Overview and Complications of Transfusion

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Special thanks to:

Jeremy Perkins, MD
Chief, Hematology-Oncology Service
John P. Murtha Cancer Center
Walter Reed National Military Medical Center
for contribution to this presentation
The presenter does not have financial relationships with any commercial interests.

"Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the U.S. Army of the Department of Defense."
Objectives

• Recognize that a restrictive blood transfusion strategy should be the standard of care.

• Associate blood transfusions with a multitude of adverse effects and worsened outcomes.

• Change their own and their hospital's transfusion practice
A 48 year old gentleman returns for his third cycle of CHOP-rituximab for diffuse large b-cell lymphoma. He complains of fatigue, but denies dyspnea or palpitations and is otherwise maintaining his usual active lifestyle.

His CBC shows:

- WBC 4,500/microL
- Hemoglobin 8.5 g/dL
- Platelets 250,000/microL
What is the most appropriate therapy for this patient’s fatigue?

A. No intervention
B. Transfuse 2 units of packed RBC’s
C. Initiate therapy with epoeitin alfa once every 3 weeks
D. Initiate therapy with darbopoetin once every 3 weeks
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Transfusion Triggers
Transfusion thresholds
Appropriate for “stable”/ICU patients
(NOT appropriate for exsanguinating patients)

RBC Transfusion
• HGB < ? For “asymptomatic” anemia in healthy pts
• HGB < 7.0 g/dL for ICU patients
• HGB < 9.0 g/dL pre-op/anticipated further blood loss
• HGB < 10.0 g/dL for acute coronary syndrome
• Acute Trauma - use clinical judgment – do not wait for labs
Multicenter RCT (25 ICUs across Canada)
Subjects: **Euvolemic** patients with Hgb ≤ 9.0, within 72 hrs of ICU admission (n=838)
Liberal: Transfusion trigger Hb <10.0
Restrictive: Transfusion trigger Hb < 7.0

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>LIBERAL</th>
<th>RESTRICTIVE</th>
<th>p VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient number</td>
<td>420</td>
<td>418</td>
<td></td>
</tr>
<tr>
<td>In-Hospital mortality</td>
<td>28.1%</td>
<td>22.2%</td>
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<tr>
<td>30-day mortality</td>
<td>23.3%</td>
<td>18.7%</td>
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<tr>
<td>MODS*</td>
<td>11.8 ± 7.7</td>
<td>10.7 ± 7.5</td>
<td>0.03</td>
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<tr>
<td>LOS ICU (days)</td>
<td>11.5 ± 11.3</td>
<td>11.0 ± 10.7</td>
<td>0.53</td>
</tr>
<tr>
<td>Hospital (days)</td>
<td>35.5 ± 19.4</td>
<td>34.8 ± 19.5</td>
<td>0.58</td>
</tr>
<tr>
<td>RBC (units)</td>
<td>5.2 ± 4.9</td>
<td>2.5 ± 3.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Transfusion Avoidance</td>
<td>0%</td>
<td>33%</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Transfusion thresholds
Appropriate for “stable”/ICU patients
(NOT appropriate for exsanguinating patients)

Plasma Transfusion

- No bleeding or planned invasive procedures
  - No specific transfusion trigger
- Active Bleeding or planned invasive procedure
  - Transfuse for PT > 17.0 or PTT > 55
- DIC with uncontrolled/diffuse oozing
- Coumadin reversal
- Plasma exchange for TTP or HUS
- Correction of KNOWN coagulation factor deficiencies for which no virus-safe fractionated product is available (Factor V, Factor XI)
- Massive transfusion protocol (uncontrolled hemorrhage)
Transfusion thresholds
Appropriate for “stable”/ICU patients
(NOT appropriate for exsanguinating patients)

Platelet Transfusion
- Platelet count < 10K
- Platelet count < 20 for febrile or “ill” patients, anatomy at risk for bleeding (tumor in stomach)
- Platelet count < 30 for patients requiring therapeutic anticoagulation (with heparin or Coumadin)
- PLT < 50K for invasive procedures or active bleeding
  - Most useful if given immediately prior to procedure
  - What is a useful “rule of thumb” for procedures requiring higher platelet count?

