

Block HEM-210
Haematology

LECTURE 4

by

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BONE MARROW

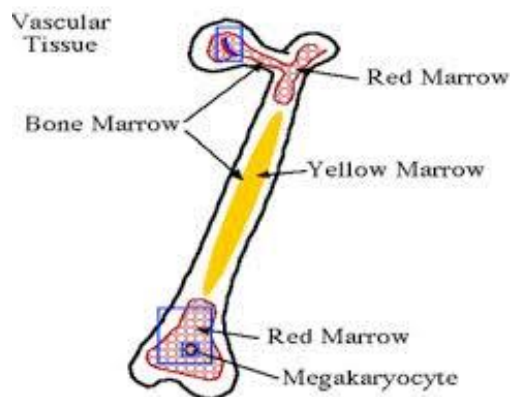
What is bone marrow?

Bone marrow is soft, gelatinous tissue that fills the medullary cavities, or the centers of bones.

Types

1. Red bone marrow consists of a delicate, highly vascular fibrous tissue containing hematopoietic stem cells. These are blood-forming stem cells.
2. Yellow bone marrow (with fatty tissue) contains mesenchymal stem cells, or marrow stromal cells. These produce fat, cartilage, and bone.

Sites: Bone marrow remains red in all body until around the age of 7 years, as the need for new continuous blood formation is high. As the body ages, it gradually replaces the red bone marrow with yellow fat tissue. In adults, **highest concentration of red bone marrow** is in the bones of the vertebrae, hips (ilium), (sternum



Hematopoiesis

- Bone marrow needs to replace blood cells constantly, as each blood cell has a set life expectancy.

Definition of Hematopoiesis:

The process of developing different blood cells from pluripotent hematopoietic stem cells .

- Red bone marrow produces all blood elements

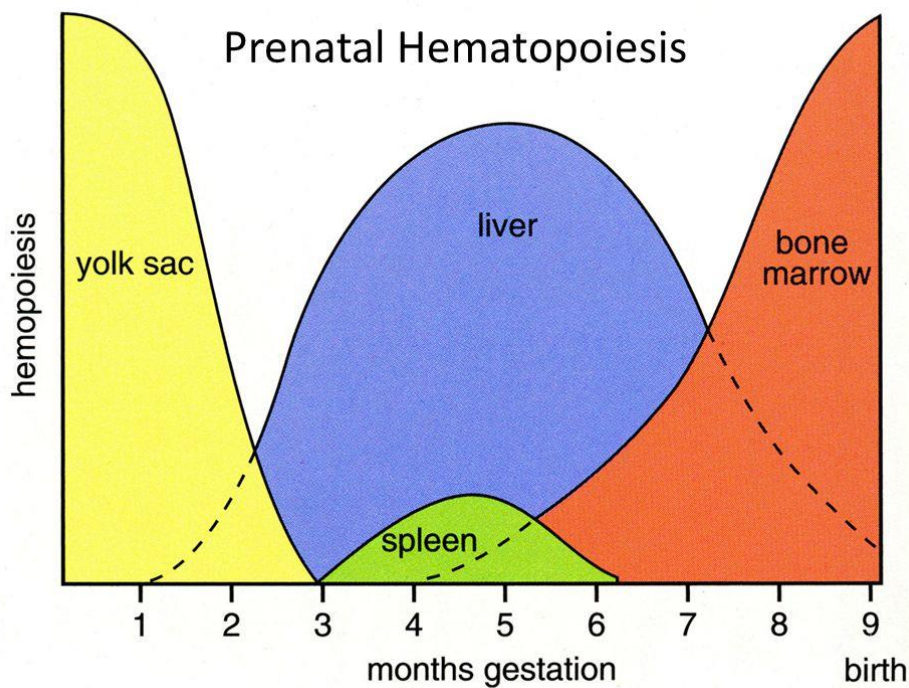
Prenatal phases of haemopoiesis

1-**yolk sac phase:**

2-**Hepatic phase:**

3-**Splenic phase:**

4-**Myeloid phase: bone marrow**



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Histological structure of the bone marrow

1-**Stroma**: it is formed of a network of reticular C.T. that supports the cells.

