

Author(s): Robertson Davenport, M.D., 2009

License: Unless otherwise noted, this material is made available under the terms of the **Creative Commons Attribution–Noncommercial–Share Alike 3.0 License:**
<http://creativecommons.org/licenses/by-nc-sa/3.0/>

We have reviewed this material in accordance with U.S. Copyright Law **and have tried to maximize your ability to use, share, and adapt it.** The citation key on the following slide provides information about how you may share and adapt this material.

Copyright holders of content included in this material should contact open.michigan@umich.edu with any questions, corrections, or clarification regarding the use of content.

For more information about **how to cite** these materials visit <http://open.umich.edu/education/about/terms-of-use>.

Any **medical information** in this material is intended to inform and educate and is **not a tool for self-diagnosis** or a replacement for medical evaluation, advice, diagnosis or treatment by a healthcare professional. Please speak to your physician if you have questions about your medical condition.

Viewer discretion is advised: Some medical content is graphic and may not be suitable for all viewers.

Citation Key

for more information see: <http://open.umich.edu/wiki/CitationPolicy>

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }



Public Domain – Government: Works that are produced by the U.S. Government. (17 USC § 105)



Public Domain – Expired: Works that are no longer protected due to an expired copyright term.



Public Domain – Self Dedicated: Works that a copyright holder has dedicated to the public domain.



Creative Commons – Zero Waiver



Creative Commons – Attribution License



Creative Commons – Attribution Share Alike License



Creative Commons – Attribution Noncommercial License



Creative Commons – Attribution Noncommercial Share Alike License



GNU – Free Documentation License

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }



Public Domain – Ineligible: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }



Fair Use: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.

Blood Banking Theory and Component Therapy

M2 Hematology/Oncology Sequence
Robertson Davenport, MD

Winter 2009



Blood Components

- Red blood cells
- Plasma
- Cryoprecipitated Antihemophilic Factor
- Platelets
- Granulocytes
- Mononuclear cells
- Hematopoietic progenitor cells

Blood Donation

- Types of donations
 - Allogeneic
 - Autologous
 - Directed
- Methods of blood collection
 - Whole blood
 - Apheresis

Blood Donor Qualification

- Determined by FDA
- Health history
 - Infectious disease risks
 - Cancer, heart or lung disease, bleeding
 - Medications
 - Pregnancy and transfusions
 - Donation reactions
- Vital signs
- Confidential self exclusion
- Donor deferral registry
- Infectious disease testing

Current Infectious Disease Testing

- *Treponema pallidum* antibody
- Hepatitis B surface antigen (HBsAg)
- Hepatitis B core antibody (anti-HBc)
- Hepatitis C virus antibody (anti-HCV)
- HIV-1 and HIV-2 antibody (anti-HIV-1 and anti-HIV-2)
- HTLV-I and HTLV-II antibody (anti-HTLV-I and anti-HTLV-II)
- HIV, HCV, West Nile Virus RNA (NAT)
- *Typanosoma cruzi* antibody
- HBV NAT under IND

Adverse Effects of Donation

- Iron deficiency
- Hematoma
- Pain at phlebotomy site
- Syncope
- Hyperventilation
- Arterial puncture
- Nerve injury

Autologous Donation Criteria

- Lower minimum hematocrit
- Shorter donation interval
- Risk factors for infectious diseases acceptable

