



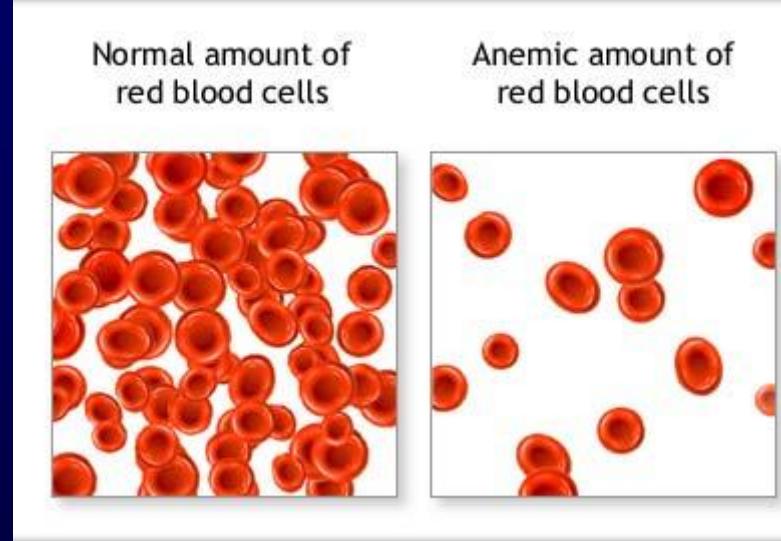
Anemias

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Anemia

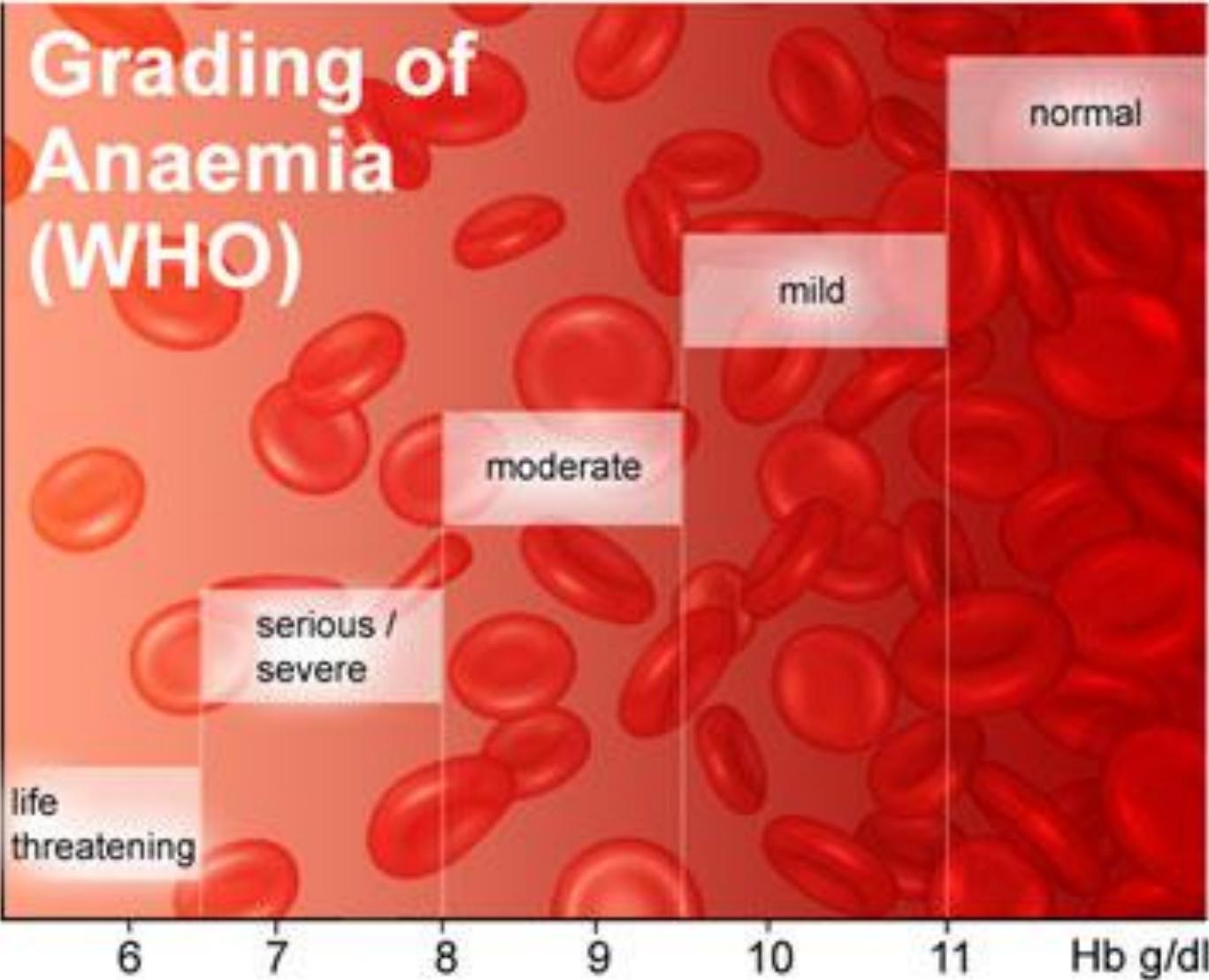
an- = „without“

-emia = „blood condition“



Anemia is actually a sign of a disease process rather than a disease itself

Grading of Anaemia (WHO)