- PLT < 100 for neurosurgery, open heart, ophtho, or NICU neonates
- There is not minimum “threshold” if known platelet dysfunction and microvascular bleeding (could also consider giving DDAVP, antifibrinolytics (aminocaproic acid), estrogens)
- AVOID in HIT, DIC, PTP, TTP, or ITP unless risk of life-threatening bleeding
Cryoprecipitate

Indications:

• Fibrinogen < 150 mg/dL with bleeding
• +/- Massive transfusion protocols
• von Willebrand’s dz only when factor concentrates unavailable
• Hemophilia A if no factor concentrates

• Dose: 1 U/10 kg $\rightarrow$ 8-10 U for adult
• One U $\uparrow$ serum fibrinogen by 5-10
  – (10 units should increase by 50-100 mg)
What is associated with the highest risk of transmission through blood transfusion?

A. HTLV
B. Hepatitis C
C. HIV
D. Hepatitis B
E. Creutzfeldt-Jacob Syndrome
What is associated with the highest risk of transmission through blood transfusion?

A. HTLV
B. Hepatitis C
C. HIV
D. Hepatitis B
E. Creutzfeldt-Jacob Syndrome
Complications of Transfusion
Complications of Transfusion

• Infectious

• Non-Infectious
  – Immediate (<24 hours)
  – Delayed (>24 hours)
TRANSFUSION COMPLICATIONS

INFECTIOUS

- Complication
  - CMV
  - West Nile Virus
  - Parvovirus B 19
  - Bacterial Sepsis
  - Hepatitis B
  - HTLV 1, 2
  - Syphilis/Malaria/Chagas Dz
  - HIV - 1
  - Hepatitis C
  - SARS, Babesiosis, Ehrlichia, Leishmaniasis
  - Creutzfeldt-Jacob

- Risk (per unit)
  - Common depending upon immune status of patient
    - 1:500 – 1:10,000
  - 1:10,000
  - 1: 100,000 (platelets>RBC)
  - 1: 205,000 highest transmission via needle stick
  - 1 : 640,000
  - 1 :1,000,000
  - 1 : 2,100,000
  - 1 : 1,935,000
  - Unknown risk
  - Case reports in UK
Post-Transfusion Bacteremia

Bacterial contamination of blood products is more common than HIV, HBV, and HCV combined

**BaCon* study results**

Risk of Transfusion-Transmitted Bacteremia:
- Apheresis/Pooled platelets: 1 : 100 K
- Packed RBCs: 1 : 5 Million

Risk of Fatal Septic Transfusions:
- Apheresis/Pooled platelets: 1 : 500 K
- Packed RBCs: 1 : 7.5 Million

- **Gram positives (20)**
  - S. epidermidis* (8)
  - S. aureus (4)
  - S. agalactiae (2)
  - Group B Strep (1)
  - S. lugdenensis (1)
  - S. saprophyticus (1)
  - B. cereus (1)
  - E. faecalis (1)
  - S. pneumoniae (1)

- **Gram negatives (14)**
  - E. coli (5)
  - S. marcescens* (3)
  - S. liquefaciens* (2)
  - E. aerogenes (1)
  - E. cloacae (1)
  - P. rettgeri (1)
  - Y. enterocolitica (1)

7 of 9 deaths – Gram negatives
A 30 year old woman with severe anemia requires a blood transfusion. Shortly after the transfusion begins, she develops pain at the injection site, fever, chills and back pain.
What is the most likely cause of her current symptoms?

A. Bacterial contamination of blood
B. Cytokines from the donor white cells
C. Laboratory errors in compatibility testing
D. Transfusion of Rh negative blood
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A. Bacterial contamination of blood
B. Cytokines from the donor white cells
C. Laboratory errors in compatibility testing
D. Transfusion of Rh negative blood
What is the first step in caring for this patient?

A. Administer acetaminophen 650mg PO x 1
B. Stop the transfusion
C. Slow down the transfusion
D. Use a leukocyte filter
What is the first step in caring for this patient?

