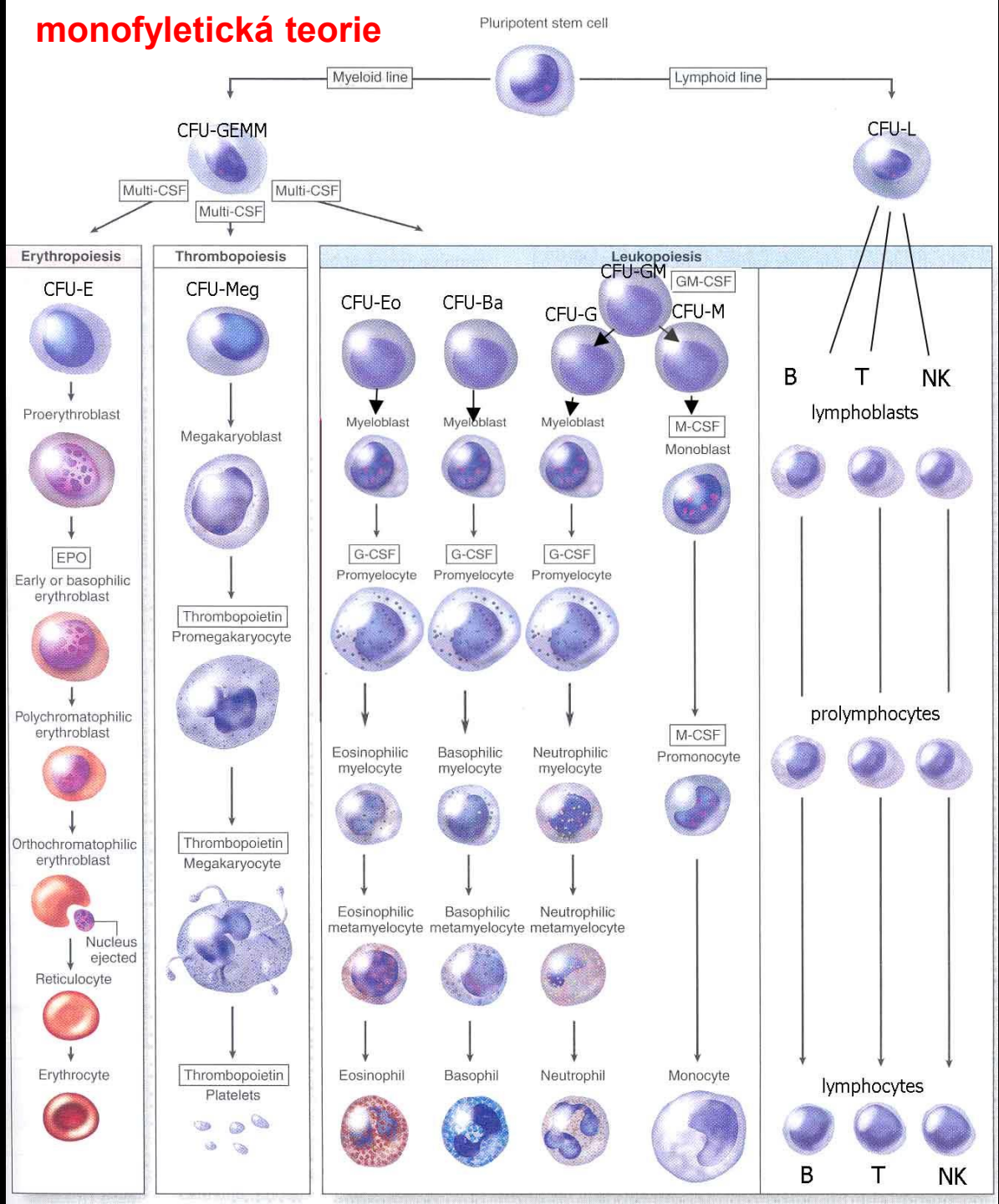
Krvetvorba (hemopoéza)

Kmenové buňky

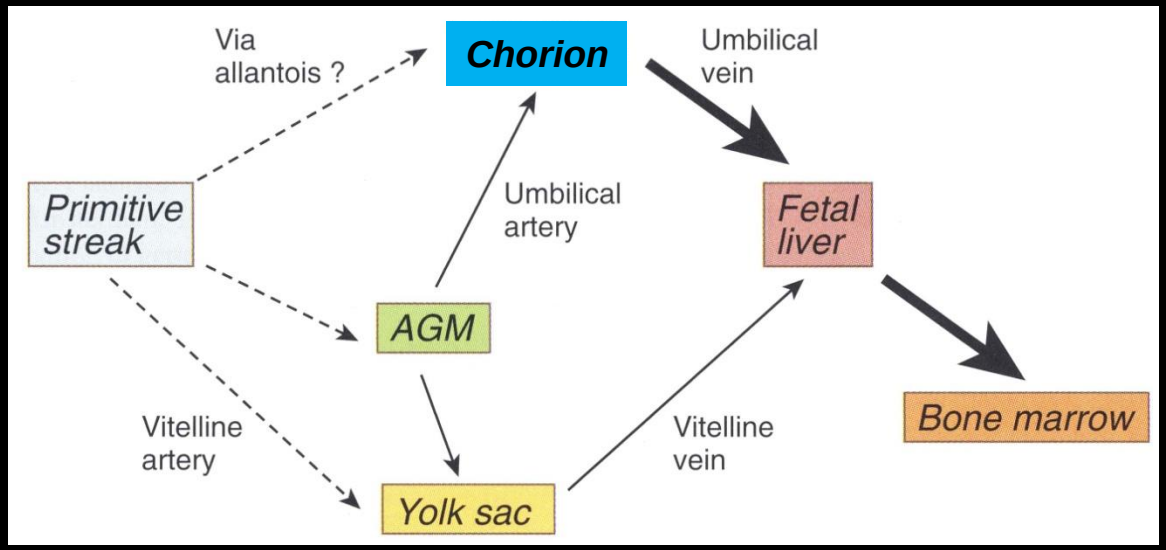
Progenitorové buňky (CFU)

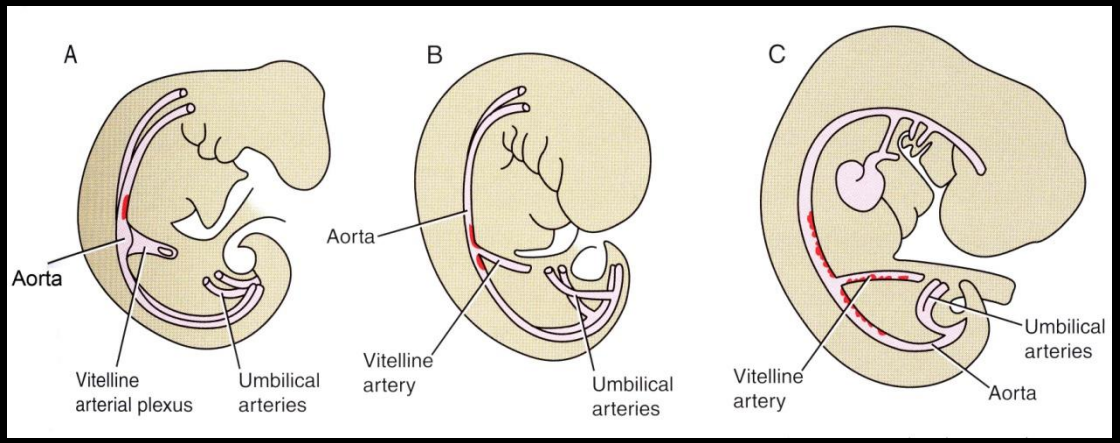
Prekursorové buňky (blasty)

Zralé buňky

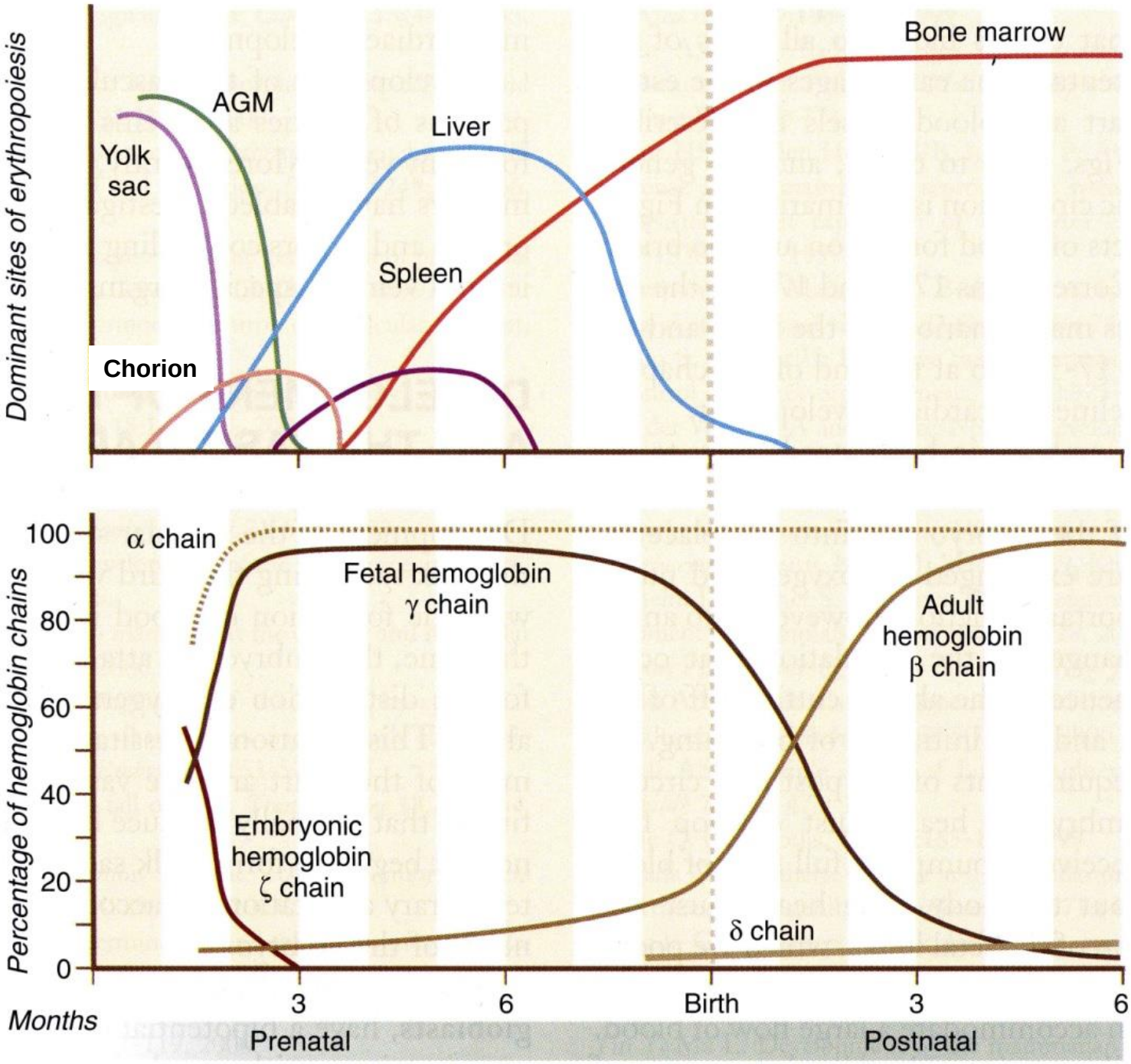


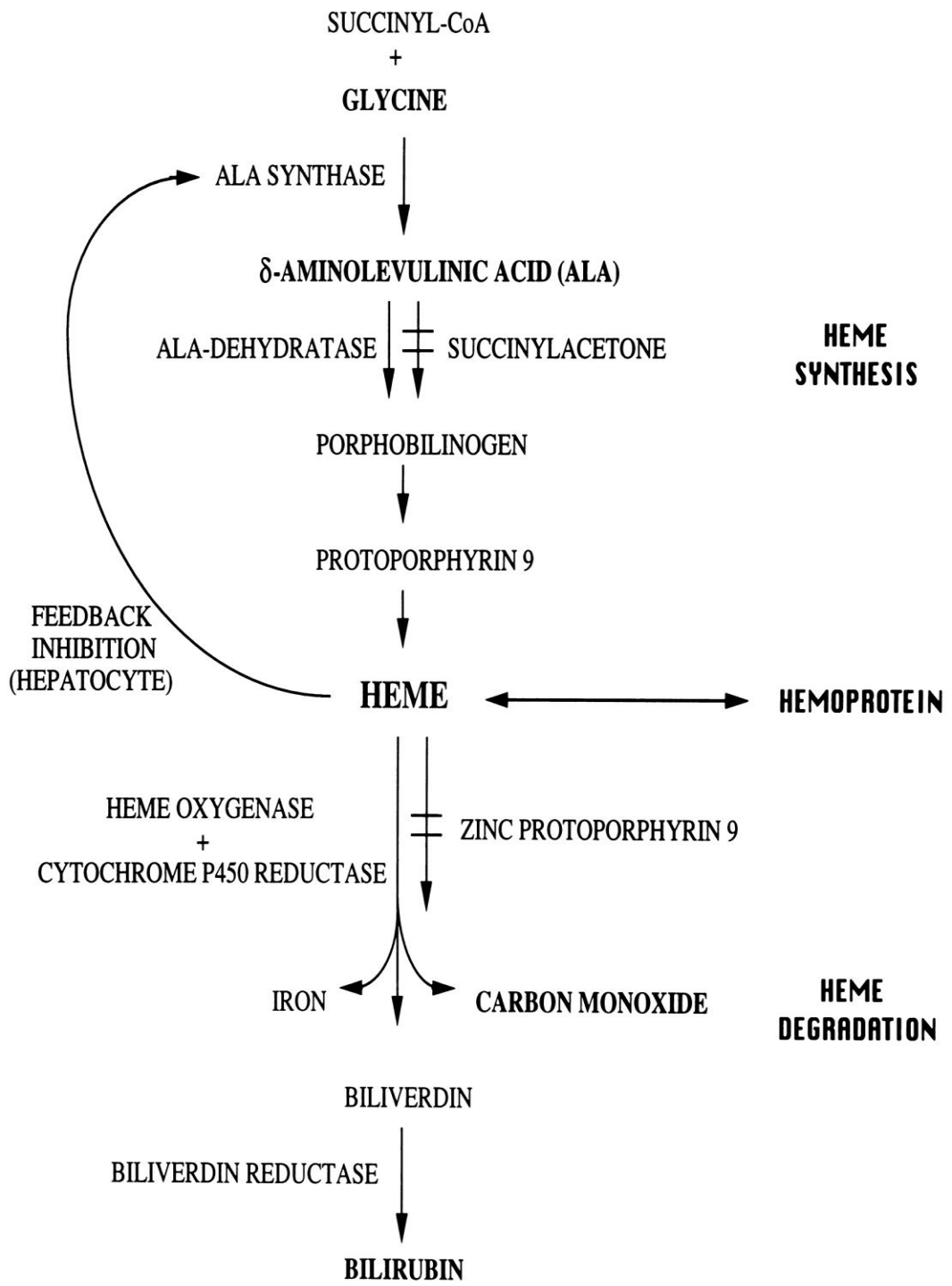
Vývoj krvetvorby

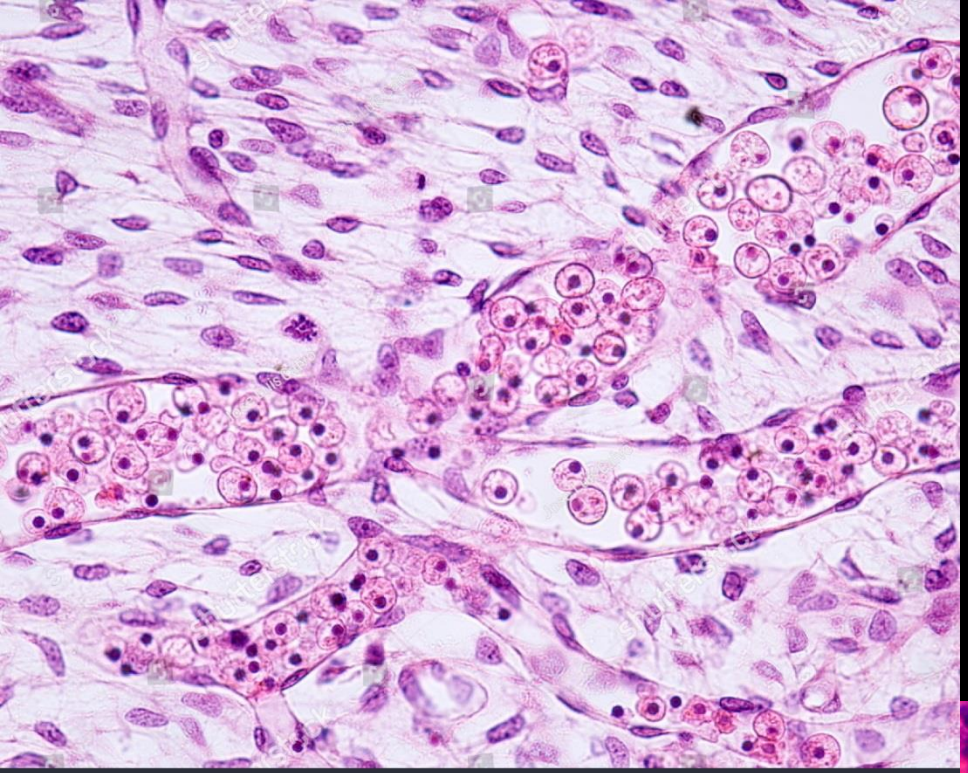




AGM = aorta, genitální lišta, mesonephros

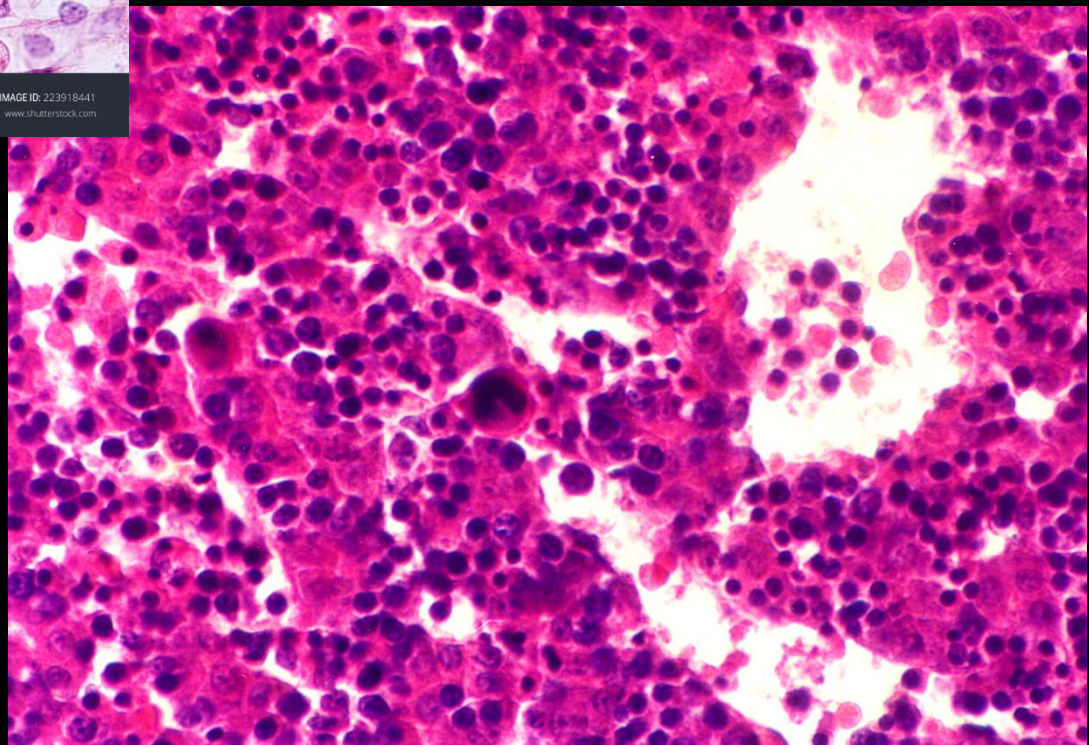

Dominant sites of erythropoiesis
Yolk sac
AGM
Liver
Spleen
Bone marrow
Chorion
Percentage of hemoglobin chains
100
80
60
40
20
0
α chain
Fetal hemoglobin
γ chain
Adult
hemoglobin
β chain
Embryonic
hemoglobin
ζ chain
δ chain
Months
3
6
Birth
3
6
Prenatal
Postnatal


SUCCINYL-CoA
+
GLYCINE
ALA SYNTHASE
δ-AMINOLEVULINIC ACID (ALA)
ALA-DEHYDRATASE
SUCCINYLACETONE
HEME SYNTHESIS
PORPHOBILINOGEN
PROTOPORPHYRIN 9
FEEDBACK INHIBITION (HEPATOCYTE)
HEME
HEMOPROTEIN
HEME OXYGENASE
+
CYTOCHROME P450 REDUCTASE
ZINC PROTOPORPHYRIN 9
IRON
CARBON MONOXIDE
HEME DEGRADATION
BILIVERDIN
BILIVERDIN REDUCTASE
BILIRUBIN

