OBSTETRICAL HEMORRHAGE

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Catastrophic Obstetrical Hemorrhage

- Educational Objectives
  - Review hematological changes in pregnancy
  - Evaluate definitions and classification
  - Consider etiology and risk factors
  - Explore effect of mode of delivery
  - Develop management strategy
  - Propose conclusions
OB Hemorrhage

- OB hemorrhage accounts for 50% of all postpartum maternal fatalities
- The single most important cause of maternal death worldwide
- 88% of deaths from postpartum hemorrhage occur within 4 hours of delivery

Maternal Mortality Rates
1987-1996

National: 7.7 / 100,000 (1987-1996)

Source: NCHS, Vital statistics
Maternal Mortality Rates for Black Women 1987-1996

New York: 28.7

Source: NCHS, Vital statistics
Trends in Cause of Pregnancy-Related Deaths* by Year

* Deaths among women with a live birth
Direct Maternal Deaths

Why Mother Die 1997 - 1999, CEMD
Approximately one-half of maternal deaths are preventable!!
Hematological Changes in Pregnancy

- 40% expansion of blood volume by 30 weeks
- 600 ml/min of blood flows through intervillous space
- Appreciable increase in concentration of Factors I (fibrinogen), VII, VIII, IX, X
- Plasminogen appreciably increased
- Plasmin activity decreased
- Decreased colloid oncotic pressure secondary to 25% reduction in serum albumin
Estimation of Blood Loss

- **Visual**
  - Underestimates by ½ to 1/3

- **Hypotension**
  - May be masked by hypertensive disorders

- **Tilt-test**
  - False positives (conduction anesthesia)
  - False negatives (hypervolemia of pregnancy)

- **Tachycardia**
  - Unreliable

- **Urine flow**
  - Reflects adequate perfusion
Reduced Maternal Blood Volume

- Small stature
- Severe preeclampsia/eclampsia
- Early gestational age
Effect of Acute Blood Loss on Hematocrit

- Change usually delayed at least 4 hours
- Complete compensation takes 24 hours
- Above affected by degree of intravenous hydration
Average Blood Loss and Complexity of Delivery

- Vaginal delivery – 500 ml
- Cesarean section – 1000 ml
- Repeat cesarean section & TAH – 1500 ml
- Emergency hysterectomy – 3500 ml

Pritchard AJOB 1961
Clark Obstet Gynecol 1984
## Classification of Hemorrhage in the Pregnant Patient *

<table>
<thead>
<tr>
<th>Hemorrhage Class</th>
<th>Acute Blood Loss (ml)</th>
<th>Percentage Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>900</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>1200-1500</td>
<td>20-25</td>
</tr>
<tr>
<td>3</td>
<td>1800-2100</td>
<td>30-35</td>
</tr>
<tr>
<td>4</td>
<td>2400</td>
<td>40</td>
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</table>
### Classification of Hemorrhage in the Pregnant Patient

<table>
<thead>
<tr>
<th>Hemorrhage Class</th>
<th>Signs and Symptoms</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Usually none</td>
</tr>
<tr>
<td>2</td>
<td>Tachycardia, tachypnea orthostatic changes, prolonged hypothenar blanching, narrowing of pulse pressure</td>
</tr>
<tr>
<td>3</td>
<td>Overt hypotension, marked tachycardia (120-160 bpm), marked tachypnea (30-40/mln, cold, clammy skin</td>
</tr>
<tr>
<td>4</td>
<td>No discernible blood pressure, oliguria or anuria, absent peripheral pulses</td>
</tr>
</tbody>
</table>
Etiology of Obstetrical Hemorrhage

- Abnormal placentation
- Trauma
- Uterine atony
- Coagulation defects
Etiology of Obstetrical Hemorrhage

- Trauma
  - Episiotomy
  - Vulvar Lacerations
  - Vaginal lacerations
  - Cervical lacerations
  - Cesarean section extensions
  - Uterine rupture
Risk Factors for Uterine Rupture

- Prior uterine scar
- High parity
- Hyperstimulation
- Obstructed labor
- Intrauterine manipulation
- Midforceps rotation
Etiology of Obstetrical Hemorrhage

- Abnormal Placentation
  - Placenta previa
  - Abruptio placenta
  - Placenta accreta
  - Ectopic pregnancy
  - Hydatidiform mole
Placenta Accreta-Increta-Percreta as a Cause of Bleeding

- Increased incidence over last 20 years
  » Increased cesarean section rate
  » Increased risk from placenta previa
    - Previa and unscarred uterus - 5% risk

Clark et al Obstet Gynecol 1985
Maternal Mortality of Placenta Accreta During the 20th Century

