Massive Transfusion Protocol
For Obstetric Hemorrhage

Patrick Pickett, MD
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Objectives

- Review of major causes of obstetric hemorrhage
- Discuss multidisciplinary management of obstetric hemorrhage
- Review indications for and risks of blood components
- Discuss UH’s own massive transfusion protocol
Postpartum Hemorrhage

- Leading cause of maternal mortality
- 140,000 deaths/year
- PPH mortality decreased in developed countries; morbidity constant:
  ARDS, shock, coagulopathy, infertility
Postpartum Hemorrhage: Causes

- Uterine atony (50-80%)
- Retained placenta (20-30%)
- Cervical/vaginal lacerations (10%)
- Abnormal placentation
- Coagulopathy (congenital vs. acquired)
- Uterine inversion (<1:1000)
Postpartum Hemorrhage

- Early (1°) PPH (≤24h): 1-6%
  - >500ml for SVDs, >1000ml for C/S
- Massive transfusion:
  - 10 units in 24 hours
- Anesthesiologists and surgeons underestimate EBL, especially when large\(^7\)
ACS classification of hemorrhagic shock

<table>
<thead>
<tr>
<th>Class</th>
<th>Shock severity</th>
<th>% Blood Volume Lost</th>
<th>EBL (mL)</th>
<th>Signs &amp; Sx</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>None</td>
<td>&lt;15%</td>
<td>&lt; 750</td>
<td>None to minimal changes in VS</td>
<td>–</td>
</tr>
<tr>
<td>II</td>
<td>Mild</td>
<td>15-30%</td>
<td>750 - 1500</td>
<td>↑HR &lt; 100, Mild ↓BP, ↑PP ↑RR subtle ΔMS ↓UOP</td>
<td>IVF (crystalloid vs colloid)</td>
</tr>
<tr>
<td>III</td>
<td>Moderate</td>
<td>30-40%</td>
<td>1500 - 2000</td>
<td>HR 100-120, SBP 80-100, ↓PP Anxiety/confusion</td>
<td>Blood transfusion likely</td>
</tr>
<tr>
<td>IV</td>
<td>Severe</td>
<td>&gt;40%</td>
<td>&gt;2000</td>
<td>HR 120-140, SBP &lt;80 Confusion/lethargy minimal UOP</td>
<td>Transfusion, possibly massive</td>
</tr>
</tbody>
</table>

Class III or IV: death from multiorgan failure without resuscitation in 1-1.5h
Management

- Multidisciplinary
  - Obstetrics
  - Anesthesiology
  - Nursing
  - Blood bank/Lab
  - ?IR
THE TRANSFUSION OF BLOOD—AN OPERATION AT THE "HOSPITAL NATIONAUX," AT PARIS.—[See Plate 569.]
## Multidisciplinary Management of PPH

<table>
<thead>
<tr>
<th>Obstetrics</th>
<th>Anesthesia/Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>removal of placenta, exploration of uterus, vagina, uterine massage, uterine tamponade</td>
<td>IV access, fluids, ephedrine, verify T&amp;C, maintain analgesia, warming, cell saver (controversial)</td>
</tr>
<tr>
<td>UtE₁, UtE₂, UtE₃, methergine</td>
<td>blood products, pressors</td>
</tr>
<tr>
<td>Arterial ligation, B-Lynch suture</td>
<td>ETT</td>
</tr>
<tr>
<td></td>
<td>IR for embolization</td>
</tr>
<tr>
<td>Hysterectomy (3-4:10,000)</td>
<td>rFVIIa (controversial)</td>
</tr>
</tbody>
</table>
Blood Bank Labs

- **Type**
  - ABO, Rh (D)
  - ABO errors 1:19,000-1:138,000
  - Fatal ABO errors 1:1,500,000

- **Screen (99.8%)**
  - Less common Ab’s: Kell, Kidd, Duffy, others

- **Crossmatch (add’l 15-45 min, 99.94%)**
  - Mix pt’s blood with donor blood.
Blood Components
Packed Red Blood Cells (PRBCs)²

- **Indications**
  - Hb >10: rarely indicated
  - Hb <6: almost always indicated
  - Hb 6-10: ???
  - Survey: most transfuse at Hb = 7-8

- **Benefits of RBCs**
  - Oxygen carrying capacity
  - RBCs release PAF (platelet activiating factor)
  - ↑ Blood viscosity
  - RBCs cluster in center of vessels, displacing platelets and factors peripherally
Risks of RBCs

- Infections
- Transfusion reactions
- RBC “storage lesion”
  - ↓2,3-DPG (needed for O₂ release)
  - ↑K (>30, hemolysis)
  - ↓pH (<7 by 3 weeks)
  - Stiff membranes ↓microcirculation
  - ↑adhesion/aggregation
## Transfusion Risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIM</td>
<td>???</td>
</tr>
<tr>
<td>TACO</td>
<td>1:100</td>
</tr>
<tr>
<td>Delayed hemolytic rxn</td>
<td>1:1,000</td>
</tr>
<tr>
<td>Bacterial contamination</td>
<td>1:2,000</td>
</tr>
<tr>
<td>TRALI</td>
<td>1:5,000</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1:12,000</td>
</tr>
<tr>
<td>Transfusion error</td>
<td>1:19,000</td>
</tr>
<tr>
<td>HBV</td>
<td>1:200,000</td>
</tr>
<tr>
<td>Acute hemolytic rxn</td>
<td>1:250,000</td>
</tr>
<tr>
<td>HCV</td>
<td>1:1,600,000</td>
</tr>
<tr>
<td>HIV</td>
<td>1:2,000,000</td>
</tr>
<tr>
<td>Malaria</td>
<td>Rare</td>
</tr>
<tr>
<td>Prions</td>
<td>Rare</td>
</tr>
</tbody>
</table>
Platelets

