Exercise 6
Formed Elements of Blood and Cardiovascular System

Objectives:

- Identify all the cellular elements in normal blood smears from different species of animals
- Recognize cardiac muscle in longitudinal and cross section in light microscope preparations
- Identify the Purkinje fibers of the myocardium
- Identify microscopic sections of different classes of arteries and of veins of various sizes
- Identify venous and cardiac valves in light microscopic sections

I. Blood

Introduction:

Blood is classically considered to be one of the connective tissues, since it has all three components which characterize these tissues: fibers, an amorphous matrix, and cells.

The fibrous component is latent in normal blood, and is expressed only in response to injury. The amorphous matrix is blood plasma, a low viscosity aqueous solution of proteins and some other components; in this exercise we will consider the cellular component, the formed elements of normal circulating blood. The cells found in circulating blood are in many cases the same cells found in loose connective tissues.

Smears

In blood smears you will be looking at preparations made with Wright’s stain. This is an alcohol based mixture of rosin and methylene blue whose staining reactions are similar (but not identical to) the common H & E stain used on tissue sections.

Most people develop a mental image of what formed elements of blood “ought” to look like based on smears, and specifically smears stained with Wright’s solution. It’s worth mentioning here that blood cells in tissue sections will look slightly different than they do in smears, and you should keep this in mind when you try to identify these cells in sections. Blood elements in smears are flattened by adhesion to the glass, and appear somewhat larger than in sections. There are, also, subtle color differences between the Wright and H & E stains that show up in side by side comparisons.

In stained smears seven types of elements can be identified on the basis of shape, size, color, and nuclear-cytoplasmic morphology. Use your textbook/atlas to identify all seven elements while you look at the following slides. You have several slides that are smears of human blood. It might be necessary for you to look at several slides in order to see all types of formed elements. In the fetal blood smear identify reticulocytes, or young erythrocytes, which exhibit a bluish-pink cytoplasm. Also look at smears from other species. Look for differences and similarities.

List of slides – Smears

B-1 Smear, human
B-2 Smear, human
B-3 Smear, human
B-4 Smear, human
B-5 Smear, monkey
B-6 Smear, fetus-reticulocytes

REVIEW BOX SLIDE 17
II. Bone Marrow

Bone marrow is a complex, highly cellular tissue which, in human adults, is restricted to medullary cavities of selected bones. The structure of bone marrow in normal human adults consists of a connective tissue stroma of reticular cells and fibers that forms a meshwork to support islands of cords of hemopoietic cells together with fat cells. Macrophages are numerous and the vascular supply, derived from nutrient arteries, branches to form extensive plexuses of blood sinusoids.

List of slides – Bone marrow

- B-7 Smear
- B-8 Smear, human – excellent prep.
- B-9 Section

REVIEW BOX SLIDE 16

List of slides – Sectioned material, find the bone marrow in the following sections:

- B-22 Femur, frog
- B-23 Femur, lizard
- B-24 Femur, bird

III. Human Blood Disorders

List of slides – Look for the differences between the samples

- B-25 Sickle cell
- B-26 Infectious mononucleosis
- B-27 Infectious mononucleosis
- B-28 Eosinophilia
- B-29 Hairy cell leukemia
- B-30 Leucocytosis
- B-31 Lead poisoning

REVIEW BOX SLIDE 17 (normal blood smear)

IV. Circulatory System

The whole circulatory system has a common basic structure:
An inner lining comprising a single layer of extremely flattened epithelial cells called endothelium, supported by a basement membrane and delicate collagenous tissue; this constitutes the tunica intima

- An intermediate muscular layer; the tunica media
- An outer supporting tissue layer; the tunica adventitia

The tissues of the walls of large vessels cannot be sustained by diffusion of nutrients from their lumina and are thus supplied by small arteries called vasa vasorum (“vessels of vessels”) which are derived either from the main vessel itself or from adjacent arteries. The vasa vasorum give rise to a capillary network within the tunica adventitia which might extend into the tunica media.

The muscular layer exhibits the greatest variation from one part of the system to another. For example, it is totally absent in capillaries but comprises almost the whole mass of the heart.