Whole Blood Derived Components

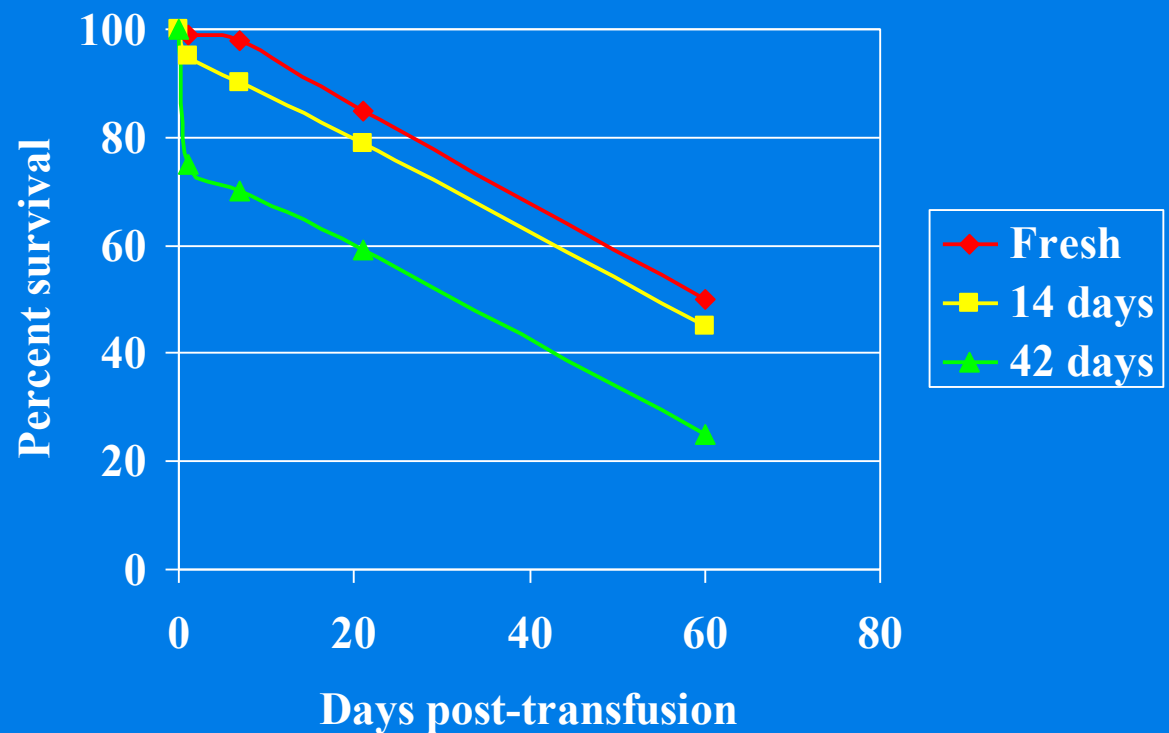
- Red Blood Cells
- Platelet Concentrate
- Fresh Frozen Plasma
- Cryoprecipitate

