Transfusion Guidelines

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LifeServe BLOOD CENTER

Your Blood. Your Hospital. Your Neighbors.

Housekeeping

- Video and pdf of the presentation will be emailed after the webinar
- If there are other topics you are interested in learning about, send them to me
  - alex.smith@lifeservebloodcenter.org

Topics

- How blood products are made
- Blood products
  - Red Blood Cells
  - Plasma
  - Platelets
  - Cryoprecipitate
  - Granulocytes

WHO IS LIFESERVE?

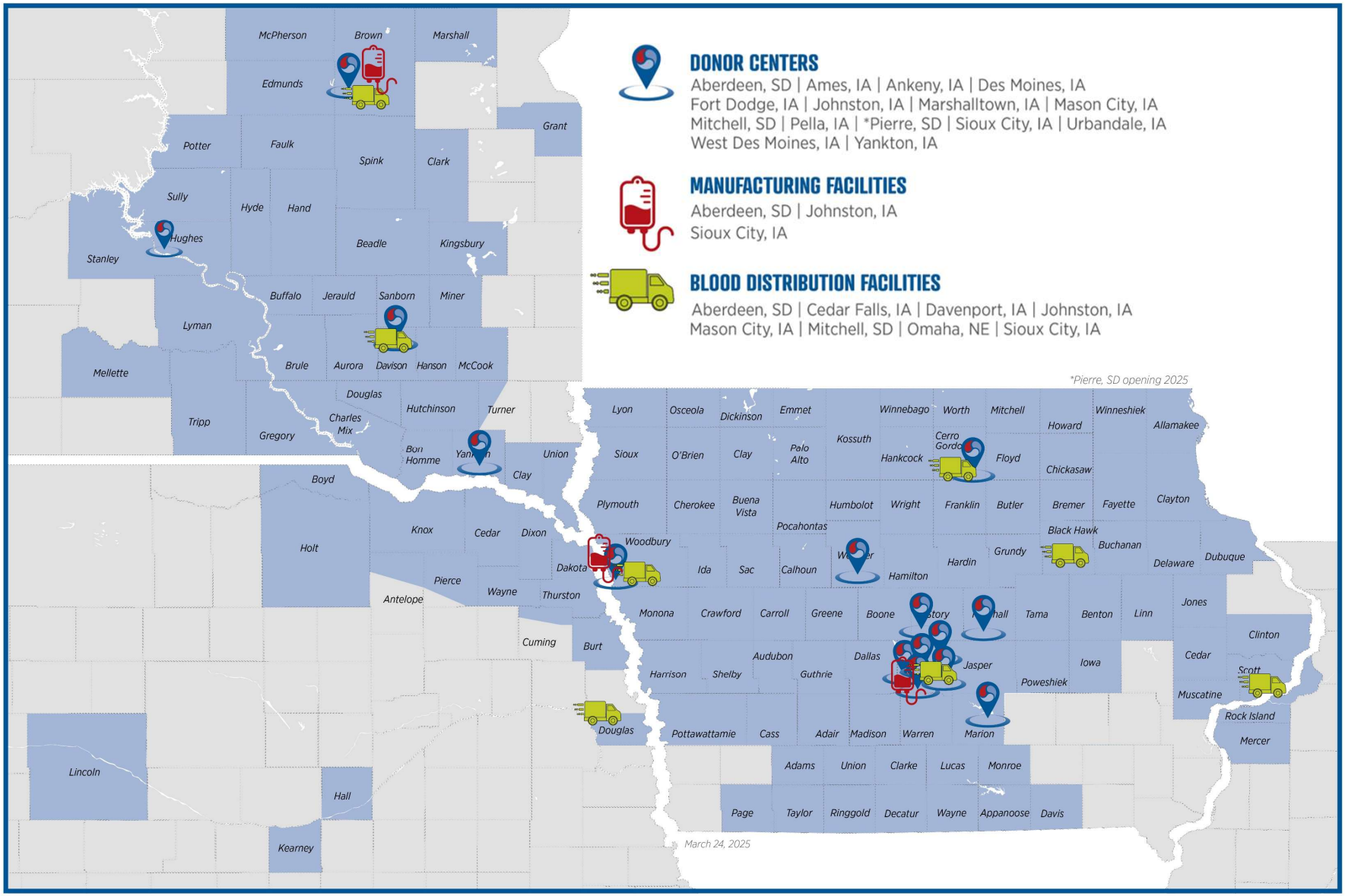
4 STATES

14 DONOR CENTERS

9 MOBILE STAGING SITES

143,154

BLOOD PRODUCTS COLLECTED


DONOR CENTERS
Aberdeen, SD | Ames, IA | Ankeny, IA | Des Moines, IA
Fort Dodge, IA | Johnston, IA | Marshalltown, IA | Mason City, IA
Mitchell, SD | Pella, IA | *Pierre, SD | Sioux City, IA | Urbandale, IA
West Des Moines, IA | Yankton, IA
MANUFACTURING FACILITIES
Aberdeen, SD | Johnston, IA
Sioux City, IA
BLOOD DISTRIBUTION FACILITIES
Aberdeen, SD | Cedar Falls, IA | Davenport, IA | Johnston, IA
Mason City, IA | Mitchell, SD | Omaha, NE | Sioux City, IA
*Pierre, SD opening 2025
March 24, 2025
McPherson
Brown
Marshall
Edmunds
Grant
Potter
Faulk
Spink
Clark
Sully
Hyde
Hand
Hughes
Beadle
Kingsbury
Stanley
Buffalo
Jerauld
Sanborn
Miner
Lyman
Brule
Aurora
Davison
Hanson
McCook
Mellette
Douglas
Hutchinson
Turner
Tripp
Charles Mix
Gregory
Bon Homme
Yankton
Union
Clay
Boyd
Knox
Cedar
Dixon
Holt
Pierce
Wayne
Thurston
Antelope
Dakota
Cuming
Burt
Douglas
Lincoln
Hall
Kearney
Lyon
Osceola
Dickinson
Emmet
Winnebago
Worth
Mitchell
Winneshiek
Howard
Allamakee
Sioux
O'Brien
Clay
Palo Alto
Kossuth
Hankcock
Cerro Gordo
Floyd
Chickasaw
Plymouth
Cherokee
Buena Vista
Humbolot
Wright
Franklin
Butler
Bremer
Fayette
Clayton
Pocahontas
Black Hawk
Buchanan
Woodbury
Ida
Sac
Calhoun
Hamilton
Hardin
Grundy
Delaware
Dubuque
Monona
Crawford
Carroll
Greene
Boone
Tama
Benton
Linn
Jones
Clinton
Audubon
Dallas
Jasper
Iowa
Cedar
Harrison
Shelby
Guthrie
Poweshiek
Scott
Muscatine
Pottawattamie
Cass
Adair
Madison
Warren
Marion
Rock Island
Mercer
Adams
Union
Clarke
Lucas
Monroe
Page
Taylor
Ringgold
Decatur
Wayne
Appanoose
Davis

STAY CONNECTED

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@LifeServeBldCtr

BE A BLOOD DONOR

With a single blood donation, you will do more to help others than most people do in a lifetime.

The average donation only takes 45 minutes. It's a fast, easy way to make a difference!


Give me some wine!

Where Do Blood Products Come From?

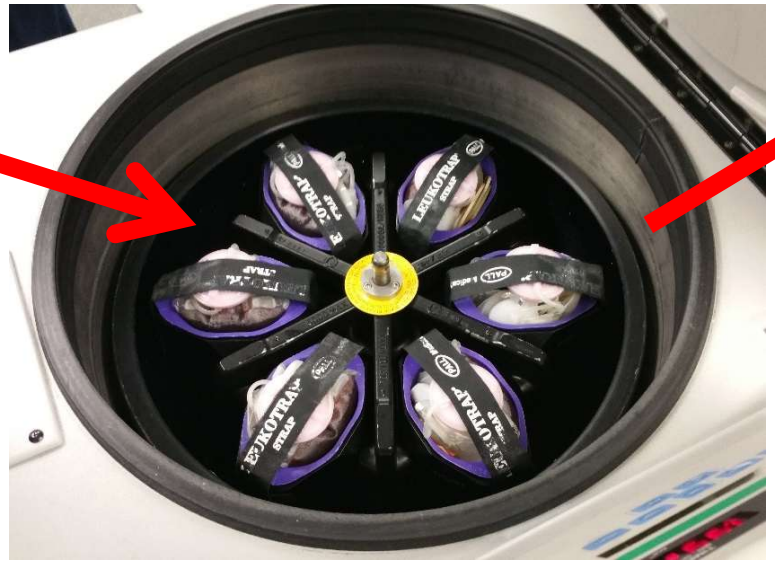
- Two methods to collect from donors
  - Whole blood donations
  - Apheresis

