

UNIT TERMINAL OBJECTIVE

5-9 At the completion of this unit, the paramedic student will be able to integrate the pathophysiological principles of the hematopoietic system to formulate a field impression and implement a treatment plan.

COGNITIVE OBJECTIVES

At the completion to this unit, the paramedic student will be able to:

- 5-9.1 Identify the anatomy of the hematopoietic system. (C-1)
- 5-9.2 Describe volume and volume-control related to the hematopoietic system. (C-1)
- 5-9.3 Identify and describe the blood-forming organs. (C-1)
- 5-9.4 Describe normal red blood cell (RBC) production, function and destruction. (C-1)
- 5-9.5 Explain the significance of the hematocrit with respect to red cell size and number. (C-1)
- 5-9.6 Explain the correlation of the RBC count, hematocrit and hemoglobin values. (C-1)
- 5-9.7 Define anemia. (C-1)
- 5-9.8 Describe normal white blood cell (WBC) production, function and destruction. (C-1)
- 5-9.9 Identify the characteristics of the inflammatory process. (C-1)
- 5-9.10 Identify the difference between cellular and humoral immunity. (C-1)
- 5-9.11 Identify alterations in immunologic response. (C-1)
- 5-9.12 Describe the number, normal function, types and life span of leukocytes. (C-1)
- 5-9.13 List the leukocyte disorders. (C-1)
- 5-9.14 Describe platelets with respect to normal function, life span and numbers. (C-1)
- 5-9.15 Describe the components of the hemostatic mechanism. (C-1)
- 5-9.16 Describe the function of coagulation factors, platelets and blood vessels necessary for normal coagulation. (C-1)
- 5-9.17 Describe the intrinsic and extrinsic clotting systems with respect to identification of factor deficiencies in each stage. (C-3)
- 5-9.18 Identify blood groups. (C-1)
- 5-9.19 Describe how acquired factor deficiencies may occur. (C-3)
- 5-9.20 Define fibrinolysis. (C-1)
- 5-9.21 Identify the components of physical assessment as they relate to the hematologic system. (C-1)
- 5-9.22 Describe the pathology and clinical manifestations and prognosis associated with: (C-3)
 - 1. Anemia
 - 2. Leukemia
 - 3. Lymphomas
 - 4. Polycythemia
 - 5. Disseminated intravascular coagulopathy
 - 6. Hemophilia
 - 7. Sickle cell disease
 - 8. Multiple myeloma
- 5-9.23 Integrate pathophysiological principles into the assessment of a patient with hematologic disease. (C-3)

AFFECTIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

- 5-9.24 Value the sense of urgency for initial assessment and

interventions for patients with hematologic crises.

PSYCHOMOTOR OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

5-9.25 Perform an assessment of the patient with hematologic disorder.
(P-1)

DECLARATIVE

- I. Introduction
 - A. Epidemiology
 - 1. Incidence
 - a. Prevalence of hematologic disorders
 - b. Supportive statistics
 - c. Prevalence of warning signs and symptoms
 - 2. Morbidity/ mortality
 - a. Reduced with early recognition
 - b. Reduced with early access to EMS system
 - 3. Risk factors
 - 4. Prevention strategies
 - B. Anatomy and physiology review
 - 1. Blood
 - a. Components
 - b. Color, specific gravity, pH
 - c. Function
 - d. Volume and volume control
 - 2. Plasma
 - a. Components
 - b. Color
 - c. Function
 - d. Volume control
 - 3. Blood-forming organs
 - a. Bone marrow
 - b. Liver
 - c. Spleen
 - 4. Normal red cell production, function and destruction
 - a. Erythrocytes
 - b. Hemoglobin
 - c. Production stimulus
 - d. Destruction
 - 5. Normal white cell production and function
 - 6. The inflammatory process
 - 7. Immunity
 - a. Cellular immunity
 - b. Humoral immunity
 - c. Autoimmune diseases
 - d. Alterations in immunologic response
 - 8. Blood groups
 - 9. Hemostasis
 - a. Vascular components

- b. Coagulation mechanisms
 - (1) Intrinsic and extrinsic pathways
- II. General pathophysiology, assessment and management
- A. Pathophysiology
 - B. Assessment of the hematopoietic system
 - 1. General signs and symptoms
 - 2. Specific signs and symptoms
 - a. Vital signs
 - b. Laboratory values
 - C. Focused history
 - 1. SAMPLE
 - 2. Chief complaint
 - 3. Pertinent past history
 - 4. Related signs and symptoms
 - D. Detailed physical examination
 - 1. Levels of consciousness
 - a. Vertigo
 - b. Fatigue
 - c. Syncopal episode(s)
 - 2. Skin
 - a. Prolonged bleeding
 - b. Bruising
 - c. Itching
 - d. Pallor
 - e. Jaundice
 - 3. Visual disturbances
 - 4. Gastrointestinal
 - a. Epistaxis
 - b. Bleeding gums
 - c. Infections of the gums
 - d. Ulcerations
 - e. Melena
 - f. Liver disease
 - g. Pain
 - 5. Skeletal
 - a. Arthralgia
 - b. Nuchal rigidity
 - 6. Cardiorespiratory
 - a. Dyspnea
 - b. Chest pain
 - c. Hemoptysis
 - d. Tachycardia

