

ADULT RED CELLS OR AUTOLOGOUS TRANSFUSION

A. Indications

1. One of the following
 - a. Hypovolemia and hypoxia (signs/symptoms: syncope, dyspnea, postural hypotension, tachycardia, angina, or TIA) secondary to surgery, trauma, GI tract bleeding, or intravascular hemolysis, OR
 - b. Evidence of acute loss of 15% of total blood volume or > 750 mL blood loss, OR
 - c. Hgb level of less than 8 grams or Hct less than 24%.

Contraindications: If reason for transfusion is Hgb less than 8, and the patient has either: iron deficiency anemia, pernicious anemia, nutritional deficiency, intestinal malabsorption, or autoimmune hemolytic anemia, but does not have symptoms of hypovolemia and hypoxia, the record must be reviewed by the committee.

2. If patient has a chronic disease listed below or is a burn/trauma patient, but Hgb greater than 8, the record does not require committee review. Chronic diseases include a diagnosis of myocardial disease, cerebral ischemia, history of TIA, previous thrombotic stroke, chronic pulmonary disease, asymptomatic anemia associated with renal disease, patients receiving active chemotherapy, or alcoholic liver disease with anticipated surgery.
3. It is recommended that blood should be transfused on a unit - by - unit basis, according to patient symptoms. One unit of blood may be sufficient. The outcome or results of the transfusion should be documented in the patient's record. A statement of improved symptoms and/or post-transfusion hemoglobin or hematocrit are examples of documentation.

B. Transfusion reactions will be reviewed and summarized by the Transfusion Service and reported back to the committee. This will also include:

1. Any patient death related to transfusion.
2. Hemolytic or anaphylactic transfusion reactions.
3. Any patient with reported diagnosis of hepatitis or abnormal liver function within 6 months of transfusion.

PEDIATRIC RED CELL TRANSFUSION

I. Newborns

A. Hypovolemia due to surgery, trauma, gastrointestinal hemorrhage, or other blood loss documented by one of the following:

1. With respiratory distress
 - a. hematocrit less than 35%
 - b. evidence of shock (one of the following):
 - 1) pallor
 - 2) poor perfusion
 - 3) tachycardia
 - 4) hypotension
 - c. greater than 10% of the blood volume has been removed within a 48 hour period (avg NB = 270 mL/blood volume)

2. Absence of respiratory distress
 - a. Hematocrit less than 30% in the first post-natal week, OR
 - b. evidence of congestive heart failure, imminent, or present (one of the following):
 - 1) tachycardia
 - 2) tachypnea
 - 3) cardiomegaly
 - B. Birth weight less than 2500 grams
- II. Older Pediatric Patients - four months to two years
- A. Symptomatic anemia (one of the following):
 1. pallor
 2. poor perfusion
 3. imminent or current congestive heart failure, from whatever cause if no other medicinal therapy has or is likely to correct it.
 - B. Chemotherapy when medicinal therapy is unlikely to correct a low hematocrit of less than 30%. OR
 - C. Prior to surgery and anesthesia, although asymptomatic, with hematocrit of less than 30%. OR
 - D. Intraoperatively estimated loss of blood greater than 10% of the blood volume.

PLATELET TRANSFUSION

The purpose in establishing guidelines for platelet transfusion is to reduce the risk of disease transmission and allosensitization. It is also important to ensure that the use of a product that is in limited supply is clinically indicated.

Assessment of need for platelet transfusion should include evaluation of current or potential risk of bleeding. Pre-transfusion and post-transfusion platelet counts should be used to monitor indications for and response to platelet therapy as well as the need for additional platelet transfusion.

It is difficult to establish a uniform dose of platelets for transfusions. However, the basic adult dose of one unit of pheresed platelets (1 pheresis or 5 platelet concentrates) should increase the platelet count approximately 25 to 50,000/mm³ in a stable adult. Decreased platelet increments can be caused by rapid utilization or destruction of platelets and may be an indication of allosensitization and refractory state.

A. Indications

1. When platelet count is 5,000/mm³ or less, platelets should ordinarily be administered, regardless of apparent bleeding.
2. Prophylaxis against bleeding in thrombocytopenic states when platelet counts are between 5,000/mm³ and 20,000/mm³ and thrombocytopenia is due to decreased platelet production or when a patient is involved in active chemotherapy.
3. Spontaneous clinical bleeding with platelet counts less than 50,000/mm³ e.g. oozing at surgical incisions, at venipuncture sites, and from mucosal membranes, widespread petechiae, ecchymoses, conjunctival hemorrhages, epistaxis, easy bruising, melena, menorrhagia, and hematuria.