Whole Blood Donation

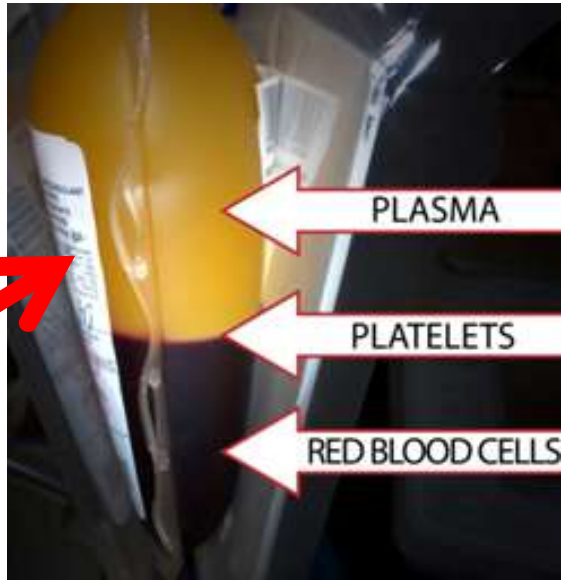
- Most common method

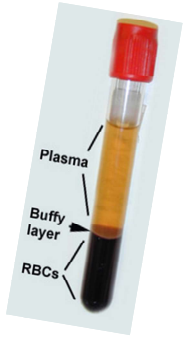
Whole Blood Donation

whole blood

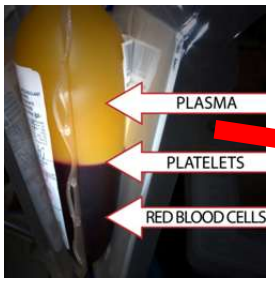


centrifuge

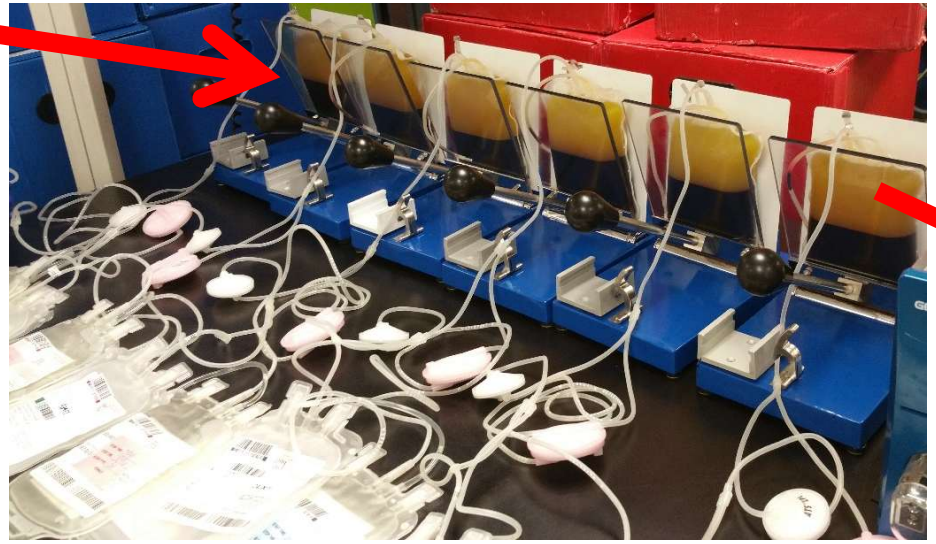




Whole Blood Donation



expresser



platelet-rich plasma

RBCs

Whole Blood Donation

plasma

platelets

What remains in the bag
are the platelets

platelet-rich
plasma

centrifuge

Most of plasma is expressed off

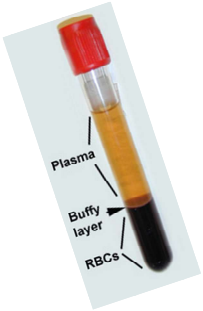
Platelets form a pellet at the bottom of the bag

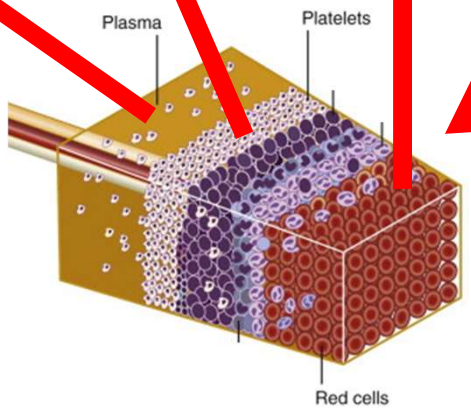
Apheresis Donation

plasma

platelets

RBCs

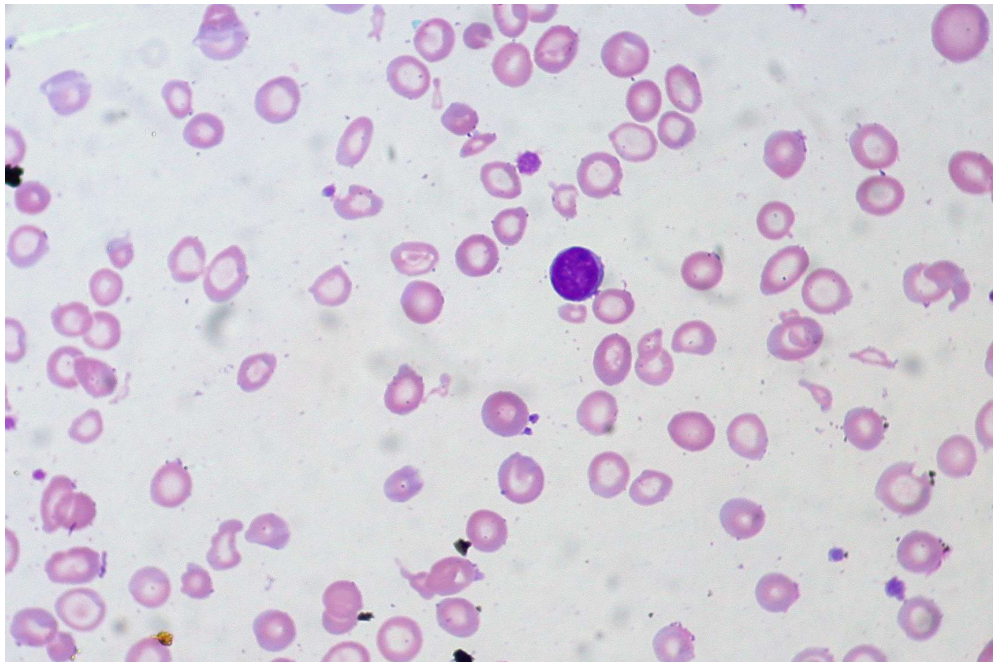




RED BLOOD CELLS

Anemia

- Anemia is associated with adverse outcomes
- Transfusion is a short-term treatment
- Diagnose and treat the underlying cause of anemia



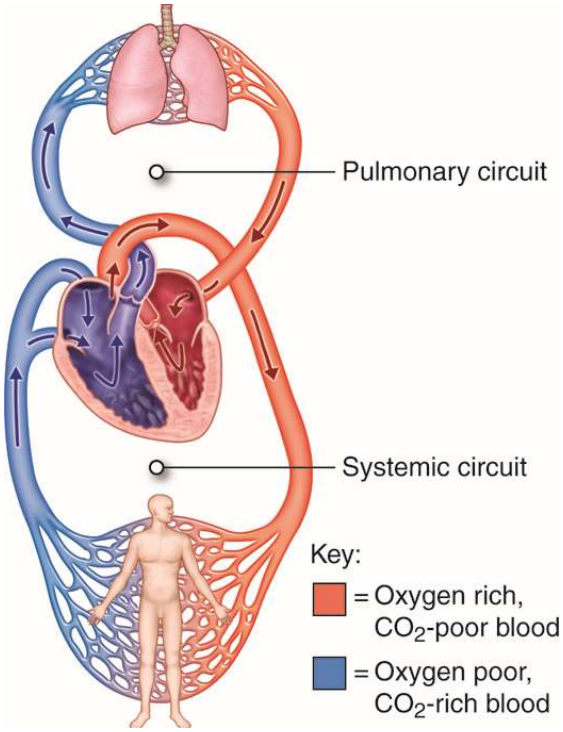
Oxygen Delivery

- Blood delivers oxygen to tissues
- Anemia has the potential to reduce oxygen delivery
- Most patients are able increase tissue oxygen delivery and extraction

Mechanisms that increase arterial oxygen content
Increased production of erythropoietin → hemoglobin synthesis
Rightward shift of oxyhemoglobin dissociation curve → increased O2 delivery
Mechanisms that increase cardiac output
Increased heart rate
Increased myocardial contractility
Decreased blood viscosity and decreased peripheral vascular resistance

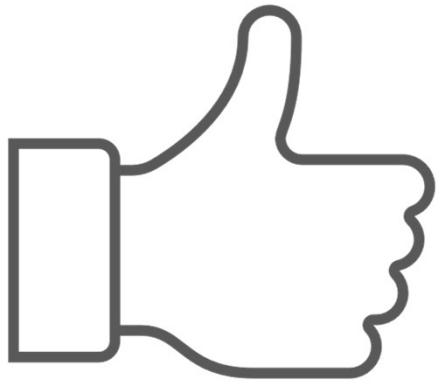
Oxygen Delivery (DO_2)

- DO_2 = cardiac output (heart rate, stroke volume) x arterial oxygen content
- Cardiac output increase is generally enough in healthy patients
- In critically ill, DO_2 may become more dependent on arterial oxygen content



Restrictive Transfusions Strategies

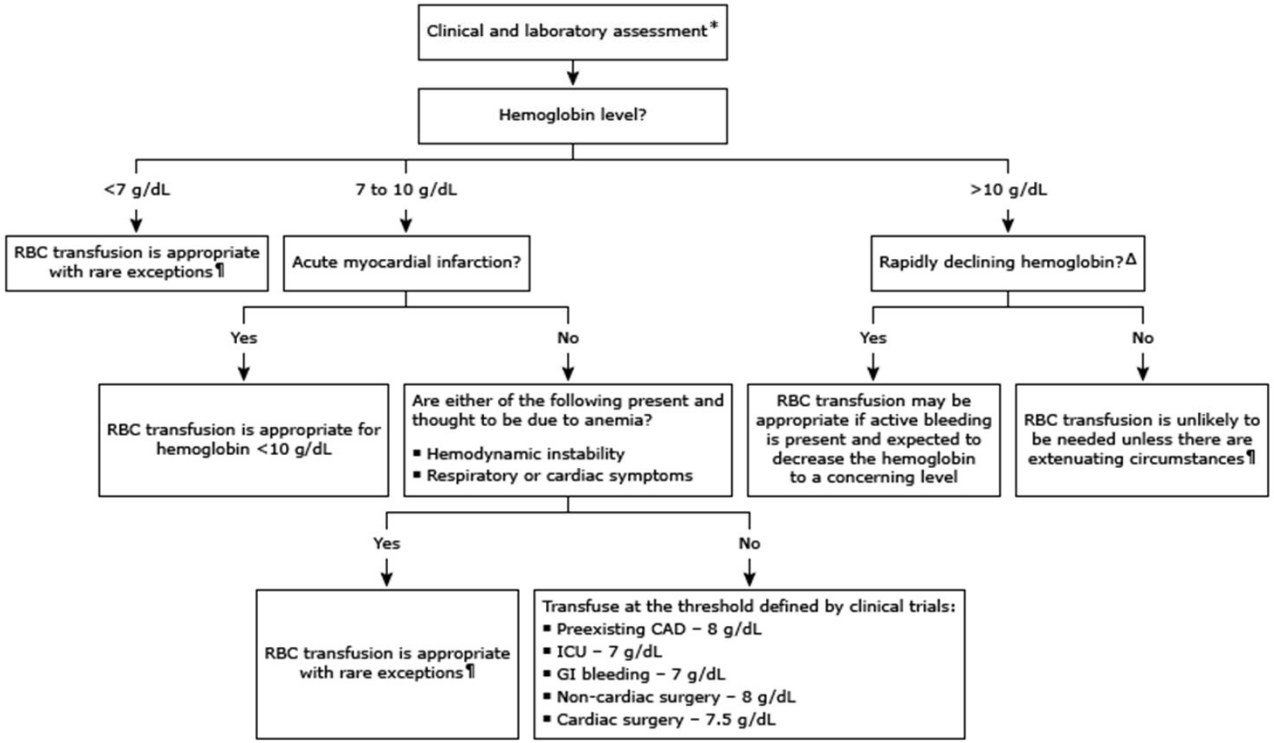
- Transfusing at a lower Hb concentration → 7 to 8 g/dL
- Excellent clinical trial data to support this strategy for most patients
- Reduces unnecessary transfusions



