Presentation Handouts

(9205-QE)

SBB/BB Exam Review

October 7, 2012 ✧ 8:30 AM - 12:00 PM

Advancing Transfusion and Cellular Therapies Worldwide

Event Faculty List

Event Title: 9205-QE: SBB/BB Exam Review
Event Date: Sunday, October 7, 2012
Event Time: 8:30 AM to 12:00 PM

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SBB/BB Exam Review

The SBB and BB Exams

Requirements
Content
Competencies

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ASCP Exam Requirements

- Refer to ASCP website (www.ascp.org) for specific requirements
  - Click on Board of Certification
  - Then US Certification
  - Numerous options to select…more about that later
- Wealth of information available there!

SBB Exam Requirements:

- 4 eligibility routes
- Most common:
  - **Route 1**
    - Bachelor's degree with required courses
    - Successful completion of CAAHEP-accredited SBB program within last 5 years
  - **Route 2**
    - MT/MLS(ASCP) or BB(ASCP)
    - Bachelor's degree
      - Course requirements met through MT/BB certification
    - 3 yrs full-time BB experience within last 10 years after degree
    - Must be attained with pathologist oversight

BB Exam Requirements:

- 5 eligibility routes
- Most common
  - **Route 1**
    - MT/MLS(ASCP) and Bachelor's degree
  - **Route 2**
    - Bachelor's degree in appropriate field with required courses
    - 1 yr full-time BB experience within last 10 years
      - Must be attained with pathologist oversight

Experience Requirements

- Serologic Testing
  - ABO, Rh Typing
  - Antibody detection and identification
  - Cross matching
  - Tests for other blood group antigens
  - Direct antiglobulin tests

Experience Requirements

- Routine Problem Solving
  - Transfusion reactions
  - Immune hemolytic anemias
  - Hemolytic disease of the newborn
  - Rh immune globulin evaluation

Experience Requirements

- Quality Control/Quality Assurance
- Laboratory Operations
- Donor Blood
  - Donor selection, preparation and collection
  - Processing and confirmation testing
  - Component preparation for storage and administration

Competencies

- Knowledge of advanced principles
- Technical skills
- Problem Solving & Analytical Decision Making
- Communication
- Teaching & Training Responsibilities
- Supervision & Management

Exam Category Percentages

Subtest	BB	SBB
Blood Products	12%	10%
Blood Group Systems	15%	17%
Immunology	8%	6%
Laboratory Operations	7%	10%
Physiology/Pathophysiology	13%	17%
Serology	33%	22%
Transfusion Practice	12%	18%

Additional information

- Available on ASCP website (**www.ascp.org)**
  - Click on **Board of Certification / US Certification**
    - Eligibility
    - Documentation
    - Applying
    - Scheduling
    - Studying
      - Content outline
      - Reading list
    - Exam Day
    - Results and Certificate
    - US Military

SBB/BB Exam Review

Blood Groups

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Most Important

Read and know:

- Technical Manual
- Standards
- CAUTION

General

Antigens

- Genetics
- Biochemistry
- Null phenotype
- Effect of chemicals
- Prevalence

General

Antigens, cont.

- Racial variation
- Cord cell expression
- Soluble antigens

General

Antibodies

- Characteristic reactivity
- Techniques for detection/confirmation
- HTR
- HDFN

ABO

- Gene interaction - A, B, H, Se
- Antigen structure
- Immunodominant sugars
- Subgroup characteristics
- Causes of ABO discrepancies
- Resolution of ABO discrepancies
- Soluble antigen
- Important lectins

MNS

- 5 terminal amino acids for M and N specificity
- Prevalence in both White and Black populations
- Chemical treatment
- Hybrid SGPs

P and Globoside

- Soluble antigen
- Autoanti-P and PCH
- Anti-PP_1P^k and spontaneous abortion

Rh

- Rh complex
- Types of Weak D
- Inheritance of Rh_{null}
  - Lack LW and Fy5
- Prevalence of 5 major antigens
- Antigens associated with D variants

Rh

- Compound antigens/antibodies
- Anti-G adsorption/elution
- Standards for D typing
- HTR
- HDFN

Kell

- Gene interaction
- Racial differences
- Chemical treatment
- KEL3 in *cis* position
- McLeod phenotype

Lewis

- Soluble antigen
- Antigen structure
- Gene interaction - Le, H, Se

Duffy

- Racial differences
- Chemical treatment
- Anti-Fy3 vs Anti-Fy5
- Association with Malarial resistance

Kidd

- Inheritance for Jk(a-b-)
- Jk(a-b-) resistant to lysis in 2M urea
- Jk(a-b-) population

Other

Lutheran

- Lu(a-b-) inheritance
- Lu linkage to Se
- Association with ALG

Other

LW

- Association with D
- Cord cell expression
- Distinction from D
- Absence on Rh_{null}

Other

I System/Collection

- Soluble antigen
- Adult and cord cell expression
- Disease associations

Other

- Diego
- Cartwright
- Scianna
- Dombrock
- Colton
- Indian
- Xg

High Incidence Antigens

Problem solving

- Phenotype clues
- Chemical treatment
- Ethnicity of antibody maker
- Source of units for transfusion
- HDFN

Former HTLA

- Chido/Rogers
  - Chemical treatment
  - Soluble antigen
  - C4 coated cells
- Knops
  - Located on CR1
  - Ethnicity of antibody maker
  - Soluble antigen

Former HTLA

- Dombrock
  - Gy^a and Hy
- Cost
- JMH
  - Chemical treatment

SBB/BB Exam Review

Methods

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General

- Read Technical Manual Methods Section
- Principle of Method
- Interpretation of Method
- Applications of Method
- Limitations of Method

Antigen/Antibody Reactions

- Agglutination
  - Stages
  - Factors affecting agglutination
- Hemolysis
- Precipitation
  - Applications
  - Double diffusion

Antigen/Antibody Reactions

- Complement Fixation
- ELISA
  - Direct assay
  - Competitive assay
- RIA

Flow Cytometry

- Principle
- Gating
- Applications
  - Define cell markers
  - Detect minor cell populations
  - Antigen zygosity

Red Cell Survival

- Applications
- Monocyte Monolayer Assay
  - Principle
- In vivo crossmatch
  - Principle

Adsorption

- Types
- Variables
  - Temperature, incubation time, etc.
- Applications
  - Remove autoantibody
  - Separate multiple antibodies
  - Confirm antigen or antibody specificity

Elution

- Principle
- Types
  - Optimal recovery
  - Limitations
- Applications
  - Investigate positive DAT
  - Remove antibody for phenotyping

Titration

- Be able to interpret a titration scheme
- Be careful about phenotypes of cells used
- Know how to score
- Applications
  - Prenatal studies
  - Antibody identification
  - Separate antibody specificities

Neutralizations

- Principle
- Look for Dilutional Control
- Sources and specificity of soluble substances
  - ABH
  - Lewis
  - P_1
  - Sd^a
  - Ch/Rg

Cell Separations

- Applications
- Microhematocrit
  - Principle
  - Limitations
- Hypotonic Wash
  - Principle
  - Sickle cell disease

Chloroquine Diphosphate

- Applications
  - Dissociate antibody from red cells
  - Denature Bg and HLA-related antigens
- Limitations
  - Complement not removed
  - Some antigens weakened with prolonged exposure

Antilymphocyte Globulin

- Made from horse serum
- Interferes with DAT and IAT
- Relation to Lu(a-b-)
- Know how to resolve

