Transfusion Therapy and Safety

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PSONEC Fundamentals – March, 2015

Blood Component Therapy

- Blood Components
- Special Processing/Attributes
  - Irradiation
  - Leukoreduction
  - CMV Negative/CMV Safe
- Patient Safety
  - Type and Crossmatch Verification
  - Unit Verification
  - Monitoring
  - Transfusion Reactions
- Reference Information

Composition of Blood

- ~55-60% Plasma
- ~40-45% Formed Elements
  - Red Blood Cells (RBC)
  - Leukocytes (WBC)
  - Platelets

Composition of Blood:

- Plasma
- Erythrocytes (RBC)
- Monocytes
- Granulocytes
- Platelets
Coagulation

Cryoprecipitate = Fibrinogen

Components - Whole Blood Donation

Apheresis Donation

- Platelets
- Plasma
- RBCs
- Granulocytes
Platelets – Standard Adult Dose

- Pooled Platelet
  - From whole blood donors
  - 5 units in pool
- Apheresis Platelet
  - From apheresis donor

Lab will issue one of the above depending on availability

Red Blood Cells

Indications

- Symptomatic anemia
- Severe bleeding
- General Guidelines:
  
  Hgb/Hct

  - <7 / 21%: RBC likely required
  - 7-10 / 21-30%: Varies with clinical condition
  - >10 / 30%: RBC unlikely required

Red Blood Cells

Therapeutic Effect

- Average size Adult (per unit)
  - \( \uparrow \text{Hgb} \sim 1 \text{ gm/dL} = \uparrow \text{Hct} \sim 3\%

- Dose: number of units given depends on clinical situation

ONE and DONE!
Platelets – Indications

- Prevent bleeding r/t bone marrow failure:
  - <10,000/μl

- Active bleeding or surgery:
  - <50,000/μl
    - general med/surg patients
  - <100,000/μl:
    - massive hemorrhage
    - severe vascular injury
    - diffuse alveolar hemorrhage
    - eye surgery
    - neurosurgery

Platelets

Therapeutic Effect

- Platelets
  - ↑~ 30,000/μl per bag

Plasma Indications

- INR > 1.5 with one of the following:
  - Active bleeding
  - Urgent invasive procedure required

Plasma

Therapeutic Effect

- Adult: One unit:
  - ↑ most coagulation factors ~ 2.5%

- Dose based on clinical condition and underlying disease process
  - Adult dose: 10-15mL/kg
    - Usually 3-6 units
**Cryoprecipitate**

**Indications**

- Hypofibrinogenemia
  - Fibrinogen < 100 mg/dL
  - Or < 150 mg/dl – if expected to fall significantly
  - Disseminated Intravascular Coagulation
  - Active bleeding

**Therapeutic Effect**

- 1 Pool (5 units/pool):
  - ↑ fibrinogen ~ 37 mg/dL

- Adult Dose:
  - 1 - 2 units per 10kg (1 or 2 Pools)

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**Granulocytes**

**Indications**

- Preparation
  - Collected by apheresis machine
  - Always Irradiated

- Indications - Severe neutropenia with:
  - Life-threatening bacterial or fungal infection
    - not responsive to antimicrobial therapy
  - Neonates with sepsis

**Therapeutic Effect**

- May or may not see increase in WBC count

- Dose
  - Pediatrics: max 20mL/kg/day
  - Adults: 1 unit/day
**Irradiation Process**

- **HOW**
  - Placed in Irradiator

- **EFFECT** - Inactivates Lymphocytes
  - Prevents replication and ability to attack the recipient’s tissue

**Applicable Components**

- RBC
- Platelets
- WBCs

*Note: Granulocytes - ALWAYS IRRADIATED*

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**Irradiation - Purpose**

- Prevent
  - Transfusion-Associated Graft versus Host Disease
- Similar to GVHD seen in BM/Stem Cell transplant recipients
- Immunocompromised patients do not destroy the infused lymphocytes in the blood component
  - Lymphocytes engraft / proliferate
  - Attack host tissue

**Transfusion-Associated Graft Versus Host Disease**

- Lymphocytes launch attack against
  - Skin, Liver, Gut
  - Bone Marrow
- Clinical symptoms present 8-12 days post-transfusion
  - Fever
  - Skin - skin rash
  - Liver - elevated LFTs, hepatitis
  - Gut - diarrhea, anorexia, nausea/vomiting
  - Bone Marrow - bone marrow failure (pancytopenia)
Transfusion-Associated Graft Versus Host Disease - Outcome

- Outcome: ~ 90% mortality
  - Infectious complications
  - Bleeding complications
  - Death typically occurs 3-4 weeks post-transfusion
- No effective treatment
- Prevention is a must!

