**Blood Management**

AmSECT: 57th International Conference

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**Topics**

- Cardiovascular Services at COA
- Irradiation
- Transfusion Complications
  - TA-GVHD
  - TRALI
  - TACO
  - Transfusion Reactions
- Blood Products
  - Directed Donor
  - Fresh RBCs
  - Whole Blood
  - Autologous Blood
- Laboratory Delays and Errors

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**Cardiovascular Services at COA**

- 3 CV Operating Rooms
- 3 Cath Labs
- 20 Bed ICU
- 25 Bed Step Down Unit
- CV Lab

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**CV Lab – Blood Bank**

- Store blood products for CVICU and CVOR
- Emergency release
  - RBC
  - Platelets
  - FFP
CV Lab - Coagulation Testing

- PT
- PTT
- Fibrinogen
- Anti-Xa
- ATIII
- D-dimer

CV Lab

- Platelet Count
- H&H
- Plasma Free Hemoglobin

CV Lab - Thrombelastograph

Irradiation – What and Why

- Blood components treated with radiation to inactivate WBCs
- Prevents Transfusion Associated Graft-versus-Host Disease
  - Occurs when donor lymphocytes mount an immunologic attack against the recipient tissues and there is no counter attack
**TA – GVHD Clinical Features**

- Occurs 2 days to 6 weeks after blood transfusion
- Clinical features include:
  - Fever
  - Rash
  - Liver damage
  - Gastrointestinal complications
  - Bone marrow aplasia leading to pancytopenia
- Rare (fewer than 1 per million transfusions)
- Fatal in more than 90% of cases

**TA-GVHD – Risk Factors**

- Patients receiving blood products with a high degree of HLA homogeneity between donor and recipient
  - Blood relatives - 1st or 2nd degree
  - Certain countries (Japanese and Israeli)
  - HLA compatible donors
- Fetal and neonatal recipients of intrauterine transfusions
- Selected immunocompromised recipients
- Recipients who have undergone bone marrow or stem cell transplant

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**Transfusion vs. Transplantation GVHD**

<table>
<thead>
<tr>
<th>Transfusion of Cellular Blood Products</th>
<th>Transplantation of Bone Marrow Stem Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare</td>
<td>Common – Roughly 30% or higher in unrelated donors</td>
</tr>
<tr>
<td>Affects bone marrow</td>
<td>Does not usually affect bone marrow</td>
</tr>
<tr>
<td>&gt; 90% fatality</td>
<td>10-20% fatality</td>
</tr>
<tr>
<td>Occurs when transfused with HLA matched blood products</td>
<td>Occurs when transfused with HLA mis-matched stem cells/bone marrow</td>
</tr>
<tr>
<td>Prevented by irradiation</td>
<td>Prevented by drugs and/or T-Cell depletion</td>
</tr>
</tbody>
</table>

**TA-GVHD – History**

- 1958: First GVHD in chick embryos
- 1955: POE in Japanese patients
- 1959: Secondary Syndrome after bone marrow transplant
- 1965: TA-GVHD in immunocompetent patient
- 1970’s: Irradiation started for selected patients in US
- 1992: First guidelines to prevent TA-GVHD

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1916: First GVHD in chick embryos
1955: POE in Japanese patients
1959: Secondary Syndrome after bone marrow transplant
1965: TA-GVHD in immunocompetent patient
1970’s: Irradiation started for selected patients in US
1992: First guidelines to prevent TA-GVHD
What Blood Products Need Irradiation?

- Only done on *cellular* blood products
- FFP and Cryo are NOT irradiated
  - The number of viable cells is not enough to cause TA-GVHD
  - T cells may not survive the freeze thaw cycle
  - To date, there has not been any confirmed cases of TA-GVHD from FFP or Cryo transfusions

Irradiation Logistics

- Operational costs
- Space constraints
- Possible time delays
- Damage to RBCs
  - Shortens expiration to 28 days from irradiation

TRALI

- Transfusion Related Acute Lung Injury
- Currently the most common cause of transfusion associated death
- Characterized by the following within 6 hours of transfusion:
  - Fever and chills
  - Respiratory failure
  - Hypotension
  - Pulmonary edema
- Most often caused by HLA or neutrophil antibodies in donor plasma