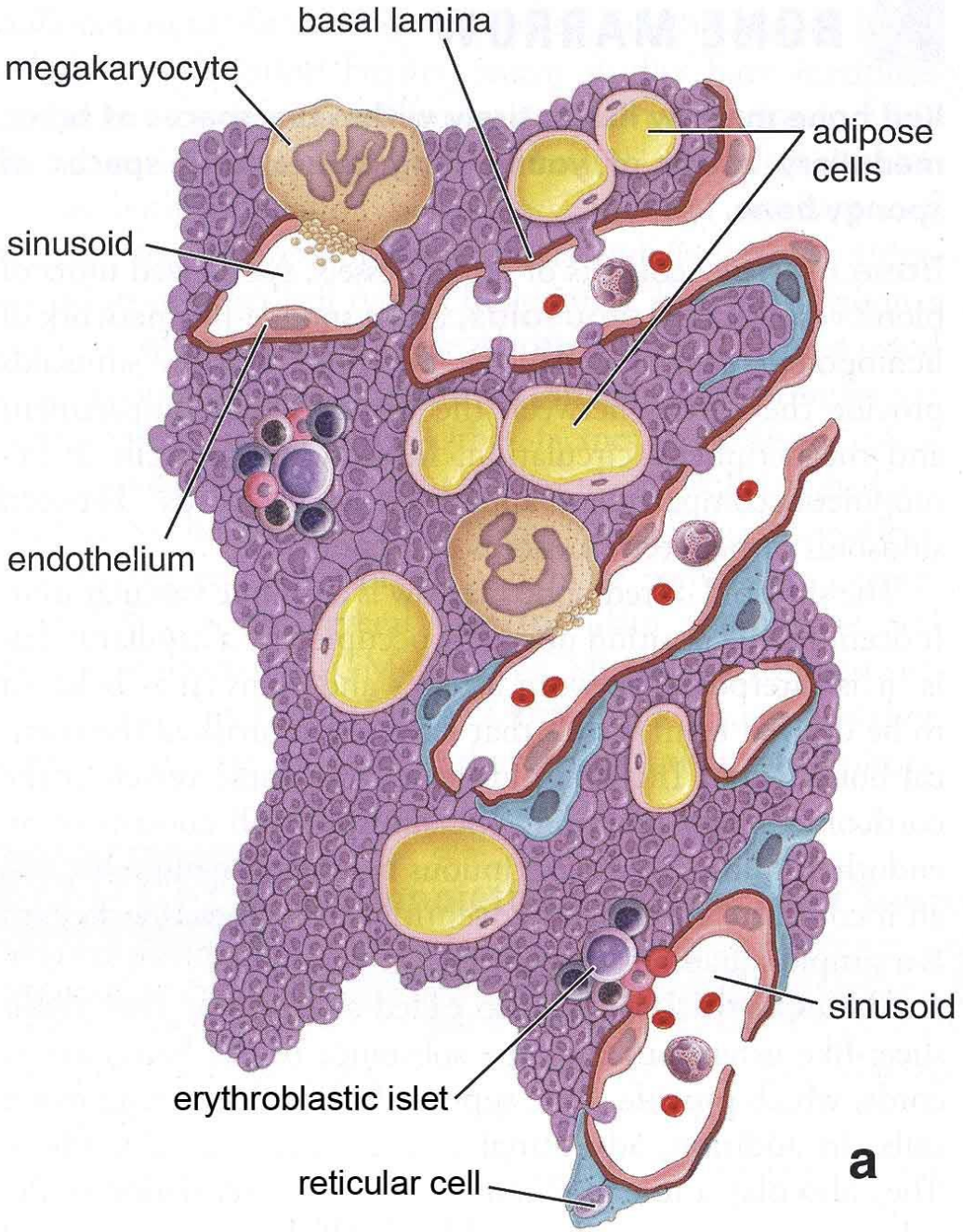


Embryonální krvinky

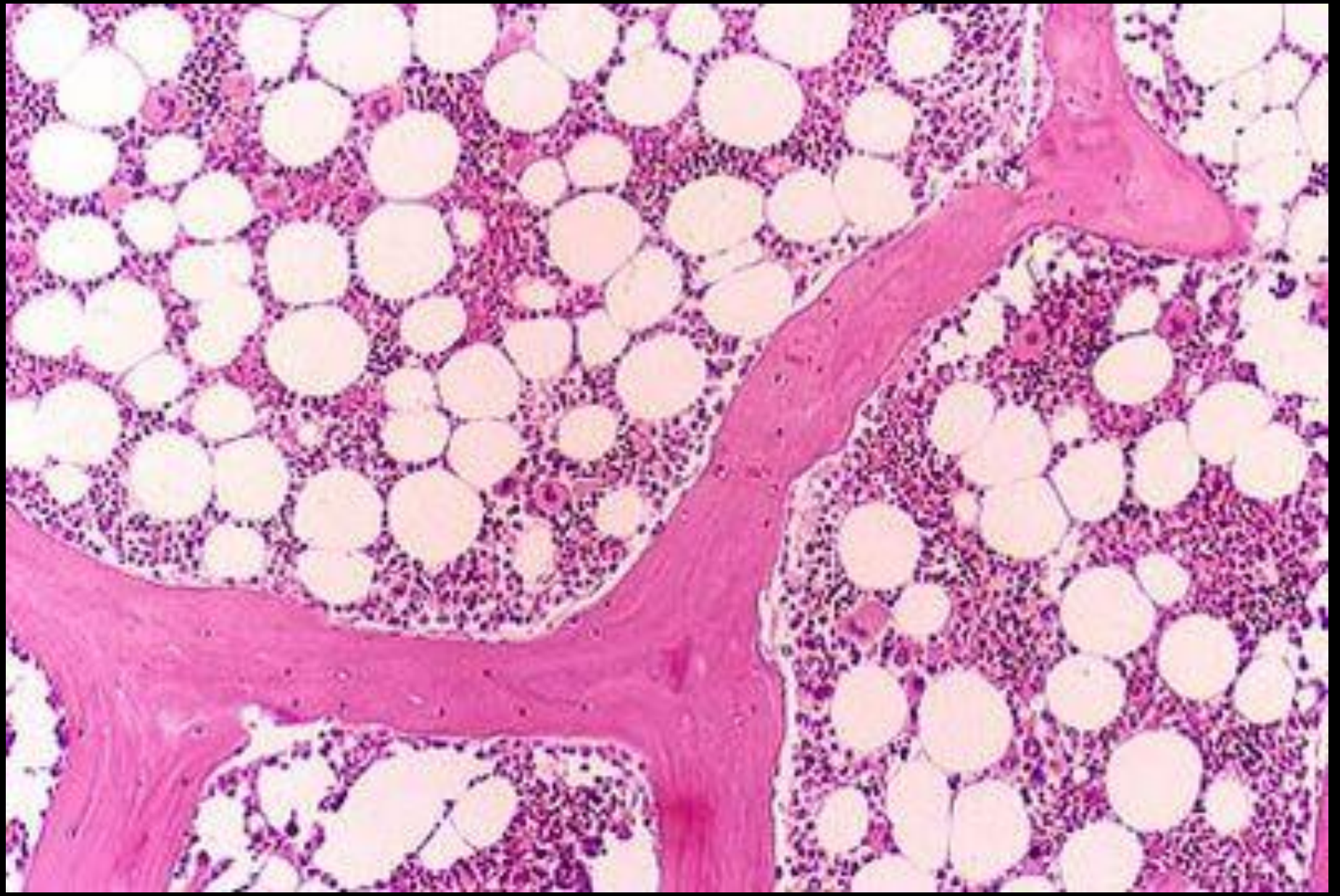
Fetální játra



Kostní dřeň

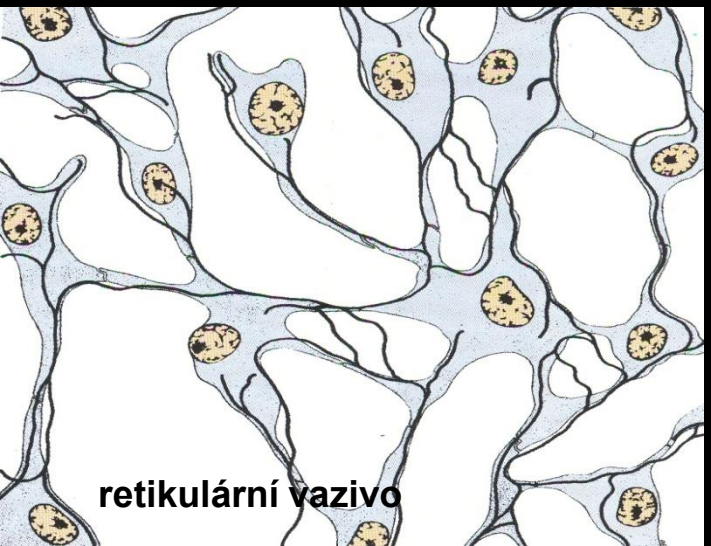


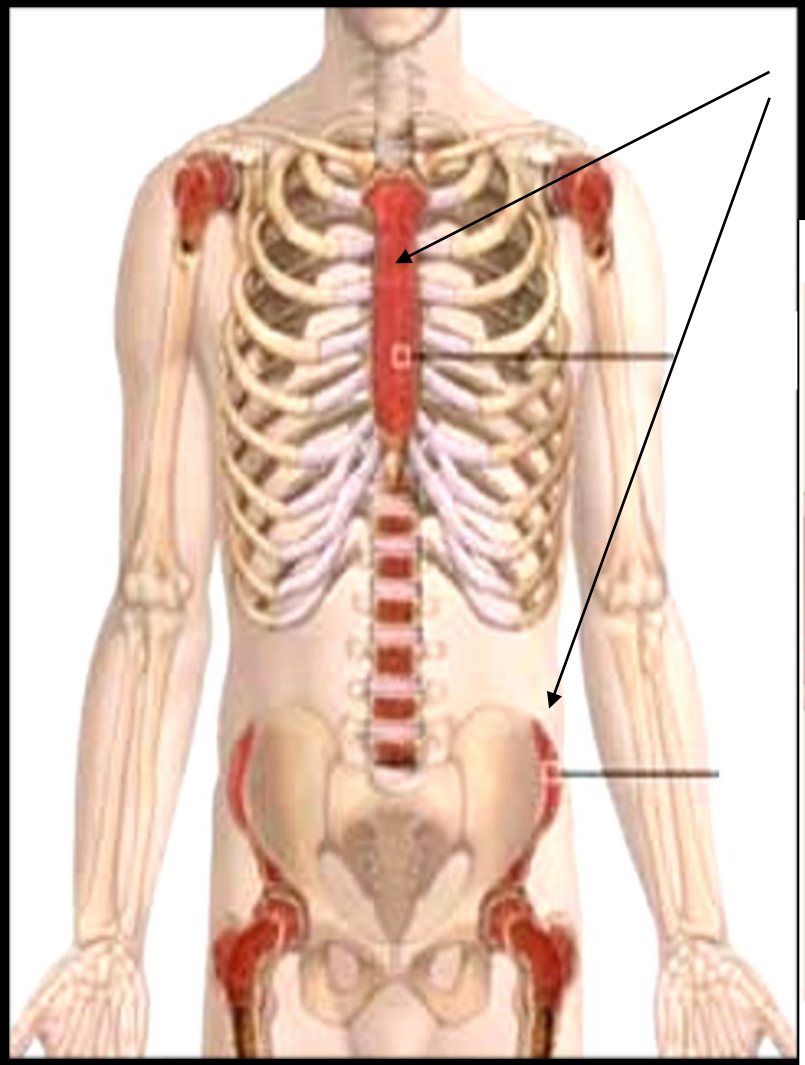
Pawlina W.: Histology, a Text and Atlas, Wolters Kluwer 2016



hemopoetické ostrůvky

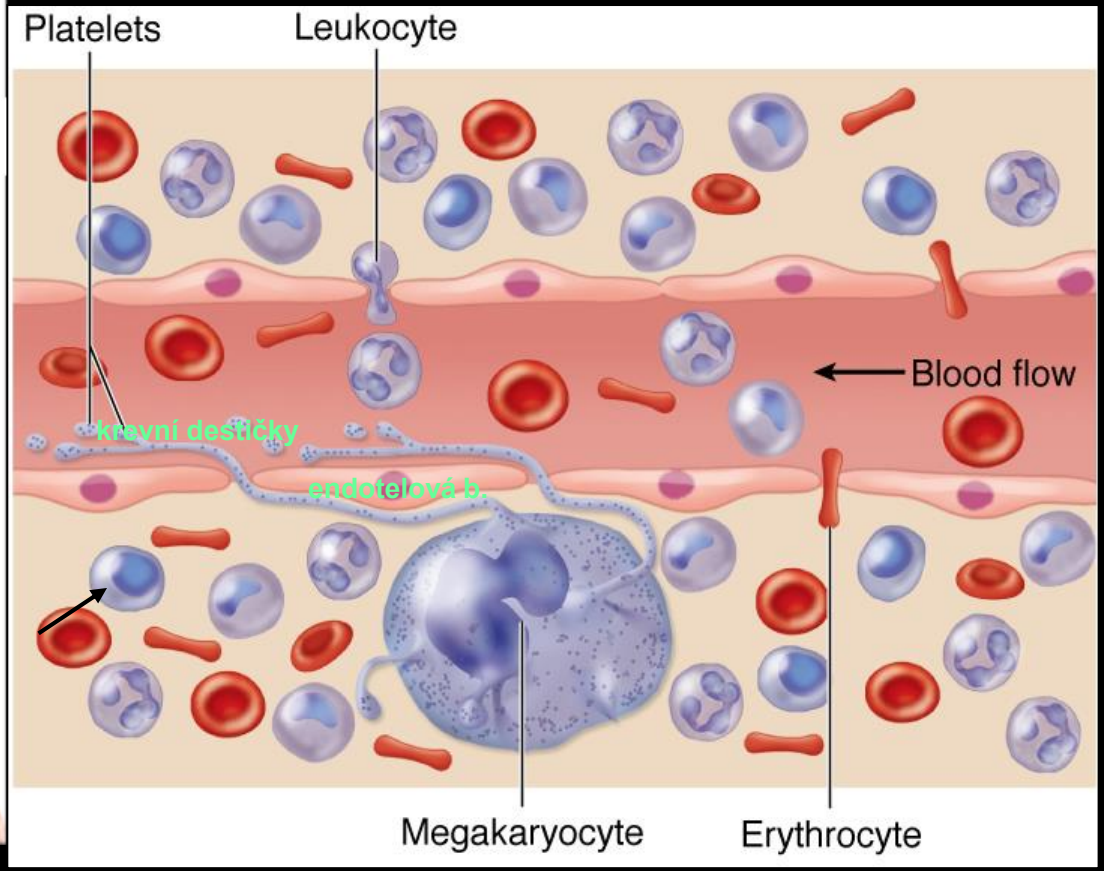
adipocyty



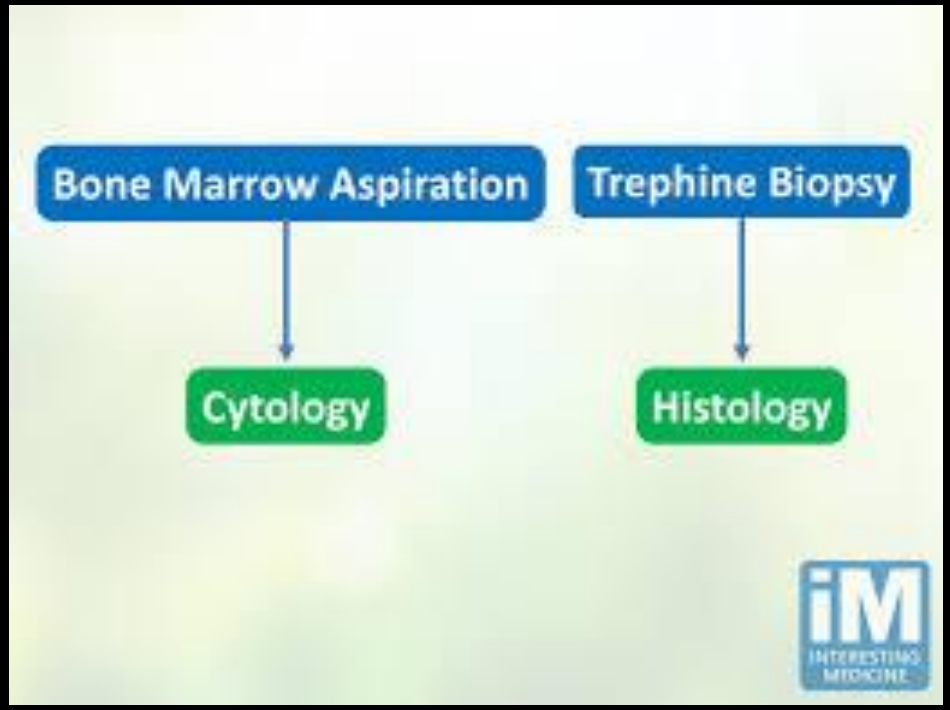


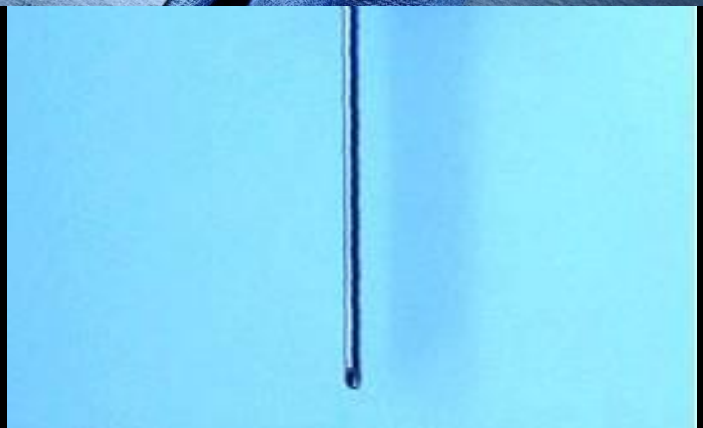
Červená kostní dřeň: dospělost:

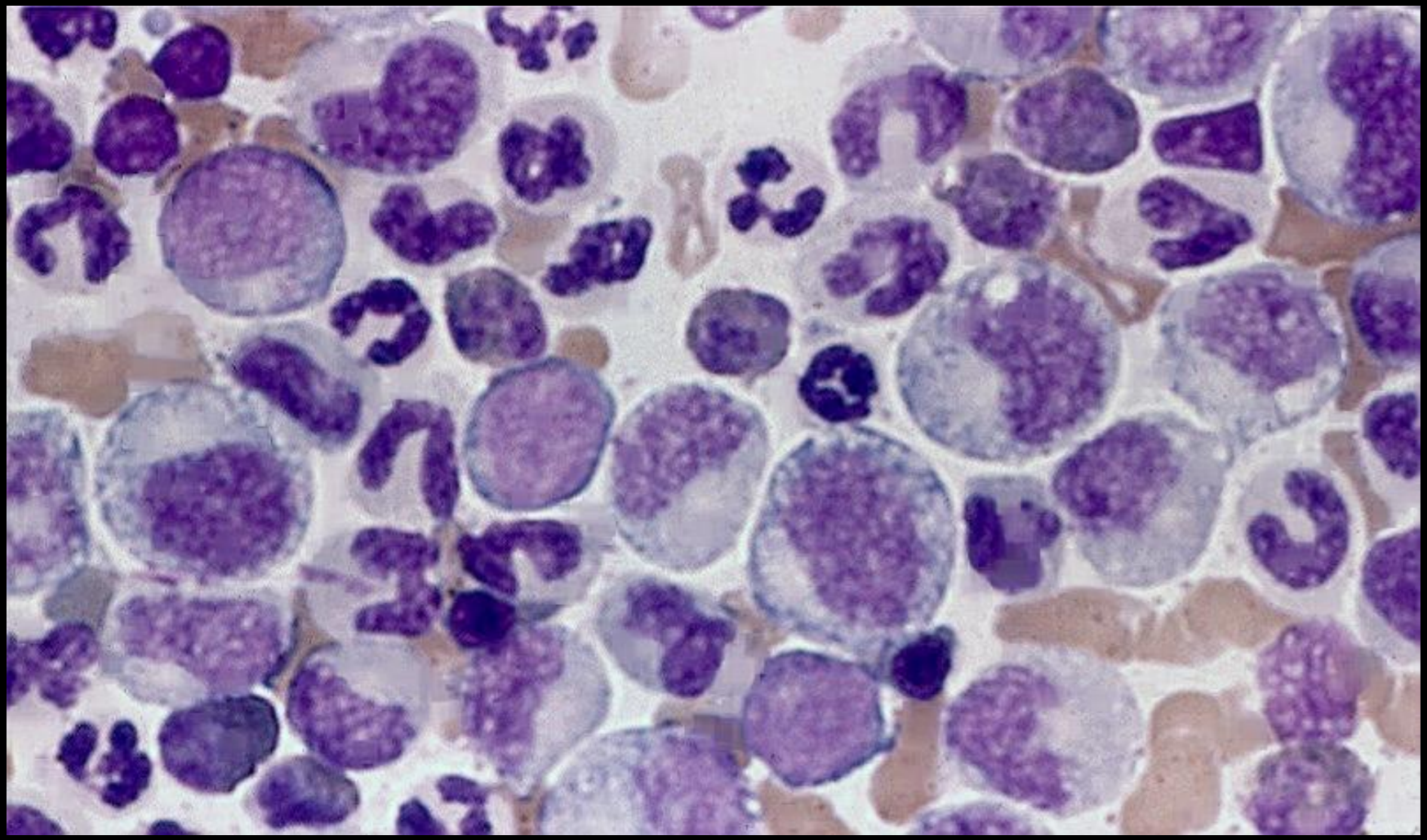
+ ploché kosti lebky



Aspirace kostní dřeně vs trepanobiopsie







Vývoj červených krvinek, erytropoéza

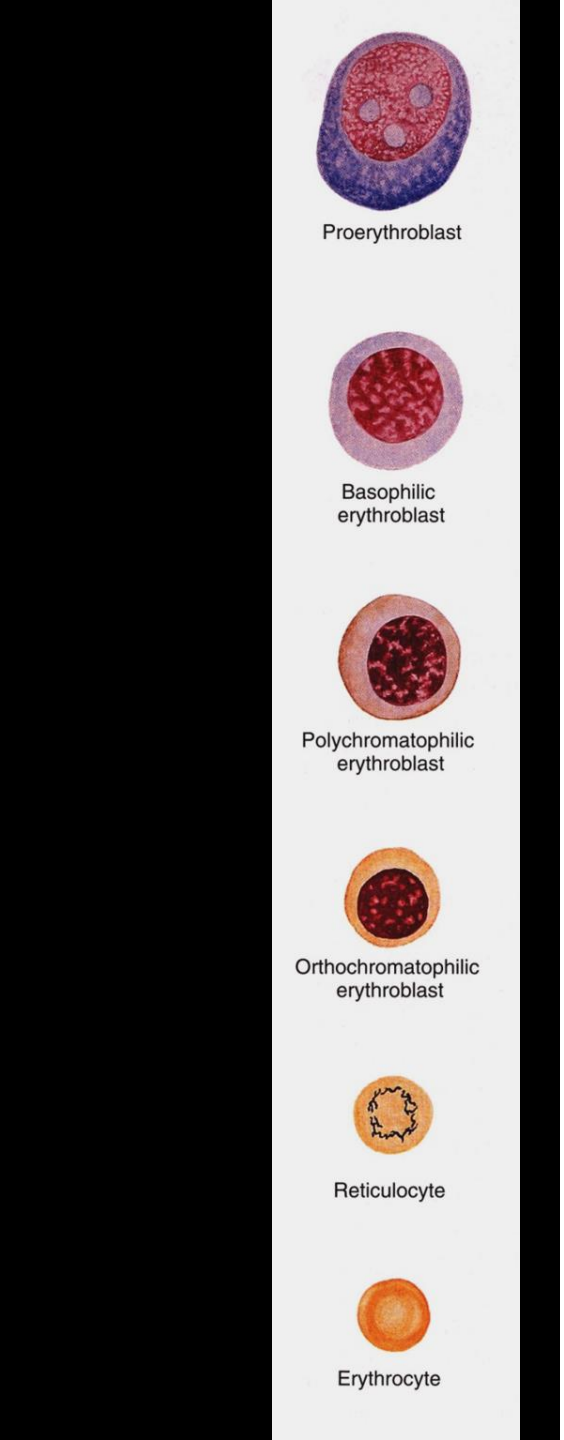
velikost buňky

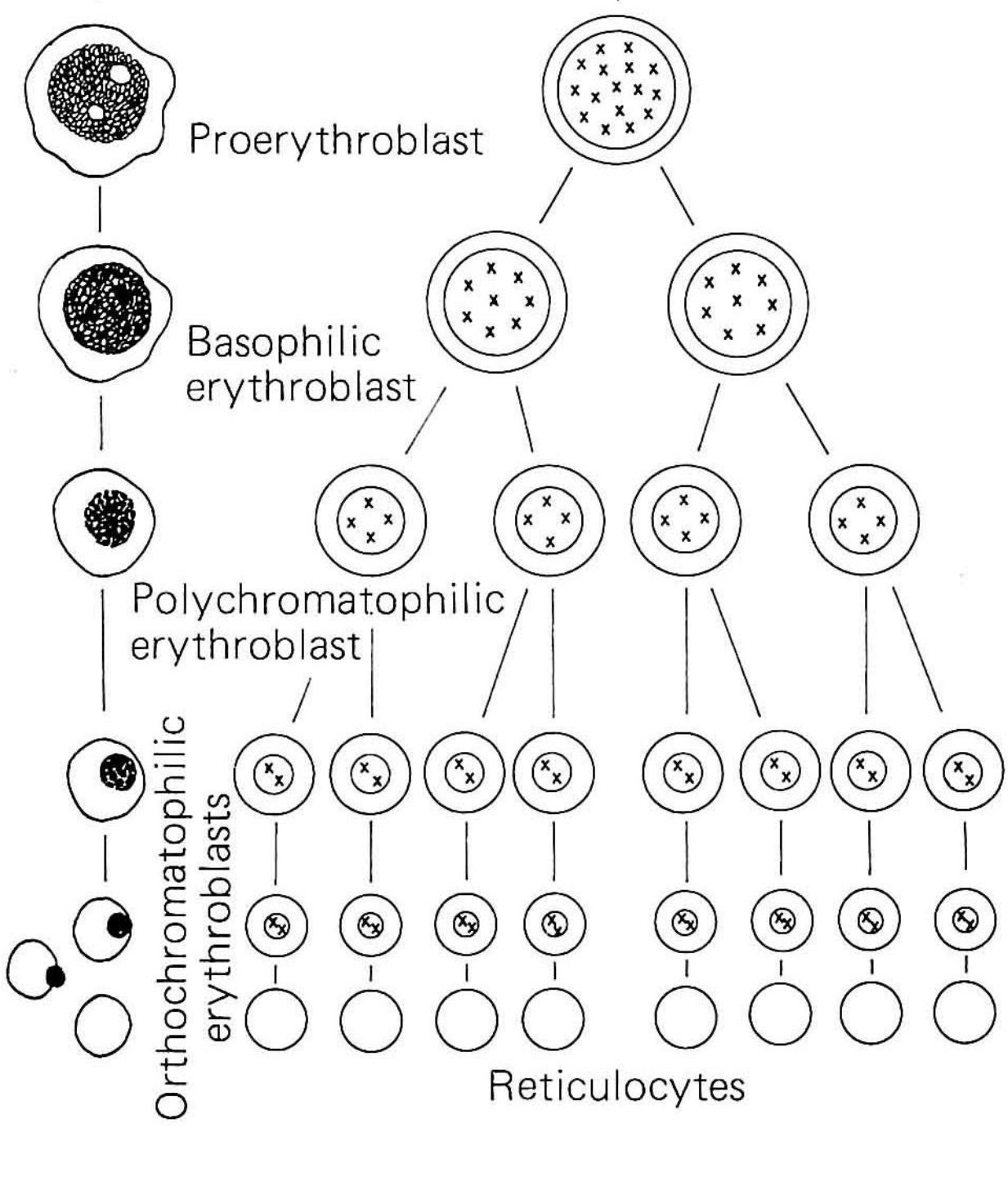
velikost jádra

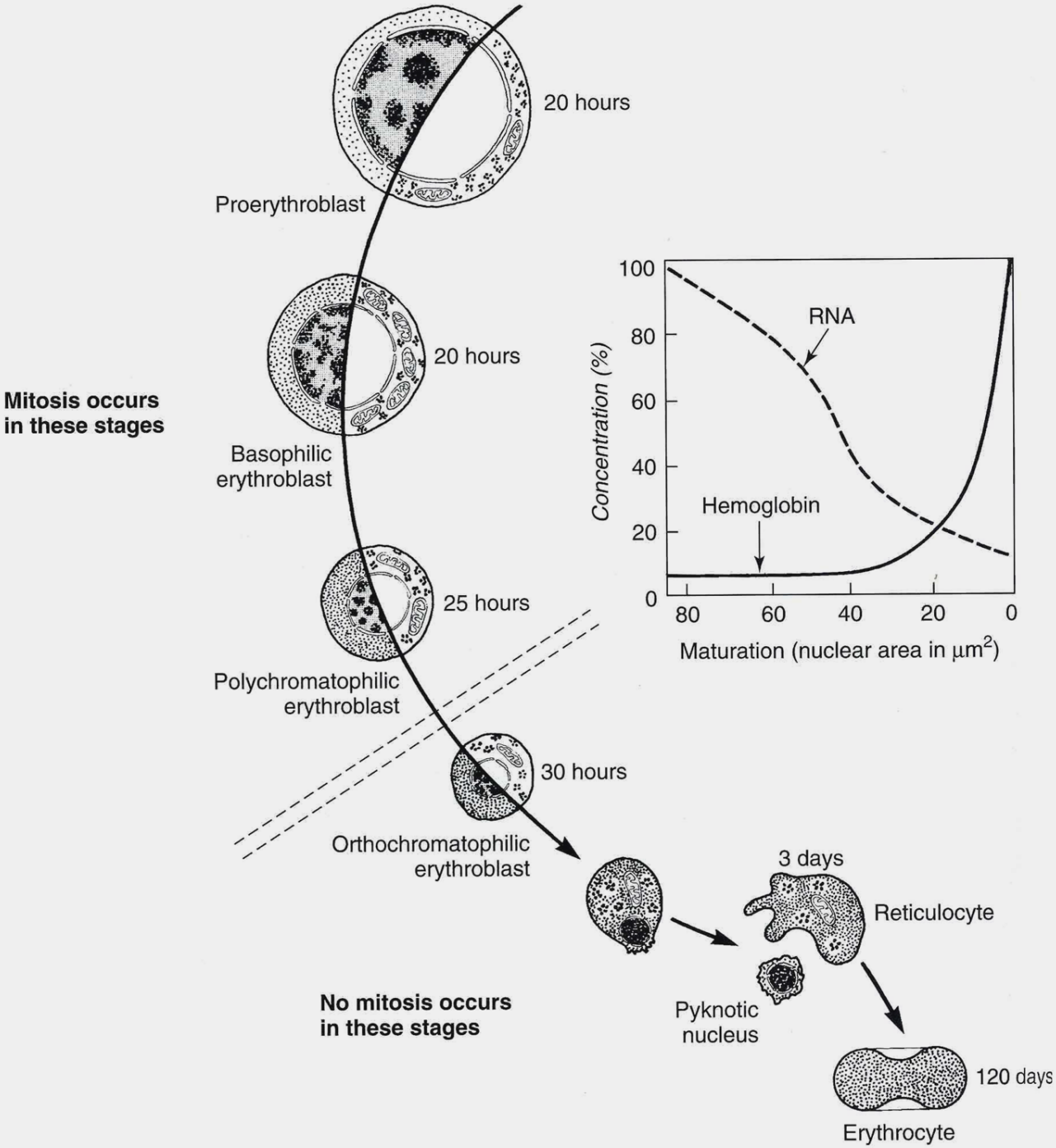
kondenzace jádra

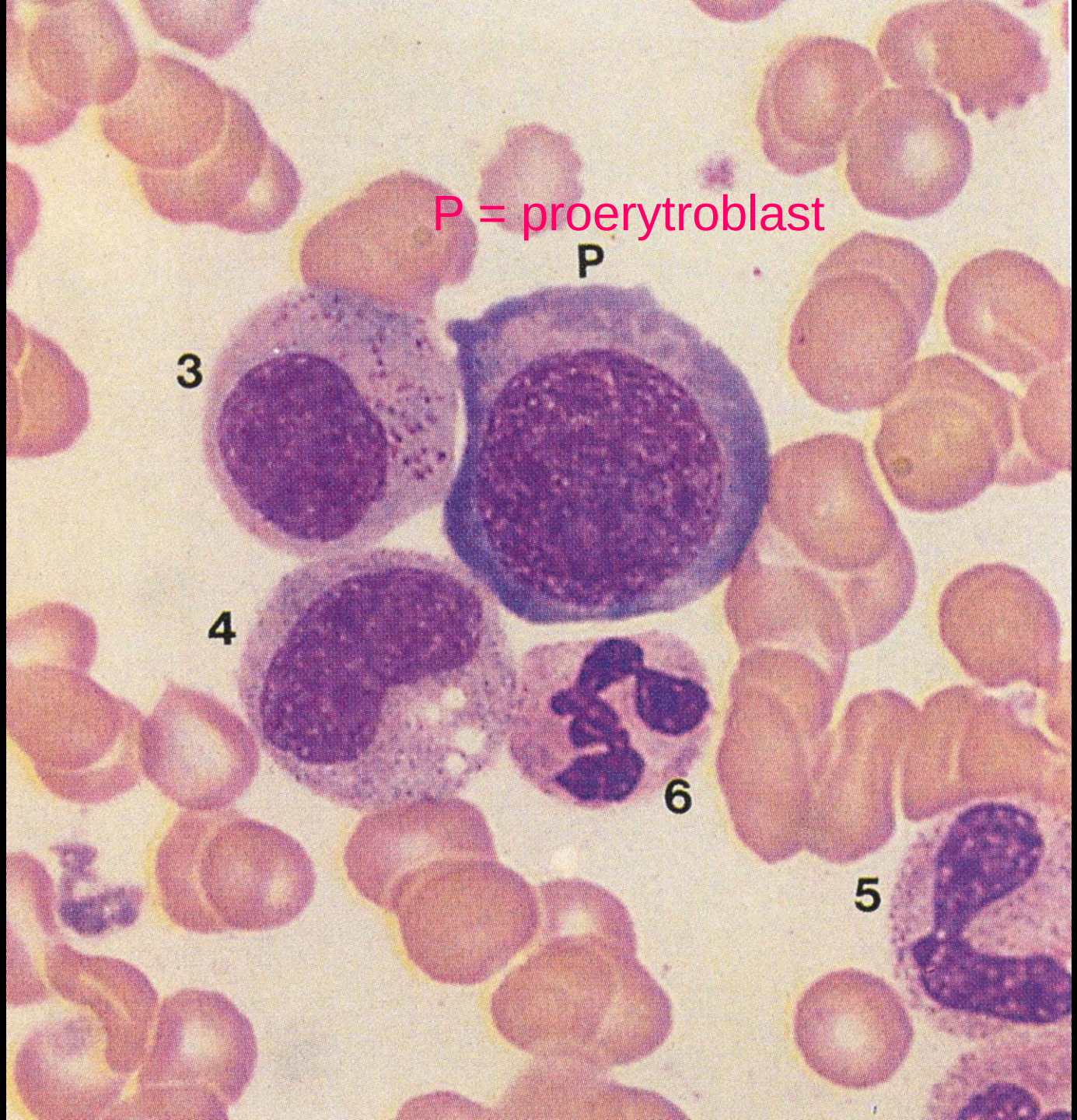
basofílie (ribosomy)

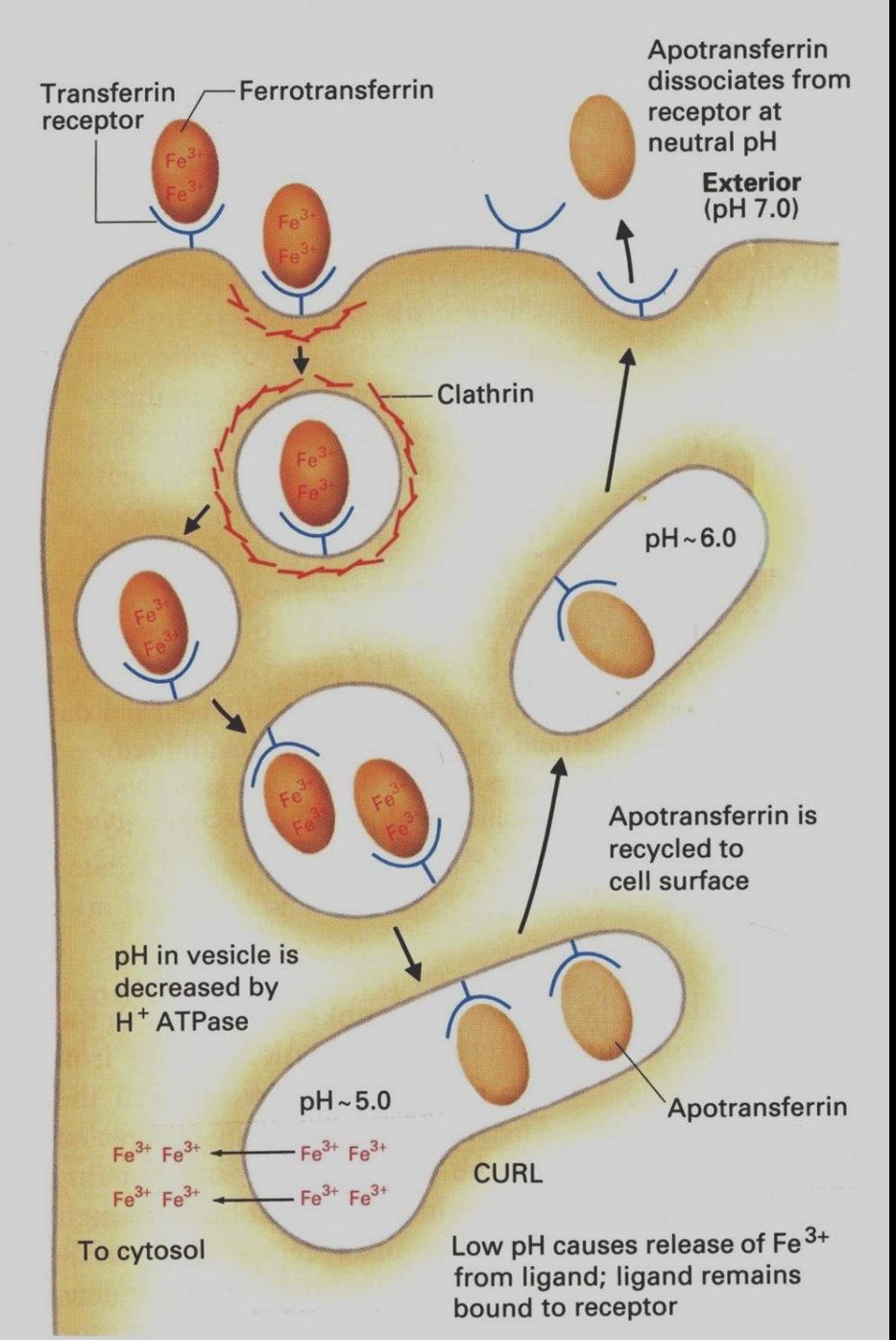
eosinofílie (hemoglobin)

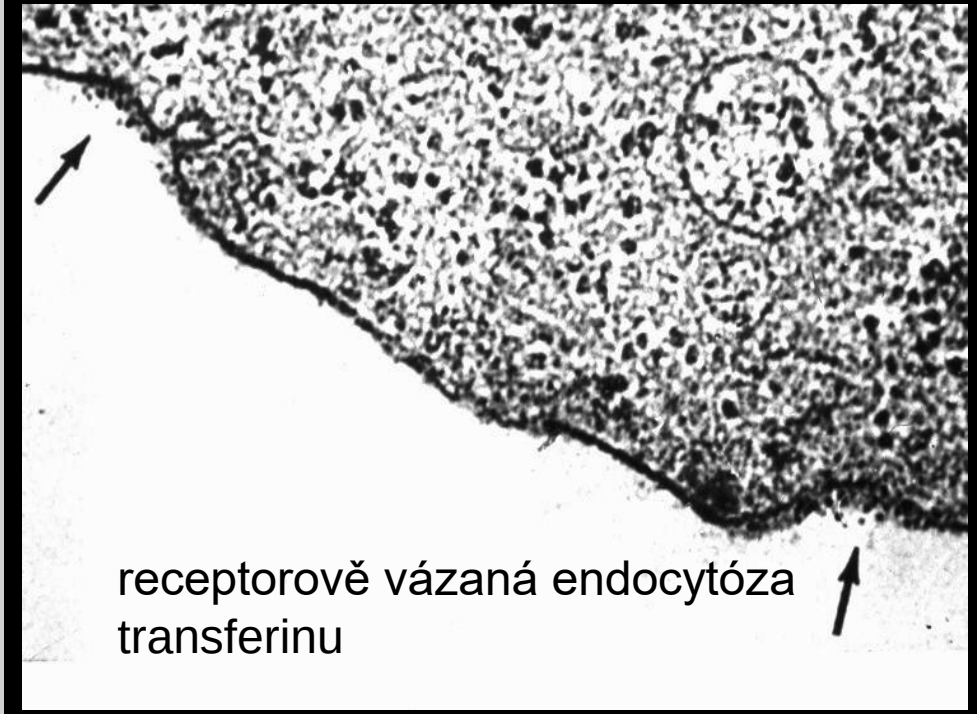

Proerythroblast
Basophilic erythroblast
Polychromatophilic erythroblast
Orthochromatophilic erythroblast
Reticulocyte
Erythrocyte


Proerythroblast
Basophilic erythroblast
Polychromatophilic erythroblast
Orthochromatophilic erythroblasts
Reticulocytes

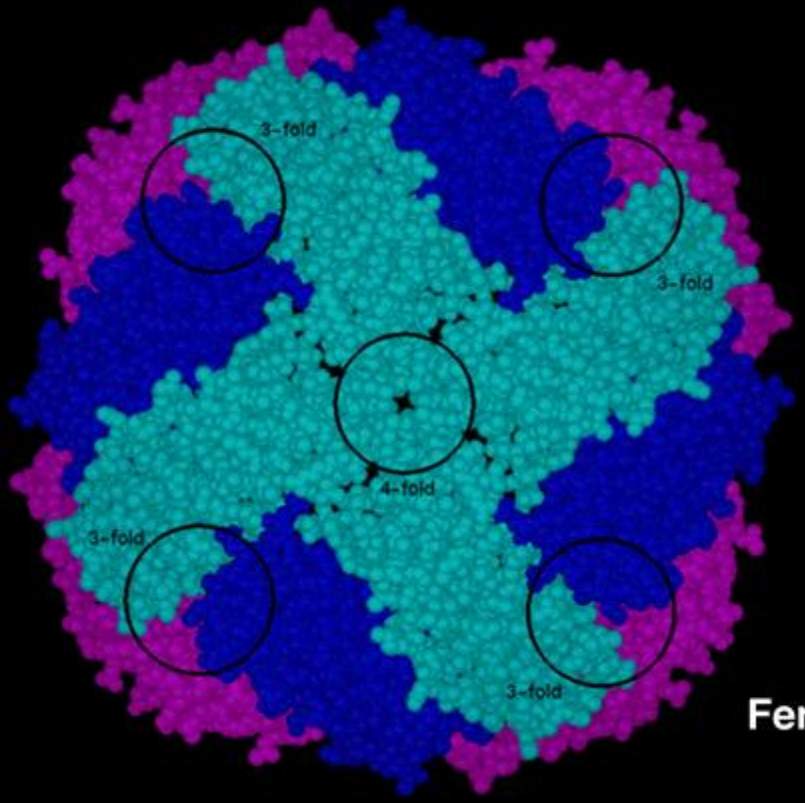

20 hours
Proerythroblast
20 hours
Basophilic erythroblast
Mitosis occurs in these stages
25 hours
Polychromatophilic erythroblast
30 hours
Orthochromatophilic erythroblast
No mitosis occurs in these stages
3 days
Reticulocyte
Pyknotic nucleus
120 days
Erythrocyte
100
80
60
40
20
0
Concentration (%)
RNA
Hemoglobin
80
60
40
20
0
Maturation (nuclear area in μm²)