Apheresis Components

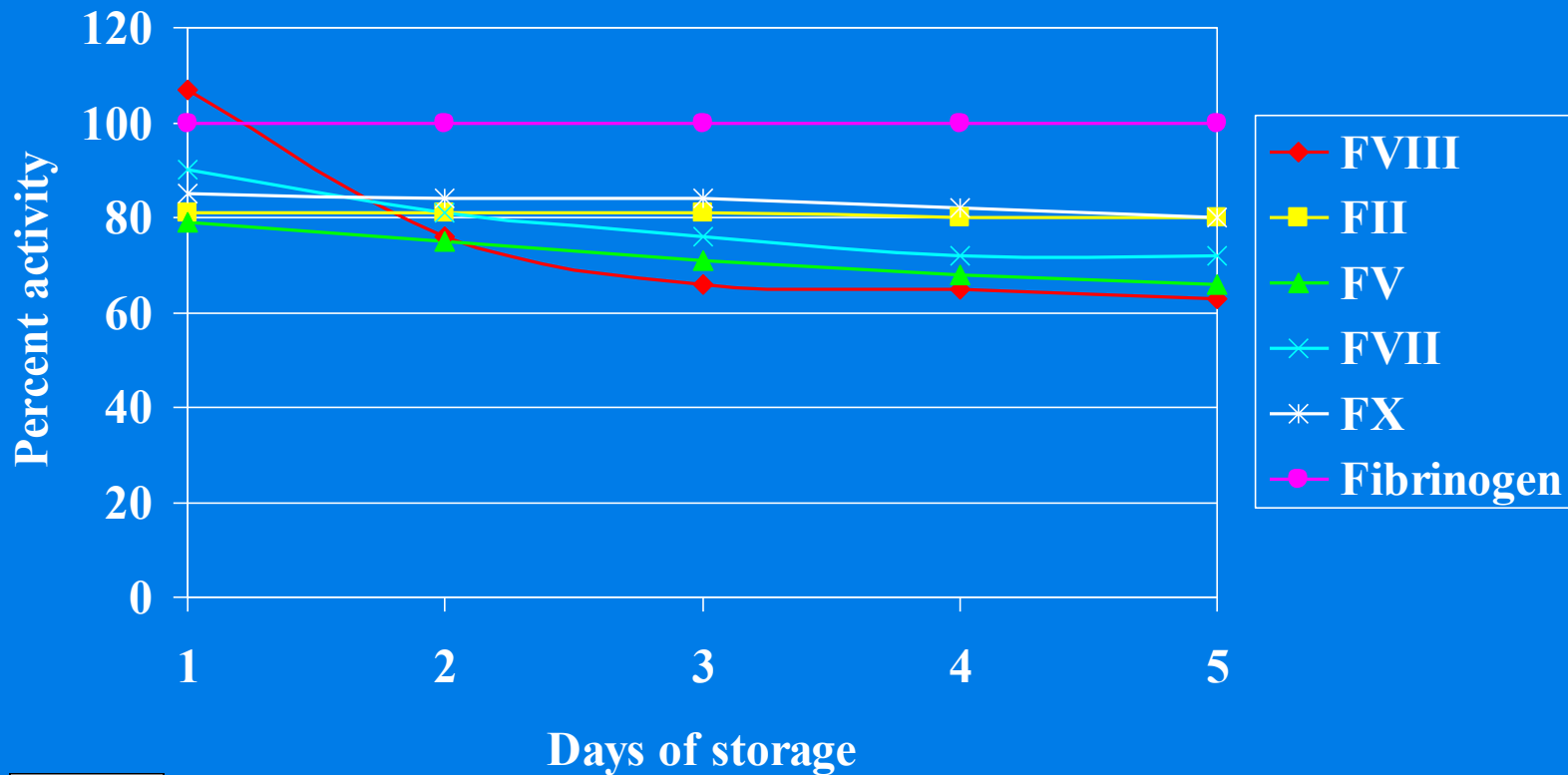
- Red Blood Cells
- Plasma
- Platelet concentrate
- Granulocytes
- Mononuclear cells
- Hematopoietic progenitor cells

Storage Changes in Red Blood Cells

- Hemolysis
- K^+ leakage
- \downarrow 2,3-DPG
- Senescence
- Loss of SNO-Hb?



Storage Changes in Liquid Plasma



Storage Changes in Platelets

- Activation
 - P-selectin
 - CD40L
- Granule release
 - Beta-thromboglobulin
 - CCL5, CXCL4, CXCL7
- GP Ib clustering

Blood Group Serology

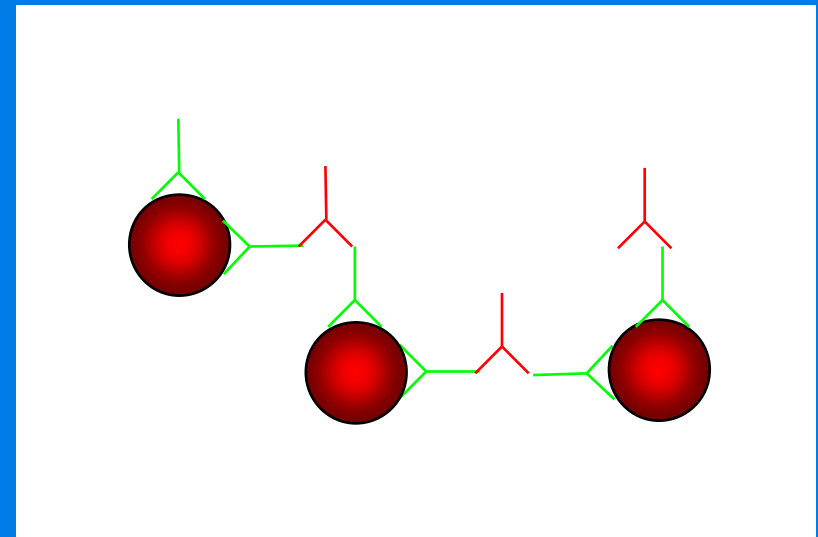
- Red cell antibodies
 - Naturally occurring
 - Secondary to exposure
 - Autoantibodies
- Leukocyte antibodies
 - HLA
 - HNA
 - Autoantibodies
- Platelet antibodies
 - HPA
 - Autoantibodies

