Atlantic Provinces Pediatric Hematology Oncology Network
Réseau d'oncologie et d'hématologie pédiatrique des provinces de l'Atlantique

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Reviewed and approved by specialists at the IWK Health Centre, Halifax, NS

The supportive care guidelines have been developed by appropriate Atlantic Provinces health professional specialists (physicians, pharmacists, nurses and other health professionals) using evidence-based or best practice references. Format and content of the guidelines will change as they are reviewed and revised on a periodic basis. Care has been taken to ensure accuracy of the information. However, any physician or health professional using these guidelines will be responsible for verifying doses, and administering medications and care according to their own institutional formularies and policies and acceptable standards of care.

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Blood Transfusion Guidelines

1. General recommendations for blood component transfusion:

A. Administration:

Blood products must be administered using the established policies and protocols of the institution/health centre.

B. General risks of transfusion: [see Table 1]:

Risks must be balanced with the expected benefits each time a transfusion is contemplated. Informed consent must be obtained per health centre policy from patients/parents for non-emergency transfusions.

a. Hemolytic transfusion reactions: [see Table 1; Figure 1]
   i) Acute (< 24 hours), immune;
   ii) Acute, non-immune;
   iii) Delayed (> 72 hours), immune;

b. Non-hemolytic transfusion reactions: [see Table 1, Figure 1]
   i) Febrile transfusion reactions;
   ii) Fluid overload; sodium overload; iron overload;
   iii) Allergic reactions;
   iv) Metabolic disturbances – hyperkalemia, hypernatremia, acidosis, citrate toxicity, hypocalcaemia;
   v) Transfusion-related acute lung injury(TRALI);

c. Transfusion-acquired infections;

d. Transfusion-associated graft versus host disease.

C. Prevention of transfusion-acquired graft versus host disease:
   a. Avoid directed blood donations by close relatives except when indicated if stem cell transplantation is a potential therapy for the patient;
   b. Irradiate all blood transfusion components with the potential to contain leucocytes; irradiation of acellular products is not required;
   c. Irradiation dose 2,500 cGy to the central midplane of the unit with a minimum of 1,500 cGy elsewhere in the unit.

D. Leucocyte-reduction pre-storage:
   a. Decreases risk of CMV infection;
   b. Decreases GVHD;
   c. Decreases leucocyte sensitization;
   d. Decreases febrile transfusion reactions.

E. Correct product to correct patient:
   a. Label clearly the blood sample for type and screen with the patient's name, check against patient's identification band;
   b. Before administering blood or blood product, check physician order, patient identification and blood product number and tags;
   c. Clerical error and misidentification of patient/product remain significant transfusion errors. The frequency of deaths related to patients receiving the incorrect blood component is estimated to be at least 30 x's greater than the risk of transfusion acquired HIV infection.

F. Rho [D] immune globulin (WinRho SDF™):
   a. If platelet transfusions given are not Rh compatible, Rh immune globulin should be given intravenously to Rh negative female and male recipients;
   b. The usual dose is 300 micrograms IV for every 35 units of platelets to be transfused. If the platelet transfusions are administered more than 4 weeks apart, the Rh immune globulin should be repeated. If the child is expected to receive fewer than 12 units of platelets within a 4-week period, 120 micrograms IV Rho [D] immune globulin can be given.

2. Red cell transfusions:

A. Definition of anemia:
   a. Significant anemia results in decreased oxygen-carrying capacity of the blood and reduction in the oxygen available to the tissues;
   b. Hemoglobin concentration is only a rough guide for an individual's adequate oxygen-carrying capacity.

B. Symptoms and signs:
   a. If anemia develops gradually, there are few symptoms;
   b. Common symptoms include fatigue, dyspnea, inactivity, difficulty concentrating, anorexia, headache, syncope, vertigo, palpitations;
   c. Common signs include pallor, tachycardia, tachypnea, ejection systolic murmur, gallop rhythm.

C. Options to prevent anemia:
   a. Recombinant erythropoietin has been used successfully in children with solid tumors;
   b. Hemodilution and other methods may be used to decrease surgical blood loss;
   c. Autologous transfusion may be an option for some children.

D. Indications for red cell transfusion:
   a. Packed red blood cell concentrates [PRBC] should be considered for patients whose hemoglobin is less than 70 g/L;
   b. A lower threshold for transfusion may be considered for children who are profoundly thrombocytopenic or who will undergo an invasive procedure with risk of bleeding;
   c. A child beginning a course of chemotherapy with a hemoglobin level <80 g/L may benefit from a transfusion.
   d. A child with acute blood loss of >10% blood volume, ongoing blood loss with loss of >10% blood volume or bleeding with a hemoglobin level <80 g/L may benefit from PRBC transfusion;
   e. A higher threshold for transfusion may be considered for patients with chronic, compensated anemia;
   f. For patients with fatigue felt to be related to anemia, or underlying cardiac or pulmonary dysfunction, the transfusion trigger may be higher;
   g. A child with a bleeding diathesis may have a higher transfusion threshold;
   h. For children receiving radiation, PRBC transfusion may be recommended to maintain Hgb>100 g/L.

