
بسم الله الرحمن الرحيم

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Welcome

ERYTHROPOIESIS/ERYTHROGENES

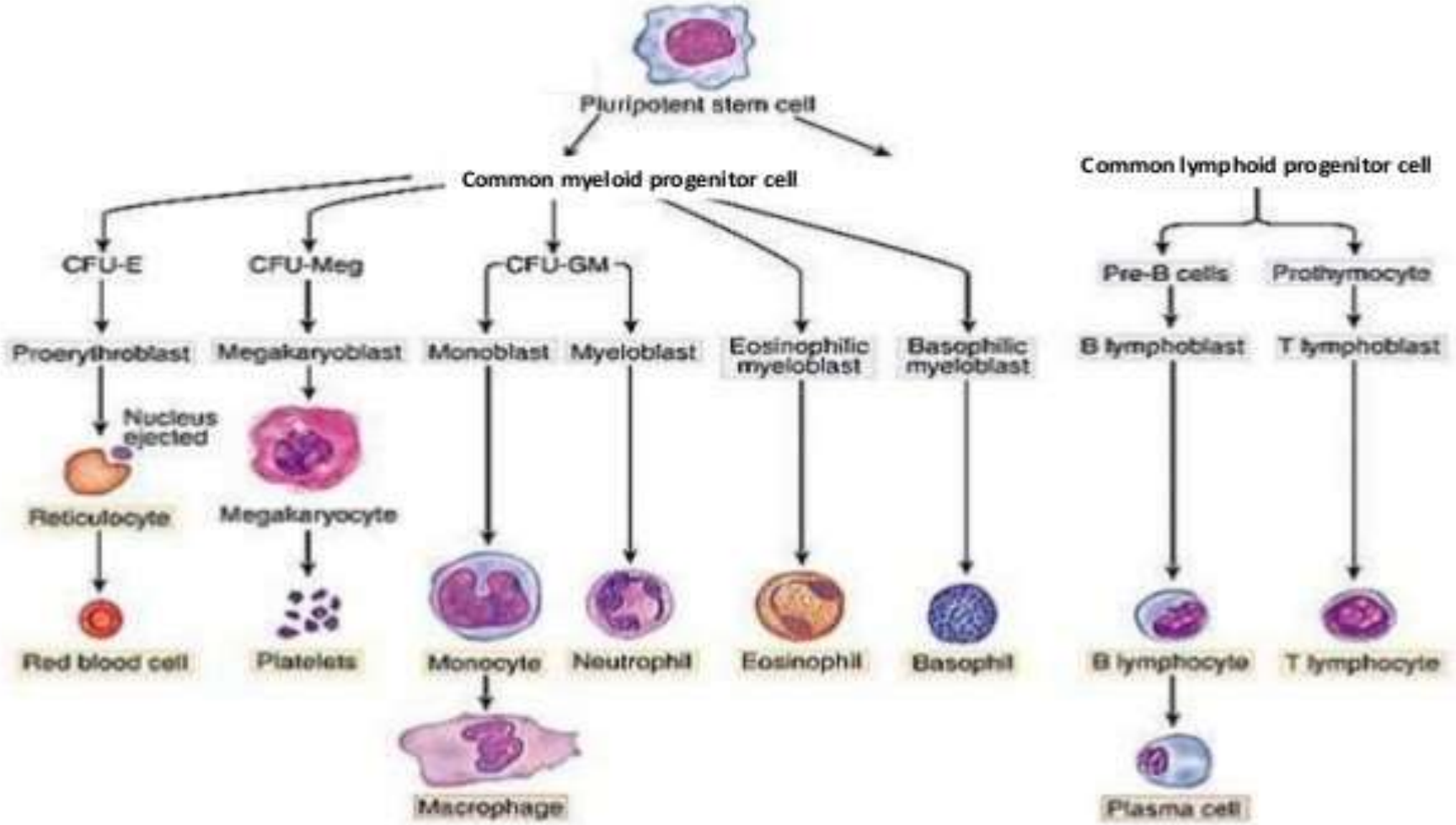
OBJECTIVES

- Definition erythropoiesis
- Sites of haemopoiesis.
- Blood cell precursors.
- Stages of erythropoiesis.
- Control of haemopoiesis
- Regulation of erythropoiesis
- Factors necessary for erythropoiesis

HAEMOPOIESIS

- Process of development of blood cells.
- **Erythropoiesis** – development of RBC
- Leucopoiesis – Development of WBC
- **Thrombopoiesis** – Development of platelets.

