Risks and Benefits of Blood Transfusions

Patient and Family Conference
Aplastic Anemia & MDS International Foundation
July 10-12th, 2009
Indianapolis, Indiana
Susan M. Carson RN, MSN, CPNP
Childrens Hospital Los Angeles

ChildrensHospital LosAngeles

Objectives

- Understand the following:
  - Benefits and indications for blood transfusions
  - Safety- incidence of infections
  - Cross matching and alloimmunization
  - Transfusion reactions
  - Iron overload- cause and screening
  - Importance of irradiation

Red Cells *(Erythrocytes)*

- Carry Oxygen to tissues
- Remove Carbon Dioxide from tissues

- Whole Blood
- Packed RBC
  - ~14 million units/year in U.S.
  - Usually stored for 5-6 weeks
  - at 4-10^{o}C

Blood: The Life Source

- Blood transfusions a vital treatment for many illnesses
- AA/MDS/PNH/Cancer/BMT: correct anemia caused by disease and therapy
- Thalassemia: replace what body can't make
- Sickle Cell: prevent life-threatening complications
- Replace blood loss due to trauma or surgery

Transfusions: The Benefit

- Safe: advanced donor screening and unit testing
- Available
- Simple
- Improve the quality of life for the patient

Transfusions: The Cost

- Infection
- Alloimmunization
- Transfusion Reactions
- Iron Overload
- TR- GVHD

Infection

- New advances in donor screening and testing
- Incidence of infected units
  - Hepatitis B 1:205,000
  - Hepatitis C 1:2 million
  - HIV 1:2 million

Vigorous donor screening and interviewing

"The next infection"

Every Donation is Tested

- ABO, Rh (blood type), Ab screen
- Hepatitis B — HBsAg, Anti-HBc
- Hepatitis C — Antibodies, Nucleic Acid Test
- HIV 1/2 — Antibodies, Nucleic Acid Test
- HTLV I and HTLV-II — Antibodies
- Syphilis — Antibodies
- West Nile Virus — Nucleic Acid Test
- T. cruzi (Chagas) — Antibodies
- Bacteria — Platelets only
- Optional — CMV (Cytomegalovirus) — Antibodies
  Sickle cell — Hgb. S

ABO blood groups

Genotype	Red cell antigens	Frequency in caucasians	Serum antibody
AA, AO	A	40%	anti-B
BB, BO	B	11%	anti-A
AB	AB	4%	none
OO	O	45%	anti-A, anti-B

Compatibility Testing

	RECIPIENT	DONOR
1. ABO and Rh (D) type	X	X
2. Antibody screen	X	X

Compatibility Testing

	RECIPIENT		DONOR
3. Crossmatch	X (serum)	PLUS	X (cells)

Alloimmunization

- All patients transfused based on A,B,O and Rh factor
- 30-40 lesser antigens on the RBC
- Ethnic trends in antigen expression
- Donor pool: mostly Caucasian
- RBC phenotyping and antigen matched blood for patients receiving multiple transfusions
  - Especially critical for non-Caucasian patients

The Pathophysiology of Alloimmunization

- Presentation of foreign antigens on donor cells
- Stimulate immune system: Ab response
  - Repeated exposure and immunization: sustained clonal response and clinically significant Ab response
  - Some antibodies are not clinically significant
- Can lead to AIHA syndrome

Treatment and Prevention

- Antigen-matched blood
  - E, Kell, D, c, Jk(a), Fy(a), c
- Observation, hydration
- Immunomodulating therapy
  - IVIG, CSA, rituximab, prednisone, vincristine

Leukoreduction

- White cells removed, usually by filtration
- Benefit
  - reduce recipient febrile reactions
  - Reduce CMV transmission
  - Reduce alloimmunization

Non Hemolytic Transfusion Reactions

- Exposure to donors WBC in trace
- Fever, hives
- Rx: premedication, leukoreduction, washed cells

Leukoreduction

Pre-BMT Considerations

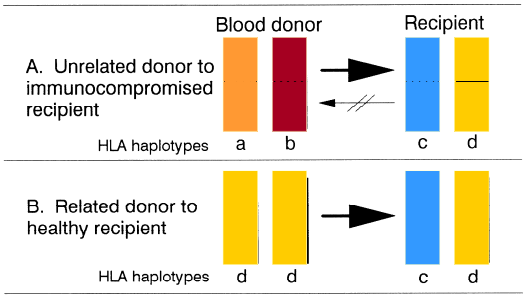
- Irradiated Units
- CMV negative units
- Directed donor
- Unit exposure

Irradiation

- Irradiation kills certain white cells (lymphocytes) that can attack the recipient's system
  - Donations from first degree blood relatives
  - Recipients who are severely immunocompromised
    - neonates
    - transplant patients

TRANSFUSION-ASSOCIATED GRAFT-VERSUS-HOST DISEASE

Pathophysiology: Viable donor lymphocytes attack host tissues -- skin, liver, GI tract, marrow; fatal



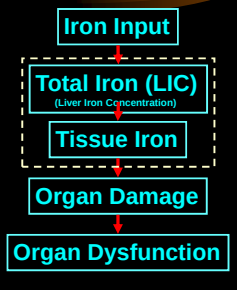
Iron Overload from Transfusions

- Each unit of blood deposits 200 mg of iron in the body.
- Iron deposits in the liver, pancreas, thyroid, parathyroid, pituitary gland, and heart.
- Oxidative damage from iron causes tissue damage.
- **THERE IS NO PHYSIOLOGICAL MECHANISM TO EXCRETE THE IRON!!**
- Signs of iron overload appear after 10-20 transfusions.

Complications of Iron Overload

Organ Dysfunction = Tissue iron x Tissue Sensitivity x Time

- Arrhythmia
- Heart Failure
- Liver failure
- Pan-endocrine failure
  - Diabetes
  - Hypothyroidism
  - Growth hormone deficiency
  - Hypogonadism



Measurement of Tissue Iron

- Ferritin
- Liver biopsy
- SQUID
- MRI
  - Heart T2*/SIR
  - Liver R2
  - (other organs?)
- NTBI / LPI

SQUID= Superconducting Quantum Interference Device
NTBI=Non-transferrin Bound Iron LPI=Labile Plasma Iron

Iron Overload

- We have no method now to predict when a patient will suffer catastrophic side effects of iron overload.
- MRI, liver biopsy, SQUID and other tests can tell us where the iron is but not when the organ will fail.
- Each patient is different: genetic factors influence effect of iron on organs.

Chelators

- desferrioxamine (Desferal®)
- deferasirox (Exjade®)
- Future: L1 (deferiprone), HES-DFO,combination therapies

Contact Information

Susan M. Carson
Children's Hospital Los Angeles
4650 Sunset Blvd MS #54
Los Angeles, CA
90027
323-361-4132
Scarson@chla.usc.edu