Resuscitation Using Whole Blood: From Trauma to OB

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Disclosures

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Blood transfusion as a predictor of injury mortality

- 1 in 400 injured people die
- 1 in 50 of the hospitalized injured die
- 20% of transfused injured die
- 40% of injured who receive more than 10 U RBC die
Hemorrhage and Shock

- Sometimes it can be easy to spot
- The longer in shock, the more likely to die
- It takes a human being very little time to bleed to death
  - ~22 minutes from penetrating injury
    - This could be internal and/or external
  - ~28 minutes from blunt injury
    - Most often this is ‘hidden bleeding’ internally
- Define Massive Transfusion
  - ≥10u PRBC 24 hrs vs 5u/60 minutes = same mortality
For patients experiencing life threatening bleeding, massive transfusion (MT) is required:

- packed red blood cells (pRBC)
- plasma (P)
- platelets (PLT)
- cryoprecipitate (Cryo)
Whole blood for hemostatic resuscitation of major bleeding

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- Logistical, economic and clinical benefits of cold stored low titer type O whole blood
- Cold stored for up to 21 days
  - Platelets OK
- Improved function compared to 1:1:1
LOW TITER GROUP O WHOLE BLOOD IN EMERGENCY SITUATIONS

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Conclusion: Low titer Group O is preferred alternative for emergency transfusions where safe ABO identical transfusions cannot be ensured
American Association of Blood Bankers October 2017

• Board approves petition to allow low titer group O whole blood as standard product without need for waiver

• Low titer defined locally

• No limit on amount of whole blood when used

• Transformational paradigm shift
Experience and Extrapolation

• 1 January 2015 to 31 August 2017 (32 months) UHS evaluated 16,947 trauma patients.
• 715 of these patients (4.2%) received 1244 units of emergency release blood products (this is before whole blood was available)
  • Red cells = 584
  • Plasma = 364
  • Platelets = 257
  • Other = 39
Experience and Extrapolation

- 289 of those patients died (40%) with an average Injury Severity Score (ISS which has a range of 0-75) of 22
- 124 (17% of emergency release blood product patients and 0.2% of the total) adults required a massive transfusion
  - The mortality in this group was 76%
  - DOA’s were excluded (no Lazarus effect)
Hypothesis

- Lack of adequate blood resuscitation in remote regions of STRAC
- Very high mortality in current MTP environment
- No agreed upon transfusion triggers
- No standard hemostatic resuscitation
- No early hemostatic resuscitation
Answers

• Cold stored whole blood

• Prehospital transfusion protocols need to be written and implemented
Component Therapy vs. Whole Blood

Component Therapy Gives You
1U PRBC + 1U PLT + 1U FFP + 10 pk Cryo =
- 660 mL
- Hct 29%
- Coag activity 65%
- 750 mg fibrinogen

Whole Blood
- Hct: 38-50%
- Plt: 150-400K
- Coags: 100%
- 1500mg Fibrinogen
RBC’s vs Whole Blood
Advantages of Whole Blood

- Natural
- Organic
- Non-GMO
- Free range
- Gluten Free
- High in protein
- Low in carbs
Rh Isoimmunization

- Of the 124 patients receiving MTP
  - 26 were women (21%)
  - 18 were age 18-50 (14%)
  - 10 of those 18 died (55%)
  - 16 of the 18 had a type and screen/cross (89%)
  - 1 was Rh negative (6.3%) (she lived)
- Published rate of isoimmunization in Rh- woman 3-6%
Rh- Data

- Risk of isoimmunization of 0.012 and 0.12 patients/year
- Would take 3000 months (250 years) to have 100 Rh- women of childbearing age receive LTO+WB, and somewhere between 3 and 30 of them would develop isoimmunization without the administration of RhIg
- Without transfusion of LTO+WB in the pre-hospital setting over this time period, nearly 500 women of childbearing age would die of hemorrhage
BROTHERS IN ARMS

TRANSFORMING TRAUMA CARE
Prehospital Cold Stored O+ Whole Blood in San Antonio

- Kicked off January 29 2018
- 18 helicopters
- 2 units each
- Mayo criteria for transfusion
- Women of child bearing age not excluded
- Rh isoimmunization risk versus bleeding to death
### Whole Blood Transfusion Criteria

<table>
<thead>
<tr>
<th>Transfusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetrating Trauma (requires 1 physiologic parameter)</td>
</tr>
<tr>
<td>Blunt Trauma (requires 1 physiologic parameter)</td>
</tr>
</tbody>
</table>

#### Physiologic Parameters

- Patient age ≥ 5
- Single reading of systolic blood pressure (SBP) < 90 mm Hg
- Single reading of heart rate (HR) > 120
- Shock index > 1
- Pulse Pressure < 45
- Positive focused assessment with sonography in trauma (FAST)
- Point of care lactate greater than 5.0 mg/dl
- Known or presumed anticoagulant use; or dual anti-platelet therapy
- Signs of hemorrhage: (high index of suspicion of active internal bleeding or visual evidence of external bleeding)
Hot off the Presses:
1 u LTO+WB saves 2 lives