Haemopoiesis



SITES OF HAEMOPOIESIS IN FOETUS

- **First 2 months** of gestation – yolk sac.
- **3rd month** onwards – liver, spleen.
- **20th week** onwards – till birth - bone marrow.

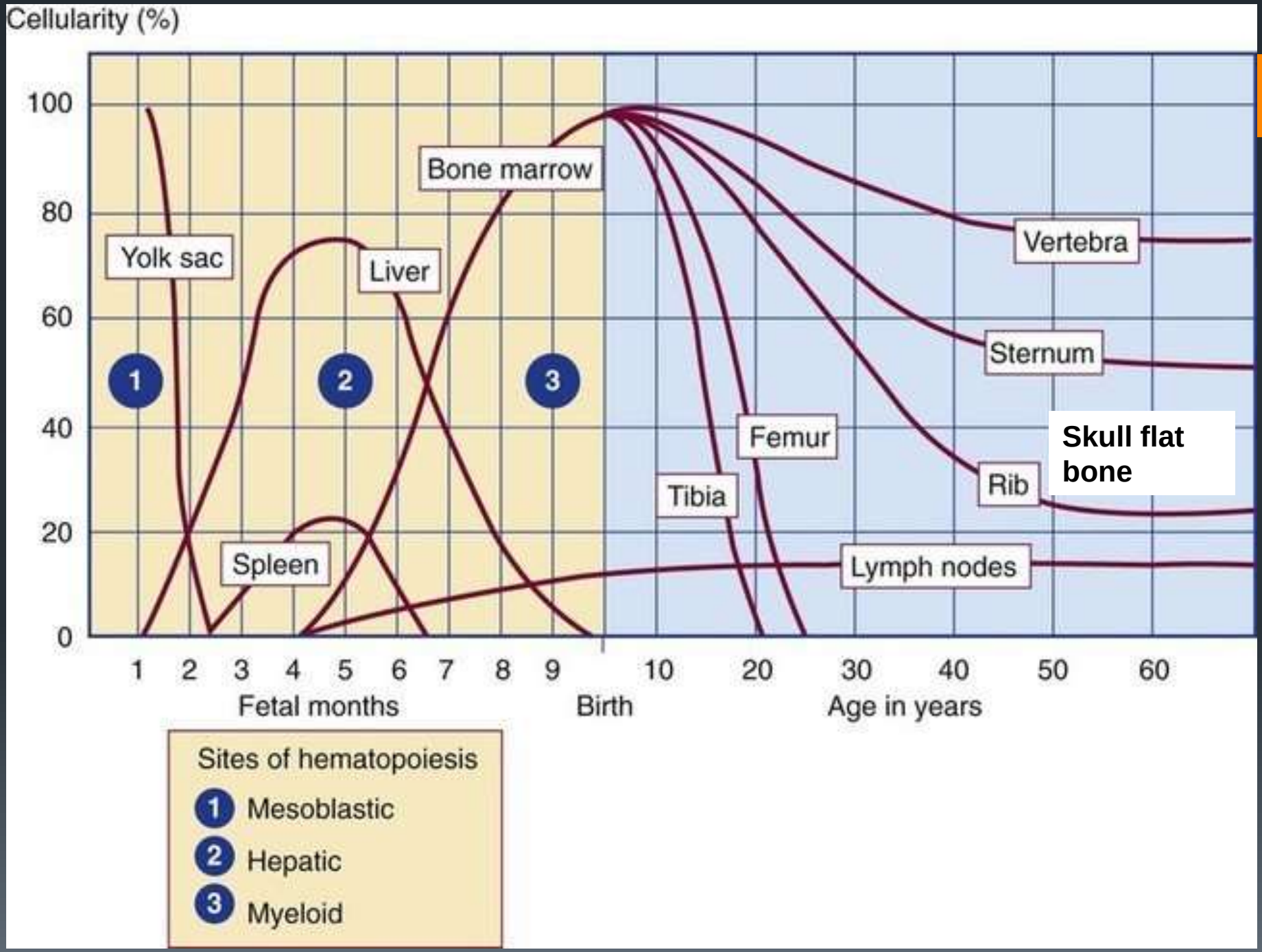
SITES OF HAEMOPOIESIS

- **In Young Children** – axial skeleton & bones of extremities i.e. Red Bone marrow.