A. Administer acetaminophen 650mg PO x 1
B. Stop the transfusion
C. Resuscitate with normal saline
D. Use a leukocyte filter
Non-Infectious Complications
Non-Infectious Complications

Immediate

Within 24 hrs
• Immune
  – Acute hemolytic
  – TRALI
  – Anaphylactic
  – Febrile, nonhemolytic
  – Urticarial/Allergic
• Non-immune
  – Hypothermia
  – Circulatory overload
  – Hypocalcemia
  – Hyper / hypokalemia
  – Atypical hypotensive
  – Physical-chemical hemolytic
  – Air embolism

Delayed

Occurring >24 hrs
• Immune
  – Delayed hemolytic
  – HLA alloimmunization
  – Graft-vs-host disease
  – Post-transfusion purpura
  – Immunomodulation
• Non-immune
  – Iron overload
Acute Hemolytic Reaction

• 1:800,000 ABO incompatible are deadly (A → O, A → B)
  – As little as 30 mL of incompatible blood can cause reaction
  – 20 deaths/yr due to ABO incompatibility

• 1:33,000 ABO incompatible transfusions each year (by mistake)
  – Sometimes you are lucky and no major reaction
    (B → A or B → O or AB → A )

• 1:14,000 units/year ABO mis-labeled – but no major reaction (A → A but blood originally intended for another pt)

• Clerical errors occur both in blood bank (1/3) and outside of blood bank (2/3)

Acute Hemolysis - causes

• ABO – most common – Anti-A, Anti-B
• Also occasionally seen with
  – Rh – Anti-D, anti-C, anti-c, anti-e
  – MNS – Anti-S and anti-s
  – Kell
    • Severe – anti-K, anti-Ku severe
    • milder reactions – anti-k, anti-Kp\(^a\), anti-Kp\(^b\), anti-Js\(^a\), anti-Js\(^b\)
Acute Hemolytic Reaction (ABO Mismatch)

- Generally develops rapidly (minutes to a few hours)
- Severity directly related to volume of incompatible RBCs transfused
  - Can occur with as little as 10 cc transfusion.
  - As little as 30 cc has been fatal
- Fever is the most common early sign
- Symptoms
  - Chills/Rigors, Nausea/vomiting, sense of “doom”
  - Pain – IV site, severe back pain (renal), chest pain, dyspnea
- Signs (particularly important for unconscious/sedated patients as these may be the only clues)
  - Fever, inappropriate hypotension, tachycardia,
  - Dark/red urine (reflecting hemoglobinuria), renal failure
  - Generalized/coagulopathic bleeding due to associated diffuse intravascular coagulation (DIC).
Febrile, nonhemolytic reaction

• Most common transfusion reaction PLT > RBC
  • Defn: ↑ at least 1°C usually within 1 hr of transfusion*
    – +/- chills/rigors, +/- Headache, +/- nausea and vomiting
    – *If pre-transfusion temperature is subnormal, a return to normal during transfusion does not constitute this reaction.

• Etiology: Cytokines (interferons, interleukins) released from WBCs during storage or, once transfused, due to recipient anti-WBC or -HLA antibodies.

• Treatment/Prevention:
  – Premedicate with Tylenol +/- demerol for rigors
    • Unlikely to mask fevers from hemolytic reactions or bacterial contamination
  – Use leukocyte-reduced blood components
Urticarial/Allergic external reaction

- Hives and itching only – can be prevented with premedication with antihistamine

- Does NOT manifest with bronchospasm or hypotension

- Etiology: Proteins in the donors' plasma, food (eg, nuts, tomatoes), or medications (eg, penicillin) that donor ingested immediately before collection of blood

- Treatment – Diphenhydramine IV

- Does not require transfusion reaction “work-up”

- May restart after antihistamine relieves symptoms
Allergic reaction

• Cause similar to urticaria – only more severe
• Symptoms: Urticaria/Rash, Abdominal pain (intestinal edema) **Hoarseness/Stridor**, Chest pain
• Signs: Wheezing, Angioedema
• Send unit back to blood bank – get another
• Treatment of Wheezing:
  – IV Diphenhydramine, +/- IV H2 blocker (ranitidine)
  – Albuterol +/- O₂
• Treatment of Angioedema
  – Epinephrine 0.3 mL of a 1:1000 solution IM q3-5 min PRN
  – Early Intubation (before edema can make oral intubation impossible)
Anaphylactic Reaction