TRALI Prevention

- In 2006 there were 35 fatal TRALI cases
  - 22 linked to FFP
- The 29th Standards for Blood Banks and Transfusion Services required that plasma and whole blood donations only come from:
  - Males
  - Never-pregnant females
  - Females who have tested negative for HLA antibodies
- TRALI is now on the decline
Transfusion Associated Circulatory Overload
- Occurs within 6 hours of transfusion
- Mostly associated with RBC transfusion
- Risks factors
  - Older than 70 years
  - Infants
  - Severe anemia
  - CHF

Clinical Features
- Acute respiratory distress
- Elevated BNP
- Elevated central venous pressure
- Positive fluid balance
- Pulmonary edema
- Treated with diuretics or therapeutic phlebotomy

Febrile Nonhemolytic Reaction
- Fever/chills

Allergic Reaction
- Swelling
- Flushing
- Hypotension
- Rash/hives
- Itching
- Respiratory Distress

Hemolytic Reactions
- Acute vs. delayed
- Clinical features:
  - Fever/chills
  - Abdominal, chest, back, and/or flank pain
  - DIC
  - Intravascular hemolysis
  - Hypotension
  - Renal Failure

A directed donation occurs when a patient's family and friends donate blood for his or her upcoming procedure
- Requires physician to submit a written request to donor center
- Takes 8-10 days to receive directed donor blood
- Blood from relatives is irradiated at the donor blood center before it is sent to the hospital
- Directed donors have higher viral marker rates than volunteer donors
### Donor Blood Testing
- Blood type
- Antibody Screen
- Infectious Disease Testing
  - Greatly improved in the past decade with the introduction of HIV/HCV/HBV NAT Testing
  - Time from infection to detection per American Red Cross
    - Hepatitis B: 3-4 weeks
    - Hepatitis C: 1 week
    - HIV: 7-10 days

### Donor Blood – Disease Testing History

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947</td>
<td>Only Syphilis testing performed</td>
</tr>
<tr>
<td>1970</td>
<td>Blood banks move towards all volunteer donors</td>
</tr>
<tr>
<td>1971</td>
<td>Hepatitis B testing</td>
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<tr>
<td>1975</td>
<td>HIV testing</td>
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<tr>
<td>1993</td>
<td>First AIDS cases reported</td>
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<tr>
<td>1990</td>
<td>HCV testing</td>
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<tr>
<td>2003</td>
<td>FDA issued guidance for donor questioning</td>
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<tr>
<td>2009</td>
<td>NAT testing for HBV, HCV, and HIV</td>
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### Fresh Blood
- During storage, potassium increases
- Irradiated products show a more rapid increase in potassium during storage
- At COA, Fresh blood is:
  - Given to all CV patients and neonates
  - < 7 days old
  - < 24 hours post irradiation

### Whole Blood
- Blood that has not been split into its individual components
- Beneficial in trauma patients
  - Massive Transfusion Protocol - Most facilities use 1:1:1 ratio to mimic whole blood
  - May be beneficial in post operative bleeding following CPB
- Rarely used for transfusion directly
  - Coagulation factors diminish in storage
  - Platelets may activate over time
  - Shorter shelf life
**Fresh Whole Blood - History**

- **WWI**
  - FWB transfusion begins
- **1970's**
  - Transfusion of FWB in civilians declines
- **1990's**
  - Use of fractionated blood products or BCT begins
- **Late 1990's**
  - Transfusion of BCT becomes normal practice
- **2000**
  - AABB Disaster Task Force on Domestic Disasters and Acts of Terrorism formed

**Transfused Whole blood must be type specific**

- Red blood cell type
  - Group A
  - Group B
  - Group AB
  - Group O

**Antigens on Red Blood Cell**

- A-antigen
- B-antigen
- A and B antigens
- None

**Antibodies in Plasma**

- Anti-B
- Anti-A
- None
- Anti-A and Anti-B

**Laboratory Delays and Errors**

- Positive Antibody Screens
  - Alloantibodies vs. Autoantibodies
  - Blood screening and crossmatching
- Short draw Type and Screens
- Unavailable Fresh Blood
  - Directed donors RBC's > 7 days old
  - Special requirements (CMV negative, antigen negative, etc)
- Inaccurate test results
  - Instrumentation errors
  - Collection issues (hemolysis, clots, lipemia, mislabels, etc)
  - EDTA sensitivity

**Autologous Blood**

- AKA cell salvage or intraoperative salvage
- Can be used postoperatively
- Stability
  - Refrigerated: 24 hours
  - Room temperature: 4 hours
- Must be properly labeled and kept at patient's bedside
Questions???