Enzymes

- One stage vs two stage
- Standardization procedure
  - Method
  - Interpretation
- Effect on various antigens

Sulfhydral Reagents

- AET, DTT, 2ME
- Principle
- Applications
  - Antigen
  - Antibody - know how to interpret serum treatment (look for dilutional control)

Enhancement Techniques

- Strengths and weakness of each
- LISS
- PEG
- Polybrene
- Bovine Albumin

Non-Traditional Techniques for Antibody Detection/Identification

- Column Agglutination Technology
  - Principle
  - Unique components of system
- Solid Phase Red Cell Adherence
  - Principle
  - Unique components of system

Other

- Donath-Landsteiner Test
  - Diagnosis of PCH
  - Method and interpretation
- Tests for PNH
  - Sucrose lysis
  - Ham's test

Polymerase Chain Reaction (PCR) and Transcription-Mediated Amplification (TMA)

- Principle
- Procedure
- Applications
  - PCR used for DNA amplification
  - TMA used for RNA amplification

SBB/BB Exam Review

Blood Donors

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Donor Identification

- Identification
- Donor Education and Consent
- Donor Qualifications
  - review most current edition of Standards

Autologous Qualifications

- Physicians order
- Hgb ≥11 g/dl or Hct ≥33%
- Collected > 72 hours before surgery or transfusion
- Deferred if there is a risk of bacteremia

Apheresis Qualifications

- Same requirements as allogeneic donors with the exception of donation interval
- Infrequent donor
  - donates no more than once every 4 weeks
- Frequent donor
  - donates more frequently than once every 4 weeks
    - max of twice / 7 day period
    - at least 2 days between donations

Plasmapheresis

- Frequent or Infrequent

Cytapheresis

- Frequent or Infrequent
- Not to exceed 24 donations / year
- Regular testing for cytopenia
- Monitor red cell loss and defer appropriately

Plateletpheresis

- Frequent donors must have a platelet count performed before beginning the procedure and have a count ≥ 150,000
  - pre procedure plt count not required for infrequent donors
  - post procedure plt count may be used to qualify the donor for the next procedure

Two-unit Red Cell Apheresis

- Hgb / Hct and weight according to FDA cleared device
- Generally:

	Allogeneic Male	Allogeneic Female
Weight	≥130 lb	≥150 lb
Height	at least 5'1"	at least 5'5"
HCT	at least 40%	at least 40%
HGB	at least 13.3 g/dl	at least 13.3 g/dl

- Donor Hct not <30% or Hgb not <10g/dl after volume replacement

Unit Identification

- Numeric or alphanumberic system for traceability

Phlebotomy and Collection of Samples

- Clean site to reduce bacterial contamination
- Anticoagulated blood in segments
- Matching ID on unit, donor form, and samples
- Wear gloves when collecting autologous donors

Post -Phlebotomy Care

- Apply firm pressure
- Remain reclined until released
- Give the following instructions:
  - eat and drink before leaving
  - do not leave until released
  - drink a lot of fluid over the next few days
  - avoid alcohol until after a good meal
  - do not smoke for 30 minutes
  - if phlebotomy site begins to bleed, raise arm and apply pressure
  - lie or sit down if feel faint or dizzy
  - return to blood bank if symptoms persist
  - remove bandage after a few hours

Adverse Donor Reactions

- General
- Fainting
- Nausea and Vomiting
- Twitching or muscle spasms
- Hematoma during or after phlebotomy
- Convulsions
- Serious cardiac difficulties
- Record all incidents

SBB/BB Exam Review

Blood Components - Preparation and Storage

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Anticoagulants

- Prevent clotting and maintain cell viability and function during storage
  - Dextrose: supports ATP generation
  - Adenine: provides substrate for ATP synthesis
  - Sodium biphosphate: controls the pH
  - Citrate: prevents coagulation
- 21 day storage = CPD, CP2D
- 35 day storage = CPDA-1
- 42 day storage
  - AS-1 (Adsol), AS-3 (Nutricel), AS-5 (Optisol)

Red Cell Components

- Whole blood (1-6ºC)
- Red Blood Cells (1-6ºC)
- Frozen Red blood Cells (-65ºC or colder)
- Rejuvenated RBCs (1-6ºC)
- Deglycerolized RBCs (1-6ºC up to 24 hours)
- Washed RBCs (1-6ºC up to 24 hours)
- Pre-storage RBCs Leukoreduced
- Low Volume RBCs
- Apheresis RBCs
- Intraoperative RBCs

Plasma Components

- Fresh Frozen Plasma
- Thawed Plasma
- Plasma Frozen Within 24 hours of collection
- Plasma and Liquid Plasma
- Plasma Cryoprecipitate Reduced
- Solvent/Detergent-Treated Pooled Plasma
- Donor Retested Plasma
- "Linked" FFP
- Recovered Plasma
- Cryoprecipitate

Platelets

- Platelet Concentrates
- Platelet - Apheresis
- Modifications of platelets
  - Irradiated
  - Leukoreduced
  - Volume-reduced
  - Aliquots
  - Washed
  - Frozen

Granulocytes

- Usually collected by apheresis
- Buffy coat harvest
- Yield must be a minimum of 1.0×10^{10} granulocytes
- Transfuse as soon as possible after collection

Component Modifications

- CMV-negative
  - reduces the risk of CMV transmission
  - leukoreduced may be an alternative
- Irradiated
  - prevents T lymphocyte proliferation; the primary cause of GVHD

Effects of Storage on Blood Components

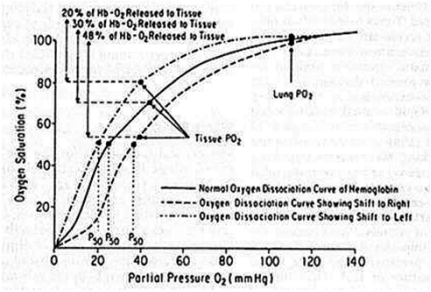
- ↓ 2,3 DPG levels
- ↓ATP
- ↑K+

	CPD		CPDA-1				AS-1	AS-3	AS-5
Variable	Whole Blood		WB	RBCs	WB	RBCs	RBCs	RBCs	RBCs
Days of Storage	0	21	0	0	35	35	42	42	42
pH (measured at 37C)	7.2	6.84	7.6	7.55	6.98	6.71	6.6	6.5	6.5
ATP (% of initial value)	100	86	100	100	56(+16)	45 (+12)	60	59	68.5
2,3 DPG (% of initial value)	100	44	100	100	<20	<10	<5	<10	<5
Plasma K+ (mmol/L)	3.9	21	4.2	5.1	27.3	78.5	50	46	45.6
Plasma hgb (mg/L)	17	191	82	78	461	658	NA	388	NA

Oxygen Dissociation Curve

- Based on affinities of tissues for oxygen
- Relationship between pO_2 and O_2 saturation of HGB
- pO_2 : oxygen pressure of tissues
- p50 : pO_2 level at which HGB is 50% saturated
- A normal p50 corresponds to ~25 pO_2
- ↑ p50 = right shift; more oxygen released
- ↓ p50 = left shift; less oxygen is released

Oxygen Dissociation Curve



SBB/BB Exam Review

Donor Testing, Transfusion Transmitted Disease Testing & Re-entry

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General Requirements

- ABO and Rh
- Antibody Screen
  - with history of transfusion or pregnancy
- ALT
  - not required by the FDA or AABB
  - plasma sales for further manufacturing

General Requirements (cont.)

