Red Blood Cell Transfusion
A Pocket Guide for the Clinician

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November 2016

Adapted from Red Blood Cell Transfusion:
A clinical practice guideline from the AABB, Clinical Practice Guidelines from the AABB: Red blood cell transfusion thresholds and storage, and additional sources
Red Blood Cells as a Therapeutic Product

Appropriate uses of red blood cell (RBC) transfusion
- Treatment of symptomatic anemia
- Prophylaxis in life-threatening anemia
- Restoration of oxygen-carrying capacity in case of hemorrhage
- RBCs are also indicated for exchange transfusion
  - Sickle cell disease
  - Severe parasitic infection (malaria, babesiosis)
  - Severe methemoglobinemia
  - Severe hyperbilirubinemia of newborn

RBC transfusion is not routinely indicated for pharmacologically treatable anemia such as:
- Iron deficiency anemia
- Vitamin B₁₂ or folate deficiency anemia

Dosage and administration
- One unit of RBC will raise the hemoglobin of an average-size adult by ~1 g/dL (or raise HCT ~3%)
- ABO group of RBC products must be compatible with ABO group of recipient
- RBC product must be serologically compatible with the recipient (see Pretransfusion Testing). Exceptions can be made in emergencies (see Emergency Release of Blood Products).
- Rate of transfusion
  - Transfuse slowly for first 15 minutes
  - Complete transfusion within 4 hours (per FDA)

Major Red Cell Products for Transfusion

Most RBC products are derived by collection of 450-500 (±10%) mL of whole blood from volunteer donors and removal of the plasma by centrifugation (see Table 1). After removal of the plasma, the resulting product is red blood cells (referred to informally as “packed red blood cells”).

The most commonly available US RBC product has a 42-day blood bank shelf life and HCT 55-65%.

Table 1. Special Processing of RBC for Transfusion

<table>
<thead>
<tr>
<th>Process</th>
<th>Indications</th>
<th>Technical Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukocyte Reduction</td>
<td>Decrease risk of recurrent febrile, nonhemolytic transfusion reactions</td>
<td>Most commonly achieved by filtration</td>
</tr>
<tr>
<td></td>
<td>Decrease risk of CMV transmission (marrow transplant)</td>
<td>Usually seen after collection (prestorage)</td>
</tr>
<tr>
<td></td>
<td>Does not prevent transfusion-associated graft-versus-host disease (TA-GVHD)</td>
<td>May be performed at bedside</td>
</tr>
<tr>
<td>Washing (removes residual</td>
<td>Decrease risk of anaphylaxis in IgA-deficient patient with anti-IgA antibodies</td>
<td>Wash fluid is 0.9% NaCl ± dextrose</td>
</tr>
<tr>
<td>plasma)</td>
<td>Decrease reactions in patients with history of recurrent severe allergic or anaphylactoid reactions to blood product transfusion</td>
<td>Shelf life of washed RBCs</td>
</tr>
</tbody>
</table>

Pretransfusion Testing

Prevents incompatible red cell transfusion
- Compatibility of donor red cells and recipient plasma
- Avoid immune hemolytic transfusion reactions in the recipient

Pretransfusion blood sample from the intended recipient
- Usually EDTA tube (plasma and red cells)
- Proper labeling of the sample
  - 2 independent patient identifiers
  - Identity of the phlebotomist
  - Date and time of sample collection
  - Sample rejected without these
- Age of the sample
  - Up to 3 days if hospital inpatient or, in past 3 months, recipient
  - Has been pregnant
  - Has been transfused
  - Has uncertain history of either
  - Longer (often 1–2 weeks, according to hospital policy) for outpatient
    - pre-op testing if negative history within 3 months

Dosage and administration
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- Rate of transfusion
  - Transfuse slowly for first 15 minutes
  - Complete transfusion within 4 hours (per FDA)
Transfusion of Incompatible RBCs

The blood bank will begin issuing type-specific and crossmatched products when it receives the patient’s testing sample. Blood bank will retrospectively crossmatch all emergently issued units already been performed:

