Introduction to Transfusion Medicine

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1500's to 1800's

- Not known when or by whom the idea of transfusing blood came was developed
- 1492 ?first transfusion to Pope Innocent VIII
- 1616 description of circulation William Harvey
- 1600's
  - Animal to Animal Transfusion
  - Animal to Human Transfusion/First Hemolytic Transfusion Reaction
- 1818 Human to Human: James Blundell (studied post-partum hemorrhage)
- Mid 1800's First transfusion in United States

Discovery of Blood Groups

- 1900 Landsteiner ABO groups (ABC); later AB by DeCastello and Sturli
- 1939 Levine and Stetson
  - Hemolytic Disease of the Newborn
- 1940 Landsteiner Weiner
  - Rh Blood Group (D antigen)
- Mid 1940's C,E,c,e of Rh Blood Group System
- Other Blood Groups
  - MNSs, Duffy, Kidd, Kell……
- 1960's anti-Rh prevents alloimmunization

Anticoagulation Plastic Bags and Components

- Early devices directly connected donor to recipient
- Blood Clotting prevented storage of components
- Calcium is needed for blood to clot
- 1915 Sodium Citrate
- ? First used for transfusion
- 1950 Plastic Bags Carl Walter
  - Separation of Components using multiple connected plastic bags
  - Platelet collection and storage
- 1955 Lewisohn Landsteiner Award for citrate work

Modern Blood Banking

- 1932 Leningrad First Blood Bank
- Cook County Hospital first in USA to store refrigerated blood
- US Army Group used sodium citrate in glass bottles during World War I and II
- Hospital and Community Blood Banks established across the world

History

- Fractionation of Coagulation Factors
- Development of recombinant factors
- Understanding of Hemolytic transfusion reactions and other adverse transfusion events
- Improved preservation medium
- leukocyte and platelet antigen systems
- Apheresis technology
- Automation
- Infectious disease screening testing
- Cellular Therapies

What do we do?

- Blood and Blood Component Collection, Processing and Storage
- Blood Banking
  - Pre-transfusion testing
  - Transfusion practices
  - Transfusion Reaction Evaluation
  - Quality Assurance
  - Regulatory Compliance: CAP, AABB, FDA, NYSDOH, JCAHO
- Stem Cell/Cellular Therapy
  - Processing and Cryopreservation and Storage
  - Novel Cellular Therapies
- Therapeutic Apheresis
  - Plasma exchange, red cell exchange, leukapheresis, platelet pheresis
- Stem Cell Collection
  - Peripheral blood
  - Cord
- Continuing Education

The Red Defender

US Blood Supply System

- US Blood Supply provided by different organization
  - American Red Cross (25% of centers)
  - Community Blood Centers (e.g. New York Blood Center); Hospital based Blood Centers (e.g. NYUMC)
- Exporting and Importing Blood Centers
  - Manages Inventory and Distribution
- Professional Blood Bank Associations
  - AABB, ABC, ABRA
- Regulation
  - Food and Drug Administration Regulates as a pharmaceutical
  - Quality Assurance!

America's Blood Centers
It's About Life.

TABLE 2. Estimated numbers (in thousands) of whole-blood and RBC units collected, rejected on testing, transfused, outdated, or unaccounted for in 1999

Activity	Blood centers	Hospitals* Total	Hospitals* ±95% CI	Combined totals	Percentage of total collections and/or transfusions	Percentage change, 1997-1999
Collections						
Whole blood						
Allogeneic, nondirected†	12,221	714	181	12,935	93.2	10.2
Autologous	427	224	28	651	4.7	1.2
Directed	112	62	19	174	1.3	−15.1
RBC apheresis	91	25	49	116	0.8	NA
Total supply	12,851	1,025	190	13,876	100.0	10.1
Rejected on testing	205	21	7	226	1.7	−2.6
Available supply	12,646	1,003	191	13,649	98.4	10.3
Transfusions						
Allogeneic, nondirected	488	11,316	789	11,804	95.3	8.0
Autologous	19	350	38	367	3	−12.6
Directed to patient	3	100	20	103	0.8	27.2
Pediatric‡	4	110	25	115	0.9	29.2
Total number of transfusions	513	11,876	791	12,389	100	7.6
Outdated§	338	448	84	787	5.7	18.2
Unaccounted for				473	3.5	

* Weighted data.
† Includes ~200,000 imported units.
‡ Expressed in adult units.
§ As reported; includes autologous units.