• Rare, but can be fatal

• **Acute, severe anaphylaxis** – SHOCK/Hypotension, +/- wheezing, +/- angioedema

• Usually seen in IgA deficient individuals (1:400-700) who have antibodies to IgA

• If inappropriate hypotension or shock are evident:
  – Intubation
  – Epinephrine 0.3 mL of a 1:1000 solution IM q3-5 min PRN
  – Fluid resuscitation and vasopressors (e.g. dopamine) as needed to maintain blood pressure
  – Consider giving methylprednisolone 125 mg IV
  – Use of washed cells for future transfusion
Washed Cells

- Washing removes plasma proteins (that 30 ml of plasma remaining) and extracellular electrolytes
  - Takes 20-30 minutes with automated machines
  - Decreases shelf-life (<24 hrs)
  - Increases risk of bacterial contamination

- Indications
  - H/O Anaphylactic rxn (e.g., IgA-deficiency)
  - H/O severe/recurrent allergic reactions to RBCs
  - Newborns to limit K, acid, and hemolyzed cells
A 50 year old gentleman is admitted to the hospital for an acute lower GI bleed. He is on anticoagulation with warfarin for atrial fibrillation and is noted to have an INR of 8. He is given FFP to reverse his INR.

Two hours later, he develops fever, hypotension and respiratory distress. A chest x-ray demonstrates bilateral pulmonary infiltrates.
What is the most likely cause of his hypoxia?

A. Transfusion-associated acute lung injury (TRALI)
B. Hospital-acquired pneumonia
C. Transfusion-associated circulatory overload (TACO)
D. Pulmonary embolism
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Transfusion Related Acute Lung Injury (TRALI)

• Non-cardiogenic pulmonary edema - usually from plasma/platelet infusion
  – Frequency in literature ranges from 1:300 to 1:5000 transfusions
  – Complex Dx in trauma – DDx pulmonary contusion, blood aspiration, fat emboli, CHF, volume overload

• Symptoms/Signs
  – Rapid dyspnea/desaturations usually within 1-2 hrs (always within 6 hours) of transfusion
  – X-ray findings - similar to ARDS - bilateral patchy alveolar infiltrates
  – Resolves in 48-96 hrs (CXR can take up to 7 days to clear)

• Prevention: At bedside – none
  – Defer female donors for plasma
Transfusion Related Acute Lung Injury (TRALI)

- Management:
  - Supportive – similar to ARDS
  - Milder cases - supplemental oxygen
  - Transfer to ICU/Intubation with mechanical ventilation often required
    - “Lung protective” modes (eg, low tidal volumes and plateau pressures)
  - Unlike ARDS, resolution occurs rapidly
    - Most can be extubated within 48 hours
    - CXR returns to normal within four to seven days
Immediate non-immune reactions
Hyperkalemia

• Approx 4-8 mEq free K+ per unit stored RBCs
  – K+ 12 mEq/L at 7 days, >32 mEq/L at 21 days
• Commonly seen in massive transfusions, hypotensive or poorly-perfused patients, renal failure, and neonatal transfusions
• Signs:
  – Early EKG changes: Peaked T-waves, short QT, and ST-depression
  – Later EKG changes: bundle-branch blocks, increased PR, decreased amplitude of the P wave, widened QRS → sine wave
  – Ventricular fibrillation, Asystole / Cardiac standstill
• Prevention:
  – Awareness of this complication!
  – Pull catheter back or use line farthest from right atrium (PIV, fem cordis)
  – Use fresher blood in MT (<14 days if possible)
  – Use Washed RBCs (generally not feasible in exsanguinating patients)
• Treat: CaCl, bicarb/THAM, 1 amp D$_{50}$/ 10u Reg Insulin → repeat PRN, +/− inhaled beta agonists
Hypocalcemia

• Citrate (anticoagulant) binds calcium – generally rapidly metabolized by liver

• Seen primarily with plasma-containing components (FFP & platelets) transfused at a rate of >100 ml/min

