

RED CELL PRODUCTS

PRODUCT	CHARACTERISTICS	INDICATIONS
Whole blood (not available at Shands)	450 mL. Coagulation factors adequate, platelets low in number	Provides oxygen-carrying capacity and blood volume not generally available
Packed red cells	250–300 mL, contain leukocytes and platelets sufficient for allo-immunization; can be stored up to 35 or 42 days at 4°C	Provide red cells for oxygen-carrying capacity
Leukocyte-depleted red cells	Like packed red cells but contain less than 5×10^6 leukocytes	Reduce incidence of febrile reactions (especially if leukodepletion performed pre-storage); reduce the risk of HLA alloimmunization and CMV transmission
Deglycerolized frozen red cells	200 mL	Used when cells with rare blood group phenotypes are required; prevention of anaphylaxis in patients with anti-IgA antibodies
Washed red cells	Saline-suspended red cells in 200–250 mL	Useful for patients with paroxysmal nocturnal hemoglobinuria, severe allergic reactions to donor plasma proteins, or non-hemolytic febrile reaction
Irradiated red blood cells	Like packed red blood cells	Used to reduce lymphocytes and prevent GVHD in those at risk (HSCT patients, aplastic anemia, directed donation)

FEVER ASSOCIATED WITH TRANSFUSION OF BLOOD COMPONENTS

DEFINITION:

- Rise of at least 1° C during or within 1–2 hours of the transfusion
- Acute hemolytic transfusion reaction
- Bacterial sepsis
- Febrile non-hemolytic transfusion reaction
- Unrelated to the transfusion

APPROACH TO FEVER ASSOCIATED WITH TRANSFUSION:

- General considerations
 - Stop the transfusion
 - Keep the intravenous line open
- Rule out acute hemolytic transfusion reaction
 - Clerical check
 - Observe plasma for free hemoglobin
 - Obtain direct antiglobulin (Coomb's) test
- Rule out sepsis
 - Consider the diagnosis
 - Gram stain and culture of remaining blood product
 - Antibiotic therapy
- Treatment of pulmonary complications
 - Monitor pulmonary function
 - Oxygen therapy
 - Intubation and ventilator support
- Management of DIC – Treat bleeding diathesis with blood components

ACUTE HEMOLYTIC TRANSFUSION REACTION

MECHANISM: Recipient has a red cell antibody that reacts with transfused red cells causing intravascular and/or extravascular red cell lysis

INITIAL MANIFESTATIONS:

Fever +/- chills

Vague uneasiness, flushing, dyspnea, chest pain, light-headedness

Severe reaction: Dyspnea, flank pain and/or hypotension; Shock with oliguria; Rarely generalized oozing or frank bleeding

Clinical severity is usually proportional to volume of incompatible blood transfused.

LABORATORY EVALUATION:

Pink or red top tube to blood bank

Free hemoglobin

Haptoglobin

DAT

Type and screen

Urine sample

Hemoglobinuria

TREATMENT:

General considerations

Establish large bore venous access

Monitor vital signs

Consider placement of Swan-Ganz catheter

Aggressive IVF administration with 1000 mL normal saline

Prevention of renal complications

Low-dose dopamine

Maintain blood pressure and urine output diuretics

FEVER WITHOUT HEMOLYSIS

The febrile non-hemolytic transfusion reaction (FNHTR) is characterized by mild to severe fever occurring usually after the blood product has been almost completely transfused or maybe seen up to 1-2 hours following the transfusion. It occurs more frequently in patients with previous pregnancies or multiple transfusions. Proposed mechanisms for the fever include reaction of the patient's antibodies with donor white blood cells or platelets as well as inflammatory cytokines released from white blood cells in stored blood products. The plasma supernatant of platelet concentrates is a major contributor to the reaction.

TREATMENT AND PREVENTION:

Fever may be the hallmark of a hemolytic reaction or transfusion of bacterially contaminated blood so that **it is usually recommended that the transfusion should be stopped**. The FNHTR can be treated with antipyretics. White blood cell reduction by filtration performed prior to blood product storage (platelets) or at the bedside is useful to reduce the incidence of the reaction.

PULMONARY EDEMA:

Pulmonary edema occurring during a transfusion is often due to heart failure secondary to volume overload. Rarely, transfusion can cause non-cardiogenic pulmonary edema due to passively transferred anti-leukocyte antibodies (transfusion-related acute lung injury or TRALI). Treatment is primarily supportive. The benefits of steroids remain unproven.

