Virginia Western Community College
MDL 227 Clinical Immunohematology/ Immunology II

Prerequisites

MDL 126 or equivalent

Course Description

Emphasizes ability to apply theories and procedures utilized in immunohematology for routine transfusion and donor services. Correlates theories with practical application in order to assess cellular and immune mechanisms in specific disease states.

The course is designed to continue instruction for MLT students in immunohematology after having completed the prerequisite course. Instruction will include review of immunology and genetics relating to blood bank, requirements for blood donation and component production, quality control, routine blood bank testing, equipment qualification, use and maintenance, pre-transfusion procedures, red cell antibody identification, transfusion practices and discussion of advanced blood bank theories and techniques. At completion the MLT students should be able to perform routine testing in a blood bank setting.

Semester Credits: 3 **Lecture Hours: 1** **Lab/Clinical/ Internship Hours: 6**

Required Materials

Textbook:

Required: Modern Blood Banking & Transfusion Practices, Seventh Edition, by Denise M. Harmening. F.A. Davis, 2019. ISBN:978-0-8036-2888-1
(prior edition is acceptable)

References: AABB Technical Manual, current edition; AABB publications (ie Circular of Information)

Course Outcomes

At the completion of this course, the student should be able to:

- Understand basic blood bank concepts, terms and procedures
- Understand quality assurance as related to blood bank reagents and equipment
- Demonstrate ability to perform routine blood bank tests from previous course -Clinical Immunohematology I (ABO/Rh, Weak D, Direct Antiglobulin Test, Tests for Red Blood Cell Phenotyping, Indirect Antiglobulin Test)
- Demonstrate blood bank skills to include blood bank tests for Antibody Detection, Antibody Identification, Crossmatch, Prenatal Antibody Titration, etc.
- Understand donor screening, collection of blood products, product storage requirements, appropriate product selection, means of transfusion and special handling requirements

- Discuss special blood products and understand when these would be needed.
- Perform calculations relating to blood bank processes to include: RhIg dosage, total blood volume, corrected platelet count increment (CCI)
- Recognize and troubleshoot unusual test results
- Be familiar with advanced testing concepts and techniques utilized in the blood bank or reference laboratory setting (i.e. adsorption, elution, chemical treatment, neutralization, inhibition)
- Discuss hemolytic disease of the fetus and newborn (HDFN) and understand what testing might be required to assist with diagnosis of HDFN
- Discuss autoimmune hemolytic anemias and understand what testing might be requested to assist with diagnosis.
- Discuss adverse effects of blood transfusion, transfusion safety, regulatory requirements and reporting for transfusion reactions and suspected transfusion –transmitted diseases.
- Explain the basics of the HLA System and relationship testing
- Discuss blood utilization management

Topic Outline

	Lecture Outline	Objectives:
	(If not covered in MDL126)	
Week 1	**Blood Collection** (Chapters 13 Donor Selection & Chapter 18 Apheresis) A. Donor selection and qualification – health history questions, physical exam B. Collection type- • Whole blood venipuncture • Apheresis – blood, platelet, plasma • Special Collections: Autologous, Homologous, and Directed C. Collection Processes and testing	• Identify the organizations that regulate or accredit the immunohematology laboratory. • List acceptable levels for the following tests in allogeneic and autologous donations: weight, temperature, hemoglobin, hematocrit. • Define leukapheresis, plateletpheresis, plasmapheresis, and erythropheresis. • Describe the procedure for whole blood donation. • State the acceptable interval of different types of donations. • Differentiate among mild, moderate, and severe reactions and state recommended treatments for each. • List the components which can be collected using apheresis technology. • List the tests required for allogeneic, autologous, and apheresis donation. • Discuss record keeping procedures for donors. • Define prion and these acronyms: HIV, HCV, HBV, HTLV, CJD, vCJD, WNV. • Discuss donor infectious disease testing, deferral, donor reentry protocol. • List some endemic countries for malaria. • State deferral criteria for Babesia, Zika, and Ebola.

Blood Components

(Chapter 15 Component Preparation)

A. Component Production
B. Blood Component Labeling
C. Product Requirements and QC
D. Product Storage and Distribution

- Discuss CFR and AABB Circular of Information in regards to component production, labeling, storage, indications and contraindications
- Identify the storage conditions and shelf life of blood products routinely encountered in the hospital blood bank.
- Discuss blood derivative products.

