''बेटी बचाओ, बेटी पढ़ाओ''

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

FACULTY OF PHYSIOTHERAPY & DIAGNOSTICS

Faculty Name	:	**JV'n Sunita Shekhawat (Assistant Professor)**
Program	:	**I Semester**
Course Name	:	**BPT(Human Physiology)**
Session No. & Name	:	**1.2 Hematopoiesis**

Academic Day starts with –

Greeting with saying **'Namaste'** by joining Hands together following by 2-3 Minutes Happy session, Celebrating birthday of any student of respective class and National Anthem.

Lecture Starts with-

Review of previous Session:

Topic to be discussed today- Today We will discuss about Hematopoiesis

Lesson deliverance (ICT, Diagrams & Live Example)-

PPT (10 Slides)

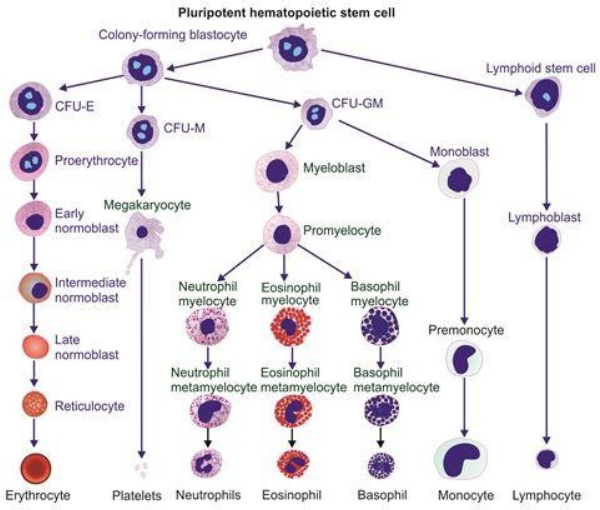
Diagrams

Introduction & Brief Discussion about the Topic

Haematopoiesis

Hematopoiesis is the process by which the blood and blood plasma's cellular components are all produced. It takes place in the hematopoietic system, which includes tissues and organs like the liver, spleen, and bone marrow.

Blood cell production in the body is referred to as hematopoiesis. it starts early in an embryo's development, long before birth, and lasts the entirety of a person's existence. Each stem cell that gives rise to a blood cell or plasma can also give rise to any other type of cell.



Blood :

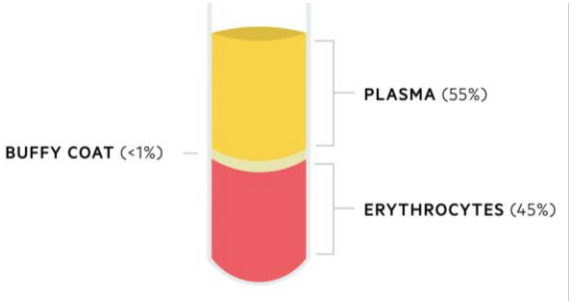
The movement of erythrocytes, leucocytes, and platelets is facilitated by blood, which is a vital transport medium for the human body.

Plasma and haematocrit make up blood :

The most dense part of blood is called the haematocrit, which accounts for 45% of blood volume. Albumin, immunoglobulins, fibrinogen, and other proteins are

found in plasma (55%) along with non-protein components such vitamins, lipids, and hormones. Plasma is primarily composed of water. Buffy coat (1% or less): platelets and leucocytes are present.

Blood will separate into its many layers when let to stand in a test tube. Plasma will float on top, while the denser haematocrit will collect at the bottom. The 'buffy coat', a thin layer, lies between them.

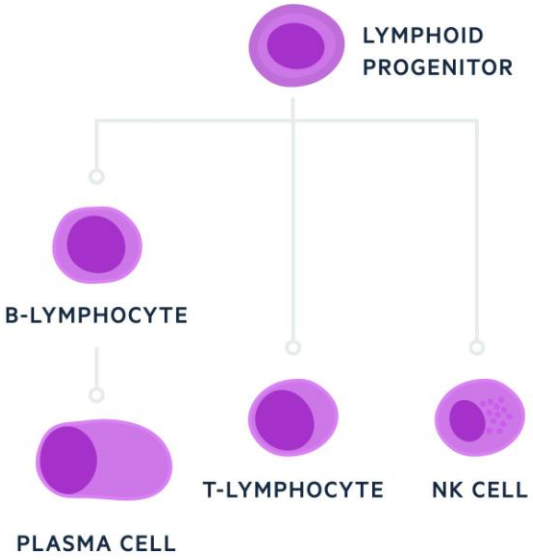


More than 10 different cell types make up the blood. Each of these cell types can be divided into one of three main groups:

1. **Red blood cells, or Erythrocytes,** are the body's main carriers of oxygen and hemoglobin.

Leukocytes, often known as white blood cells, help the immune system. There are numerous types of white blood cells, including:

T and B cells are examples of lymphocytes that aid in the defense against several infections and malignancies.



Neutrophils : These work to combat fungal and bacterial infections.

Eosinophils : These help combat some parasites and are involved in the inflammatory response.

The histamines required for the inflammatory response are released by basophils.

Macrophages: These ingest and consume germs and other detritus.

3. **Platelets** (thrombocytes) are blood clotting factors.

The monophyletic theory of hematopoiesis is supported by current research. According to this hypothesis, all blood cells are produced by a single type of stem cell.

Acute hemopoiesis

Around 14 to 19 days after fertilization, the embryonic yolk sac in utero starts to produce blood cells.

During the second trimester, the liver is the primary location for haematopoiesis in the fetus. The bone marrow takes control at seven months and remains the dominating location in adults.

Nearly all marrow cavities in the first four years of life contain red marrow, which is hematopoietic tissue. This hemopoietic tissue becomes less abundant as we age and is replaced by fat (yellow marrow). Only the long bones and axial skeleton contain red marrow in adulthood.

