Tachycardia, tachypnea, sweating, weakness, narrowed systolic pressure, orthostatic hypotension</td>
</tr>
<tr>
<td>3</td>
<td>2000 cc</td>
<td>30:35</td>
<td>Significant tachycardia, restlessness, pallor, cool extremities, hypotension</td>
</tr>
<tr>
<td>4</td>
<td>≥2500 cc</td>
<td>40</td>
<td>Shock, air hunger, oliguria or anuria</td>
</tr>
</tbody>
</table>

How much blood is in the drape on the left?

500 cc
Quantification of Blood Loss
California Maternal Quality Care Collaborative

- Visual estimates underestimate by 33-50%
  - Large volumes often over estimated
  - Small volumes often under estimated
- No difference between in the accuracy of blood loss estimation
- No association between accuracy and years of training or experience
- Both improve with training


Quantification of Blood Loss
California Maternal Quality Care Collaborative

- Formally estimate blood loss by recording percent (%) saturation
  - Visual cues such as pictures/posters
- Formally measure blood loss by weighing blood soaked pads/chux
- Formally measure blood loss by collecting blood in graduated measurement containers

Quantification of Blood Loss
California Maternal Quality Care Collaborative

Develop Training Tools: Visual aids displayed in L&D and/or postpartum areas are guides for more accurate visual estimation

Training Tools
Posters 18 X 18 inch Dry Lap Sponges
- 25 ml saturates about 90% area
- 50 ml saturates about 75% area
- 75 ml saturates entire surface
- 100 ml will saturate and drip
Estimating Blood Loss With Simulation

- OB providers (attendings, residents, medical students) estimated blood loss at “stations”
- 62% of subjects underestimated EBL by 20%
- After 20 min didactic lecture
  - 98% of participants accurately estimated the blood loss


Etiologies of PPH
Remember — PPH is not the diagnosis

- Early (< 24hrs)
  - Uterine atony
  - Lower genital tract lacerations
  - Retained placenta
  - Placental invasion
  - Uterine rupture
  - Uterine inversion
  - Coagulopathy

- Late (>24hrs-6wks)
  - Infection
  - Retained placenta
  - Placental site subinvolution
  - Coagulopathy
Risk Factors for OB Hemorrhage

<table>
<thead>
<tr>
<th>&quot;4 Ts&quot;</th>
<th>Pathophysiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal uterine contractility (TONE)</td>
<td>Over distended uterus</td>
</tr>
<tr>
<td></td>
<td>Uterine muscle fatigue</td>
</tr>
<tr>
<td></td>
<td>Chorioamnionitis</td>
</tr>
<tr>
<td></td>
<td>Uterine distortion/abnormality</td>
</tr>
<tr>
<td></td>
<td>Uterine relaxant</td>
</tr>
<tr>
<td>Retained products of conception (TISSUE)</td>
<td>Accreta/Increta/Percreta</td>
</tr>
<tr>
<td></td>
<td>Retained placenta/membranes</td>
</tr>
<tr>
<td>Genital tract trauma (TRAUMA)</td>
<td>Laceration of the cervix, vagina or perineum</td>
</tr>
<tr>
<td></td>
<td>Extension/laceration at cesarean section</td>
</tr>
<tr>
<td></td>
<td>Uterine rupture</td>
</tr>
<tr>
<td></td>
<td>Uterine inversion</td>
</tr>
<tr>
<td>Abnormalities of coagulation (THROMBIN)</td>
<td>Preexisting clotting abnormalities (vWD/Tx, hemophilia)</td>
</tr>
<tr>
<td></td>
<td>Acquired in Pregnancy</td>
</tr>
<tr>
<td></td>
<td>DIC/HELLP/Anticoagulation</td>
</tr>
</tbody>
</table>

Team Work!