Detection of Red Cell Antibodies

- Direct agglutination
 - IgM antibodies
- Indirect antiglobulin test
 - IgG antibodies
- Direct antiglobulin test
 - IgG or C3 coated red cells

Red Cell Antibody Screen

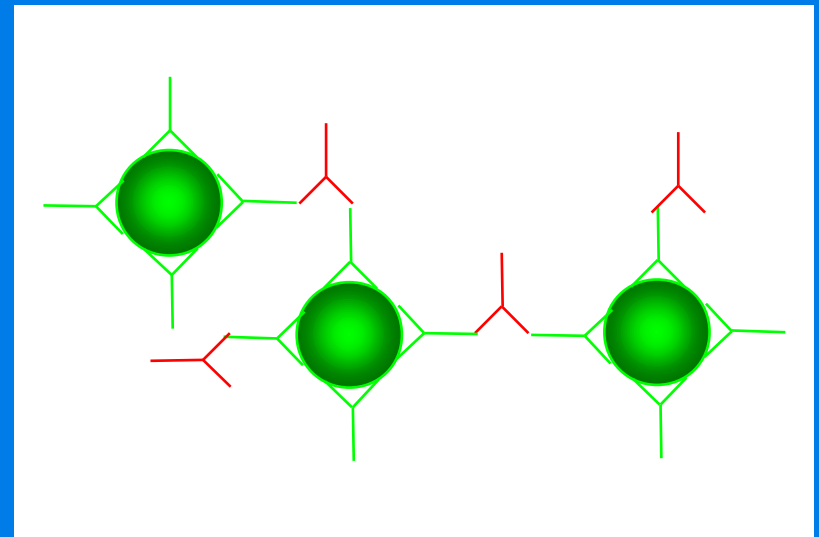
- Indirect antiglobulin test
 - Patient serum
 - Known phenotype red cells
 - Antiglobulin (anti-IgG) serum



© PD-INEL R. Davenport

Direct Antiglobulin Test

- Patient red cells
- Antiglobulin (anti-IgG or anti-C3) serum



© PD-INEL R. Davenport

Applications of Direct Antiglobulin Test

- Autoimmune hemolytic anemia
- Transfusion reactions
- Drug induced hemolysis
- Cold agglutinin disease
- Autoimmune diseases

Routine Pretransfusion Testing

- ABO typing
 - A and B antigen test
 - Anti-A and Anti-B antibody test
- Rh typing
 - Rh(D) antigen test
- Red Cell antibody screen

Common Blood Types

Blood type	A antigen	B antigen	Anti-A	Anti-B	Rh(D) antigen
A Positive	+	-	-	+	+
O Negative	-	-	+	+	-

Selection of Compatible Blood

- ABO type
- Rh type
- Unexpected antibodies
 - Antibody identification
 - Phenotype negative donors
- Crossmatch

Emergency Transfusion

- Group O red cells
- Group AB plasma
- Rh negative preferable
 - Women of child bearing potential
- Obtain pretransfusion sample ASAP
- Good communication is essential

Blood Component Therapy

- Clinical considerations
 - Cause of bleeding or red cell loss
 - Rate of blood loss
 - Underlying diseases
 - Risks of future bleeding
 - Physiologic compensations