- HBsAg
- Anti-HBc
- Anti-HCV
- HCV-RNA (NAT)
- Anti-HIV-1/2
- HIV-1 RNA (NAT)
- Anti-HTLV-I/II
- WNV RNA
- Syphilis
- Antibodies to *Trypanosoma cruzi* (tested once)
- Bacterial Detection (platelets)

Hepatitis B Infection

- Anti-HBs and Anti-HBc persist after recovery and indicate immunity
- HBsAg and Anti-HBc persist in chronic carriers while Anti-HBs is absent

Invalidation of Test Results

- Faulty equipment, improper procedure, compromised reagents ***and/or***
- Internal control results do not meet package insert acceptance criteria
  - all results, reactive and non-reactive, must be rejected
  - all specimens must be tested in a new run which becomes the test of record

Acceptable Test Results

- No error in test performance
- Internal batch controls are acceptable
  - remains test of record
  - reactive results must be retested in duplicate, per manufacturer's instructions

External Controls

- Purchased commercially
- Used for surveillance of test performance
- Tested the same as donor samples
- *Non-reactive test results can be invalidated based on the external controls but if all other manufacturer's guidelines were followed, external controls cannot be used to invalidate reactive test results*

Supplemental and Confirmatory Tests

- Neutralization: HBsAg and HIV-1Ag
- Western Blot: Anti-HIV
- RIBA: Anti-HCV
- Anti-HTLV confirmation

Re-entry Algorithm

Reentry of Donors with Repeatedly Reactive Screening Tests:

	Anti-HIV-1 or Anti-HIV-1/2	Anti-HIV-2	HIV-AG	HBsAG	Anti-HCV	*Reentry Status*
Initial Sample	WB+ or IND or IFA reactive	Different HIV-2 EIA repeat reactive (RR)	Confirmed by neutralization	Confirmend by neutralization or anti-HBc RR	RIBA Indeterminate or positive	Not eligible for reentry
	WB or IFA NR	Different HIV-2 EIA NR and WB or IFA NR	Not confirmed by neutralization	HBsAg specificity not confirmed by neutralization and anti-HBc NR	RIBA negative	Evaluate for reentry
Follow-up Sample	6-months later	6-months later	8-weeks later	8-weeks later	6-months later	
	EIA RR or WB+ or IND or IFA reactive	RR HIV-1 or different HIV-2 EIA RR or WB or IFA reactive or IND	HIV-1-Ag RR, neutralization confirmed or not confirmed	HBsAGg RR or anti-HBc RR	EIA RR or RIBA IND or +	Not eligible for reentry
	Original EIA method NR and whole virus lysate anti-HIV-1 EIA NR and licensed WB or IFA NR	Screening test and different HIV-2 EIA NR and WB or IFA NR	HIV-1Ag and annti HIV-2 EIA NR or HIV-1-Ag RR, not confirmed temporary deferral for additional 8 weeks)	HBsAg NR and anti-HBc NR	Licensed multiantigen EIA method NR and RIBA negative	Eligible for Reentry

HTLV Testing

- Indefinite deferral:
  - 2 or more reactive HTLV EIA screening assays
  - 1 reactive HTLV EIA screen and 1 reactive HTLV EIA by second manufacturer
- 8-week eligible:
  - 1 reactive HTLV EIA screen and negative screen by second manufacturer

HIV/HCV NAT re-entry

- No algorithm available from the FDA

SBB/BB Exam Review

Transfusion Practice

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Basics

- Components are used for:
  - Oxygen delivery
    - Red blood cells
  - Correct coagulopathies
    - plasma, platelets, and cryoprecipitate
  - Replace deficient coag factors
    - plasma and cryoprecipitate
  - Fight infections
    - Leukocytes

Whole Blood

- Used infrequently
- Increases both oxygen carrying capacity and plasma volume

Red Blood Cells

- Used for increasing oxygen carrying capacity
  - Leukocyte-reduced
  - Washed
  - Frozen, deglycerolized

Fresh Frozen Plasma

- Used to treat coagulation deficiencies

Cryoprecipitate

- Provides Factor VIII, fibrinogen, vWF, Factor XIII
- Small amounts can be used for “fibrin glue”

Cryo-poor Plasma

- Primarily used to treat TTP patients

Platelets

- Improve hemostasis
- Given when patient is bleeding, the platelet count is low, and/or the platelets are not working properly
- Do not give for TTP or ITP unless absolutely necessary

Granulocytes

- Used to fight infection
- Should be irradiated

References

- Technical Manual, current edition
- Blood Transfusion Therapy: A Physician's Handbook, 8th edition
- Practical Guide to Transfusion Medicine by Petrides and Stack
- Therapeutic Apheresis: A Physician's Handbook, 1st edition
- Transfusion Medicine Self Assessment and Review by Helekar, Blackall, Winters, Triulzi

Case Study #1

- Jack is rushed to the ER after falling down a hill. It appears that Jack has lost 1/3 of his blood volume. What is the component of choice for transfusion?
- Jack needs both oxygen carrying capacity and an increase in his blood volume therefore, transfuse with whole blood or RBCs and plasma.

Case Study #2

- Jack's has ruptured his spleen and he is immediately taken to surgery. The surgeon ordered apheresis platelets to be given. When should the platelets be administered?
- After the splenic artery is clamped.

Case Study #3

- Jill was recently diagnosed with TTP. Her physician has ordered a 3L therapeutic plasma exchange. What is the replacement fluid of choice?
- Cryo-poor plasma is the replacement fluid of choice but plasma is also acceptable.

Case Study #4

- Susie was admitted to the hospital with severe septicemia. She is not responding to antibiotics. What blood product may be useful in her treatment?
- Granulocytes if she is an adult.
- Buffy coat if she is a neonate or small child.

SBB/BB Exam Review

Genetics

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Mendel's Principles

- Random segregation
  - Distinct units (genes) inherited
  - one from each parent
  - random
- Independent assortment
  - Genes inherited independently if carried on different chromosomes
  - Combinations of genes are not dependent on other genes (Exception: linkage)

Definitions

- Dominant/Recessive
- Genotype/Phenotype
- Crossover
- Recombination
- Allele
- Locus
- Cis/Trans
- Homozygous/Heterozygous/Dosage

Genetic Symbols

- See Study Guide and current Technical Manual...