Factors to Consider

- Transfusions should provide enough RBCs to maximize clinical outcomes while avoiding unnecessary transfusions
- Should be considered a short-term treatment with a mixed risk-benefit profile
- The cause of the anemia

Red blood cell (RBC) transfusion decisions in adults



The decision to transfuse always incorporates an assessment by the clinician caring for the patient. Thresholds included here are based on data from clinical trials; refer to UpToDate for details. This algorithm does **not** apply to individuals with hemoglobinopathies (sickle cell disease, transfusion-dependent thalassemia); separate criteria apply to these individuals as discussed in UpToDate. To convert hemoglobin to g/L, multiply by 10 (hemoglobin of 7 g/dL = 70 g/L). Refer to UpToDate topics on indications for transfusion for further details and discussions.

CAD: coronary artery disease; GI: gastrointestinal; ICU: intensive care unit; RBC: red blood cell.

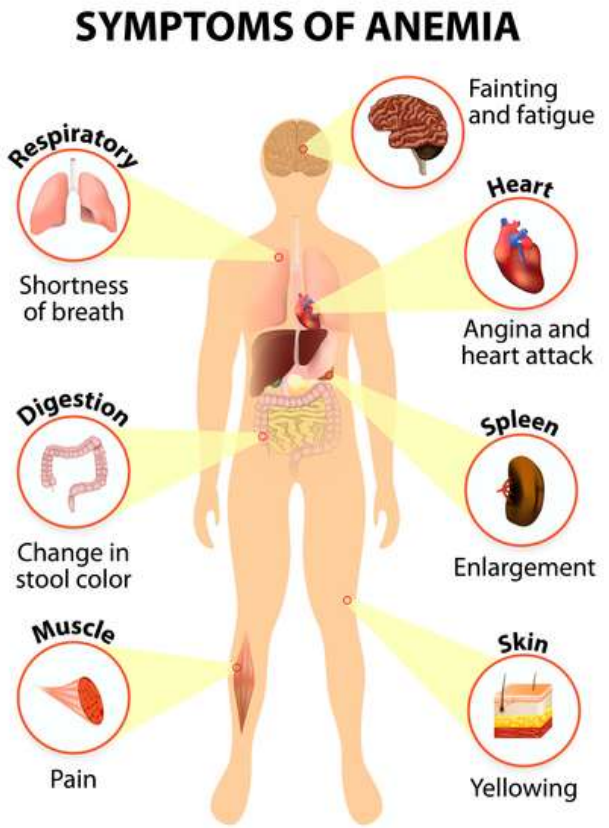
* Assessment includes:
- Symptoms (and whether attributable to anemia)
- Clinical status (vital signs, signs of hemodynamic instability, cardiac and respiratory examination)
- Underlying comorbidities
- Hemoglobin level
- Rate of hemoglobin decline and cause (active bleeding versus ongoing hemolysis versus decreased RBC production)

¶ Rarely, an individual with hemoglobin below an accepted threshold may decline transfusion (Jehovah's Witness, healthy young adult); it is important that they understand the risks and alternatives. Rarely, an individual with a hemoglobin above 10 g/dL may warrant transfusion, such as if there are clear symptoms attributable to anemia and the cause of anemia cannot otherwise be rapidly treated.

Δ Rapidly declining hemoglobin includes rapid bleeding associated with hemodynamic instability or a fall in hemoglobin of ≥2 g/dL per day.

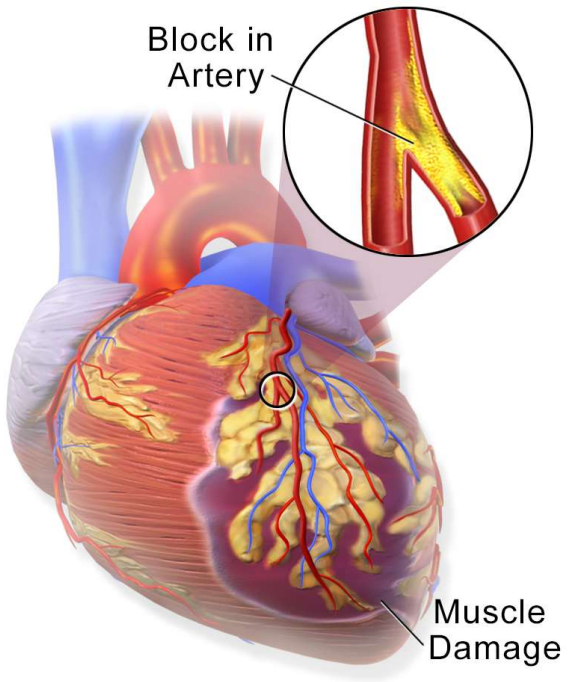
Exceptions to the Restrictive Threshold

- Symptomatic patients
  - Symptoms are severe enough and clearly related to the anemia
  - Hb < 10 g/dL
- Irritability, weakness, exercise intolerance are nonspecific and often not considered indications
- Ensure that the symptoms improve post-transfusion



Exceptions to the Restrictive Threshold

- Acute myocardial infarction
  - < 10 g/dL
- Palliative care
  - No clinical trials in palliative care patients
  - Case-by-case
  - Assess symptoms before and after transfusion to guide future transfusion decisions
  - Insurance may not cover



One Unit at a Time

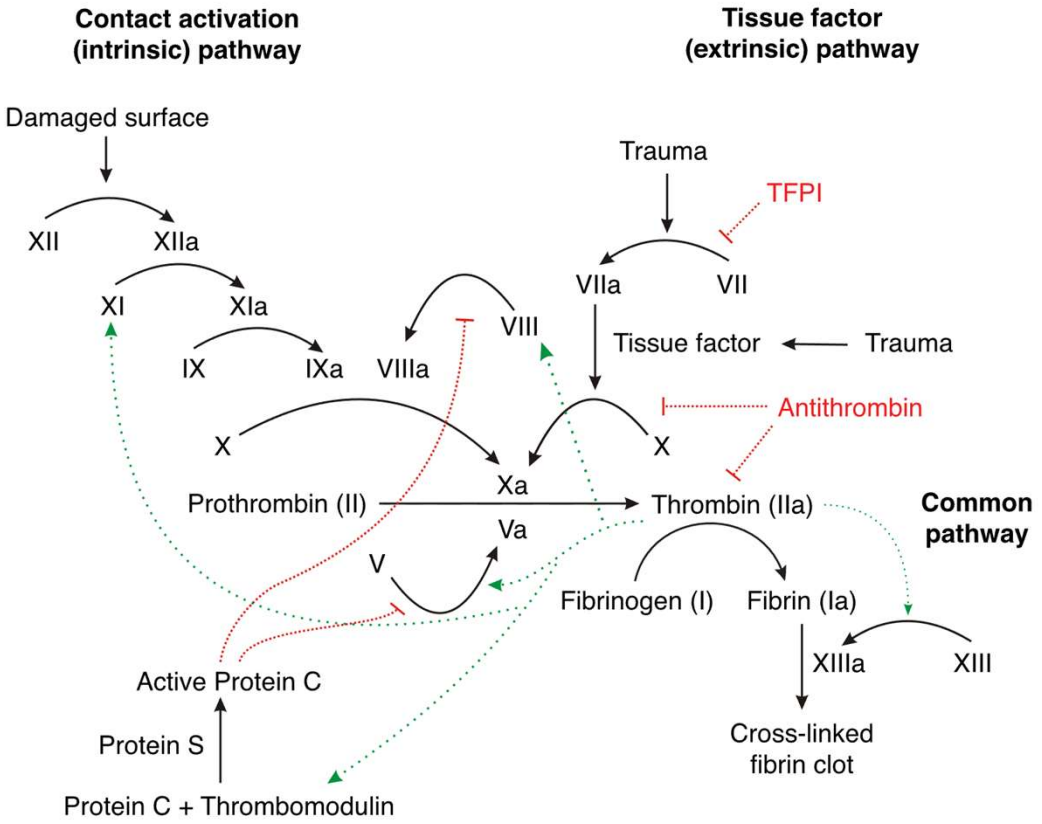
- Avoids unnecessary transfusions
- Post-transfusion Hb can be performed 15 minutes after transfusion (if the patient is not bleeding)
- Initiate/continue treatment for underlying anemia

Plasma


W0379 17 159710 8 1
RECOVERED PLASMA
CAUTION: FOR MANUFACTURING USE ONLY
FROZEN WITHIN 24 HOURS AFTER PHLEBOTOMY
230 from CP2D Whole Blood
Store at -20 C or colder
9-28-17