4. Prophylaxis against bleeding in premature and extremely ill neonates with active bleed and platelet counts less than $150,000/\text{mm}^3$, Sick infants with platelet count less than $70,000/\text{mm}^3$ and premature neonates with platelet counts less than $25,000/\text{mm}^3$.
5. Maintenance of counts above $70,000/\text{mm}^3$ when there are extensive incisions and large exposed surface areas with evidence of considerable blood loss. Generally, platelet counts of $50,000$ to $70,000/\text{mm}^3$ are adequate both preoperatively and postoperatively for most major surgical procedures.
6. Prophylaxis after rapid (within 6-12 hours) transfusion of 15-20 units of blood or a single total blood volume replacement for pediatric patients.
7. For bleeding (regardless of platelet count) due to a platelet dysfunction when there is a bleeding time of greater than 16 minutes or an abnormal platelet function test e.g., inherited qualitative disorder, following aspirin ingestion, or platelet inhibitors such as Plavix, Ticlid; or chronic uremia.
8. For bleeding following severe trauma with:
 - a. platelet count less than $100,000/\text{mm}^3$, OR
 - b. abnormal bleeding time (greater than 2 X normal i.e. > 16 minutes) or an abnormal platelet function test regardless of platelet count, OR
 - c. life-threatening hemorrhage requiring massive transfusion
9. For excessive clinical bleeding* after cardiopulmonary bypass (CPB) or aortic balloon pump and either:
 - a. Platelet count less than $100,000/\text{mm}^3$, OR
 - b. Abnormal bleeding time (greater than 2 X normal i.e. >16 minutes) or an abnormal platelet function test despite adequate platelet numbers, OR
 - c. Evidence of emergency situation of uncontrolled bleeding.

*Suggested parameters for excessive bleeding post-CPB:

 - 1) Bleeding from the chest, with no obvious surgical cause, exceeding 450 mL per hour during the first two post-pump hours.
 - 2) Bleeding at a rate of 250 mL/hr (3 mL/kg/hr pediatric) for three consecutive hours without sign of reduction.
 - 3) Oozing from all incisions.
 - 4) Cardiopulmonary bypass involving the use of global hypothermic circulatory arrest.

B. Contraindications:

1. When bleeding is the result of coagulation factor deficiency, inhibitors, anticoagulants, or von Willebrand's factor deficiency.
2. When bleeding time or platelet function test is normal and platelet range is adequate for hemostasis.
3. For prophylaxis against bleeding when thrombocytopenic state is due to excess platelet destruction or sequestration e.g. ITP, TTP, immune-mediated drug purpura, DIC, post-transfusion purpura or neonatal isoimmune thrombocytopenic purpura unless accompanied by active bleeding.
4. For prophylaxis or preoperatively when there is a treatable clinical disease state which causes an extrinsic qualitative platelet defect e.g. uremia, dysproteinemia.

5. Routine post CPB platelet transfusion. Prolonged duration of cardiopulmonary bypass per se is not an indication for post CPB platelet transfusion unless the bleeding tendency is appropriately documented by clinical or laboratory parameters.

THAWED FRESH FROZEN PLASMA AND/OR THAWED PLASMA FOR TRANSFUSION

Thawed Plasma is the same as Thawed Fresh Frozen Plasma except that it should not be used to treat coagulation factor deficiencies of factor V and factor VIII. Fresh Frozen Plasma dosing guidelines of 10-15 mL to kg.