Anemia diagnosis

Age	Hemoglobin (g/dl)
3 mo	< 10.0
6 mo - 5 y	< 11.0
6 - 14 y	< 12.0
Adult woman	< 12.0
Adult man	< 13.0

Anemia classification

<u>MICROCYTIC</u> <u>HYPOCHROM</u>	<u>NORMOCYTIC</u> <u>NORMOCHROM</u>	<u>MACROCYTIC</u>
(MCV<75 fl MCH<27 pg)	(MCV 75-90 fl MCH>27 pg)	(MCV>90 fl)

MCV

- mean corpuscular volume
- average volume of RBCs
- $Ht \times 1000 : RBC$
- normal range: 75-90 fl
(1mo: 108 fl, 6mo: 91 fl, 2y: 78 fl,
6y: 86 fl, 12y: 90fl)

MCH

- mean corpuscular hemoglobin
- average mass of hemoglobin per RBC
- Hb (g/l) : RBC
- normal range: 27-32 pg
(1mo: 34 pg, 6mo: 30 pg, 2y: 27 pg,
6y: 29 pg, 12y: 30 pg)

MCHC

- mean cell hemoglobin concentration
- average cc. hg in a given volume of blood
- Hb (g/l) : Ht
- normal range: 330-360 g/l
(1mo: 330g/l, 6mo: 330g/l, 2y. 330g/l,
6y: 340g/l, 12y: 340g/l)
- low: hypochrom anaemias
- high: spherocytosis

