PATIENT BLOOD MANAGEMENT

An Evidence based Approach to the practice of Transfusion Medicine

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Florida Hospital, Orlando, Florida
NO CONFLICTS OF INTEREST
OUTLINE

• Transfusion Medicine: The Journey
• Definition of Patient Blood Management
• Evidence Background for Patient Blood Management Program
• How safe is “safe”? 
• Patient Blood Management: Florida Hospital Experience
• Blood Products & Transfusion Guidelines 101
• Optimizing Coagulation
1667: FIRST SUCCESSFUL HUMAN TRANSFUSION

• By Dr. Jean-Baptiste Denis in France using blood from a lamb…

• Several Deaths resulted in transfusion practices being banned for over a century…
1900: DISCOVERY OF THE A, B, O BLOOD GROUPS

Dr. Karl Landsteiner
BLOOD STORAGE: THE BLOOD BANK
• Heart Surgeon Dr. Denton Cooley reported his experience with blood conservation techniques

EVOLUTION OF TRANSFUSION MEDICINE
BLOOD MANAGEMENT

BLOOD SAFETY

TRANSFUSION SAFETY

BLOOD CONSERVATION
(DECREASE NEED FOR TRANSFUSIONS)
OUTLINE

• Patient Blood Management: Florida Hospital Experience
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A patient-centered, evidence-based and multidisciplinary approach to optimize the use of blood and blood related products and improve patient outcomes

http://www.who.int/bloodsafety/en/
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BACKGROUND

Over 21,000,000 blood related products are transfused in the US per year

The international consensus conference on transfusion outcomes. Transfus Med Rev. 2011 Jul;25(3) (1)
Over 21,000,000 blood related products are transfused in the US per year. Around 50% of all transfusions are considered inappropriate.
TRANSFUSIONS ARE RISKY

- Blood transfusions increases the risk for:
  - Pneumonia
  - ICU stay
  - Ventilator Time
  - Hospital acquired infections
  - Mortality

CONCLUSIONS:

- A restrictive strategy (<7 g/dl) of red-cell transfusion is at least as effective as and possibly superior to a liberal transfusion strategy (<10g/dl)

- ...With the possible exception of patients with acute myocardial infarction and unstable angina
Transfusion Strategies for Acute Upper Gastrointestinal Bleeding

Cándid Villanueva, M.D., Alan Colomo, M.D., Alba Bosch, M.D., Mar Concepción, M.D., Virginia Hernández-Gea, M.D., Carles Arscíl, M.D., Isabel Grauera, M.D., María Poca, M.D., Cristina Álvarez-Urturi, M.D., Jordi Gordillo, M.D., Carlos Guarner-Argente, M.D., Miguel Santaló, M.D., Eduardo Muñiz, M.D., and Carlos Guarner, M.D.

- 921 patients with upper GI bleeding
- Randomized to 2 transfusion strategies:

<table>
<thead>
<tr>
<th>Liberal (9 g/dl)</th>
<th>Restrictive (7 g/dl)</th>
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<tbody>
<tr>
<td>- Increased Mortality</td>
<td>- Increased Mortality</td>
</tr>
<tr>
<td>- Increased Bleeding</td>
<td>- Increased Bleeding</td>
</tr>
<tr>
<td>- Increased Portal Pressure</td>
<td>- Increased Portal Pressure</td>
</tr>
</tbody>
</table>

“...in patients with acute gastrointestinal bleeding, a strategy of not performing transfusion until the hemoglobin concentration falls below 7 g per deciliter is a safe and effective approach.”
A retrospective study evaluating single-unit red blood cell transfusions in reducing allogeneic blood exposure

M. Ma,* K. Eckert,† F. Ralley* and I. Chin-Yee‡ *University of Western Ontario, †London Health Sciences Centre, and ‡Canadian Blood Services, London Centre, London, Ontario, Canada

“Adopting a policy of transfusing RBC in single-unit aliquots could significantly improve RBC utilization and decrease patient exposure to allogeneic blood”
HOW SAFE IS SAFE?
RISKS OF TRANSFUSIONS

Fig. 2. Estimates of the current risk per unit of blood transfu-
TRANSFUSIONS ARE RISKY

Figure: Risks of major transfusion-transmitted viruses related to interventions, and accelerating rate of emerging infectious diseases of concern to blood safety.


