The River of Life

Blood

Chapter 17
Overview: Blood Composition and Function

- Describe the composition and physical characteristics of whole blood. Explain why it is classified as a connective tissue.

- List and describe eight functions of blood.
Blood

- The body’s only fluid tissue
- Has both cellular and liquid components
- Highly specialized connective tissue composed of formed elements suspended in fluid matrix called plasma
Components of Blood

❖ Formed Elements
  ❖ Erythrocytes (hematocrit): 45% of whole blood
  ❖ Leukocytes and platelets: <1% of whole blood
❖ Plasma 55% of whole blood
Functions

❖ Distribution
  ❖ Oxygen, CO2, nutrients, wastes, hormones

❖ Regulation
  ❖ temp, pH, fluid volume

❖ Protection
  ❖ clot formation, antibodies, WBC’s
Blood Plasma

- 90% Water
- contains >100 dissolved solutes (nutrients, gases, hormones, wastes, proteins, inorganic ions)
- Albumin comprises 60% of plasma proteins
- Albumin maintains plasma osmotic pressure
Check Your Understanding

❖ What is the Hematocrit? What is its normal value?
❖ List two protective functions of blood
❖ Are plasma proteins used as fuel for body cells? Explain your answer.
Formed Elements

- Erythrocytes, leukocytes, and platelets
- 2 of 3 are not true cells
- Most formed elements survive in the blood for only a few days
- Most blood cells do not divide
Erythrocytes

- Describe the structure, function, and production of erythrocytes
- Describe the chemical composition of hemoglobin
- Give examples of disorders caused by abnormalities of erythrocytes
Structural Characteristics of Erythrocytes

- Biconcave discs = large surface area and easy access to cytoplasm
- Anucleate, no organelles
- Highly deformable
- 97% Hemoglobin (Hb)
- Generate ATP anaerobically
Functions of Erythrocytes

- Gas Transport!
- Hemoglobin
  - oxyhemoglobin
  - deoxyhemoglobin
  - carbaminohemoglobin
Production of Blood Cells

- Hematopoiesis
- Occurs in red marrow (100 billion blood cells/day)
- All blood Cells arise from hematopoietic stem cell
Production of Erythrocytes

- Stages of Erythropoiesis

- 15 day process

- Reticulocytes account for 1-2% of erythrocytes in healthy people
Regulations and Requirements for Erythropoiesis

- 2 million erythrocytes produced per second
- Process controlled hormonally
Fate and Destruction of Erythrocytes

- figure 17.17
Erythrocyte Disorders

- Anemia
  - blood loss
  - not enough cells produced
  - too many cells destroyed
    - thalassemias
    - sickle cell anemia
- Polycythemia
  - polycythemia vera
  - blood doping
Check Your Understanding

- How many molecules of oxygen can each hemoglobin molecule transport? Which part of the hemoglobin molecule binds the oxygen?
Leukocytes (WBC’s)

❖ Goals
❖ List the classes, structural characteristics, and functions of leukocytes.
❖ Describe how leukocytes are produced
❖ Give examples of leukocyte disorders, and explain what goes wrong in each disorder
General Structural and Functional Characteristics

- WBC count over 11,000 = leukocytosis
- 2 major categories:
  - Granulocytes
  - Agranulocytes
Granulocytes

- Neutrophils (50-70% of WBC’s)
  - Bacteria slayers (phagocytize, respiratory burst, spears)
- Eosinophils (2-4% of WBC’s)
  - Primarily attack parasitic worms
- Basophils (.5-1% of WBC’s)
  - Mediate inflammatory response (release histamine)
Agranulocytes

- Lymphocytes (25% of WBC’s)
  - very rare in blood
- Monocytes (3-8% of WBC’s)
  - differentiate into macrophages once they leave the blood
  - macrophages highly phagocytic
Leukocyte Disorders

- Leukemias
- Infectious Mononucleosis
Platelets

- Fragments of extraordinary large cells (megakaryocytes)
- Essential for the clotting process
- Thrombopoietin
Hemostasis

- Step 1: Vascular Spasm
- Step 2: Platelet Plug Formation
- Step 3: Coagulation
Transfusion and Blood Replacement

- Goals
  - Describe the ABO and Rh blood groups. Explain the basis of transfusion reactions
  - Describe fluids used to replace blood volume and the circumstances for their use.
Human Blood Groups

- RBC plasma membranes bear highly specific glycoproteins on their external face (antigen)
- Agglutinogens
- 30 groups of antigens, but ABO and Rh are most important
ABO Blood Groups

- Based on the presence or absence of two agglutinogens
  - Type A, Type B
- Agglutinins
  - Type O blood contains anti-a and anti-b agglutinins
  - Type A blood contains anti-b agglutins, and vice versa
  - Type AB blood contains neither agglutinin (antibodies)
Rh Blood Groups

- 52 named Rh Agglutinogens, each called an Rh factor
- Only 3 are common: C, D, and E
- Blood types are labeled as either Rh+ or Rh-
- ABO and Rh reported together. O-, AB+, etc
Blood Groups

TYPE A
- RBC
- Surface antigen A
- Anti-B antibodies

TYPE B
- Surface antigen B
- Anti-A antibodies

TYPE AB
- Surface antigens A and B
- Neither anti-A nor anti-B antibodies

TYPE O
- Neither A nor B surface antigens
- Anti-A and anti-B antibodies

(a)

Surface antigens + Opposing antibodies → Agglutination (clumping) and hemolysis
Transfusion Reactions

- Occurs when mismatched blood is transfused
- Recipients agglutinins attack donor blood cells
- Group O = universal donor
- Group AB = universal recipients
Study Guide

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