Medical Physiology

Physiology

Physiology attempts to explain the physical and chemical factors that are responsible for the origin, development, and progression of life (*physio* = nature; *ology* = the study of). Each type of life, from the very simple virus up to the largest tree or to the complicated human being, has its own functional characteristics. Therefore, the vast field of physiology can be divided into *viral physiology*, *bacterial physiology*, *cellular physiology*, *plant physiology*, *human physiology*, and many more divisions.

In human physiology we are concerned with the specific characteristics and mechanisms of the human body that make it a living being. The very fact that we remain alive is almost beyond our own control, for hunger makes us seek food and fear makes us seek refuge. Sensations of cold make us provide warmth.

Physiology has many subdivisions. For example, *neurophysiology* explains the workings of nervous system, and *cardiac physiology* studies the function of the heart, which acts as a muscular pump to keep blood flowing throughout the body.

Blood Physiology

Blood is the "the river of life" that surges within us. It transport everything that must be carried from one place to another within the body; nutrients, wastes, and body heat, through blood vessels.

Components and Functions of Blood

Among all of the body's tissues, blood is unique: it is the only fluid tissue. Although blood appears to be a thick, homogeneous liquid, the microscope reveals it has both solid and liquid components. Essentially blood is a complex connective tissue in which living blood cells, the **formed elements**, are suspended in a nonliving fluid matrix called **plasma.**

If a sample of blood is spun in a centrifuge, the heavier elements are packed down by centrifugal force and plasma rises to the top (fig.1). Most of the reddish mass at the bottom of the tube consist of **erythrocytes**, the red blood cells that function in oxygen transport. There is a thin, whitish layer called the **buffy coat** at the junction between the formed elements and the plasma. This layer contains **leukocytes**, the white blood cells that

act in various ways to protect the body, and **thrombocytes** (platelets), cell fragments that function in the blood-clotting process. Erythrocytes normally account for about 45 percent of the total volume of a blood sample, a percent known as the hematocrit. White blood cells and platelets contribute less than 1 percent and plasma makes up most of the remaining 55 percent of whole blood.

Physical Characteristics and Volume

Blood is sticky opaque fluid with a characteristic metallic and salty taste. Depending on the amount of oxygen it is carrying, the color of blood varies from scarlet (oxygen-rich) to a dull red (oxygen-poor). Blood is heavier than water and about five times thicker, or more viscous, largely because of its formed elements. Blood is slightly alkaline, with a pH between 7.35 and 7.45. Its temperature (38^0C) is always slightly higher than body temperature.

Blood accounts for approximately 8 percent of body weight. The average adult body contains approximately 6 liters of blood.

Plasma

Plasma, which is approximately 90% water, is the liquid part of the blood and 10% of various substances. Over 100 different substances are dissolved in this straw-colored fluid. Examples of dissolved substances include nutrients, vitamins, salts (electrolytes), respiratory gases, hormones, plasma proteins, and various wastes and products of cell metabolism.

Plasma proteins are the most abundant solutes in plasma. Except for antibodies and protein-based hormones, the liver makes most plasma proteins. The plasma proteins serve a variety of functions. For instance, **albumin** contributes to the osmotic pressure of blood, which acts to keep water in the bloodstream; **fibrinogen**, a coagulation proteins, help stem blood loss when a blood vessel is injured; and antibodies or **immunoglobulins**, part of the body's defense mechanisms against diseases, help protect the body from pathogens. Other proteins include enzymes, hormones, growth factors, which are necessary to clot the blood when bleeding occurs. Plasma proteins are not taken up by cells to be used as food fuels or metabolic nutrients, as are other solutes such as glucose, fatty acids, and oxygen.

The composition of plasma varies continuously as cells remove or add substances to the blood. Assuming a healthy diet, however, the composition of plasma is kept relatively constant by various homeostatic mechanisms of the body. For example, when blood proteins drop to undesirable levels, the liver is stimulated to make more proteins; when

the blood starts to become too acid (acidosis) or too basic (alkalosis), both the respiratory system and the kidneys are called into action to restore it to its normal, slightly alkaline pH range of 7.35 to 7.45. various body organs make literally dozens of adjustments day in and day out to maintain the many plasma solutes at life-sustaining levels. Besides transporting various substances around the body, plasma helps to distribute body heat evenly throughout the body.