Hemostatic factor content of factor V and VIII in a typical 300 mL plasma unit are shown in the following table:

Factor	Level when freshly thawed	Level at 24 hours	Level at 5 days
V	80 IU/mL	75 IU/mL	66 IU/mL
VIII	92 IU/mL	51 IU/mL	41 IU/mL

A. Indications - one of the following:

1. Replacement of isolated factor deficiencies when specific component therapy is not available
 - a. Factors II, V, VII, X, and XI
2. Replacement for multiple factor deficiencies
 - a. Liver disease
 - 1) when an invasive procedure is to be performed and
 - a) INR > 1.4, OR
 - b) PT > 15 seconds, OR
 - c) PTT > 50 seconds
 - b. Warfarin effect prior to surgery or with active bleeding
 - 1) INR > 1.5, OR
 - 2) PT > 16 seconds, OR
 - 3) PTT > 60 seconds
 - c. Consumptive coagulopathy (DIC)
 - 1) PT > 16 seconds; PTT > 60 seconds OR
 - 2) D-Dimers increased
3. Thrombotic Thrombocytopenic Purpura
4. Immunodeficiencies
 - a. Infants with secondary immunodeficiency associated with severe protein-losing enteropathy, OR
 - b. Neonates with hypotension and infection.
5. Antithrombin III Deficiency
 - a. Difficulty heparinizing a patient
6. Plasma exchange

7. Birth weight of less than 2500 grams
 - a. Suspected DIC without laboratory confirmation.
 8. C1 Esterase Deficiency
- B. Contraindications:
1. Volume expansion or colloid replacement
 2. Protein source
 3. von Willebrand's disease and factor VIII deficiency
 4. Prophylaxis in multiply transfused patients who do not have a documented coagulation defect.

CRYOPRECIPITATE TRANSFUSION

Principle: Cryoprecipitate is a cold-insoluble protein that is harvested when fresh frozen plasma is thawed at 4C. Each unit comes from a single donor. Therefore, the risk of transfusion transmitted disease such as hepatitis increases concomitantly with each unit administered in the pool. Cryoprecipitate is an excellent source of Factor VIII:C (the Factor VIII procoagulant portion), Factor VIII:vWF (von Willebrand's factor), fibrinogen, and Factor XIII.

Composition:

1. Factor VIII:C - 80-120 units/cryo unit
2. Factor VIII:vWF - 40-70% of vWF/single FFP unit
3. Fibrinogen - av. 250 mg/cryo unit
4. Factor XIII - 20-30% of F XIII/one FFP

A. Indications - one of the following:

1. Hemophilia A (Factor VIII: C deficiency)

If available, commercial Factor VIII concentrates are recommended. However, if not available, cryoprecipitate may be used for the following:

- a. Prophylaxis prior to surgery/dental extraction
 - 1) DDAVP (desmopressin) is preferred in mild form (6-30% VIII:C levels)
 - b. Traumatic hemorrhage
 - 1) If mild and when following minor trauma
 - a) DDAVP initially
 - c. CNS hemorrhage
2. von Willebrand's disease (Factor VIII:vWF deficiency)
 - a. Congenital
 - 1) Prophylaxis prior to surgery/dental extraction
 - a) DDAVP is recommended in Type I
 - 2) Spontaneous hemorrhage
 - a) DDAVP recommended initially only for Type I but contraindicated for Type II b
 - b. Acquired

- 1) Collagen Vascular Disease
 - a) SLE
 - b) Scleroderma
 - 2) Lymphoproliferative disorders
 - a) non-Hodgkin's lymphoma/CLL
 - 3) Other neoplasms
 3. Dysfunctional platelets - DDAVP recommended initially
 - a. Congenital
 - 1) platelet storage pool disease
 - b. Acquired
 - 1) Uremia
 4. Plasma Fibrinogen level below 100 mg/dL or dysfunctional fibrinogen
 - a. Dosage calculation
 - 1) Adults: Normal dose for a 70 kg adult is 10 units which is expected to raise the fibrinogen level by 50-100 mg/dL.
 - 2) Pediatrics: One unit/5 kg body weight
 5. Factor XIII deficiency
 6. Fibrin glue as "tissue sealant"
 7. For removal of kidney stones located in the renal pelvis and calyces
 8. For topical tissue adhesive.
- B. Contraindications:
1. Coagulation deficiencies secondary to factors not present in cryoprecipitate
 2. Quantitative platelet defects

LEUKOREduced RED CELLS AND PLATELETS

All red cell and platelet products, with the exception of autologous products, must be leukoreduced. The preferred method is prestorage leukoreduction, providing leukoreduction under controlled conditions. Prestorage filtration of red cells reduces the leukocyte count to less than 5×10^6 white cells per unit, retains 85% of the original red cells, and reduces certain cytokines released from leukocytes during storage. If the product is prestorage leukoreduced, a leukocyte reduction filter is not required for transfusion and will not be issued by the Transfusion Service.

