Transfusion Reactions

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Synonyms and related keywords: blood transfusions, blood products, acute hemolytic transfusion reactions, transfusion complications, blood product reactions, allergic transfusion reaction, blood type, circulatory volume overload, anaphylactic transfusion reaction, blood anaphylaxis, hemolytic reactions, allergic reactions, anaphylactic reaction, anaphylaxis, transfusion-related acute lung injury, TRALI, transfusion-related lung injury, ABO antibody reaction, blood contamination, contaminated blood

AUTHOR INFORMATION

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Author: **S Gerald Sandler, MD, FACP, FCAP**, Director of Transfusion Medicine, Professor, Departments of Medicine and Pathology, Georgetown University Medical Center

Coauthor(s): **David A Sandler, MD**, Fellow, Department of Medicine, Division of Cardiology, New York University Medical Center

S Gerald Sandler, MD, FACP, FCAP, is a member of the following medical societies: American Association of Blood Banks, and College of American Pathologists

Editor(s): **Pradyumma D Phatak, MD**, Chair, Associate Professor, Department of Internal Medicine, Division of Hematology and Medical Oncology, Rochester General Hospital; **Francisco Talavera, PharmD, PhD**, Senior Pharmacy Editor, eMedicine; **Ronald A Sacher, MD**, Director of the Hoxworth Blood Center, Professor, Departments of Internal Medicine and Pathology, University of Cincinnati Medical Center; **Rajalaxmi McKenna, MD, FACP**, Southwest Medical Consultants, SC, Department of Medicine, Good Samaritan Hospital, Advocate Health Systems; and **Emmanuel C Besa, MD**, Professor, Department of Medicine, Division of Hematologic Malignancies, Thomas Jefferson University, Jefferson Medical College

Disclosure

INTRODUCTION

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Background: Acute transfusion reactions present as adverse signs or symptoms during or within 24 hours of a blood transfusion. The most frequent reactions are fever, chills, urticaria, or shortness of breath, which resolve promptly without specific treatment or complications. More serious reactions, such as hemolysis or sepsis, are potentially fatal. Acute transfusion reactions may present in complex clinical situations when diagnosis requires distinguishing between a reaction to the transfused blood product and a coincidental complication of the illness being treated that occurs during or immediately after a blood transfusion.

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Urticaria

Pathophysiology: Acute transfusion reactions may be divided into at least 8 distinct entities. Acute hemolytic transfusion reactions may be either immune mediated or non–immune mediated. Immune-mediated hemolytic transfusion reactions caused by immunoglobulin M (IgM) anti-A, anti-B, or anti-A,B typically result in severe, potentially fatal complement-mediated intravascular hemolysis. Immune-mediated hemolytic reactions caused by immunoglobulin G (IgG), Rh, Kell, Kidd, or other non-ABO antibodies typically result in extravascular sequestration, shortened survival of transfused red cells, and relatively mild clinical reactions.

Nonimmune hemolytic transfusion reactions occur when RBCs are damaged prior to transfusion, resulting in hemoglobinemia and hemoglobinuria without significant clinical symptoms. Nonhemolytic febrile transfusion reactions usually are caused by cytokines from leukocytes in transfused red cell or platelet components, causing fever, chills, or rigors.

The presentation of allergic reactions—rash, urticaria, or pruritus—is indistinguishable on examination from most food or drug allergies. Allergic reactions are immunoglobulin E (IgE) mediated. Anaphylactic reactions have been associated with anti-immunoglobulin A (IgA) in recipients who are IgA deficient.

Passive transfusion of antibodies that react with the recipient's leukocytes has been identified as the primary cause of transfusion-related acute lung injury (TRALI).

Circulatory (volume) overload occurs when the volume of the transfused blood components and any coincidental infusions cause acute hypervolemia and, typically, acute pulmonary edema.

Bacterial contamination and endotoxemia may result from inadequate sterile preparation of the phlebotomy site, opening the blood container in a nonsterile environment, or the presence of bacteria in the donor's circulation at the time of blood collection.