What you’ll get from the blood bank (depending on how much testing has been performed):
- Blood bank unable to determine presence or absence of underlying alloantibodies
- All RBC units are crossmatch-incompatible

Balance of risks:
- Severe anemia requiring transfusion support
- Possibility of hemolytic transfusion reaction due to undiagnosed underlying alloantibodies

Principles of approach to this situation:
- Communication between bedside clinician and transfusion service physician is essential
  - Obtain careful history of prior transfusion or pregnancy
  - If history negative, probably safe to transfuse ABO-compatible RBCs
  - If history positive or uncertain, assess risk/benefit of delaying transfusion to complete testing
- Assess how long it may take for blood bank or reference lab to complete pretransfusion testing
- Agree on best approach to choosing among incompatible RBC units (transfusion physician will advise)
- Attempt to mitigate need for immediate transfusion: bed rest, oxygen

Ultimately, do not deprive a patient with autoimmune hemolytic anemia of a needed, lifesaving transfusion:
- Autoantibody will shorten survival of transfused RBCs and patient’s endogenous RBCs to a similar extent
- Most undetected alloantibodies will cause delayed hemolytic transfusion reactions
- May be misdiagnosed as worsening of autoimmune hemolysis
- Not usually life-threatening
- Bedside team must be hypervigilant for acute intravascular hemolytic reaction during transfusion (see Adverse Effects of Transfusion)

Red Blood Cell Transfusion

<table>
<thead>
<tr>
<th>Clinical Situation</th>
<th>Potential Transfusion Threshold</th>
<th>Strength of Recommendation</th>
<th>Quality of Supporting Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Inpatients, Hemodynamically Stable</td>
<td>Hgb ≤ 7 gm/dL</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>ICU Patients, Hemodynamically Stable (adult or pediatric)</td>
<td>Hgb ≤ 7 gm/dL</td>
<td>Strong</td>
<td>High</td>
</tr>
<tr>
<td>Postoperative Orthopedic or Cardiac Surgery Patients</td>
<td>Hgb ≤ 8 gm/dL, † or for symptoms ‡</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>Hgb ≤ 8 gm/dL, † or for symptoms ‡</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Acute Coronary Syndrome</td>
<td>AABB does not recommend for or against a liberal or restrictive RBC transfusion strategy</td>
<td>Uncertain</td>
<td>Very Low</td>
</tr>
<tr>
<td>All Patients</td>
<td>Guided by symptoms as well as by Hgb level</td>
<td>Weak</td>
<td>Low</td>
</tr>
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</table>

**Hgb=Hemoglobin level
†Cannot be generalized to the preoperative setting, where expected surgical blood loss must be taken into account in transfusion decision making.
‡Chest pain, orthostatic hypotension or tachycardia unresponsive to fluids, or congestive heart failure.
§There remains some uncertainty regarding the risk of perioperative myocardial infarction with a restrictive transfusion strategy.

Emergency Release of Blood Products

An emergency release of blood products is warranted when the clinical setting precludes waiting for completion of pretransfusion and compatibility testing. Examples include:
- Severe, ongoing life-threatening hemorrhage
- Life-threatening anemia

What you should do:
- Notify blood bank of need for emergency release of RBCs
- Complete hospital’s “emergency release” form
- Document your declaration of a transfusion emergency
- U.S. federal regulations require 2 specific items on the form
  - Statement of the nature of the emergency (e.g. “massive GI hemorrhage”)
  - Signature of MD or “equivalent”; (PA, NP, RN, etc. cannot sign)
- Send patient blood sample to blood bank ASAP (before emergency transfusion begins, if possible)

What you’ll get from the blood bank (depending on how much testing has already been performed):
- Uncrossmatched RBCs (ABO group-specific if determined on a current blood specimen)
- Group O RBCs if blood bank has not documented patient’s ABO group on a fresh blood sample
- Rh type depending on availability and hospital policy, if patient’s Rh status is unknown

Blood bank will retrospectively crossmatch all emergently issued units when it receives the patient’s testing sample
Blood bank will begin issuing type-specific and crossmatched products when testing is complete