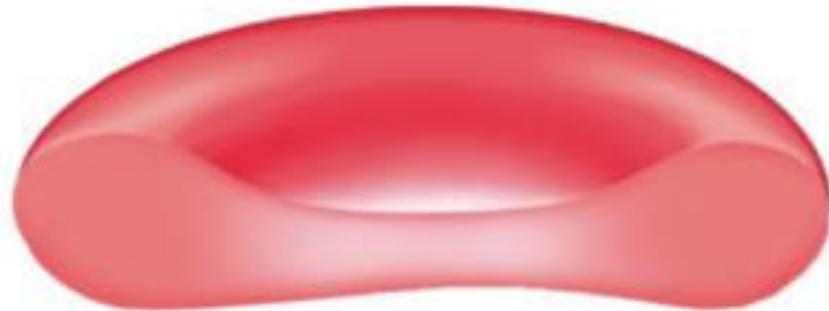
RDW

- red cell distribution width
- how much RBC vary in size from each other



6-8 μm





2.0 μm

Side view



7.5 μm

Top view

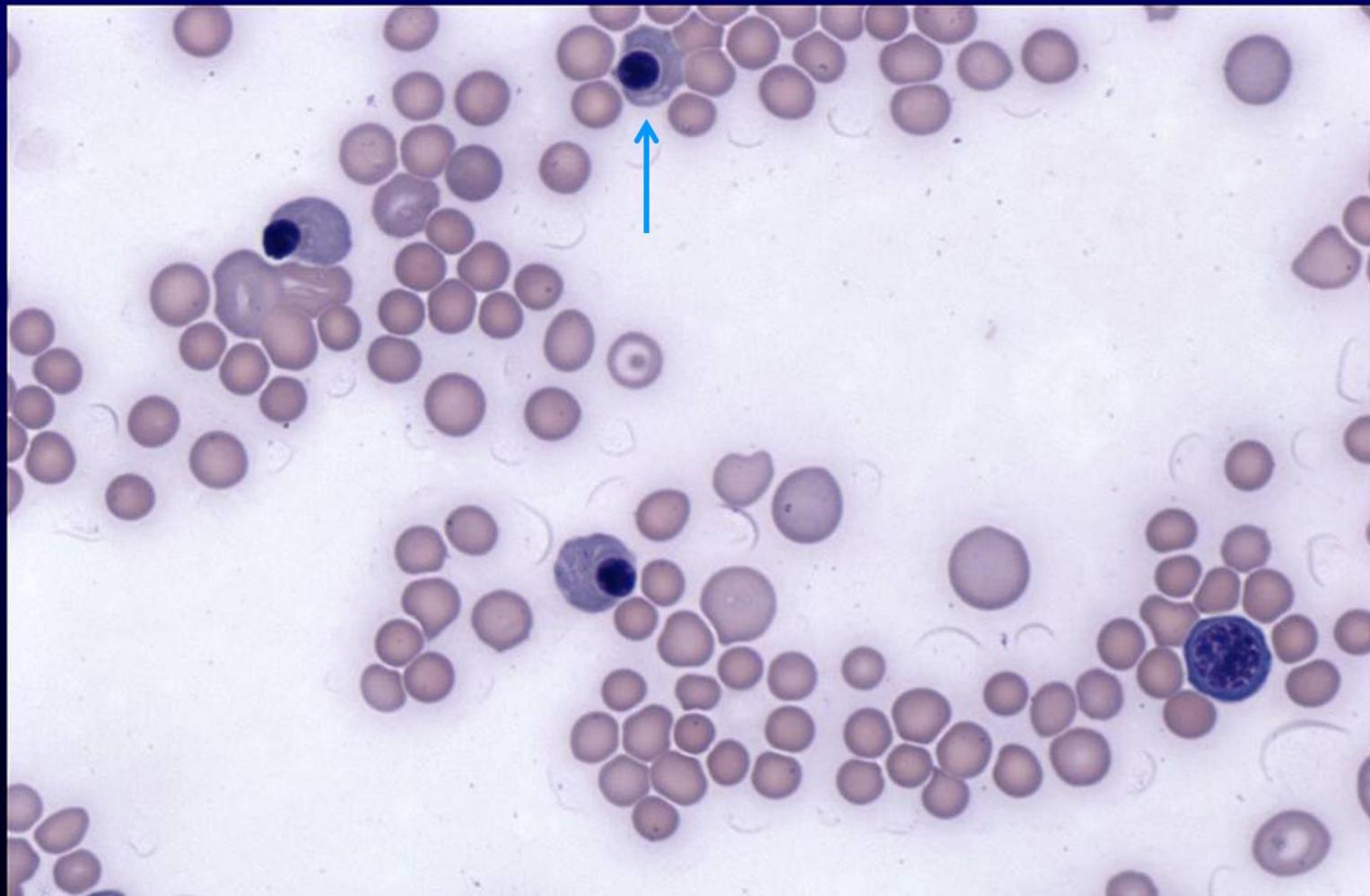
RDW

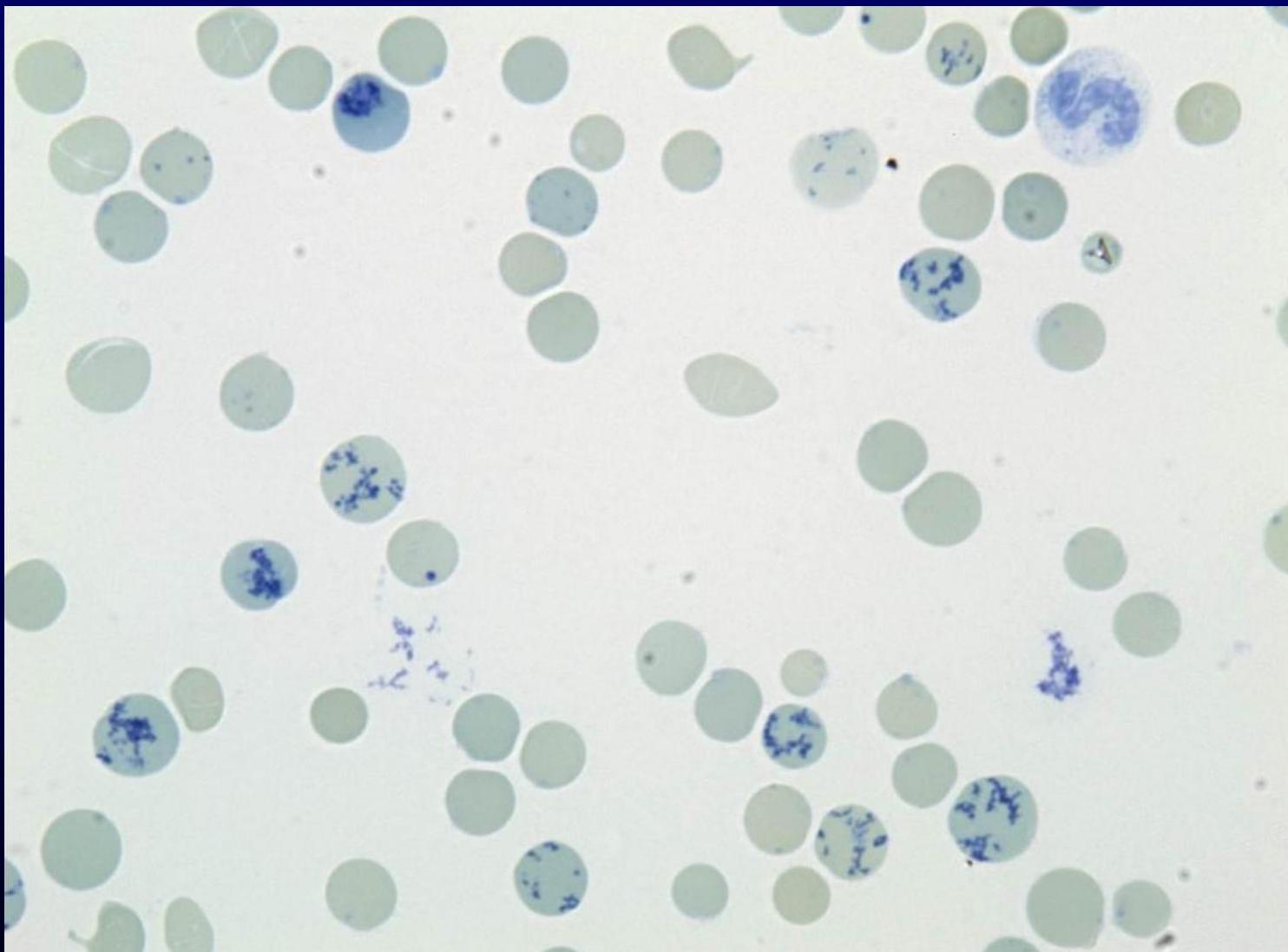
- red cell distribution width
- how much RBC vary in size from each other
- $(SD \text{ of } MCV \div \text{mean } MCV) \times 100$
- normal range: 9-14%
- ↑: iron-, vit-B12, folic acid deficiency
- →: blood loss, thalassemia