P = proerytroblast
P
3
4
6
5



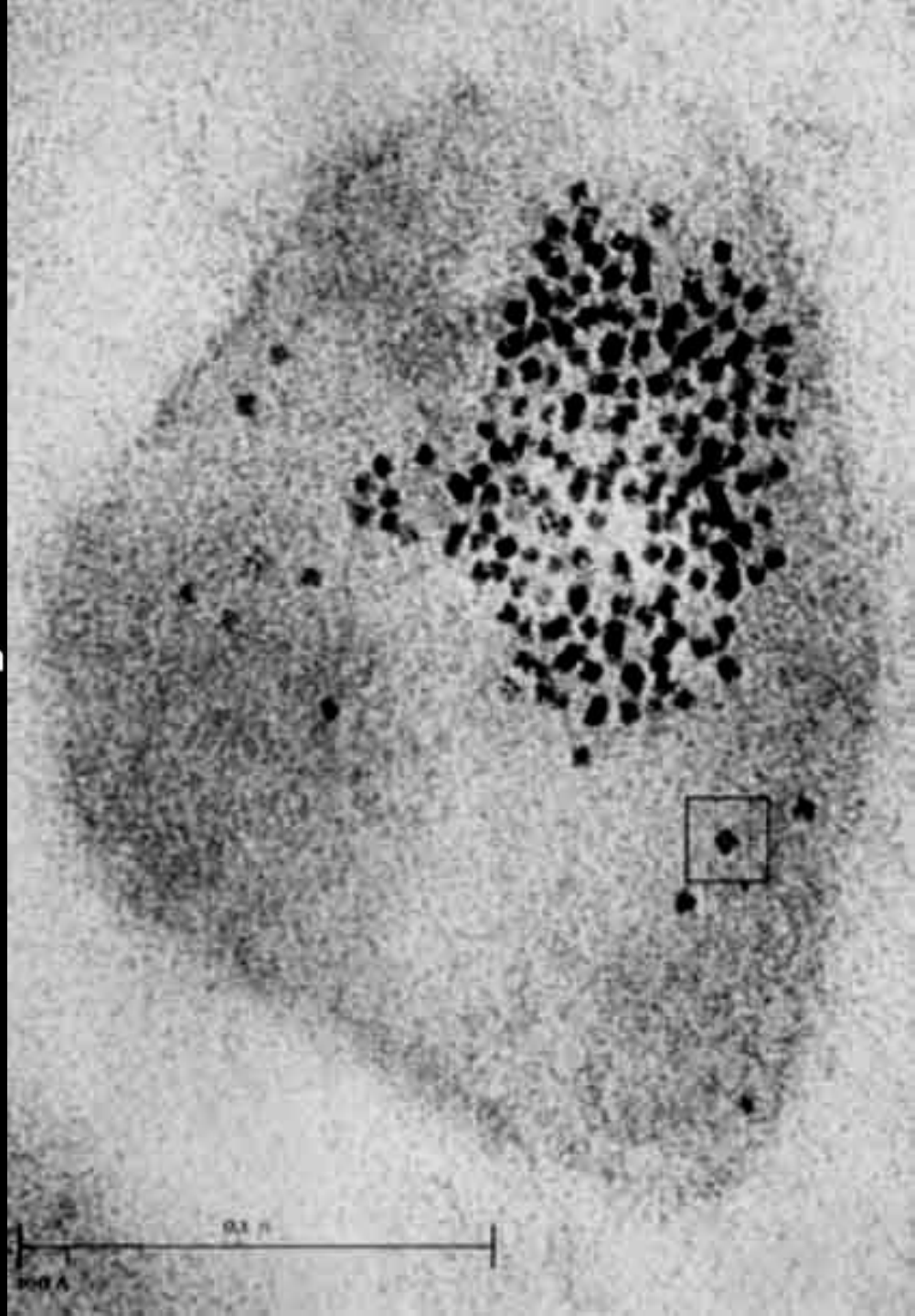


receptorově vázaná endocytóza transferinu

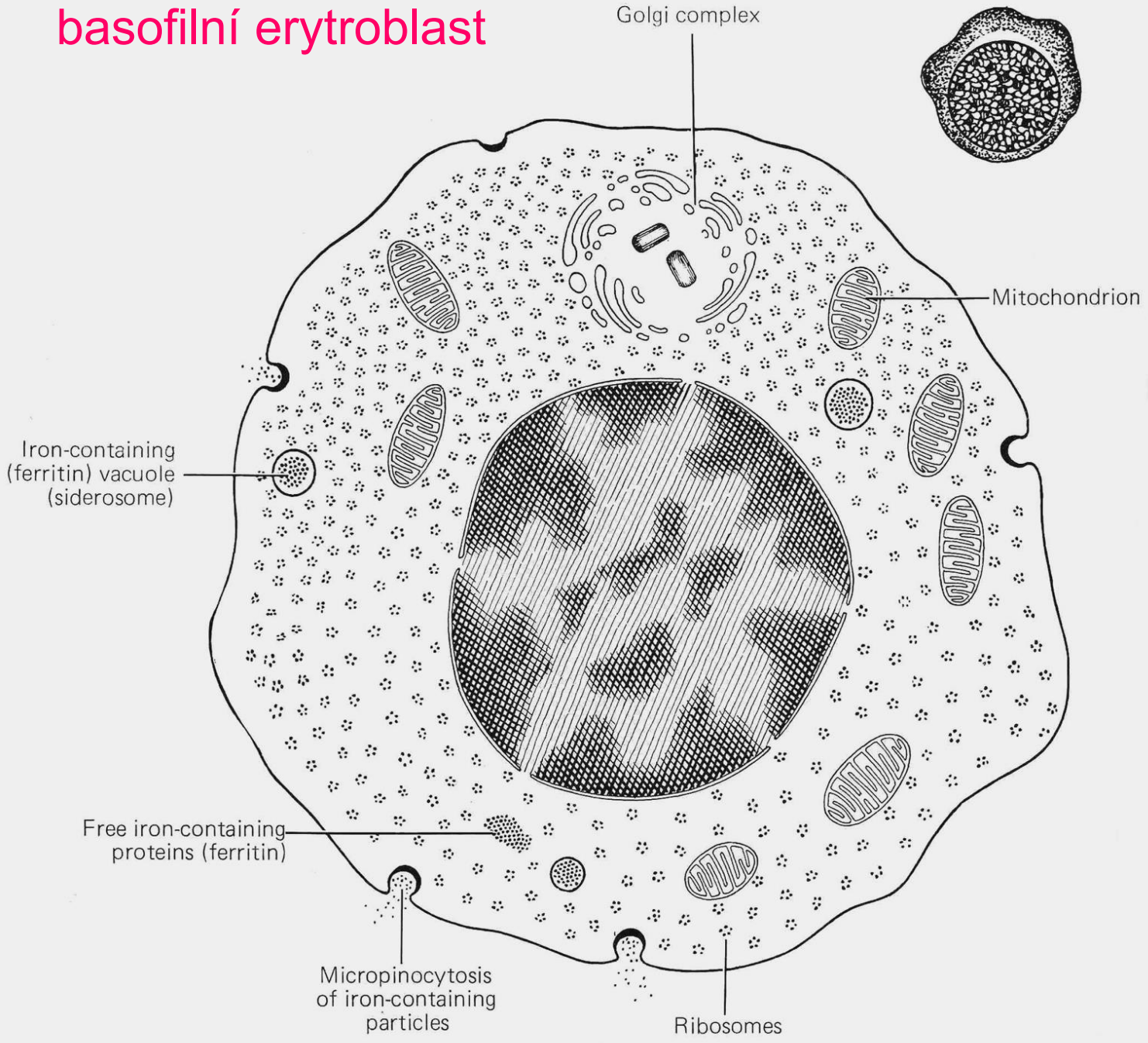


Ferritin

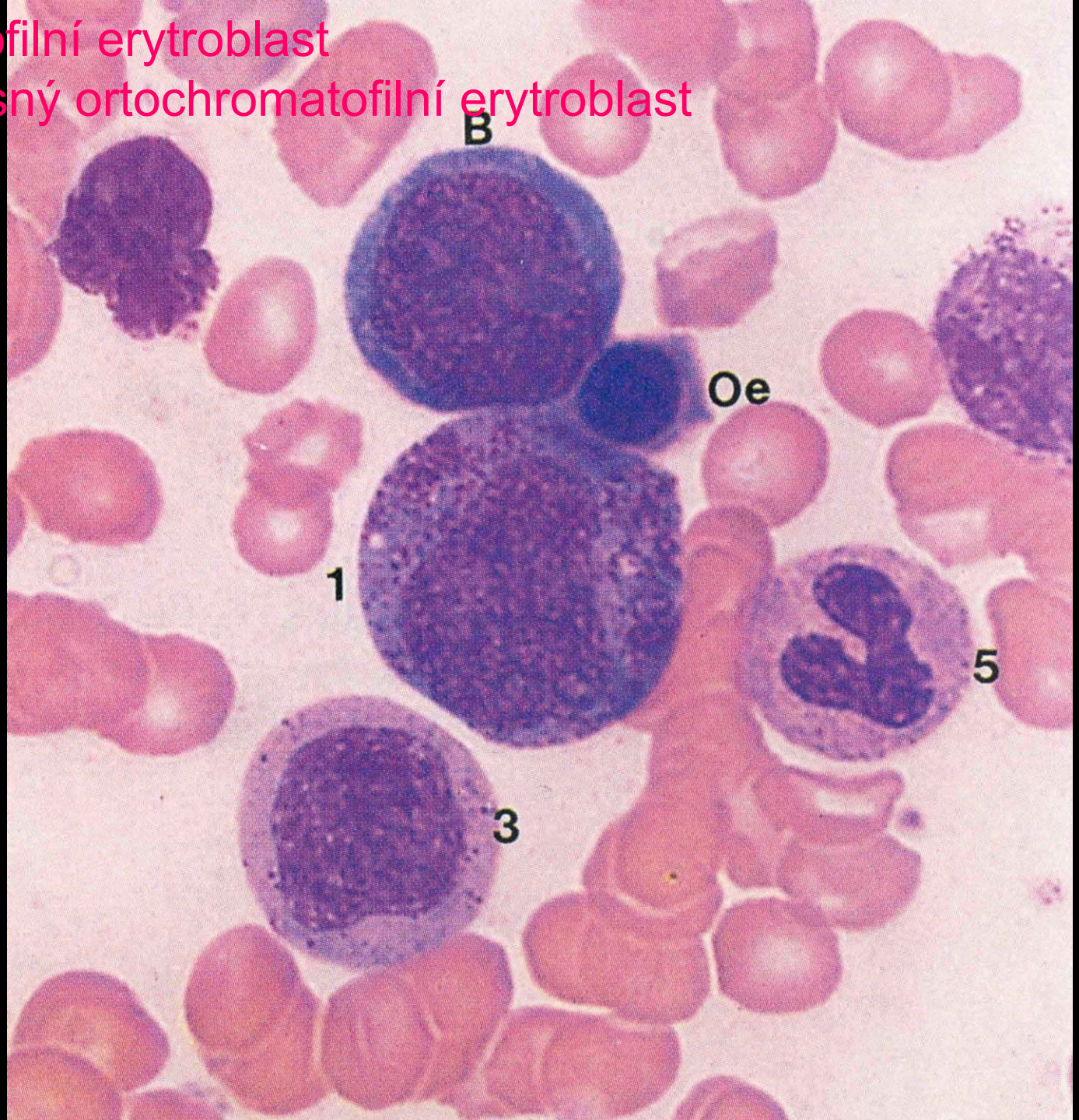
Ferritin
Ø 8 nm



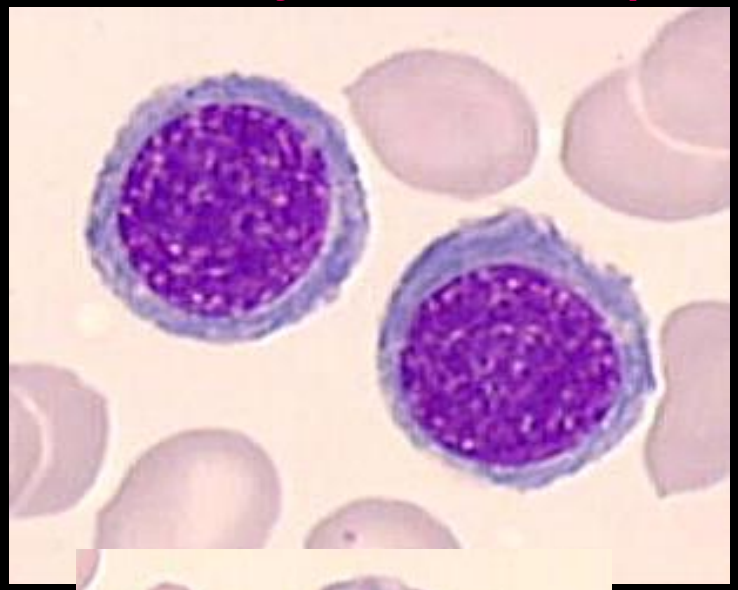
basofilní erytroblast

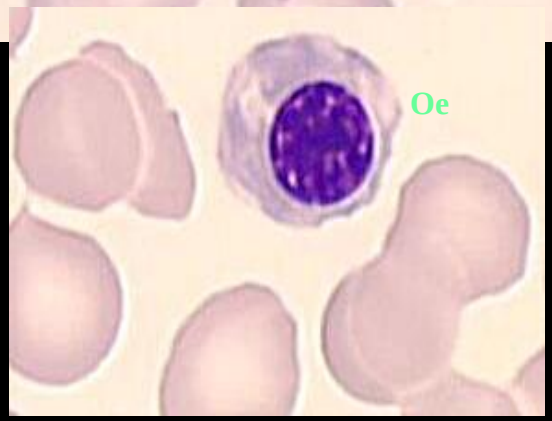


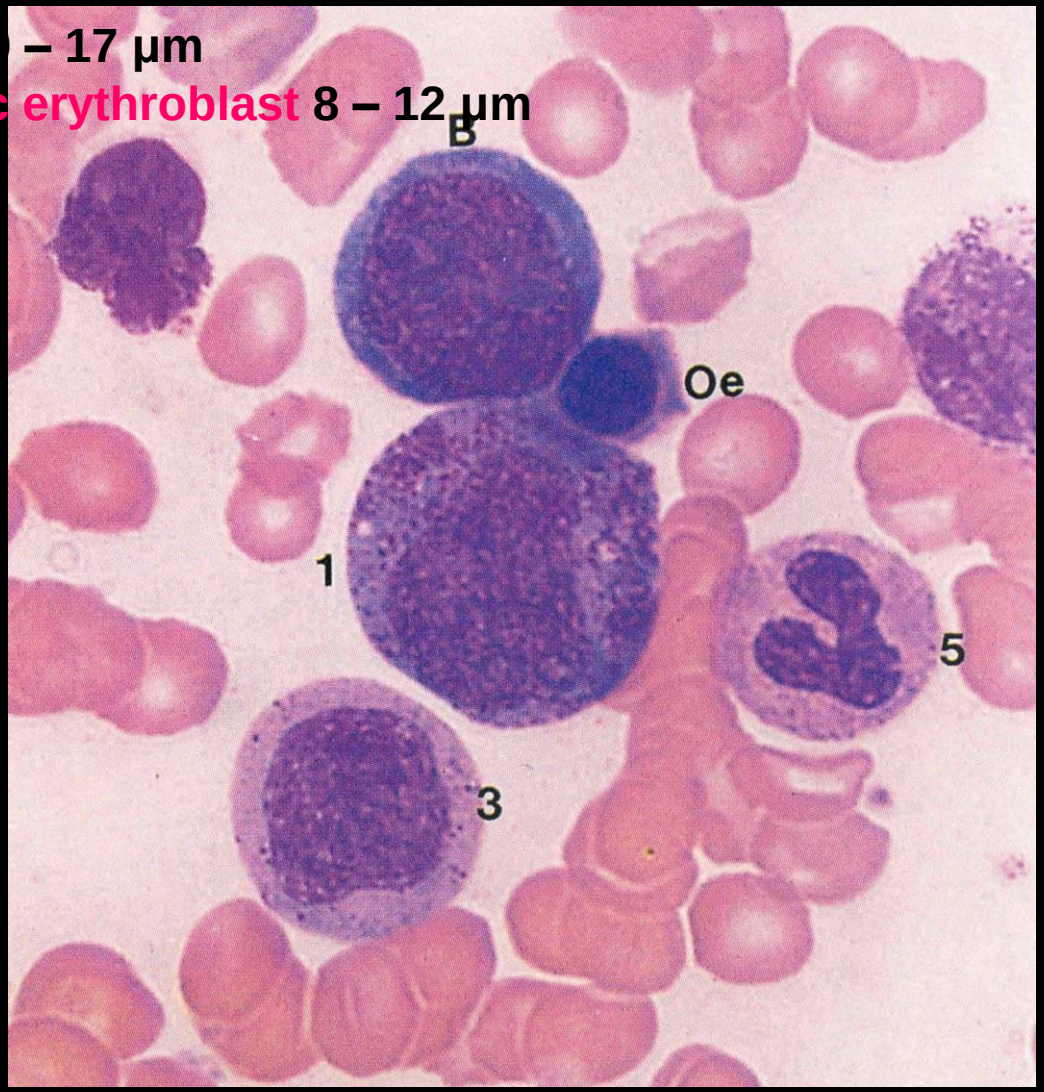
B = basofilní erytroblast
Oe = časný ortochromatofilní erytroblast



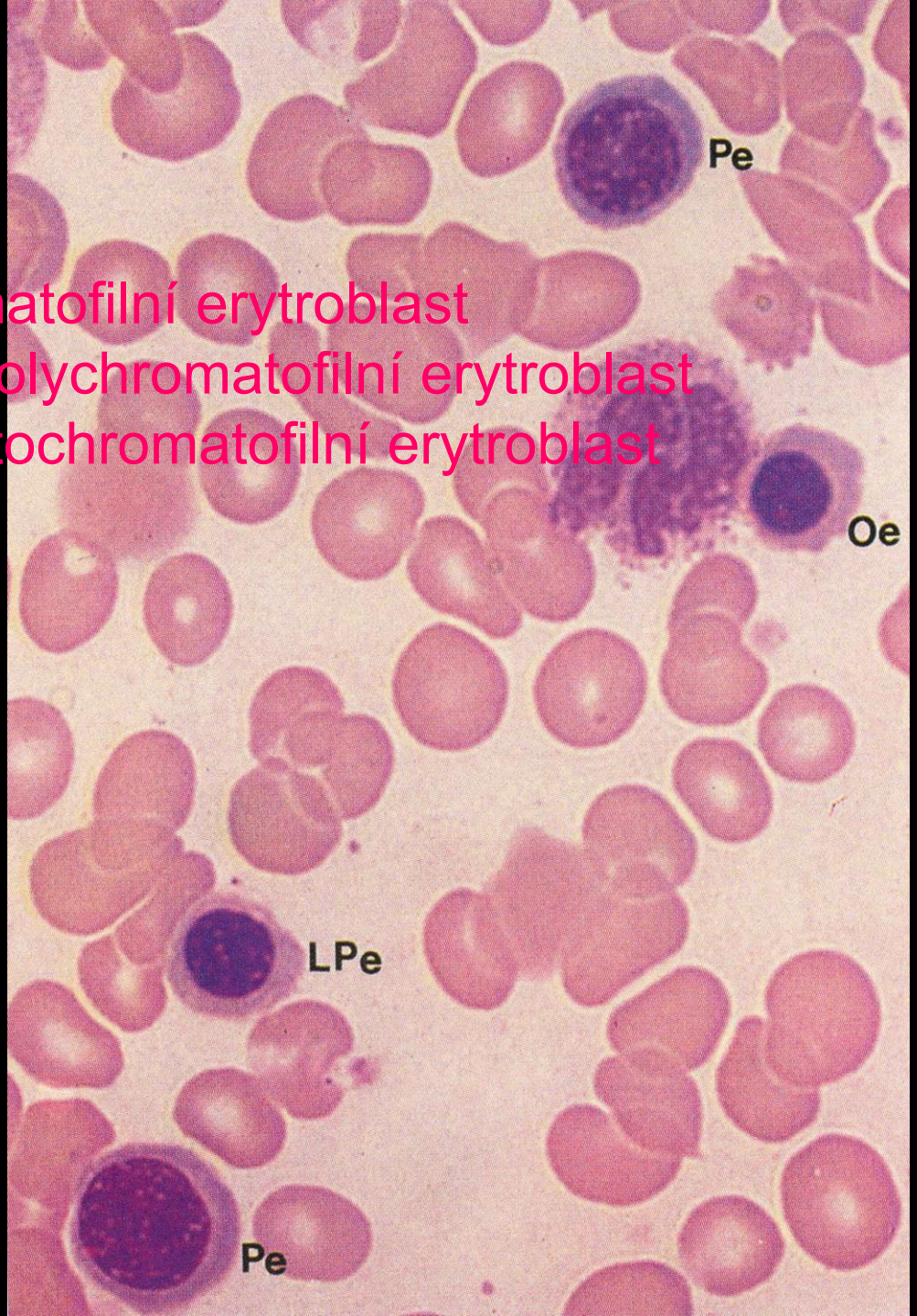
B = basophilic erythroblast – 17 µm
Oe = early ortochromatophilic erythroblast 8 – 12 µm

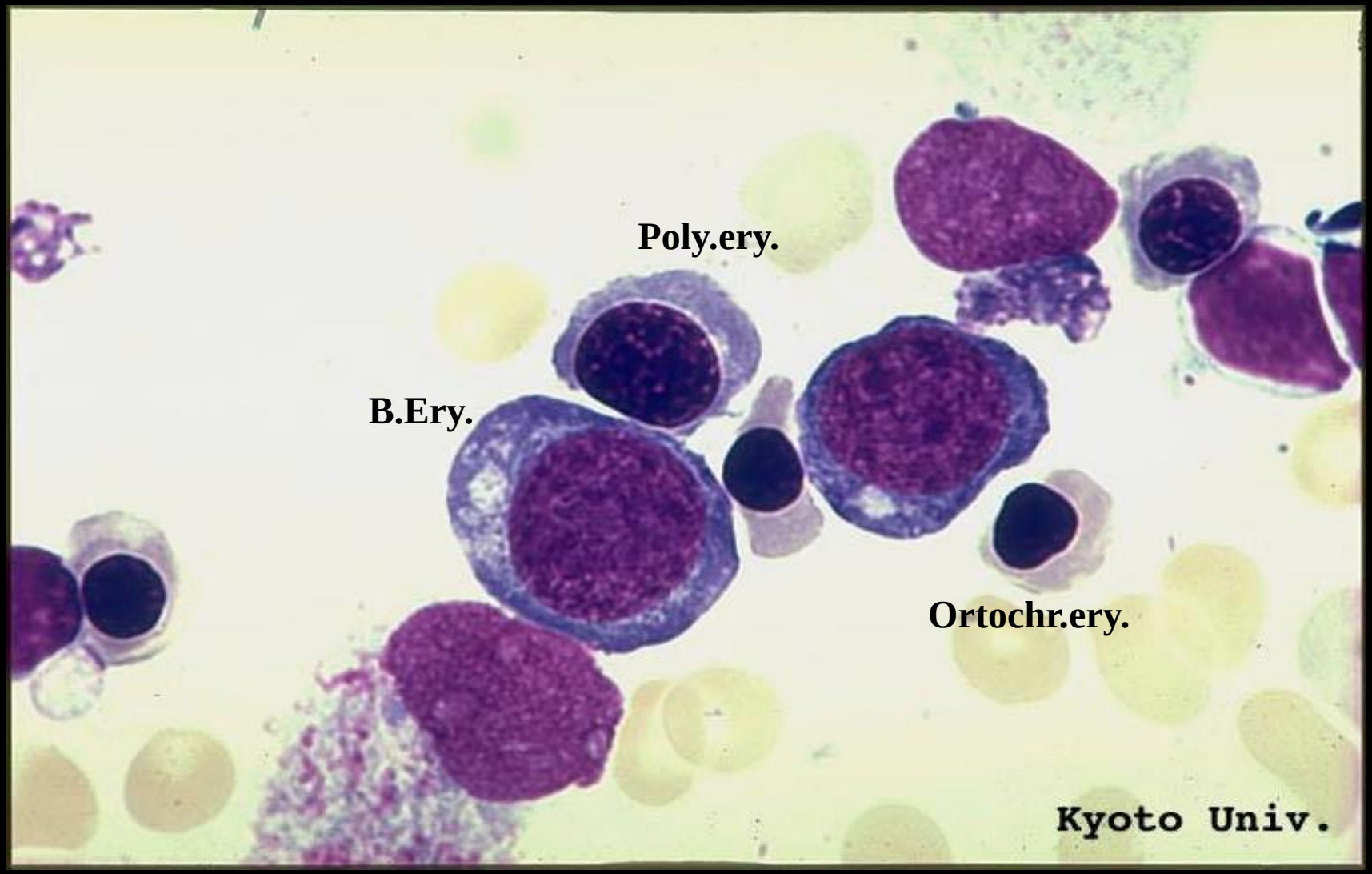


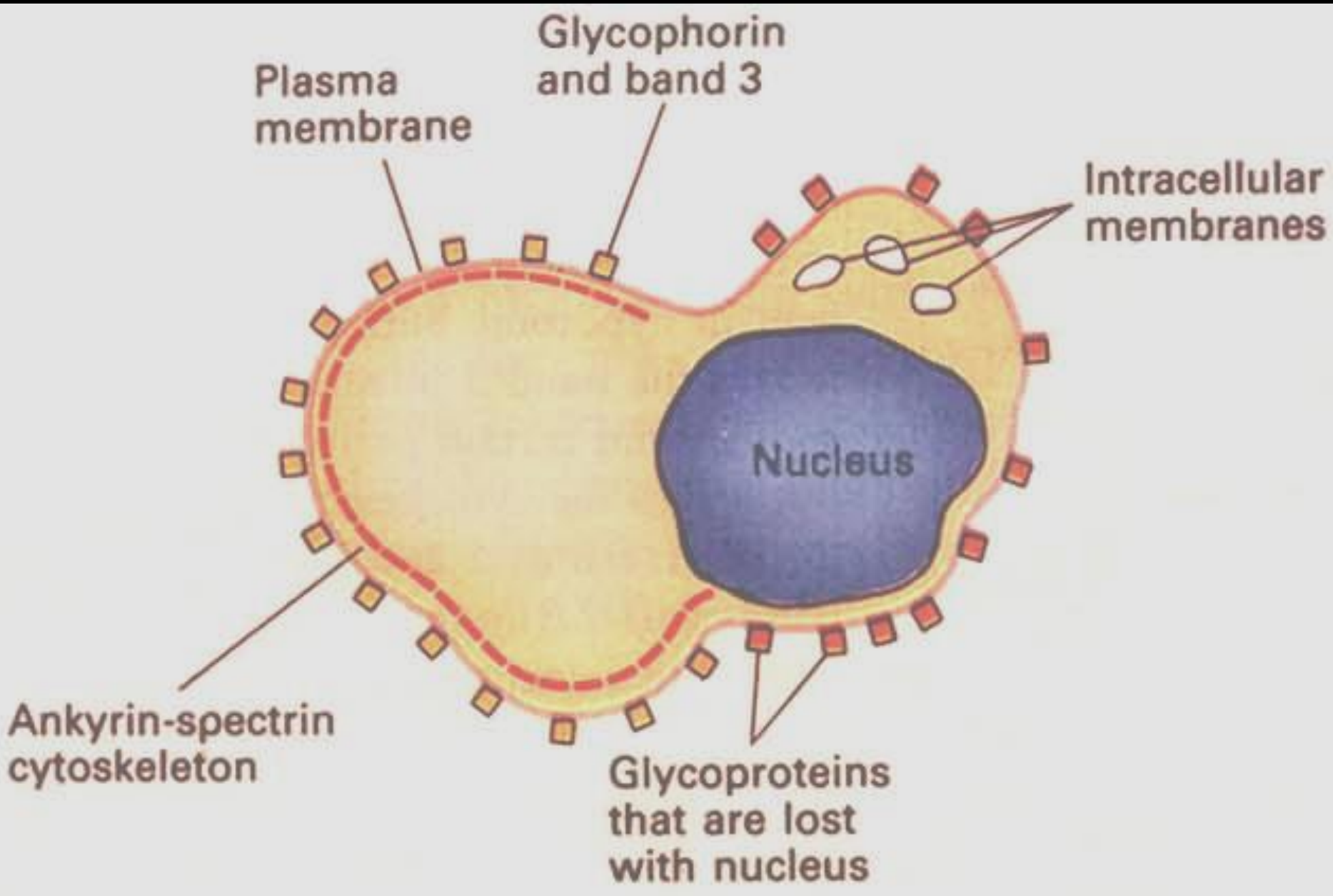


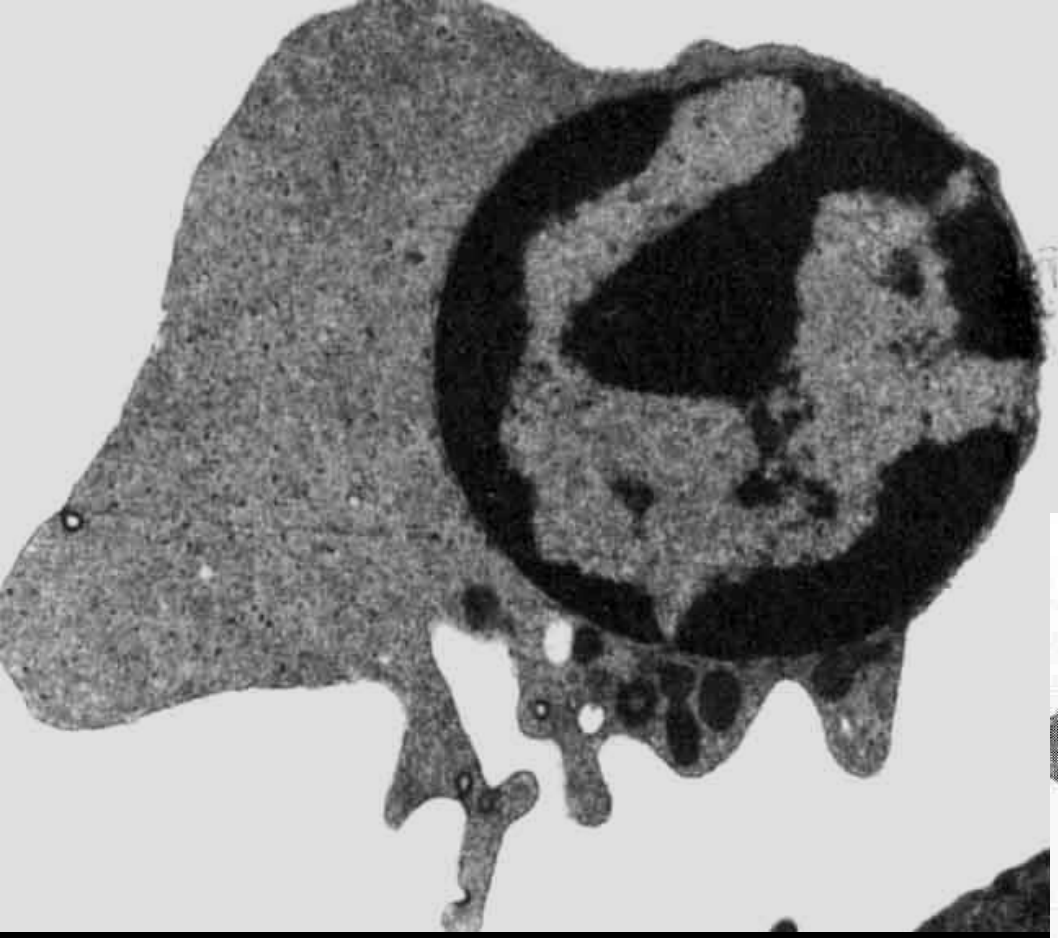


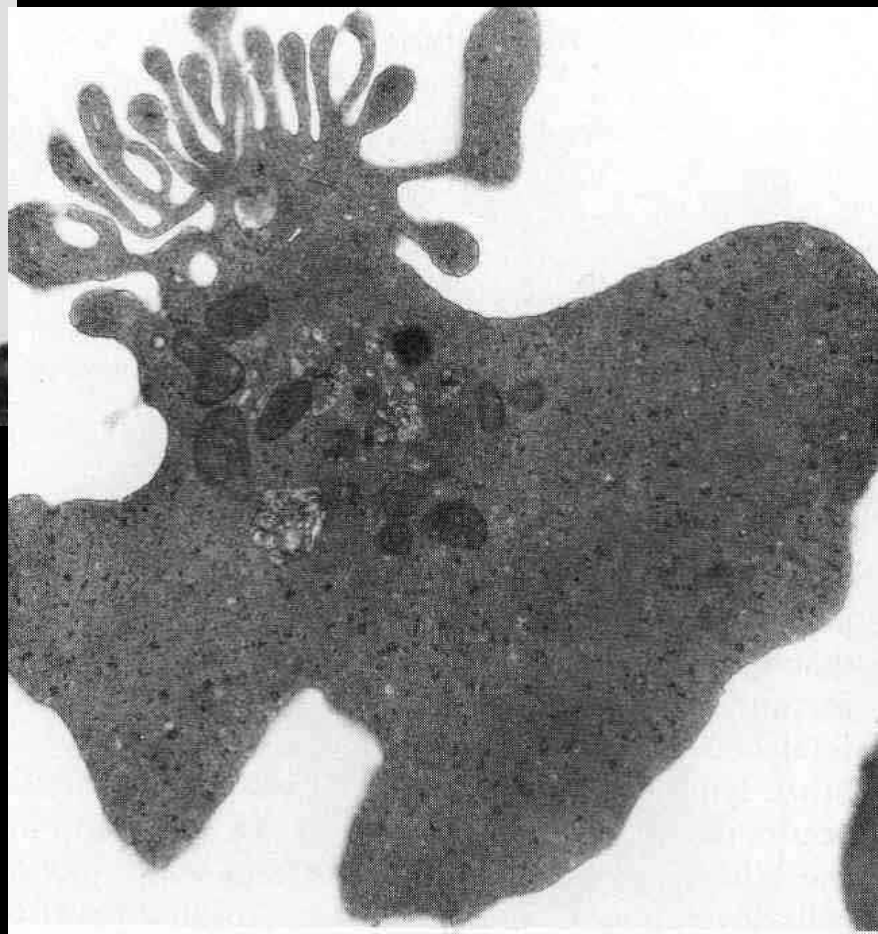
Pe = polychromatofilní erytroblast
LPe = pozdní polychromatofilní erytroblast
Oe = pozdní ortochromatofilní erytroblast