Types of Inheritance

- Autosomal Dominant
  - Trait appears in every generation; no "skipping"
  - Trait is transmitted by an affected person to half his children on the average
  - Unaffected persons do not transmit the trait to their children
  - Occurrence and transmission of the trait are not influenced by sex; equally likely in both males and females

Types of Inheritance

- Autosomal recessive
  - Trait appears in sibs, not in their parents or offspring
  - On the average, one-fourth of sibs of propositus are affected
  - Parents of the affected child may be consanguineous
  - Males and females equally likely to be affected

Types of Inheritance

- Sex-linked dominant
  - Affected males transmit the trait to all daughters and to no sons
  - Affected females (heterozygous) transmit to half of their children of either sex.
  - Homozygous females transmit to all their children
  - Distinguished from autosomal dominant only by offspring of affected males

Types of Inheritance

- Sex-linked recessive
  - Incidence of the trait is much higher in males than females
  - Trait passed from affected man through all daughters to half of sons
  - Trait is never transmitted directly from father to son
  - Trait may be transmitted through a series of female carriers

Types of Inheritance

- Y-linked
  - Resembles X-linked
  - Trait is transmitted only from father to son, never to daughter
  - All sons will be affected

Chromosome locations of blood groups

- Chromosome 1
  - Rh, Duffy, Scianna, Cromer. Knops
- Chromosome 9
  - ABO
- Chromosome 19
  - Lutheran, Lewis, LW, Hh

Population Genetics

- Hardy/Weinberg Equation
- Basic Formula: $(a + b)^2$
  - Two heterozygous parents: (Aa x Aa)
  - Offspring: 1 AA + 2 Aa + 1aa

	Mom Aa	
Dad Aa	AA	Aa
	Aa	aa

Hardy-Weinberg Equation

- Generalized equation:
  - $(p + q)^2 = p^2 + 2pq + q^2 = 1$
  - For 2 alleles: $p + q = 1$ or $q = 1 - p$
  - Expanded: $p^2 + 2p(1 - p) + (1 - p)^2 = 1$

Example

- Assume that in a given population 84% of the individuals are D positive and 16% are D negative (d):
  - p = gene frequency of D
  - q = gene frequency of d
  - Then:

Homozygous (DD) = p^2
Heterozygous (Dd) = 2pq } = 0.84

D negative (dd) = q^2 = 0.16

1.00

Example, cont.

- $q^2 = 0.16$, so q = square root of 0.16 = 0.4
- p + q = 1 and p = 1 - q = 1 - 0.4 = 0.6
  - p = 0.6
  - q = 0.4
- Therefore:
  - DD = p^2 = $(0.6)^2$ = 0.36
  - Dd = 2pq = (2)(0.6)(0.4) = 0.48
  - dd = q^2 = $(0.4)^2$ = 0.16

1.00

Three assumptions for Hardy-Weinberg equilibrium

- Individuals of each genotype must be as reproductively fit as individuals of any other genotype.
- Population must have large number of individuals.
- Random mating must occur.

Calculations

- Gene and phenotype frequencies are based on probability.
  - A number of individuals in any population are tested and the frequency of the trait is determined in that population.
  - It is assumed, based on probability, that the frequency of the trait in the population is equivalent to the frequency in the tested population.
- To determine the frequency of any two (or more) unrelated traits, simply multiply the frequencies of each trait.

Example:

- A patient has an anti-E and anti-K. How many units of ABO compatible RBCs must be tested to find three compatible units?
  - Approx. 30% of population E positive
    - (70% E negative)
  - Approx. 10% of population K positive
    - (90% K negative)
  - 0.7 X 0.9 = 0.63 (or 63% of population is negative for E and K)
- Therefore, approximately 3 out of 5 random units would be negative for K and E.

Caution!

- Beware of racial differences
  - (i.e. Duffy antigens in Black population).

Hardy-Weinberg Example 1
(2 allele system):

- Trait is autosomal dominant; occurs in 51% of the population. What is the gene frequency?
  - $p^2 + 2pq + q^2 = 1$; $p + q = 1$
  - p = GF of dominant trait
  - q = GF of recessive allele
  - $p^2 + 2pq = 0.51$; $q^2 = 0.49$
  - **q = 0.7**
  - **p =** 1 - 0.7 = **0.3**

Hardy-Weinberg Example 2
(2 allele blood group system):

- Population studies reveal that 27% type Jk^a negative. What are the gene frequencies of Jk^a and Jk^b in this population? What percentage are Jk(a+b+)?
  - $p^2 + 2pq + q^2 = 1$; $p + q = 1$
  - p = gene freq. of Jk^a; q = gene freq. of Jk^b
  - $q^2 = 0.27$; **q = 0.52 (Jk^b)**
  - **p = 0.48 (Jk^a)**
  - **2pq = 0.50 - Jk(a+b+)**

Hardy-Weinberg Example 3
(3 allele blood group system):

- 3 Genes: p + q + r = 1
- Phenotypes:
  - $p^2 + 2pq + q^2 + 2qr + r^2 + 2pr = 1$
  - Homozygous:
    - p^2 = AA; q^2 = BB; r^2 = OO
  - Heterozygous:
    - 2pq = AB; 2qr = BO; 2pr = AO

Hardy-Weinberg Example 3
(3 allele blood group system):

- Our population has:
  - 28% A (AA, AO)
  - 15% B (BB, BO)
  - 53% O (OO)
  - 4% AB (AB)

- O's: r^2; $r^2 = 0.53$; **r = 0.73**
- A's & O's: $p^2 + 2pr + r^2 = 0.81$
  $(p + r)^2 = 0.81$; $p + r = 0.90$
  $p = 0.90 - 0.73$; **p = 0.17**
- $p + q + r = 1$
  $q = 1 - (p+r)$; $q = 1 - 0.90$; **q = 0.10**

Hardy-Weinberg Example 3
(3 allele blood group system):

- G.F. (*A [p]*) = 0.17
- G.F. (*B [q]*) = 0.10
- G.F. (*O [r]*) = 0.73

- What is percentage of BO individuals in this population?
  $2qr = 2 (0.10)(0.73) = 0.146$ or **14.6%**

Another problem...

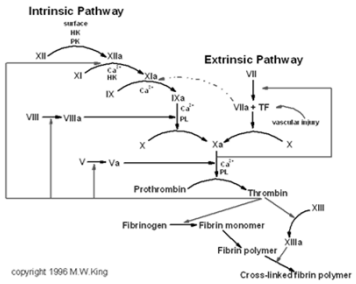
- A father's genotype is BO and the mother is OO? What is the probability that they will have 3 OO children in a row?
  Each time the probability is 50% (or 0.5).
  $0.5 \times 0.5 \times 0.5$ = **0.125 or 1/8**

SBB/BB Exam Review

Coagulation

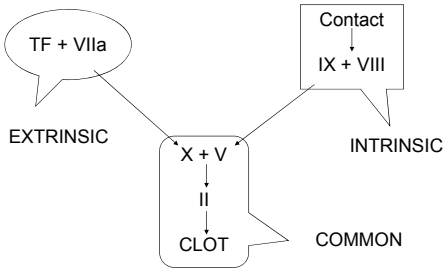
William Turcan, MT(ASCP)SBB
Brenda Barnes, MEd, MT(ASCP)SBB

Traditional Pathway



From http://web.indstate.edu/thcme/mwking/blood-coagulation.html#image. Accessed 7/6/05.

"The old pathways…"



The Players

- Most of the coagulation proteins are either enzymes (serine proteases) or cofactors

Enzymes	Cofactors	Miscellaneous
Factor IIa	Tissue factor	Fibrinogen
Factor VIIa	Factor V	Factor XIII
Factor IXa	Factor VIII	$Alpha_2$ antiplasmin
Factor Xa	Protein S	PAI-1
Protein C		Antithrombin
TPA		
Plasmin		

Enzymes

- Factors II, VII, IX, X, protein C and protein S
  - Vitamin-K dependent
    - Without vitamin K, dysfunctional proteins are produced
      - Bleeding can occur
  - **Warfarin blocks recycling of vitamin K**

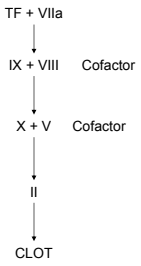
Cofactors

- Cofactors V and VIII
  - Similar molecules
  - Require activation by thrombin
  - Enhances efficiency of coagulation factors by at least 100,000-fold
  - Defects in both proteins result in common hemostatic problems

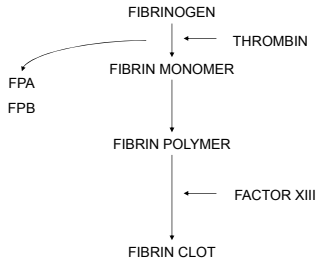
"Coagulation Factory"

- *Enzyme* binds a *cofactor* which is bonded by *calcium* to a *surface*
  - Enzyme – VIIa, IXa, Xa, IIa, protein C
  - Cofactor – V, VIII, tissue factor, protein S
    - Speeds up reactions by orders of magnitude
  - Calcium – binds protein to surfaces
  - Phospholipid surface
    - Negative charge
    - Brings proteins closer together

The "New" Model



Formation of Fibrin Clot



What about the other players?