- Multidiscipline effort
  - OBs, RNs, and Anesthesiologists
- Organize early
- Involve other services as necessary
  - Lab, blood bank, ICU
- Allows for professionals to work in their fields of expertise

Responsibilities

- Assessment
  - Refers constant awareness of the patient’s hemodynamic status
  - Evaluation to determine cause of bleeding
- Breathing
  - Admin, supplemental
  - Airway, anticipate difficulty with intubation
- Circulation
  - IV access
  - Assess adequate circulating blood volume through resuscitation
Responsibilities

- Review ongoing fluid resuscitation and pharmacotherapy and assume responsibility for these
  - Place arterial line early if significant hemorrhage present or anticipated
  - Send initial lab sample (hemoglobin, coagulation status) if not already sent
  - Order blood and blood products as needed
- Adequacy of analgesia

Therapeutic Care Plan for PPH

<table>
<thead>
<tr>
<th>BLEEDING</th>
<th>Blood loss needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loss estimation</td>
</tr>
<tr>
<td></td>
<td>Etiology</td>
</tr>
<tr>
<td></td>
<td>EBL replacement</td>
</tr>
<tr>
<td></td>
<td>Drug therapy</td>
</tr>
<tr>
<td></td>
<td>Intraoperative management</td>
</tr>
<tr>
<td></td>
<td>Nonobstetrical services</td>
</tr>
<tr>
<td></td>
<td>General complication assessment</td>
</tr>
</tbody>
</table>

Oxytocin

- Short ½ life (3min) IV infusion required
- Dosing 10-80 IU in 500 ml of crystalloid
- Metabolized via renal and hepatic routes
- Antidiuretic effect: Water toxicity
  - Large volumes in electrolyte free soln.
- Rapid IV admin. of undiluted Oxytocin
  - Hypotension
Oxytocin
- Cesarean delivery
- RCT comparing infusion of 10U vs 80U oxytocin over 30 min after cord clamping
  - 80 unit
    - Less uterine atony or PPH
    - Less need for additional uterotonic agents
  
  Study did not find any difference in estimated blood loss or change in hematocrit


Oxytocin
- Vaginal deliveries
  - Using 10, 40, and 80 units of oxytocin infused over 60 min
  - No difference in PPH was noted between the groups
  - The 80 unit group
    - Required less additional oxytocin
    - Less risk of a decline in hematocrit of 6% or more compared to 10 units of oxytocin


Ergot Derivatives
- Methylergonovine (Methergine)
  - IM injection of the standard 0.2 mg (q5min max 5 doses)
  - Acts within 2 minutes-5 minutes
  - Metabolism hepatic route
  - ½ life is 30 minutes (clinical effect of approx. 3 hrs.
  - Side effects nausea, vomiting, and dizziness
  - Contraindications: HTN, Heart ds., PVD
**Carboprost (Hemabate)**
- 0.25mg IM or intramyometrial injection
- Smooth muscle stimulant
- Second line agent
- Peak plasma concentration (15min IM or 5 min myometrial injection) repeat doses q15 min max 8 doses (2mg)
- Side effects: GI, bronchospasm, and pyrexia
- **Contraindications:** cardiac and pulmonary

**Misoprostol**
- PG E1 analog
- Onset of action 20-30 min
- PO, sublingually, PV, PR, or direct IU
- Usual dose 800 microgram
- Hepatic metabolism
- Protracted uterine bleeding
- Side effects: GI and dose-dependent

**Recombinant Activated Factor VIIa (Novoseven)**
- Enhances platelet aggregation
- Promotes clotting through extrinsic pathway (binds to tissue factor)
  - Complexes with tissue factor → activates Factor IX and X, and generates thrombin
- Dose 40-60 mcg/Kg IV bolus, repeat in 15-30 minutes
- Controls bleeding rapidly – 10 minutes!
- Very few adverse effects reported < 1%
- Short ½ life (2 hours)
Recombinant Activated Factor VIIa (Novoseven)

- Administration of rFVIIa:
  - Hemoglobin 9-10; Plts 70K; Fibrinogen 2g/L
  - FFP to goal of PT/PTT < 1.5 times upper limit of normal
  - Correct acidosis, hypothermia, low ionized calcium, and rule out arterial bleeding
  - High Cost approx. $5000-10,000/dose

Tranexamic Acid (Antifibrinolytic)

- Reduces blood loss during and after cesarean delivery (pooled CD data)
- Vaginal delivery
  - Two prospective studies (2000 subjects)
  - Treatment group:
    - PPH was significantly lower
    - Progression to severe PPH and blood transfusion was less frequent than controls (P = 0.03, 0.07, and <0.001 respectively)

?Carries a risk of thrombosis?