  With fatty replacement it becomes Yellow Bone Marrow.

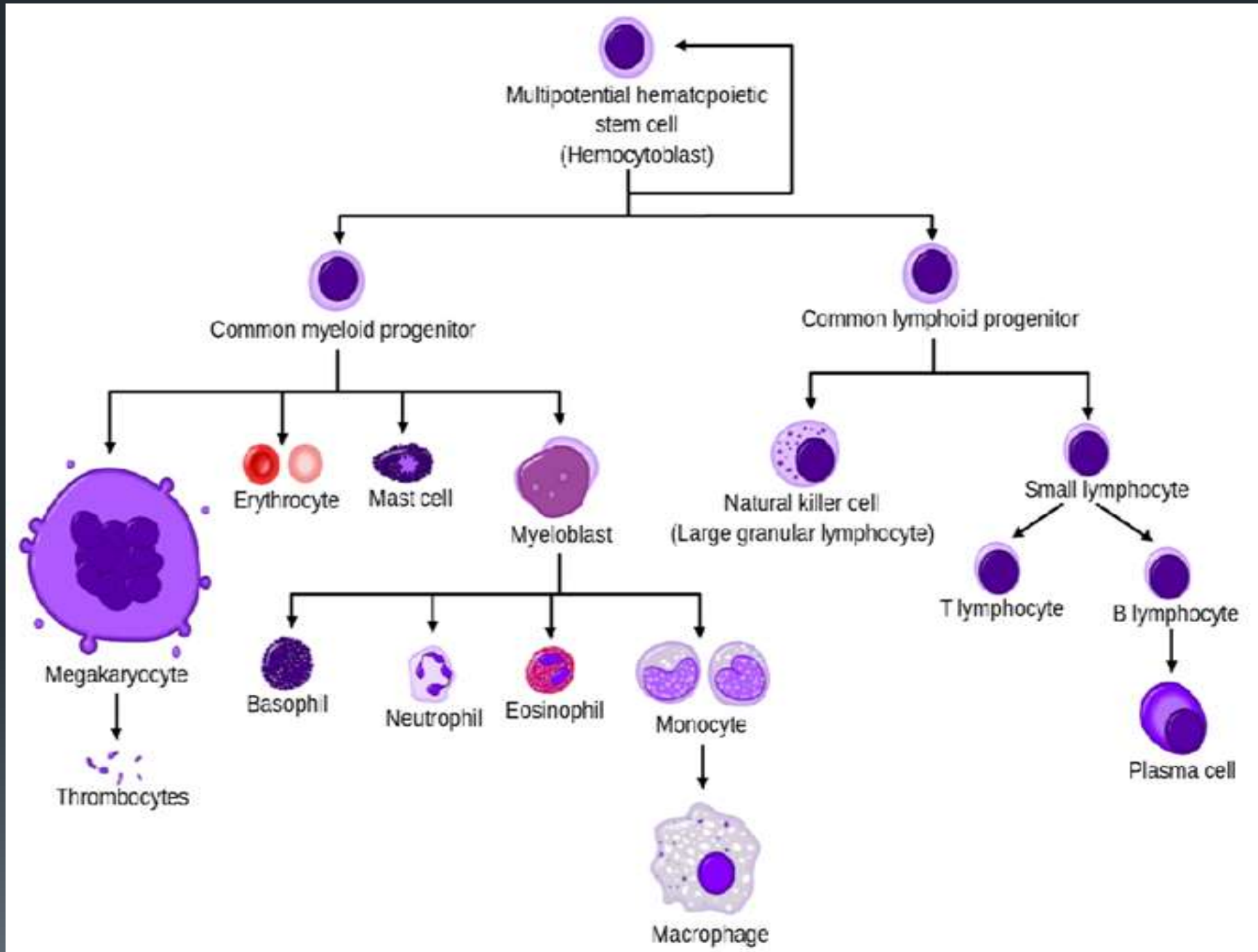
- **In Adults** – axial skeleton & proximal extremities of long bones.

