MLT-2461: HEMATOLOGY

Cuyahoga Community College

Viewing: MLT-2461 : Hematology

Board of Trustees:
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Academic Term:
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Subject Code
MLT - Medical Laboratory Technology

Course Number:
2461

Title:
Hematology

Catalog Description:
An introduction to the theory, principles and procedures used in hematology and coagulation (hemostasis). Hematopoiesis, enumeration, differentiation and evaluation of blood formed elements and the basic process of coagulation are discussed. Manual and automated techniques are explained, demonstrated, and performed. Anemias, leukemias and other hematological disorders are studied, correlating test results with disease states. Problem solving skills are applied in related case studies and unknowns.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
MA-1020 Medical Terminology I and departmental approval.

Outcomes

Course Outcome(s):
Discuss the function of hematology and common hematological tests.

Essential Learning Outcome Mapping:
Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):
1. Name the common tests performed in hematology.
2. List the tests performed in a complete blood count (CBC).
3. Describe specimen types, collection requirements and specimen acceptability criteria for hematology and coagulation testing.
4. Explain the effects of anti-coagulants on specimens for hematology and coagulation testing.
5. Describe situations in which the Medical Laboratory Technician (MLT) would interact with a physician.
6. Discuss, review and practice safety protocol in hematology.

Course Outcome(s):
Review cell development, morphology and physiology.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Describe the structure and function of the cellular organelles.
2. Describe the composition and function of a cell membrane.
3. Review active transport, facilitated diffusion, osmosis and passive diffusion.
4. Indicate which cellular metabolites are clinically significant in hematology.
5. Explain the role of the spleen and RBC circulation.
6. Review cell and nuclear structure(s) including nuclear to cytoplasmic (N/C) ratios.

Course Outcome(s):

Discuss the role of the hematology laboratory in bone marrow studies.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. List indications for performing bone marrow studies.
2. Identify the sites for obtaining bone marrow samples.
3. Explain the use and difference between a core biopsy and bone marrow aspirate.
4. List and explain why special stains are performed on bone marrow specimens.
5. Describe how a bone marrow differential count is performed.
6. Describe how bone marrow cellularity and iron stores are estimated.
7. Define myeloid/erythroid (M/E) ratio.
8. List disorders that can be identified by bone marrow studies.

Course Outcome(s):

Correlate the results of basic hematology laboratory procedures with normal and abnormal disease states.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Using the World Health Organization (WHO) classification for neoplastic hematological diseases and clinical laboratory results, identify myelodysplastic syndromes (MDS) describing symptoms and causes as required by the instructor.
2. Using the WHO Classification for neoplastic hematological diseases and lymphoid malignancies, clinical laboratory data and special stains identify chronic myeloproliferative diseases (MPD), MDS, myelodysplastic/myeloproliferative diseases, acute myeloid leukemias and lymphoid malignancies as required by the instructor.
3. Discuss the etiology, morphology, symptoms and clinical laboratory findings for the following disorders: May-Hegglin Anomaly, Chediak-Higashi Syndrome, Infectious mononucleosis, Systemic Lupus Erythematosus (SLE), Waldenstrom's Macroglobulinemia, and Pelger-Huet Anomaly.
4. Identify an anemia, leukemia or other disorder using a case history and laboratory data.

Course Outcome(s):

Discuss hemostasis and coagulation testing.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Define hemostasis.
2. Explain primary and secondary hemostasis and fibrinolysis.
3. Discuss the coagulation factors (including synonyms) and their role in the coagulation cascade.
4. Diagram the stages of the intrinsic and extrinsic pathways.
5. Explain how and where each coagulation factor is formed.

