Transfusion Therapy & Safety

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PSONEC Fundamentals – March 2016

Topics

• Blood Components
• Special Processing/Attributes
  – Irradiation
  – Leukoreduction
  – CMV Negative/CMV Safe
• Patient Safety
  – Type and Crossmatch Verification
  – Blood Unit Verification
  – Administration / 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: 55-60%
- Formed Elements: 40-45%
- Red Blood Cells (RBC)
- Leukocytes (WBC)
- Platelets

Composition:

- Plasma
- Lymphocytes
- Monocytes
- Neutrophils

Packed Red Cells

Composition:

- Plasma
- Lymphocytes
- Monocytes
- Neutrophils

Granulocytes

Packed Red Cells

Composition:

- Plasma
- Lymphocytes
- Monocytes
- Neutrophils

Granulocytes

Packed Red Cells
Coagulation

(a) Vasoconstriction
(b) Platelet aggregation
(c) Clot formation

Cryoprecipitate = Fibrinogen

Kinds of Blood Components
Whole Blood Donation

- RBC
- Platelet
- Plasma
- Cryoprecipitate

Donor Whole Blood

Single Donor / Apheresis Platelets

Pool for adults (5 units pooled in one bag)

Pool for adults (5 units pooled in one bag)

Donor Whole Blood

Single Donor / Apheresis Platelet
Platelets – Standard Adult Dose

• Pooled Platelet
  • From whole blood donors
  • 5 units in pool
  - or -

• Apheresis Platelet
  • From apheresis donor

• Lab will issue one of the above depending on availability

RBCs - Indications

<table>
<thead>
<tr>
<th>Hemoglobin (g/dl)</th>
<th>Restrictive threshold should be used for the vast majority of hospitalized, stable patients with symptomatic anemia</th>
</tr>
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<tbody>
<tr>
<td>&lt; 7-8</td>
<td></td>
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<tr>
<td>&lt; 8</td>
<td>Evidence supports this threshold in patients with pre-existing cardiovascular disease</td>
</tr>
</tbody>
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Exceptions:
Patients that may not benefit from restrictive approach:
• Bleeding, hemodynamically unstable patients
• Hematology / oncology patients
• Anemia in the setting of acute coronary syndrome

Misuse of RBC Transfusions

Both excessive and inappropriate use of blood transfusions exist.

Carries significant risk that may outweigh its benefits in some settings.

Why give 2, when 1 will do?

Transfusion decisions should be based on:
• clinical situation/symptoms
• lab values

Red Blood Cells
Therapeutic Effect

• Average size Adult (per unit)
  – ↑ Hgb ~ 1 gm/dL  =  ↑ Hct ~ 3%

• Dose - 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**

**Adult Dose**

- Usually one bag

- Increment
  - Platelet count ↑ ~ 30,000/µl per bag

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**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

- **Disseminated Intravascular Coagulation**

- **Active bleeding**

### Cryoprecipitate Therapeutic Effect

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

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

### 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

### Granulocytes 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

Irradiation Applicable Components

- RBC
- Platelets
- WBCs

Note: Granulocytes - ALWAYS IRRADIATED

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

* Above components ALWAYS irradiated for ALL patients

Irradiation Indications

See Handout for Specifics

Leukoreduction Process

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

Applicable Components

- RBC
- Platelets

Bloodworks NW

ALL RBCs and Platelets are Leukoreduced

Note: Granulocytes are NEVER Leukoreduced

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
**HLA Antibody Development – 2 to 4 weeks later**

- **Recipient anti-HLA antibody**
- **HLA Class I**
- **Donor White Blood Cell**
- **HLA Class II**
- **Donor Platelet**

**Alloimmune Platelet Refractoriness**

- Poor platelet count increment ~ < 5,000
  - At 1 hour post transfusion
  - On at least 2 occasions
- Obtain platelets counts
  - Pre-transfusion
  - 1 hour post (10-60 min)
- Bloodworks NW does 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 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 Leukocyte Reduction of ALL RBCs/Platelets
  - Many facilities discontinued CMV Neg ordering option
  - LR substituted for CMV Neg
CMV Safe Indications
See Handout for Specifics

Critical Points in Transfusion Process

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

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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
3. Both individuals observe filling of blood tube
4. Label immediately after collection at bedside