- **In Pathological conditions** – extra medullary haemopoiesis i.e liver & spleen resumes .


Cellularity (%)
100
80
60
40
20
0
Yolk sac
Liver
Bone marrow
Spleen
Vertebra
Sternum
Femur
Tibia
Rib
Lymph nodes
1
2
3
Skull flat bone
1 2 3 4 5 6 7 8 9
Fetal months
Birth
10 20 30 40 50 60
Age in years
Sites of hematopoiesis
1 Mesoblastic
2 Hepatic
3 Myeloid

BLOOD CELL PRECURSORS.

- **The stem cells – Monophyletic Theory.**
  - All originate from PHSC, Pleuripotent Hamopoietic Stem Cell.
- **Fundamental properties**
  - Self replication.
  - Differentiation & commitment.


Multipotential hematcpoietic
stem cell
(Hemocytoblast)
Common myeloid progenitor
Common lymphoid progenitor
Erythrocyte
Mast cell
Myeloblast
Natural killer cell
(Large granular lymphocyte)
Small lymphocyte
Megakaryocyte
Basophil
Neutrophil
Eosinophil
Monocyte
T lymphocyte
B lymphocyte
Thrombocytes
Plasma cell
Macrophage

BLOOD CELL PRECURSORS

- **Progenitor cells.**
- **Pleuripotent progenitor cells**
- **Lymphoid stem cell – Lymphocytes.**
- **Myeloid stem cell.**
  - Granulocyte – Monocyte progenitor.
  - Erythroid progenitor.
  - Megakaryocyte Progenitor.

FEATURES OF PROGENITOR CELLS

Progenitor cells form group of cells called Clones so also called CFU- (colony forming units.)

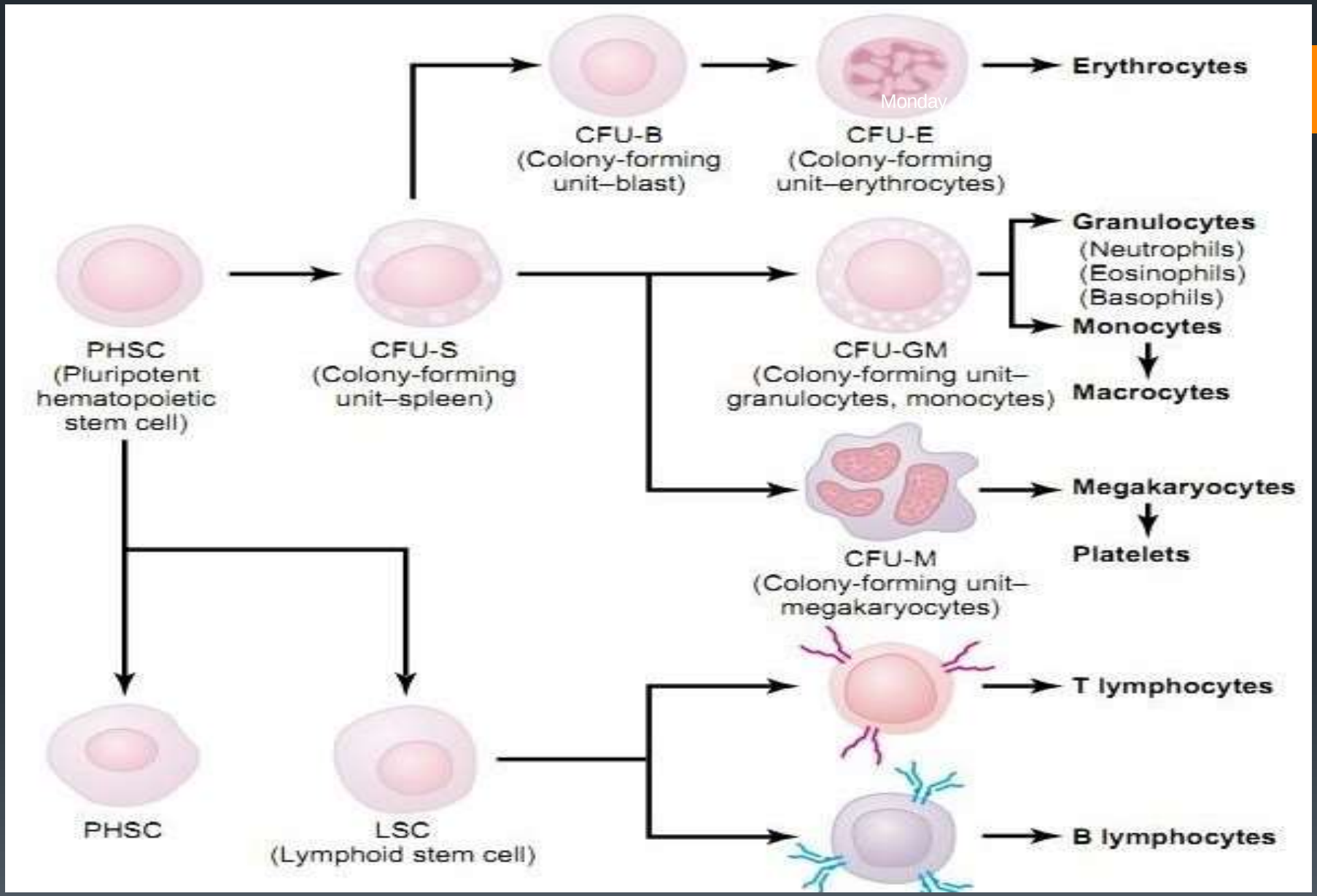
CFU-GEMM – Granulocyte, Erythroid, Megakaryocyte & Macrophages.