Intraoperative Cell Salvage in Obstetrics

- Considered safe in obstetric patients
- >400 cases in OB literature without AFE
- Automated system can provide 225 cc of washed, saline suspended RBC with Hct of 50% in 3 minutes
- ACOG recommends considering its use when massive blood loss is expected
- Rh negative receive Rhogam

Medical Therapy Options

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Route</th>
<th>Dosing Frequency</th>
<th>Side Effects</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitocin</td>
<td>10-80 U/L</td>
<td>IV (IM, IU)</td>
<td>Continuous</td>
<td>N/V Water intoxication</td>
<td>None</td>
</tr>
<tr>
<td>Methergine (Methyl-ergonovine)</td>
<td>0.2 mg</td>
<td>IM (IU)</td>
<td>Q2-4hr</td>
<td>HTN, N/V, hypotension</td>
<td>HTN, Preeclampsia</td>
</tr>
<tr>
<td>Hemabate (PGE$_2$)</td>
<td>0.25mg</td>
<td>IM (IU)</td>
<td>Q15-90min, Max = 8</td>
<td>N/V, F/C, diarrhea</td>
<td>Active cardiac, renal, liver, lung disease</td>
</tr>
<tr>
<td>Dinoprostone (PGE$_2$)</td>
<td>20mg</td>
<td>PR</td>
<td>Q2hr</td>
<td>N/V, F/C, diarrhea, HA</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Cytotec (Misoprostol)</td>
<td>600-1000 mcg</td>
<td>PO (PR)</td>
<td>Single dose</td>
<td>Fever</td>
<td>None</td>
</tr>
</tbody>
</table>
Active Management of the 3rd Stage of Labor

- Three Key Components
  - Use uterotonic agent (Oxytocin)
  - Early clamping of the umbilical cord
  - Controlled traction

Cochrane Review
Comparison of Oxytocin, Placebo and ergot alkaloids
Oxytocin use associated with reduced risk of hemorrhage (RR 0.5) and reduced need for therapeutic uterotonics (RR 0.5)


ACOG Patient Safety Checklist for Postpartum Hemorrhage

What should I order?
Transfusion Therapy

- Classic thinking:
  - Resuscitation using crystalloid and PRBCs
  - FFP, cryo, and plts only if hematologic parameters are abn (plts<50K, FBG<100K; PT/aPTT<1.5XNL)
  - FAILED TO PREVENT COAGULOPATHY IN MASSIVE HEMORRHAGE – DILUTIONAL COAGULOPATHY

- New Concept
  - Limit early aggressive crystalloid use
  - Early admin. of FFP and PLTs (with pRBCs) ratio 1:1:1
  - Early use of IFVIIa

Massive Transfusion
Principles of Massive Transfusion

- Manage airway and breathing
- Evaluate and address cause of hemorrhage
- Establish two large bore peripheral intravenous lines
- Consider central line and arterial line placement
- Administer crystalloid (1-2 L) intravenously
- Initiate massive transfusion protocol, if available
- Administer PRBCs, FFP, and platelets in a timely fashion
- Maintain core temperature >35°C
- Monitor CBC, PT, PTT, fibrinogen every 30 min
- Correct hypocalcemia
- Correct hyperkalemia
- Correct acidosis (pH = 7.4, normal base deficit, normal lactate)

Continue product replacement until: hemodynamically stable, platelet count >50,000, INR <1.5

<table>
<thead>
<tr>
<th>Components</th>
<th>Contents</th>
<th>Indications</th>
<th>Volume</th>
<th>Shelf Life</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRBC’s</td>
<td>RBC’s, WBC’s, plasma</td>
<td>Anemia</td>
<td>300</td>
<td>42 days</td>
<td>Increase Hgb 1g</td>
</tr>
<tr>
<td>Platelets</td>
<td>Platelets, plasma</td>
<td>Bleeding due to low plt</td>
<td>50</td>
<td>5 days</td>
<td>Increase Plt count 7500/unit</td>
</tr>
<tr>
<td>FFP</td>
<td>FBG, plasma, clotting factors</td>
<td>DIC, coagulation disorder, reverse warfarin</td>
<td>250</td>
<td>12 mo frozen 2 hr thawed</td>
<td>Increase FBG 10-15</td>
</tr>
<tr>
<td>Cryoppt</td>
<td>FBG, factor VIII, vWF, XIII</td>
<td>DIC, von Willebrand’s, hemophilia A</td>
<td>40</td>
<td>4-6 h thawed</td>
<td>Increase FBG 10-15</td>
</tr>
</tbody>
</table>