E. Dose of PRBC:
   a. Whenever feasible, transfuse to the nearest full unit of PRBC;
   b. The usual dose depends on the anticoagulant utilized and varies from 10-15 mL/kg [@12 mL/kg of CPD, CPDA-1 PRBC should increase hemoglobin by 30 g/L; @12 mL/kg of AS PRBC should increase hemoglobin by 20 g/L];
   c. Smaller and slower transfusions should be given to children who are profoundly anemic, except for those presenting with an acute bleed or a rapid rate of fall. For severe chronic anemia the dose of PRBC should be lower and the infusion rate slower [rate of infusion in mL/kg should be 10% of the pre-transfusion hemoglobin level and given IV over 3½ hours, e.g., if pre-transfusion level is 40 g/L, initial infusion rate @ 4 mL/kg IV over 3½ hours].

3. Platelet transfusions:

A. Signs and symptoms of thrombocytopenia:
   a. Common signs include mucosal bleeding, epistaxis, ecchymosis, petechiae, gastrointestinal bleeding, hematuria, increased menstrual bleeding, prolonged bleeding;

b. Common symptoms of an intracranial bleed include severe headache with or without vomiting, changed level of consciousness.

B. Avoidance of bleeding precipitants:
   a. For platelet level <50,000/µL, avoid, if possible, invasive procedures (e.g., NG tubes, urinary catheters), contact sports or rough activities, blowing nose, hard foods;
   b. Avoid use of acetylsalicylic acid [Aspirin®] and other products with antiplatelet effects;
   c. Prevent constipation, and avoid rectal thermometers, suppositories, enemas or rectal examinations;
   d. If platelet level <20,000/µL, avoid using toothbrush, razor.

C. Indications for platelet transfusion:
   a. Platelet concentrate transfusion should be considered for children who are actively bleeding, or those requiring an invasive procedure [lumbar puncture <20,000/µL; IM injections <20,000/µL; dental procedures {extractions, gum incisions, etc.} <40,000/µL; surgical procedures <50,000/µL; neurosurgery <100,000/µL];
   b. For most well children with platelet count <5,000/µL, platelet transfusion should be considered.
   c. For a well but febrile child, platelet transfusion should be considered for a platelet count <10,000/µL;
   d. For an ill child or a febrile unstable child, platelet transfusion should be considered when the platelet count <20,000/µL;
   e. For a post bone marrow transplant child, the platelet count should be maintained >20,000µL;
   f. For a child receiving imatinib [Gleevec®], or a child with a brain tumour receiving radiation, the platelet count should be maintained >20,000/µL;
   g. For a child receiving therapeutic anticoagulants, the platelet count should be maintained >50,000/µL;
   h. For neonates with platelet count <30,000/µL, platelet transfusion is recommended;
   i. If platelets are unavailable in <4 hours, or a high rate of platelet drop related to chemotherapy induced thrombocytopenia is evident and anticipated, platelet transfusion may be considered at a higher platelet count;
   j. Supportive measures such as DDAVP, aminocaproic acid or tranexamic acid may be useful. Avoid antifibrinolytics if renal bleeding.

D. Dose:
   a. One unit of pre-filtered platelet concentrate/5-10 kg, or 10 mL/kg, or 6 units/m^2, or 1 unit apheresed pre-filtered platelet concentrate/m^2, should raise the platelet count by 40-50,000/µL;
   b. Recommended maximum single dose is 4 to 6 units.

4. **Plasma transfusions:** [plasma contains all coagulation factors and complement]

   A. Plasma transfusion should be considered for patients with clinically significant coagulation protein deficiencies for which specific factor concentrates are not available, for coagulopathy of liver disease or for significant prolongation of PT and/or PTT [>1.5 x upper reference range] in a bleeding patient before the results of factor assays are available.
   B. Plasma transfusion may be useful when the anti-thrombin level is <50% if reported as percentages, otherwise < 0.5 g/L or < 0.5 units/mL. Anti-thrombin concentrate, if available, may be given. The usual dose of fresh frozen plasma is 10-15 mL/kg which will increase factor levels by 15-20%. Normal factor levels are not usually required to establish hemostasis.
   C. Alternatives to plasma:
      a. Single coagulation factor concentrates when specific single factor deficiency identified;
      b. Synthetic colloids for volume expansion in resuscitation;
      c. Albumin solutions for volume replacement in plasmapheresis;
      d. Pentastarch for volume expansion or product sparing during surgery;
      e. Pharmaceutical agents such as DDAVP, aminocaproic acid, tranexamic acid, aprotinin;
      f. Fibrin glue.