Frequency:

- **In the US:**
  - Acute hemolytic, immune mediated (fatal) - 1 case per 250,000-600,000 population
  - Acute hemolytic, immune mediated (nonfatal) - 1 case per 6000-33,000 population
  - Acute hemolytic, nonimmune - Infrequent
  - Febrile, nonhemolytic - 1 case per 200 population
  - Allergic - 1 case per 333 population
  - Anaphylactic - 1 case per 20,000-50,000 population
  - TRALI - 1 case per 5000 population
  - Circulatory (volume) overload - Varies with concurrent illness
  - Bacterial contamination/endotoxemia -The incidence of septic reactions may be as high as 1 case per 700 pooled random donor platelet concentrates, 1 case per 4000 single-donor (pheresis) platelet products, and 1 case per 31,000 red cell transfusions.

Mortality/Morbidity:

- Acute hemolytic reactions (antibody mediated): Most severe and fatal reactions result from inadvertent transfusion of group AB or group A red cells to a group O recipient. Renal failure and disseminated intravascular coagulation (DIC) are potential complications for patients who survive the initial acute reaction.
- Acute hemolytic reactions (non–antibody mediated) typically are benign. Transfusion of serologically compatible but hemolyzed red cells results in acute hemoglobinemia and hemoglobinuria. Rarely, short- or long-term complications occur.
- Nonhemolytic febrile reactions are discomforting but typically benign. Occasionally, patients may have rigors, nausea, vomiting, and considerable distress. Patients who develop fever associated with a blood transfusion must be monitored carefully until the possibility of bacterial contamination of the blood product is excluded.

Continuing Education

CME available for this topic. Click here to take this CME.

Patient Education

Kidneys and Urinary System Center

Blood in Urine Overview

Causes of Blood in Urine

Blood in Urine Symptoms

Blood in Urine Treatment

- Allergic reactions are benign but bothersome to recipients.
- Anaphylactic reactions are potentially, but rarely, fatal. The only fatal case report identified in the medical literature by the authors involved a patient with an anti-IgA/IgA reaction who died of a myocardial infarction.
- TRALI: Fatal cases are reported. Early and intensive pulmonary support reduces the risk of a fatal outcome. No long-term morbidity has been described in survivors.
- Circulatory (volume) overload: Outcome varies with the overall clinical status of the patient. No long-term sequelae occur.
- Bacterial contamination/endotoxemia potentially is fatal and may be caused by gram-positive or gram-negative bacteria. Early diagnosis, initiation of broad-spectrum antibiotics, and other intensive supportive measures may reverse the outcome of an otherwise fatal complication of transfusion.

Race: In the United States, some black persons with sickle cell anemia require chronic red cell transfusions and, as a result, may form multiple alloantibodies to common Rh, Kell, Kidd, or other blood group antigens. The presence of such alloantibodies may increase the time required for a transfusion service to supply serologically compatible red cells. If undetected, these red cell alloantibodies may cause shortened survival of transfused red cells and extravascular hemolysis, but severe acute hemolytic reactions are uncommon.

Sex:

- Multiparous women may form alloantibodies to leukocyte, red cell, or platelet antigens as the result of an overt or inapparent fetal-maternal hemorrhage. Women who form leukocyte antibodies following pregnancy are more likely to have febrile, nonhemolytic transfusion reactions if subsequently transfused with leukocyte-containing blood components.
- Multiparous women who form IgG red cell alloantibodies may experience delays while serologically compatible red cells are located for future transfusions. Undetected weak IgG alloantibodies are unlikely to cause acute hemolytic reactions, but they may cause shortened survival of the transfused incompatible red cells.

Age: Acute transfusion reactions may occur at any age.

- Because newborns do not form naturally occurring antibodies to ABO blood group antigens (isoagglutinins) during the first few months of life, acute ABO-related transfusion reactions are not observed in this age group.
- Most blood transfusions are administered to persons aged 60 years and older; therefore, most acute transfusion reactions also occur in this age group.
- A decline in the titers of ABO antibodies after the sixth decade of life reduces the likelihood that the inadvertent transfusion of ABO-incompatible red cells will cause a severe fatal reaction.

