

PEDIATRIC TRANSFUSION GUIDELINES

(Approved by Medical Staff Executive Committee on 12/11/2006)

- I. Red Blood Cells^a
 - A. Reconstituted whole blood
Exchange transfusion
 - B. Red Blood Cells
 1. Premature infant^[1-3]
 - a. Stable, growing, Hgb < 7 g/dL
 - b. IRDS, without oxygen requirement, Hgb < 10 g/dL
 - c. IRDS, with oxygen requirement, Hgb < 12 g/dL
 - d. Mildly symptomatic anemia (e.g., apnea, tachycardia, poor wt. gain), Hgb < 10 g/dL
 - e. Severely symptomatic (e.g., worsening apnea, hypotension, acidosis, heart disease), Hgb < 12 g/dL.
 2. Term infant < 4 months of age^[1,4,5]
 - a. Clinical manifestations of anemia (e.g., apnea, tachycardia, poor wt. gain), Hgb < 7 g/dL
 - b. Perioperative anemia, Hgb < 10 g/dL [6]
 - c. Hypoxia or on ECMO, ECLS Hgb < 12 g/dL
 - d. Cyanotic heart disease, Hgb < 13 g/dL
 - e. Acute blood loss > 10% blood volume, not responsive to other forms of therapy
 - f. Clinical shock or severe decrease in BP, Hgb < 10g/dL
 3. Pt > 4 months of age^[4,5]
 - a. Acute blood loss > 15% of blood volume, or anticipation thereof, or hypovolemia not responsive to other forms of therapy
 - b. Postoperatively with signs of anemia (e.g., apnea) Hgb < 10 g/dL^[6]
 - c. Severe cardiopulmonary disease, Hgb < 12 g/dL
 - e. Patients receiving chemotherapy or irradiation, or patients with chronic anemia not responsive to medical therapy, Hgb < 7 g/dL (symptomatic patients may be transfused at a higher hemoglobin level)
 - f. Complications of SC disease (e.g., CVA or acute chest

^a There are several general features of products selected for transfusion to pediatric patients. All cellular components, RBCs and Platelets, are leukoreduced (usually prior to storage but rarely with bedside filter) to a residual WBC content of < 5 X 10⁶. Donor exposures should be limited to the greatest degree possible. All blood products should be infused using a “large pore” filter via standard blood administration set with the intrinsic 170-260 micron filter or, for smaller pediatric units only, the Baxter blood component infusion set with the intrinsic 80 micron filter.

syndrome) or for preoperative preparation of such patients; chronic transfusion regimen for thalassemia or other red cell disorders

- g. Circuit prime for plasma exchange, or stem cell collection.
- h. Clinical shock or severe decrease in BP, Hgb < 10g/dL

4. Low-potassium packed red blood cell unit^b

Indications include:

- i. Extracorporeal membrane oxygenation
- ii. Cardiopulmonary bypass
- iii. Renal failure

II. Platelets^[7]

A. Prophylactic transfusion

- 1. Premature infants^[3,5,8,9]
 - a. Stable premature infant: < 30,000/uL
 - b. Sick premature infant: <50,000/uL
- 2. Term infants < 4 months old:^[5, 8] <20,000/uL
- 3. Term infants > 4 months old: ^[5]<10,000/uL
- 4. Prior to lumbar puncture and platelet count <10,000/uL (patient is not actively bleeding)^[10]
- 5. Patient scheduled for invasive procedure and platelet count is < 50,000/uL^[1, 10]

B. Bleeding patients^[3, 5, 8]

- 1. Patients with active bleeding and platelet counts < 50,000/uL
- 2. Diffuse microvascular bleeding in association with cardiopulmonary bypass or extracorporeal membrane oxygenation (ECMO), and platelet count < 100,000/uL or laboratory value not available
- 3. Bleeding in a patient with a qualitative platelet defect, regardless of platelet count

III. Granulocytes^{c [11, 12]}

- A. Bacterial sepsis in an infant < 2 weeks of age with neutrophil count < 3 x 10⁹ /L.
- B. Bacterial sepsis or disseminated fungal infection that is unresponsive to antibiotics in a patient > 2 weeks of age with neutrophil count < 0.5 x 10⁹/L and whose neutrophil count is expected to recover.

^b A low potassium unit is less than 5 days old with irradiation no more than 3 days prior OR washed OR deglycerolized. A non-irradiated adult (250mL) CPDA-1 unit ≤ 5days old will contain <1 mEq of K+ but the same unit, if irradiated and stored for 3 days, will contain <5mEq K+.

^c All granulocyte transfusions are irradiated.

- C. Infection that is unresponsive to antibiotics and the presence of a qualitative neutrophil defect, regardless of neutrophil count.