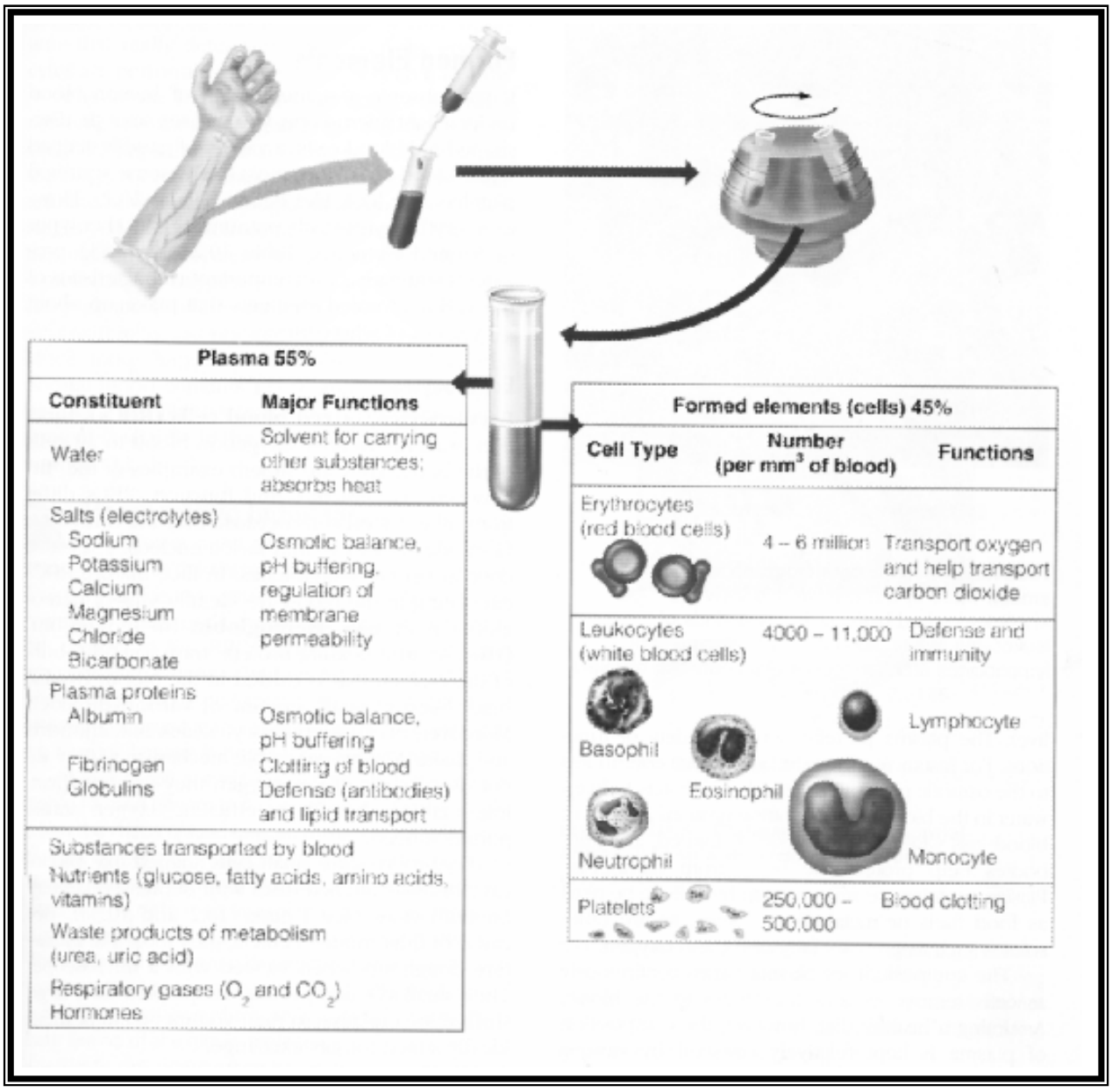

Fig.(1): Blood composition

Formed Elements

If you observe a stained smear of human blood under a light microscope, you will see smooth, disc shaped red blood cells, a variety of gaudily stained white blood cells, and most likely, some scattered platelets that look like debris (fig.2). However, erythrocytes vastly outnumber the other type of formed elements.