When I was a kid I thought heart looked like this

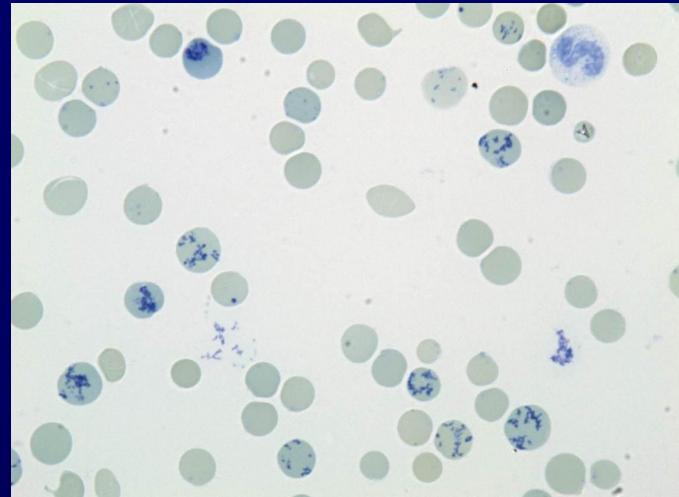


nucleated erythrocytes

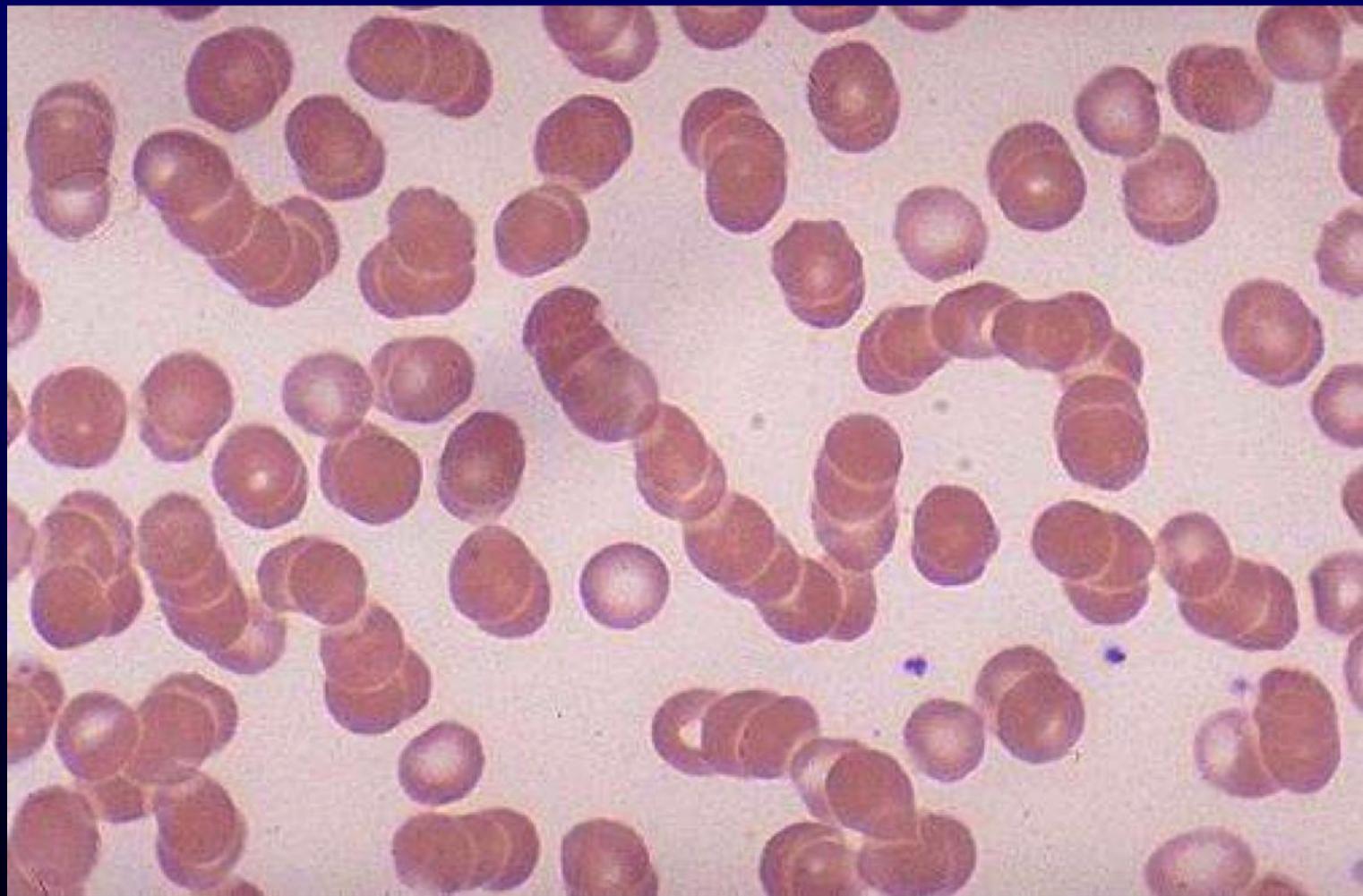




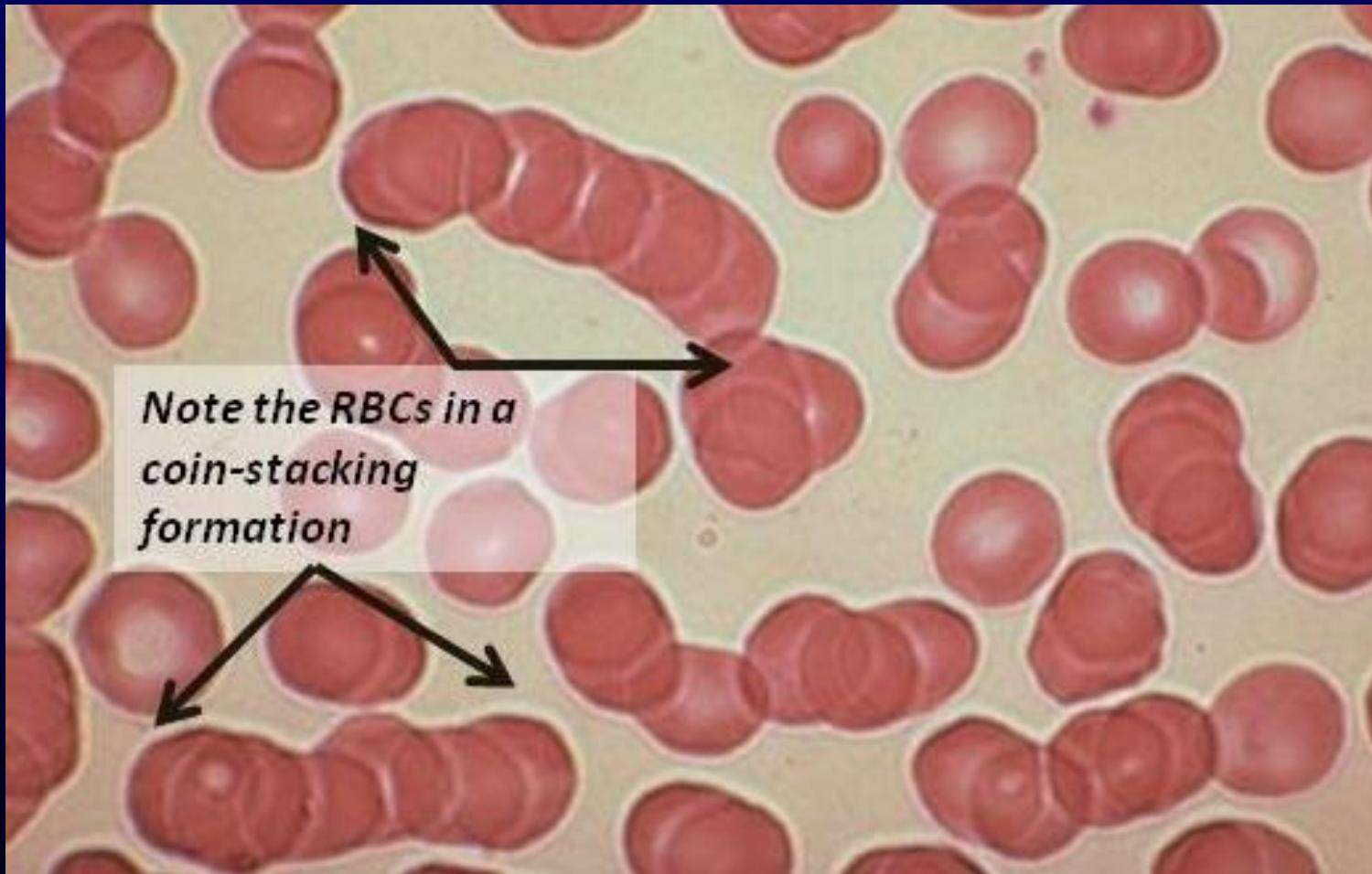
Reticulocyte



- immature RBC, ca. 1%
- reticular network of ribosomal RNA
- ↑: hemolysis, blood-loss, regeneration
- ↓: BM disorder, deficiency's (EPO, Fe, vit-B12, folic acid)
- →: ineffective erythropoiesis (MDS, CDA, thalassemia, myelofibrosis), chronic inflammation, malignancy



Rouleaux formation

