Histology Lesson X:
Classification of Blood

Warm Up:

1. Identify the type of muscle tissue: Smooth, Cardiac, or Skeletal Striated

Cardiac  Smooth  Striated

Blood:

- The blood is like all other connective tissue is derived from the mesenchymal cells
- The blood can be roughly divided into two:
  1) Plasma (fluid)
  2) Corpuscles (cellular structures)

1) Plasma

- The blood plasma is a protein rich fluid and consists of 91% water and 9% solutes (proteins, lipids, electrolytes). The salt concentration in the blood is 0.9%. This concentration is important because if a physiological salt solution has a higher concentration than the blood plasma’s it will be hypertonic (if it is lower it will be hypotonic).
- The proteins in the blood plasma is mainly Fibrinogen which is capable of forming Fibrin fibers. The clotting mechanism is triggered by the platelets, which “break” as they pass over rough places in an injured surface. Fibrin is the clotting protein of the blood.
- Blood clotting occurs when:
  - exposure to air
- pathological - the endothelial layer of the blood vessels is usually very smooth, but when an internal wound or other irregularities are formed, the formation of fibrin can occur. Clots of fibrin are called Trombus, these can follow the blood circulation and get stuck (block) small blood vessels.

2) Corpuscles

- Blood smears are made by spreading a small drop of blood across a slide. Analysis of the following cell types can help diagnose many illnesses.
- The cellular component of the blood:
  - Erythrocytes (Red Blood Cells)
  - Thrombocytes/Platelets
  - Leukocytes (White Blood Cells)
    - Granulocytes:
      - a) Neutrophils
      - b) Eosinophils
      - c) Basophils
    - Agranulocytes
      - d) Lymphocytes
      - e) Monocytes

ERYTHROCYTES

- More commonly known as red blood cells
- Mature erythrocytes do not have a nucleus, ribosome, ER, or mitochondria
- The life span of an erythrocyte is 90-180 days.
- Their function is to bind to O2 and transport it to the cells of the body. The size of the erythrocytes differ between species
- Erythrocytes are round, biconcave discs. The erythrocytes transport oxygen by Hemoglobin
- The RBC are formed in the bone marrow and fresh erythrocytes have a network at the site of the nucleus

THROMBOCYTES
• More commonly known as Platelets
• Not cells but cell fragments of giant cells in the bone marrow, *Megakaryocytes*.
• Cell fragments contain: microfilaments, microtubules, mitochondria, lysosomes
• Have a major role in blood coagulation and clot retraction.
• Megakaryocyte in bone marrow →

**LEUKOCYTES**

• More commonly known as White Blood Cells
• The leukocytes are true cells that have a nucleus. Many of them are capable of amoebic movement and migration between the blood and connective tissue
• They are divided into two groups according if they contain granules or not.

**Granulocytes:**

1) *Neutrophils* (60% of the leukocytes)
   - Lobulated nucleus with 3-5 lobules joined by strands.
   - Motile phagocytotic cells, form the first line of defense against microbial infection. Life span: 1 day
   - Move by amoebic motion, even into connective tissue
   - Granules work together in the destruction of phagocytized bacteria
   - Pus- comes from the neutrophils

2) *Eosinophils*
   - Eye-glasses nucleus- two parts connected by a bridge.
   - Eosinophilic granules (rectangular in EM)
   - Motile phagocytotic cells, have a limited phagocytic and bactericidal capacity. - Life span: 3-8 hours

3) *Basophils*
   - Less than 1% of the leukocytes
   - Bean shaped nucleus, usually not seen because it is covered by the granules.
- Basophilic granules- can be seen also outside the cell because they diffused out

**Agranulocytes**

1) *Lymphocytes* (30-40% of the leukocytes)
   - Compact nucleus, with a small rim of cytoplasm
   - Immature lymphocytes have more cytoplasm
   - B-lymphocytes - primary role in humoral (blood borne) immunity and precursor of plasma cells
   - T-lymphocytes - primary role in cellular immunity

2) *Monocytes*
   - Horse-shoe shaped nucleus (indentated nucleus)
   - Function not fully known, but number increases during viral infections- the circulating monocyte migrates into tissue and body cavities and transform into a tissue macrophage. Once in the tissue the monocytes generally don’t re-enter the blood

**Avian Blood versus Mammal Blood Corpuscles**

- All submammalian species (Fish, Amphibians, Reptiles and Birds) have red blood cells of ovoid shape containing a centrally located ellipsoidal nucleus
- Eosinophils and Basophils are very similar to mammalian leukocytes
- Instead of Neutrophils however, they have *Heterophils*
- **Heterophils:**
  - Have several orange colored rod like granules which cover the segmented nucleus
- Instead of platelets, they have *Thrombocytes*
- **Thrombocytes:**
  - Cells found in the blood of non-mammalian species
  - Functionally equivalent to platelets
  - Circulate as intact, mono-nuclear, ovoid cells. Not fragments