TABLE 4. Estimated numbers (in thousands) of non-RBC blood component units produced, transfused, outdated, or unaccounted for in 1999

Activity	Blood centers	Hospitals* Total	Hospitals* ±95% CI	Combined totals	1997 total	Percentage change, 1997-1999
Production						
Single-donor PLTs†	6,311	910	252	7,220 (1,203)	6,786	6.4
PLT concentrates	4,390	303	108	4,693	4,991	−6.0
Total PLTs	10,701	1,213	336	11,913	11,777	1.2
FFP and single-donor plasma	3,476	333	104	3,810	3,310	15.1
Cryoprecipitate	1,946	26	19	1,972	1,199‡	NA
Transfusions						
Single-donor PLTs	207	5,809	781	6,017 (1003)	5,640	6.7
PLT concentrates	181	2,855	518	3,036	3,396	−10.6
Total PLTs	388	8,665	938	9,052	9,037	0.17
FFP and single-donor plasma	154	3,165	321	3,319	3,320	−0.03
Cryoprecipitate	62	798	192	860§	816	5.4
Outdated¶	927	631	89	1,558	1,490	4.6
Unaccounted for				2,791‖		

Donor Evaluation

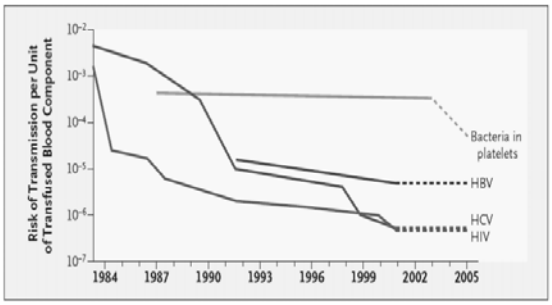
- Protect Donor and Recipient
  - Donor History Questionnaire/Physical Exam
  - Donor Testing (Infectious Disease Markers)
- See handout of Donor Questionnaire

Collection of Blood

- Blood Containers
- Phlebotomy
- Treatment of Adverse Donor Reaction
  - Nausea/Vomiting
  - Syncope
  - Hyperventilation
  - Hematoma
  - More Serious
- Meets FDA regulations

Infectious Disease Markers and Testing

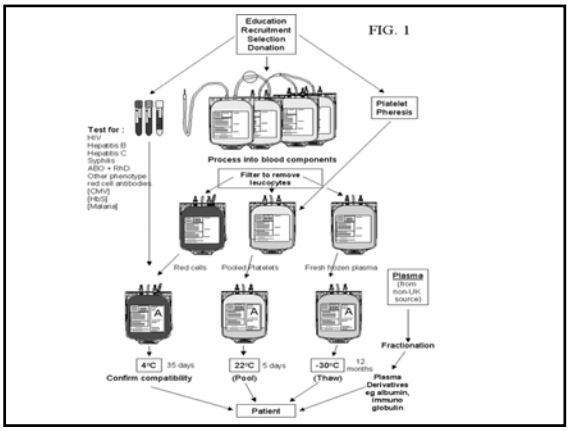
- ABO/Rh; antibody screen
- Hepatitis B (1 in 63,000)
- Hepatitis C (1 in 1.6 million)
- HIV (1 in 1.9 million)
- HTLV (1 in 641,000)
- WNV
- STS
- CMV



Risks of Transfusion-Transmitted HIV, HBV, HCV, and Bacterial Infection in the United States, 1984–2005.