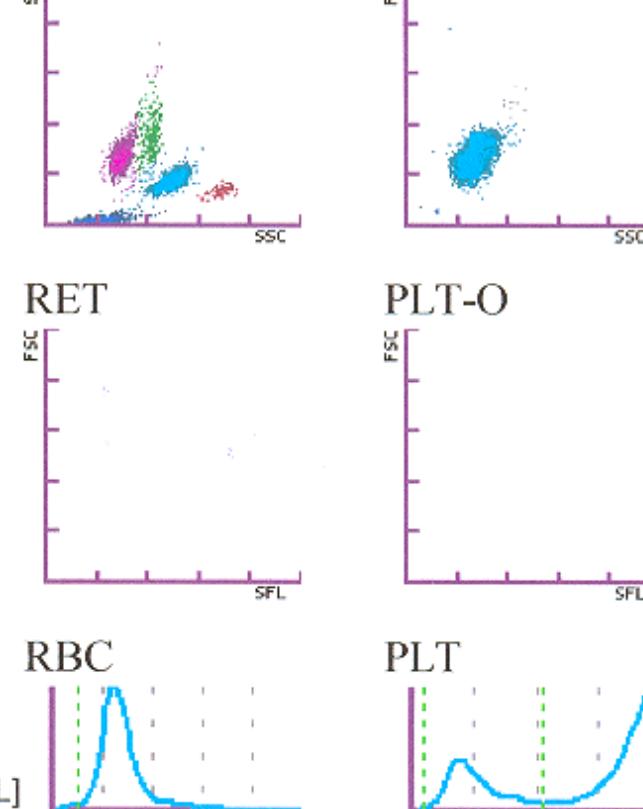


Anemia classification

<u>MICROCYTIC</u> <u>HYPOCHROM</u>	<u>NORMOCYTIC</u> <u>NORMOCHROM</u>	<u>MACROCYTIC</u>
(MCV<75 fl MCH<27 pg)	(MCV 75-90 fl MCH>27 pg)	(MCV>90 fl)
iron deficiency	hemolytic anemia	megaloblastic (B12-, folic acid def)
thalassemia	infections	alcohol, liver disease
chronic disease	acute bleeding	MDS, aplastic anemia
lead toxicity	bone marrow disease	CDA
sideroblastic	secondary anemia kidney disease	pregnancy, myeloma myxoedema