Week 1 **Review Basic Concepts / Blood Bank Tests from Clinical Immunohematology / Immunology I**

A. Laboratory Safety
B. Topics from MDL 126:
   - Quality
   - Blood Bank Testing Methodologies
   - ABO/ Rh Testing
   - DAT/ IAT
   - Blood Group Terminology

- See lab objectives
- Refer to MDL 126

QUIZ

Week 2-4 **Detection and Identification of Antibodies** (Chapter 10)

A. Low incidence antigens
B. High incidence antigens
C. Antibody Identification
   - Requirements to rule out specificities
   - Requirements to confirm antibody identification
   - Probability (P-value)
   - Positive DAT / AC

- Differentiate between the following antibodies: expected and unexpected, naturally occurring, passive, autoantibody and alloantibodies, warm and cold.
- Explain what factors make an antibody clinically significant
- Describe which patient populations require an antibody screen.
- Select appropriate cells to include in a screening cell set.
- Describe the impact of various enhancement media on antibody detection
- Compare and contrast antibody detection methods
- Interpret the results of an antibody screen
- Summarize the exclusion and inclusion methods
- Correlate knowledge of the serologic characteristics of commonly encountered antibodies with antibody identification panel findings.
- Identify the situations in which additional panel cells should be tested and select additional panel cells
- Describe antigen typing techniques
- Calculate the number of RBC units that must be antigen - tested to fulfill a physician's request for crossmatch

Review of Blood Group Systems - Characteristics of antigen/ antibody and special testing for antibody identification

(chapter 8 Blood Group Terminology and Common Blood Groups, and chapter 9 Uncommon Blood Groups)

A. Lewis /H/I Systems
B. Kell System
C. Kidd System
D. Duffy System
E. MNS System
F. P System
G. Other Blood Group Systems

- Refer to MDL 126

Week 4

Advanced Antibody Identification Techniques (chapter-10)

A. Adsorption/ Elution
B. Chemical Treatments
C. Inhibition
D. Titration

- Describe elution methods and give an example of when each would be used
- Explain the principles behind enzyme and neutralization techniques
- List antigens that are denatured by enzymes and antigens whose reactivity are enhanced with enzymes.
- Discuss principles of neutralization and inhibition testing.
- Explain titration procedure and how it is used to determine semiquantitative amounts of antibody

TEST

Weeks 5-9

Transfusion Practices

A. Pre-transfusion Testing (chapter 11)

- Describe appropriate methods for proper patient identification in sample collection
- Describe specimen and specimen labeling requirements
- Outline the procedure for testing donor units and patient specimens
- Describe the importance of coparing historical records with current records
- List criteria for appropriate selection of donor units
- Compare and contrast serologic and computer crossmatch procedures
- Explain compatibility tests and appropriate blood component selection in special circumstances
- Describe the required steps in blood component issuance and transfusion of patients

B. Transfusion Therapy (chapter 16)

- Describe the blood products that are currently available for therapeutic use
- List the indications for each blood product, including the appropriate volume of each product
- Select appropriate blood products for patients with specific disorders
- Explain the use and content of the AABB Circular of Information
- State the expected incremental increase of a patient's hematocrit level following transfusion of each unit of RBC and platelet count following transfusion of each unit of platelets
- List the required procedures for preparing each blood component for transfusion

- Identify the groups of recipients who are at highest risk of infection from transfusion of cytomegalovirus- positive RBCs or platelets
- Explain the role of irradiation in the prevention of transfusion associated graft-versus-host-disease (GVHD)
- State the purpose of the surgical blood order schedule
- List the main advantages and disadvantages of autologous transfusion
- Identify the most important factors to consider when emergency transfusion is indicated
- Define massive transfusion
- Specify the steps involved in the proper administration of blood

C. Adverse Effects of Blood Transfusion (Chapter 17)

- Compare the relative risks of adverse events due to transfusion
- Identify the major causes of transfusion-associated fatalities
- Outline the steps involved in the recognition and evaluation of a transfusion reaction
- Define hemovigilance
- List the types of acute transfusion reactions and delayed transfusion reactions
- Differentiate the clinical signs and symptoms of the various types of transfusion reactions
- Describe the various factors that influence the development of alloimmunization to RBC antigens
- List laboratory findings associated with acute transfusion reactions
- Describe the pathophysiology, signs, symptoms, therapy, prevention, and clinical work-up of transfusion reactions
- Discuss the factors that contribute to the pathophysiology of febrile nonhemolytic transfusion reactions
- Compare transfusion reactions in which respiratory problems are the main feature: transfusion-related acute lung injury, transfusion-associated circulatory overload, and transfusion=associated dyspnea
- Explain the importance of a patient's history in the relation to medications, transfusion history, and pregnancies
- List the logical steps and procedures to follow in a laboratory investigation of transfusion reactions
  Describe the appropriate reporting of transfusion reaction workups

D. Transfusion Transmitted Diseases (Chapter 14)

- Describe the pathology, epidemiology, laboratory findings, an prophylaxis/ treatment of the following diseases: hepatitis A through G, HIV 1 and 2, human T-cell lymphotropic viruses (HTLV) I and II, and West Nile virus (WNV)
- Explain the importance of the following diseases for blood transfusion; Epstein-Barr virus, cytomegalovirus (CMV), parvovirus B19, herpesvirus 6 and 8, general bacterial contamination, syphilis, Babesia microbi, Trpanosoma cruzi, malaria (Plasmodium species), and Ceutzfeldt-Jakob disease, and variant Creutzfeldt-Jakob disease