- <1937
- 1945-55
- 1975-79
- 1985-94

Percent (%)
Incidence of Placenta Previa/Accreta as a Function of Number of Cesarean Sections
Midsagittal Sonographic Image of Placenta Previa-Percreta
Risk Factors for Uterine Atony

- Excessive uterine distension
  - Macrosomia
  - Hydramnios
  - Multiple gestation
  - Clots
- Anesthetic agents
  - Halogenated agents
- Myometrial exhaustion
  - Rapid or prolonged labor
  - Oxytocin
  - Chorioamnionitis
- Prior uterine atony
Risk Factors for Coagulation Defects

- Placental abruption
- Severe preeclampsia
- Amniotic fluid embolus
- Massive transfusions
- Severe intravascular hemolysis
- Congenital or acquired coagulopathies
- Retention of dead fetus
- Sepsis
- Anticoagulant therapy
Postpartum Hemorrhage

- **Definitions**

- **Traditional: >500 ml**
  - Immediate: Within 24 hours of delivery
  - Delayed: More than 24 hours following delivery

- **Coombs et al, 1991**
  - Amount requiring transfusion or producing 10 volume % reduction in hct
Postpartum Hemorrhage Following Vaginal Delivery

- 30,000 deliveries
- 1976 – 1996 at Beth Israel Hospital
- 2.6% overall transfusion rate
- 4.6% in 1976; 1.9% in 1996
- 20% of transfusions > 3 units
Postpartum Hemorrhage
Following Vaginal Delivery

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative Risk</th>
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<tr>
<td>Prolonged 3\textsuperscript{rd} stage</td>
<td>7.6</td>
</tr>
<tr>
<td>Pre-eclampsia</td>
<td>5</td>
</tr>
<tr>
<td>Mediolateral episiotomy</td>
<td>4.7</td>
</tr>
<tr>
<td>Postpartum hemorrhage</td>
<td>3.6</td>
</tr>
<tr>
<td>Twins</td>
<td>3.3</td>
</tr>
<tr>
<td>Arrest of Descent</td>
<td>2.9</td>
</tr>
<tr>
<td>Lacerations</td>
<td>2</td>
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</table>

## Postpartum Hemorrhage Following Cesarean Deliveries

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative Risk</th>
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<tbody>
<tr>
<td>General Anesthesia</td>
<td>2.9</td>
</tr>
<tr>
<td>Amnionitis</td>
<td>2.7</td>
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<tr>
<td>Protracted Active Phase</td>
<td>2.4</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>2.2</td>
</tr>
<tr>
<td>Second-stage Arrest</td>
<td>1.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.8</td>
</tr>
<tr>
<td>Classical Incision</td>
<td>1.1</td>
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</table>

Strategies for the Prevention of Postpartum Hemorrhage

- Enhance natural contractions of the uterus
- Shortening of the 3rd stage
- Treat aggressively
Active Management of the 3rd Stage of Labor

- Principal action
  - Hasten and augment uterine contractions after delivery of the baby
  - Prevent hemorrhage due to uterine atony

- Prevent blood loss
Active Management versus Expectant Management

- Main Components of Active Management
  - Administration of a prophylactic uterotonic agent soon after delivery
  - Early clamping and cutting of the umbilical cord
  - Controlled cord traction after the uterus has contracted
Active Management versus Expectant Management

- Main Components of Expectant Management
  - Wait for signs of placental separation
  - Allow placenta to deliver spontaneously
    - Aided by gravity or nipple stimulation
Active vs. Expectant Management of the 3rd Stage of Labor


Findings
- Active management reduced risk of maternal blood loss
- Reduced prolonged 3rd stage of labor

Side Effects
- Increased nausea and vomiting
- Elevated BP’s

Recommendations
- Active management should be the routine approach for women having a vaginal delivery in a hospital

MacDonald et al 2003
Prophylactic use of Oxytocin in the 3rd Stage of Labor

  - Findings
    » Reduced blood loss
    » Reduced need for additional uterotonic drugs
    » Nonsignificant trend towards more manual removal of placenta and more blood transfusion in the expectant management subgroup

Elbourne et al 2003
Alternative Agents for Prevention of Postpartum Hemorrhage

- **Umbilical Uterotonic Agents:**
  - 1\textsuperscript{st} trial in 1987 using Oxytocin vs. Saline – not significant
  - 3 other trials (1988, 1991, 1996) showed the same NS
    » Oxytocin decreased the length of 3\textsuperscript{rd} stage but not blood loss
Alternative Agents for Prevention of Postpartum Hemorrhage

- **Oral Ergometrine and Methylergometrine**
  - Both drugs have a strong uterotonic effect and slight vasoconstriction
  - Act differently than Oxytocin and Prostaglandins
  - Unfortunately both are unstable even refrigerated
  - No place in modern obstetrics