History:

- A history of prior blood transfusions or pregnancy often is present but is not essential for the diagnosis of a febrile nonhemolytic transfusion.
- Similarly, acute transfusion reactions caused by ABO antibodies, TRALI (donor's antibodies), allergy, IgA/anti-IgA anaphylaxis, or sepsis may occur during the first transfusion or subsequent transfusions.
- Persons known to have formed red cell alloantibodies as the result of prior transfusions or pregnancy should be informed and provided with a written report listing the antibodies to be presented to the transfusion service if additional transfusions are required at another hospital.
- Red cell antibodies may decrease in titer, and, while remaining clinically important, they may not be detected by

routine compatibility testing before future red cell transfusions. Ask patients scheduled for red cell transfusions about any history of prior transfusions and if they are aware of any complications or blood bank antibody problems. Obtain details of any prior transfusions during the medical history or when obtaining the patient's informed consent for a transfusion.

Physical:

- Acute hemolytic reactions
    - Early signs may include fever, hypotension, flushing, wheezing, and anxiety.
    - Late signs may include a generalized bleeding tendency (DIC).
- Nonhemolytic febrile reactions
    - Typically, only fever is present.
    - However, some recipients experience severe rigors, shaking, chills, hypotension, and vomiting.
- Allergic reactions - Maculopapular rash and/or urticaria without fever or hypotension
- Anaphylactic reactions
    - Dyspnea
    - Wheezing
    - Anxiety
    - Hypotension without fever
    - Bronchospasm in severe cases
- TRALI - Shortness of breath, hypoxemia, and rales, without signs of acute cardiogenic pulmonary edema
- Circulatory (volume) overload - Shortness of breath, hypoxemia, and rales, with orthopnea, tachycardia, distended jugular veins, or other evidence of cardiac decompensation
- Bacterial contamination
    - High fever, shock, tachycardia, and weak pulse, without a clear focus of infection
    - Examination of the contents of the container of blood being transfused may reveal clots, discoloration, or a difference in color between the contents of the bag (hemolyzed by contaminating bacteria) and the contents of the segmented tubing attached to the bag (not hemolyzed, no bacteria).

Causes:

- Acute hemolytic reactions (ABO incompatibility): Typically, a recipient with group O blood type is transfused accidentally with group A or group AB RBCs because of (1) misidentification of either the patient or the blood component when the blood sample was collected for compatibility testing or (2) failure to recognize that 2 patients have the same or similar names but different ABO blood types.
- Febrile nonhemolytic reactions: Cytokines and other normal constituents of leukocytes, platelets, or plasma accumulate in blood components during storage. When blood components are transfused, some recipients react with varying generalized symptoms, of which fever is the most common symptom.
- Allergic reactions: The clinical presentation of rash, pruritus, and/or urticaria during a transfusion suggests that the recipient was exposed to a foreign substance in the blood product to which the recipient is sensitized. Usually, a specific allergen is not identified. Studies published in the medical literature suggest that causes of allergic reactions include polymorphic proteins in the donors' plasma, food (eg, nuts, tomatoes), or medications (eg, penicillin) that the donor ingested immediately before collection of the implicated blood product.

- Anaphylactic reactions: Most cases are reported in recipients with IgA deficiency who developed anti-IgA and whose transfused product contains donor plasma with a normal content of IgA. Similar reactions in ahaptoglobinemia have been reported. Not all IgA-deficient persons who have anti-IgA have a history of transfusions or pregnancy.

- TRALI: This condition occurs when transfusing a plasma-containing blood component from a donor with antileukocyte antibodies to a person whose leukocytes express the corresponding antigen. The offending passively transfused antibodies may be specific for a human leukocyte antigen (HLA) on lymphocytes and platelets or a human granulocyte antigen (HGN) on neutrophils. Because routine pretransfusion compatibility testing does not include tests for donor antibodies to recipient leukocytes, such reactions occur unpredictably. When such reactions are investigated, the donor usually is identified as a multiparous female or a multitransfused person with a history consistent with alloimmunization to leukocyte antigens.

