

**Tikrit University**

**College of Nursing**

**Basic Nursing Sciences**



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**Physiology**

**Hematopoiesis**

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## **Hematopoiesis**

Hematopoiesis (blood cell formation), occurs in red bone marrow ie myeloid tissue.

- Erythrocyte production and the formation of leukocytes and platelets is stimulated by hormones.
- Hemocystoblast. All the formed elements arise from a common type of stem cell, the haematocystoblast.

The haemocystoblast forms two types of descendants:

1. Lymphoid stem cell, which produces lymphocytes
2. Myeloid stem cell, which can produce all other classes of formed elements.

Formation of Red Blood Cells (the entire developmental process from haemocystoblast to mature RBC takes 3 to 5 days).

- Anucleate - RBCs are unable to synthesize proteins, grow, or divide.
- Life span - RBCs become more rigid and begin to fragment, or fall apart, in 100 to 120 days.
- Lost RBCs - Replaced more or less continuously by the division of haemocystoblasts in the red bone marrow.
- Immature RBCs - Developing RBCs divide many times and then begin synthesizing huge amounts of haemoglobin.
- Reticulocyte - When enough haemoglobin has been accumulated, the nucleus and most organelles are ejected and the cell collapses inward; the resulting in young RBC (ie reticulocyte) because it still contains some rough endoplasmic reticulum (ER).

- Mature erythrocytes - Within 2 days of release, they have rejected the remaining ER and have become fully functioning erythrocytes.
- Erythropoietin. The rate of erythrocyte production is controlled by a hormone called erythropoietin; normally a small amount of erythropoietin circulates in the blood at all times, and red blood cells are formed at a fairly constant rate.
- Control of RBC production. An important point to remember is that it is not the relative number of RBCs in the blood that controls RBC production; control is based on their ability to transport enough oxygen to meet the body's demands.

## **Formation of White Blood Cells and Platelets**

- In the human adult, the bone marrow produces 60–70 percent of the white cells (i.e., the granulocytes), and all of the platelets.
- The lymphatic tissues, particularly the thymus, the spleen, and the lymph nodes, produce the lymphocytes (comprising 20–30 percent of the white cells).
- The reticuloendothelial tissues of the spleen, liver, lymph nodes, and other organs produce the monocytes (4–8 percent of the white cells).
- The platelets, which are small cellular fragments rather than complete cells, are formed from bits of the cytoplasm of the giant cells (megakaryocytes) of the bone marrow.
- Colony-stimulating factors and interleukins: prompt red bone marrow to turn out leukocytes and marshal up an army of WBCs to ward off attacks by enhancing the ability of mature leukocytes to protect the body.
- Thrombopoietin (a hormone): accelerates the production of platelets, but little is known about how that process is regulated.

## **Blood Disorders**

There are many conditions of/ or affecting the human hematologic system i.e the biological system that includes plasma, platelets, leukocytes, and erythrocytes, the major components of blood and the bone marrow. This list is an example of disorders:

- Sickle Cell Anemia
- Anaemia of Chronic Disease
- Acute Lymphoblastic Leukemia
- Acute Myeloid Leukemia
- Multiple Myeloma
- Aplastic Anaemia
- Erythrocytosis
- Hemochromatosis
- Paraneoplastic Syndrome
- Hypercoagulable Disorder
- Iron Deficiency and vitamin B12 Anemia
- Leucocytosis
- Leucopenia

## **Blood Disorders in Paediatrics**

There are several blood disorder types. They are classified according to the blood component that is affected. Blood disorders may involve malfunction in platelets, erythrocytes, leucocytes. They can also involve problems in bone marrow, lymph nodes and blood vessels.<sup>[24]</sup>

## **Erythrocytes Disorders:**

Disorders of erythrocytes are also known as red blood cell and iron disorders. These disorders are manifested by a failure of O<sub>2</sub> transportation from the lungs to various body tissues.

They can be diagnosed as various types of anaemias such as Iron-refractory iron deficiency anaemia (IRIDA), Congenital sideroblastic anaemia, Congenital dyserythropoietic anaemia, Megaloblastic anaemia (including pernicious anaemia), Iron deficiency anaemia, Hemolytic anaemia and Sickle Cell Anemia. Thalassemia, Hemolytic disease of the newborn, Spherocytosis and Hemochromatosis are other erythrocyte disorders that can occur.

## **Leukocytes Disorders:**

Leukocytes disorders are also known as white blood cells disorders. WBCs can either increase in number, decrease in number or malfunction. The most common WBCs disorders are found with the neutrophils and lymphocytes. Disorders of monocytes and eosinophils are less common. Basophil disorders are very rare.

WBCs disorders characteristic of low WBC counts includes neutropenia, Shwachman-Diamond syndrome and Kostmann Syndrome. Disorders characteristic of high WBC counts include Eosinophilia and Neutrophilia.

Sinuses, lung and ear infections, skin abscesses, mouth sores, periodontal disease and invasive fungal infection are the most common symptoms of leucocyte disorders.

## **Bleeding Disorders:**

When some coagulates found in the plasma are malfunctioned it will lead to bleeding disorders such as haemophilia and von Willebrand disease.