Microcytic anemia

WBC	5.66	[10 ⁹ /L]
RBC	5.02	[10 ¹² /L]
HGB	87	[g/L]
HCT	30.7	[%]
MCV	61.2 -	[fL]
MCH	17.3 -	[pg]
MCHC	283 -	[g/L]
PLT	339	[10 ⁹ /L]
RDW-SD	45.1	[fL]
RDW-CV	21.4 +	[%]
PDW	12.1	[fL]
MPV	9.2	[fL]
P-LCR	20.4	[%]
PCT	0.31	[%]
NEUT	3.35	[10 ⁹ /L]
LYMPH	1.59	[10 ⁹ /L]
MONO	0.55	[10 ⁹ /L]
EO	0.16	[10 ⁹ /L]
BASO	0.01	[10 ⁹ /L]
RET		[% %]
IRF		[%]
LFR		[%]
MFR		[%]
HFR		[%]



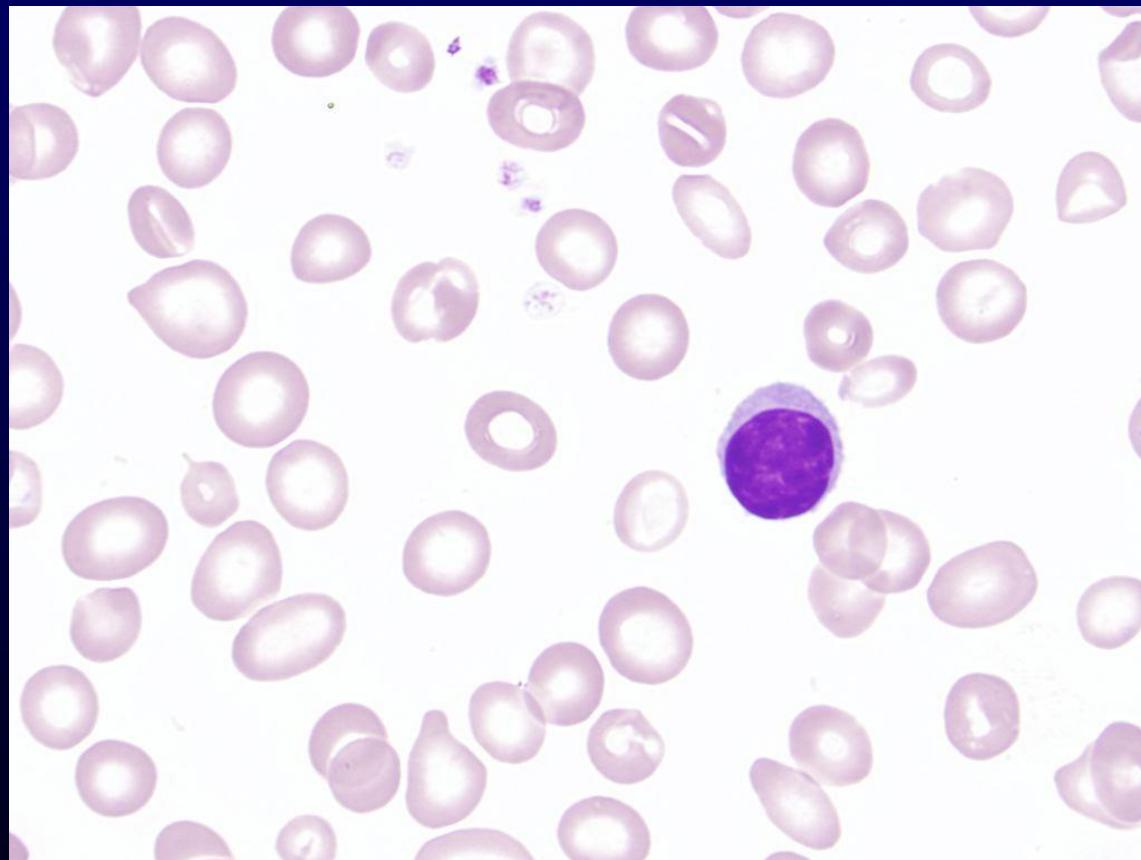
WBC IP Message(s)