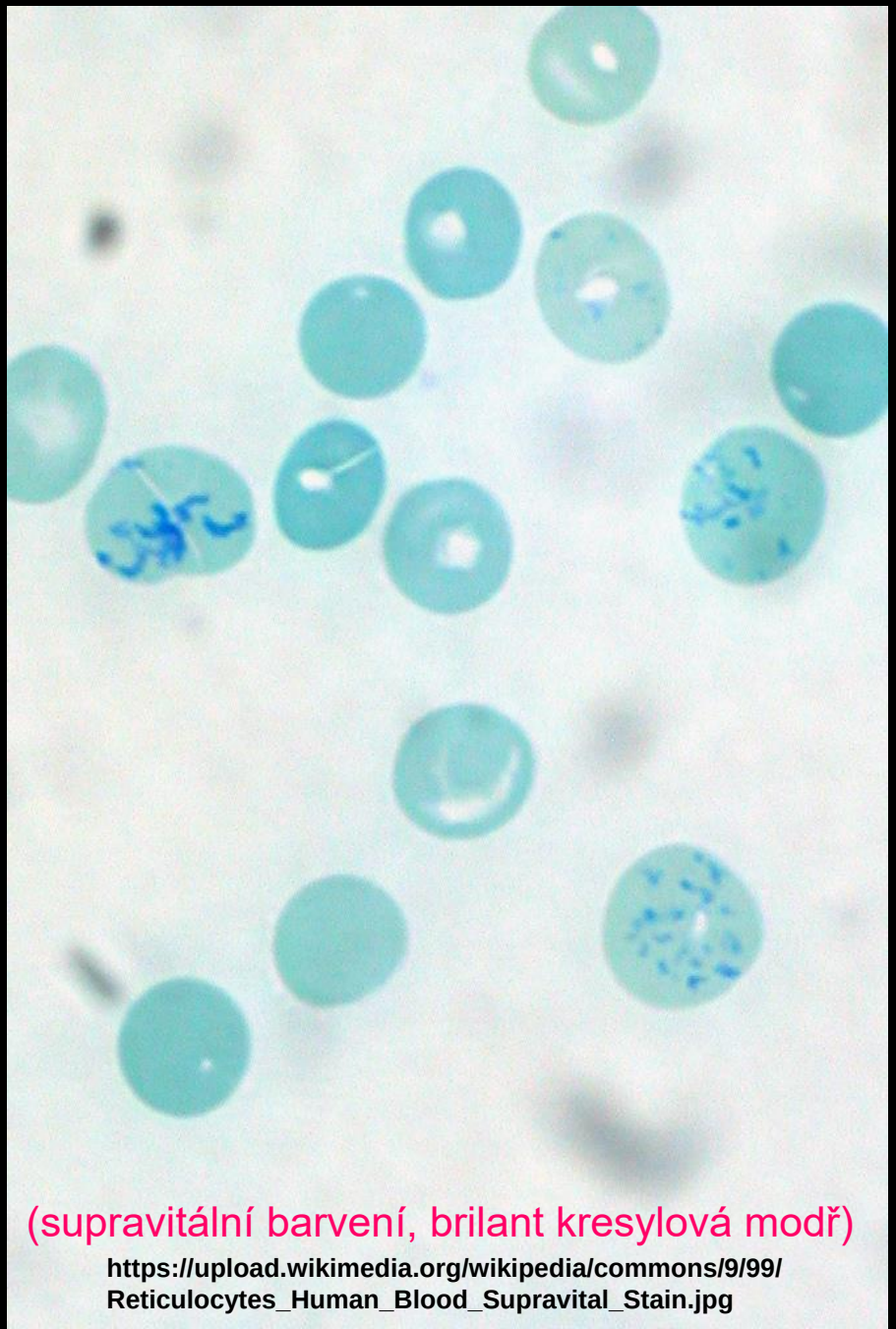

Poly.ery.
B.Ery.
Ortochr.ery.
Kyoto Univ.


Plasma membrane
Glycophorin and band 3
Intracellular membranes
Nucleus
Ankyrin-spectrin cytoskeleton
Glycoproteins that are lost with nucleus



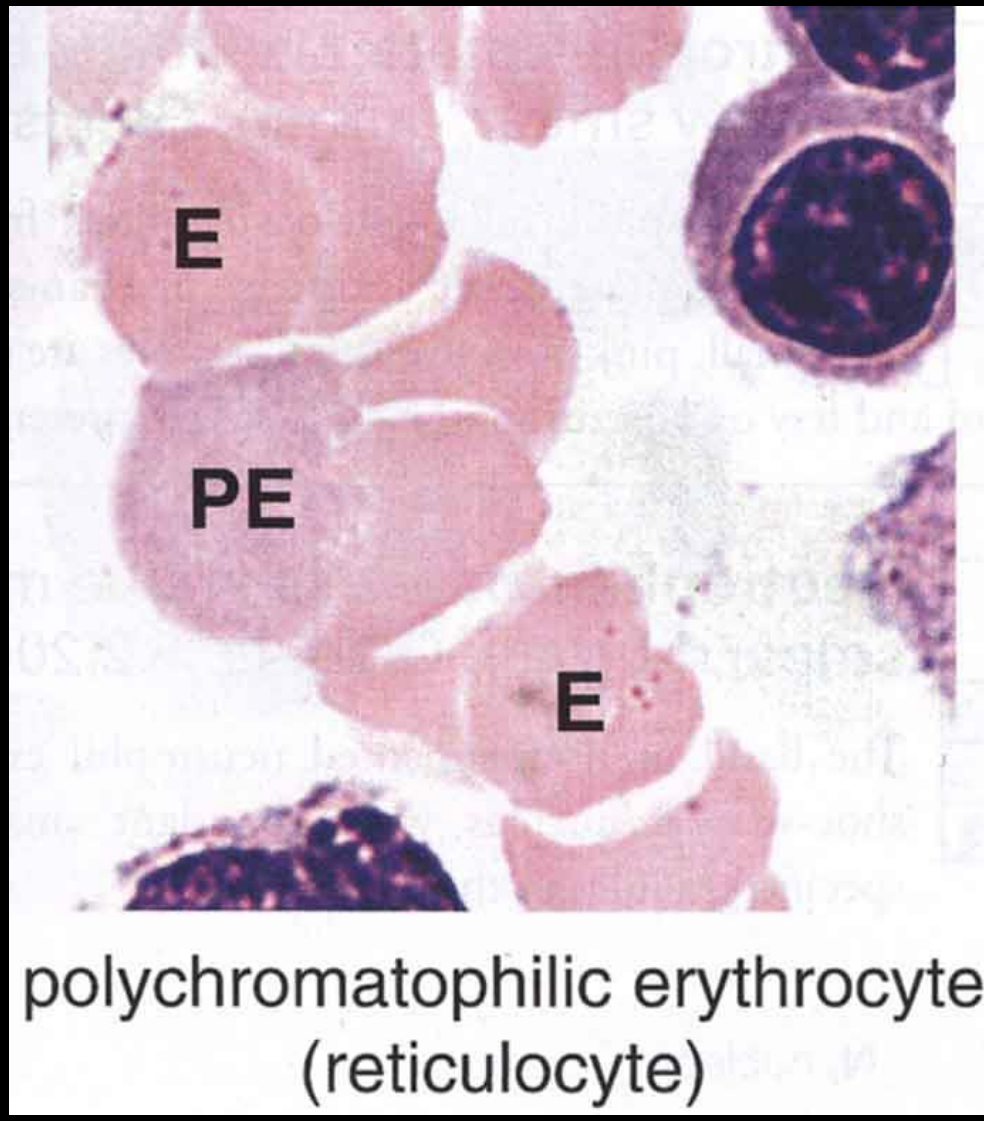


Retikulocyty



(supravitální barvení, brilant kresylová modř)

https://upload.wikimedia.org/wikipedia/commons/9/99/Reticulocytes_Human_Blood_Supravital_Stain.jpg



polychromatophilic erythrocyte (reticulocyte)

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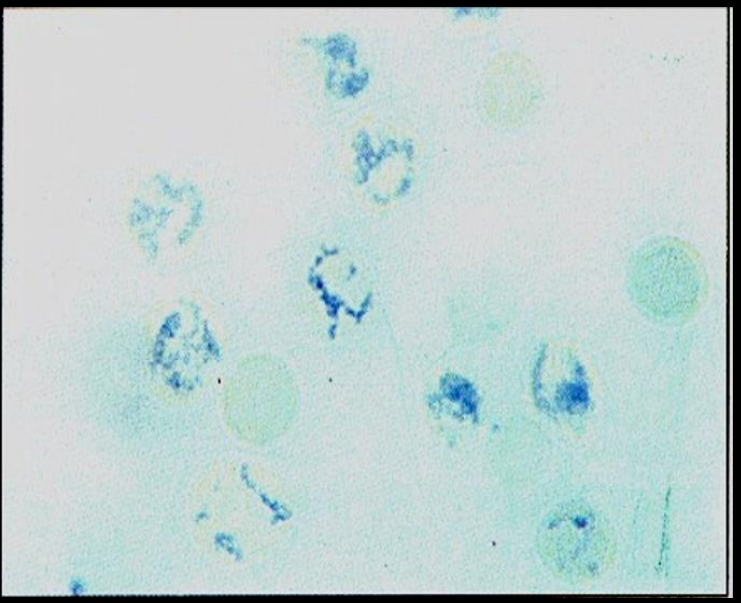
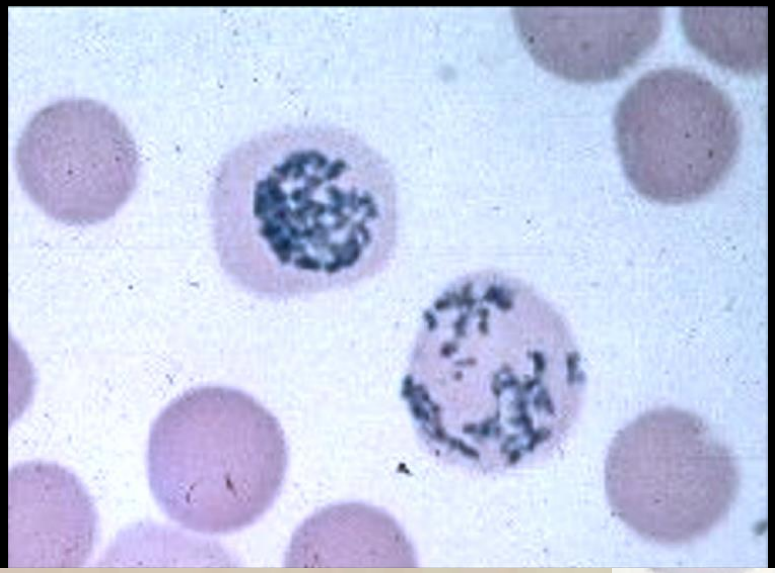
Retikulocyty

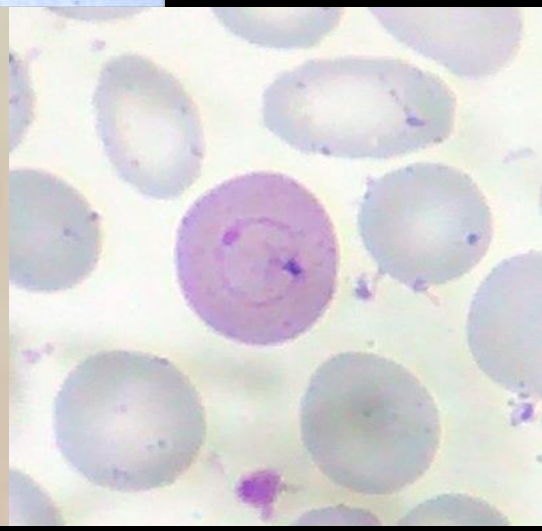




0,5 – 2,5 % v periferní krvi

Substantia Reticulofilamentosa : Remmants of r RNA

Fragmenty jádra: Howell – Jolly bodies
Cabot rings



Vývoj granulocytů, granulopoéza, myelopoéza

↓ velikost buňky

↓ velikost jádra

↑ kondenzace a segmentace jádra

↑ azurofilní granula ↓

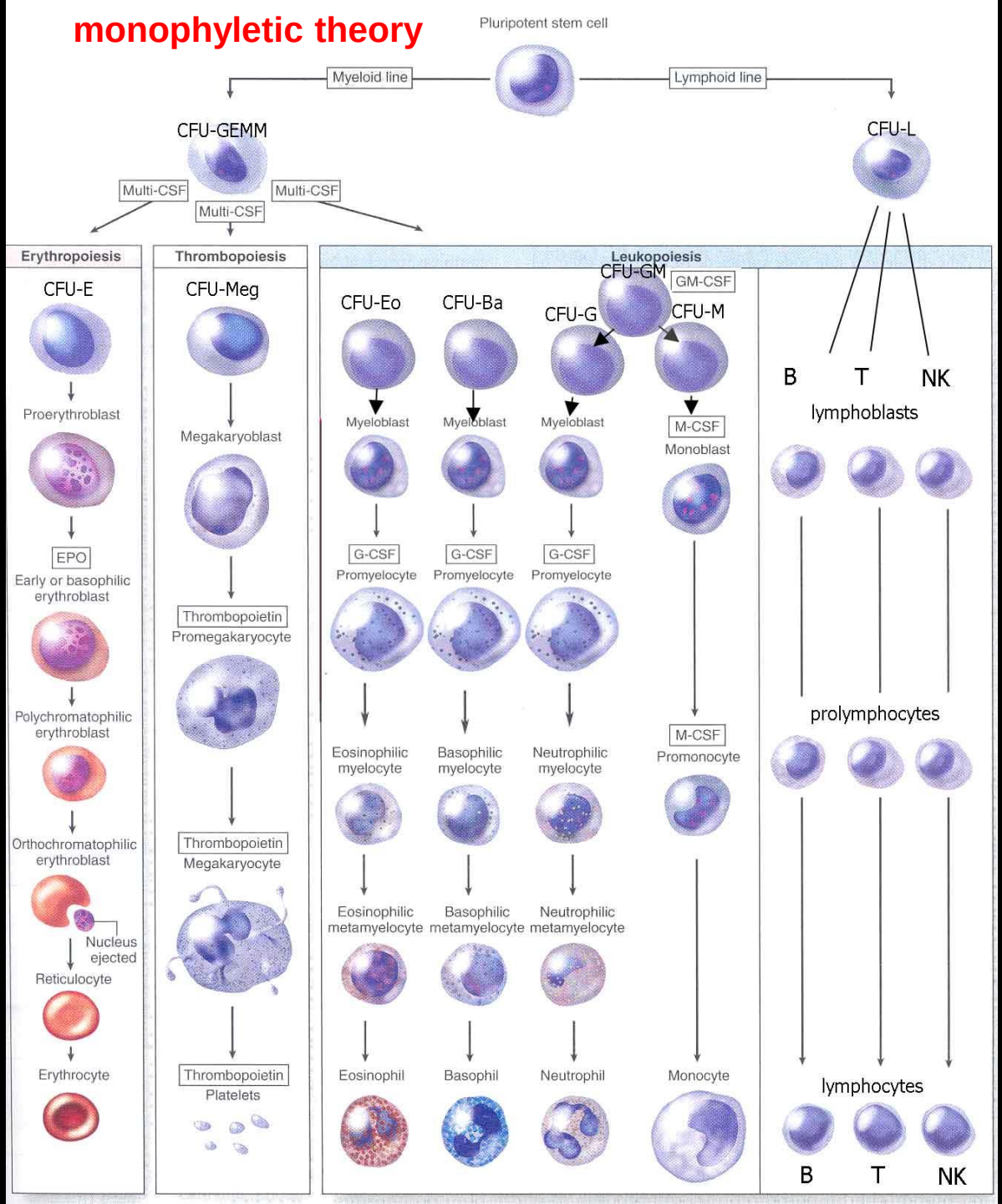
↑ specifická granula

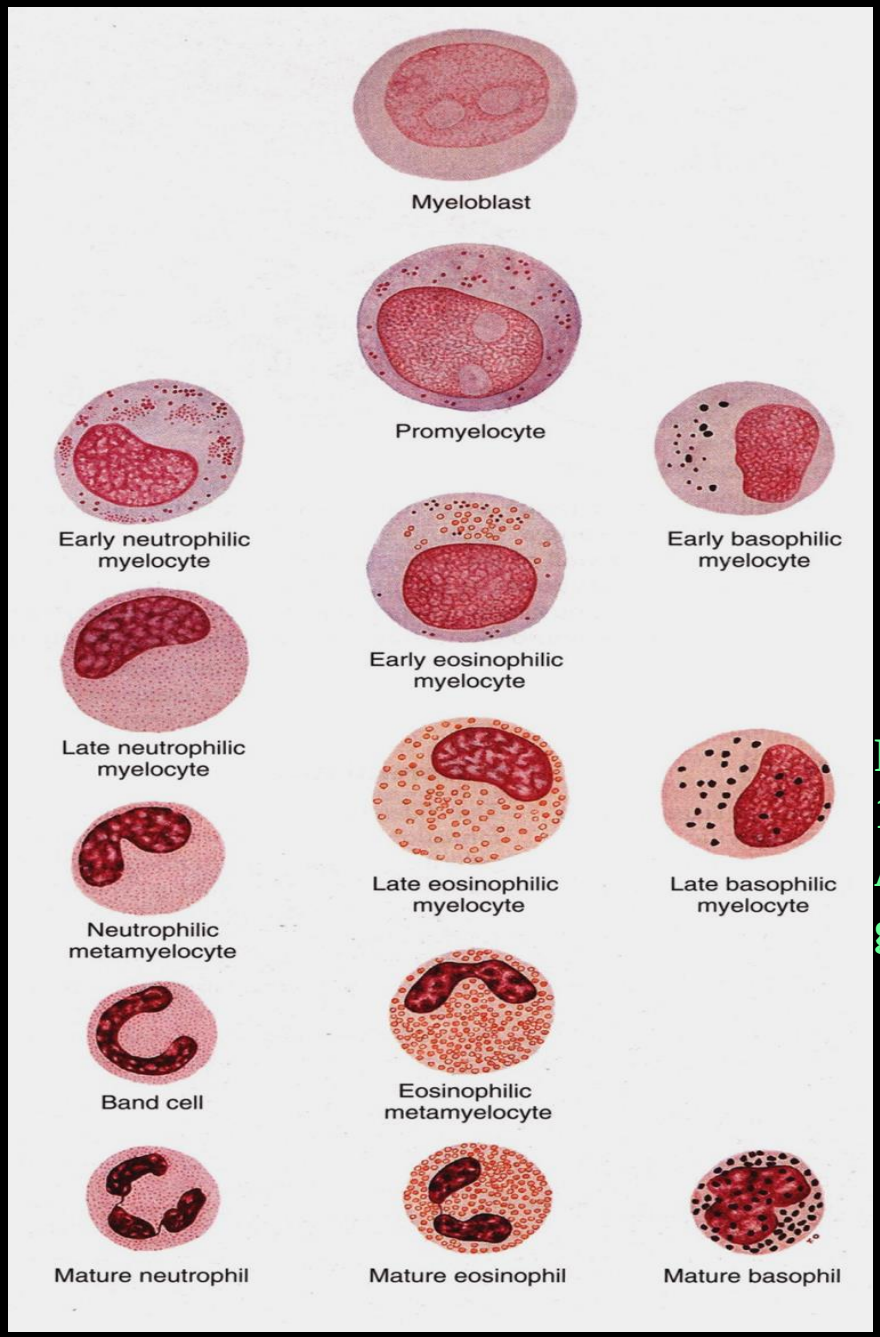
Stem cells (kmenové buňky)

Progenitor cells (CFU)

Precursor cells (blasts)