- Contact system
  - XII, kallikrein (also HK, PK)
  - Plays a role in inflammation
  - Deficiencies do not cause bleeding
- XI
  - Deficiencies cause bleeding, especially after surgery
  - Role is still emerging….

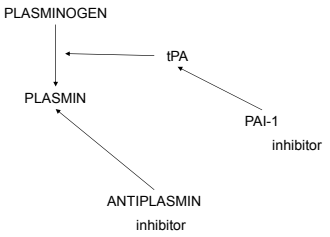
Thrombin (IIa)

- Multifunctional molecule
  - Cleaves **fibrinogen** into fibrin
  - Activates **Factors V and VIII**
  - Activates **Factor XIII**
  - Activates **Factor XI**
  - Activates **platelets**
  - Activates **thrombin activatable fibrinolysis inhibitor (TAFI)**
  - Activates **Fibrinolysis**
  - Activates **protein C**

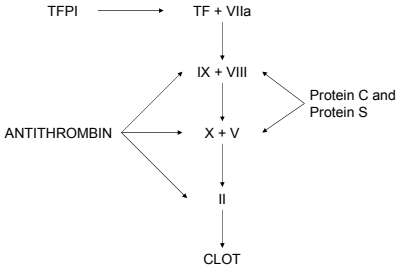
Fibrinolysis

- Breakdown of formed blood clots
  - Keeps thrombi from getting too large
  - Aids in wound healing
  - Prevents thrombosis in undesirable places
- Key proteins:
  - Plasminogen and Plasmin
  - Tissue Plasminogen Activator (tPA)
  - Urokinase (UK)
  - Inhibitors:
    - Plasminogen Activator Inhibitor (PAI-1)
    - $Alpha_2$ Antiplasmin

Fibrinolytic Pathway



Natural Anticoagulants



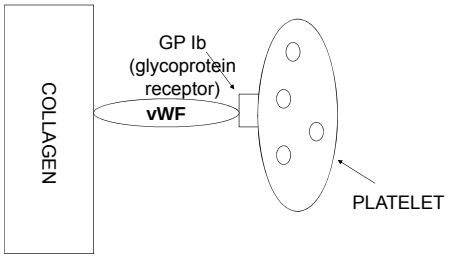
Platelets

- Produced in bone marrow
- Megakaryocyte – precursor
  - One megakaryocyte can produce 2,000 platelets
  - Platelets bud off edge
  - Megakaryocyte eventually perishes
- Platelet lifespan is 7-10 days
- Platelets circulate freely or are sequestered in spleen
  - 1/3 of platelets are usually located in spleen

Function of Platelets

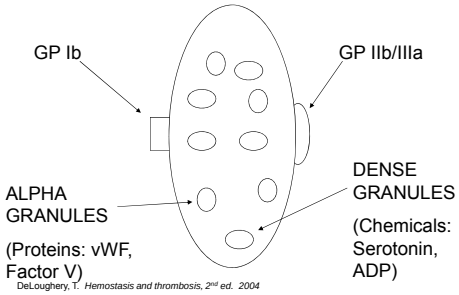
- **Adhesion** to damaged endothelium
- **Storage** of ADP and proteins
- **Aggregation** with other platelets
- Provide **surface** for coagulation reactions

Platelet Adhesion



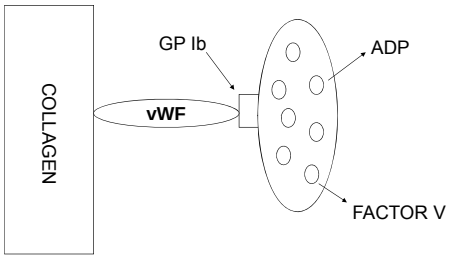
DeLoughery, T. *Hemostasis and thrombosis, 2nd ed. 2004*

Platelet Structure - Storage



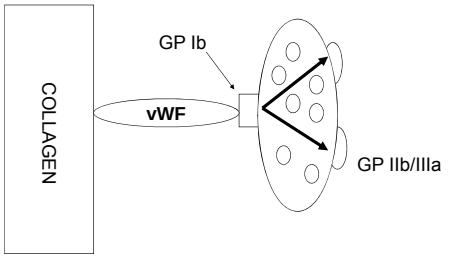
DeLoughery, T. *Hemostasis and thrombosis, 2nd ed. 2004*

Activated Platelet



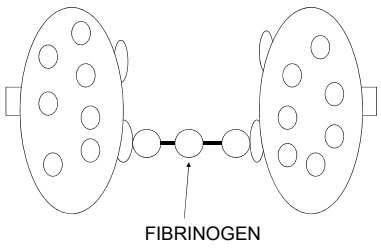
DeLoughery, T. *Hemostasis and thrombosis, 2nd ed. 2004*

GP IIb/IIIa Receptors



DeLoughery, T. *Hemostasis and thrombosis, 2nd ed. 2004*

Platelet Aggregation



DeLoughery, T. *Hemostasis and thrombosis, 2nd ed. 2004*

Prothrombin Time (PT)

- Measures time from formation of TF+VIIa complex to clot formation
  - Plasma + Calcium + Tissue Thromboplastin
- Major use is to monitor warfarin therapy
- Monitors Extrinsic pathway

Activated Partial Thromboplastin Time (aPTT)

- Activator is added to plasma
  - Plasma + Calcium + Kaolin + Phospholipids
- Measures speed of contact pathway
  - (XII, kallikrein, XI) → IXa+VIIIa → Xa+Va → IIa → CLOT
- Monitors Intrinsic pathway

International Normalized Ratio (INR)

- Method of standardizing PT times obtained at different labs
- Derived by dividing PT time by control value and raising it to the International Sensitivity Index (ISI)
  - ISI is known for each PT reagent
- Use of INR results in better patient monitoring

Coagulation Disorders

- Primary Hemostasis
  - Vascular
  - Platelets
- Secondary Hemostasis
  - Coagulation factors

Primary: Vascular

- Marfan's Syndrome
- Hereditary Hemorrhagic Telangiectasia
- Easy bruising/bleeding
- Painful

Primary: Platelets

- ITP
  - Idiopathic Thrombocytopenic Purpura
  - Immune complexes
  - IVIG
- TTP
  - Thrombotic Thrombocytopenic Purpura
  - Platelet/Fibrin microthrombi
  - Plasma exchange