IV. Washed Red Blood Cells

- A. For patients with hyperkalemia with poor renal function (until hyperkalemia resolves)
- B. History of anaphylactic or severe, unexplained reaction to blood components.
- C. Extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass patients if fresh red blood cells are unavailable
- D. Paroxysmal nocturnal hemoglobinuria
- E. Intrauterine transfusion (fetal transfusion)

V. Frozen deglycerolized red blood cells ^d

- A. IgA-deficient patients with Anti IgA antibodies if IgA-deficient product is unavailable (see Section XI)
- B. Intrauterine transfusions
- C. Paroxysmal nocturnal hemoglobinuria

VI. Fresh Frozen Plasma ^{[1, 8, 9, 13] e}

- A. INR > 1.5-2 times the mean normal value in a nonbleeding patient scheduled for surgery or invasive procedure
- B. Diffuse microvascular bleeding in a patient with a PT or PTT > 1.5 times the mean normal value or values not yet available
- C. Warfarin overdose with major bleeding or impending surgery
- D. Patients with thrombotic thrombocytopenic purpura (TTP) undergoing transfusion or plasma exchange
- E. Protein C, protein S, anti-thrombin III deficiencies, or other single-factor deficiency where no product is available and patient is bleeding
- F. Bleeding secondary to vitamin K deficiency

VII. Cryoprecipitate ^[1, 5, 13-15]

- A. Quantitative fibrinogen disorder with fibrinogen < 100 mg/dL and scheduled for invasive procedure ^[1, 14]
- B. Qualitative fibrinogen disorder with diffuse bleeding or scheduled for invasive procedure
- C. Von Willebrand disease or Hemophilia A (Factor VIII deficiency) with active bleeding or invasive procedure planned, unresponsive to DDAVP and/or

^d Frozen deglycerolized red blood cells are prepared off site and require 3-6 hours for preparation and transport.

^e Patients with IgA-deficiency and anti-IgA antibodies require IgA-deficient fresh frozen plasma (see Section XI.)

- factor concentrates
D. Fibrin glue production [5]

VIII. CMV-negative components [1, 3, 5]

- A. CMV seronegative patients who are immunoincompetent and at risk for CMV disease, including:

1. Intrauterine transfusions
2. Infants < 6 months of age
3. Bone marrow or solid organ transplant candidates
4. Bone marrow or solid organ transplant recipients of a CMV-negative graft
5. Congenital or acquired immunodeficiencies

IX. Leukodepleted components [1,3,5,9]

- A. UCDMC practices universal leukoreduction, effectively producing a count <5 x 10⁶ residual WBC's per unit. This level of leukoreduction is usually effective for:

1. Prevention of CMV transmission
2. Prevention of nonhemolytic febrile transfusion reactions
3. Prevention or delay of WBC alloimmunization and platelet refractoriness in selected patients requiring repeated transfusions over an extended time period

X. Irradiated components to prevent graft-versus-host disease [1, 3, 5]

- A. Infants < 6 months of age
- B. All pediatric malignancies
- C. Intrauterine or neonatal exchange transfusions
- D. Recipients of components from blood relatives and all designated donors
- E. Recipients of crossmatched or HLA matched platelets
- F. Myelosuppressive therapy (chemotherapy or irradiation)
- G. Patients undergoing, or candidates for, marrow or peripheral blood progenitor cell transplant
- H. Congenital immunodeficiency syndromes, include suspected DiGeorge Syndrome [1, 9]

XI. IgA-deficient patients: special considerations for single-component therapy^[16, 17]

- A. *Platelets*: IgA-deficient patients with anti-IgA antibodies should receive platelets from IgA-deficient donors
- B. *Red blood cells*: IgA-deficient patients may receive washed red blood cells, but frozen deglycerolized red blood cells are preferred

- C. *FFP*: IgA-deficient patients with anti-IgA antibodies require IgA-deficient FFP

XII. Partially Phenotypically-Matched RBC's ^[18]

- A. Hemoglobinopathy with ongoing transfusion needs
B. Exchange transfusions in patients with RBC sensitization and resultant antibody formation