- Bacterial contamination (sepsis): Bacteria may enter the blood product container if it is opened at any time from collection from the donor until transfusion to the recipient. Bacteria on the donor's skin may enter the container if the needle entry site on the donor's skin is sterilized incompletely. Some donors implicated in septic reactions have low concentrations of bacteria (eg, *Yersinia enterocolitica*) in their blood (ie, bacteremia) that are not associated with a fever or other signs at the time of collection. If such contaminated blood is stored for a few days at room temperature (eg, platelets) or for a few weeks at refrigerated temperature (eg, red cells), bacteria may grow and elaborate endotoxin, which is a major adverse factor in such reactions.

Anaphylaxis
Angioedema
Disseminated Intravascular Coagulation
Food Allergies
Hemolytic Anemia
Hypersensitivity Reactions, Immediate
Pulmonary Edema, Cardiogenic
Septic Arthritis
Shock, Hemorrhagic
Sudden Cardiac Death
Urticaria

Other Problems to be Considered:

Cold agglutinin immune hemolysis

Lab Studies:

- Acute hemolytic reactions

    - Visual inspection of the recipient's plasma: Plasma in a sample of centrifuged anticoagulated venous blood is clear and pink-red if significant intravascular hemolysis (ie, hemoglobinemia) has occurred within the previous few hours. If serum from a nonanticoagulated sample (eg, clotted blood) is examined, a risk exists of traumatic hemolysis in the laboratory when the clot is separated, resulting in a false-positive interpretation. The red discoloration (ie, hemoglobinemia) may be present immediately after transfusion of only several milliliters of incompatible red cells and may persist for hours until the hemoglobin is metabolized to bilirubin. At that time, depending on the volume of incompatible RBCs that were transfused, the plasma may be deep red-brown or yellow.

    - Visual inspection of the recipient's urine: Within minutes of an ABO blood group–incompatible transfusion, the recipient's urine may become red. To distinguish between hematuria (red cells from the lower urinary tract) and hemoglobinuria (hemoglobin monomers and dimers cleared from the plasma by the kidney), centrifuge the urine. As illustrated in Image 1, centrifuged urine from a patient

with hematuria is clear yellow with red cells sedimented at the bottom of the tube. Urine from a patient with hemoglobinuria remains clear red and unchanged in color.

- Retyped donor and recipient RBCs: Repeat ABO typing of the donor's unit using a sample from the blood container's segmented tubing. Repeat ABO typing of the recipient using a blood sample collected after the transfusion reaction. A discrepancy between the original ABO type and the repeat ABO typings should raise the urgent question of whether a mix-up of blood samples could place another patient at risk of a similar mismatched transfusion.
- Direct antiglobulin (Coombs) test: ABO-related acute transfusion reactions usually cause a positive direct antiglobulin reaction, reflecting the presence of complement (C3d) on circulating red cells, as well as recipient's anti-A, anti-B, or anti-A,B. In certain situations, donor-derived IgG anti-A, anti-B, or anti-A,B may be detected on circulating red cells.

- Febrile nonhemolytic reactions
  - Visual inspection of the recipient's plasma: Appearance is normal. Red discoloration indicating hemolysis excludes this diagnosis.
  - Visual inspection of the recipient's urine: Appearance is normal. Red discoloration indicating hemolysis excludes this diagnosis.
  - Retype donor and recipient red cells for ABO/Rh(D): Results are concordant. No discrepancy should be detected.
  - Direct antiglobulin (Coombs) test: Coombs test yields a negative result.
- Allergic reactions
  - The presence of red plasma or urine, discordant pretransfusion and posttransfusion ABO blood types, or a positive antiglobulin (Coombs) test indicates diagnoses in addition to an allergic reaction.
  - Allergic transfusion reactions usually do not cause an increased number of eosinophils in subsequent white blood cell differential counts.
- Anaphylactic reactions
  - The presence of red plasma or urine, discordant pretransfusion and posttransfusion ABO blood types, or a positive direct antiglobulin (Coombs) test excludes this diagnosis.
  - Demonstration of anti-IgA in a pretransfusion sample of the recipient's serum or plasma establishes the diagnosis. Testing for anti-IgA is difficult to perform and is available only in a few reference laboratories; therefore, screening for IgA deficiency should be the initial laboratory study. The presence of IgA in the recipient's pretransfusion sample excludes the diagnosis of a class-specific IgA/anti-IgA reaction.