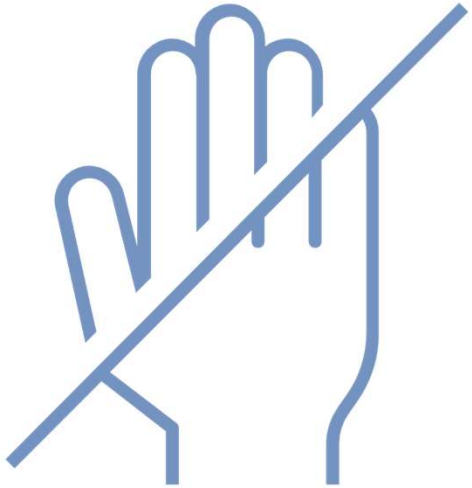
What is in it

- All coagulation factors
- Soluble proteins



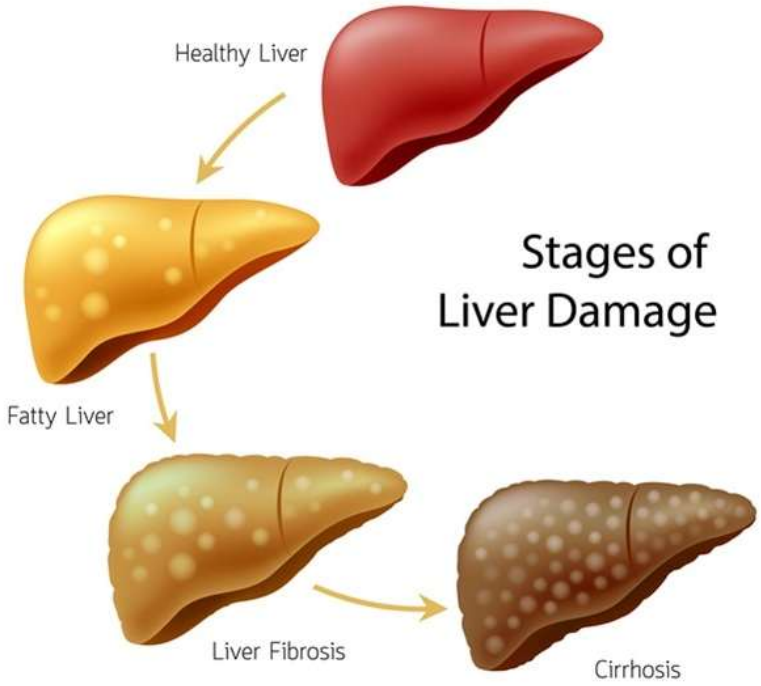
Introduction

- Plasma transfusions are often misused
  - Results in unnecessarily high use
- Closely monitor use and restrict when needed
- Generally indicated in the management of bleeding
  - Deficiency of multiple coagulation factors
  - Specific factor concentrate unavailable



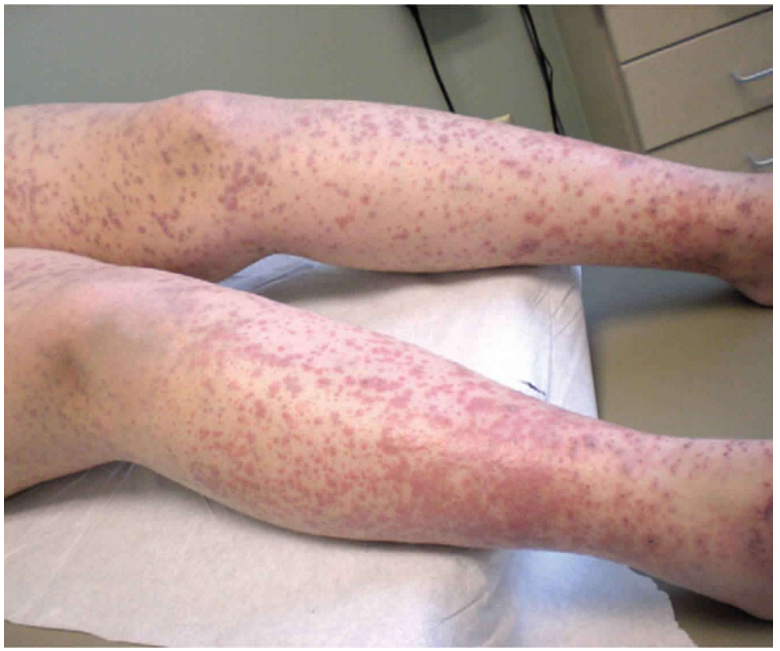
Severe Liver Disease

- Patients may have bleeding due to decreased coagulation factor production
- Treat the underlying disease also



Disseminated Intravascular Coagulation (DIC)

- Complication of an underlying severe medical condition that triggers a systemic activation of the body's clotting system
  → consumes the body's clotting factors and platelets
  → uncontrolled bleeding
- Treat the underlying disease also

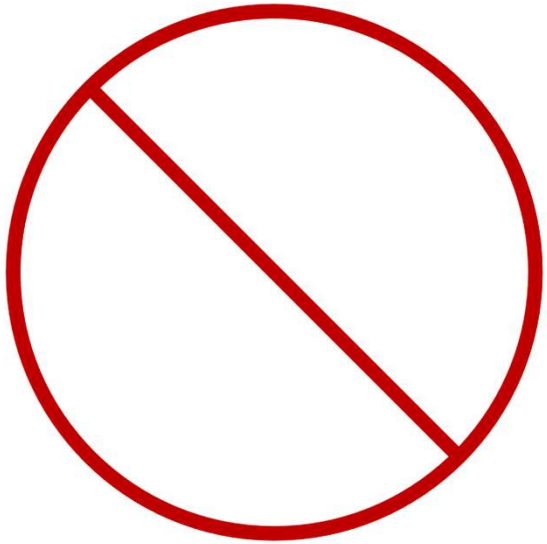


Clotting Factor Deficiency

- First-line treatment should be coagulation factor concentrate
- Plasma may be used if concentrate is not available
  - Factor II
  - Factor V

Not Appropriate for…

- Correct excessive anticoagulation from a vitamin K antagonist, other anticoagulants, or causes of prolonged INR
  - Especially in the absence of bleeding
- However, may be used if prothrombin complex concentrate is not available to…
  - Treat bleeding
  - Prevent surgical bleeding



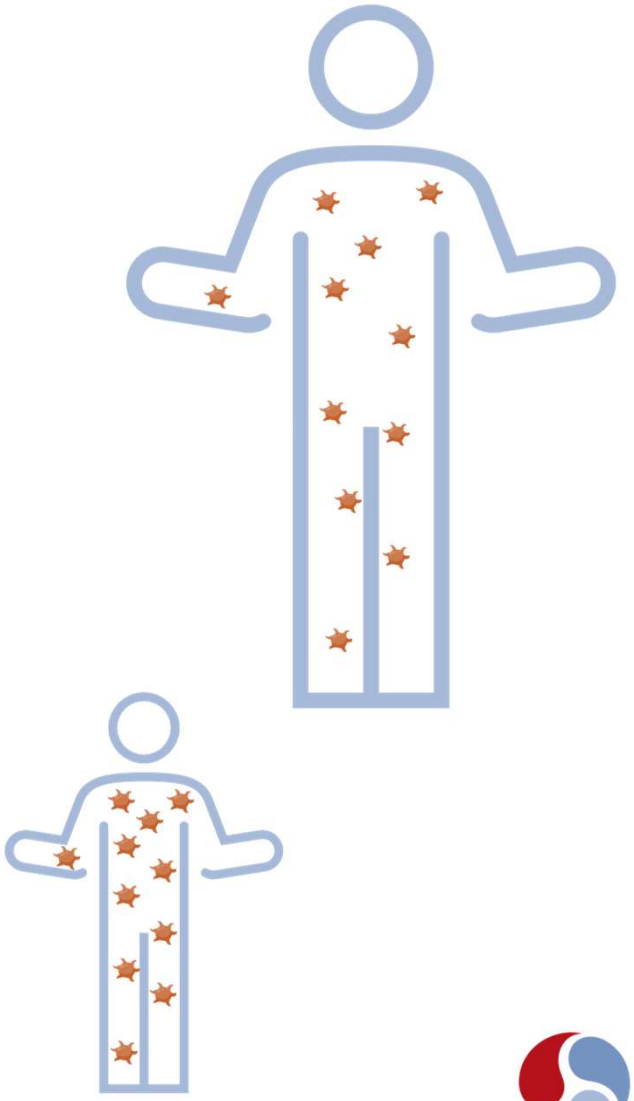
Dose

- 10 to 15 ml/kg

Platelets

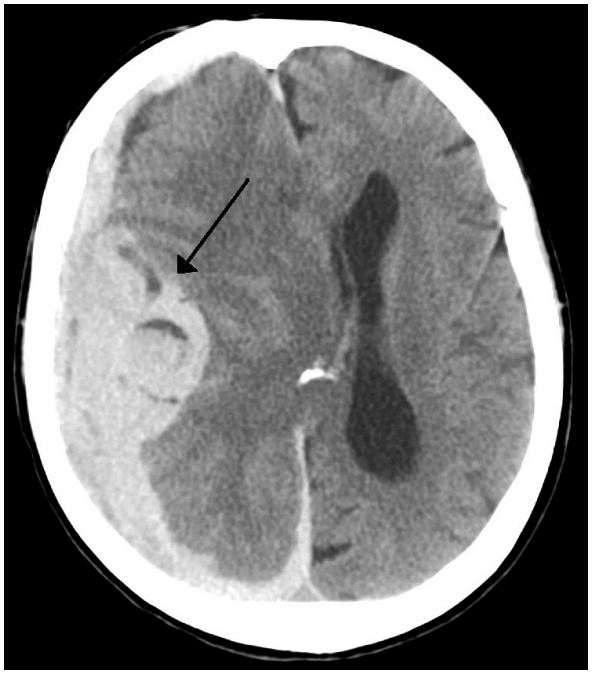
Introduction

- Typically, around 3.5 to 5.5 × 10^{11} platelets per unit
- Will increase platelet count by 20,000 to 40,000/μL in an averaged-sized adult
  - Smaller increase in someone with a larger body mass
  - Larger increase in someone with a smaller body mass