5. Cryoprecipitate transfusions: [contains fibrinogen (± 150 mg/mL), factor VIII, Von Willebrand's Factor, Factor XIII]

   A. Cryoprecipitate transfusion should be considered for patients with decreased fibrinogen [< 0.6 g/L] or dysfibrinogenemia.
   B. The usual dose is 6 units/m^2 or 1 unit/5 kg given IV push. This will give a 1 g/L increase in plasma level.

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Table 1
Identification and management of a transfusion reaction

TYPE OF REACTION	INCIDENCE	SIGNS & SYMPTOMS	ETIOLOGY	TREATMENT
HEMOLYTIC				
acute hemolytic reaction < 24 hours (immune)	• Incidence 1:33,000-1:12,000	• Acute onset of symptoms [often within the first 15 minutes] • Acute intravascular hemolysis • Shock, chills, fever, dyspnea, chest pain, back pain, headache, DIC, renal failure, hemoglobinuria, hypotension, oozing from IV site, pain along infusion vein	• Cross-match error • Wrong identification of blood specimen • Blood administered to wrong patient	• Stop transfusion • Treatment aimed primarily at prevention of renal failure [IV fluids and diuretics]
delayed hemolytic reaction > 72 hours (immune)	• Incidence is 1:11,000-1:2,500 • Occur more often in patients with a history of multiple transfusions or pregnancies	• Unexplained fall in hemoglobin 4-14 days post transfusion, extra-vascular hemolysis may be accompanied by fever, hemoglobinuria, hyperbilirubinemia	• Immune response to RBC antigens	• Transfuse with antigen negative RBCs as necessary
Other hemolytic reactions (acute, non-immune)	• unknown	• Shock, chills, fever, dyspnea, chest pain, back pain, headache, DIC, renal failure, hemoglobinuria, hypotension, oozing from IV site, pain along infusion vein	• Related to bacterial contamination, mechanical damage, heat damage or administration with a hypotonic solution	• Stop transfusion

TYPE OF REACTION	INCIDENCE	SIGNS & SYMPTOMS	ETIOLOGY	TREATMENT
NON-HEMOLYTIC				
Febrile	• Incidence: 1:200-1:100 • Usually occurs in patients with a history of previous transfusions or pregnancies	• Rise in temperature 1%C above baseline, rigors • Headache, malaise, vomiting	• Antibody to donor leucocytes • Release of endogenous pyrogens • Occurs in 1-2% of transfusions	• Stop transfusion, assess, may resume transfusion on advice of physician • Pre-medication with acetaminophen
Circulatory overload (fluid, sodium, iron)	• Incidence is • 1:10,000-1:100	• Dyspnea, orthopnea, productive cough with pink frothy sputum, tachycardia, hypertension, headache	• Volume overload	• Stop transfusion • Head of bed should be kept elevated • Oxygen and diuretics may be ordered
Bacterial Contamination	• Incidence is 1:1700 in pooled platelet units and 1:500,000 in red cell components	• Fever, shock, DIC	• Bacteria from donor venipuncture site • Bacteria from donor with undiagnosed bacteremia • Bacteria from proliferation during storage	• Stop transfusion • Assess patient • Obtain blood cultures from patient • Notify health centre transfusion service • Return discontinued blood unit for culture
Allergic reaction	• Incidence is 1:100-1:33	• Pruritis, rash, urticaria, flushing	• Antibody to donor plasma proteins	• Stop transfusion • Antihistamines
Anaphylactic reaction	• Incidence is 1:170,000-1:18,000	• Urticaria, erythema, anxiety, respiratory distress, hypotension, laryngeal/pharyngeal edema, bronchospasm	• Antibody to donor plasma proteins	• Stop transfusion • Epinephrine • Antihistamines • Hydrocortisone sodium succinate