Mature cells

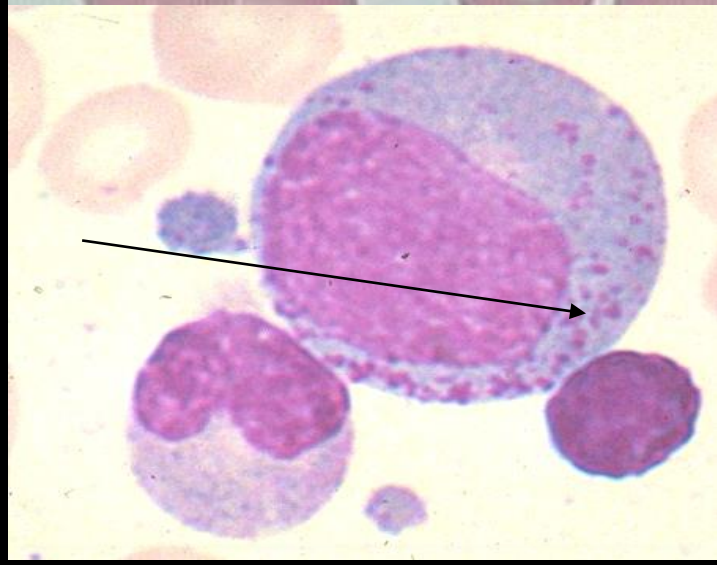


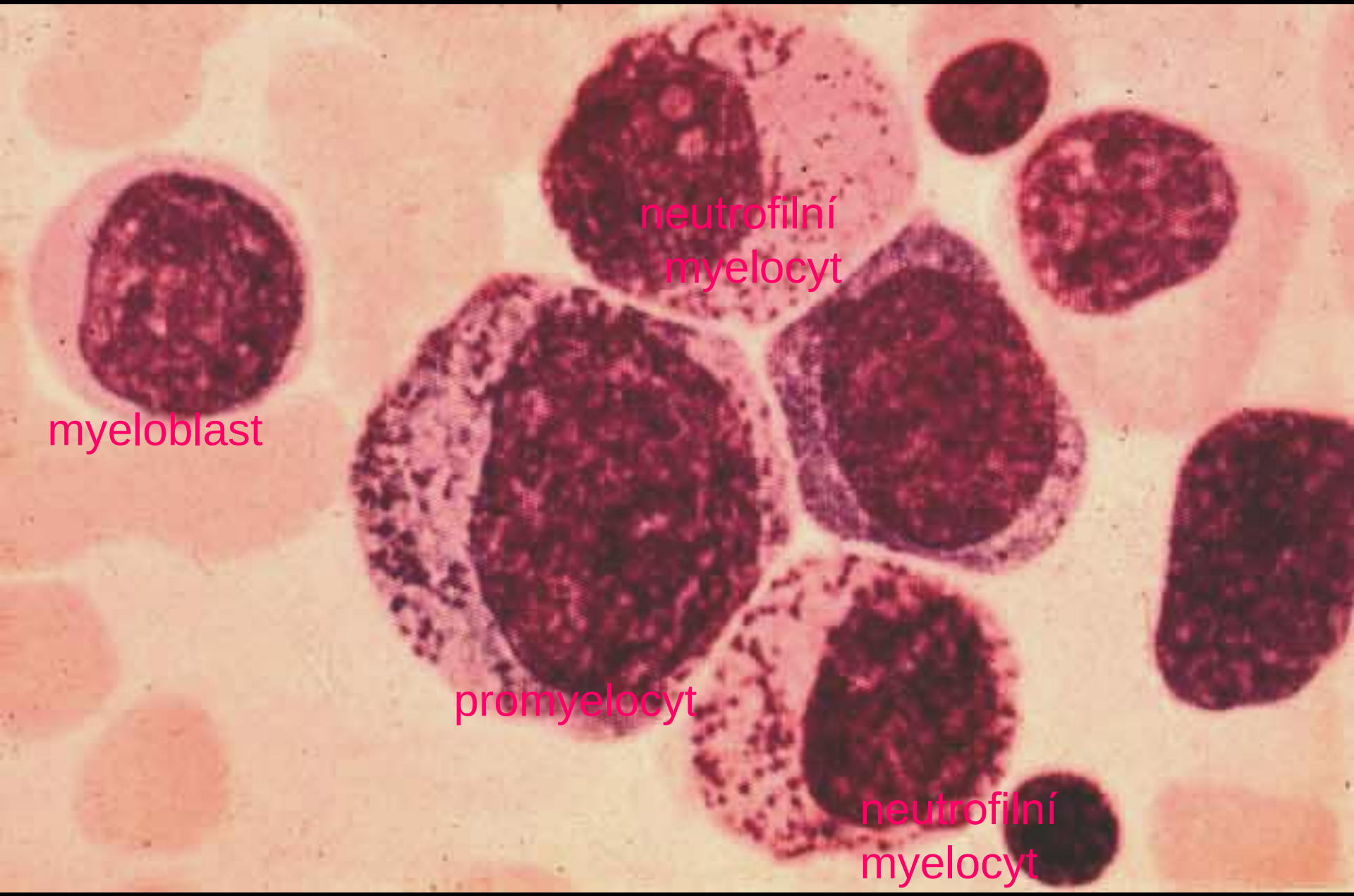


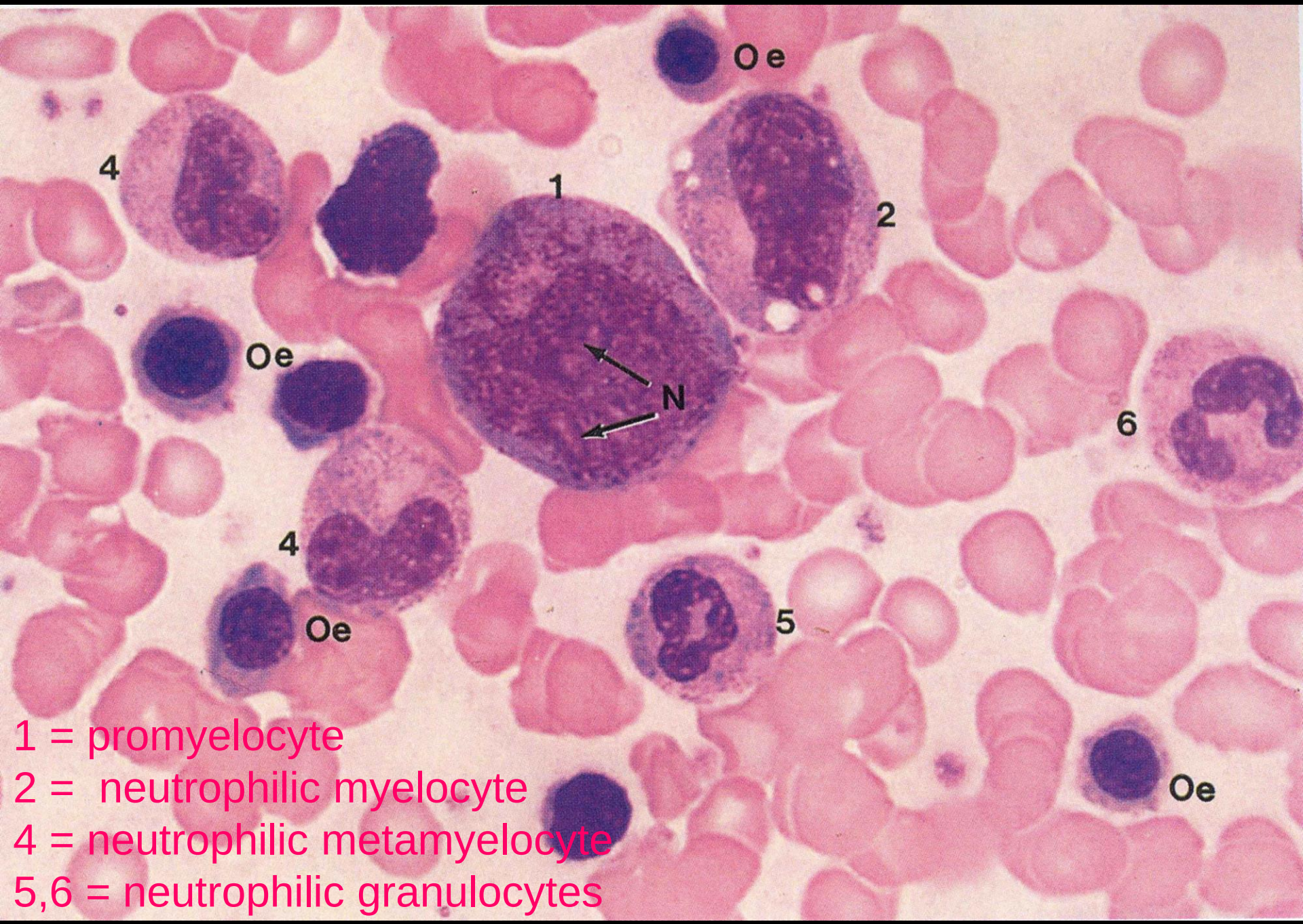
Granulopoiesis

Myeloblast
10 – 20 µm

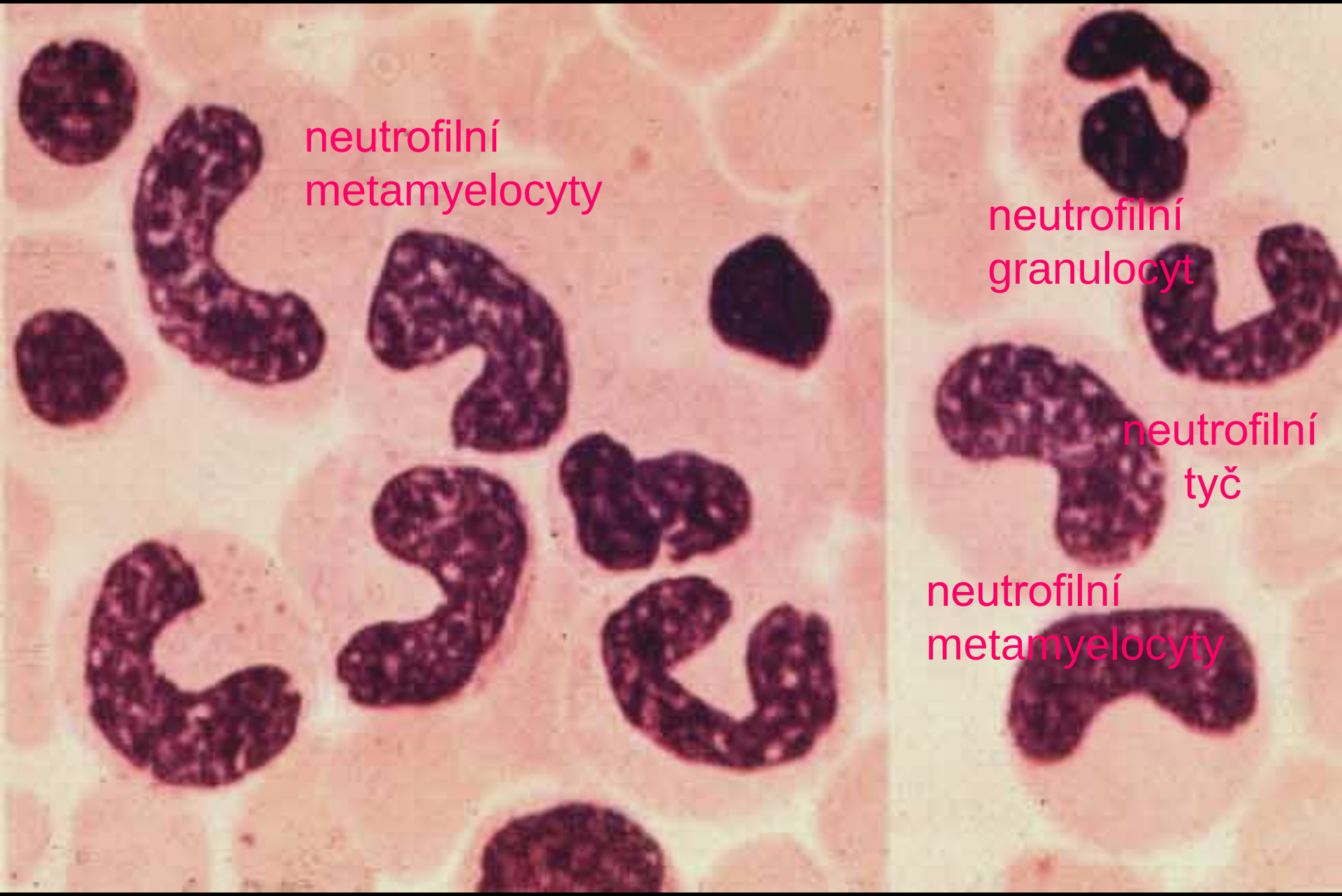
Promyelocyte
15 – 24 µm
Azurophilic granules



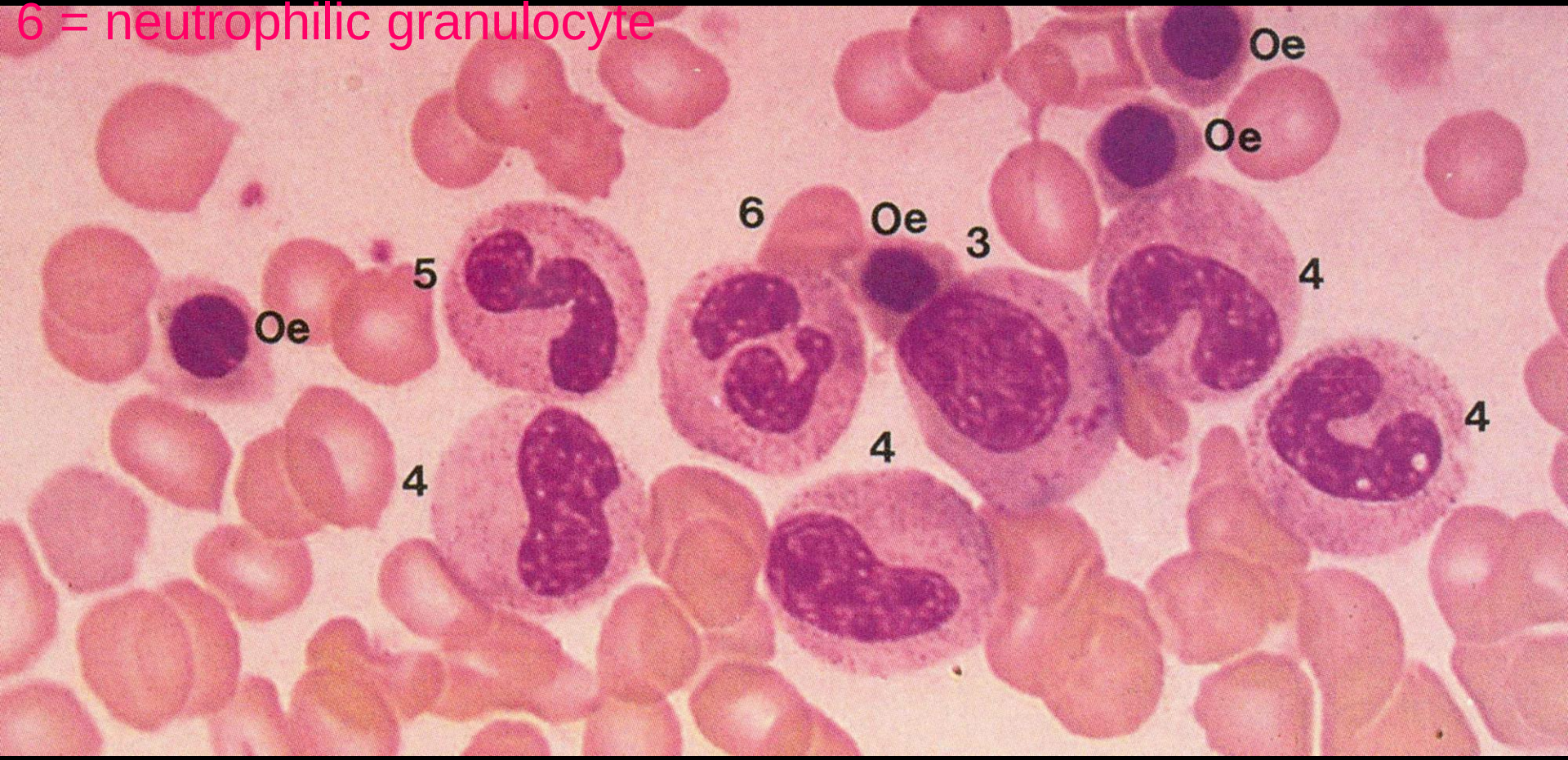

neutrofilní
myelocyt
myeloblast
promyelocyt
neutrofilní
myelocyt

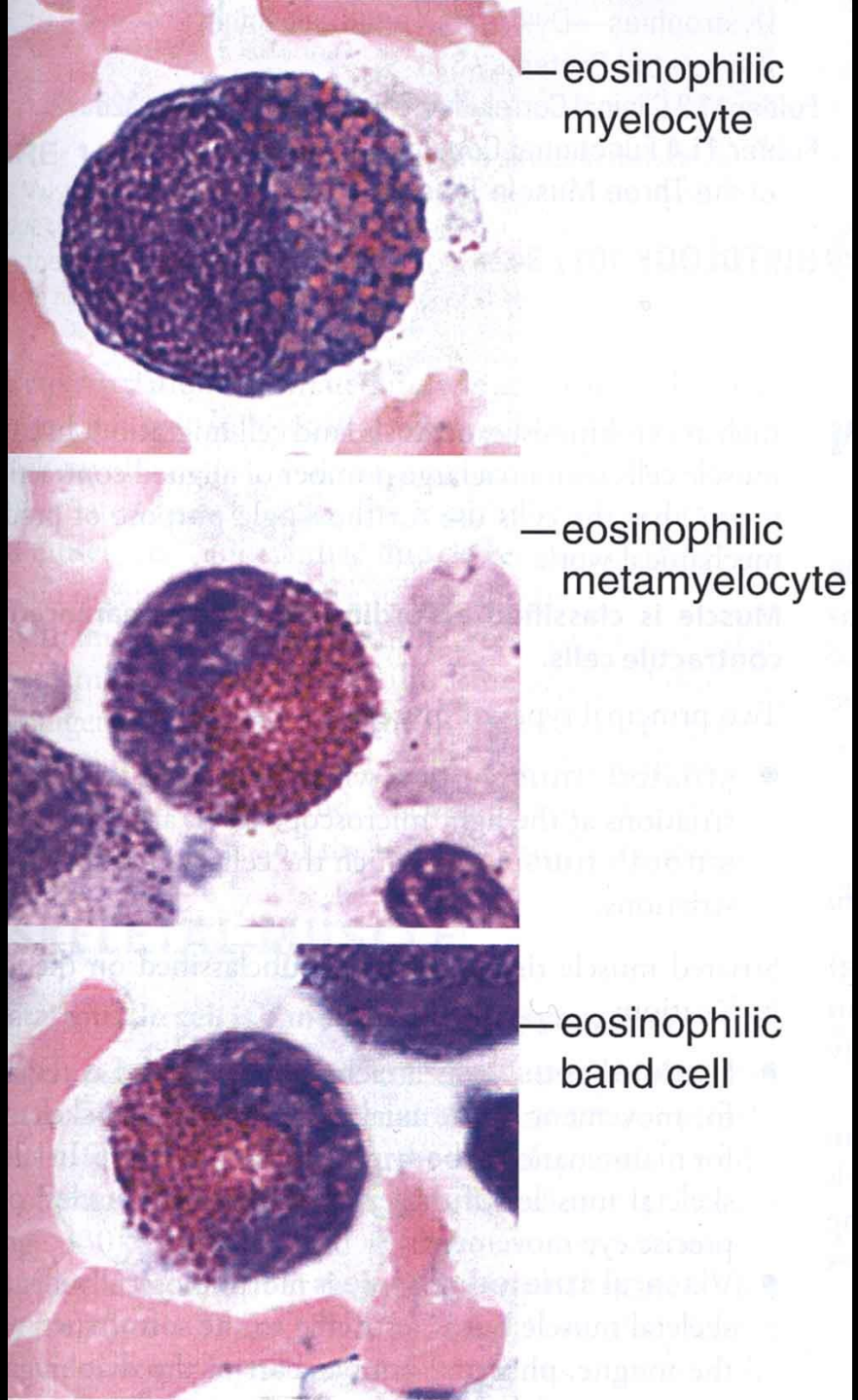


1 = promyelocyte
2 = neutrophilic myelocyte
4 = neutrophilic metamyelocyte
5,6 = neutrophilic granulocytes


neutrofilní
metamyelocyty
neutrofilní
granulocyt
neutrofilní
tyč
neutrofilní
metamyelocyty

3 = neutrophilic myelocyte
4 = neutrophilic metamyelocyte
5 = neutrophilic band
6 = neutrophilic granulocyte

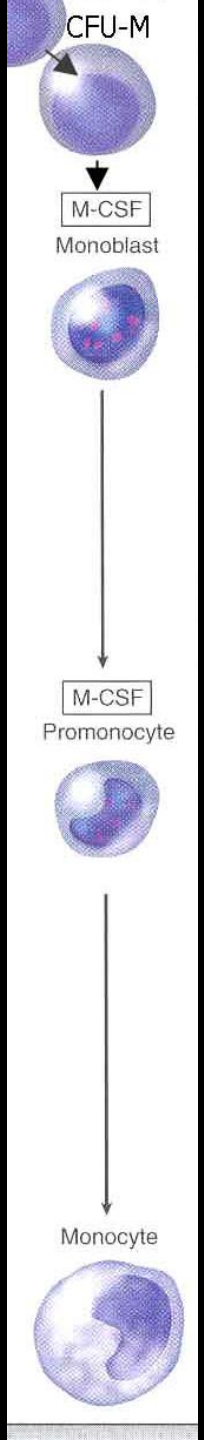


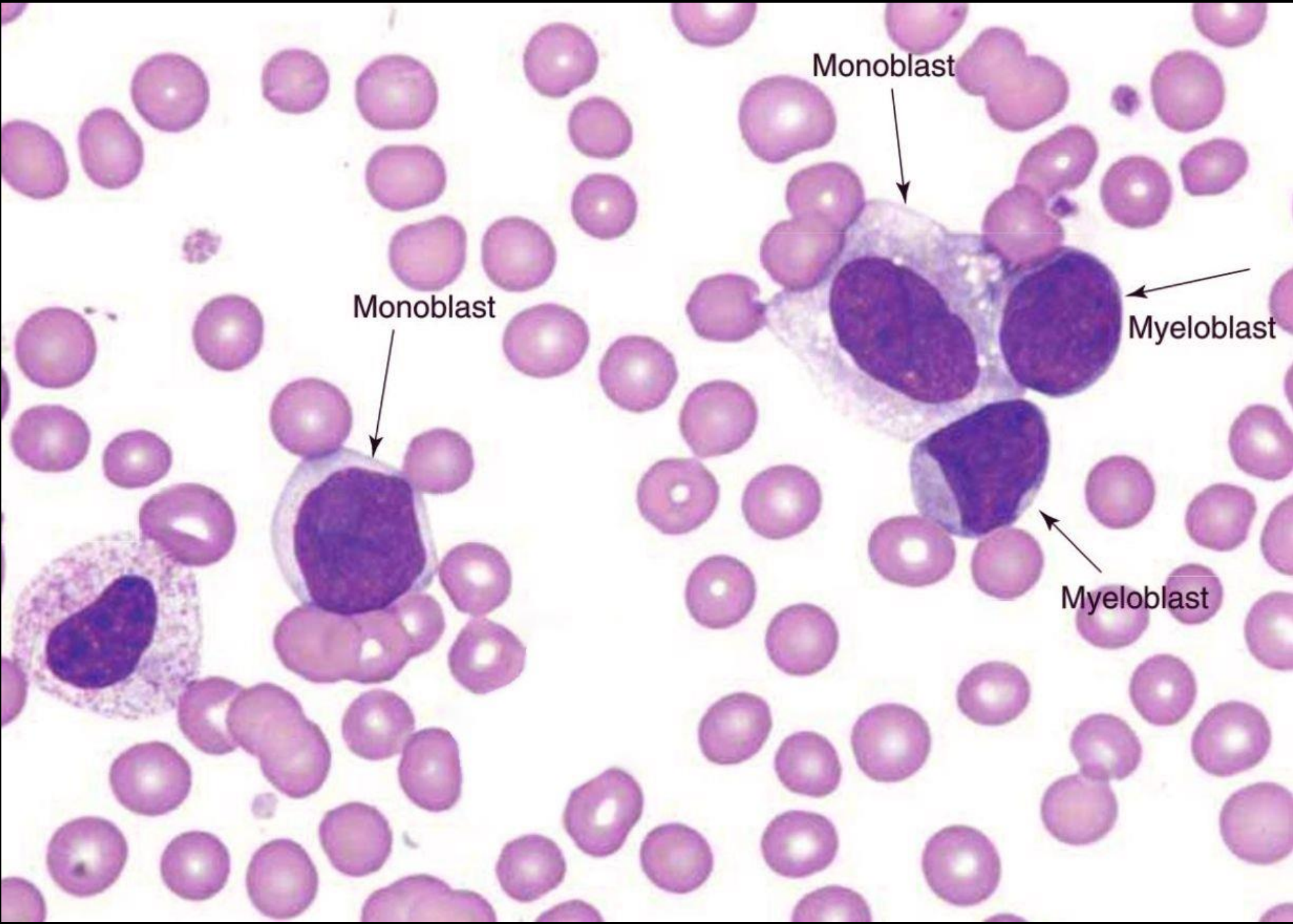


Pawlina W.: Histology, a Text and Atlas, Wolters Kluwer 2016

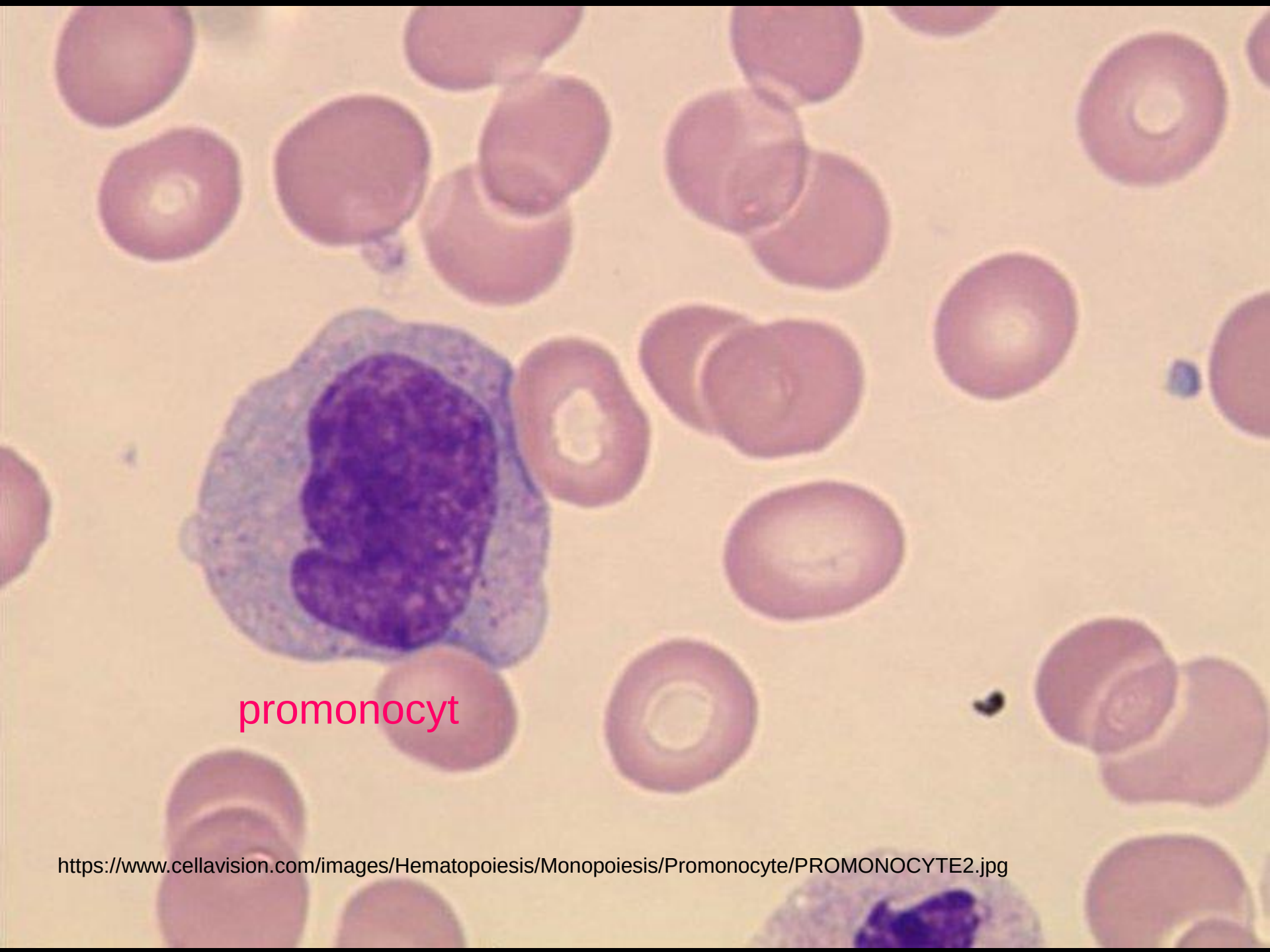
Hochová I. a spol.: Myelodysplastický syndrom. Diagnostický atlas, Maxdorf 2006