ANAPHYLACTIC TRANSFUSION REACTION

MECHANISM: Anti-IgA antibodies cause some reactions; many have no apparent cause

CLINICAL AND LABORATORY ASPECTS:

- Fever is usually absent
- Gastrointestinal symptoms followed by hypotension
- Stop the transfusion and administer epinephrine
- Determine serum IgA level and consider anti-IgA assay
- Prophylaxis by washing blood products
- Transfusion of IgA negative plasma products

DELAYED HEMOLYTIC TRANSFUSION REACTION

MECHANISM: Formation or recall of antibody to transfused donor red blood cells

CLINICAL AND LABORATORY ASPECTS:

- Variable delay in hemolysis (2 to 21 days)
- Usually asymptomatic unexplained decrease in the hematocrit unless baseline severe anemia or ongoing chronic hemolysis
- Presentation as pain crisis in the patient with sickle cell disease
- Antibody usually identified by indirect antiglobulin test

PLATELETS

The finding of a decreased platelet count (less than $150 \times 10^9/L$) necessitates an evaluation to identify the etiology for the thrombocytopenia. Platelet transfusions are contraindicated for certain diagnoses (e.g., heparin-induced thrombocytopenia and thrombotic thrombocytopenic purpura).

INDICATIONS:

The majority of platelet transfusions are prescribed to prevent hemorrhage in patients with production-related thrombocytopenia (e.g., cytotoxic chemotherapy, bone marrow failure). Transfusions are generally not indicated for conditions with enhanced platelet destruction (e.g. immune thrombocytopenic purpura, hypersplenism).

A “trigger” platelet count of $10 \times 10^9/L$ for prophylactic transfusions in the stable patient without additional risk factors is reasonable. The platelet count should be greater than or equal to $50 \times 10^9/L$ for major surgery or life-threatening bleeding.

DOSAGE:

Random donor platelets should be transfused at a dose of 1 unit/10 kg body weight but not to exceed 10 units. The typical apheresis single-donor product contains approximately 4×10^{11} platelets equivalent to approximately 6 – 8 multiple donor units.

REFRACTORINESS TO PLATELET TRANSFUSION:

The average life span of platelets produced by the bone marrow is 9–12 days. In comparison, transfused platelets usually survive for approximately 3 days. Platelet survival time may be further reduced due to multiple factors:

- Age of transfused platelets

- Nonalloimmune causes such as fever, active bleeding, splenomegaly, drug administration, or ongoing consumption coagulopathy, alloimmunization

$$CCI = \frac{(\text{post-transfusion platelet count} - \text{pre transfusion platelet count}) \times BSA}{\text{Platelets transfused} \times 10^4}$$

MINIMUM CCI:

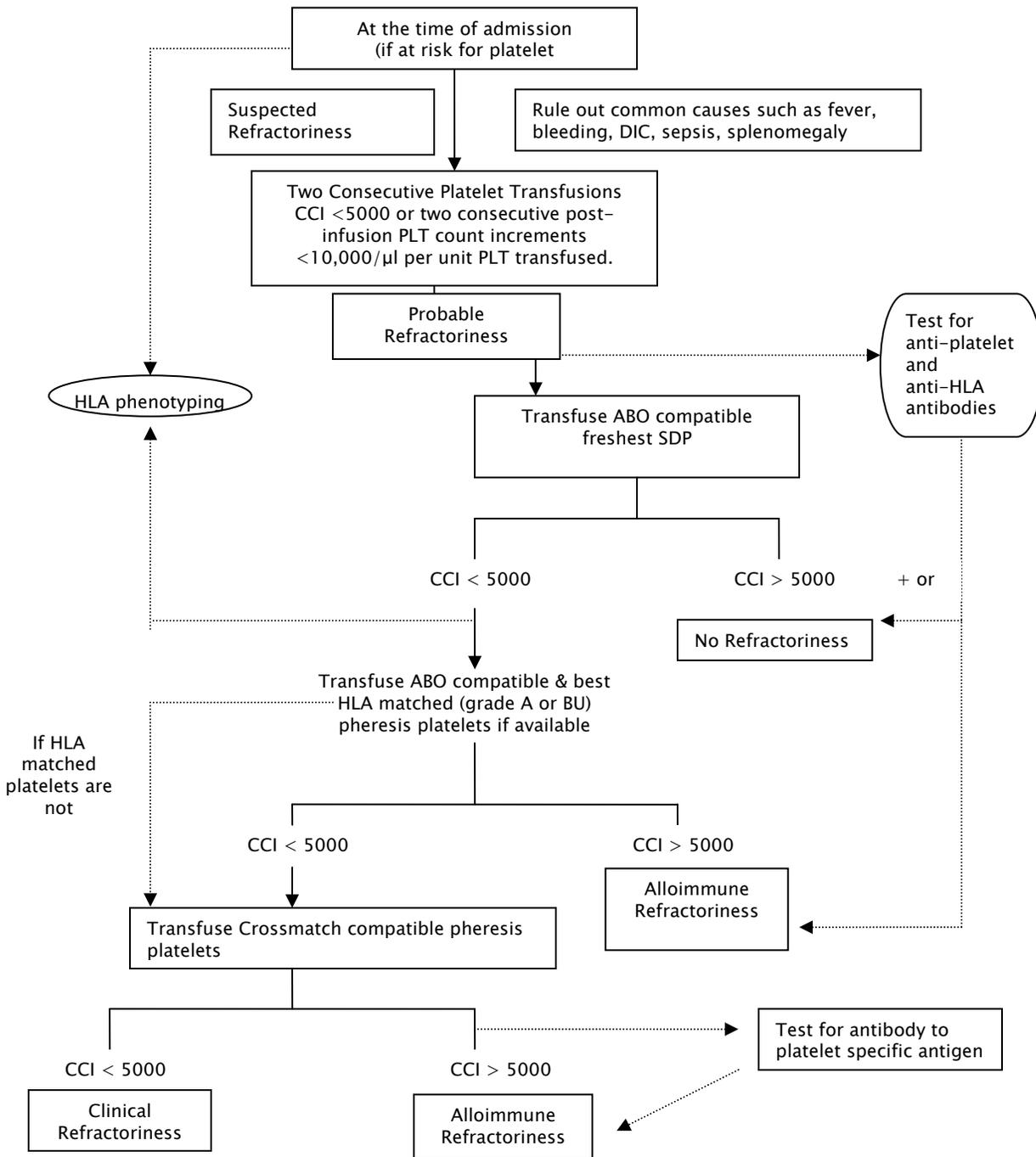
- > $5 - 7.5 \times 10^9$ at 10 to 60 minutes
- > 4.5×10^9 at 18 – 24 hours

Estimate $5 - 6 \times 10^9/L$ increase per random unit of platelets transfused.

SUMMARY:

Platelets should not be transfused in certain clinical conditions despite significant thrombocytopenia. Patients with platelet counts of $50,000/\mu L$ or greater usually do not require prophylactic platelet transfusions.

Transfusion Algorithm for Patients Refractory to Pooled Platelets



SDP: Single Donor Platelets

CCI: Corrected count increment

* Assess PLT transfusion response by obtaining a 1-hour post-transfusion PLT count

FRESH FROZEN PLASMA

INDICATIONS:

Active bleeding with evidence of coagulopathy (PT or PTT greater than 1.5 x normal);
Massive blood transfusion (replacement of more than 1 blood volume) with evidence of active bleeding;
Reversal of warfarin effect:
 Recombinant Factor VIIa (Novoseven[®]): Immediate
 Plasma transfusion: 1 – 2 hours
 Vitamin K administration: 6 – 12 hours
 Discontinue warfarin: 2 – 3 days
Treatment of thrombotic thrombocytopenic purpura (TTP) plasma infusion vs. plasma exchange;
Treatment of identified deficiency of coagulation factor (when alternative product is not available e.g., Factor XI).

DOSAGE:

For active bleeding with coagulopathy, a 70 kg individual may require 10 – 15 mL/kg. Each unit contains approximately 200 – 250 mL so that an initial transfusion would be 3 – 4 units.

SUMMARY:

Patients with evidence of coagulopathy due to liver disease, however, without active bleeding should not receive fresh frozen plasma. A trial of vitamin K administration should be considered prior to plasma administration. Parenteral vitamin K is the treatment for warfarin overdose, unless immediate reversal is needed.

CRYOPRECIPITATE

Cryoprecipitate is the precipitable protein fraction prepared from fresh frozen plasma thawed at 1–6° C.

INDICATIONS:

Fibrinogen replacement: fibrinogen levels of 100 mg/dL are considered adequate in most clinical situations;
Von Willebrand's disease: Consideration should be given to the use of desmopressin (DDAVP) or factor VIII concentrates with von Willebrand factor activity;
Hemophilia A (if concentrates are not available);
Factor XIII deficiency.

PRODUCT CONTENTS:

80 – 100 units Factor VIII
100 – 250 mg Fibrinogen
40–70% of VWF originally in plasma
Factor XIII

DOSE: 1 – 4 bags/10 kg body weight.

SUMMARY: Cryoprecipitate is the blood product used to replace fibrinogen.