(type/cross, type/screen, hold, 2nd sample)

Type/Screen/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

(follow facility’s policy)
2nd Confirmatory ABO/Rh Sample

- If pt has no prior hx of blood type (ABO/Rh) at Bloodworks
  - 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

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 (pump must be manufacturer approved for this use)

Pre-Transfusion Preparation (continued)

4. Blood Administration Tubing Set (with 150 – 260 micron filter)
   - Prime with 0.9% NS or blood component
   - Saturate filter, fill drip chamber ~ 1/2 full
   - See manufacturer insert for specific instructions
   - Never use other IV solutions
   - Never add medications
   - Limit per set:
     - Max 4 hours
     - Max 2 - 4 units *
     - * Varies – see manufacturer’s instructions
     - Exception – use new set for Platelets

Transfusion Administration
Component Pick-up from Lab (follow facility’s policy)

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

2 Person BEDSIDE CHECK

- Informed Consent
- Check component against MD's order
- Involve patient, ask patient to state name and birth date, verify against ID band
- Compare items shown below, must be identical
- Expiration date/time not passed and will not pass before transfusion completion
- Compare patient’s blood type on trans tag with unit type to ensure they are compatible
- * Compatibility testing expiration on tag (RBCs and Grans only) has not passed
- Visual Inspection
- Check boxes - sign tag

Blood Bag Label

- Check 3 boxes
- Two signatures with date / time of verification
- Never discard
- Place in patient’s paper chart

Transfusion Report (tag attached to blood bag)

Blood Tags
**Recommended Monitoring – All Products**

1. Start within 30 minutes of Lab issue
   - If unable, then return to Lab < 30 min
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 (whichever occurs first)

(follow facility’s policy)

**Transfusion Rates – Routine Non-Emergent (Adults)**

- **First 15 minutes (non-emergent):**
  - Start slowly: 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
    - Grans: 1 – 2 hours

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**Transfusion Reactions – Signs/Symptoms**

Change from Baseline

- 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

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**Suspected Transfusion Reactions: Patient Education**

“Call me if you feel any differently than you do right now.”
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

Suspected Reaction - Steps
1) STOP TRANSFUSION
2) Notify Provider (RRT/Code prn)
3) Monitor vital signs/lungs/skin/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) Order and send reaction workup to hospital lab
8) Document findings / actions in medical record

Call BW Physician On-Call for help, prn (206) 292-6525 (#3)

FDA – U. S. Transfusion Fatalities

Figure 1: Transfusion Related Fatalities by Complication, FY2010 through FY2014

- Transfusion Related Acute Lung Injury (TRALI) and Transfusion Associated Circulatory Overload (TACO) caused the highest number of deaths in last 5 years
- IMPORTANT TO ASSESS RESPIRATORY STATUS WHEN MONITORING PATIENTS
  ➢ Listen to lung sounds, monitor respiratory rate and SaO2

• TRALI
• HTR (CHS/ADHD)
• HTR (ABCD)
• Infection
• TACO
• Anaphylaxis
• Other

Number of Fatalities

Call BW Physician On-Call for help, prn (206) 292-6525 (#3)
**Reaction Workup – Submit to Lab**

- 1 or 2 Lavender or Pink tops
- Bag and attached tubing/IV solution
- Next Fresh Urine Sample (if red/dark)
- Call Lab to obtain pink Reaction form

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**Reference Information**

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

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**Ways to Help Ensure Safest Transfusion Possible for Your Patient**

1. 2 Person Verification at Bedside - Blood Bank Samples
2. 2 Person Verification at Bedside - Pre-Transfusion
3. 0.9% NS only to prime blood tubing set
4. Begin transfusion slowly first 15 minutes = **100 ml/hour**
5. Monitor patient before, during, and after transfusion
6. Ensure rate of infusion is appropriate for your patient
7. Finish within 4 hrs of Lab issue (or before expiration, if sooner)
8. Change blood tubing set every **2 - 4** units (**varies**) or 4 hrs (whichever first)
   - Always use new set for Platelets
9. Know how to recognize and treat reactions
10. Report reactions to Provider and submit workup to Lab

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**Resources**

- Hospital’s / Facility’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