Vývoj monocytů, monopoéza



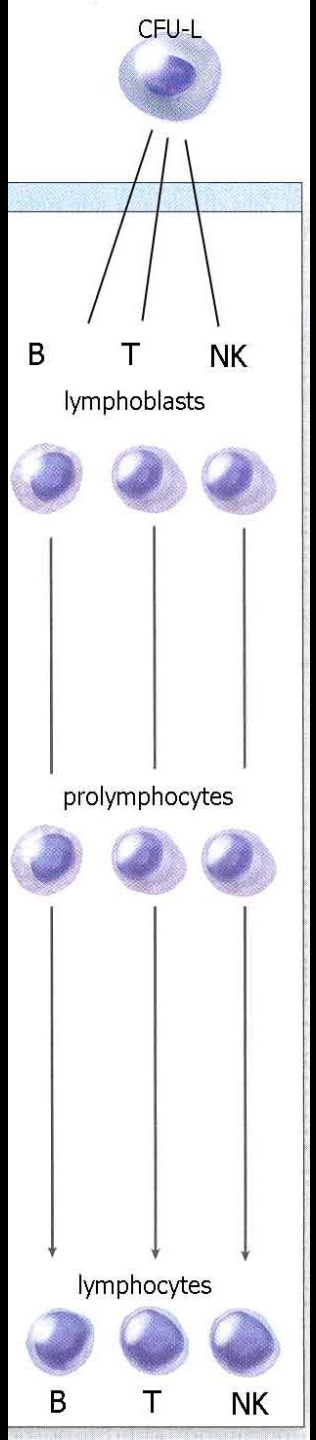


https://i.pinimg.com/originals/65/c9/8f/65c98f09f03f4cf6ef86e6f7c8693c8b.jpg



https://www.cellavision.com/images/Hematopoiesis/Monopoiesis/Promonocyte/PROMONOCYTE2.jpg

Vývoj lymfocytů, lymfopoéza

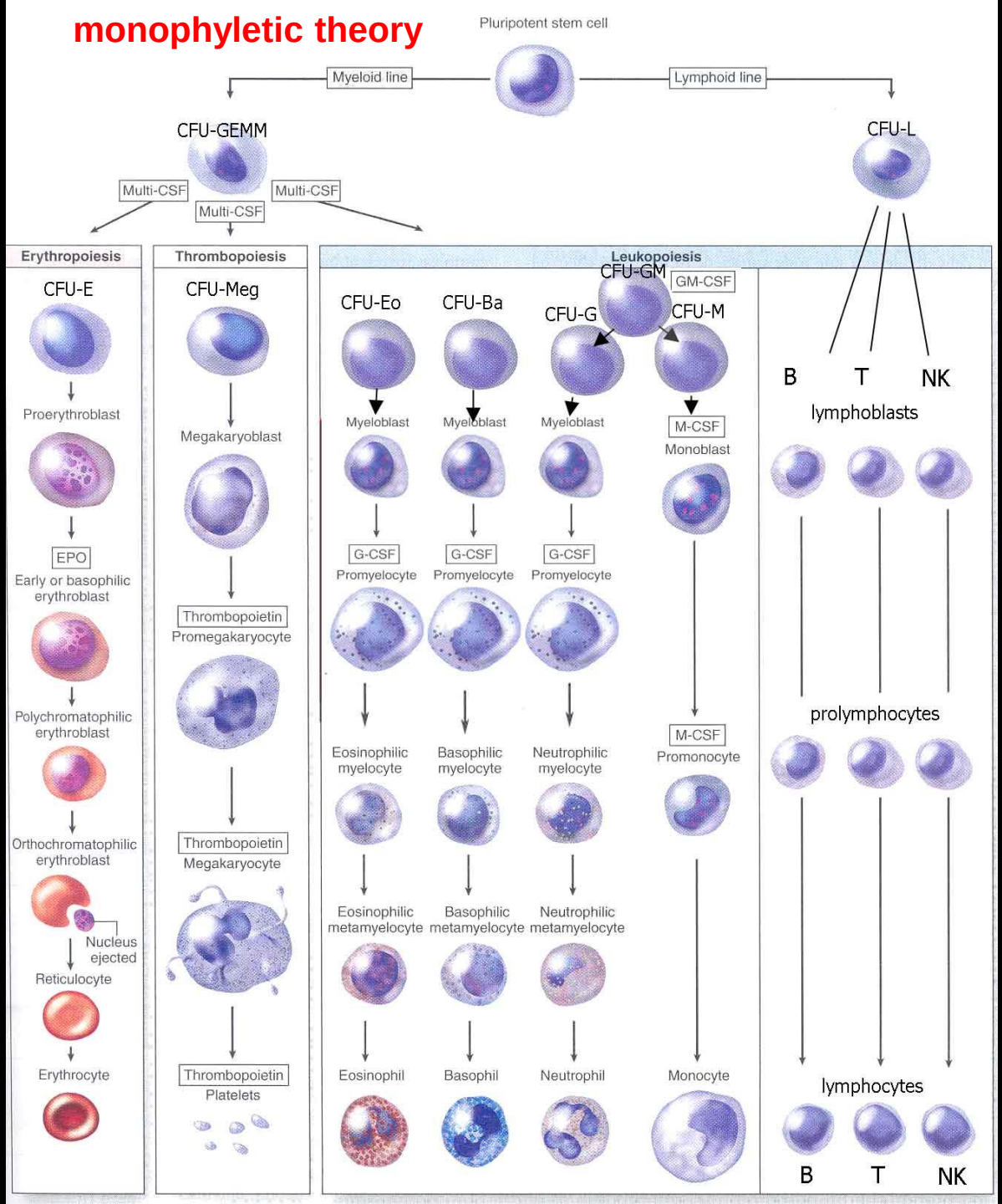


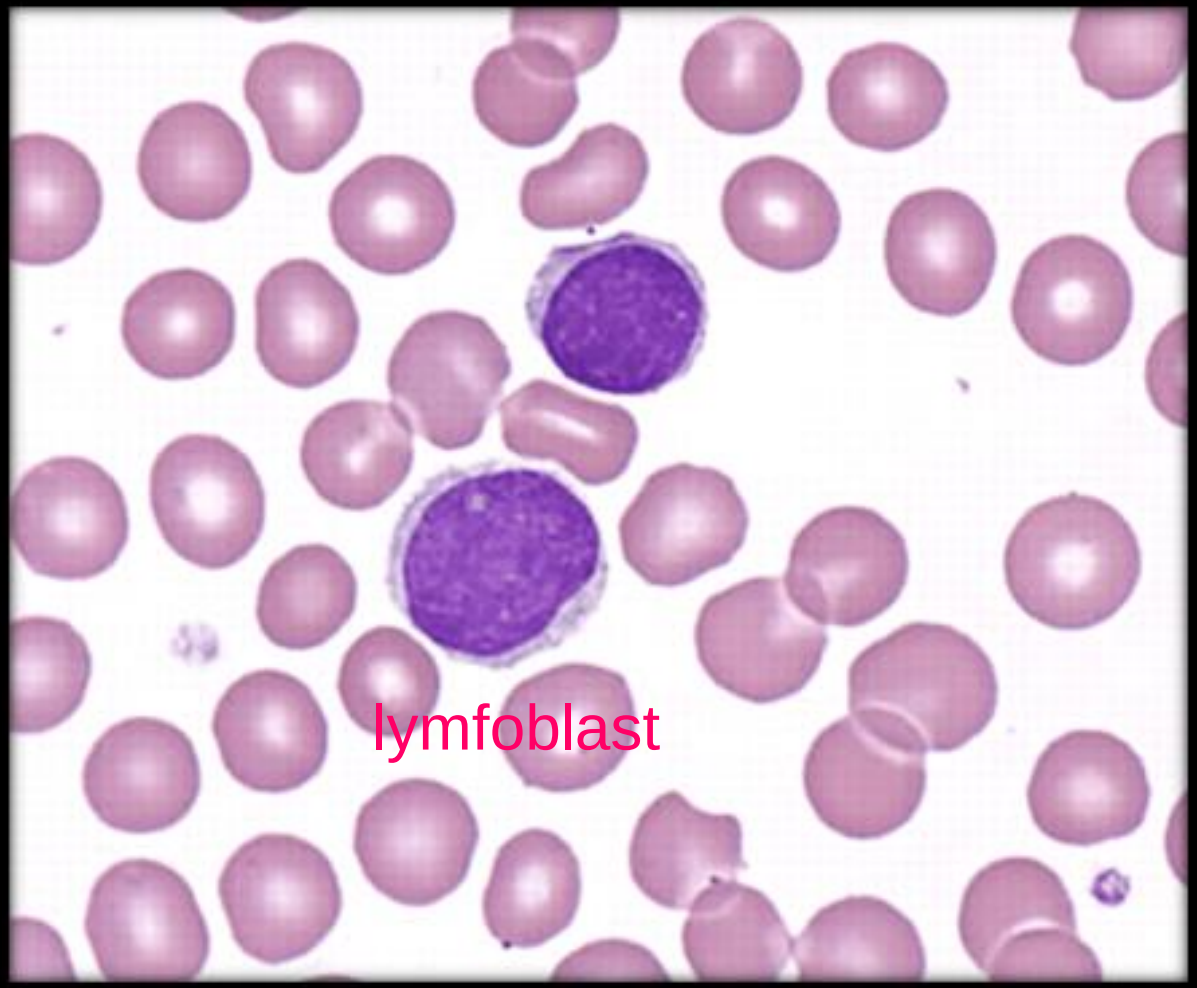
Stem cells

Progenitor cells (CFU)

Precursor cells (blasts)

Mature cells





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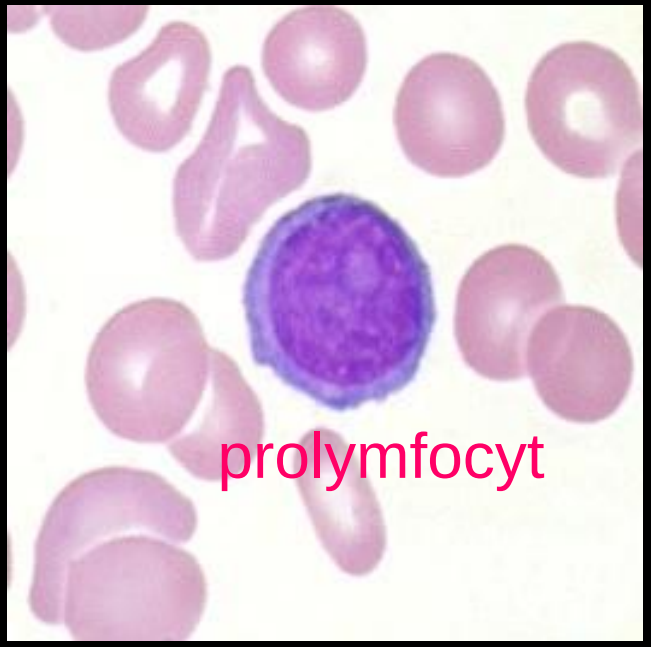
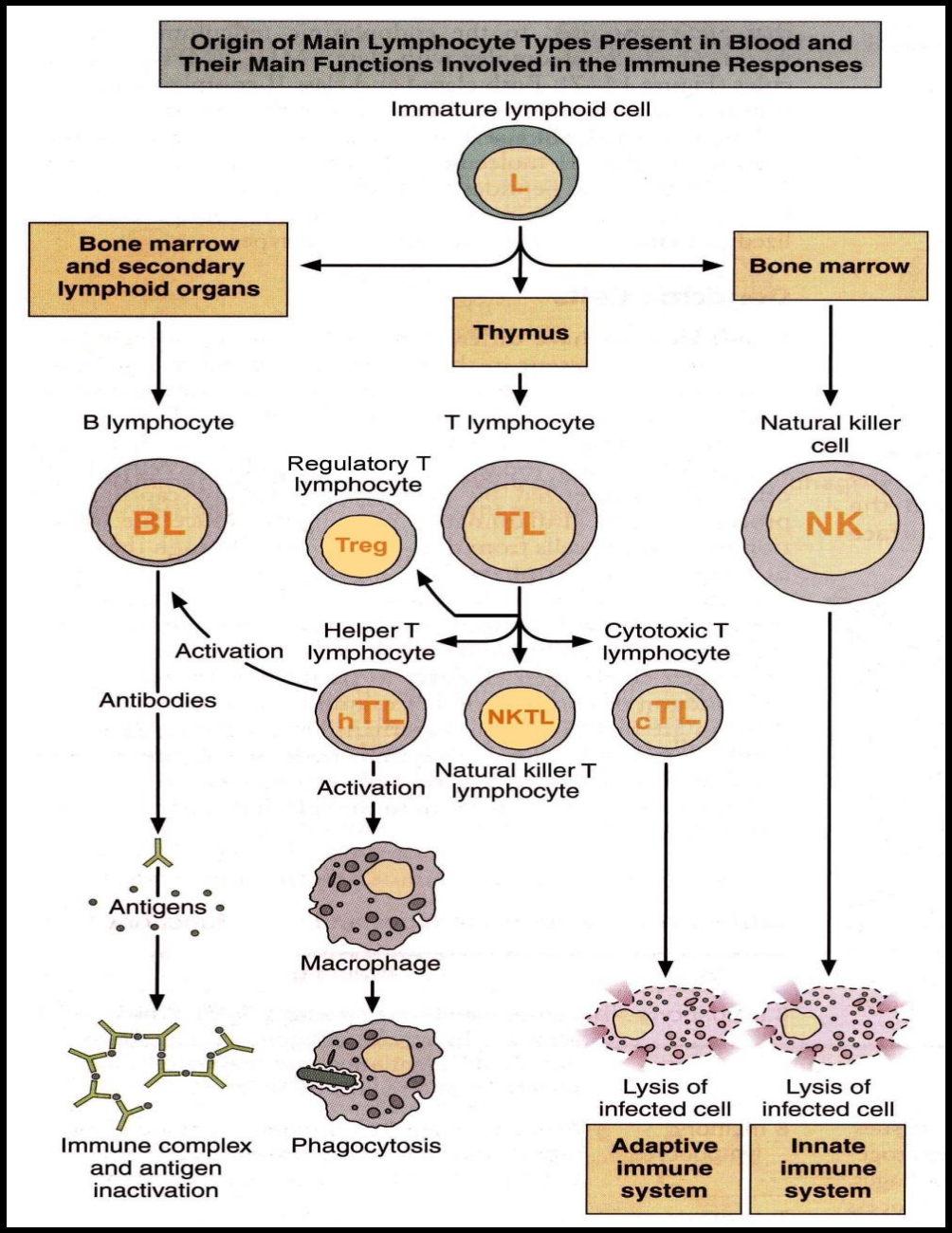


http://classconnection.s3.amazonaws.com/801/flashcards/3398801/jpg/prolymphocyte-13FE36EA10E493AEAD5.jpg

Lymphoblast (in bone marrow)

Places of maturation (immunocompetency acquirement)