- vCJD
- Trypanosoma cruzi
- PTLVs
- SFV
- WNV
- SARS
- Monkey pox
- Leishmania
- Influenza
- DENV
- Babesia
- CHIKV
- XMRV
Emerging infectious agents and the nation’s blood supply: responding to potential threats in the 21st century

Simone A. Glynn, Michael P. Busch, Roger Y. Dodd, Louis M. Katz, Susan L. Stramer, Harvey G. Klein, Graham Simmons, Steven H. Kleinman, and Susan B. Shurin for the NHLBI Emerging Infectious Disease Task Force convened November 7, 2011

1) Babesia
2) Dengue Virus
3) Variant CJD
4) ________?
COST ANALYSIS OF BLOOD TRANSFUSIONS

1985 $43

2004 $178

$154

http://www.americasblood.org/download/bloodcounts_v4_n1.pdf
COST ANALYSIS OF BLOOD TRANSFUSIONS

PATIENT BLOOD MANAGEMENT

IMPROVED PATIENT OUTCOMES

Optimizing Coagulation

Interdisciplinary Blood Conservation Modalities

Patient-Centered Decision Making

Managing Anemia

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PATIENT BLOOD MANAGEMENT
THE FLORIDA HOSPITAL EXPERIENCE
FLORIDA HOSPITAL PATIENT BLOOD MANAGEMENT STRATEGIC PLAN: FEBRUARY 2013

1) Assessment

2) Define organizational structure for PBM Committee

3) Standardization of Transfusion Practices

4) Decision Support Systems

5) Development of Blood Conservation Services

6) Clinical Integration
STANDARDIZATION OF TRANSFUSION PRACTICES (GUIDELINES)

Transfusion Guidelines, Massive Transfusion Guidelines, MSBOS
STANDARDIZATION OF TRANSFUSION PRACTICES (GUIDELINES)
DECISION SUPPORT SYSTEMS:
DISCERN ALERT MAY 2014- JAN 2015

- Alert fired 1,716 times (May-Jan)
- 390 times the Transfusion Order was cancelled (23%)

BLOOD CONSERVATION INITIATIVES

1) Decrease the need for Blood Transfusions (Anemia Management).
2) Decrease Blood Loss.

**Orthopedic Surgery**
- Pre-operative Anemia Management Program

**Florida Hospital for Children**
- Blood collection Optimization
- Laboratory Task Force

**Surgery**
- Hemostasis Optimization
- Clinical Consultation

**“Bloodless” Medicine**
- Bloodless Patient Consent & Consultation (Jehovah’s Witness)
Pathology Representative at:

- System Pharmacy & Therapeutics Committee
- Patient Blood Management Committee
- Blood Bank System
- PSQC (WPMH & FH East Orlando)
- FH Ambulatory Committee
- Transplant Institute Quarterly Meeting
- FH Bone Marrow Transplant Center QA/QI meeting
- Advisory Board Member Trans life
- System Perinatal High Reliability Committee
- FH Mortality Review Program
EVIDENCE-BASED EDUCATIONAL MEETINGS
PATIENT BLOOD MANAGEMENT

Optimizing Coagulation

Interdisciplinary Blood Conservation Modalities

Patient-Centered Decision Making

Managing Anemia

IMPROVED PATIENT OUTCOMES
PATIENT BLOOD MANAGEMENT

“It goes beyond the concept of appropriate use of blood products, because it prevents and significantly reduces the resort to transfusion by addressing modifiable risk factors that may result in transfusion long before a transfusion may even be considered”

DEVELOPMENT OF BLOOD CONSERVATION CLINICAL SERVICES

- **PRE-OPERATIVE**
  - Development of a preoperative hemoglobin optimization program
  - Decrease “Pre-surgical Anemia”
    - 5% to 75% of patients may present with preoperative anemia
    - 35% of patients scheduled for joint replacement surgery had a hemoglobin level less than 13 g/dL on preadmission testing

2. Getting Started in Patient Blood Management, AABB 2011
PRE-OPERATIVE ANEMIA MANAGEMENT

History and Physical examination
  • History of anemia
  • Bleeding history

Medications

Prepare the patient
  • Treat anemia
  • Treat Coagulation Disorders
DEVELOPMENT OF BLOOD CONSERVATION CLINICAL SERVICES