- 1st week of January
  - SAEMS responds to woman down in bathtub
    - 38 weeks pregnant (G3P2)
    - Hemorrhaging
    - SBP = 60
  - SAEMS MOF transfuses 1u LTO+WB
    - On hospital arrival SBP = 85, 2 more units PRBC
    - Stat C-section for placenta previa, A+ blood type
- The next day
  - Mom and baby doing well
Contemporary work by Pokorny
First Year in Whole Blood Era

• **Component therapy emergency transfusion**
  • Death rate in trauma room = 24%
  • Time to death = 1 ½ hours

• **Whole blood as emergency transfusion**
  • Death rate in trauma room = 11%
  • Time to death = 5 ½ hours
Obstetric Hemorrhage and Massive Transfusion
Postpartum Hemorrhage

• Definition $>500$ mL vaginal delivery or $>1000$ mL cesarean section
  • ACOG reVITALize $\geq 1000$ mL in 24 hrs or hypovolemia
• PPH has been widely recognized as a major cause of maternal mortality worldwide
  • Early mortality (within 24 hours)
  • 1 woman dies of PPH every 4 minutes worldwide and PPH is increasingly frequent
  • PPH rate over past 20 years from 1.5 to 4%
WOMAN Trial
World Maternal Antifibrinolytic

- 200 hospitals, 21 countries > 20,000 women
- TXA for PPH
- 10,000 women got TXA, 10,000 placebo
  - No difference in hysterectomy
  - Significant decrease in hemorrhage deaths with TXA, especially if within 3 hours of delivery
WHO Recommendations

- Uterotonic in 3rd stage of labor
- Tranexamic acid for refractory bleeding
- Aortic occlusion
- Angioembolization
- Surgical intervention
- Isotonic crystalloids, not colloids
- NOTHING about transfusion
• Finding #2 — The leading causes of pregnancy-related death in 2012 included cardiovascular and coronary conditions, obstetric hemorrhage, infection/sepsis, and cardiomyopathy.
  • 76 percent of all pregnancy-related deaths.

• Finding #5 — Most pregnancy-related deaths were potentially preventable.
  • Case review found that the majority of pregnancy-related deaths caused by cardiovascular disease, obstetric hemorrhage, and infection/sepsis were preventable.

• Finding #8 — Hemorrhage and Cardiac Event were the two most common causes of death while pregnant or within 7 days postpartum.
  • Of the 80 deaths that occurred while a woman was pregnant or within 7 days postpartum, hemorrhage & cardiac event accounted for 36% of these deaths.
• Finding #14 — Obstetric hemorrhage was the leading cause of severe maternal morbidity.

• Finding #15 — Black women are at a higher risk of severe maternal morbidity involving obstetric hemorrhage.

• Finding #16 — Rates of SMM due to obstetric hemorrhage disorders varied by county.
  
  • DSHS estimated the rate of SMM due to obstetric hemorrhage. Based on CDC recommendations, this rate was determined by the number of times blood was given to a woman in labor per 10,000 delivery hospitalizations.
Recommendations

- **Recommendation #4** — Promote a **culture of safety and high reliability** through implementation of best practices in birthing facilities.
  - The Task Force found a number of **provider and facility factors** associated with maternal death including failure to recognize risk status, delays in diagnosis, and delays in implementation of appropriate treatment.
  - DSHS and its partners have begun implementation of the maternal safety initiatives of **TexasAIM**, which address both hemorrhage and severe hypertension. The TexasAIM initiative also includes education and implementation of the **Maternal Early Warning Systems (MEWS)** which prompts early diagnosis and intervention.

- **Recommendation #5** — Identify or develop and implement **programs to reduce maternal mortality** from cardiovascular and coronary conditions, cardiomyopathy and infection/sepsis.
  - The Task Force recommends identification and implementation of **best-practice programs** to reduce risks of maternal death from these conditions.

University Hospital Experience

- 2 years, over 7000 deliveries
- 600+ women transfused in first 24 hours following delivery
  - Over 10% required MTP
- MTP patients
  - Greater length of stay/ICU
  - Greater rate of fetal death
  - Greater rate of hysterectomy
<table>
<thead>
<tr>
<th>Condition</th>
<th>MTP</th>
<th>Non-MTP</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported PPH</td>
<td>53 (72.6%)</td>
<td>163 (30.35%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Placenta Previa</td>
<td>12 (16.44%)</td>
<td>20 (3.73%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Placenta Acreta</td>
<td>8 (10.96%)</td>
<td>9 (1.68%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Placenta Increta</td>
<td>2 (2.74%)</td>
<td>1 (0.19%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Placenta Percreta</td>
<td>9 (12.33%)</td>
<td>2 (0.37%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Placental Abruption</td>
<td>8 (10.96%)</td>
<td>36 (6.73%)</td>
<td>0.191</td>
</tr>
</tbody>
</table>