TREATMENT

Medical Care: Continuous monitoring of vital signs during generalized anesthesia may prevent acute circulatory (volume) overload, but it may not detect early signs of other reactions (eg, acute hemolytic transfusion reactions).

The onset of red-colored urine in a transfused patient should raise the question of a hemolytic transfusion reaction. While performing checks to confirm that the correct blood was transfused to the correct patient, centrifuge a urine sample to determine whether the red color represents hematuria or hemoglobinuria (see Image 1).

In addition, the onset of abnormal bleeding/generalized oozing during surgery in a transfused patient should raise the question of a hemolytic transfusion reaction with DIC.

- Acute hemolytic reactions (antibody mediated)
  - Immediately discontinue the transfusion while maintaining venous access for emergency management.
  - Anticipate hypotension, renal failure, and DIC.
  - Prophylactic measures to reduce the risk of renal failure may include low-dose dopamine (1-5 mcg/kg/min), vigorous hydration with crystalloid solutions (3000 mL/m^2/24 h), and osmotic diuresis with 20% mannitol (100 mL/m^2/bolus followed by 30 mL/m^2/h for 12

h).

- If DIC is documented and bleeding requires treatment, transfusions of frozen plasma, pooled cryoprecipitates for fibrinogen, and/or platelet concentrates may be indicated.

- Acute hemolytic reactions (non–antibody mediated)
  - The transfusion of serologically compatible, although damaged, RBCs usually does not require rigorous management.
  - Diuresis induced by an infusion of 500 mL of 0.9% sodium chloride per hour, or as tolerated by the patient, until the intense red color of hemoglobinuria ceases usually is adequate treatment.
- Febrile, nonhemolytic reactions: Usually, fever resolves in 15-30 minutes without specific treatment. If fever causes discomfort, oral acetaminophen (325-500 mg) may be administered. Avoid aspirin because of its prolonged adverse effect on platelet function.
- Allergic reactions: Diphenhydramine usually is effective for relieving pruritus associated with hives or a rash. The route (oral or intravenous) and the dose (25-100 mg) depend on the severity of the reaction and the weight of the patient.
- Anaphylactic reactions
  - A subcutaneous injection of epinephrine (0.3-0.5 mL of a 1:1000 aqueous solution) is standard treatment. If the patient is sufficiently hypotensive to raise the question of the efficacy of the subcutaneous route, epinephrine (0.5 mL of a 1:10,000 aqueous solution) may be administered intravenously.
  - In overt shock, epinephrine as a 1:1000 aqueous solution may be administered as an intracardiac injection. If the patient has not already received an antihistamine, a parenteral dose of diphenhydramine may be added.
  - While no documented evidence exists that intravenous corticosteroids are beneficial for the management of acute anaphylactic transfusion reactions, theoretical considerations cause most clinicians to include an infusion of hydrocortisone or prednisolone if an immediate response to epinephrine does not occur.
- Transfusion-related acute lung injury
  - Immediately discontinue the transfusion while preserving venous access.
  - Mild episodes should respond to oxygen administered by nasal catheter or mask. If shortness of breath persists after oxygen administration, transfer the patient to an intensive care setting where mechanical ventilation can be administered.
  - In the absence of signs of acute volume overload or cardiogenic pulmonary edema, diuretics are not indicated.
  - No evidence exists that corticosteroids or antihistamines are beneficial.
  - Treat complications with specific supportive measures.
- Circulatory (volume) overload
  - Move the patient to a sitting position and administer oxygen to facilitate breathing.
  - The most specific treatment is discontinuing the transfusion and removing the excessive fluid.
  - If practical, the unit of blood component being transfused may be lowered to reverse the flow and to decrease intravascular volume by a controlled phlebotomy.
  - Less urgent situations may be managed by a parenteral or oral diuretic (eg, furosemide).
  - If the patient has symptomatic anemia requiring additional transfusions of RBCs, select concentrated (ie, CPDA-1-anticoagulated) red cells (hematocrit = 80-85%). Avoid red cell components diluted with saline additives (ie, AS-1).
- Bacterial contamination (sepsis)
  - Immediately discontinue the transfusion, including all tubing, filters, and administration sets, and save the transfusion materials for cultures, while preserving venous access.