PERIOPERATIVE/HOSPITALIZATION

• Limiting Loss through Phlebotomy for testing
• Minimizing Perioperative Blood Loss
• Use of Point-of-Care Testing Devices
• Intraoperative Blood Recovery Techniques
• Making Evidence-Based Hemotherapy Decisions

2. Getting Started in Patient Blood Management, AABB 2011
LIMITING LOSS THROUGH RATIONAL LABORATORY ORDERING

## Average Phlebotomy-induced Blood Loss in Critically Ill Patients

<table>
<thead>
<tr>
<th>Reporting Country</th>
<th>Setting</th>
<th>Average phlebotomy-induced blood loss (mL/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Cardiothoracic ICU</td>
<td>377</td>
</tr>
<tr>
<td>United States</td>
<td>General Surgical ICU</td>
<td>240</td>
</tr>
<tr>
<td>United States</td>
<td>Medical Surgical ICU</td>
<td>41.5</td>
</tr>
<tr>
<td>Great Britain</td>
<td>First day in ICU</td>
<td>85.3</td>
</tr>
<tr>
<td>Great Britain</td>
<td>Following days</td>
<td>66.1</td>
</tr>
<tr>
<td>Europe</td>
<td>Medical ICUs</td>
<td>41.1</td>
</tr>
</tbody>
</table>

Fowler RA, Berenson M. Blood conservation in the ICU. Crit Care Med 2003;31:S715-720
**Anesthesia**

- Positioning intra and post operative
- Controlled hypotension
- Control of temperature
- Choice of ventilation patterns
- Choice of medications
- Timing of fluid administration
- Choice of anesthetic procedure
BLOOD CONSERVATION MODALITIES

• Blood Products: What to give, When to give

• Assessment of Hemostasis during Surgery
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BLOOD PRODUCTS AND SPECIAL NEEDS
**RED BLOOD CELLS**

- **Content**
  - RBCs: 200-250 mL
  - Plasma: <50 mL
  - WBCs: (109) and PLTs
  - Anticoagulant: 63 or 70 mL
  - Additive solution
  - 200-250 mg iron

- **Purpose**
  - Improve oxygen-carrying capacity
  - Decrease percent of hemoglobin S in sickle cell disease
  - Improve symptoms related to acute anemia secondary to hemorrhage

- **What to expect**
  - Hgb should increase 1 gm/dL and HT by 3% with each unit
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APHERESIS PLATELETS

• **Content**
  - PLTs: $3.0 \times 10^{11}$ in 90%
  - Plasma: 100-150 mL
  - WBCs: less than $5.0 \times 10^6$
  - pH: 6.2 or more (90%)
  - 1 unit for AD-PLTs is equivalent to six for WBD-PLTs

• **Purpose**
  - To Control or prevent bleeding associated with platelet deficiencies or dysfunction

• **What to expect**
  - For each apheresis unit, expect to see a rise in platelet count of 20,000-30,000 (if patient not actively bleeding)
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PLASMA PRODUCTS

- **Content**
  - All coagulation factors
  - Fibrinogen: 400 mg
  - 1 IU/ml of all others
  - Almost no viable WBCs
  - No QC testing

- **Purpose**
  - A plasma transfusion increases the prevents blood loss by increasing the amount of blood-clotting factors.

- **Dosage**
  - Adults: 10-20 mL/Kg
  - Neonates: 10-15 mL/Kg

- **What to expect**
  - Standard dose increases factor levels by about 20-30% in a 70 Kg person

VITAMIN K SHOULD ALWAYS BE USED BEFORE FFP FOR AN INCREASED INR UNLESS NEED FOR CORRECTION IS URGENT.
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CRYOPRECIPITATE

- **Content**
  - Fibrinogen: 150 mg or more
  - Factor VIII: 80 IU or more
  - vWF: 80-120 IU
  - Factor XIII: 40-60 IU
  - Fibronectin

- **Purpose**
  A plasma transfusion increases the prevents blood loss by increasing the amount of blood-clotting factors.