BFU-E – Burst forming units Erythroid.

CFU-E - Erythroid **CFU-Ba** – Basophil.

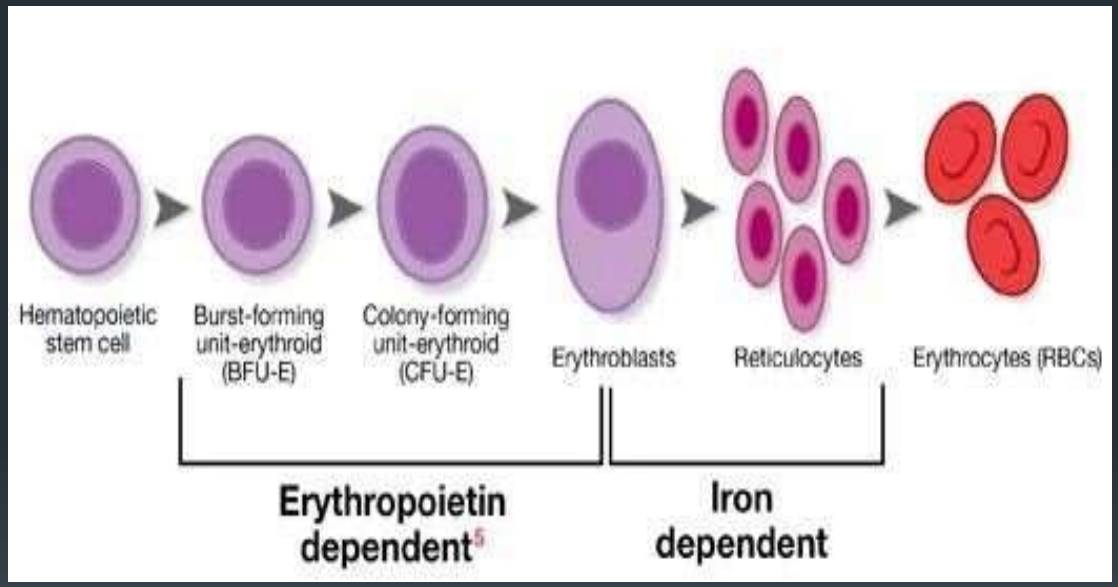
CONTROL OF HAEMOPOIESIS

- Mainly by Hamopoietic Growth Factors i.e. Cytokines.
- These are called Colony Stimulating Factors (CSF)
  - **CSF-G**
  - **CSF-M**
  - **CSF-GM**
- **Interleukins** – for Lymphocyte precursor.
- **Erythropoietin**