RBC/RET IP Message(s)
Anisocytosis
Microcytosis
Hypochromia
Anemia

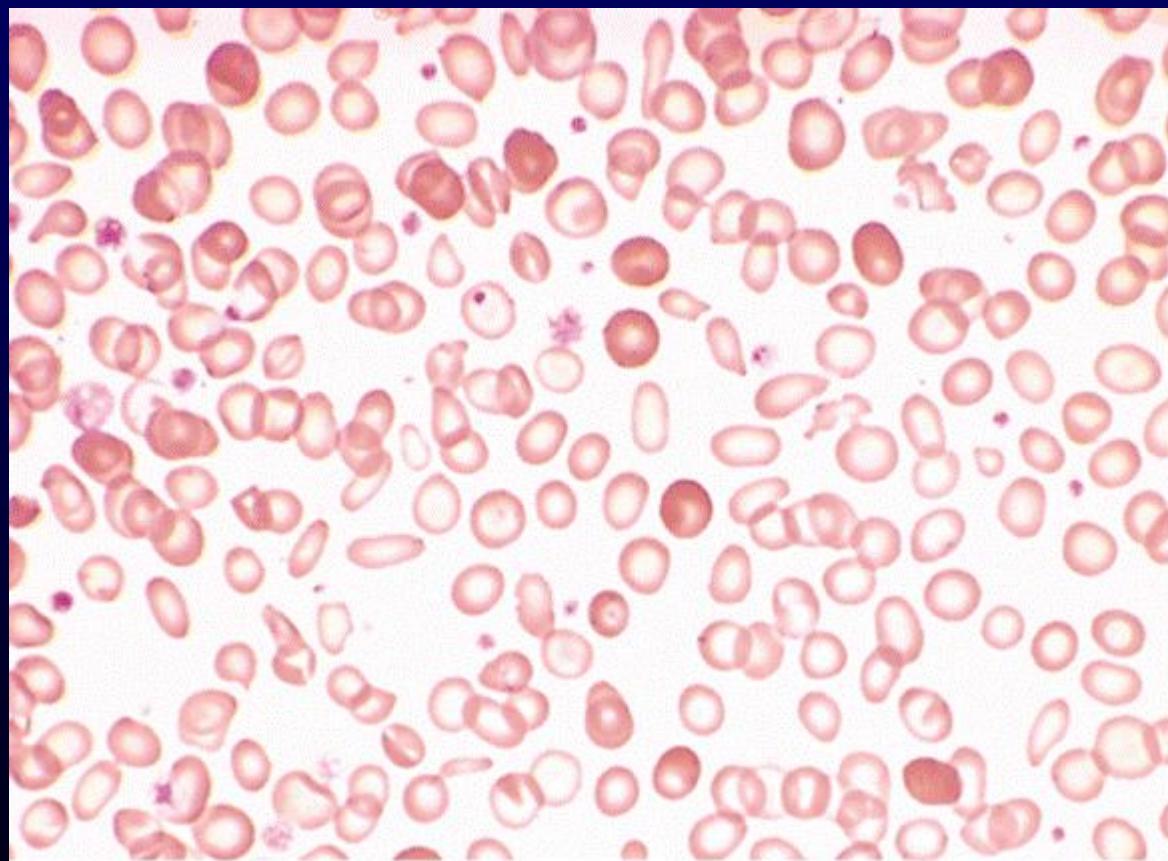
PLT IP Message(s)

Iron Deficiency?

Iron-deficiency



Iron-deficiency

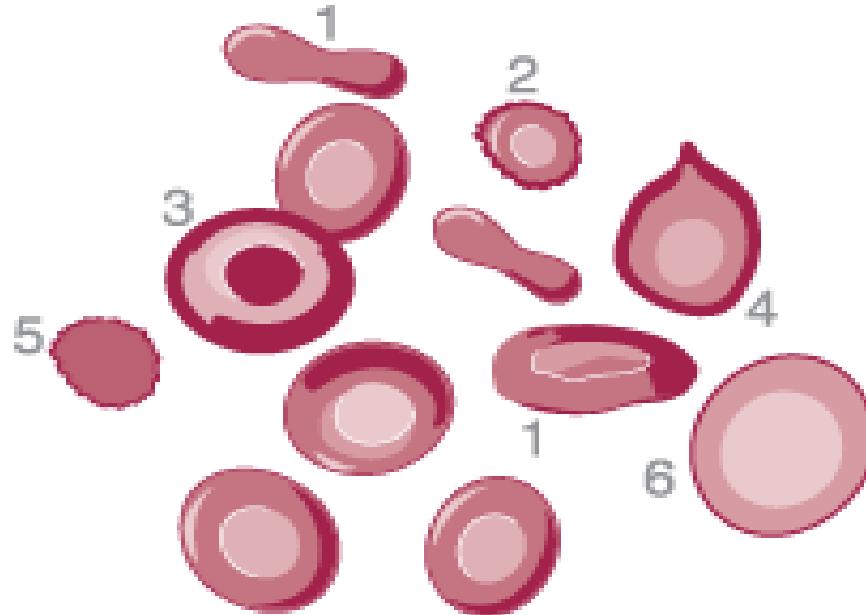




Thalassemia



Thalassemia



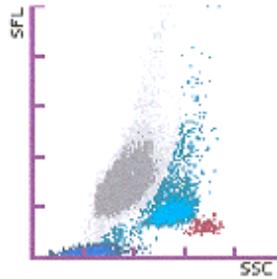
Poikilocytic red cells
(elliptocytes¹, schistocytes²,
target cells³, tear drop⁴,
spherocytes⁵ & hypochromic⁶)
usually present
in Thalassemia Major.