2- The **vascular sinuses** of the marrow are 50-75 um in diameter.

They are lined with continuous endothelium joined together by junctional complexes. Transendothelial pores often found in the peripheral portions of the cells indicating the site of passage of blood cells. A continuous basal lamina is absent.

3-**Free cells**: these are the free stem cells, immature and mature cells of all blood elements.

4-**Fixed cells**: these are the reticular cells, fibroblasts, adipocytes and macrophages.

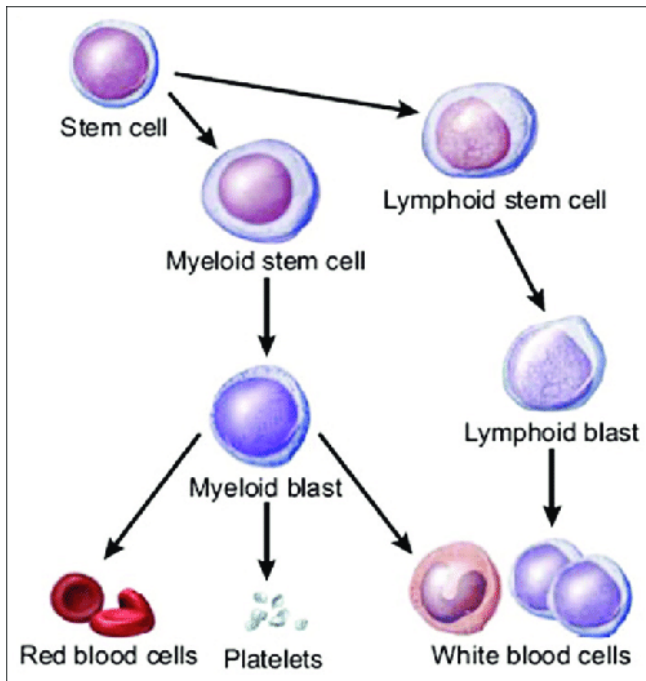
Hemopoietic stem cells:

These are pluripotential cells that can generate all of blood cell types. They are highly active proliferating cells that undergo self renewing divisions or they may undergo differentiation to give rise to progenitor cells

Progenitor cells : have a differentiating capacity to one cell type.

Also called Colony forming unit and include two types:

1. **Common myeloid progenitors** give rise to either:
 - megakaryocyte/erythrocyte **progenitors**
 - granulocyte/monocyte **progenitors**
2. **Common lymphoid progenitors** give rise to lymphocytes.



Development of erythrocytes (erythropoiesis)

1. Pluripotential haematopoietic stem cells.

2. common myeloid progenitor

3. Proerythroblasts:

4. Basophil erythroblasts:

basophilic cytoplasm due to presence of large number of ribosomes that start to synthesize hemoglobin.