DeGroot et al: Drugs, 1998
Alternative Agents for Prevention of Postpartum Hemorrhage

- **Sublingual Oxytocin**
  - Widely varying bio-availability
  - Long lag time, long half life
  - Not used in modern obstetrics

DeGroot et al J Pharm Pharmacol 1995
Alternative Agents for Prevention of Postpartum Hemorrhage

- **Injectable Prostaglandins**
  - International trial in 1996
    » Similar results to prophylactic IM/IV Oxytocin
      - Higher rates of diarrhea, higher cost
    » 2001 Randomized trial in United Kingdom using hemabate
      - Study stopped early due to side effects
        - 21% with severe diarrhea
      - As effective as Oxytocin in preventing hemorrhage
    » Cochrane Review in 2000
      - Injectable PG’s have decreased blood loss and shortened 3rd stage but should be used when other measures fail
Alternative Agents for Prevention of Postpartum Hemorrhage

• **Carbetocin**
  – Long acting Oxytocin receptor agonist
  – Produces tetanic contractions within 2 minutes lasting 6 minutes, lasts for approximately 1 hour
  – IM has a prolonged effect (2 hours) versus IV
  – 1998 and 1999 – 2 trials in Canada – double-blind, randomized for patients having a cesarean section
    » Was more effective in a single IV dose than continuous Oxytocin
    » Similar safety profile to Oxytocin
  – No clinical trials for postpartum hemorrhage prevention
Alternative Agents for Prevention of Postpartum Hemorrhage

- **Misoprostil**
  - Synthetic analog of PGE$_1$
  - 1996-1st trial outlining its use to prevent 3rd stage
  - 24 randomized controlled trials from 1998-2003
    - Oral and rectal Misoprostil not as effective as conventional injectable uterotonic agents
    - High rate of side effects
  - May be useful in less-developed countries where administration of parenteral uterotonic agents are problematic
Surgical Therapy

- Uterine packing
- Uterine artery ligation
- Internal iliac (hypogastric) artery ligation
- Hysterectomy
- Suture techniques
Surgical Management of Uterine Atony

General Considerations

- Stability of patient
- Reproductive status of patient
- Skill of surgeon
- Skill of assistants
- Availability of blood products
- Visualization of pelvis
  - Choice of incision
  - Retroperitoneal approach
  - Anatomic distortion
Uterine Packing

- Fell into disfavor in 1950’s
  - Concealed hemorrhage
  - Infection
  - Non-physiologic approach

- Maier AJOB, 1993
  - Simple, safe, effective
  - Pack side to side
    » Avoid dead space
Pelvic Pressure Pack

- Bleeding may persist post hysterectomy
- Original description by Logothetopulos in 1926
- High success rate, but numbers are limited

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>OB</th>
<th>GYN</th>
<th>Total</th>
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<tbody>
<tr>
<td>1962</td>
<td>Parente</td>
<td>0</td>
<td>14</td>
<td>14/14</td>
</tr>
<tr>
<td>1968</td>
<td>Burchell</td>
<td>0</td>
<td>8</td>
<td>8/8</td>
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<tr>
<td>1985</td>
<td>Cassels</td>
<td>1</td>
<td>0</td>
<td>1/1</td>
</tr>
<tr>
<td>1990</td>
<td>Robie</td>
<td>1</td>
<td>0</td>
<td>1/1</td>
</tr>
<tr>
<td>1991</td>
<td>Hallak</td>
<td>1</td>
<td>0</td>
<td>1/1</td>
</tr>
<tr>
<td>2000</td>
<td>Dildy</td>
<td>7</td>
<td>1</td>
<td>7/8</td>
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</table>
The Pelvic Pressure Pack for Persistent Post hysterectomy Hemorrhage

Dildy AJOG 2000
Postpartum Uterine Hemorrhage

Uterine Artery Ligation

- Waters, 1952
  - Original description
- O’Leary & O’Leary, 1974
  - Post-cesarean hemorrhage
  - Simpler more rapid technique
- Reported efficacy 80-92%
Stepwise Uterine Devascularization

- Alexandria, Egypt – Shatby Maternity University Hospital
- 103 patients with non-traumatic postpartum hemorrhage
- Failure of non-surgical management
- Absorbable sutures
- No vessels clamped or divided

AbdRabbo, 1994
Stepwise Uterine Devascularization

- Unilateral uterine vessel ligation
- Contralateral (bilateral) uterine vessel ligation
- Low bilateral uterine vessel ligation
- Unilateral ovarian vessel ligation
- Contralateral (bilateral) ovarian vessel ligation