- After appropriate blood cultures have been obtained, initiate treatment with intravenous broad-spectrum antibiotics. If a microbiological stain or a culture of the contents of the transfused product identifies an organism, the initial broad-spectrum antibacterial approach may be modified accordingly.

Consultations:

- The possibility of an acute transfusion reaction should trigger an immediate consultation with the medical director of the hospital's blood bank or a designee (eg, a clinical pathology resident, transfusion medicine fellow). Depending on the findings, the blood bank consultant may arrange for microbiological stains and cultures of the residual contents of the blood product container, clerical checks for patient and product identification in the laboratory, repeat compatibility testing using a freshly collected blood sample from the recipient, or other pertinent diagnostic studies.
- The diagnosis of an acute hemolytic transfusion reaction should trigger consultation with a nephrologist to ensure optimal prophylactic measures to prevent renal damage.
- A hematology consultation is appropriate if a hemolytic transfusion reaction or bacterial contamination precipitated DIC.
- A clinical diagnosis of bacterial contamination of a transfused blood product should trigger an infectious diseases consultation.

Use an antihistamine to ameliorate allergic reactions to plasma. These agents serve as adjuncts to epinephrine and other standard measures for therapy of anaphylaxis related to transfusions of plasma-containing blood products.

Analgesics and antipyretics reduce fever associated with nonhemolytic transfusion reactions. An osmotic diuretic promotes urinary excretion of hemoglobin resulting from an acute hemolytic transfusion reaction.

Drug Category: *Antihistamines* -- Prevent histamine response in sensory nerve endings and blood vessels. Are more effective in preventing histamine response than in reversing it.

Drug Name	Diphenhydramine hydrochloride (Benadryl) -- Antihistamine with anticholinergic effects that competes with histamine for receptor sites on effector cells. Among other indications, used to treat urticaria, pruritus, and other histamine-mediated manifestations of allergic reactions to blood products.
Adult Dose	25-50 mg PO/IV/IM for management of acute allergic reaction to blood or plasma
Pediatric Dose	>20 lb: 12.5-25 mg PO/IV/IM; alternatively, 5 mg/kg/d PO/IV/IM or 150 mg/m^2/d PO/IV/IM; not to exceed 300 mg qd
Contraindications	Documented hypersensitivity; concurrent or recent administration of MAOI; should not be used in newborn or premature infants or in nursing mothers
Interactions	MAOIs prolong and intensify anticholinergic effects; potentiates effects of CNS depressants; due to alcohol content, do not administer syrup dosage form to patients taking medications that can cause disulfiramlike reactions
Pregnancy	B - Usually safe but benefits must outweigh the risks.
Precautions	May exacerbate narrow-angle glaucoma, hyperthyroidism, stenosing peptic ulcer, pyloroduodenal obstruction, symptomatic prostatic hypertrophy, or bladder neck obstruction; may cause drowsiness, patients receiving a dose should not drive or operate machinery for 4 h

Drug Category: *Analgesics and antipyretics* -- Improve patient comfort and reduce fever.