Transfusion-Associated Graft Versus Host Disease

- Patients with competent immune systems at risk for TA-GVHD
  - * Components from blood relatives
    - No longer offered by Bloodworks NW
  - * HLA matched platelets

* ALWAYS irradiate above components for ALL patients

Irradiation Indications

See Handout for Specifics

Leukoreduction Process

- HOW
  - Pass component through Leukoreduction filter at PSBC
  - Apheresis machine during collection
- Effect
  - Majority of the leukocytes removed
Leukocyte Reduction

Applicable Components

- RBC
- Platelets
- WBCs

Note: Granulocytes are NEVER Leukoreduced

PSBC
100% Leukoreduction of RBCs and Platelets

Leukoreduction – Purpose

- Reduce unwanted effects caused by WBCs and their by-products released during storage
  - Prevent Febrile Non-Hemolytic Transfusion Reactions
  - Prevent Alloimmunization
  - Use as substitute for CMV negative components

Leukoreduction

- Prevent recurrent:
  - Febrile Nonhemolytic Transfusion Reaction

- Cause – not completely understood
  - Antibody mediated
    - Patient antibodies react with infused WBCs
  - WBCs breakdown during storage
    - Cytokines released into the component

Leukoreduction

- Help prevent:
  - Alloimmune Platelet Refractoriness

- Alloimmunization
  - Development of patient antibodies against donor HLA antigens

- WBCs contain human leukocyte antigens (HLA)
- 30-50% of multitransfused patients develop HLA antibodies
Multiple Non-Leukoreduced Transfusions

HLA Class II

HLA Class I

Donor White Blood Cell

HLA Antibody Development – 2 to 4 weeks later

Recipient anti-HLA antibody

HLA Class II

HLA Class I

Donor White Blood Cell

Donor Platelet

Alloimmune Platelet Refractoriness

Multiple antibodies to different HLA antigens via multiple transfusions with non-LR products

Anti-HLA-A5

HLA-A5

Transfused Platelet

Premature removal by the spleen

No increase in platelet count

Alloimmune Platelet Refractoriness

• Poor platelet count increment \( \sim < 5,000 \)
  - At 1 hour post transfusion
  - On at least 2 occasions

• Obtain platelets counts
  - Pre-transfusion
  - 1 hour post (10-60 min)

• PSBC do workup
  - Patient – HLA antibodies
### HLA Matched Platelets

- Donor’s HLA typing
  - Matched to patient’s HLA typing (HLA A, B)
  - As much as possible

- Apheresis - collect from matched donor

- Initial order often requires 48 hours notice

- Resource limited by donor pool

### Leukocyte Reduction

- Reduce rate of HLA alloimmunization in organ transplant patients/candidates
  - Renal
  - Heart
  - Lung

- Risk of transplant rejection due to HLA antibodies

### Leukoreduction

- Creates CMV “Safe” Component
  - Help prevent CMV transmission

### CMV (Cytomegalovirus)

- Herpes virus

- CMV lies dormant in tissues and circulating leukocytes of infected individuals

- ~50% of population in WA is CMV positive

- Poses little problems to those with competent immune systems
  - Most have no history of illness
CMV Neg/Safe Components

• Purpose
  – Prevent primary CMV infection in immunocompromised CMV-negative patients

• Serious complications
  – CMV-associated pneumonia, myocarditis, retinitis, hepatitis, gastroenteritis

CMV Safe Components

• CMV transmission– reduced by use of either:
  – CMV Negative Components
  – Leukoreduced Components

• With 100% Leukocyte Reduction
  – Many facilities discontinued CMV Neg ordering option
  – LR substituted for CMV Neg

CMV Safe Indications

See Handout for Specifics

1) Collection and labeling of Type/Cross/Screen sample
   • “Wrong Blood In Tube” can be fatal!
   • Two person verification at bedside

2) Pre-Transfusion Verification
   • Transfusing wrong unit can be fatal!
   • Two person verification at bedside
2 Person Verification at Bedside
(Type/Cross, Type/Screen, Hold, 2nd Sample)

1. If able, ask patient to state name/DOB and compare to armband
2. At bedside, check that Name and MRN on all three sources match exactly:
   - 1. ARMBAND
   - 2. PATIENT LABEL
   - 3. REQUEST FORM

Type and Crossmatch Sample

- Required – Red Blood Cells
  - Sample in last 3 days

- Not required – platelets, plasma, or cryo
  - If pt’s blood type (ABO/Rh) on file at Bloodworks NW

2nd Confirmatory ABO/Rh Sample

- If pt has no prior hx of blood type (ABO/Rh) at PSBC
  - 2nd separately collected sample is required before routine RBCs will be issued

- Purpose – Increased Safety!
  - Double check blood type
  - Prevent Wrong Blood in Tube errors – which can be fatal

- Must be drawn at later (different) time than 1st sample

- Not required: Platelet, Plasma, or Cryo orders

- 1st sample – send immediately

- 2nd sample – send ASAP
  - Emergency RBC units will not be delayed due to lack of 2nd Sample

Transfusion Administration
### Pre-Transfusion Preparation

1. Verify Consent
2. Verify IV access: 20 gauge or larger preferred, but not required
3. IV Pump – use for all components