AbdRabbo, 1994
### Stepwise Uterine Devascularization

#### Step Employed (%)

<table>
<thead>
<tr>
<th>Indications</th>
<th>Patients</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Uterine Atony</td>
<td>66</td>
<td>14</td>
<td>85</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Abruptio Placenta</td>
<td>17</td>
<td>0</td>
<td>88</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Couvelaire Uterus</td>
<td>9</td>
<td>0</td>
<td>33</td>
<td>0</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>Placenta Previa</td>
<td>5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Placenta Previa with Accreta</td>
<td>2</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Afibrinogenemia</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>103</strong></td>
<td><strong>9</strong></td>
<td><strong>75</strong></td>
<td><strong>4</strong></td>
<td><strong>7</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

AbdRabbo, 1994
Stepwise Uterine Devascularization
Follow-Up

- All patients resumed normal menstruation
- 11/15 patients conceived following discontinuation of contraception
- Subsequent pregnancies normal
  - 4 Vaginal deliveries
  - 7 Cesarean sections
  - No postpartum hemorrhage

AbdRabbo, 1994
Suture Techniques

- B-Lynch procedure
  - Fundal Compression suture
    #2 chromic on a 75 mm heavy, round bodied needle
- 4 Case reports total

<table>
<thead>
<tr>
<th>Suture Technique</th>
<th>Reference</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Lynch</td>
<td>BJOB 1997</td>
<td>5/5</td>
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<tr>
<td>Ferguson</td>
<td>OB &amp; GYN 2000</td>
<td>2/2</td>
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<tr>
<td>Dacus</td>
<td>JMFM 2000</td>
<td>1/1</td>
</tr>
<tr>
<td>Vangsgaard</td>
<td>Ugesker Laeger 2000</td>
<td>12/12</td>
</tr>
</tbody>
</table>
B-Lynch Procedure
Internal Iliac (Hypogastric) Artery Ligation

- Controls blood loss by reducing art. pulse pressure
  - Converts pelvic art. circulation into a venous system

- Burchell et al Obstet Gynecol 1964
  - Arterial pulse pressure reduced
    - 14% by contra lateral
    - 77% by homolateral
    - 85% by bilateral

- Need experienced surgeon
- Need hemodynamically stable patient
Selective Arterial Embolization

- Widely used for management of uncontrollable hemorrhage
- First OB trial 1979 (Brown et al Obstet. Gynecol)
- 7 Trials from 1998-2000
  - Cumulative success rate = 97%
- Excellent first line therapy but . . .
  - Difficult to perform in Labor and Delivery
  - Availability of interventional radiologist
Hysterectomy

- Clark et al Obstet Gynecol 1984
- Largest series of emergency hysterectomy
  - 70 cases 1978-1982
    » 60 Post cesarean sections
    » 10 post vaginal delivery
  - Indications
    » Atony – 43%
    » Placenta accreta – 30%
    » Uterine rupture – 13%
    » Extension of low transverse incision – 10%
    » Fibroids preventing closure – 4%
  - TAH for atony
    » Higher rates; amniotics, C/S for labor arrest, augmentation of labor, MgSO₄ infusion, larger fetal weight
Changing Indications for Emergency Hysterectomy

Percent (%)


Other  Accreta  Atony
Autotransfusion

- Use of cell saver to collect blood from operative field, processing and reintroducing red cells to patients.
- Not well defined in obstetrics
  - Removal of fetal and amniotic debris
  - Appears effective
- Largest series to date (Rebarber AJOB 1998)
  - 139 cases performed at cesarean section
  - No complications related to AFE or coagulopathies
- Use two separate suction devices
  - Amniotic fluid and red cell product
  - Increase wash volume
  - Measure clotting factors and platelets every 1 to 1.5 blood volumes lost
- Contraindications
  - Heavy bacterial contamination
  - Malignancies
Fluid and Blood Component Replacement

- Whole blood vs. components, debate continues
- Maintain urine output > 30 cc/hr
- Maintain hematocrit > 30% (with acute blood loss)
- Choice of components:
  - Hemoglobin – packed red blood cells
  - Fibrinogen-cryoprecipitate
  - Other clotting factors-fresh frozen plasma
  - Platelets-platelet packs
  - Volume-lactated Ringer’s solution
Risks of Blood Transfusion

- HIV 1:2,135,000
- Hepatitis A 1:1,000,000
- Hepatitis B 1:205,000
- Hepatitis C 1:276,000
- HTLV I/II 1:2,993,000
- Transfusion-related acute lung injury 1:5,000
- Alloimmunization 0.5%

Int. Anesthesia Clinics 2004
Conclusions

- Incidence low, but significant
- Amount of blood loss hard to determine; catastrophic clearer
- Earlier the intervention, less the blood loss
- Organized approach essential to management
- Exhaust medical measures prior to surgery
- Precise fluid and blood component therapy essential