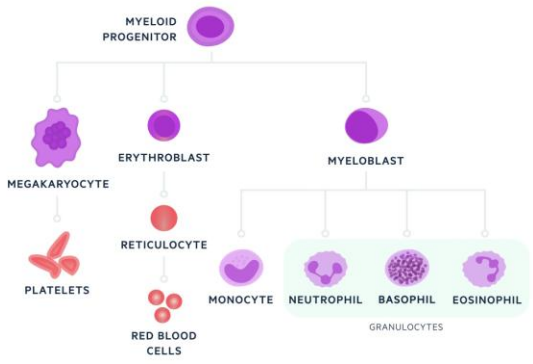
Leucopoietic activity during early haematopoiesis is minimal. So early in infancy, maternally produced antibodies are crucial for the immune system.

Hematopoiesis in adults

A continuous state of normal adult haematopoiesis takes place in the bone marrow to balance the loss of mature blood cells.

The axial skeleton and the proximal ends of long bones (such as the femur and humerus) are the only places where hemopoiesis can occur due to the increase in yellow marrow that occurs with age.

The red marrow may expand when there is poor or inadequate haematopoiesis in the bone marrow. Extra-medullary haematopoiesis, the process of hemopoiesis occurring in organs like the liver and spleen, is a possibility.



The most basic haematopoietic cell, also known as a multipotent haemopoietic stem cell, is the source of all blood cells. All cell lineages can develop from these cells.

Both cellular maturation (such as the emergence of structural proteins) and cell proliferation are necessary for successful haematopoiesis.

Growth Factors:

Glycoprotein growth factors, which promote the proliferation and differentiation of progenitor cells, are essential for controlling haematopoiesis.

Growth factors include, for instance:

EPO, or erythropoietin

TPO, or thrombopoietin

Interleukins (IL-3, IL-6, IL-7, and IL-11, for example)

Colony-stimulating substances (like G-GSF and M-CSF)

negative regulators, such as TGF-beta and TNF-alpha

Red blood cell development and proliferation depend on EPO. Its release is brought on by low hemoglobin levels.The 165 amino acid polypeptide hormone EPO is produced by the EPO gene, which is found on chromosome 7.

The liver produces TPO, which is crucial for regulating platelet formation.

Blood cells, Red non-nucleated erythrocytes, which have a diameter of around 7 microns, are crucial for the circulation of oxygen throughout the body.

They are the most common blood cells and remain in the blood for 110–120 days before being cleared from circulation by liver and splenic macrophages.

Erythrocytes are biconcave structures with a pallid region in the center. Erythrocytes lose their nucleus, RNA, and mitochondria during maturation. Thus, adult erythrocytes are composed primarily of three things:

Red cell lining

metabolic apparatus

Haemoglobin

The oxygen-carrying molecule, hemoglobin, is made up of four polypeptide globin chains with one haem group apiece. The mitochondria of growing red blood cells create adult hemoglobin (HbA), which has two alpha and two beta chains.

Because the haem group has a ferrous atom and a porphyrin ring, an oxygen molecule can be reversibly bound and transported to the tissue where it is needed.

The process of producing erythrocytes, known as erythropoiesis, takes place in the bone marrow and is reliant on the kidneys' secretion of EPO.

White blood cells

The immune system is made up of leucocytes, nucleated cells that can be found in the blood and reticuloendothelial system.

Leucocytes' main function is to defend the body against infections. Immuno modulation, immune surveillance, and inflammation all play additional roles.

The most prevalent leucocytes, neutrophils, play a significant part in the innate immune response. They have a segmented nucleus with 3-5 lobes and are 9–15 microns in diameter.

The biggest leucocytes are called monocytes, and they can penetrate peripheral tissue where they develop into macrophages, also called histiocytes or macrophages. Monocytes have a diameter of 15 to 30 microns.

Pathogens can be phagocytosed by monocytes and neutrophils alike. Additionally, monocytes and later macrophages play a part in the antigen presentation process that initiates the adaptive immune system.

The leucocytes basophils and eosinophils are also frequent. The host's defense against parasitic organisms and disorders of the allergic variety depends heavily on eosinophils, which have a diameter of 12 to 17 microns.

Basophils have big granules that contain histamine and are about 10–14 microns in size. Polymorphonuclear leucocytes, sometimes referred to as "polymorphs," are the aggregate term for basophils, eosinophils, and neutrophils.

Last but not least, lymphocytes are a crucial part of the adaptive immune response. T lymphocytes play a key role in cell-mediated immunity, whereas B lymphocytes play a key role in humoral immunity and immunoglobulin synthesis.

Platelets:

The creation of a haemostatic plug at the site of vascular damage depends on platelets.

Similar to erythrocytes, these cells are about one-fifth the size of erythrocytes and lack a nucleus. The bone marrow's megakaryocytes are the source of platelets. A

single megakaryocyte can directly release large quantities of platelets into the bone marrow sinusoids.

A number of illness conditions, such as idiopathic thrombocytopaenic purpura, can be characterized by few platelets (thrombocytopaenia), which increases the risk of bleeding. Aspirin and clopidogrel, two regularly used anti-platelet medications, can also impair platelet function.

- University Library Reference-

  Essential of Medical Physiology By K. Sembulingam & Prema Sembulingam.

  Textbook of physiology By A K Jain

  Textbook of Medical Physiology By Guyton
- Suggestions to secure good marks to answer in exam-
- Explain answers with the help of proper diagram & flow charts.
- Explain answer with key point answers
- Questions to check understanding level of students-
- Differentiate between mature and immature RBC.
- Small Discussion About Next Topic-

Academic Day ends with-

National song' Vande Mataram'