7. Genitourinary
 - a. Hematuria
 - b. Menorrhagia
 - c. Infections
- E. Management
 1. Airway and ventilation
 - a. Oxygen
 2. Circulation
 - a. Fluid volume replacement
 - b. Manage dysrhythmias
 3. Pharmacological
 - a. Oxygen
 - b. Platelet aggregate inhibitor
 - c. Alkalinizing agents
 - d. Narcotic/ analgesic
 - e. Diuretic
 4. Non-pharmacological
 5. Transport considerations
 - a. Appropriate mode
 - b. Appropriate facility
 6. Psychological/ communication strategies

III. Specific illnesses/ injuries

- A. Anemia
 1. Epidemiology
 - a. Reduction below normal levels of hemoglobin or erythrocytes and is a symptom of an underlying disease process
 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Can be self-limiting disease
 - (2) Must be confirmed by laboratory diagnosis
 - b. Precipitating causes
 - (1) Blood loss (acute or chronic)
 - (2) Decreased production of erythrocytes
 - (3) Increased destruction of erythrocytes
 - c. Hemolytic
 - (1) Hereditary
 - (a) Sickle cell
 - (b) Thalassemia
 - (c) Glucose-6-phosphate dehydrogenase deficiency
 - (2) Acquired

- (a) Immune
 - (b) Drug
- 3. Initial assessment findings
 - a. Airway/ breathing
 - (1) Labored breathing may or may not be present
 - b. Circulation
 - (1) Peripheral pulses
 - (a) Quality
 - (b) Rhythm
 - (2) Changes in skin
 - (a) Color
 - (b) Temperature
 - (c) Moisture
- 4. Focused history
 - a. Complaints
 - (1) Complaints secondary to anemia
 - (a) Fatigue
 - (b) Lethargy
 - (c) Hypoxia
 - (d) Dyspnea
 - (2) Complaints secondary to leukopenia
 - (a) Infections
 - (b) Fevers
 - (3) Complaints secondary to thrombocytopenia
 - (a) Cutaneous bleeding
 - (b) Bleeding from mucous membranes
- 5. Detailed physical exam
 - a. Airway
 - b. Breathing
 - c. Circulation
 - (1) Alterations in heart rate and rhythm may occur
 - (2) Peripheral pulses
 - (3) Blood pressure
 - (4) ECG findings
 - (a) Arrhythmias and ectopy
- 6. Management
 - a. Airway and ventilation
 - b. Circulatory support
 - c. Pharmacological
 - (1) Analgesics
 - (2) Fluid volume replacement
 - (3) Control of bleeding

- d. Non-pharmacological
 - (1) Position of comfort
 - e. Transport considerations
 - (1) Appropriate mode
 - (a) Indications for rapid transport
 - i) Significant changes in LOC
 - ii) Hypotension/ hypoperfusion
 - (2) Appropriate facility
 - f. Support and communication strategies
 - (1) Explanation for patient, family, significant others
 - (2) Communications and transfer of data to the physician
- B. Leukemia
- 1. Epidemiology
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Blood loss
 - (2) Death
 - b. Neoplastic disease
 - (1) Acute versus chronic
 - c. Precipitating causes
 - (1) Radiation exposure
 - (2) Viral infections
 - (3) Chemicals
 - (4) Immune defects
 - (5) Chromosomal changes
 - 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - (1) Labored breathing may or may not be present
 - c. Circulation
 - (1) Peripheral pulses
 - (a) Quality
 - (b) Tachycardia
 - (2) Changes in skin
 - (a) Color
 - (b) Temperature
 - (c) Moisture
 - 4. Focused history
 - a. Complaints
 - (1) Fatigue, bone pain, diaphoresis
 - (2) Elevated body temperature

- (3) Sternal tenderness
 - (4) Heat intolerance
 - (5) Abdominal fullness
 - (6) Bleeding
 - b. Contributing history
 - (1) Recurrent bleeding
 - (2) Increasing frequency and/ or duration
 - 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - c. Circulation
 - (1) Skin
 - (2) Blood pressure may low
 - (3) ECG findings
 - (a) Tachycardia
 - (b) Ectopic
 - 6. Management
 - a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Increase or decrease heart rate
 - (3) Fluid volume replacement
 - c. Electrical
 - (1) Constant ECG monitoring
 - d. Transport
 - (1) Criteria for rapid transport
 - (a) No relief with medications
 - i) Hypotension/ hypoperfusion
 - ii) Significant changes in ECG
 - (2) Indications for no transport
 - (a) Refusal
 - (b) Referral
 - e. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- C. Lymphomas
 - 1. Epidemiology
 - a. Hyperplasia of the lymphoreticular system
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Blood loss