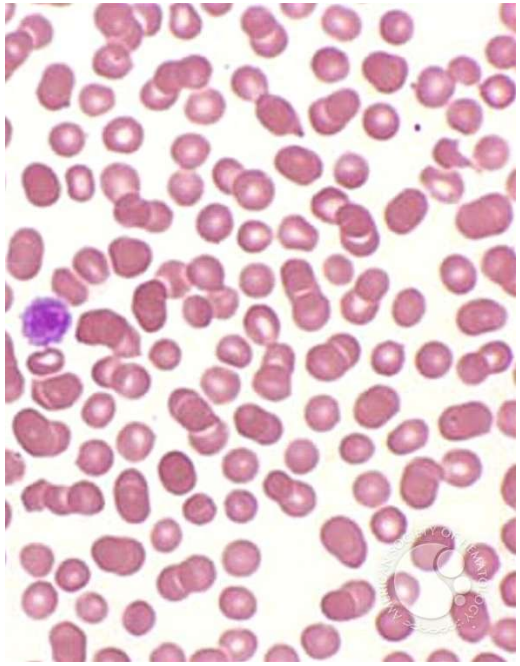
Active Bleed

- Most patients
  - Platelets < 50,000/μL
  - Including DIC
- Central nervous system bleed
  - Platelets < 100,000/μL
- Address factors that my contribute to bleeding
  - Surgical/anatomic lesion
  - Coagulopathy
  - Acquired/inherited platelet function disorder



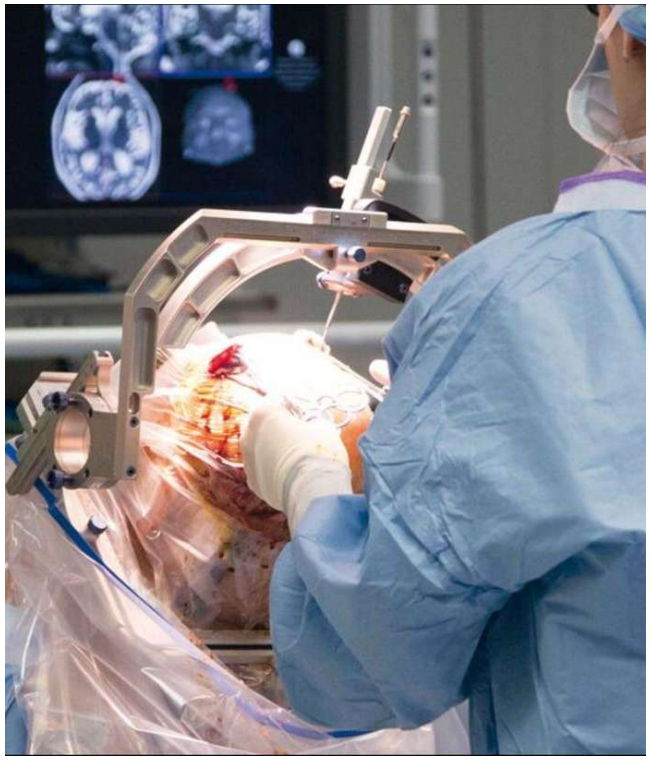
Prevention of Spontaneous Bleeding

- No ideal test to predict who will spontaneously bleed
  - Bleeding time, thromboelastography (TEG) not helpful
- Much more likely when platelets < 5000/ μL
- Possible indicators
  - Platelet count at which last spontaneously bled
  - Mucosal bleeding, epistaxis
  - Coexisting inflammation, infection, fever



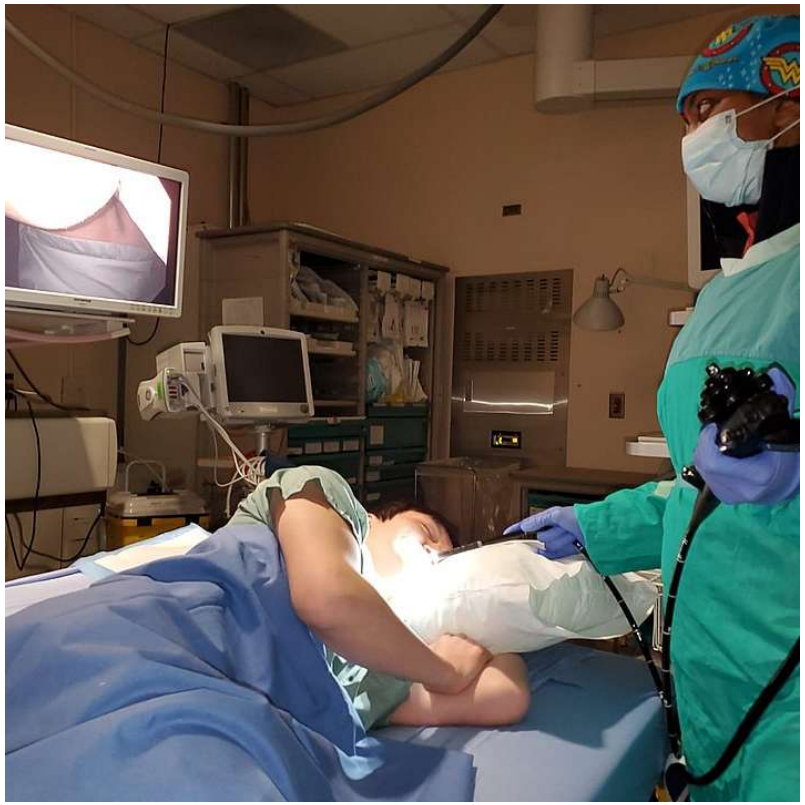
Preparation for Invasive Procedure

- Neurosurgery, ocular surgery
  < 100,000/μL
- Neuraxial analgesia/anesthesia
  < 80,000/μL
- Most other major surgeries
  < 50,000/μL



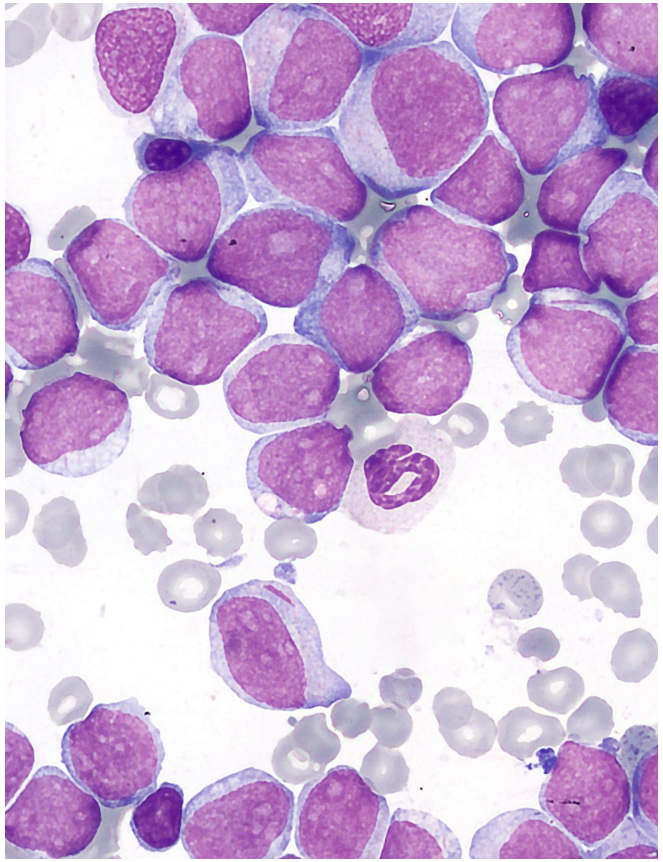
Preparation for Invasive Procedure

- Endoscopy < 50,000/μL
- Bronchoscopy with bronchoalveolar lavage (BAL) < 20,000 to 30,000/μL
- Low-risk diagnostic procedures < 20,000/μL



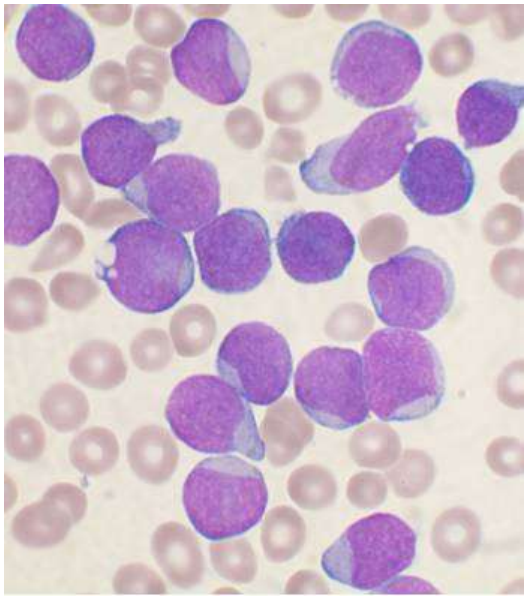
Leukemias

- Acute myeloid leukemia (AML)
  - Can have suppressed bone marrow from the AML, chemotherapy, or HSCT
  - < 10,000/μL
  - Higher if petechial bleeding
- Acute promyelocytic leukemia (APL)
  - Often have severe coagulopathy → higher risk for DIC and bleeding
  - < 30,000 to 50,000/μL
  - Immediate transfusion if signs of bleeding



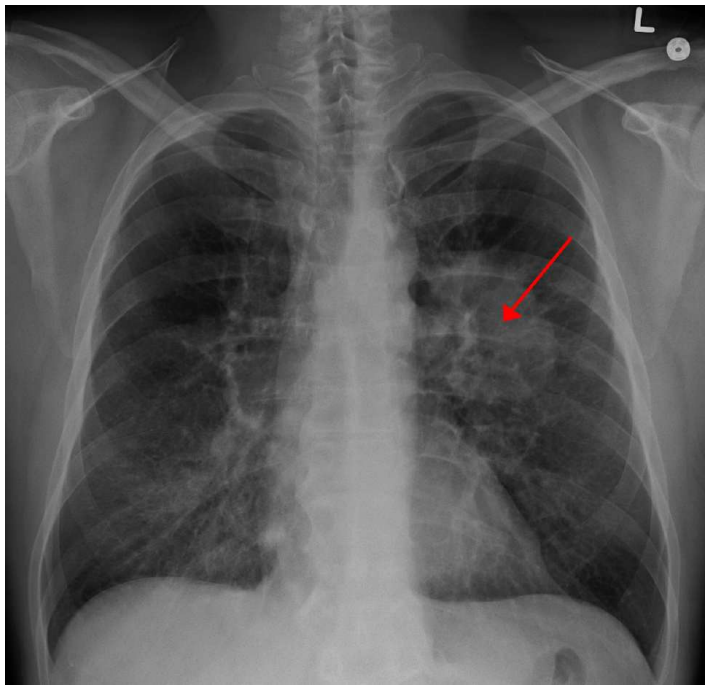
Leukemias

- Acute lymphoblastic leukemia (ALL)
  - Have bone marrow suppression
  - Risk of life-threatening bleeding is low
  - < 10,000/μL