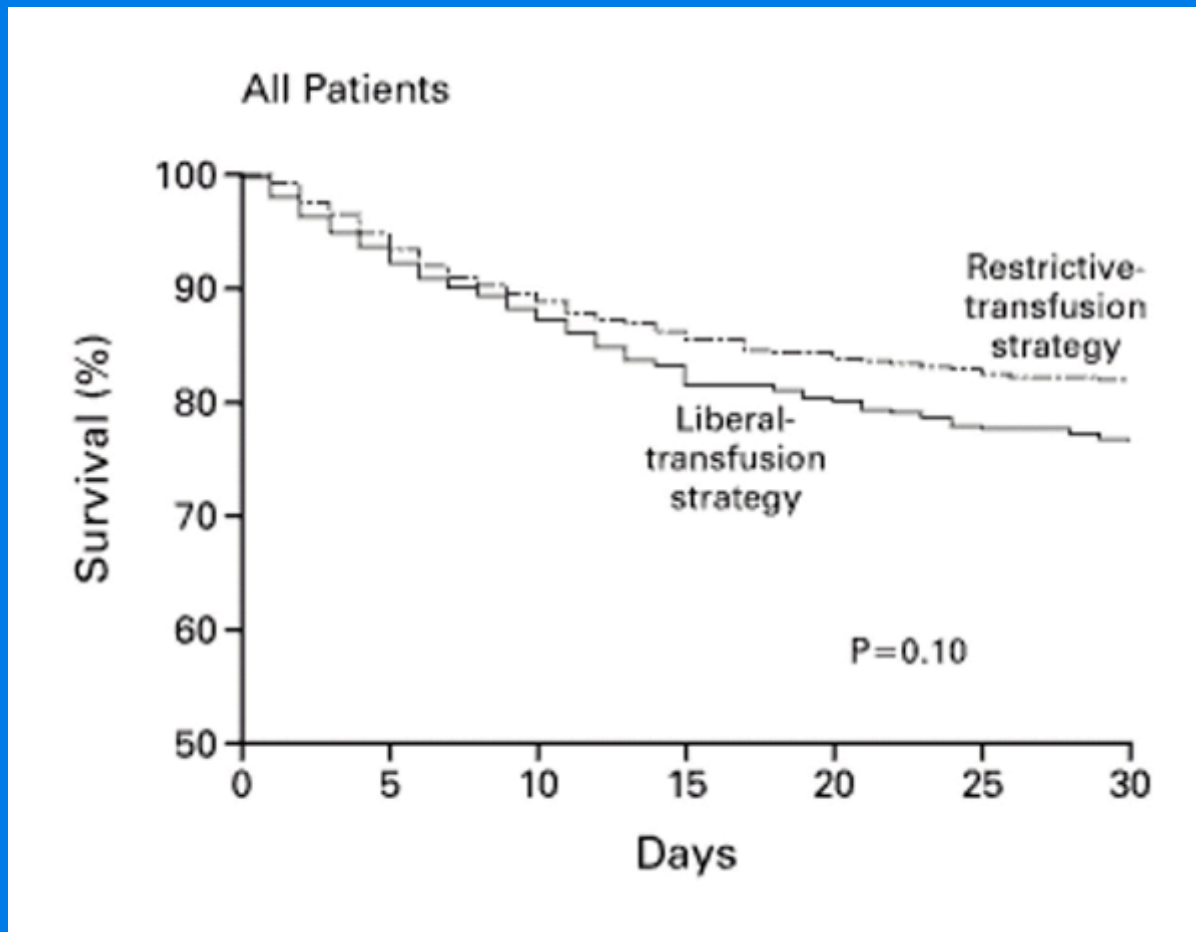
Indications for Red Blood Cell Transfusion

- Symptomatic anemia
- Bleeding $> 15\%$ total blood volume
- Chronic hypoproliferative anemia
- Hemolytic anemia
 - Sickle cell anemia
 - Hemolytic crisis
 - Acute chest syndrome
 - Stroke prophylaxis
- Uremic bleeding