- (2) Pain
- (3) Death
- 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - c. Circulation
- 4. Focused history
 - a. Complaints
 - (1) Fever
 - (2) Night sweats
 - (3) Generalized pruritus
 - (4) Anorexia
 - (5) Weight loss
 - (6) Fatigue, bone pain, diaphoresis
- 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - (1) May be clear to auscultation
 - (2) Congestion in bases may be present
 - c. Circulation
 - (1) Skin
 - (a) Pallor during the episode
 - (b) Temperature may vary
 - (c) Diaphoresis is usually present
 - (2) Blood pressure may low
 - (3) ECG findings
 - (a) Tachycardia
 - (b) Ectopic
- 6. Management
 - a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Increase or decrease heart rate
 - (3) Fluid volume replacement
 - c. Electrical
 - (1) Constant ECG monitoring
 - d. Transport
 - (1) Criteria for rapid transport
 - (a) No relief with medications
 - i) Hypotension/ hypoperfusion
 - ii) Significant changes in ECG
 - (2) Indications for no transport
 - (a) Refusal

- (b) Referral
 - e. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- D. Polycythemia
 - 1. Epidemiology
 - a. Overabundant production of red blood cells, white blood cells and platelets
 - b. Rare disorder seen in persons over 50 years of age
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Thrombosis
 - (2) Death from thrombosis
 - 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - (1) Labored breathing is common
 - c. Circulation
 - (1) Peripheral pulses
 - (a) Quality
 - (b) Tachycardia
 - (2) Changes in skin
 - (a) Color - red-purple complexion
 - (b) Red hands and feet
 - (c) Pruritic
 - 4. Focused history
 - a. Complaints
 - (1) Dyspnea
 - (2) Generalized pruritus
 - 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - c. Circulation
 - (1) Skin
 - (a) As above
 - (b) Temperature may vary
 - (2) ECG findings
 - (a) Tachycardia
 - 6. Management
 - a. Position of comfort
 - b. Pharmacological

- (1) Analgesia
- (2) Increase or decrease heart rate
- c. Non-pharmacological
 - (1) Phlebotomy
- d. Transport for
 - (1) Indications for no transport
 - (a) Refusal
 - (b) Referral
- e. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- E. Disseminated intravascular coagulopathy
 - 1. Epidemiology
 - a. A complication of severe injury, trauma or disease; acute bleeding disorder resulting from defibrination
 - b. First phase characterized by free thrombin in the blood, fibrin deposits and aggregation of platelets
 - c. Phase two is hemorrhage caused by depletion of clotting factors
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Uncontrolled bleeding
 - (2) Shock
 - (3) Death
 - 3. Initial assessment findings
 - a. Level of consciousness
 - b. Airway/ breathing
 - (1) Labored breathing is common
 - c. Circulation
 - (1) Peripheral pulses
 - (a) Weak and thready
 - (2) Tachycardia
 - d. Changes in skin
 - (1) Pallor
 - (2) Purpura over chest and abdomen
 - (3) Cool, clammy
 - (4) Bleeding
 - (5) Hypotension/ hypoperfusion
 - 4. Focused history

- a. Complaints
 - (1) Dyspnea
 - (2) Bleeding
 - 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - (1) May be clear to auscultation
 - (2) Congestion in bases may be present
 - c. Circulation
 - (1) Skin
 - (a) As above
 - (b) Temperature may vary
 - (2) ECG findings
 - (a) Tachycardia
 - (b) Ectopic
 - 6. Management
 - a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Increase or decrease heart rate
 - (3) Fluid volume replacement
 - c. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- F. Hemophilia
- 1. Epidemiology
 - a. A hereditary disorder transmitted by the female to the male
 - b. In true hemophilia A factor VIII is nearly absent
 - c. In hemophilia B there is a deficiency in factor IX
 - d. The ability to produce thrombin is severely impaired by deficiency or absence of these factors
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Uncontrolled bleeding
 - (2) Shock
 - (3) Death
 - 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - (1) Labored breathing is common
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- c. Circulation
 - (1) Peripheral pulses
 - (a) Weak and thready
 - (2) Tachycardia
 - d. Changes in skin
 - (1) Pallor
 - (2) Cool, clammy
 - (3) Bleeding
 - (a) From body orifices
 - (b) Knees
 - (c) Wrists
 - (d) Elbows
 - (e) Hematuria
 - (f) Epistaxis
 - (g) Hemoptysis
 - (h) Hematemesis
 - (i) Melena
 - (4) Hypotension/ hypoperfusion
4. Focused history
- a. Complaints
 - (1) Dyspnea
 - (2) Bleeding
5. Detailed physical exam
- a. Airway
 - b. Breath sounds
 - (1) May be clear to auscultation
 - (2) Congestion in bases may be present
 - c. Circulation
 - (1) ECG findings
 - (2) Tachycardia
 - (3) Ectopy
 - d. Skin
 - (1) As above
 - (2) Temperature may vary
6. Management
- a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Fluid volume replacement
 - c. Transport for reperfusion
 - (1) Indications for no transport
 - (a) Refusal
 - d. Support and communication strategies