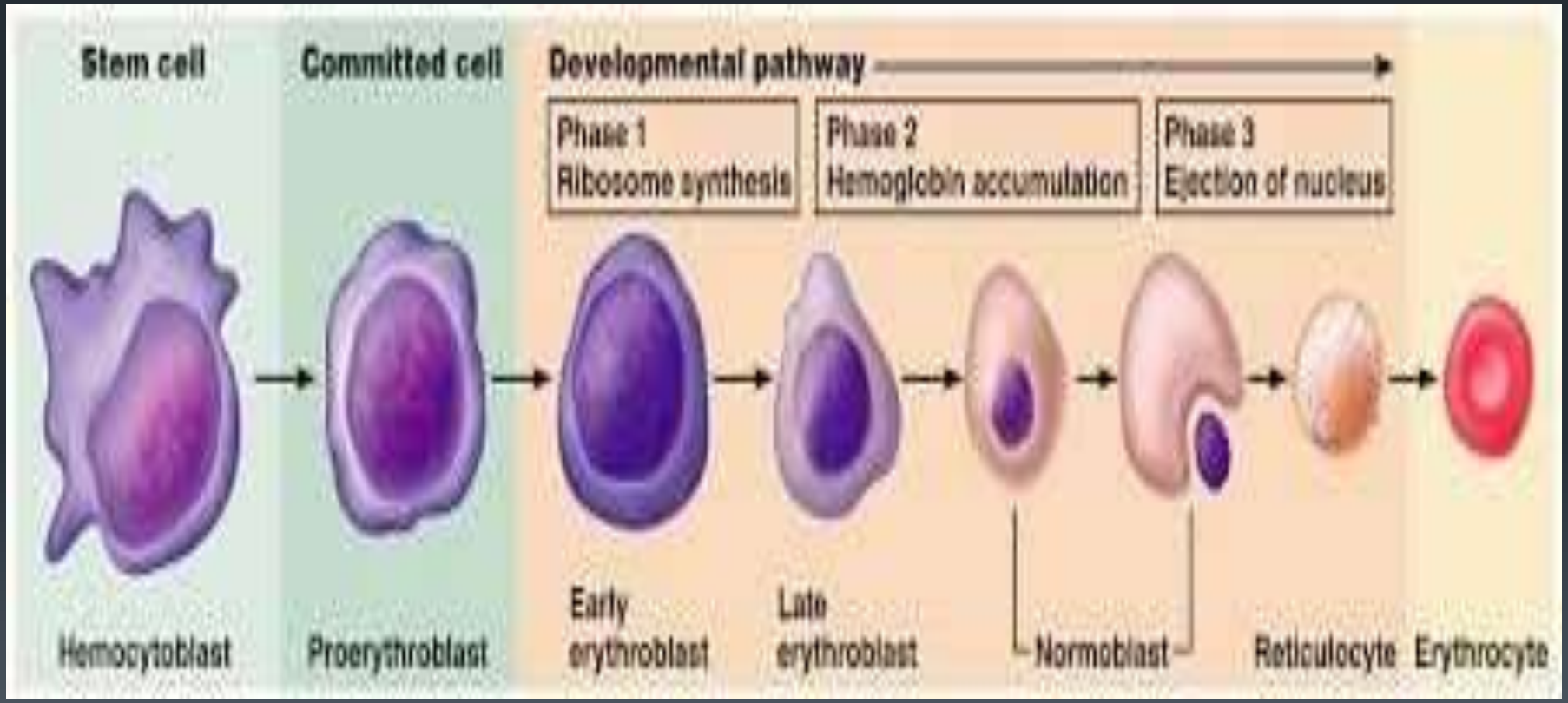

Erythrocytes
CFU-B
(Colony-forming
unit–blast)
CFU-E
(Colony-forming
unit–erythrocytes)
Granulocytes
(Neutrophils)
(Eosinophils)
(Basophils)
Monocytes
Macrocytes
PHSC
(Pluripotent
hematopoietic
stem cell)
CFU-S
(Colony-forming
unit–spleen)
CFU-GM
(Colony-forming unit–
granulocytes, monocytes)
Megakaryocytes
Platelets
CFU-M
(Colony-forming unit–
megakaryocytes)
T lymphocytes
B lymphocytes
PHSC
LSC
(Lymphoid stem cell)