• Problematic in Liver Disease, & Shock (liver perfusion), Massive Transfusion

• Signs/symptoms:
  – Perioral or digital numbness/tingling in conscious patient
  – Decreased myocardial contractility
  – Prolonged QT interval on EKG
  – More susceptible to arrhythmias (e.g. hyperkalemia, hypothermia)

• Treatment:
  – Slow down transfusion, if non-trauma
  – CaCl – can also be given prophylactically for >8-10 units
  – CaCl Given in 2nd IV site (not transfusion line, will clot).
Hypothermia

- Blood stored at 4°C, plasma once thawed generally still cold
- Commonly seen in massive transfusions and exacerbated in trauma
  - Environmental and surgical exposure (evaporation, radiation, conduction, and convection)
  - Impaired temperature regulation from shock/anesthesia

- Signs/Complications:
  - **Coagulopathy** – platelet/coagulation enzyme dysfunction
  - **Arrhythmias** – Increased cardiac toxicity from hypocalcemia and hyperkalemia, may mask classic EKG changes!
  - Less effective defibrillation if unstable arrhythmias develop

- Prevention/Treatment:
  - With non-exsanguinating patients, slower rate of infusion
  - Convective warmers (Bair Huggers), Reflective Blankets
  - Warmed trauma/surgical suites
  - Blood warmers (Belmonts/Level 1 infusers)
TACO - Circulatory Overload

• Too much / too fast – Common!
• Signs/symptoms: CHF
• Approximately 1% of transfusion patients\(^1\)

• Treatment
  – Furosemide peri-transfusion
  – Transfuse units slowly (up to 4 hours allowed).
  – Consider transfusing split units for small patients

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Physical-chemical hemolysis

- **Thermal hemolysis:**
  - Microwaving RBC units
  - Malfunctioning blood warmer

- **Mechanical Hemolysis**
  - High pressure cuffs
  - Small bore Iv's
  - IO with pressure infusion

- Complications: poor HGB bump

- If marked hemolysis:
  - hemoglobinuria, hyperkalemia, arrhythmia, ARF – can mimic ABO mismatch

(Comment: All RBC units show mild hemolysis by end of shelf life, but not enough to cause clinical S/S.)
Osmotic hemolysis:

- Medications added to pRBCs
- Hypo or hypertonic crystalloids
  - $\frac{1}{2}$ NS = 154 mOsm/Liter
  - D5W = 252 mOsm/Liter
  - D5 $\frac{1}{2}$NS = 560 mOsm/Liter

Hemolysis, agglutination, and clotting can occur when RBCs are mixed with, infused together with the above fluids.

NS 0.9% = 308 mOsm/Liter is the only fluid approved for mixing with blood (anesthesia will argue LR is ok)
- LR = 273 mOsm/Liter (contains calcium = coagulation)
A 65 year old woman with metastatic lung cancer is receiving chemotherapy with gemcitabine. On cycle 4, day 1, she is noted to have severe anemia. Chemotherapy is held and she is transfused 1 unit of packed RBCs.

The next week, she returns with purpura and CBC is notable for platelet count <10,000/microL.
What is the most likely cause of her thrombocytopenia?

A. Cumulative chemotherapy toxicity
B. Post transfusion purpura
C. Disseminated intravascular coagulation (DIC)
D. HLA alloimmunization
What is the most likely cause of her thrombocytopenia?

A. Cumulative chemotherapy toxicity
B. Post transfusion purpura
C. Disseminated intravascular coagulation (DIC)
D. HLA alloimmunization
Delayed Adverse Reactions
Delayed hemolytic reaction

• Primary immunologic (serologic) reaction (DSTR):
  – Occurs usually weeks or months after transfusion.
  – No hemolysis observed, because by the time antibody develops, most senescent RBCs have been removed.