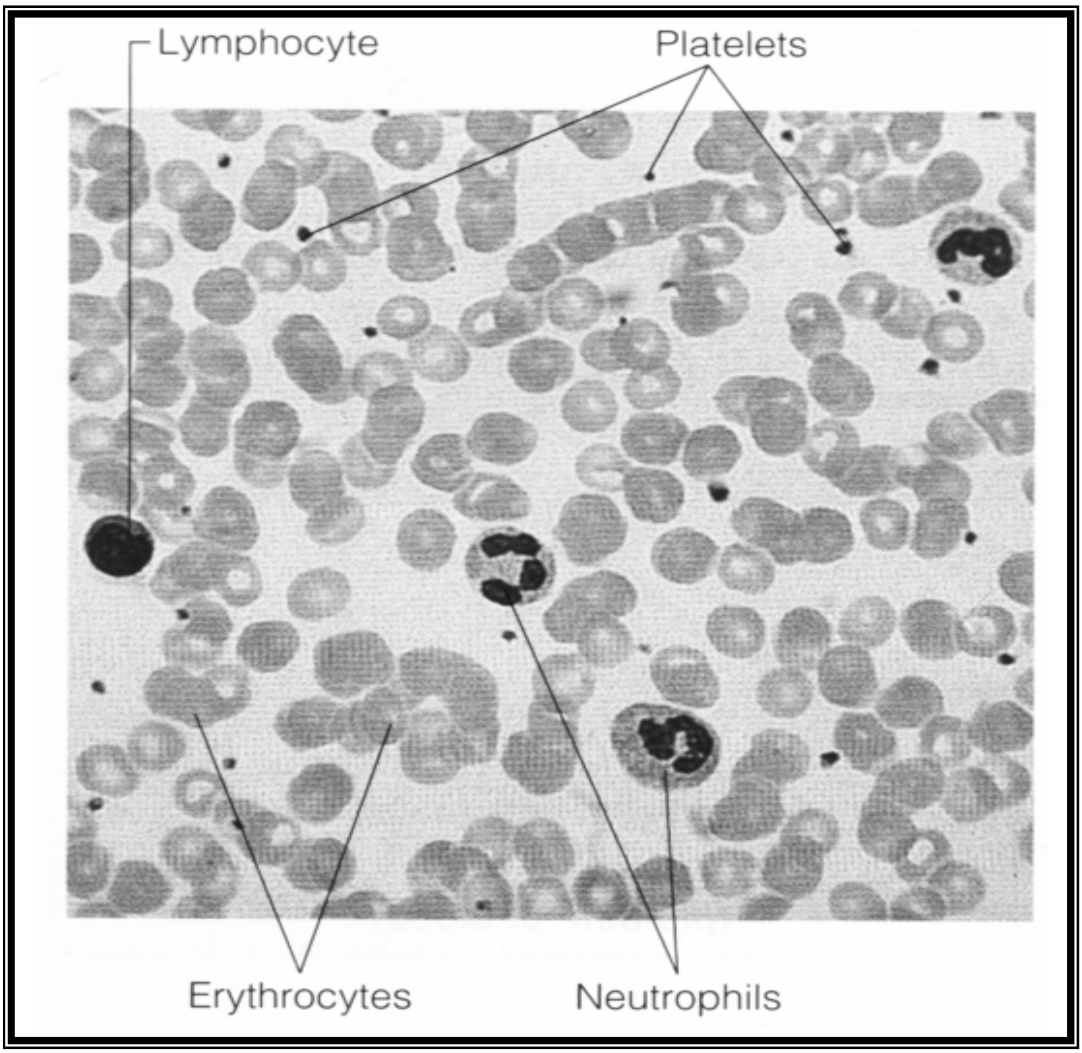

Fig.(2): Blood smear showing blood cells