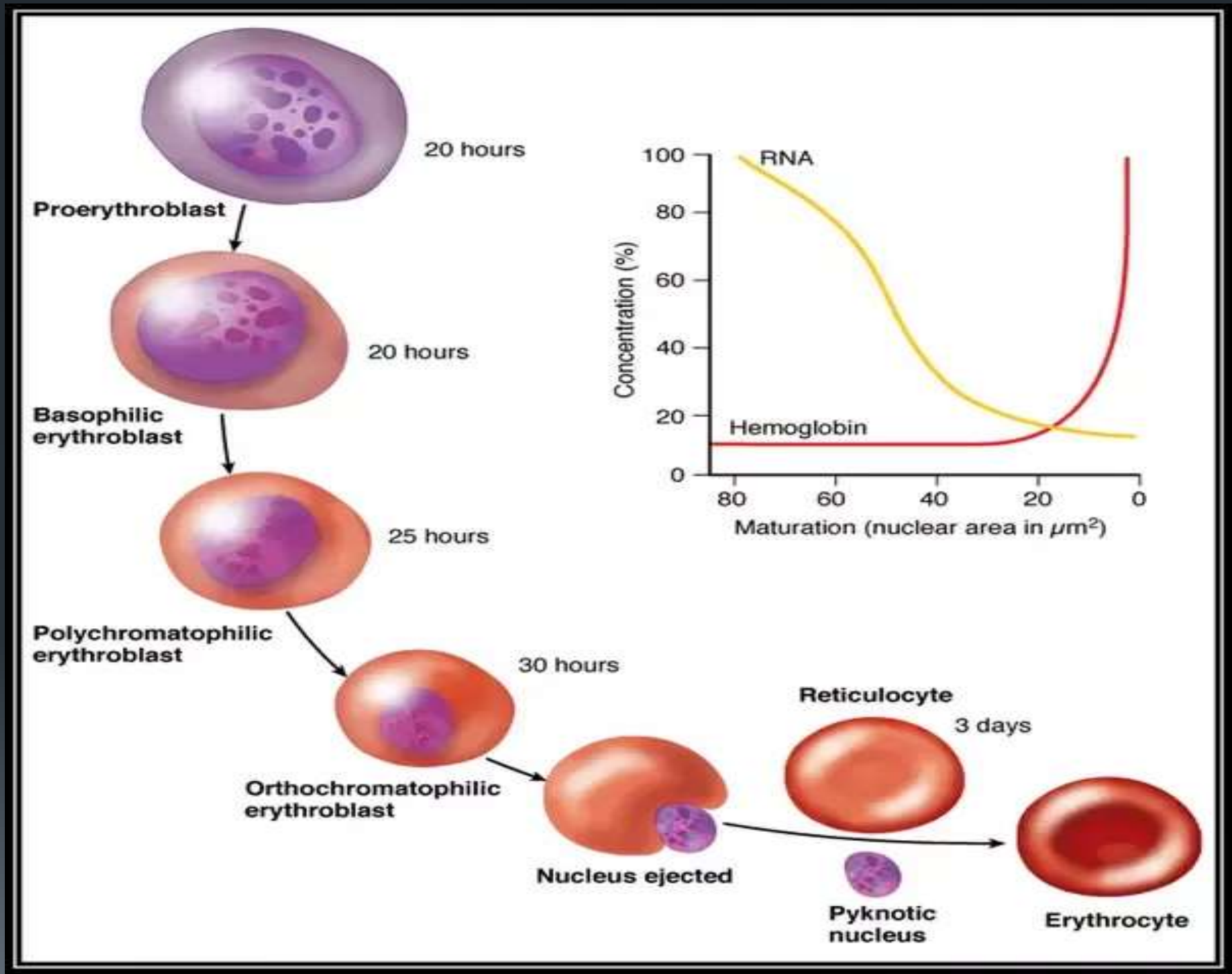
STAGES OF ERYTHROPOIESIS

- **Pronormoblast**
- **Early normoblast (Basophilic)**
- **Intermediate normoblast (Polychromatic)**
- **Late normoblast (orthochromatic)**
- **Reticulocyte**
- **Erythrocytes**



STAGES OF ERYTHROPOIESIS.