### Pre-Transfusion Preparation (continued)

4. Blood Tubing Y-Set (with filter)
   - 0.9% NS only
   - Prime with NS, saturate filter, fill drip chamber 1/3 full
   - Never use other IV solutions
   - Never add medications
   - Limit – 4 units or 4 hours (whichever 1st)
   - Exception – use new set for Platelets

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- Take a copy of EMR Pick-Up Slip to Lab
- Downtime
- Copy of paper Order
- Emergency when neither available
- Patient chart label
- Perform double check with sign log

- Never place a RBC or Plasma unit in refrigerator on nursing inpatient unit
- Units may be stored in Blood Bank Refrigerator only
- Platelets and Cryoprecipitate must always remain at room temperature
- Must never be placed in any refrigerator or cooler
### 2 Person BEDSIDE CHECK

- **Informed Consent**
- **Check component against MD's order**
- **Involve patient, ask patient to state name and birth date, verify against armband**
- **Compare items shown below, must be identical**
- **Compare patient’s blood type on trans tag with unit type to ensure they are compatible**
- **Check compatibility testing date/time, if performed**
- **Visual Inspection**
- **Check boxes - sign tag**

### Transfusion Report
(tag attached to blood bag)

### Blood Bag Label

### Monitoring – All Products

1. **Start within 30 minutes of Lab issue**
   - Return to Lab < 30 min, if cannot
2. **Transfusion Assessment**
   (T, RR, HR, BP, SaO2, lung & skin assessments)
   - Pre, 15 minutes, End
   - 1 hour post
   - Any time reaction is suspected
3. **Stay with patient - first 15 minutes**
4. **Reaction Assessment q 30 minutes**
5. **Complete within 4 hours of issue from Lab or before expiration (if sooner)**
**Transfusion Rates – Routine Non-Emergent (Adults)**

- **First 15 minutes (non-emergent):**
  - Start slowly: 25 ml over 15 min = 100 ml/hour

- **After 15 minutes:**
  - If no reaction, increase to rate on Transfuse Order
  - Rate guidelines (non-emergent transfusions):
    - Red cells: 1.5 - 4 hours
    - Platelets: 1 hour
    - Plasma: 30 - 60 min
    - Cryoprecipitate: 15 - 30 min

**Transfusion Reactions – Signs/Symptoms**

- Anxiety
- Hypotension/Shock
- Hypertension
- **Fever (≥1 °C or 1.8 °F)**
- Chills (with or without fever)
- Pain - Back, Chest, IV
- Dyspnea
- Tachycardia
- Hemoglobinuria
- Oliguria / Anuria
- Hives
- Itching
- Cough
- Nausea
- Vomiting
- Abdominal cramps
- Headache
- Cyanosis
- Diaphoresis
- Generalized bleeding

**Acute Transfusion Reactions**

**Stop and do not restart:**
- Febrile Nonhemolytic
- Acute Hemolytic
- Transfusion Related Acute Lung Injury
- Anaphylactic
- Bacterial Contamination
- Volume Overload

**With Provider order, may restart:**
- Urticarial (Mild Allergic) only
  - Stop
  - Antihistamine (Benadryl)
  - If reaction resolve, restart slowly
  - Observe q 15 min

**Reaction Job Aid**

*Reaction Job Aid Image*
Possible Reaction - Steps

1) STOP TRANSFUSION
2) Notify Provider (RRT/Code prn)
3) Monitor vital signs and symptoms
4) Check tag against armband and bag label to verify right unit was given to right patient
5) Hang new IV set with new 0.9% NS bag to keep line open (TKO). Do not flush or use blood set.
6) Treat symptoms per Provider’s orders
7) Send workup to hospital lab

Reference Information

- Special Attributes Indications Sheet
- Transfusion Reaction Algorithm
- Other guides at BloodworksNW.org

Reaction Workup – Submit to VMC Lab

Call Lab to obtain pink Reaction form

Bag and attached tubing-IV solution
1 or 2 Lavender or pink tops
Next Fresh Urine Sample (if red/dark)

2 Person Verification at Bedside - Blood Bank Samples
2 Person Verification at Bedside - Pre-Transfusion
0.9% NS only to prime blood tubing set
Begin transfusion slowly first 15 minutes = 100 ml/hour
Monitor patient before, during, and after transfusion
Ensure rate of infusion is appropriate for your patient
Finish within 4 hrs of Lab issue (or before expiration, if sooner)
Change blood tubing set every 4 units or 4 hrs (whichever first)
- Always use new set for Platelets
Know how to recognize and treat reactions
Report reactions to Provider and submit workup to VMC Lab
Resources

• Institution’s Policies
• Bloodworks NW website
  – http://www.BloodworksNW.org
• Transfusion Safety Officer, Mary Grabowski
  Pager 206-969-5222
  marygr@BloodworksNW.org
• Bloodworks NW, Central Seattle Lab
  – (206) 292-6525, #3
  – Request On-Call Physician as needed