Drug Name	Acetaminophen (Tylenol) -- Nonopiate, nonsalicylate analgesic and antipyretic. Reduces fever by acting directly on hypothalamic heat-regulating centers, which increase dissipation of body-heat via vasodilation and sweating.
Adult Dose	325-650 mg (1-2, 325-mg tab) PO for fever associated with a nonhemolytic transfusion; if fever persists or increases, reconsider diagnosis
Pediatric Dose	7-12 years: 10 mL elixir (120 mg/5 mL) or a single 325-mg tab PO
Contraindications	Documented hypersensitivity; liver failure
Interactions	Rifampin can reduce analgesic effects of acetaminophen; interactions that increase toxicity are not significant for 1- to 2-tab dose for fever; rifampin can reduce analgesic effect
Pregnancy	C - Safety for use during pregnancy has not been established.
Precautions	Hepatotoxicity can occur in people with chronic alcoholism with various dose levels of acetaminophen; severe or recurrent pain or high or continued fever may indicate a serious illness

Drug Category: *Osmotic diuretics* -- Osmotic agents increase the osmolarity of the glomerular filtrate and induce diuresis. This in turn hinders the tubular reabsorption of water, causing sodium and chloride excretion to increase also.

Drug Name	Mannitol injection 20% USP (Osmitrol) -- An obligatory osmotic diuretic only slightly metabolized and excreted by the kidney. Induces diuresis by increasing osmolarity of the glomerular filtrate, thereby hindering tubular reabsorption of water. Excretion of sodium and chloride also enhanced.
Adult Dose	100 g IV as a bolus dose using a blood administration filter to prevent infusion of mannitol crystals; dose is coincident with infusion of 0.9% sodium chloride to promote diuresis and excretion of hemoglobin
Pediatric Dose	<12 years: Not established >12 years: Administer as in adults
Contraindications	Documented hypersensitivity; anuria; severe pulmonary congestion; progressive renal damage; severe dehydration; active intracranial bleeding; progressive heart failure

Interactions	None reported
Pregnancy	C - Safety for use during pregnancy has not been established.
Precautions	Carefully evaluate cardiovascular status before rapid administration of mannitol because a sudden increase in extracellular fluid may lead to fulminating CHF; avoid pseudoagglutination; when blood is administered simultaneously, add at least 20 mEq of sodium chloride to each liter of mannitol solution; electrolyte-free mannitol should not be administered conjointly with blood

Drug Category: *Vasopressors* -- Used to reverse hemodynamic compromise associated with anaphylaxis or allergic reaction.

Drug Name	Epinephrine (Epi-Pen, Adrenaline) -- A sympathomimetic that activates both alpha-receptors and beta-receptors. Causes bronchial smooth muscle relaxation and cardiac stimulation.
Adult Dose	Severe anaphylaxis: 0.1-0.5 mg IM/SC; may repeat in 10- to 15-min intervals prn
Pediatric Dose	Anaphylaxis: 0.01 mg/kg SC; not to exceed 0.5 mg
Contraindications	Organic heart disease; cardiac dilatation; arrhythmia; narrow-angle glaucoma; hypertension; hyperthyroidism
Interactions	Concomitant sympathomimetics; MAOIs may increase effects of epinephrine; beta-blockers or alpha-blockers may blunt effect of epinephrine
Pregnancy	C - Safety for use during pregnancy has not been established.
Precautions	Rapid IV infusions may cause death from cerebrovascular hemorrhage or cardiac arrhythmias

Drug Name	Dopamine (Intropin) -- An immediate precursor to epinephrine, dopamine stimulates dopaminergic, beta-adrenergic, and alpha-adrenergic receptors.
Adult Dose	1-5 mcg/kg/min IV infusion; as much as 50 mcg/kg/min
Pediatric Dose	Not available
Contraindications	Pheochromocytoma; uncorrected ventricular arrhythmia
Interactions	MAOIs may prolong the effects of dopamine; beta-blockers antagonize the effects of dopamine
Pregnancy	C - Safety for use during pregnancy has not been established.
Precautions	Avoid infusion through small peripheral veins to prevent extravasation

Drug Category: *Loop diuretics* -- Diuretics may used to alleviate volume overload caused by transfusion of blood products.