		• Describe procedures for look-back and recipient follow-up • Describe pathogen inactivation for plasma and cellular components
	E. Transfusion Safety and Regulatory Requirements (chapter 27)	• Describe why laws governing the regulation of biological products were enacted • Define a biological product manufacturer • Describe the regulatory process • List the requirements for being registered with the FDA • List the requirements for FDA licensure • Describe the FDA's inspection authority of biological product manufacturers • Distinguish between licensed and unlicensed manufacturers and between interstate and intrastate commerce • Describe the role of FDA current good manufacturing practice (CGMP) in biological product manufacturing
TEST		
Week 10	**Hemolytic Disease of the Fetus and Newborn (HDFN)** (chapter 20) A. Etiology B. ABO versus Rh HDFN C. Pathogenesis, Diagnosis and Management D. RhIG	• State the definition and characteristics of hemolytic disease of the fetus and newborn (HDFN) • Describe the role of the blood bank in the diagnosis and clinical management if HDFN • Compare and contrast ABO versus HDFN due to RBC alloimmunization in terms of: pathogenesis, incidence, blood type of mother and infant, severity of disease, laboratory data - anemia, DAT and bilirubin, prevention and treatment • Define Rh-immune globulin and describe its function. • Identify approach to dosing Rh-immune globulin. • List the test used for detecting fetomaternal hemorrhage • Outline the procedure for testing maternal and cord blood in cases of suspected HDFN and • Describe the RBC selection requirements for transfusion of newborns, and intrauterine or exchange transfusion
Week 11	**Autoimmune Hemolytic Anemias** (chapter 21) A. Autoantibodies B. Cold Reactive Autoantibodies C. Warm Autoantibodies D. Drug-Induced Immune Hemolytic Anemia	• Define autoantibody and compare the types of immune hemolytic anemias with respect to thermal amplitude, method of RBC destruction, and the type of immunoglobulin that characteristically coats the RBC • Characterize autoantibodies that react at temperatures below 37ºC and identify the common specificities of benign cold autoagglutinins • Describe problems encountered in the laboratory testing of specimens containing cold autoagglutinins • Explain techniques used to investigate serologic findings and detect underlying clinically significant alo-antibodies in the presence of clod autoantibodies • Describe pathological cold autoagglutinins, including laboratory testing and treatment • Differentiate between idiopathic warm autoimmune hemolytic anemia (WAIHA) and drug-induced immune hemolytic anemia

- Describe the clinical and laboratory findings in WAIHA, including indicators of RBC hemolysis, difficulties in serologic testing, and selection of blood for transfusion
- Explain procedures used to investigate serologic findings and detect underlying clinically significant alloantibodies in the presence of warm autoantibodies
- Compare the mechanisms for drug-induced hemolysis and give examples of medications causing each type
- Describe the Donath-Landsteiner test

TEST

Week 12

Patient Blood Management (Chapter 26)

- Describe the purpose and goals of a patient blood utilization management program (PBM)
- List and describe PBM goals
- Define TSO and identify key functions of the TSO in PBM
- Define transfusion guidelines, how these are established and their importance in PBM

Week 13-14

HLA System and Relationship Testing

A. The HLA System (Chapter 23)
B. Relationship Testing (Chapter 24) Overview

- Define the abbreviations HLA, MLR, SSO, SSP, SBT, TRALI, and MCH
- List characteristics of HLA genes
- Describe the current nomenclature for HLA genes
- Define the term haplotype
- Describe the difference between HLA phenotype and HLA genotype
- List the characteristics, importance, and clinical relevance of HLA class I and class II gene products
- Describe the characteristics of HLA antibodies
- Describe the techniques used for HLA genotyping
- Describe the techniques for HLA antibody detection
- Describe crossmatch technology to evaluate tissue compatibility
- Describe the role of HLA typing in paternity testing, disease association, platelet transfusion, TRALI, and transplantation
- State the goals of parentage testing
- List some testing technologies used

Week 15

Cellular Therapy in the Hematopoietic Transplant Setting (Chapter 17) (overview)

A. Hematopoietic Progenitor Cell (HPC) Collection
B. Processing HPC Products
C. Storage and Shipping
D. Clinical Uses

- List and define the categories of hematopoietic progenitor cell (HPC) donors
- Name a registry for HPC unrelated donors
- State the chance for an HLA match between siblings
- Describe the differences in health screening of cord blood donors compared with other HPC donors
- Name the antigen that defines HPCs
- Identify three diseases treated with HPC transplantation
- List five tests performed on all HPC products
- State the temperature for frozen storage of HPCs
- Identify the cryoprotectant generally use for HPCs
- Define graft-versus-host disease (GVHD)

Week 15	**Overview of Chapter 29 - Medicolegal and Ethical Aspects** (if time permits)	• Describe the legal and ethical parameters for providing blood collection and transfusion services • Describe the legal bases for liability for providing transfusion medicine services • List 2 reasons why patients mat sue for transfusion injury • Describe the steps that blood bank professionals can take to avoid or minimize litigation

Final Exam - Cumulative

Additional comments:

- **There will be chapter or lab announced and/ or unannounced quizzes**
- **The outline is tentative and subject to change**
- **Study guides/ questions are provided at the discretion of the instructor**
- **The final exam is cumulative and may include some questions from past quizzes and exams, as well as questions on new material**