- Usually provided in 5-9 “packs”
- “5 pack” represents the apheresis donor volume equivalent to the amount pooled from 5 separate units of whole blood.
- 1 unit = 5,000 – 10,000 platelets
- Indications: microvascular bleeding in setting of platelet count < 50,000
- ABO/Rh compatibility recommended in OB
- Blood product most commonly contaminated with bacteria (warm storage)
Fresh Frozen Plasma (FFP)

- FFP = whole blood − RBCs − platelets
- Contains all plasma proteins and clotting factors
- Indications
  - Microvascular bleeding in setting of factor deficiency (e.g., massive transfusion)
  - INR or PTT > 1.5x normal
  - Typical “dose” 15-30ml/kg − 3-6 units
  - Need ~30% clotting factor activity
- ABO compatibility required (Rh compatibility also needed for pregnant women)
- Needs 45 minutes to thaw
Cryoprecipitate

- What’s left over when you thaw FFP slowly
- Factors VIII, XIII, vWF, fibrinogen
- Indications
  - Microvascular bleeding in setting of fibrinogen < 100 (e.g., DIC)
- ABO compatibility unnecessary
- 1 U/kg if fibrinogen < 75
Massive Transfusion Protocol (MTP)

- Severe PPH requiring massive transfusion is an uncommon event.
- Not all of us have experience ordering blood products on a large scale.
- An MTP allows for the rapid, standardized mobilization of blood components.
- This frees clinicians to focus on management of hemorrhaging patient.
Treat Coagulopathy Early

- Hemorrhaging patients enter vicious cycle
- Hemorrhage $\rightarrow$ coagulopathy $\rightarrow$ hemorrhage $\rightarrow$ etc.
- Related to hypothermia, acidosis, hemodilution
- Early correction of coagulopathy with FFP, platelets results in improved survival in military and civilian trauma patients$^{13,14,15}$
Evolution of MTPs$^{13,14,15}$

- During wars in Iraq/Afghanistan, observed improved survival when plasma and platelets given early in resuscitation of hemorrhage
- This led to development of 1:1:1 ratio of PRBC:FFP:Plt
- Results confirmed in civilian trauma pts although ratios slightly different
Benefits of MTPs$^{13,14,15}$

- Decreased mortality
- Shorter ICU/hospital stay
- Shorter vent duration
- Decreased total blood product use
- ? “Survivor bias” ?
- No large trials for OB/PPH pts yet...
UH MTP: Indications

- Massive blood loss with profound shock
- Refractory hypotension not responsive to 40 ml/kg PRBC
- ↑PT, ↓fibrinogen, ↓platelets during resuscitation of profound hemorrhage
UH MTP: Implementation

- Can be used anywhere in hospital
- Initiated by attending (OB or anesthesia)
- 42800
- Need sample (T&C or T&S)
- Emergency release blood available
  - 4U O(−) PRBCs from BB
  - 2U O(−) PRBCs on L&D
- CMV negative if antepartum
UH MTP: Logistics

- 45 minutes to get blood
- Call for next cooler
  - BB starts preparing next cooler as soon as previous was sent
# UH MTP

<table>
<thead>
<tr>
<th>Cooler</th>
<th>RB</th>
<th>FFP</th>
<th>Plt</th>
<th>Cryo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>–</td>
</tr>
<tr>
<td>≥3</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
## OB MTP Example – University of Cincinatti

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<td>–</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>10</td>
</tr>
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<td>6</td>
<td>4</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
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- **Stanford**: 6:4:1 ratio of PRBC:FFP:PLT
  - (1 apheresis platelet unit = 5 pooled units)
Early FFP, Platelets Improve Trauma Mortality

- Optimal FFP:RBC Ratio: 1 to 1.0 - 2.0
- Optimal platelet:RBC Ratio: 1 to 1.5 - 2.5


UH-CMC

Bar graph showing mortality rates for different plasma:RBC ratio groups:
- Low (1:8): 65%
- Medium (1:2.5): 34%
- High (1:1.4): 19%

Graph showing predicted probability of FFP:RBC at 6 hours:
- Upper Quartile
- Median
- Lower Quartile

UH-CMC

Conclusion

- PPH remains significant cause of morbidity/mortality
- Successful management of PPH requires coordination between services, blood bank
- Use of massive transfusion protocol may lead to improved patient outcomes and conservation of scarce resources
References

3. California Maternal Quality Care Collaborative (CQMCC)
5. University of Cincinnati, Department of Ob/Gyn, 10/22/2009
THE END