6. Describe tests commonly performed to assess coagulation, and measure specific factors. PT (protime), aPTT(activated partial thromboplastin time), TT(thrombin time). Fibrinogen, FDP(Fibrin degradation products), D-dimer. Factor Assays, Antithrombin III. Circulating anticoagulants. Mixing studies. Anticoagulant therapy.
7. List normal ranges for the PT/International Normalized Ratio (INR) and Activated Partial Thromboplastin Time (aPTT).
8. Compare results of the coagulation tests and discuss disease correlation.
9. Discuss anti-coagulant therapy effect on coagulation tests.
10. Perform a coagulation test (PT, PTT) using instrumentation.
11. Discuss disease correlations using a case history and laboratory data.

Course Outcome(s):

Describe instrumentation that is commonly used in the hematology laboratory.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Explain rationale for selection of instrumentation.
2. Describe testing principles, components, calibration techniques, quality control (QC) and maintenance procedures.
3. Explain the use of reagents, blanks, controls and standards.
4. Describe whether instrumentation employs batch mode or random access.
5. Perform an automated complete blood count.

Course Outcome(s):

Review quality control procedures applicable to the hematology Laboratory.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Perform and record the results of routine quality control procedure as specified.
2. Evaluate instrumentation and or test data, recognizing problem(s), taking corrective action to ensure the reporting of accurate data.
3. Identify the source of pre-analytic, analytical and post-analytic error using a case history.
4. Explain the purpose of a laboratory inspection and proficiency survey programs.

Course Outcome(s):

Explain hematopoiesis.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Define hematopoiesis.
2. Name the blood forming organs and changes related to age.
3. Describe the formation of blood in the bone marrow and age related changes.
4. Identify each stage in the maturation of erythrocytes, leukocytes and thrombocytes based on cytological criteria.
5. Recognize blood cells normally found in the peripheral blood and the length of time they circulate in the peripheral blood.

Course Outcome(s):

Discuss erythrocyte morphology and hemoglobin.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Review red blood cell (RBC) maturation using both systems of nomenclature.
2. Discuss the function of RBCs in the body regarding iron, hemoglobin, O_2 and CO_2.
3. State the function of erythropoietin and the site of production.
4. Briefly explain the formation, function and catabolism of hemoglobin.

5. Define the significance of methemoglobin, carboxyhemoglobin, reduced hemoglobin, sulfhemoglobin, oxyhemoglobin and cyanmethemoglobin.
6. Describe diseases and list the tests for abnormal hemoglobin(s).
7. Perform a test for hemoglobin SS (homozygous form of sickle cell disease).
8. Define terms used to describe the morphology of RBCs indicating their clinical relevance.
9. Describe, recognize and indicated the clinical significance of immature RBCs in the peripheral blood
10. Identify inclusions found in RBCs and discuss their clinical significance.

Course Outcome(s):

Explain and perform common tests for the evaluation of erythrocytes.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Perform a microhematocrit procedure observing the buffy coat layer.
2. Describe a Neubauer hemocytometer and its application for a RBC count.
3. Define erythrocytosis and anemia.
4. State normal values for the ESR test and explain the significance of an abnormal ESR.
5. Perform an erythrocyte sedimentation rate correlating abnormal values with disease.
6. Define and state the clinical significance of Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) - RBC indices.
7. Explain variables affecting the indices, applying appropriate troubleshooting methods
8. Given hemoglobin, hematocrit and RBC count results, calculate red blood cell indices.

Course Outcome(s):

Discuss leukocyte/white blood cells (WBCs) morphology and function.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Review the maturation and life span of each cell line of WBCs.
2. Explain the function of neutrophils, monocytes, eosinophils, basophils, lymphocytes, and macrophages.
3. Describe and recognize normal and immature granulocytes, monocytes, and lymphocytes.
4. Discuss the composition and pH of the granules found in neutrophils, basophils and eosinophils.
5. Explain the relationship between a macrophage and a monocyte.
6. Name and locate primary and secondary lymphoid tissue.
7. Identify the anatomical sites populated by T lymphocytes (T cells) and B lymphocytes (B cells).
8. Discuss the appearance and function of T cells, B cells, and plasma cells.
9. Indicate the clinical significance of granules and vacuoles in plasma cells.
10. Explain the role of the spleen and WBC circulation.