• Secondary (amnestic) hemolytic response (DHTR):
  – Occurs days (rarely, hours) after transfusion.
  – Sequence of events:
    • Transfusion in a previously transfused/pregnant patient whose antibody level is below detection in blood bank
    • At first DAT-, negative antibodies (circulating antibodies below threshold of detection).
    • Next Antibody screen positive (circulating antibody detected).
    • S/S of extravascular hemolysis – fever, ↓ Hct, mild jaundice
Delayed hemolytic reaction

• Destruction of transfused RBCs by antibodies other than ABO
  – Rh - Anti-D, anti-C, anti-c, anti-e
  – Kidd – COMMON . . . anti-Jk\textsuperscript{a}, anti-Jk\textsuperscript{b}, anti-Jk\textsubscript{3} (rare)
  – Diego - anti-Di\textsuperscript{a} and anti-Di\textsuperscript{b}
  – MNS – Anti-S and anti-s
  – Duffy – Anti-Fy\textsuperscript{a}, Anti-Fy\textsuperscript{b}

• Typically an **extravascular** hemolysis, as IgG- coated RBCs are ingested bite-after-bite by splenic macrophages.

• Peripheral smear shows spherocytes.
Delayed hemolytic reaction

- Once you make one antibody – you are more likely to make more antibodies in the future

- 2.6% pts developed an RBC antibody.
  - If previous RBC antibody (N=86) – 8.9% developed an additional RBC antibody (i.e. they are “antibody formers”)*

- The earlier the blood bank is aware, the better. Can also try to limit blood losses as best as possibly (?limit blood draws)

1995 study of 2,490 transfused patients (11,218 RBC units) prospectively followed for 7 days.
Immunomodulation

• Clinical observations
  – Renal transplants survive better with transfusions
• Associated with increased
  – Risk of infection
  – Increase risk of SIRS
  – Increase risk of acute lung injury/ARDS
  – Increased risk of multiorgan failure

• Theories/Mechanisms
  – Age of stored blood (older blood increases risk)
  – Bioreactive lipids with neutrophil priming
    • Red cell microparticles
    • Lysed WBCs from non-leukoreduced blood products
  – Foreign Antigen exposure
Risk of infection with transfusion in trauma patients

Fig. 1. Infectious episodes by ISS where low = <15, moderate = 15 to 24, and high = ≥25. * P < 0.001.
Aged RBCs assoc MOF and infection

Figure 1. The age of transfused blood was analyzed in patients who developed multiple organ failure (MOF+) and was compared with patients who did not develop MOF (MOF−). The age of transfused blood was significantly older in the MOF+ group (P < 0.05 compared with MOF−).

TABLE II
Results of Multivariate Analysis of Age of Transfused Blood as a Predictor of Postinjury Multiple Organ Failure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of blood, days</td>
<td>1.16 (1.02–1.32)</td>
<td>0.026</td>
</tr>
<tr>
<td>Number of units &gt; 14 days old</td>
<td>1.16 (1.01–1.34)</td>
<td>0.03</td>
</tr>
<tr>
<td>Number of units &gt; 21 days old</td>
<td>1.22 (1.06–1.41)</td>
<td>0.006</td>
</tr>
</tbody>
</table>


Table 3. Results Stratified by Total RBC Transfusion Requirement*

<table>
<thead>
<tr>
<th>Total RBCs: 6-10 U (n = 34)</th>
<th>Infection</th>
<th>No Infection</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Total RBCs</td>
<td>8.5 ± 0.40</td>
<td>7.7 ± 0.34</td>
<td>.12</td>
</tr>
<tr>
<td>RBCs &gt; 14 d old</td>
<td>7.8 ± 0.60</td>
<td>5.9 ± 0.60</td>
<td>.11</td>
</tr>
<tr>
<td>RBCs &gt; 21 d old</td>
<td>6.6 ± 0.72</td>
<td>4.8 ± 0.81</td>
<td>.11</td>
</tr>
<tr>
<td>Total RBCs: 11-15 U (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total RBCs</td>
<td>13.5 ± 0.5</td>
<td>13.1 ± 0.5</td>
<td>.67</td>
</tr>
<tr>
<td>RBCs &gt; 14 d old</td>
<td>10.5 ± 3.5</td>
<td>12.5 ± 0.6</td>
<td>.44</td>
</tr>
<tr>
<td>RBCs &gt; 21 d old</td>
<td>8 ± 3</td>
<td>11.4 ± 0.8</td>
<td>.19</td>
</tr>
<tr>
<td>Total RBCs: 16-20 U (n = 15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total RBCs</td>
<td>18.3 ± 0.6</td>
<td>19.3 ± 1.2</td>
<td>.46</td>
</tr>
<tr>
<td>RBCs &gt; 14 d old</td>
<td>17.4 ± 1</td>
<td>15 ± 2.9</td>
<td>.33</td>
</tr>
<tr>
<td>RBCs &gt; 21 d old</td>
<td>15 ± 1.4</td>
<td>7.3 ± 1.3</td>
<td>.02</td>
</tr>
</tbody>
</table>