- (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- G. Sickle cell disease
- 1. Epidemiology
 - a. Highest incidence in blacks, Puerto Ricans and persons of Spanish, French, Italian, Greek and Turkish origin
 - 2. Pathophysiology
 - a. A congenital hemolytic anemia
 - b. A chemical defect within the hemoglobin of red blood cells
 - c. Morbidity/ mortality
 - (1) Sepsis
 - (2) Shock
 - (3) Death
 - 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - c. Circulation
 - (1) Peripheral pulses
 - (2) Changes in skin
 - (a) Pallor
 - (b) Cool; clammy
 - (3) Hypotension/ hypoperfusion
 - 4. Focused history
 - a. Chief complaint
 - (1) Sudden onset develops into a condition called "crisis"
 - (a) Thrombotic crisis (painful)
 - (b) Aplastic
 - (c) Hemolytic
 - 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - c. Circulation
 - (1) Skin
 - (a) As above
 - (b) Temperature may vary
 - (2) ECG findings
 - (a) Tachycardia
 - (b) Ectopy

- d. Increased weakness
- e. Aching
- f. Chest pain
- g. Sudden, severe abdominal pain
- h. Bony deformities
- i. Icteric sclera
- j. Abdominal pain
- k. Fever
- l. Arthralgia
- 6. Management
 - a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Fluid volume replacement
 - c. Transport for reperfusion
 - (1) Indications for no transport
 - (a) Refusal
 - d. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician
- H. Multiple myeloma
 - 1. Epidemiology
 - a. A plasma cell dyscrasia characterized by neoplastic cells that infiltrate bone marrow
 - b. Eventually plasma cells become malignant leading to tumor formation within the bone
 - 2. Pathophysiology
 - a. Morbidity/ mortality
 - (1) Fractures
 - (2) Bleeding
 - (3) Shock
 - (4) Death
 - 3. Initial assessment findings
 - a. Levels of consciousness
 - b. Airway/ breathing
 - (1) Labored breathing is common
 - c. Circulation
 - (1) Peripheral pulses
 - (a) Weak and thready
 - (b) Tachycardia
 - (2) Changes in skin

- (a) Pallor
 - (b) Cool, clammy
 - (3) Bleeding
 - (4) Hypotension/ hypoperfusion
- 4. Focused history
 - a. Complaints
 - (1) Weakness
 - (2) Skeletal pain
 - (3) Hemorrhage
 - (4) Hematuria
 - (5) Lethargy
 - (6) Weight loss
 - (7) Frequent fractures
- 5. Detailed physical exam
 - a. Airway
 - b. Breath sounds
 - c. Circulation
 - (1) Skin
 - (a) As above
 - (b) Temperature may vary
 - (2) ECG findings
 - (a) Tachycardia
 - (b) Ectopy
 - d. Increased weakness
 - e. Aching
 - f. Chest pain
 - g. Sudden severe abdominal pain
 - h. Bony deformities
 - i. Arthralgia
- 6. Management
 - a. Position of comfort
 - b. Pharmacological
 - (1) Analgesia
 - (2) Fluid volume replacement
 - c. Transport for reperfusion
 - (1) Indications for no transport
 - (a) Refusal
 - d. Support and communication strategies
 - (a) Explanation for patient, family, significant others
 - (b) Communications and transfer of data to the physician

IV. Integration

- A. Apply pathophysiological principles and the assessment findings to a patient with a hematologic disorder
- B. Formulation of field impression - decisions based on
 - 1. Initial assessment
 - 2. Focused history
 - 3. Detailed physical examination
- C. Develop and execute a patient management plan based on field impression
 - 1. Initial management
 - a. Airway support
 - b. Ventilation support
 - c. Circulation support
 - d. Non-pharmacological
 - e. Pharmacological
 - 2. On-going assessment
 - 3. Transport criteria
 - a. Appropriate mode
 - b. Appropriate facility
 - 4. Non-transport criteria
 - 5. Advocacy
 - 6. Communications
 - 7. Prevention
 - 8. Documentation
 - 9. Quality assurance