Course Outcome(s):

Explain and perform procedures used to enumerate leukocytes.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Describe the principle, procedure, normal value, clinical significance and sources of error for WBC counts in men, women, newborns and one-year olds.
2. Describe a Neubauer hemocytometer and discuss its application for WBC counts.
3. Name the diluents used for WBC counts and their constituents.
4. Perform a manual WBC count using the a manual dilution system and a Neubauer hemocytometer.
5. Calculate a WBC count given dilution, number of squares, and number of cells counted.
6. Discuss the protocol for automated methods of WBC counts.
7. Define leukocytosis, granulocytosis, monocytosis, lymphocytosis, leukopenia, neutropenia, lymphocytopenia and causes for each condition.

Course Outcome(s):

Describe thrombocyte (platelet) maturation, enumeration and function.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Name each cell in the maturation process of a thrombocyte (platelet).
2. Discuss laboratory tests used to assess platelets function.
3. Describe the principle, procedure, normal value, clinical significance and sources of error for platelet counts.
4. Describe a Neubauer hemocytometer and discuss its application for platelet counts.
5. Describe the Unopette System for platelet counts.
6. Name the diluents used for platelet counts and their constituents.
7. Perform a manual platelet count using the Unopette System and a Neubauer hemocytometer.
8. State normal range for platelets.
9. Define thrombocytosis and thrombocytopenia discussing causes for each condition.

Course Outcome(s):

Discuss and perform evaluations of blood formed elements on stained preparation.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Name stains commonly used in morphological studies and the importance of pH and filtering on staining quality.
2. Define acidophilic, eosinophilic, azurophilic and basophilic.
3. Describe the criteria for making a good peripheral blood smear.
4. Define a differential count listing normal values for men, women, newborns and children.
5. Explain why adults and children have different normal values for the percentage of lymphocytes on peripheral smear.
6. Differentiate an absolute WBC count from a relative WBC count.
7. Describe how WBC and platelet estimations are performed.
8. Correlate WBC and platelet estimates with manual or automated counts
9. Make, stain and perform a differential count, RBC morphological evaluation and platelet estimation on a peripheral blood smear.
10. Recognize and identify abnormalities in stain quality, WBCs, RBCs and platelets.
11. Correlate abnormalities in formed elements identified on a stained smear with disease.
12. Define a reticulocyte and describe the stains used in its identification and enumeration including normal values.
13. Make, stain and perform a reticulocyte count correlating the count with RBC morphology if available.
14. Given a case history and laboratory data discuss disease and cause.

Methods of Evaluation:

1. Written exams
2. Written quizzes
3. Laboratory reports
4. Laboratory study questions
5. Term papers/oral reports
6. Participation
7. Homework
8. Individual lab project
9. Individual lecture project
10. Mid-Term Examination
11. Comprehensive written final exam
12. Comprehensive laboratory practical exam

Course Content Outline:

1. Function and common tests
    a. Common tests
    b. Complete blood count (CBC)

   c. Specimen types, collection and acceptability criteria
   d. Physician/MLT interaction
   e. Safety in Hematology
2. Cell development, morphology and physiology
   a. Cell and nuclear structures(s)
   b. Cellular organelles
   c. Cell membrane
   d. Osmosis and diffusion
   e. Cellular metabolites
   f. Spleen and RBCs
3. Hematopoiesis
   a. Definition
   b. Blood forming organs
   c. Bone marrow
   d. Maturation of cells
   e. Normal cells in peripheral circulation
4. Erythrocyte morphology and hemoglobin
   a. Nomenclature
   b. Function of RBCs
   c. Erythropoietin
   d. Hemoglobin
   e. Abnormal hemoglobins
   f. Tests for abnormal hemoglobins
   g. Sickle cell preparation
   h. RBC morphology
   i. Immature RBCs
   j. RBC inclusions
5. Common tests for the evaluation of erythrocytes
   a. Hemoglobin, hematocrit and RBC counts
   b. Microhematocrit procedure
   c. Neubauer hemocytometer
   d. RBC diluents
   e. Definition of erythrocytosis and anemia
   f. Westergren Erythrocyte Sedimentation Rate (ESR) test
   g. Normal ESR values
   h. Perform ESR
   i. RBC indices
   j. RBC indices calculations
6. Leukocyte/WBC morphology and function
   a. WBCs maturation and life span
   b. Function of WBCs and macrophages
   c. Normal and immature WBCs
   d. Granulocytic granules
   e. Macrophage and monocyte
   f. Lymphoid tissue
   g. Lymphocytic anatomical sites
   h. T cells, B cells and plasma cells
   i. Plasma cell granules and vacuoles
   j. Spleen and WBC circulation
7. Enumeration of leukocytes
   a. Principle of WBC counts
   b. Neubauer hemocytometer for WBC counts
   c. Systems for WBC counts
   d. Manual WBC
   e. Calculation of a WBC count
   f. Automated methods
   g. Terms and causes for increase or decrease in WBC lines
8. Thrombocyte (platelet) maturation, enumeration

a. Maturation of a thrombocyte (platelet)
b. Platelet function tests
c. Principle of platelet counts
d. Neubauer hemocytometer for platelet counts
e. System for platelet counts
f. Diluent used for platelet counts
g. Manual platelet count
h. Normal range for platelets
i. Definitions

9. Evaluation of blood formed elements on stained preparation
    a. Stains used in morphological studies
    b. Criteria of a good peripheral blood smear
    c. Color staining properties
    d. Normal values of a differential count
    e. Lymphocyte percentages
    f. Absolute and relative WBC counts
    g. Platelet estimations
    h. Estimates versus actual counts
    i. Evaluation of formed elements stained smear
    j. Abnormalities in stain quality, WBCs, RBCs and platelets
    k. Reticulocyte stains and normal values
    l. Reticulocyte count
    m. Case history
10. Bone marrow studies
    a. Indications for bone marrow studies
    b. Sample sites
    c. Core biopsy and aspirate
    d. Special stains
    e. Differential count
    f. Cellularity and iron stores estimates
    g. M/E ratio
    h. Disorders
11. Identification of myelodysplastic syndromes (MDS)
12. Identification of leukemias, lymphoid malignancies
13. Miscellaneous disorders
14. Case histories
15. Hemostasis and coagulation testing
    a. Definition of hemostasis
    b. Hemostasis and fibrinolysis
    c. Coagulation cascade
    d. Intrinsic and extrinsic pathways
    e. Formation of coagulation factors
    f. Coagulation tests
    g. Normal ranges of PT/INR and APTT
    h. Correlation of coagulation tests and disease
    i. Effects of anti-coagulation therapy
    j. Coagulation instrumentation
    k. Case history
16. Instrumentation
    a. Selection
    b. Procedure
    c. Reagents, blanks, controls and standards
    d. Sampling modes
    e. Automated CBC
17. Quality control
    a. Routine quality control procedures
    b. Problem recognition and corrective action

c. Pre-analytical, analytical and post analytical errors
d. Laboratory inspection and proficiency survey programs

Resources

Carr, Jacqueline and Rodak, Bernadette. *Clinical Hematology Atlas*. 6th ed. St. Louis: Saunders/Elsevier, 2017.

Ciesla, Betty. *Hematology In Practice*. 2nd ed. Philadelphia: F.A. Davis, 2012.

Turgeon, Mary. *Clinical Hematology*. 6th. Philadelphia: Wolters Kluwer Health , 2018.

Instructional Services

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Transfer Assurance Guide OHL009

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