Component Production

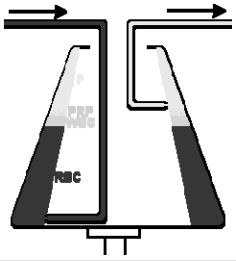
- Collect in ACD
- Soft Spin and take off platelet rich plasma
- Red cells finished add adsol → Fridge
- Platelet rich plasma hard spin
- Express off plasma → freeze as FFP
- Platelet concentrate → RT
- Freeze FFP, thaw at 4C, express off supernatant → cryopoor plasma, cryoprecipitate



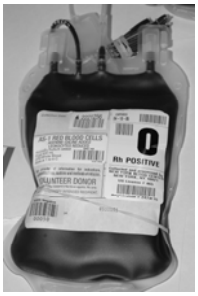
Apheresis Technology

- Single Donor Platelets (6-8 U)
- Double Plt
- Double Red
- FFP and Red

But need HES

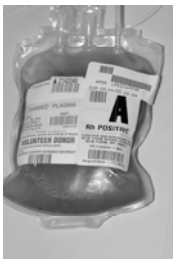


Red Cells



- Homologous
- Autologous
- Packed Red Cells
- Frozen thawed
- Irradiated
- CMV negative
- Antigen Negative
- Sickle negative
- Leukoreduced

Plasma



- Repletion of all known clotting factors
- Short half-life of coagulation factors (some <4 hours)
- Takes 1 hour to thaw
- Good for 24 hours post thaw
- 200-300 ml per unit
- 4-6 units is the appropriate dose (large volume load!)
- Vitamin K!
- TRALI

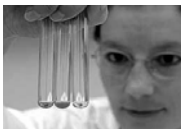
Platelets

- Random vs Apheresis
- kept at room temperature increasing risk of bacterial contamination
- 5 day outdate
- Always in short supply
- Apheresis SDP is 200-400 ml (6-8 units)

Cryoprecipitate

- Fraction of blood that does not dissolve on thawing at 4 degC
- Rich in fibrinogen, factor VIII, vWF, fibronectin
- 15ml/unit; dose is 10 units; NOT concentrated plasma!;
- Treats low fibrinogen (↑50-100g/dl)
- Can be used to treat uremic thrombocytopathy

Blood Bank



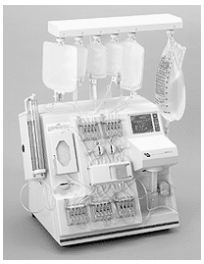
- **Pretransfusion Testing:**
  - Blood Typing
  - Antibody Screening and Identification
  - Direct Antiglobulin Test
  - Indirect Antiglobulin Test
- **Transfusion Services**
  - PRBC, PLT, FFP, Cryo..etc
  - Autologous Program
  - Directed Blood
  - RhoGAM, Novoseven, Factors
- **Consultative Services**
  - Rare Blood and Red Cell Antibodies
  - Difficult Transfusions
  - Appropriate Component Therapy
- Responsible for Quality Assurance
- Meets regulations (FDA, NYSDOH, AABB, CAP, JCAHO)

Apheresis

- Collections
  - Single Donor Platelets; FFP; Red cells
  - Peripheral Blood Stem Cell Collections
- Therapeutic
  - ABO/XM incompatible transplants
  - Myasthenia Gravis
  - Thrombotic thrombocytopenic purpura
  - Guillain-Barre
  - Sickle Cell Disease
  - Leukostasis
  - Thrombocytosis
  - etc

Stem Cell Processing and Transplantation

- Volume Reduction
- T-cell depletion
- CD34 Selection
- Cryopreservation
- Thawing
- Washing
- Novel Therapies
  - Dendritic Cell Vaccines, Immunotherapy, Mesenchymal and Tissue Stem Cells



Cord Blood Collection and Transplants