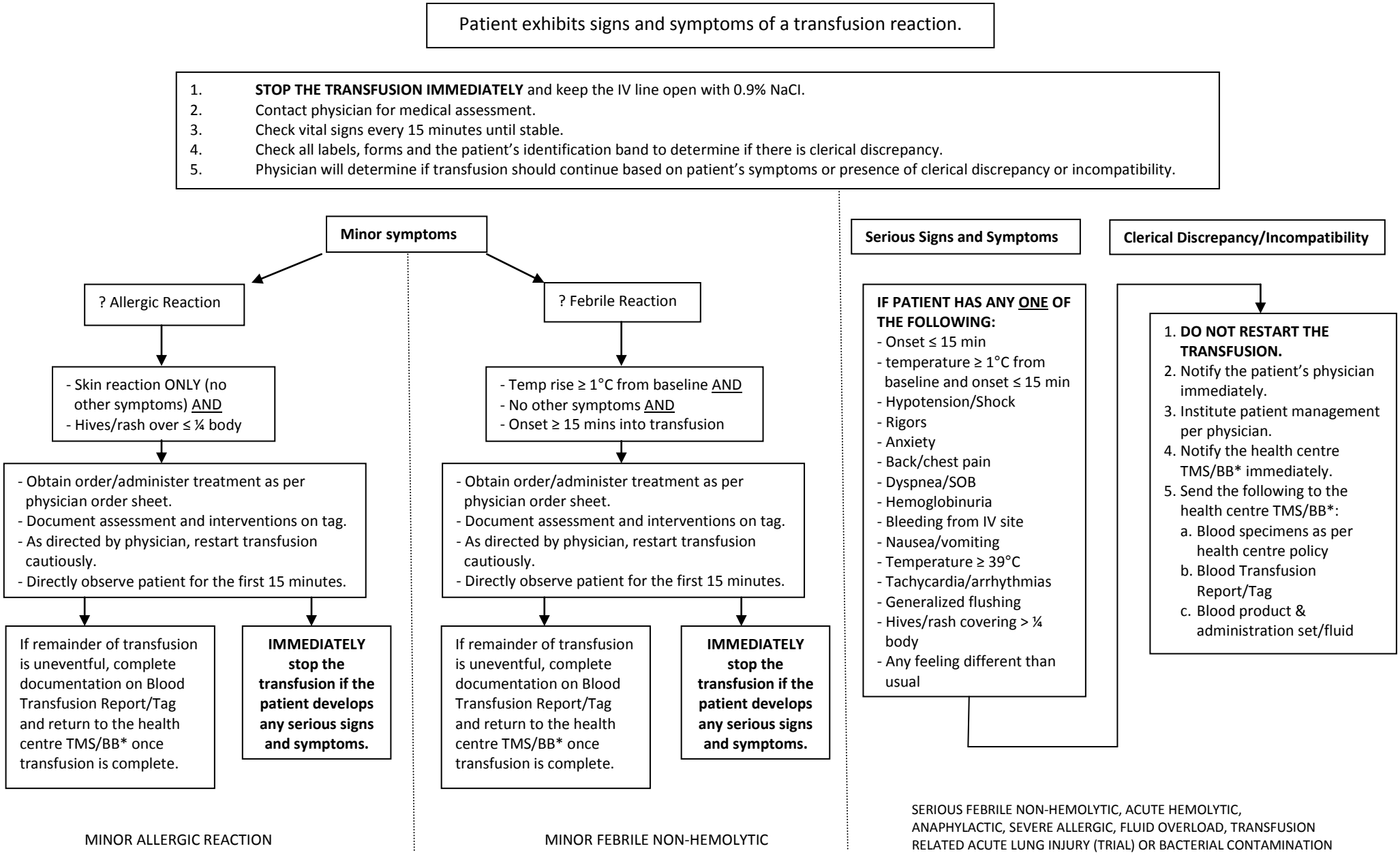
TYPE OF REACTION	INCIDENCE	SIGNS & SYMPTOMS	ETIOLOGY	TREATMENT
Transfusion related acute lung injury [TRALI]	• Incidence unknown, but estimated as 1:5,000	• Shortness of breath, hypoxemia, chills, fever, cyanosis, hypotension within 4-6 hours of transfusion • X-ray findings consistent with pulmonary edema but no evidence of cardiac failure	• Transfused antibodies to HLA or white cell antigens which may react with recipients leucocytes	• Treat acute respiratory distress [oxygen therapy, ventilator support]

Table 2
Complications and frequency

Complication	Frequency
Acute hemolytic transfusion reaction	1 per 12,000 – 33,000 RBC units transfused
Delayed hemolytic transfusion reaction	1 per 2,500 – 11,000 RBC units transfused
RBC alloimmunization	8% of adult patients transfused with PRBC
Febrile reaction	1 per 100 RBC units, higher with platelet transfusions
Anaphylaxis	1 per 18,000 – 170,000 units transfused
Urticaria	1 per 100 units transfused
Circulatory overload	1% of transfusions
Death due to transfusion error	1 per 600,000 units transfused
Transfusion related infection: • HIV • Hepatitis C virus • Hepatitis B virus • West Nile virus • Creutzfeld-Jacob Disease (CJD) • bacteria	 < 1 per 4,000.000 units transfused < 1 per 3,000,000 units transfused 1 per 275,000 to 1,000,000 units transfused 1 per 4000,000 to 1 per 600,000 units transfused < 1 per 10,000,000 units transfused < 1 per 500,000 units transfused

FIGURE 1

ALGORITHM FOR TRANSFUSION REACTIONS



*Transfusion Medicine Services/Blood Bank

[adapted from Nova Scotia Provincial Blood Coordinating Program Physicians' Algorithm for Transfusion Reactions March 2005]