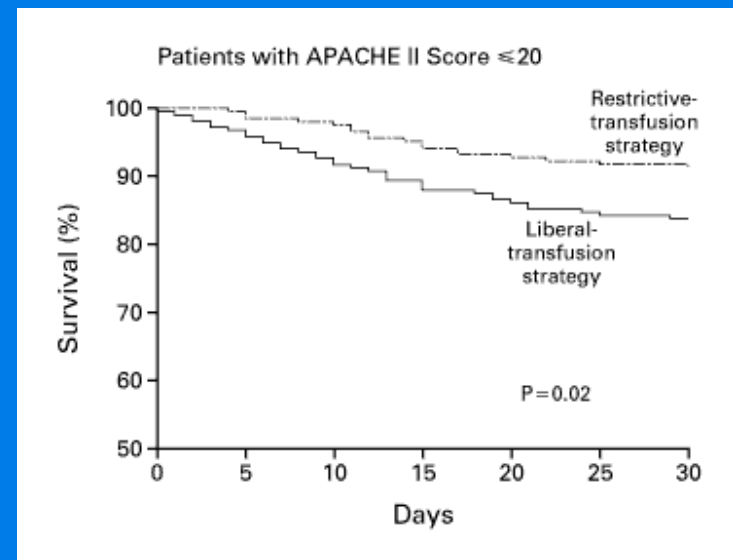
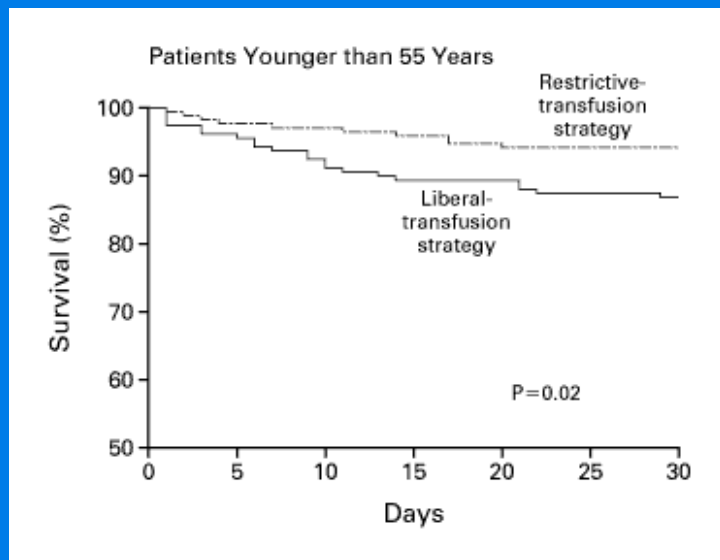
TRICC Trial

- 838 ICU patients with Hb <9.0
- Restrictive transfusion
 - Hb <7.0 target 7.0 - 9.0
- Liberal transfusion
 - Hb <10.0 target 10.0 - 12.0

TRICC - Overall Outcome



TRICC Subgroup Outcomes



© PD-INEL N Eng J Med 1999; 340:409-417 (Both Images)