Colloid Solutions

<table>
<thead>
<tr>
<th>Colloid</th>
<th>Dose (mL)</th>
<th>Crystalloid Volume Expansion Equivalent</th>
<th>Duration of Effect (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin</td>
<td>5% solution 500-700</td>
<td>similar to crystalloid</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>25% solution 100-200</td>
<td>3.5 times crystalloid</td>
<td>24</td>
</tr>
<tr>
<td>Hespan®</td>
<td>500-1000</td>
<td>similar to crystalloid</td>
<td>24-36</td>
</tr>
<tr>
<td>Dextran 70</td>
<td>500</td>
<td>1050 mL over two hours</td>
<td>24</td>
</tr>
</tbody>
</table>


Anticipate risk for intraoperative bleeding

More Cesarean = More Invasion

The majority of patients with accreta have a history of prior cesarean delivery and previa
A placenta previa with no prior sections is associated with a 3-4% risk of accreta. Accreta risk is low without a previa until section # 4.

Conclusions

- PPH is a common obstetrical event and a major source of maternal morbidity and mortality
- Early recognition and treatment of PPH is critical
- Anticipation of potential need for blood products is important
Have an Operative Plan

- Uterine curettage
- Laceration repair
   - Lower genital tract
   - Uterine
- Arterial ligation/embolization
- B-Lynch suture
- Packing
- Hysterectomy

Arterial Ligation
Arterial Ligation: Hypogastric Vessels

- Reported success rates variable
  - 25-80%

Clark Obstet Gynecol 1985;42:306
Wagaarachchi Hum Reprod 2000;15:1311

Recent Results BHAL Turkey

- 58 patients (1997-2008)
  - 24 HELLP with coagulopathy
    - 25% complication rate
  - 24 Uterine atony
    - 12.5% complication rate
  - 10 Massive hemorrhage due to inadequate surgical control or rupture
    - 10% complication rate
  - 1 death in each group

- Complications
  - DIC
  - Hysterectomy
  - Relaparotomy
  - Wound infection
  - ATN

Unal J Mat Fet Med 2011;24(10):173

Before

After

Suture placed 2-3 cm distal from bifurcation to ensure placement distal to posterior division

Unal J Mat Fet Med 2011;24(10):173
Arterial Embolization

- Technique
  - Pelvic arteriogram in order to identify extravasation of blood from pelvic vessels
  - Selective catheterization of bleeding pelvic vessels and embolization of Gelfoam, glue or coils

- Pros
  - Selectivity
  - Highly successful (>90%)
  - Uterine preservation
  - Definitive surgical therapy possible if embolization fails

- Cons
  - Requires stable patient
  - Availability of interventional radiology
  - Complications
    - Fever/Pain
    - Infection
    - Procedure-related problems

B-Lynch Suture Technique
Uterine Compression: SOS Bakri Tamponade Balloon

- FDA approved for temporary control of postpartum uterine bleeding; provides compression
- May be used vaginally or at cesarean
- Allows assessment of ongoing bleeding
- Remove after 24 hours

Uterine Compression: ebb™ Balloon

- Hook port directly to IV fluid bag: Fill uterine balloon in 250 cc increments up to 750 cc
- Hook port directly to IV fluid bag: Fill vaginal balloon in up to 300 cc
Hysterectomy

- Definitive therapy – don’t delay!
  - Refractory uterine atony
  - Irreparable uterine rupture/vessel lacerations
  - Placental invasion

Packing

- Useful temporizing technique that controls uterine bleeding or post-hysterectomy bleeding from the vaginal cuff
- Provides pressure to bleeding surfaces until coagulation factors can be replaced

Packing Technique

- Supplies
  - Sterile plastic bag
  - Packing gauze
  - IV bag for traction
- Recommendations
  - Foley catheter
  - Prophylactic antibiotics
Concealed Abruption

Anticipate Blood Loss Needs
- Establish large bore IV access
- Type & crossmatch
  - PRBC, FFP, cryoprecipitate, platelets
- Baseline laboratory assessment
  - CBC, platelets, fibrinogen, PT/PTT, BMP
- Consider Cell Saver