Primary: Platelets

- Glanzmann's Thrombasthenia
  - GP IIb/IIIa abnormal
  - Aggregation test abnormal with: epinephrine, collagen, ADP (Normal with: ristocetin)
- Bernard-Soulier syndrome
  - GP Ib abnormal
  - Aggregation test normal with: epinephrine, collagen, ADP (Abnormal with: ristocetin)

Platelet or HLA antibodies

- Anti-HPA-1a
- Anti-HLA (Class I)

- Treat platelets with Chloroquine diphosphate
  - Denatures HLA (Bg) antigens

Aspirin Effect

- Inhibits platelet function by Acetylation of Platelet Cyclo-oxygenase
- Leads to decreased Thromboxane-A_2 formation
- Platelets can adhere to collagen and release granules, but cannot aggregate
- Cannot be used as a sole source of platelets, but can be used in a pool

Primary: vWD

- von Willebrand's Disease (many types)
- Type 1 treated with DDAVP
- All others treated with Factor VIII that contains vWF
- Humate-P

Secondary: Coagulation Factors

	PT Normal	**PT Abnormal**
APTT Normal	Factor XIII deficiency	Factor VII deficiency
APTT Abnormal	Factor VIII, IX, XI, XII deficiency Factor VIII inhibitor	Factor I, II, V, X deficiency

Hemophilia A

- Deficient or absent FVIII
- FVIII levels
  - <1: Severe
  - 1-5: Moderate
  - >5: Mild
- Treatment: Factor VIII concentrates
  - Recombinant: Safest
  - Virus inactivated, plasma derived

Inhibitors to FVIII

- Bethesda units
- <5 BU
  - Increased dose of FVIII
- >5 BU
  - Factor VIIa
  - Activated Prothrombin Complex Concentrates (FEIBA)
  - Porcine FVIII

Hemophilia B

- Factor IX deficiency
  - Recombinant Factor IX
  - Virus inactivated, Plasma derived Factor IX
- Patients with Inhibitors
  - Factor VIIa

DIC

- Disseminated Intravascular Coagulation
- Increased: PT, PTT, TT, FDP's, D-dimers
- Decreased: Platelets, Factor levels
- Treat underlying cause
- Maintain hemostatic function
  - RBC's, Plasma, Cryoprecipitate
  - Platelets (except in cases of severe thrombosis)

SBB/BB Exam Review

Transfusion Reactions

William Turcan, MT(ASCP)SBB
Monica LaSarre, MT(ASCP)SBB

Categories

- Acute (<24hrs) or Delayed (>24 hrs)
- Immunologic (Ag-Ab) or Non-immunologic
- Intravascular or Extravascular Hemolysis
- Table in Technical Manual
- Recognize signs and symptoms

Acute HTR - Immune

- ABO incompatible RBC's
- Patient misidentification most common cause of ABO incompatibility
- Occurs within minutes of start of infusion

Acute HTR

- IgM or complement-fixing IgG
- ABO, Vel, Kidd
- Fever, chills, hypotension, renal failure, DIC, excessive pain and/or bleeding at infusion site
- Interaction of Complement, Kinin and Coagulation systems

Acute HTR

- Treatment
  - Stop transfusion
  - Treat hypotension and promote adequate renal blood flow
  - Monitor for/support DIC
  - Medical management may be complicated and require aggressive interventions
- How could this have been prevented?

Transfusion Reactions

- Acute Non-immune Mediated Hemolysis
  - Heating, Freezing, IV solutions
- Transfusion-Associated Sepsis
  - Platelet testing
- Febrile Nonhemolytic Reactions
  - Common, but initial symptom is Fever

Transfusion Reactions

- Urticarial
  - Only reaction where the transfusion can be stopped and restarted
- ACE Inhibitor hypotension
  - Inhibited metabolism of Bradykinin
- Know causes, treatment, and prevention

Anaphylactic Reactions

- Occurs rapidly
- Causes
  - IgA deficiency, Anti-IgA
- Treatment
  - Epinephrine
- Prevention
  - IgA-deficient components
  - Washed RBCs and platelets
  - Autologous (Transfusing what product would have prevented this reaction?)

Transfusion-Related Acute Lung Injury (TRALI)

- Definition
  - Acute onset
    - During transfusion or within 6 hrs
  - Hypoxemia
  - Bilateral lung infiltrates
  - No circulatory overload (TACO)
- Risk factors
  - Donor with multiple pregnancies?

Transfusion-Related Acute Lung Injury (TRALI)

- Severity of distress is usually disproportionate to volume of blood infused
- Causes
  - Antibody to HLA or neutrophil antigen
  - Transfusion of cytokines
- Treatment and prevention
- Do not use donor for plasma-containing components

Other Acute Complications

- **Transfusion-Associated Circulatory Overload (TACO)**
  - Similar symptoms to TRALI
- Metabolic Reactions
  - Citrate toxicity
  - Hypothermia
  - Hyperkalemia
- Air embolism

Evaluation of Suspected Acute Transfusion Reaction

- Role of clinician
- Role of laboratory
- Comments about DAT
  - If transfused incompatible cells have been coated with antibody, but not destroyed, DAT will be positive (mixed field)
  - If RBCs have been rapidly destroyed, DAT may be negative
  - Non-immune hemolysis causes hemoglobinemia, but negative DAT

Delayed Immunologic: Alloimmunization

- Immune response to foreign antigens on RBC, or WBC and platelets (HLA)
- Weeks to months after transfusion
- Antibody may fall to undetectable levels (esp. Kidd)
- Anamnestic response (within hours to days)
- DAT will become positive first
  - May need to elute Ab off RBCs to identify
- Prior to antibody being detected in serum, crossmatch may be compatible

Delayed HTR

- Usually only causes delayed serologic reaction (no clinical symptoms) occasionally, may see hemolysis
- Most common antibodies – Kidd, Kell, Duffy, E, c, D
- If DHTR suspected, obtain sample & test for unexpected alloantibody on RBCs and in serum & compare with previous results

Transfusion-Associated Graft-vs-Host Disease (TA-GVHD)

- Rare, usually fatal - no effective treatment
- Donor lymphocytes engraft in the recipient, proliferate, and attack host tissue.
- Symptoms usually appear within 10-12 days of transfusion
- Usually see refractory pancytopenia with bleeding and infectious complications
- Patient risk factors
- Prevention – Irradiation
- First degree relatives: Homozygous HLA infused into Heterozygous HLA

Post-transfusion Purpura

- Abrupt onset of severe thrombocytopenia (<10,000/μL) following blood transfusion in a previously pregnant or transfused patient
- Most patient cases have platelets that lack the HPA-1a (PI^{A1}) antigen, and form an antibody directed to this antigen
- Antibody destroys HPA-1a positive donor platelets, but also the patient's own HPA-1a negative platelets (mechanism unknown)
- Random platelet transfusions are contraindicated

Iron Overload

- One red cell unit contains 200 mg iron
- Chronically transfused patients at risk
- Storage first in reticuloendothelial system, then parenchymal cells
- Iron deposits interfere with heart, liver, and endocrine glands
- Threshold for clinical damage: lifetime exposure to 50-100 units (maybe even as low as 25) of red cells in a non-bleeding person
- Treatment: Iron-chelating agents, "fresh" blood

Records of Transfusion Complications

- Interpretation of the evaluation shall be recorded in the patient's medical record
- Maintain records indefinitely
- Review of previous records
- Notification to collecting facility
- Fatalities – report to FDA

SBB/BB Exam Review

Hemolytic Disease of the Fetus and Newborn (HDFN)

William Turcan, MT(ASCP)SBB
Monica LaSarre, MT(ASCP)SBB

HDFN Prerequisites

- Mom lacks antigen (exposed through pregnancy or transfusion)
- Fetus possesses antigen; inherited from father
- Mom has formed an IgG antibody
  - Sensitization depends on:
    - Recognition of foreign antigen
    - Responder
    - Antigen is immunogenic
    - Amount of bleed
    - ABO compatibility

Antibodies and HDFN

- Is the antibody IgG?
- Is the antigen well developed at birth?