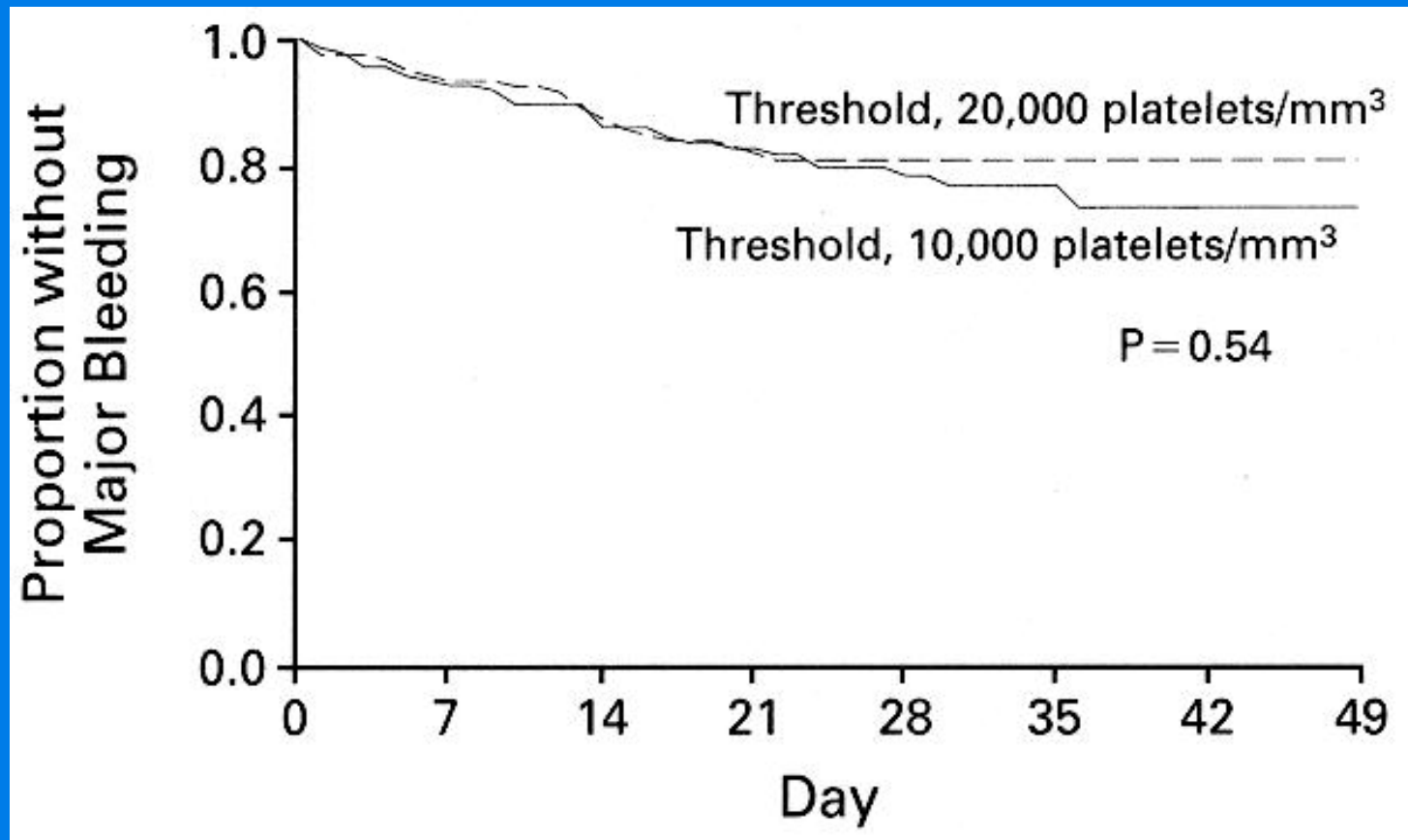
Red Cell Transfusion Examples

- Usually indicated
 - Acute blood loss of 1000 ml in an adult
 - Chronic anemia, hematocrit 24%, in a patient with dyspnea and angina
- Usually not indicated
 - Hematocrit 30% in a patient scheduled for tonsillectomy
 - Hematocrit 25% in a patient with autoimmune hemolytic anemia

Indications for Platelet Transfusion

- Hemorrhage due to thrombocytopenia
- Hemorrhage due to platelet dysfunction
- Hypoproliferative thrombocytopenia with risk of hemorrhage (e.g. $<10,000/\mu\text{l}$)
- Thrombocytopenia (e.g. $<50,000/\mu\text{l}$) with bleeding or invasive procedure

Prophylactic Platelet Transfusion in AML



Platelet Transfusion Examples

- Usually indicated
 - Platelet count 5,000/ μl in a patient on chemotherapy
 - Platelet count 40,000/ μl in a patient on aspirin with hemorrhage
- Usually not indicated
 - Platelet count 20,000/ μl in a patient with ITP

Factors Affecting Platelet Transfusion Effectiveness

- Antibodies
 - HLA
 - Platelet specific
 - ABO
- Splenomegally
- Consumption/DIC
- Sepsis
- Drugs
- Body size
- Rate of transfusion