Types of lymphocytes



SURFACE ANTIGENS

all B- lymphocytes
CD20,23,(19) BCR
MHC II

all T-lymphocytes
CD3 TCR

T_hL CD4

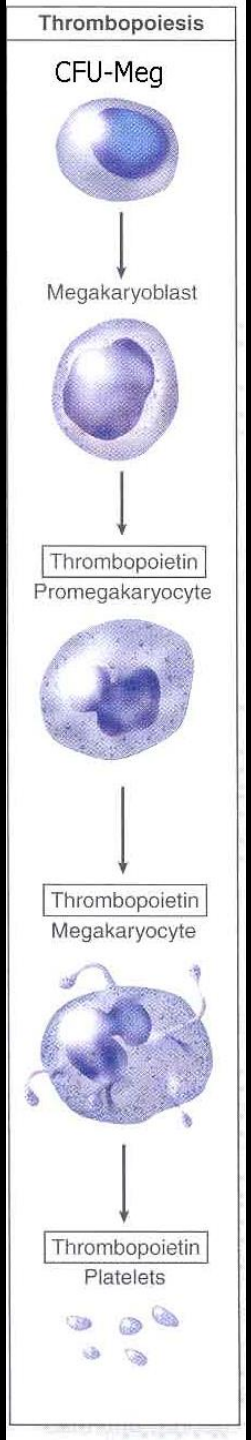
T_cL CD8

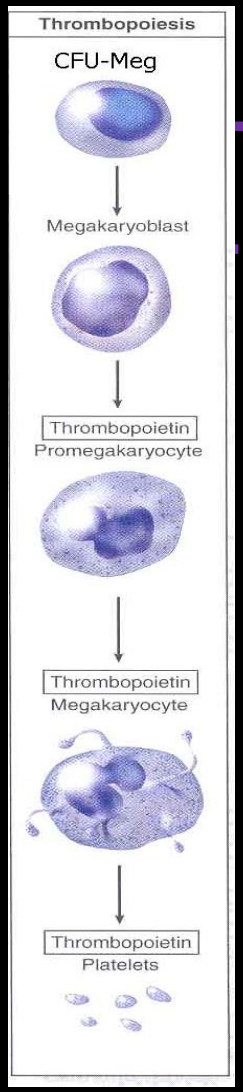
$T_{reg}L$ CD4 or CD8
CD25 and FOXP3

NKTL and other unconventional TL (MAIT)
CD1d CD16

NK-cells CD16
CD56

Vývoj krevních destiček, trombopoéza



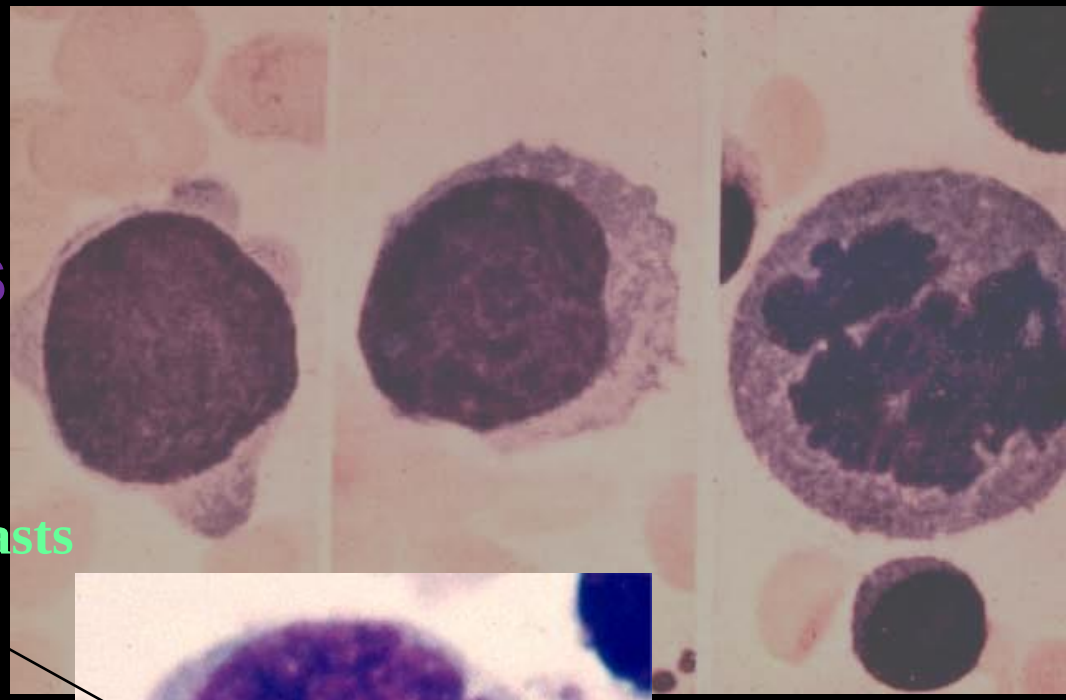


Thrombocytes

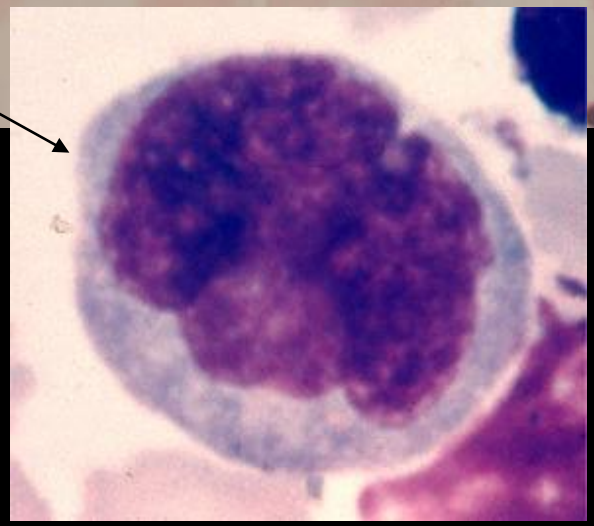
hrombopoiesis

endomitosis

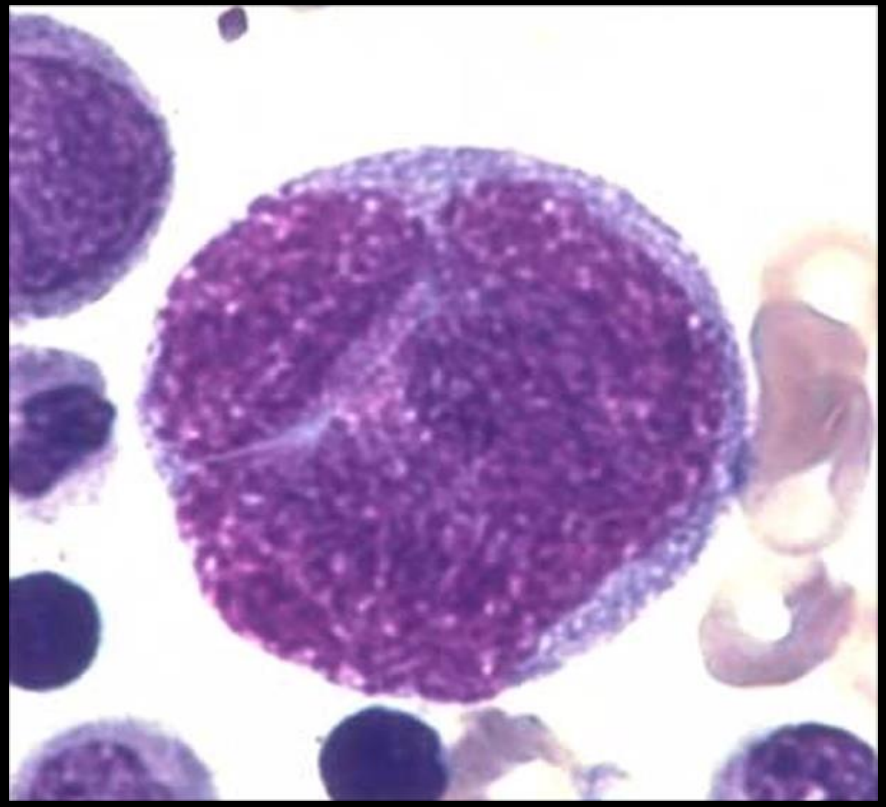
Megakaryoblasts
15 – 35 µm

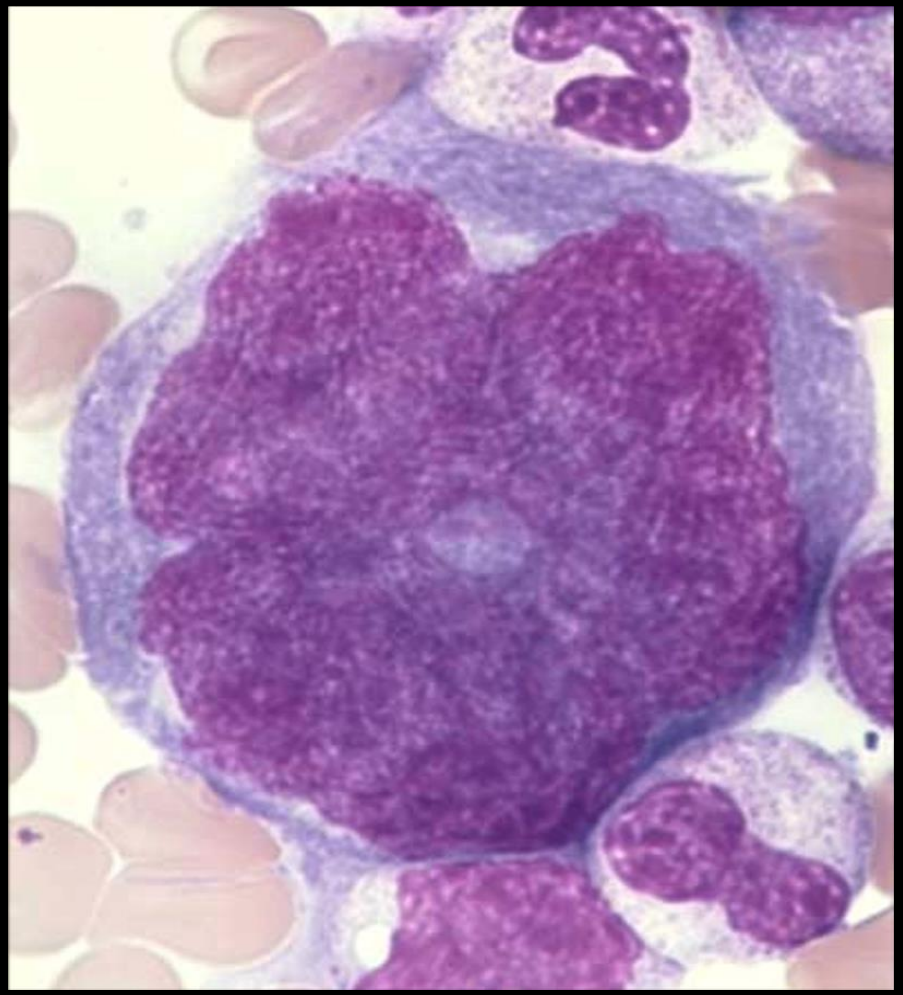


Any karyokinesis and cytokinesis



Promegakaryocytes
30 – 60 µm





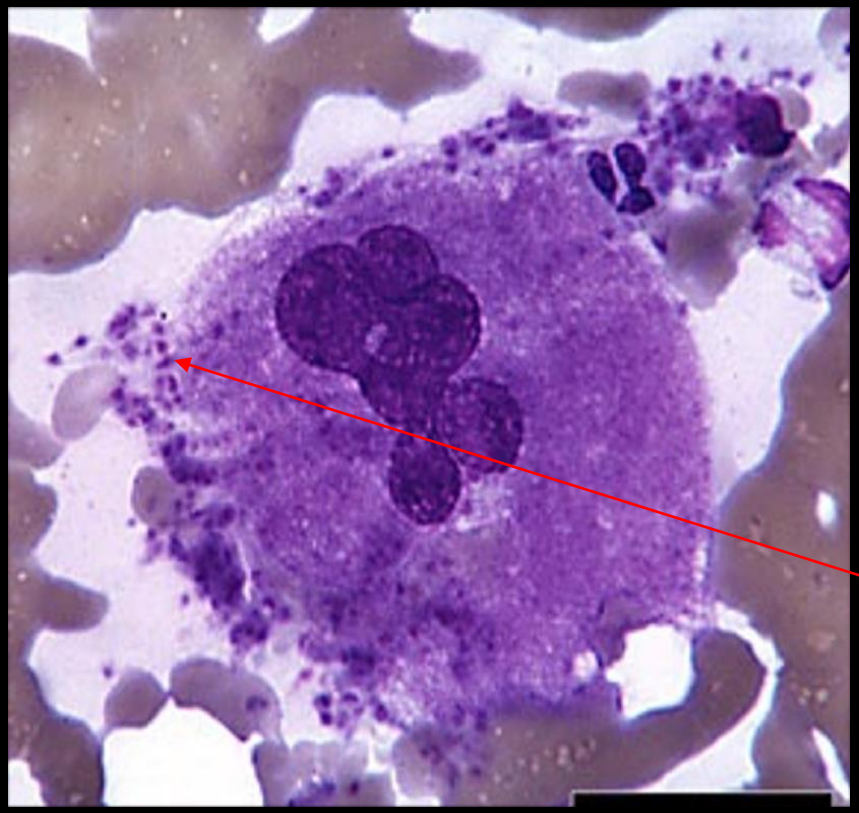
MEGAKARYOCYTE

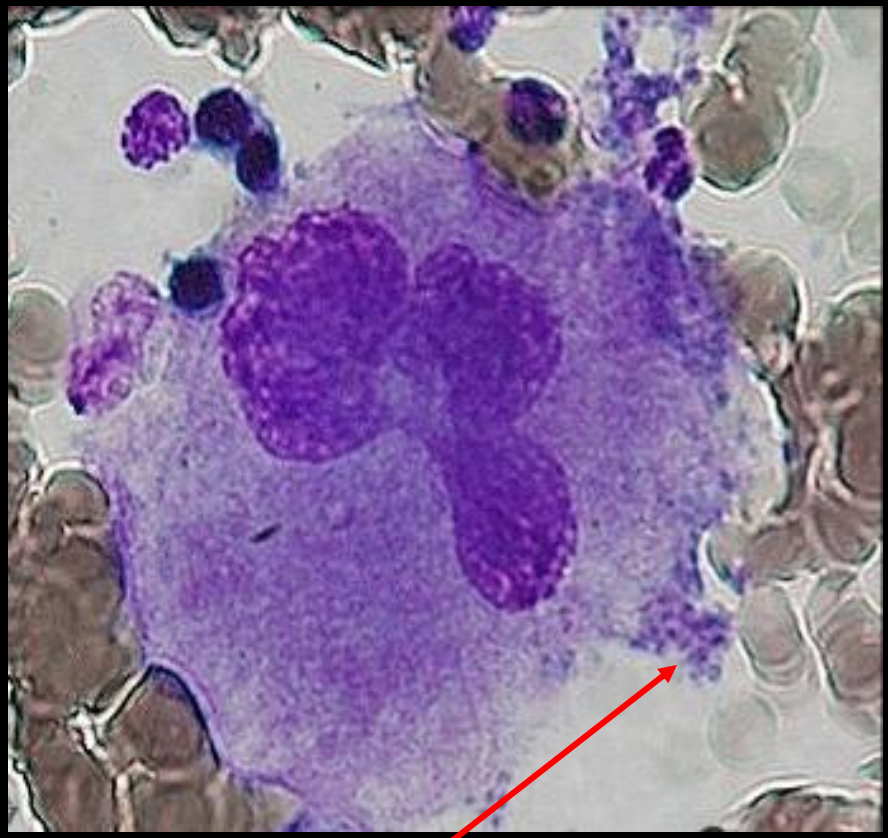
Polyploid nucleus

Azurophilic granules

Demarcation lines

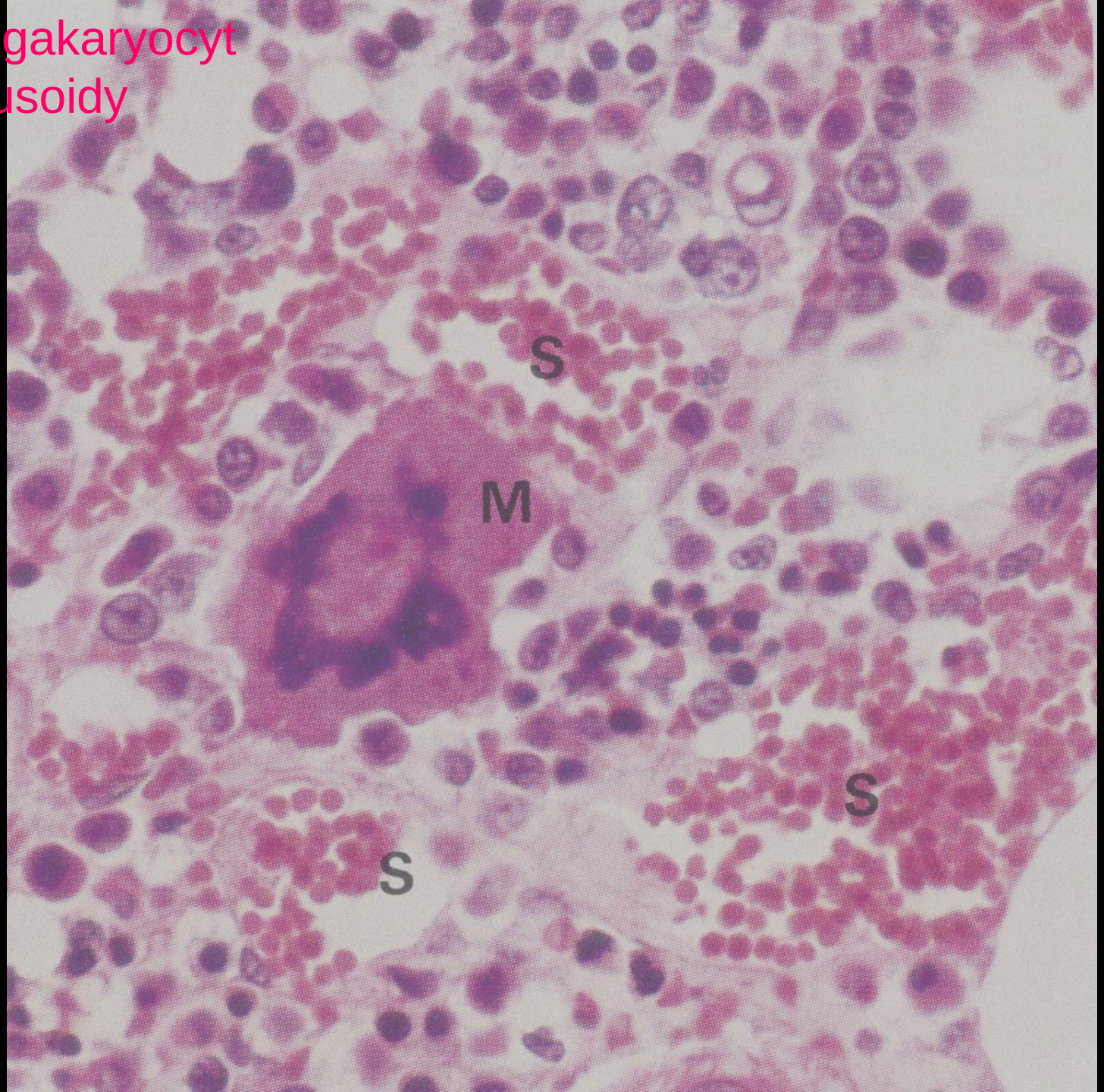
Megakaryocytes

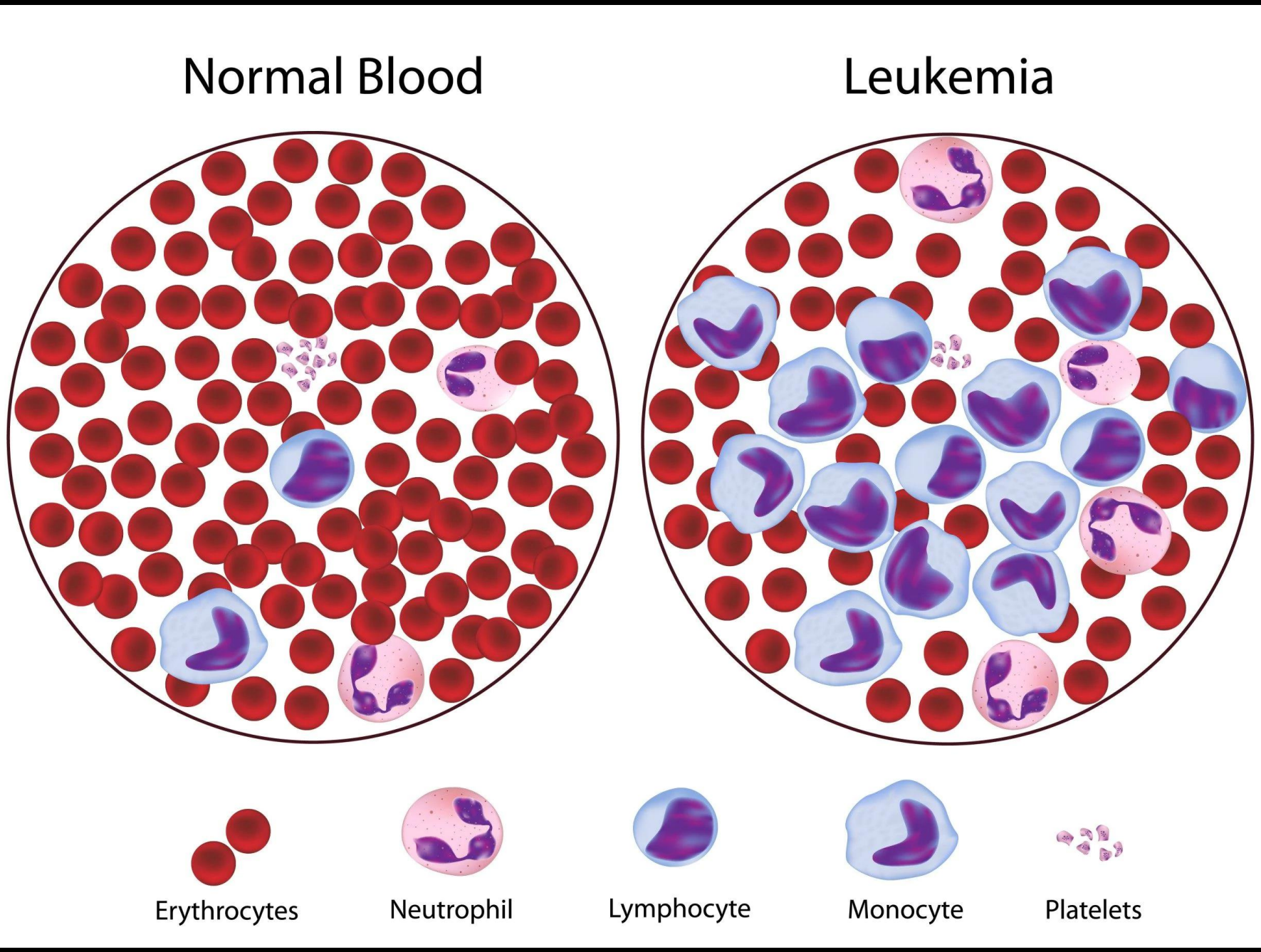


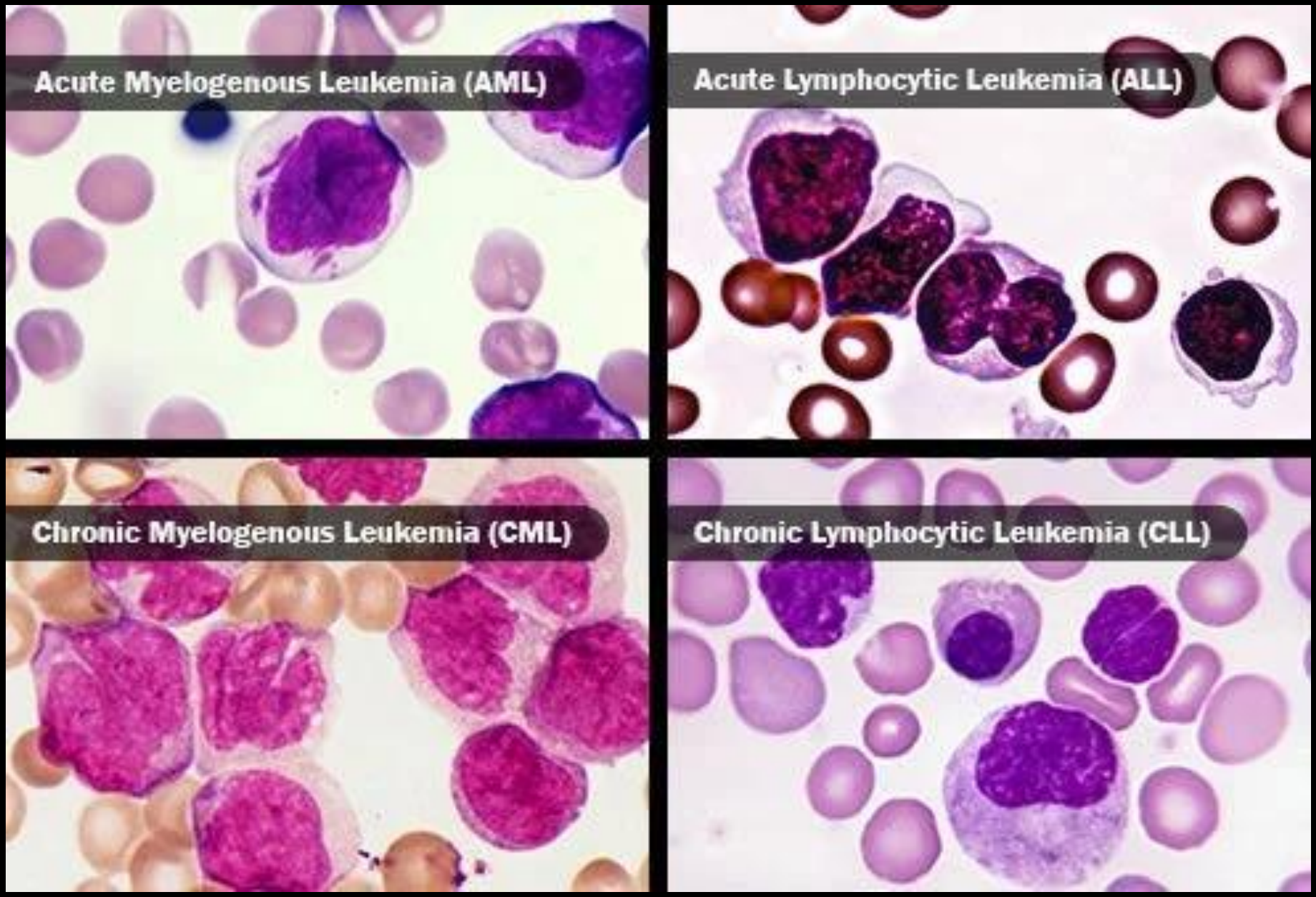


Fragmentation of thrombocytes from the cytoplasm 2000 - 4000 thrombocytes directly into the sinusoid

M = megakaryocyt
S = sinusoidy




Normal Blood
Leukemia
Erythrocytes
Neutrophil
Lymphocyte
Monocyte
Platelets

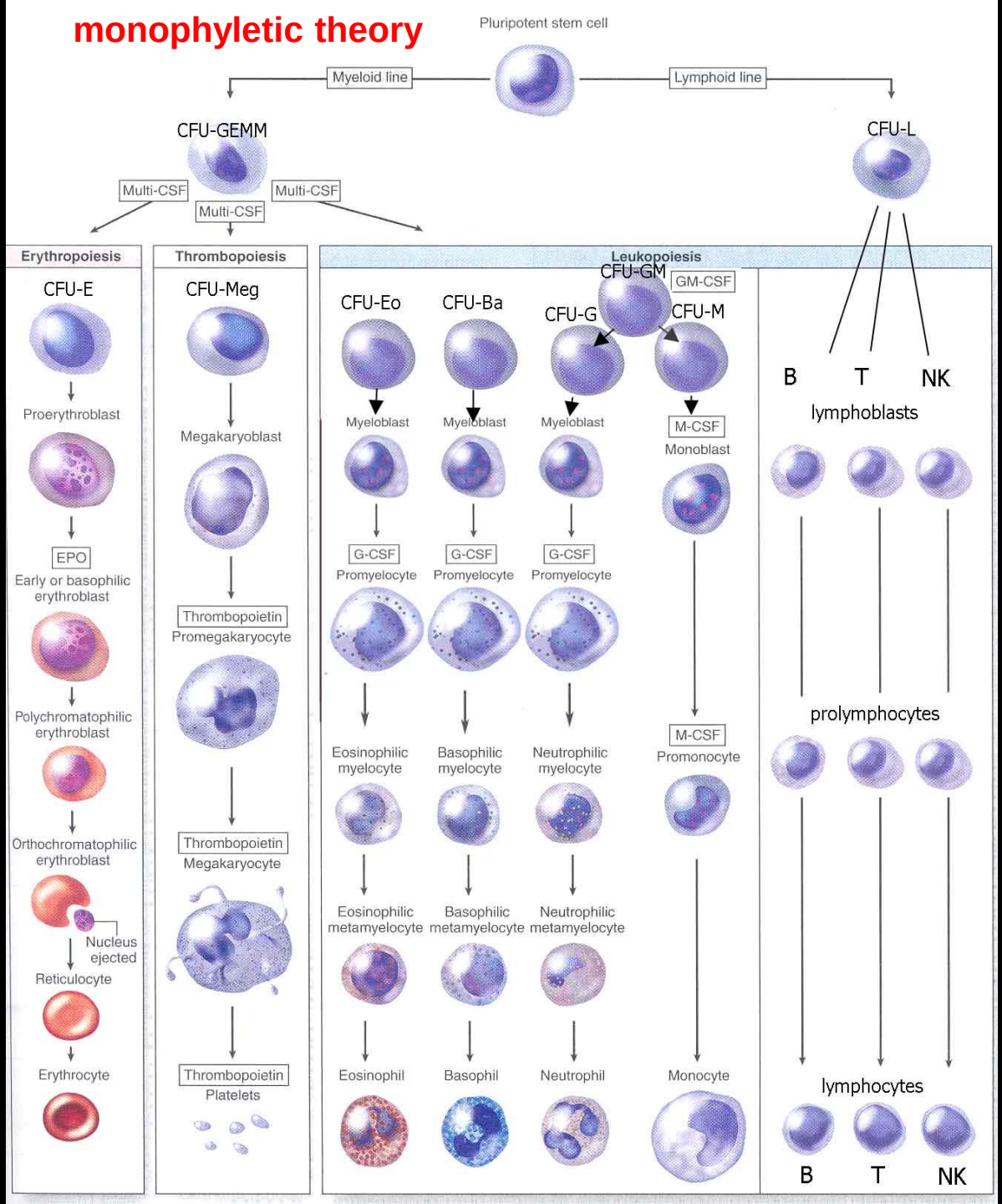

Acute Myelogenous Leukemia (AML)
Acute Lymphocytic Leukemia (ALL)
Chronic Myelogenous Leukemia (CML)
Chronic Lymphocytic Leukemia (CLL)

Stem cells

Progenitor cells (CFU)

Precursor cells (blasts)

Mature cells




Thank you for your attention
meme-arsenal.ru