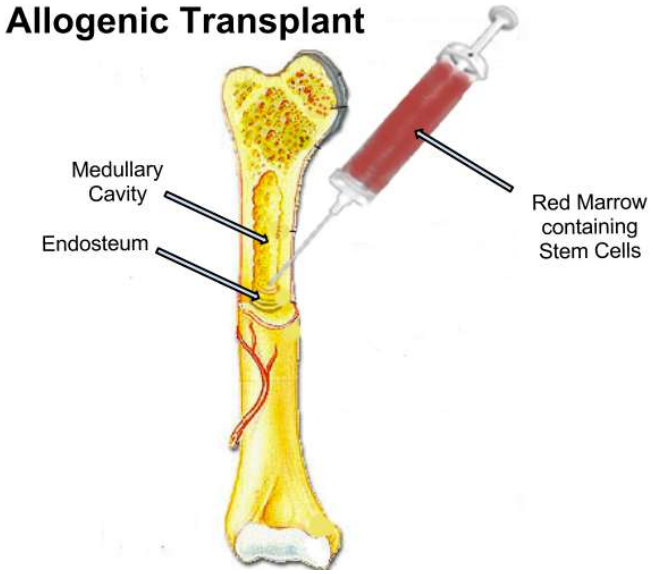
Chemotherapy for Solid Tumors

- Often suppresses bone marrow
- < 20,000/μL if necrosis
- < 10,000/μL if no necrosis



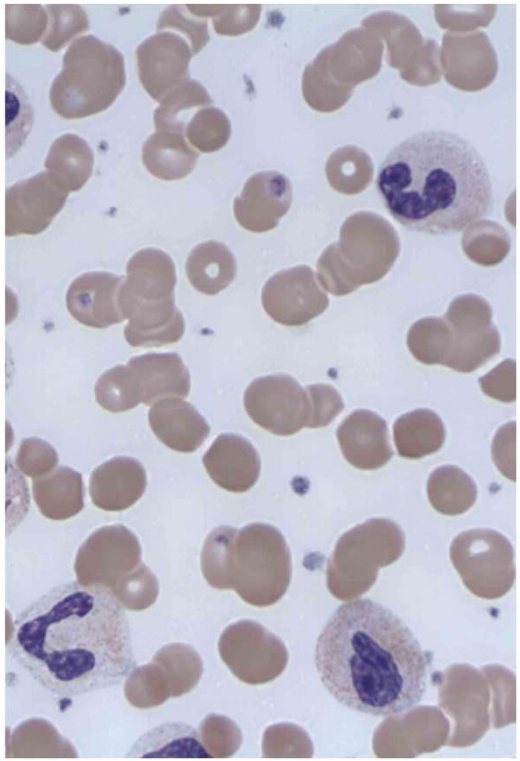
Others

- Hematopoietic Stem Cell Transplant
  - Bone marrow is suppressed
  - < 10,000/μL
- Immune thrombocytopenia (ITP)
  - Produce antiplatelet antibodies
  - Circulating platelets tend to be highly functional
  - Bleeding is rare, even with severe thrombocytopenia
  - Transfuse if bleeding



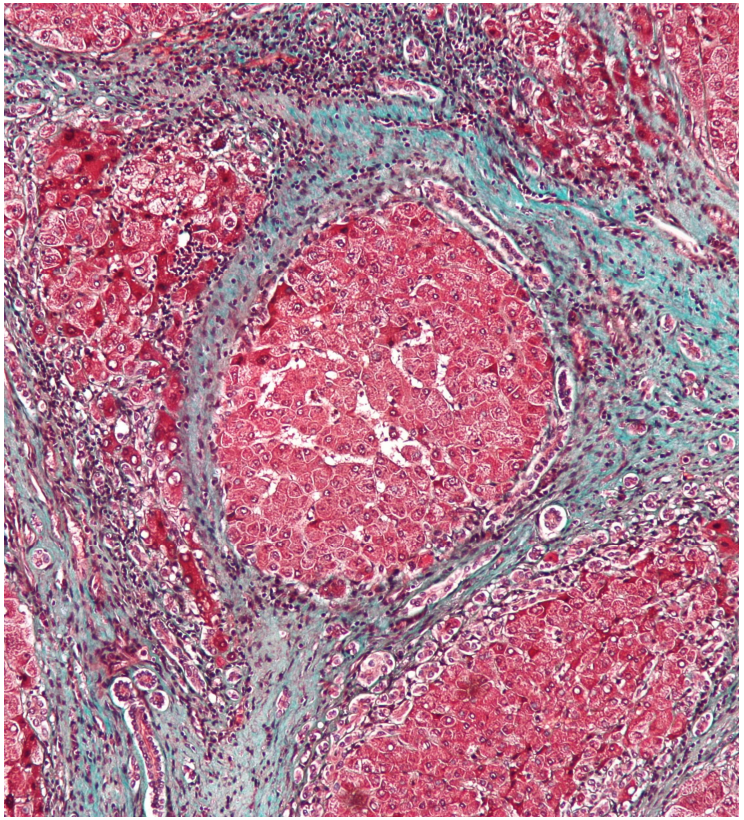
Others

- Thrombotic thrombocytopenic purpura (TTP) and heparin-induced thrombocytopenia (HIT)
  - Disorders of platelet consumption
  - Increased risk of bleeding
  - Platelet activation increases thrombosis risk
  - Do not withhold platelet transfusion due to concerns about exacerbating thrombotic risk
  - Transfuse if bleeding or anticipated to bleed due to an invasive procedure



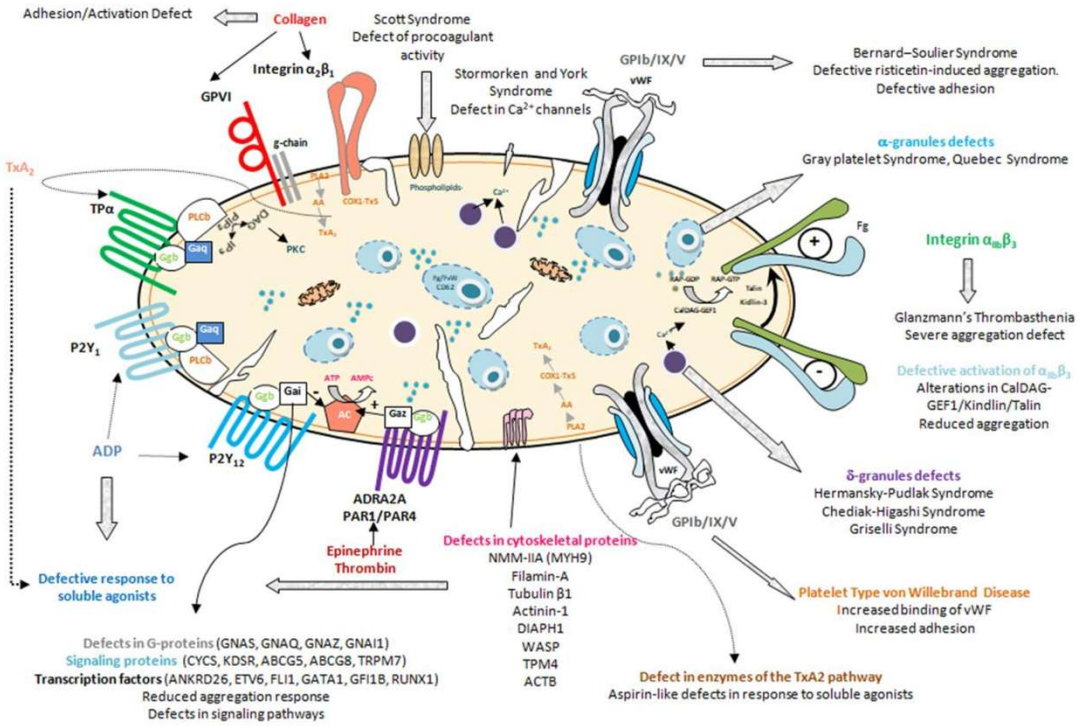
Others

- Liver Disease and DIC
  - Thrombocytopenia
  - Complex mixture of procoagulant and anticoagulant effects
  - Increased risk for both bleeding and thrombosis
  - Transfuse if…
    - Bleeding
    - High risk for bleeding, e.g. post-surgery
    - Invasive procedure



Others

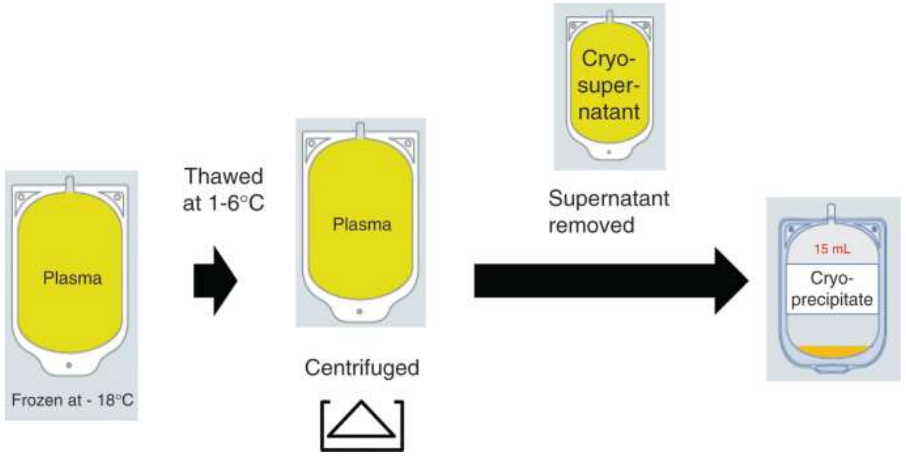
- Platelet function disorders
  - Can be inherited or acquired
  - Transfuse if bleeding