5. Polychromatophil erythroblasts:

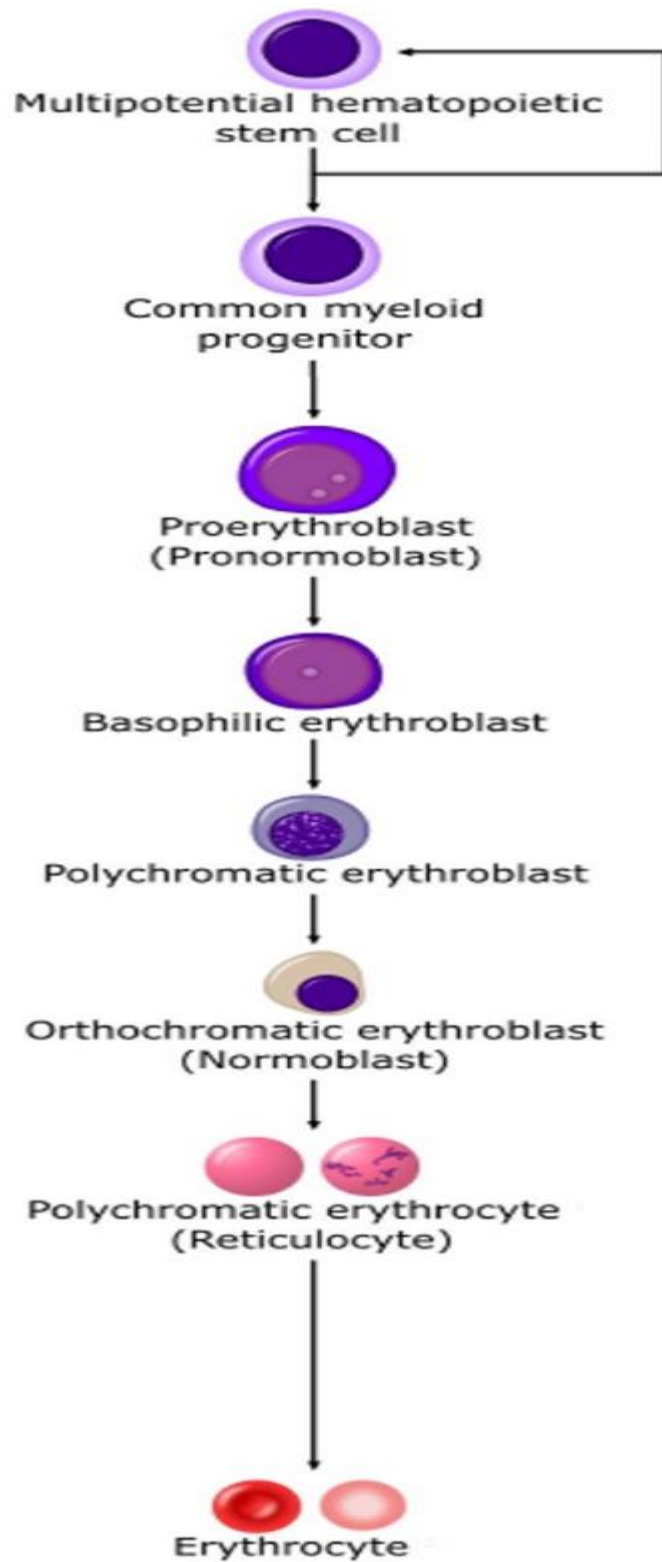
hemoglobin in their cytoplasm.

6. Orthochromatophil erythroblasts or normoblasts:

have pink cytoplasm. The nucleus is small

7. Polychromatophil erythrocytes or reticulocytes:

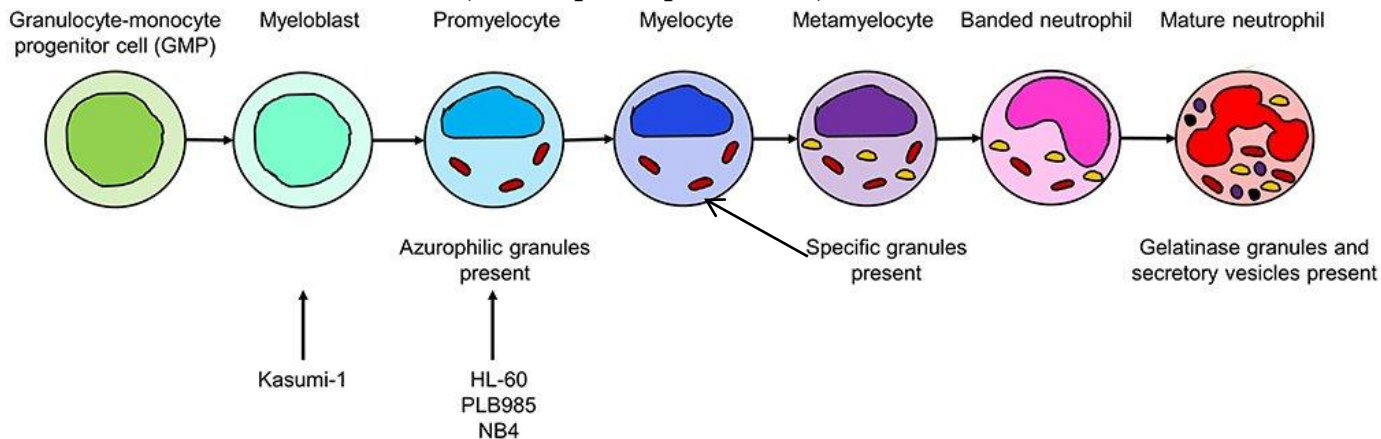
are immature R.B.Cs result from extrusion of the nucleus of normoblast