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  10 bags deliver about 2500 mg of fibrinogen in about 150 ml of volume
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Volume: 15 mL
IRRADIATION

- Irradiation dose deactivates T-lymphocytes
- Prevent transfusion-associated graft vs. host disease.
- **Radiation dose**
  - 1) 2500 cGy ("rad") dose required targeted to center of bag, with at least 1500 cGy in all parts of the bag
- **Storage:** 28 days after irradiation or regular exp date
• Hereditary Immunodeficiency.

• Immunosuppression or Imminent Immunosuppression from Hematopoietic Cell Transplant, Solid Organ Transplant, and Cytotoxic Chemotherapy.

• History of treatment with Purine analogs and related drugs:
  • Fludarabine.
  • 2 CDA (cladribine).
  • Deoxycoformycin (pentostatin).
  • Clofarabine (clolar).
  • Bendamustine (treanda).
  • Nelarabine (arranon).

• History of treatment with Alemtuzumab (anti-CD 52).

• Hodgkin's Disease and other Hematologic Malignancies.

• Intra Uterine Transfusion.

• Blood product donated by family member.

• Blood product from HLA-selected donor.

• Blood product from directed donor whose relationship to recipient's family has not been established.

• Granulocyte Transfusion.
WASHING

- **Washing**
  - 1-2 L of saline removes about 99% of plasma.
  - Generally takes one to several hours (automated)

- **Shelf life**
  - 1) Red cells: 24 hours post-wash
  - 2) Platelets: 4 hours post-wash

- **Indications:**
  - 1) Removal of plasma proteins for hypersensitivity (RBCs and platelets)
  - 2) Neonatal alloimmune thrombocytopenia (NAT, NAIT, FNAIT)
  - 3) Removal of unwanted electrolytes (RBCs/PLTs)
WASHING

- Severe or recurrent allergic reactions (e.g., hives) associated with red blood cell transfusions felt triggered by donor plasma proteins.

- Paroxysmal Nocturnal Hemoglobinuria (PNH).

- Ig A deficiency for whom Ig A negative donors are not available.

- Individuals susceptible to hyperkalemia.

- Patient with complement dependent autoimmune hemolytic anemia to prevent complement infusion.
GENERAL PRINCIPLES OF MANAGEMENT
ANTICOAGULANT-ASSOCIATED BLEEDING
### GENERAL PRINCIPLES OF MANAGEMENT OF ANTICOAGULANT-ASSOCIATED BLEEDING

<table>
<thead>
<tr>
<th>H</th>
<th><strong>Hold further doses of anticoagulant (or anti-platelet agent)</strong></th>
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<tbody>
<tr>
<td>A</td>
<td>Consider <strong>Antidote</strong> (e.g. Vitamin K, protamine)</td>
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<tr>
<td>S</td>
<td><strong>Supportive treatment:</strong></td>
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<tr>
<td></td>
<td>• volume resuscitation, inotropes as needed</td>
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<td></td>
<td>• optimize oxygenation</td>
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<tr>
<td>H</td>
<td><strong>Hemostatic measures:</strong></td>
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<tr>
<td></td>
<td>• Local or topical agents (fibrin glue, sealants, hemostatic agents, topical aminocaproic acid or tranexamic acid)</td>
</tr>
<tr>
<td></td>
<td>• Systemic hemostatic measures (intravenous tranexamic acid)</td>
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<tr>
<td></td>
<td>• Surgical intervention</td>
</tr>
<tr>
<td></td>
<td>• Interventional radiology, e.g. embolization</td>
</tr>
<tr>
<td>T</td>
<td><strong>Transfusion</strong></td>
</tr>
<tr>
<td></td>
<td>• Red cells, platelets, FFP, cryo as indicated</td>
</tr>
<tr>
<td></td>
<td>• Factor concentrates: Factor VIIa, Prothrombin Complex Concentrate (PCC), FEIBA</td>
</tr>
<tr>
<td>I</td>
<td><strong>Investigate for bleeding source</strong></td>
</tr>
</tbody>
</table>
TRANSFUSE OR NOT TRANSFUSE?

Very Clear Indication
For Transfusion

No Indication
For Transfusion
TRANSFUSE OR NOT TRANSFUSE?

1) Benefits

1) Known Infectious risks
2) Unknown Infectious Risks
3) Reactions
4) Cost

Very Clear Indication For Transfusion

No Indication For Transfusion
THANK YOU

Juliana.Gaitan.md@flhosp.org