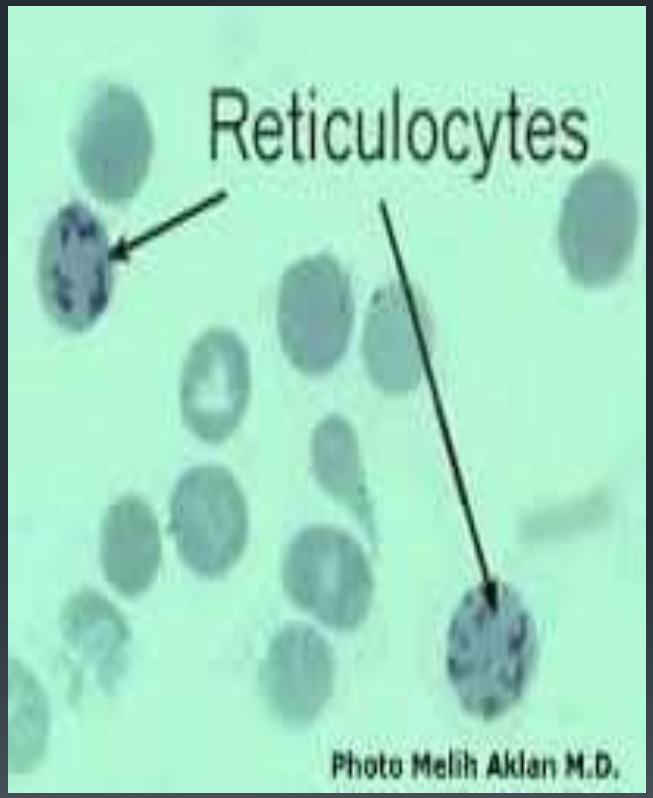



20 hours
Proerythroblast
20 hours
Basophilic erythroblast
25 hours
Polychromatophilic erythroblast
30 hours
Orthochromatophilic erythroblast
Nucleus ejected
Reticulocyte
3 days
Pyknotic nucleus
Erythrocyte
100
80
60
40
20
0
Concentration (%)
RNA
Hemoglobin
80
60
40
20
0
Maturation (nuclear area in μm²)

CELLS/FEATURES	SIZE	CYTOPLASM	NUCLEUS	HAEMOGLOB IN	MITOSIS
PRO-NORMOBLAST	15-20 µm	BASOPHILIC	LARGE WITH RETICULAR FORMATION	ABSENT	SEEN
EARLY	12-16µm	BASOPHILIC	LARGE,NUCLEOLI DISAPPEARED.	ABSENT	SEEN
INTERMEDIATE	10-14µm	POLYCHROMATIC	CONDENSED	APPEARS	PRESENT
LATE	8-10µm	ACIDOPHILIC	SMALL PYKNOTIC	INCREASES	ABSENT
RETICULOCYTE	7-7.5µm	RETICULUM LIKE	ABSENT	INCREASES	ABSENT

MATURATION OF RETICULOCYTE TO ERYTHROCYTES.

- **Reticulocyte** – juvenile red cells without nucleus but contains ribosomal RNA so can synthesize Hb.
- Mature Red cells maturation in spleen, lost Ribosomes, Mitochondria.
- Reticulocyte in Infants -2-6%, Adults 0.5-2%.
- Slightly basophilic hue in cytoplasm & can stain with new Methelene Blue or Brilliant Cresyl Blue



SUMMARY OF CHANGES

Cell	Duration	Size	Nucleus	Hb synthesis	Cytoplasm staining	Mitosis
Reticulocyte	0-5 DAYS	7.5-8 µm	Condenses, pyknotic	Present	Basophilic-polychromatic - acidophilic	Only upto intermediate normoblast
RBC	2 DAYS	7 µm	Absent	Absent	acidophilic	Absent only cell matures.

THANK YOU