(erythropoiesis)

Granulopoiesis

1. Pluripotential stem cells.
2. Colony forming unit for granulocytes/monocytes CFU-GM.
3. CFU-G.
4. Myeloblasts
5. Promyelocytes: non specific granules appear
6. Myelocytes: specific granules appear
7. Metamyelocytes:
8. Band cells or stab cells: (neutrophils precursors)



Monopoiesis

It passes through the following steps:

- 1-Pluripotential stem cells.
- 2-CFU-GM(from common myeloid progenitor).
- 3-GFU-M
- 4-Monoblasts.
- 5-Promonocytes.
- 6-Monocytes.

Lymphopoiesis:

It passes through the following steps:

1-Pluripotential stem cells.

2-Colony forming unit for lymphocytes CFU-L(from common lymphoid progenitor).

3-Lymphoblasts.

4-Prolymphocytes.

5-Large lymphocytes.

6-Small lymphocytes.

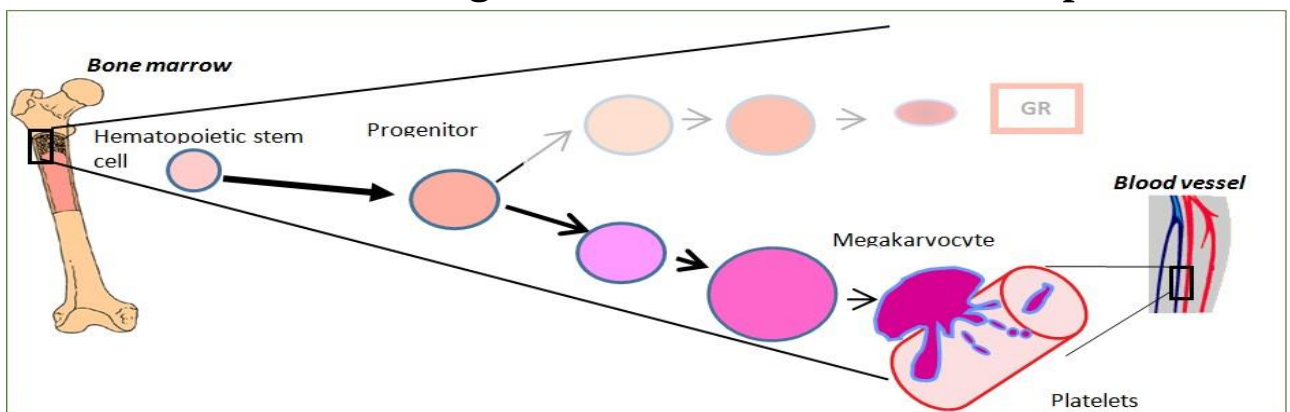
Development of blood platelets (thrombopoiesis)

Thrombopoiesis refers to the development of platelets. It passes through steps till become **Megakaryocytes**

Megakaryocytes: These are giant cells (50-70 μm) with large polyploid nucleus. The cytoplasm contains scattered azurophilic granules.

Mechanism of platelet formation:

These cells extend processes called **proplatelets** which protrude inside the **blood sinusoid** then fragmented inside it to become platelets.



Platelet formation