BIBLIOGRAPHY

1. Hume, H.A., Limoges, P., *Perioperative Blood Transfusion Therapy in Pediatric Patients*. American Journal of Therapeutics, 2002. **9**: p. 396 - 405.
2. Strandjord, T.P., MD, *Transfusion Guidelines*. 1999, University of Washington Academic Medical Center: Neonatology, found at <http://neonatal.peds.washington.edu/NICU-WEB/transfusion.stm>.
3. UCSF, *Intensive Care Nursery House Staff Manual: Administration of Blood Products*. 2004, The Regents of the University of California, found at www.neonatology.org.
4. Hume, H.A., *Red Blood Cell Transfusions for Preterm Infants: The Role of Evidence-Based Medicine*. Seminars in Perinatology, 1997. **21**(1): p. 8 - 19.
5. Roseff, S.D., Luban, Naomi, Manno, Catherine, *Guidelines for assessing appropriateness of pediatric transfusion*. Transfusion, 2002. **2002** (42): p. 1398 - 1413.
6. Cote, C., MD, Zaslavsky, Alan, PhD, Downes, John J., MD, et al, *Postoperative Apnea in Former Preterm Infants after Inguinal Herniorrhaphy: A Combined Analysis*.d. Anesthesiology, 1995. **82**(4): p. 809 - 822.
7. Stanworth, S.J., Hyde, C., et al, *Prophylactic Platelet Transfusion for Haemorrhage after Chemotherapy and Stem Cell Transplantation*, in *The Cochrane Database of Systematic Reviews*. 2004.
8. Murray, N.A., Roberts, A.G., *Neonatal transfusion practice*. Arch Dis Child Fetal Neonatal Ed, 2004. **89**: p. F101 - F107.
9. New, H.V., *Paediatric transfusion*. Vox Sanguinis, 2006. **90**: p. 1 - 9.
10. Rebull, P., *Platelet transfusion trigger in difficult patients*. Transfus Clin Biol, 2001. **8**: p. 249 - 254.
11. Stanworth, S.J., Massey, E., et al, *Granulocyte Transfusions for Treating infections in Patients with Neutropenia or Neutrophil Dysfunction*, in *The Cochrane Database of Systematic Reviews*. 2005.
12. *Handbook of Pediatric Transfusion Medicine*, ed. R. Strauss, Luban, N., Hillyer, C., San Francisco: Academic Press. 167 - 180.
13. Nuttall, G.A., MD, *American Society of Anesthesiologists: Practice Guidelines for Perioperative Blood Transfusion and Adjuvant Therapies*, found at www.asahq.org. 2005.
14. Fanaroff, A.A., Martin, Richard J., *Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant*. 7th ed. Vol. 2. 2002, St. Louis: Mosby. 1224.

15. Monagle, P.E.A., *Developmental haemostasis. Impact for clinical haemostatis laboratories*. Thromb Haemost, 2006. 95(2): p. 362 - 372.
16. Schmidt, A.P., et al, *Anaphylactic Transfusion Reactions Associated with Anti-IgA Antibody*. N Engl J Med, 1969. 280(4): p. 188 - 193.
17. *Allergic and Anaphylactic Reactions in Transfusion Reactions*. 2nd ed, ed. M.A. Popovsky. 2001, Bethesda: American Association of Blood Banks. 113 - 118.
18. Osby, M., Shulman, I.A., *Phenotype matching of donor red blood cell units for nonalloimmunized sickle cell disease patients: a survey of 1182 North American laboratories*. Arch Pathol Lab Med, 2005. 129(2): p. 190 - 193.

APPENDIX I

Definitions

PATIENTS

Premature infant: under 6 months of age following gestation of less than than 37 weeks

Term Infant: under 12 months of age following gestation of ≥ 37 weeks

Neonate: infant < 1 month of age

Infant: child < 12 months of age and > 1 month of age

Child: < 16 years of age and > 12 months of age

PRODUCTS

Adult Units: Packed Red Cells: Citrate-phosphate-dextrose, CPDA-1 (250 mL) and ADSOL, Adenine-saline, AS-1 (340mL)
 FFP: Regular (250 ml) or Jumbo (600 mL)
 Platelets: Pheresis, Single Donor (250 mL)
 Cryoprecipitate: 10 mL units delivered in pools of 6 (60mL) or 10 (100mL)
 CPDA-1: Citrate phosphate dextrose adenine, an anticoagulant preservative, allowing RBC storage time of 21 days
 Adsol: Additive Solution, similar constituents to CPDA-1, with the addition of mannitol; extends RBC storage time to 42 days.

Pediatric Units:

Packed Red Cells: CPDA-1 “Pedipack” (80 mL) and “Minipack” (30mL)^a,

FFP: “Pedi” (80 mL)

Platelets: Divided (adult) Pheresis Single Donor platelet unit that is separated into halves (125mL) or quarters (65mL)

Cryoprecipitate: Single “Cryo” (10 mL)

Special Units: Reconstituted whole blood: used for neonatal exchange transfusion made from O-neg RBCs and AB plasma

^a When a single “minipack” is ordered, the Blood Bank holds 3 “minipacks” from the same unit to limit donor exposure in the event of further transfusion; this is not the case when a single “Pedipack” is ordered.

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