Bilirubin

- Fetal bilirubin is processed by maternal liver before birth
- Infant liver is immature at birth
  - Cannot conjugate amount of bilirubin that results from destruction of antibody-coated RBCs
- Unconjugated bilirubin is toxic to CNS
  - Kernicterus

HDFN Big Problems

- Newborn
  - Excess unconjugated bilirubin
  - Kernicterus
- Fetus
  - Severe anemia
  - Cardiac failure and generalized edema
  - Hydrops fetalis

Complications of HDFN

- Rising levels of unconjugated bilirubin biggest risk
  - Decision to perform exchange transfusion driven by bilirubin levels
- CNS damage caused by:
  - Prematurity
  - Acidosis
  - Hypoxia
  - Hypoalbuminemia

HDFN Categories

- Rh HDFN
  - Anti-D alone, or in combination with
  - Anti-C or anti-E
- "Other" HDFN
  - Other antigens in Rh system
    - Anti-c
  - Antigens in other systems
    - Anti-K
- ABO HDFN
  - Anti-A,B in group O woman

ABO vs. Rh HDFN

ABO-HDFN

- Most common
- Least severe
- Can affect 1st baby
- Weak-neg. DAT
- Occurs in "O" moms
- Slight rise in bilirubin (phototherapy)

Rh-HDFN

- Immune exposure (2nd child)
- Very strong + DAT
- May need exchange transfusion

HDFN

- Prenatal Testing
  - Patient history (Has this Ab caused problems before?)
  - Testing on mom (Antibody Titers)
  - Most probable phenotype of most probable father
  - Amniocentesis (Liley Graph)
- PUBS (Cordocentesis)
- Intrauterine transfusion (exchange)

HDFN

- Rh Immune Globulin
  - Indications
  - Antenatal (28 weeks or after invasive procedure)
  - Postpartum
  - Rosette test (semi-quantitative)
  - Kleihauer-Betke (acid-elution) Stain (quantitative)
    - Calculations & RhIG dosage
- Exchange transfusion
  - Indications, beneficial effects, component requirements, calculations, methods

Anti-G

- Reacts with cells that are D and/or C positive
- Patient can have a mixture of Anti-D, Anti-C and Anti-G
- If Anti-D is not present, RhIG is indicated

Test Tip #1

What blood type of FFP should be used for a plasma exchange in a patient that is O positive?

A. O
B. A
C. B
D. AB

Test Tip #1

What blood type of FFP should be used for a plasma exchange in a patient that is O positive?

A. O ***All answers are clinically correct***
B. A ***O is the BEST answer***
C. B
D. AB

Test Tip #2

Which of the following phenotypes would be found the least in the general population?

A. Fy(a-b-), Jk(a+b-)
B. E-c-K-
C. M+N-S-s+
D. H-

Test Tip #2

Which of the following phenotypes would be found the least in the general population?

A.Fy(a-b-), Jk(a+b-)
B.E-c-K-
C.M+N-S-s+
D.H- ***Read the question and all four choices BEFORE you attempt to answer***

Test Tip #3

- Anti-Fy^a will react the strongest with which of the following cells?

- A. Fy(a+b-), Kp(a+)
- B. Fy(a+b-), Js(a+)
- C. Fy(a+b+)
- D. Fy(a-b-)

Test Tip #3

- Anti-Fy^a will react the strongest with which of the following cells?

- A. Fy(a+b-), Kp(a+)
- B. Fy(a+b-), Js(a+)

Many times you can eliminate two answers quickly, but the remaining two answers are very close

Test Tip #3

- Anti-Fy^a will react the strongest with which of the following cells?

- **A. Fy(a+b-), Kp(a+)**

- White, Fy^{a}Fy^a Homozygous genotype

- B. Fy(a+b-), Js(a+)

- Black, Fy^{a}Fy Heterozygous genotype

Dedication

SBB/BB Exam Review

Lab Math Problems

LeeAnn Walker, MEd, MT(ASCP)SBB
Immucor, Inc.
Norcross, GA

Lab Math

- Refer to Study Guide for
  - Formulae
  - Helpful hints
  - Practice Problems
  - Answer discussions

Problem 2

- A unit of FFP contains 0.6 units/mL of Factor VIII in 250 mL. When the cryoprecipitate is made from this unit, it contains 10 units/mL in 12 mL. What is the Factor VIII yield as a percentage of the original Factor VIII?
  - (10 units/mL x 12 mL) / (0.6 units/mL x 250 mL)
  - 120 units / 150 units = 80%

Problem 3

- In a population of 6129 individuals, 1787 individuals reacted 3-4+ and 3039 individuals reacted 1+ with anti-Q. What is the percentage of individuals with the negative phenotype?
  - 4826 are Q+; 1303 are Q negative
  - 1303 / 6129= 21.2% are Q negative

Problem 6

- A severe hemophiliac is scheduled for surgery tomorrow. His physician wants to increase his Factor VIII level to 75% before the procedure. His hematocrit is 40% and his plasma volume is 3000 mL. How many bags of cryoprecipitate should be given?
  - [3000 mL x (0.75 - 0)] / 80 U/bag = 28 bags

Problem 10

- An acid elution stain on a post-partum specimen shows 2.5% fetal cells present in the maternal circulation. How many vials of RhIg must be given?
  - 2.5 x 50 = 125 mL WB FMH
  - 125 / 30 = 4.2 or 5 vials RhIg

Problem 11

- A male patient weighing 190 lbs. has lost an estimated 1900 mL of blood following an auto accident. What percentage of his total blood volume has been lost?
  - 190 lb / 2.2 lb/kg = 86.4 kg
  - 86.4 kg x 75 mL/kg = 6480 mL total blood volume
  - 1900 mL / 6480 mL = 29% of total blood volume

Problem 17

- Given the following information, determine the number of FTEs required for the workload:
  - Vacation/year: 3 weeks
  - Ave. sick leave/year: 5 days
  - Holidays/ year: 6 days
  - Continuing Education: 4 days
  - Productivity: 75%
  - Annual Workload: 800,000 units (minutes/year)

Problem 17, cont.

- # hours worked/year:
  - 46 weeks/year x 40 hours/week = 1840 hrs/year
- # productive minutes/year:
  - 1840 hours/year x 45 min/hour = 82800 min/year
- # FTEs
  - 800,000 units / 82,800 min/year = 9.66 FTE

More problems 1...

- A 70 kg man has a 40% hematocrit. What volume of plasma is needed for a one-volume plasma exchange?
  - 70 kg x 75 mL/kg = 5250 mL blood volume
  - 5250 mL x 0.60% = 3150 mL plasma

More problems 2...

- 500 donors must be antigen-typed using a rare antisera. Two drops of antisera are required for each test. If the antisera can be diluted 1:8, how much neat serum is needed for all testing?
  - 500 tests x 2 drops/test = 1000 drops
  - 1000 drops/8 = 125 drops

More problems 3...