**The heart**

The longitudinal sections of the heart, show hearts which have been sectioned from the apex to the cranial end of the atria. After orienting yourself, place it on the microscope under low power and try to identify the chambers of the heart. (You might not be able to see all four chambers). Running from the apex to the cranial end you will see the septum dividing the right and left sides. There should be at least one of the heart valves in the section. External to the heart proper, you should see a cross section of one of the large vessels (the pulmonary artery).

When looking at the transverse section of the heart (sectioned below the level of the atrioventricular junctions), notice the difference in the thickness of the walls of the two chambers.

**List of slides – The heart**

- V-1 Cardiac muscle
- V-2 Cardiac muscle, t. s.
- V-3 Heart
- V-4 Heart
- V-5 Heart, chick
- V-6 Cardiac muscle, amphiuma, t. s.
- V-7 Heart, frog
- V-8 Heart, dogfish

**REVIEW BOX SLIDE 53**

**Reminder:** In the heart the layers of tissue have specific names

- Tunica intima – endocardium
- Tunica media – myocardium
- Tunica adventitia – epicardium (visceral pericardium)
- Vasavasorum – coronary artery

**Arteries**

Arteries may be sub-classified by size. **Elastic arteries** are the largest blood vessels in the body. Examples include the aorta, subclavian and pulmonary arteries. The walls of these vessels are primarily composed of elastic fibers which provide great resilience and flexibility during blood flow.

The elastic arteries branch to become medium sized, **muscular arteries** which are the most numerous vessels in the body. The muscular arteries contain increased amounts of smooth muscle fibers in the walls. The **arteries**, the terminal branches of the arterial tree, have walls consisting of a few layers of smooth muscle fibers.
List of slides – Arteries

V-9  Aorta
V-10 Aorta, monkey, t. s.
V-11 Aorta, rabbit, t. s.
V-12 Artery, muscular
V-13 Artery
V-14 Artery, elastic stain

REVIEW BOX SLIDE 54

Capillaries:

Capillaries are the smallest blood vessels. There are three types of capillaries: continuous capillaries, fenestrated capillaries and sinusoids.

List of slides – capillaries

V-15 Capillaries

Veins:

The structure of the venous system conforms to the general three layered arrangement elsewhere in the circulatory system, but the elastic and muscular components are much less prominent features. Compared to arteries, veins are typically more numerous and have thinner walls, larger diameters, and greater structural variation.

List of slides – veins

V-16 Vein
V-17 Large vein
V-18 Vena cava, monkey, t. s.
V-19 Vein, human, t. s.

REVIEW BOX SLIDE 56

General slides

V-20 Aorta, artery and vein
V-21 Artery, vein, nerve
V-22 Artery, vein, nerve
V-23 Artery, vein, t. s.
V-24 Coronary artery, atherosclerosis

REVIEW BOX SLIDE 56

Slides V-21, V-22, and box slide 56 show a neuromuscular bundle. In these slides you can see how the vessels supplying and draining a particular are of tissue tend to pass together frequently accompanied by a peripheral nerve. These three elements are surrounded by a condensation of collagenous tissue which forms an ill-defined protective sheath.
V. The Lymph Vascular System

The lymph vascular system consists of lymph capillaries and lymph vessels and is merely a passive drainage system for returning excess extra-vascular fluid, the lymph, to the blood vessels. The endothelium in lymph capillaries and vessels is extremely thin. The structure of larger lymph vessels is similar to that of veins except that their walls are thinner. Lymphatic vessels may be distinguished from veins by the absence of erythrocytes and the presence of small numbers of white blood cells, mainly lymphocytes. Another characteristic feature of the lymphatic system is the numerous delicate valves in small and medium-sized vessels. The structure of these valves is similar to that of valves in the venous system, but the supporting tissue core consists merely of reticulin fibers and little ground substance.

List of slides – lymph vascular system

| V-25  | Thoracic duct |
| V-26  | Lymphatic vessel, valve |
| V-27  | Lymphatic vessel, valve |
| V-28  | Lymphatic vessel |