Drug Name	Furosemide (Lasix) -- Acts by inhibiting sodium and chloride resorption in the ascending loop of Henle, promoting excretion of sodium, water, chloride, and potassium.
Adult Dose	Acute pulmonary edema: 40 mg IV slowly
Pediatric Dose	Acute pulmonary edema: 1 mg/kg IV/IM; not to exceed 6 mg/kg/d
Contraindications	Documented hypersensitivity; anuria; hepatic coma; electrolyte depletion; riding BUN/creatinine
Interactions	Potentiates effects of other antihypertensive agents; may interact with lithium, digoxin, indomethacin, probenecid, or other nephrotoxic or ototoxic drugs
Pregnancy	C - Safety for use during pregnancy has not been established.
Precautions	Caution in patients hypersensitive to sulfonamides and patients with cirrhosis or ascites

Deterrence/Prevention:

- Persons known to have formed red cell alloantibodies as the result of prior transfusions or pregnancy should be informed and provided with a written report listing the antibodies to be presented to the transfusion service if additional transfusions are required at another hospital.
- Ask patients scheduled for red cell transfusions about any history of prior transfusions and if they are aware of any complications or blood bank antibody problems.
- Obtain details of any prior transfusions during the medical history or when obtaining the patient's informed consent for a transfusion.
- In cases of transfusion reaction, retype donor and recipient RBCs. A discrepancy between the original ABO type and the repeat ABO typings should raise the urgent question of whether a mix-up of blood samples could place another patient at risk of a similar mismatched transfusion.

Complications:

- Acute hemolytic reactions (antibody mediated): Renal failure and disseminated intravascular coagulation DIC are potential complications for patients who survive the initial acute reaction.
- Acute hemolytic reactions (non–antibody mediated): Transfusion of serologically compatible but hemolyzed red cells results in acute hemoglobinemia and hemoglobinuria. Rarely, short- or long-term complications occur.

Prognosis:

- Acute hemolytic reactions (antibody mediated): Most severe and fatal reactions result from inadvertent transfusion of group AB or group A red cells to a group O recipient.
- Acute hemolytic reactions (non–antibody mediated) typically are benign.
- Nonhemolytic febrile reactions are discomforting but typically benign.
- Allergic reactions are benign but bothersome to recipients.
- Anaphylactic reactions are potentially, but rarely, fatal.
- TRALI: Fatal cases are reported. Early and intensive pulmonary support reduces the risk of a fatal outcome.
- Circulatory (volume) overload: Outcome varies with the overall clinical status of the patient.
- Bacterial contamination/endotoxemia potentially is fatal and may be caused by gram-positive or gram-negative bacteria. Early diagnosis, initiation of broad-spectrum antibiotics, and other intensive supportive measures may reverse the outcome of an otherwise fatal complication of transfusion.

Patient Education:

- For excellent patient education resources, visit eMedicine's Kidneys and Urinary System Center. Also, see eMedicine's patient education article Blood in the Urine.

Medical/Legal Pitfalls:

- Many hospitals have separate informed consent forms for blood transfusions. Prior to ordering a blood transfusion, the physician should explain the expected benefits and potential risks to the patient and obtain signed informed consent.
- Chart notes for transfusion reactions: The medical record should contain a description of all acute transfusion reactions. If the wrong blood was transfused to the wrong patient, the medical record should contain details of the clinical events and medical management. Speculation on the source of human error is not an appropriate entry. All transfusion events involving human error should be reported to the hospital's risk manager.

PICTURES

Caption: Picture 1. Rapid test to distinguish hematuria from hemoglobinuria. The onset of red urine during or shortly after a blood transfusion may represent hemoglobinuria (indicating an acute hemolytic reaction) or hematuria (indicating bleeding in the lower urinary tract). If freshly collected urine from a patient with hematuria is centrifuged, red blood cells settle at the bottom of the tube, leaving a clear yellow urine supernatant. If the red color is due to hemoglobinuria, the urine sample remains clear red after centrifugation.

View Full Size Image

eMedicine Zoom View (Interactive!)

Picture Type: Photo

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