A. Benefits of leukoreduction of cellular products

1. Prevention/reduction of febrile transfusion reactions for patients with a history of non-hemolytic febrile transfusion reactions, especially when two or more reactions have been reported
2. Prevention/reduction of HLA alloimmunization. This may be important to prevent/lessen future platelet refractoriness in chemotherapy patients and to improve graft survival in certain kinds of transplants.

3. Prevention/reduction of transfusion transmitted CMV infection and other leukotropic viruses (EBV, HTLV)
4. Prevention/reduction of immune modulation. Immune modulation may cause increased susceptibility to viral or bacterial infection and diminished immune surveillance against tumors.

OTHER SPECIAL NEEDS (IRRADIATION, CMV NEGATIVE OR SAFE, AND/OR HEMOGLOBIN S NEGATIVE) – See Chart for Indications.

Irradiation of Red Cells, Platelets, and Granulocytes: Irradiation is indicated for patients at risk of Transfusion Associated Graft vs Host Disease (TA-GVHD). Irradiated blood products receive a minimum of 25 GY of gamma radiation. This effectively renders the lymphocytes incapable of proliferating. The effect on red cells results in a slight increase in plasma hemoglobin and potassium and the product outdate is reduced from 42 to 28 days. The effect on other cells is variable and probably not significant.

In addition to the absolute indications listed in the chart, irradiation may also be indicated for patients with Secondary Immunodeficiencies, including lymphoreticular disease, malignancy, other solid organ transplants, heavy chemo- or radiotherapy.

CMV Negative or Safe Red Cells, Platelets and Granulocytes: When CMV transmission by transfusion is a concern, some specialties will only accept CMV negative products while others will accept “CMV Safe”.

CMV Safe is defined as either CMV negative or prepared by a method known to reduce the leukocyte number in the final component to less than 5×10^6 . Prestorage leukoreduction is known to reduce the leukocyte number in the final component to less than 5×10^6 and is therefore CMV Safe. Bedside leukoreduction does not always reduce the leukocyte count sufficiently and therefore is only to be used if prestorage leukoreduced products or CMV seronegative products cannot be obtained and the ordering physician agrees.

OTHER SPECIAL NEEDS CHART	For Cellular Products (Red Cells, Platelets and Granulocytes)			For Red Cells Only
	Irradiation	CMV Neg*	CMV Safe	Hb S Neg
Transplants				
Bone marrow transplant or stem cell (peripheral blood progenitor cell) transplant	Yes	Yes		
Lung and/or liver transplant patients (both before and after transplantation)	Yes	Yes		
Heart, kidney, pancreas, and/or other solid organ not named transplant patients		Yes		
Neonates				
All Neonates and fetuses	Yes**	Yes**		
Neonates requiring exchange transfusion	Yes	Yes		Yes
Other				
Patients known to have a diagnosis or past history of Hodgkin's disease	Yes			
Patients treated with fludarabine (current or past)	Yes			
Patients with primary immune deficiency syndromes, particularly SCIDS	Yes			
Patients being maintained for organ retrieval			Yes	
Pregnant women prior to delivery or termination of pregnancy			Yes	
Sickle Cell Patients				Yes
Patients receiving white cell products	Yes			
Recipients of directed units from blood relatives	Yes			
Recipients of HLA-selected platelets or platelets known to be HLA homozygous	Yes			

*If CMV Negative products cannot be obtained in the required time frame, CMV Safe products may be used with physician permission.

**For emergent transfusion of babies not known to be at high risk of GVHD, medical approval has been obtained to suspend Irradiation and CMV Negative requirements. Babies at high risk of GVHD include those who have had intrauterine transfusion and/or have a birth weight of less than 1200 g.

REFERENCES

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2. American Association of Blood Banks, American National Red Cross, and America's Blood Centers, Circular of information for the use of human blood and blood components, Bethesda, MD.
3. Blood Transfusion Therapy: A Physician's Handbook, current edition, American Association of Blood Banks.

4. Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant, British Journal for Haematology, 2004, 11-28.
5. aaBB Standards for Blood Banks and Transfusion Services, current edition, American Association of Blood Banks.
6. www.pathology.med.umich.edu/bloodbank/manual/bbch_4/