Cryoprecipitate

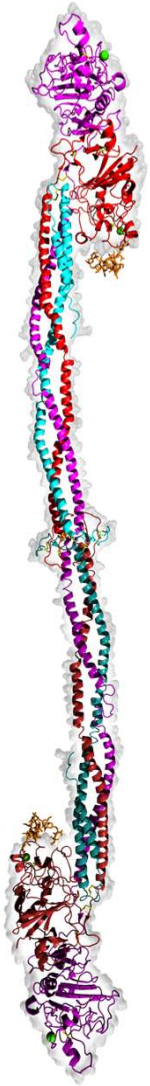
Composition

- Manufactured by thawing frozen plasma at 1 to 6°C → proteins precipitate out
  - Fibrinogen
  - Factor VIII
  - Factor XIII
  - Fibronectin
  - Von Willebrand factor



Uses

- Low/dysfunctional fibrinogen with bleeding or a high risk of bleeding
- Hereditary fibrinogen disorders
  - Can cause afibrinogenemia, hypofibrinogenemia, dysfibrinogenemia, or hypodysfibrinogenemia
  - First-line treatment fibrinogen concentrate
    - Use cryoprecipitate if this is not available

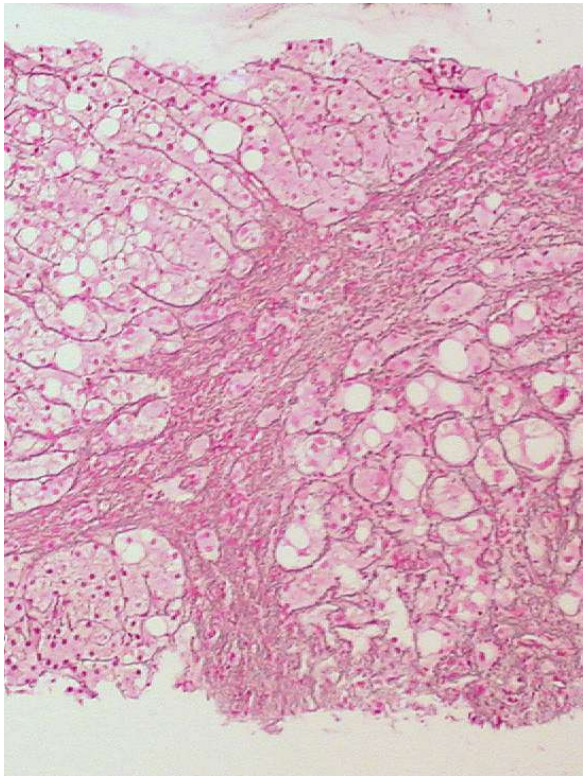


Uses

- Cardiac surgery
  - Bypass causes acquired fibrinogenemia
  - Associated with excessive bleeding, especially when fibrinogen < 200 mg/dL
- Postpartum hemorrhage
  - Blood loss > 500 to 1000 mL
  - Increased risk when fibrinogen < 200 mg/dL

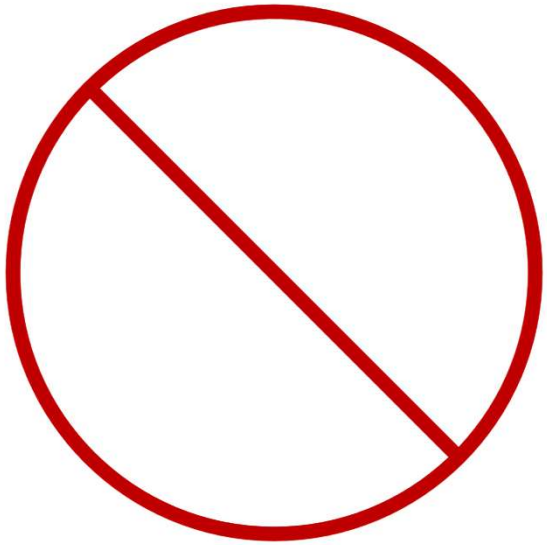
Uses

- Liver disease
  - Use if fibrinogen is very low and there is bleeding or need for a surgical procedure
- DIC
  - If serious bleeding or serious concern about bleeding and fibrinogen < 100 mg/dL
- Uremic bleeding
  - Bleeding risk is primarily due to platelet dysfunction
  - Use if other therapies have been unsuccessful or if there is severe, life-threatening bleeding



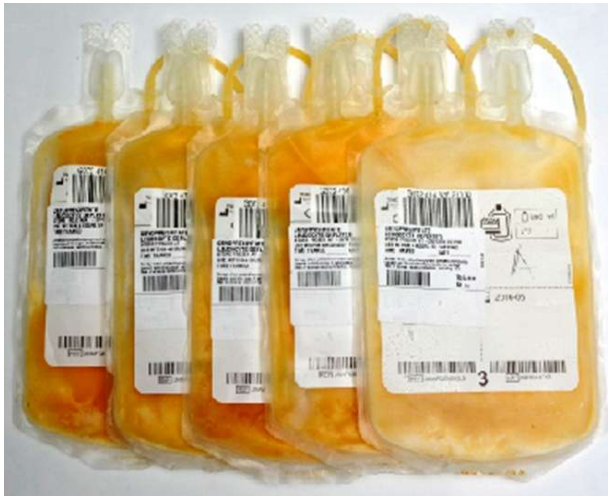
Inappropriate Uses

- Bleeding due to coagulation factor deficiency
  - Congenital hypofibrinogenemia → fibrinogen concentrate
  - Hemophilia A (factor VIII deficiency) → factor VIII concentrate
  - Factor XIII deficiency → factor XIII concentrate
  - Von Willebrand disease → von Willebrand factor concentrate
- May be used if there is bleeding and factor concentrate is not available

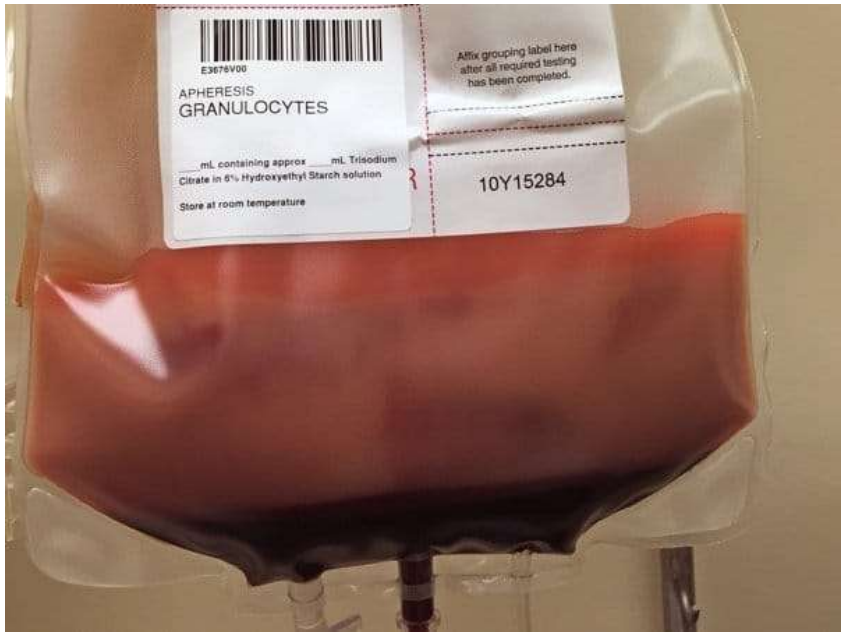


Dosing

- Can be provided as single units or pools containing five or more units
  - Check with your blood bank to determine the correct dose
- In a 70 kg patient, each unit increases fibrinogen by 7 to 10 mg/dL

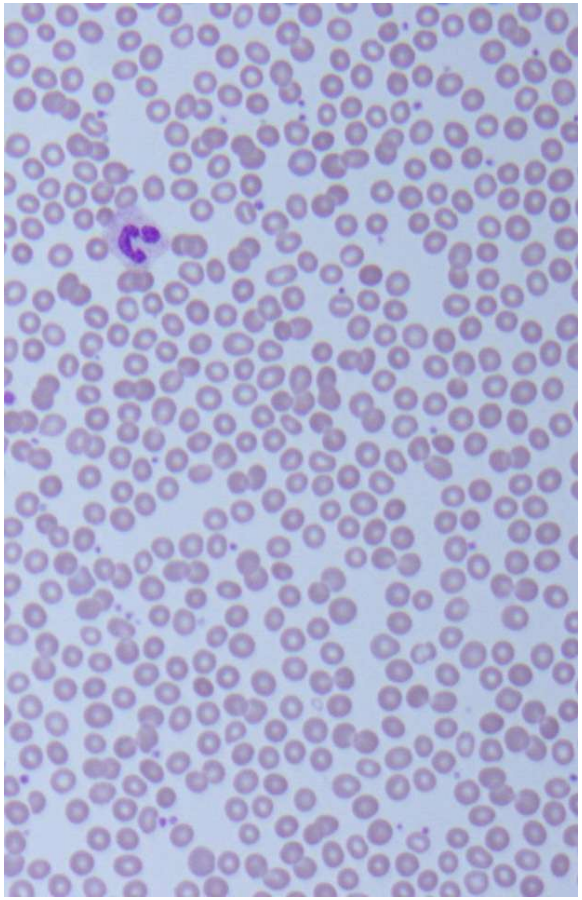


Granulocytes



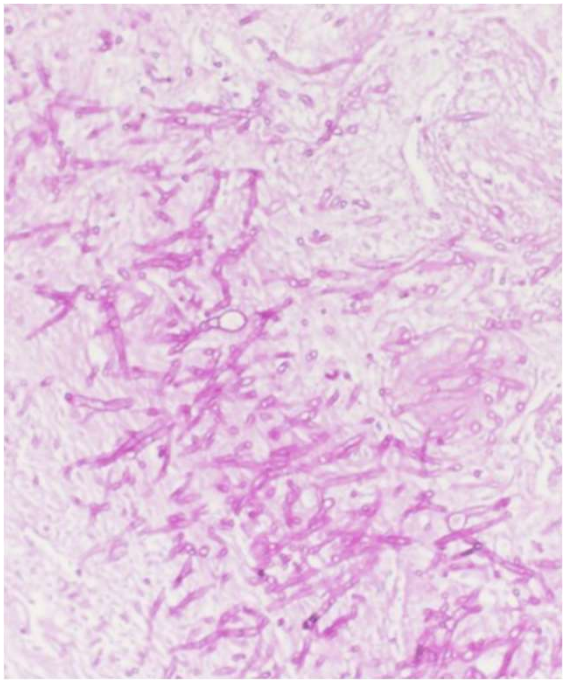
Introduction

- Rarely used
- For treatment neutropenic patients with sepsis
- A randomized trial did not demonstrate improved outcomes, but there were not enough patients enrolled to show efficacy