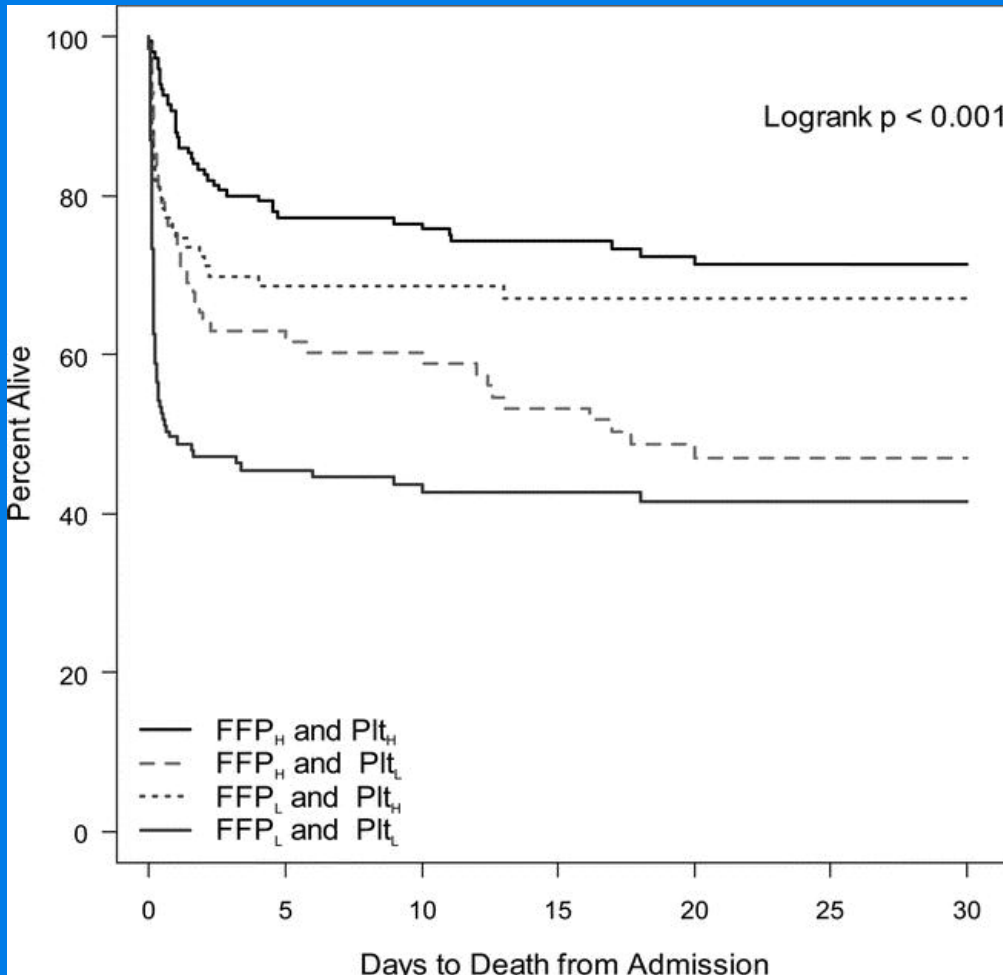
Contraindications to Platelet Transfusion

- Immune thrombocytopenic purpura
- Thrombotic thrombocytopenic purpura
- Heparin-associated thrombocytopenia

Indications for Plasma Transfusion

- Coagulation factor deficiency (consider factor concentrates)
- Disseminated intravascular coagulation
- Reversal of warfarin anticoagulation
- Dilutional coagulopathy (massive transfusion)
- Hemorrhage in liver disease
- Thrombotic thrombocytopenic purpura

Transfusion in Trauma



FFP_H
Plasma:RBC >1:2

FFP_L
Plasma:RBC <1:2

Plt_H
Platelet:RBC >1:2

Plt_L
Platelet:RBC <1:2

Indications for Cryoprecipitate Transfusion

- Factor VIII deficiency
- von Willebrand's disease
- Hypofibrinogenemia
- Factor XIII deficiency
- Uremic bleeding

Additional Source Information

for more information see: <http://open.umich.edu/wiki/CitationPolicy>

Slide 12: Robertson Davenport

Slide 13: Robertson Davenport

Slide 17: Robertson Davenport

Slide 18: Robertson Davenport

Slide 21: Robertson Davenport

Slide 26: N Eng J Med 1999; 340:409-417

Slide 27: N Eng J Med 1999; 340:409-417

Slide 28: N Eng J Med 1999; 340:409-417 (Both Images)

Slide 31: Source Undetermined

Slide 36: Source Undetermined