Transfusion of Incompatible RBCs

Clinical scenario: severe warm (or cold) autoimmune hemolytic anemia
- Patient’s plasma autoantibody reacts with all of the blood bank’s reagent red cells

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<th>Purpose</th>
<th>Reagents</th>
<th>Time</th>
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<tr>
<td>ABO Group &amp; Rh Type</td>
<td>Determine if recipient’s blood group Rho(D) is positive or negative</td>
<td>Test recipient’s red cells with anti-A, anti-B, anti-D, test recipient’s plasma with A,” and B cells</td>
<td>~25 min</td>
</tr>
<tr>
<td>Antibody Screen</td>
<td>Detect unexpected, clinically significant (non-ABO) anti-RBC antibodies in recipient’s plasma</td>
<td>Test recipient’s plasma with phenotyped “reagent” RBCs</td>
<td>~50 min</td>
</tr>
<tr>
<td>Antibody Identification</td>
<td>Identify specificity of anti-RBC antibody if antibody screen is positive</td>
<td>Test recipient’s plasma with many “reagent” RBCs</td>
<td>Varies: Hours to days</td>
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<tr>
<td>Immediate Spin Crossmatch (when antibody screen is negative)</td>
<td>Ensure ABO compatibility between recipient’s plasma and RBC product chosen for transfusion</td>
<td>Test recipient’s plasma with sample of red cells from product chosen for transfusion</td>
<td>~10 min</td>
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<td>Full Serological Crossmatch (when antibody screen is positive)</td>
<td>Ensure full serological compatibility between recipient’s plasma and RBC product chosen for transfusion</td>
<td>Test recipient’s plasma with sample of red cells from product chosen for transfusion. Includes extra incubations (e.g. at 37°C and with Coombs reagent).</td>
<td>Up to an hour</td>
</tr>
<tr>
<td>Electronic Crossmatch (not universally available)</td>
<td>Match ABO/Rh-compatible RBC from inventory with patient whose ABO/Rh status has been confirmed and who has no history of, and negative testing for, RBC alloantibodies</td>
<td>Validated blood bank computer system.</td>
<td>~10-15 min</td>
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* A is the most common subgroup of Group A

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Adverse Effects of Transfusion

The most clinically important adverse effects of transfusion in medical patients are infectious or immunological phenomena. The most significant infectious risks are addressed during the donor screening process, and most blood centers employ bacteriological surveillance measures on certain blood products.

Table 4. Some Infectious Risks of Blood Transfusion (all products)

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<th>Transfusion-Transmitted Infection</th>
<th>Residual Risk Per Transfused Component</th>
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<tr>
<td>HIV</td>
<td>1 in 1,467,000</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>1 in 1,149,000</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>1 in 282,000</td>
</tr>
<tr>
<td>West Nile Virus</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Cytoamegalovirus</td>
<td>50-85% of donors are carriers. Leukocyte reduction is protective.</td>
</tr>
<tr>
<td>Bacterial Infection</td>
<td>1 in 2-3,000 (mostly platelets)</td>
</tr>
<tr>
<td>Parasitic Diseases, Babesiosis, Chagas, Malaria</td>
<td>Relatively uncommon</td>
</tr>
</tbody>
</table>

Other Important Adverse Effects of Blood Transfusion

For any of the following, except allergic reactions, stop transfusion and return remaining product to blood bank with transfusion reaction report:

Acute hemolytic transfusion reaction (AHTR): Preformed antibodies to incompatible product (1:76,000). ABO incompatibility (1:40,000). Sometimes fatal (1:1.8x10^6). Presents with chills, fever, hypotension, to incompatible product (1:76,000). ABO incompatibility (1:40,000). Preformed antibodies.

Transfusion reaction report: Transfusion and return remaining product to blood bank with supporting evidence (high, moderate, low, or very low). These ratings are intended to have the following implications (adapted from GRADE):

- Strong recommendation: Recommendation can apply to most patients in most circumstances.
- Weak recommendation: The best action may differ depending on circumstances or patient or societal values.
- Other alternatives may be equally reasonable.

References


Rating System and Implications of Recommendations

How to Use This Pocket Guide

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