*Values are mean ± SEM. RBC indicates red blood cell.
Post-transfusion purpura

- Rapid onset SEVERE thrombocytopenia
  - 90% have PLT < 10K with purpura &/or extensive, life-threatening hemorrhage
- Occurs 5-10 days following transfusion (usually of RBCs).
- PTP mostly in older women immunized by pregnancies or transfusions (HPA-1a negative). Also occurs sporadically in men
- Etiology: Recipient negative for a platelet antigen, usually HPA-1a (a.k.a. PlA1), and make antibodies to that antigen
- Antibodies destroy not only the transfused platelets, but also cross-react with their own. Mechanism unknown.
- Untreated mortality is 10% historically
- Treatment – IVIg 1-2 g/kg over 1-2 days is considered 1st line treatment or plasmapheresis (2nd line)
HLA alloimmunization

- Development of HLA antibodies due to multiple transfusions
- Shortened platelet survival often called “platelet refractoriness.”
- Defined or diagnosed as 2 consecutive poor one-hour corrected count increments (CCIs).

Explanation:
- Antibody production requires both Class I & II antigens. Platelets only have Class I antigens.
- WBCs have both Class I and II and thus stimulate immune response

Prevention – leukocyte-reduced blood components.
- Treatment – crossmatch-compatible platelets. Special request that takes 1-2 days to arrange.
Transfusion-associated Graft-vs-host disease

- Etiology: Transfusion of sufficient numbers of viable, immunocompetent cytotoxic T cells into:
  - an immunocompromised recipient, or
  - an immunocompetent recipient who is heterozygous for an HLA haplotype for which the donor is homozygous

- More common with “fresh” units (<96 hrs old).
- Occurs within 30 days of transfusion.
- Whole body erythroderma, desquamation, nausea, vomiting, diarrhea, liver dysfunction and bone marrow failure.
Transfusion-associated

Graft-vs-host disease

- Unlike marrow transplant GVHD, TA-GVHD is 99.9% fatal.
- Treat with aggressive immunosuppression/prayer - ? transplant
- Prevention – transfuse irradiated cellular blood components to immunocompromised pts and related-donors.
- Leukocyte reduction alone is not sufficient to prevent
Iron overload

• Arises from frequent RBC transfusions (thalassemias, sicklers, bone marrow failure) – not from transfusions secondary to blood loss
• 1 mg iron/ml RBCs ($\approx 225$ ml/unit). $100u$ symptoms, $250u$ life-threatening without chelation
• Indistinguishable from hemochromatosis – cirrhosis, pancreatic insufficiency, heart failure
• Ferritin commonly $> 2000$
• Consider chelation starting at 30 lifetime units
• Treatment/Prevention:
  – Minimize transfusions (epogen)
  – Avoid Iron to “treat the anemia” – potential medico-legal consequences
  – Pharmacologic iron chelation. Deferasirox (ExJade) oral or Desferoximine SQ 8-12 hour daily infusion
How does this change my practice?

• Understand that any transfusion has risks
• Understand that the risk of transfusion must be weighed against the benefit
• The Blood Usage Review Committee is the BEST place in the hospital to have a balanced discussion to determine hospital transfusion policy
Key Members of the Transfusion Committee

Multidisciplinary Approach

• Physician Committee Chair
• Senior Management
• Major Medical & Surgical Departments
• Nursing Services
• Blood Bank
• Pathology Laboratory
• Quality Management
• Risk Management/Legal
In summary

• A restrictive blood transfusion strategy is the standard of care.
• Transfusion reactions can be immediate or delayed.
• Bacterial infections are more common than viral infections.
• ABO mismatch causes an acute hemolytic reaction.
  – Stop the transfusion!
• The hospital’s blood utilization / transfusion committee is the best place to have a balanced discussion to determine hospital transfusion policy.
Thank you!