Distribution of patient characteristics between MTP and Non-MTP groups.
### Distribution of blood types between MTP and Non-MTP groups

<table>
<thead>
<tr>
<th>Blood type</th>
<th>MTP</th>
<th>Non-MTP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>25 (34.25%)</td>
<td>140 (26.07%)</td>
<td>165 (27.05%)</td>
</tr>
<tr>
<td>A-</td>
<td>0 (0%)</td>
<td>6 (1.12%)</td>
<td>6 (0.98%)</td>
</tr>
<tr>
<td>AB+</td>
<td>2 (2.74%)</td>
<td>15 (2.79%)</td>
<td>17 (2.79%)</td>
</tr>
<tr>
<td>B+</td>
<td>8 (10.96%)</td>
<td>51 (9.5%)</td>
<td>59 (9.67%)</td>
</tr>
<tr>
<td>B-</td>
<td>0 (0%)</td>
<td>7 (1.3%)</td>
<td>7 (1.15%)</td>
</tr>
<tr>
<td>O+</td>
<td>36 (49.32%)</td>
<td>296 (55.12%)</td>
<td>332 (54.43%)</td>
</tr>
<tr>
<td>O-</td>
<td>2 (2.74%)</td>
<td>22 (4.1%)</td>
<td>24 (3.93%)</td>
</tr>
</tbody>
</table>
Multivariate Analysis

- Age > 35
- Percreta/Acreta/Increta
- Previa
- Uterine atony

Statistically significant predictor of need for PPH MTP

NOT statistically significant predictor of need for PPH MTP
Hypothesis

• Lack of adequate blood resuscitation in OB PPH resuscitation
• Many MTP’s, no agreed upon ratios
• No agreed upon transfusion triggers
• No standard hemostatic resuscitation
• No early hemostatic resuscitation
• No use of aortic occlusion
• No use of TXA
Answers

• Develop and implement transfusion protocols
  • Cold stored whole blood as initial emergency transfusion
  • TXA if transfusion initiated
  • Access femoral artery in high risk cases
    • Easy/rapid deployment of aortic occluding balloon
LTO+WB

- 93% of our patients are Rh+
- Plan to use same LTO+WB as is used for trauma patient
- If high risk patient admitted ahead of scheduled delivery
  - Direct crossmatch and set units aside
  - If Rh-, draw 4 units O-WB, crossmatch and set units aside
Follow Up

- Close performance improvement
  - Study each patient proactively
  - Safety review at 30 days and at 25 patients
  - Modify program as needed based upon incidents or trends
    - Is 4 units of whole blood enough? Too much?
    - Waste of blood?
    - Antibody development?
    - ICU and overall length of stay
    - Complications
Benefits

- Decrease recipient exposure to multiple donors
- Most physiologic and hemostatic agent
- May (should) decrease rate of need for MTP
- Shorter ICU and overall LOS
### Clinical References/Resources

www.strac.org/blood

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### Pre-Hospital Blood Product Transfusion Record

<table>
<thead>
<tr>
<th>Product Unit Number</th>
<th>Product Type (Circle One)</th>
<th>Transfusion Date &amp; Start Time</th>
<th>Transfusion Complete* (Circle One)</th>
<th>Transfusion Reaction** (Circle One)</th>
<th>MedRec/Initilas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRBC / Plasma / LTOWS</td>
<td>Yes / Ongoing</td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>PRBC / Plasma / LTOWS</td>
<td>Yes / Ongoing</td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>PRBC / Plasma / LTOWS</td>
<td>Yes / Ongoing</td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>PRBC / Plasma / LTOWS</td>
<td>Yes / Ongoing</td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Blood product transfusion is ongoing at time of patient transfer to hospital; document "Ongoing"**

**Document actions taken in "Comments" section**

**Actions to Take for Suspected Transfusion Reaction**
- STOP TRANSFUSION
- Disconnect tubing from infusion site; flush line with normal saline
- Keep IV line open with normal saline
- Re-institute new transfusion if it is deemed clinically essential
- Document actions taken in comments section

### Patient Identification:

Run/MRN #:

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Visit strac.org/blood for FAQs & More Information

This card can be given to receiving facilities
References

- https://apps.who.int/iris/bitstream/handle/10665/75411/9789241548502_eng.pdf;jsessionid=056E99DEE2B321D808D5E4CC456B0F7B?sequence=1
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2680565/
References

- Lin, Lin MD; Chen, Yan-Hong MD; Sun, Wen MD; Gong, Jing-Jin MM; Li, Pu MM; Chen, Juan-Juan MD; Yan, Hao MD; Ren, Lu-Wen MM; Chen, Dun-Jin MDRisk factors of obstetric admissions to the intensive care unit: An 8-year retrospective study. Medicine. 98(11):e14835, March 2019.
Thank You!

Questions?
Contact

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