- To protect the lab staff from HBV infection, it is recommended that the Hepatitis B vaccine be given to all employees. You have 20 techs who will need 3 injections each at $15 per injection. Which is more cost effective: testing all employees first ($10/test) to determine those who are already positive (5% rate) or vaccinating all employees?

More problems 3...

- 20 techs, 3 injections, $15 each
  - Cost of vaccination:
    20 techs x 3 shots/tech x $15/shot = $900
  - Cost of testing:
    20 techs x $10/test = $200
    5% positive = 1 tech
    - Total cost:
      19 x $45 = $855
      + cost of testing 200
      $1055

More problems 4...

- A patient with anti-c, anti-E, anti-K and anti-Fy^a requires 4 units of blood for surgery tomorrow. How many units would you need to screen to find these units?
  - cE neg = 0.19; K neg = 0.90; Fy^a neg = 0.35
    % negative for all = 6.0%
    6/100 = 4/x; x = 400/6
    Need to screen 67 units

More problems 5...

- WB donor has platelet count of 220,000 and donates 500 mL WB. The platelet concentrate prepared contains 8.5 x 10^{10} platelets. What is the platelet yield?
  - 220 x 10^3 plt/uL x 500 mL x 1000uL/mL = 1.1 x 10^{11} platelets
  - 0.85 x 10^{11} / 1.1 x 10^{11} = 77%

SBB/BB Exam Review

THE SBB EXAM

Resources
Preparation Guide
Testing Strategies

LeeAnn Walker, MEd, MT(ASCP)SBB
Immucor, Inc.
Norcross, GA

Resources

- Know current AABB Standards
  - If current edition recently implemented, know differences from previous edition
- Comprehensive study of Technical Manual: each chapter, each method section. Extra chapter references, suggested readings
- Blood Transfusion Therapy: A Physician's Handbook

Review Courses

- Carefully study AABB SBB/BB Exam Review Study Guide material and go beyond…
  - GWU SBB Review course
  - Last Chance Review
    - Each winter; cwong@giveblood.org; 713-791-6201
  - Some regional blood bank meetings
    - check web sites

Reference Lists

- SBB Exam Reference List
  - www.ascp.org
    - Reading List has links to purchase references
  - Check on internet sources, ie. Amazon
- Blood Banking Reference List
  - www.aabb.org/marketplace
  - Can search by keyword

Study Plan

- Consistent study and review time
  - Make an action plan and time line
    - What are your weak areas?
    - What you want to do to prepare?
    - Time requirements for each part of review
  - Stick to your plan!
  - Final review
    - organize time according to category % and weak subjects

Study Plan

- Make notecards, review questions, comparative charts
- Compile all lab math formulas, genetics equations
- Practice exams, problems, “brain dump”
  - More on that later…

Study Plan

- Compile all Blood Group information
  - genetics
  - biochemistry
  - antigen
  - antibodies
  - highlights, unique points
- Compile serological testing information
  - procedure
  - quality control
  - appropriate use
  - results

Study Plan

- Compile component information
  - collection & preparation
  - storage requirements
  - expiration dates
  - content
  - quality control
  - appropriate use

Getting in the Door

- Admission Letter
- 2 valid IDs
  - Name must match admission letter
- Palm vein image
  - To establish your account
- Say Cheese!
  - Picture
  - Audio/ video
- Testing center will provide:
  - White paper or white board.
  - Any required panel master lists.
- You may use a non-programmable calculator.
- No cell phones allowed!

Test Strategy: The "Brain Dump"

- Make study notes at the exam site before starting exam
- Write down all memorized facts
  - Blood group %s
  - Formulas
  - Techniques
  - Effects of chemical treatment
  - Etc…
- Can sometimes request more paper during exam

Taking the Exam

- Computer use and problems
- Read instructions before arriving at the test site
  - www.ascp.org
- 2.5 hours for 100 questions
  - Timing does not start until you click on the 'Start Exam' button
- 10 questions will not be graded.
  - New questions to be evaluated
- Must give best guess before next question will be given.

Exam Categories

- Blood Products
- Blood Group Systems
- Immunology
- Laboratory Operations
- Physiology/Pathophysiology
- Serology
- Transfusion Practice

Taxonomy Levels

- Level One
  - Recall - remember facts
- Level Two
  - Interpretive Skills - Use facts to interpret
- Level Three
  - Problem Solving - Use facts to interpret and resolve problems

Computer Adaptive Testing

- Exam Categories
  - Computer will give fixed number of questions from each category
  - Computer does not give more or less, regardless of performance
- Question Difficulty Rating:
  - Taxonomy Level
  - Amount of “SBB ability” needed to achieve the correct answer

Computer Adaptive Testing

- Fixed number of questions from each category
- Computer adapts exam to your performance
- Chooses each specific category question by difficulty
- Estimates your "SBB ability" and selects questions with matching difficulty

How does computer estimate "SBB ability"?

- Student answers "a few" questions
- Computer makes rough estimate of ability based on those answers
- Computer gives student a question equal to that ability

How does computer estimate "SBB ability"?

- Answers correctly, ability is boosted
  - Next question is chosen at higher difficulty
- Answers incorrectly: ability is maintained
  - Next question is chosen at same difficulty
  - Second and subsequent incorrect answers lower ability and question difficulty

In summary,

- Computer makes rough estimate of ability
- Each question answered boosts or lowers estimated ability
- With each question answered, estimate of ability becomes more statistically correct
- Passing score range is 400-999

Example

- Student answers ten questions
- Computer estimates ability at 450
- Computer chooses next question at a difficulty level of 450

Example, continued

- Student answers correctly
- Computer adjusts ability and chooses next question at a difficulty level of 460
- Student answers incorrectly
- Computer maintains ability and chooses next question at same difficulty level

How is the Exam Scored?

- The score is based on:
  - the combined level of difficulty of all 90 graded questions AND
  - total number correct answers
- The higher the difficulty of the test, the fewer questions need to be answered correctly to have a minimum passing score (400)

Considering "Tricking" the Computer?

- Could you answer all questions incorrectly, get a very easy test, then correctly answer questions in review phase?
  - If too many are answered incorrectly, exam becomes non-adaptive
  - So questions are at minimum difficulty and a very high number must be correct to pass

More Test Strategy

- Do the very best you can as you answer every question
  - this gives you a test with high difficulty
  - a difficult test requires fewer correct answers
- Answers corrected during review phase DO boost final score so mark questions for review if unsure

Reviewing

- At end, can review all questions or only marked questions
  - review all questions if more than 30 minutes
  - review marked questions if less than 30 minutes
- When reviewing questions
  - revise ONLY if you are positive of the correct answer
  - this assures you have answered each question to the best of your ability

If you do NOT pass the first time:

- DO NOT GIVE UP!!!
- Call ASCP for help formulating a study plan based on subtest scores.
- Don't Delay!
  - Register for the next exam period.
- Make an action plan for studying.
- You can take same exam by same eligibility route up to 5 times.

ASCP Contact

For FAQ, Test Content, Scoring, and Study Plans

Website

www.ascp.org

A word on Registering...

- Do NOT take exam during the last two weeks of the three month exam period
- Example:
  - If you are unsuccessful in the last two weeks of the first quarter, you can't take the test until fourth quarter
  - If you are unsuccessful earlier in the first quarter, you can re-register and take the test in the third quarter

GOOD LUCK!!!

You can do it…