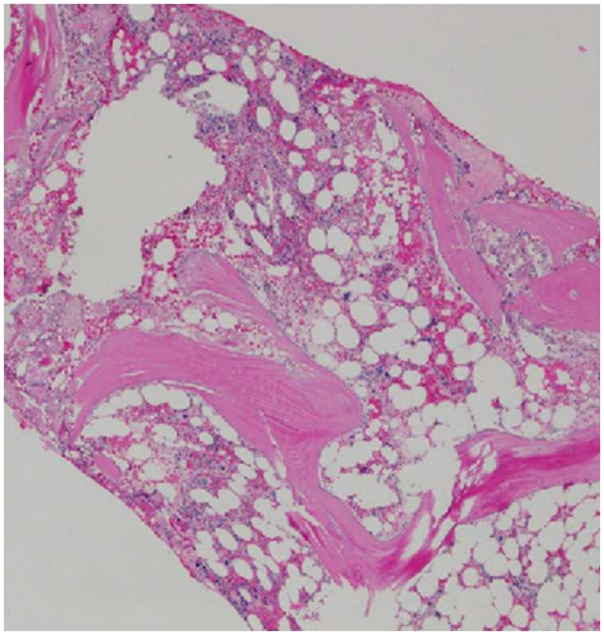
Minimal Criteria

1. Absolute neutrophil count < 500 cells/µL
   - Except with chronic granulomatosis disease
2. Evidence of bacterial or fungal infection
   - Symptoms
   - Cultures
   - Biopsy
   - Radiographic
3. Not responsive to antibiotics for at least 48 hours
   - Unless if infection is life-threatening
4. Bone marrow recovery is likely or there is a plan for potentially curative therapy



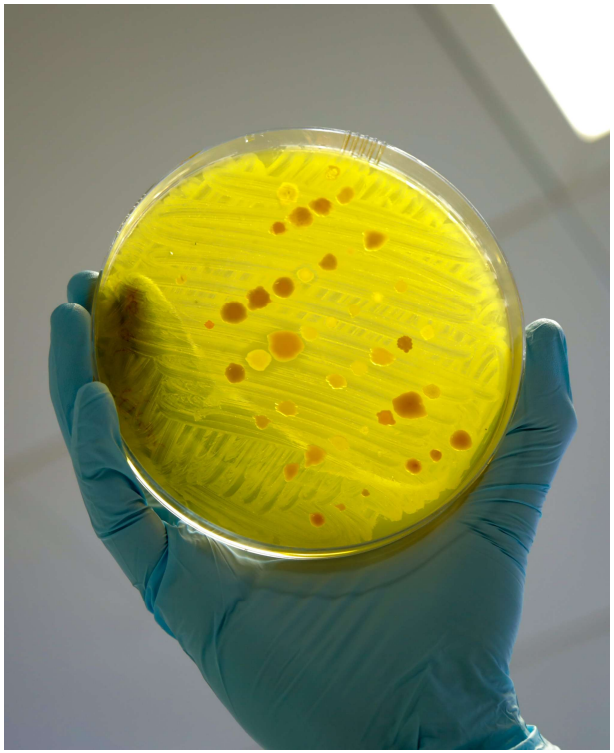
Chemotherapy-/HSCT-Induced Neutropenia

- Bone marrow production of all cell lines is suppressed
- Most common use
  - Still rare in this population
- Can also use granulocyte colony stimulating factor (G-CSF)
  - Response is usually poor



Infection Treatment

- Most bacterial and some fungal infections can be controlled with antimicrobials
- Multidrug-resistant bacterial infection and fungal infection in patients with neutropenia remain a major cause of morbidity and mortality
  - Consider use in these patients

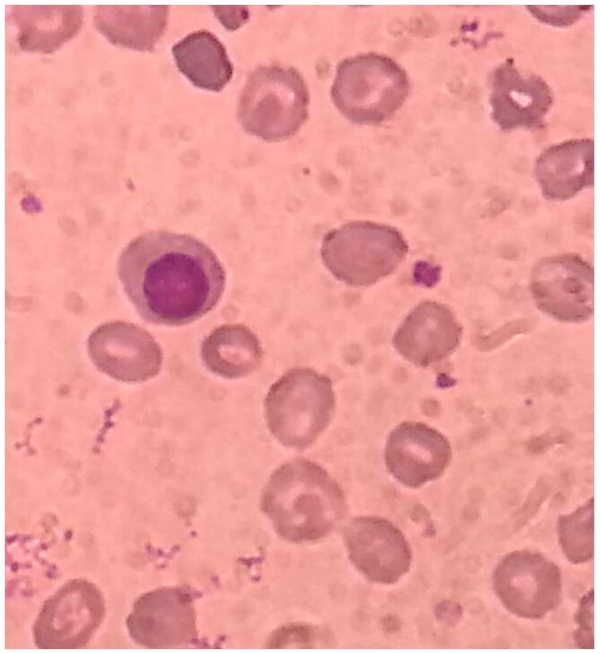


Infection Prophylaxis

- Controversial
- Not done outside of clinical trials

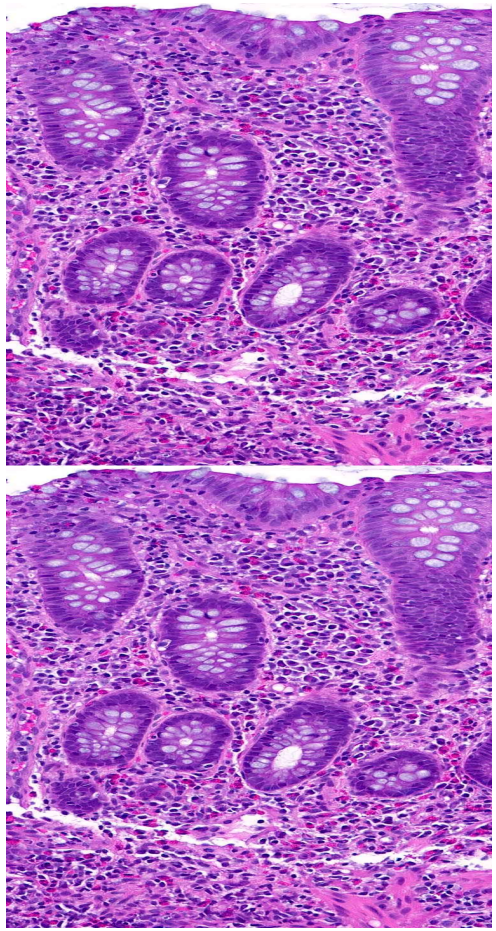
Aplastic Anemia

- May be appropriate if neutropenia is severe and bacterial/fungal infection is unresponsive to antimicrobials
- High incidence of HLA alloimmunization → increases risk of transfusion-related acute lung injury (TRALI)



Chronic Granulomatous Disease

- Defect in granulocyte function
- May have a normal granulocyte count
- Antimicrobials are usually efficacious
- Use granulocytes if patient continues to deteriorate under maximum antimicrobial therapy

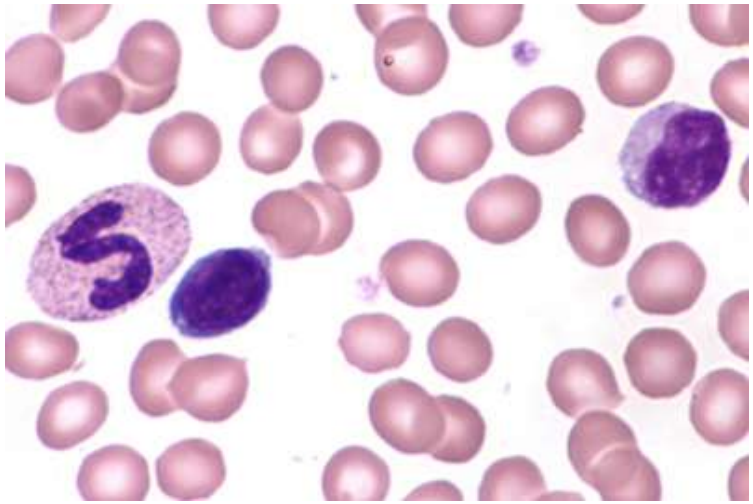


Neonatal Sepsis

- Immature granulopoietic system
- May benefit from granulocytes

Recipient Response

- Daily morning WBC count and differential
- Absolute neutrophil count (ANC) increase can be quite large → 1000/μL
- Treatment can vary from three days to months



Stopping Criteria

- Infection is resolved based on clinical signs/symptoms and lab/radiological evidence
- Sign of bone marrow recovery → ANC > 500 for three days without granulocytes transfusion
- Poor response and patient changes to palliative care

Questions?

LifeServe BLOOD CENTER

Your Blood. Your Hospital. Your Neighbors.

Outreach

- Physician available 24/7
  - Practitioners with transfusion-related questions/issues
  - Blood bank-related questions/issues
  - (515) 309-4840
- Educate the medical community to keep them up to date on transfusion-related topics
  - Presentations to medical personnel
  - Contact me: *alex.smith@lifeservebloodcenter.org*
- Quarterly webinars
  - *https://www.lifeservebloodcenter.org/for-hospitals/resource-guide/education*
  - To request to be on the notification list please contact Shelly Schnell-Petersen: Shelly.Schnell-Petersen@lifeservebloodcenter.org

Thank you!

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