Normocytic anemia

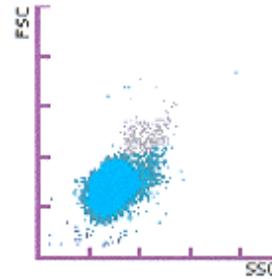
Morph. Count

WBC	<u>36.93</u> *	[10^9/L]
RBC	<u>2.50</u>	[10^12/L]
HGB	72 -	[g/L]
HCT	21.1 -	[%]
MCV	84.4 -	[fL]
MCH	28.8 -	[pg]
MCHC	341 -	[g/L]
PLT	86 * -	[10^9/L]
RDW-SD	54.0 -	[fL]
RDW-CV	20.7 +	[%]
PDW	---	[fL]
MPV	---	[fL]
P-LCR	---	[%]
PCT	---	[%]
NEUT	---	[10^9/L]
LYMPH	---	[10^9/L]
MONO	---	[10^9/L]
EO	0.23 * -	[10^9/L]
BASO	0.19 * -	[10^9/L]
RET	<u>72.3</u> [%] -	0.1808 [10^12/L]
IRF	17.5 -	[%]
LFR	82.5 -	[%]
MFR	15.4 -	[%]
HFR	2.1 -	[%]

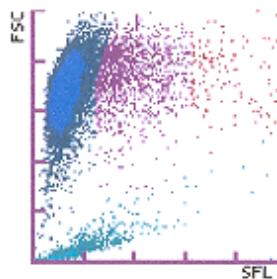
DIFF



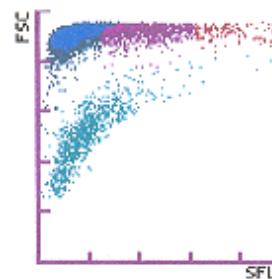
WBC/BASO



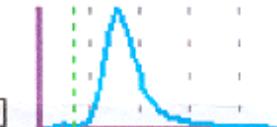
RET



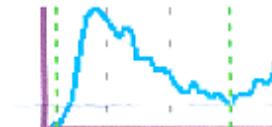
PLT-O



RBC



PLT

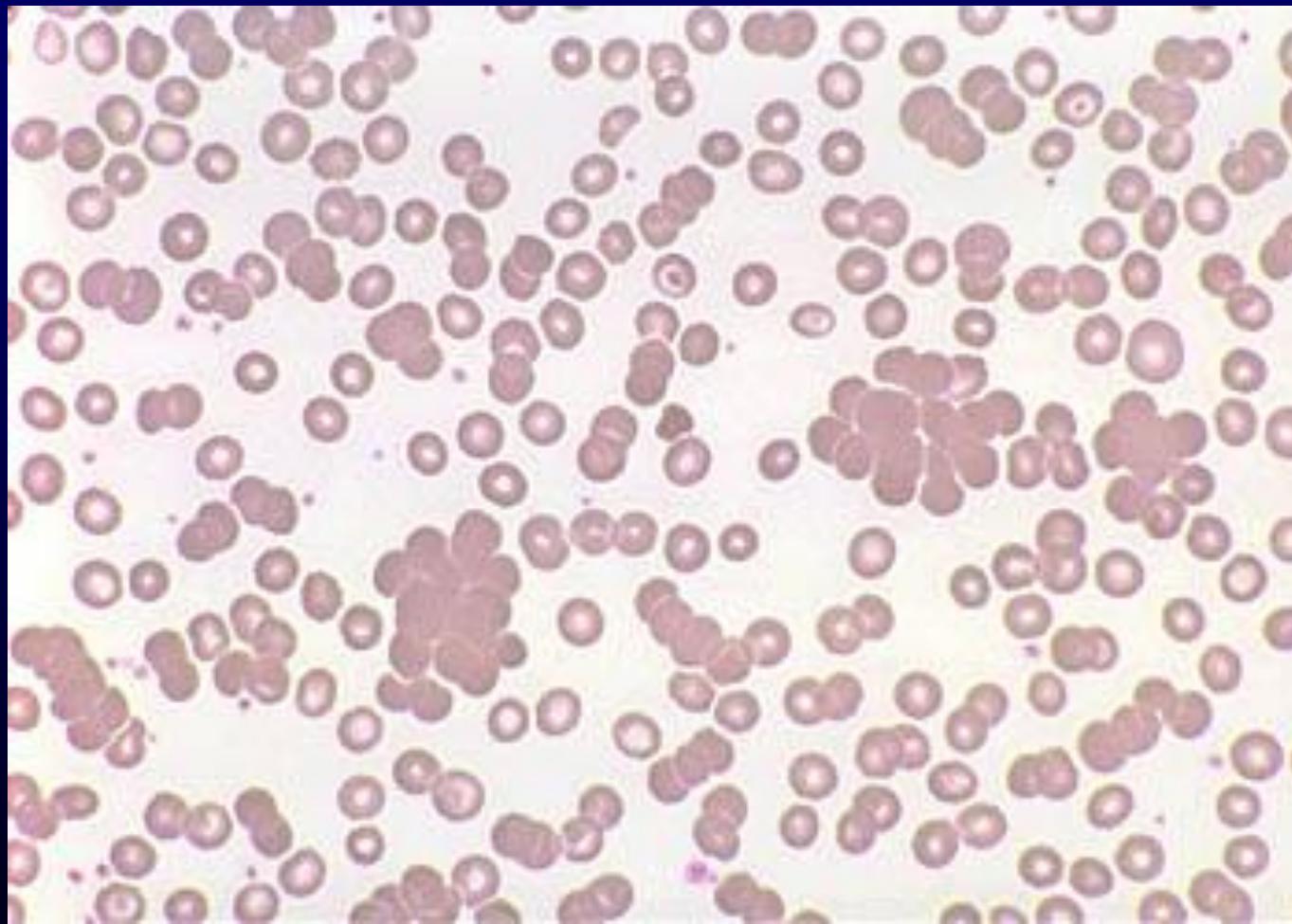


WBC IP Message(s)
WBC Abn Scattergram
Leukocytosis
Blasts?

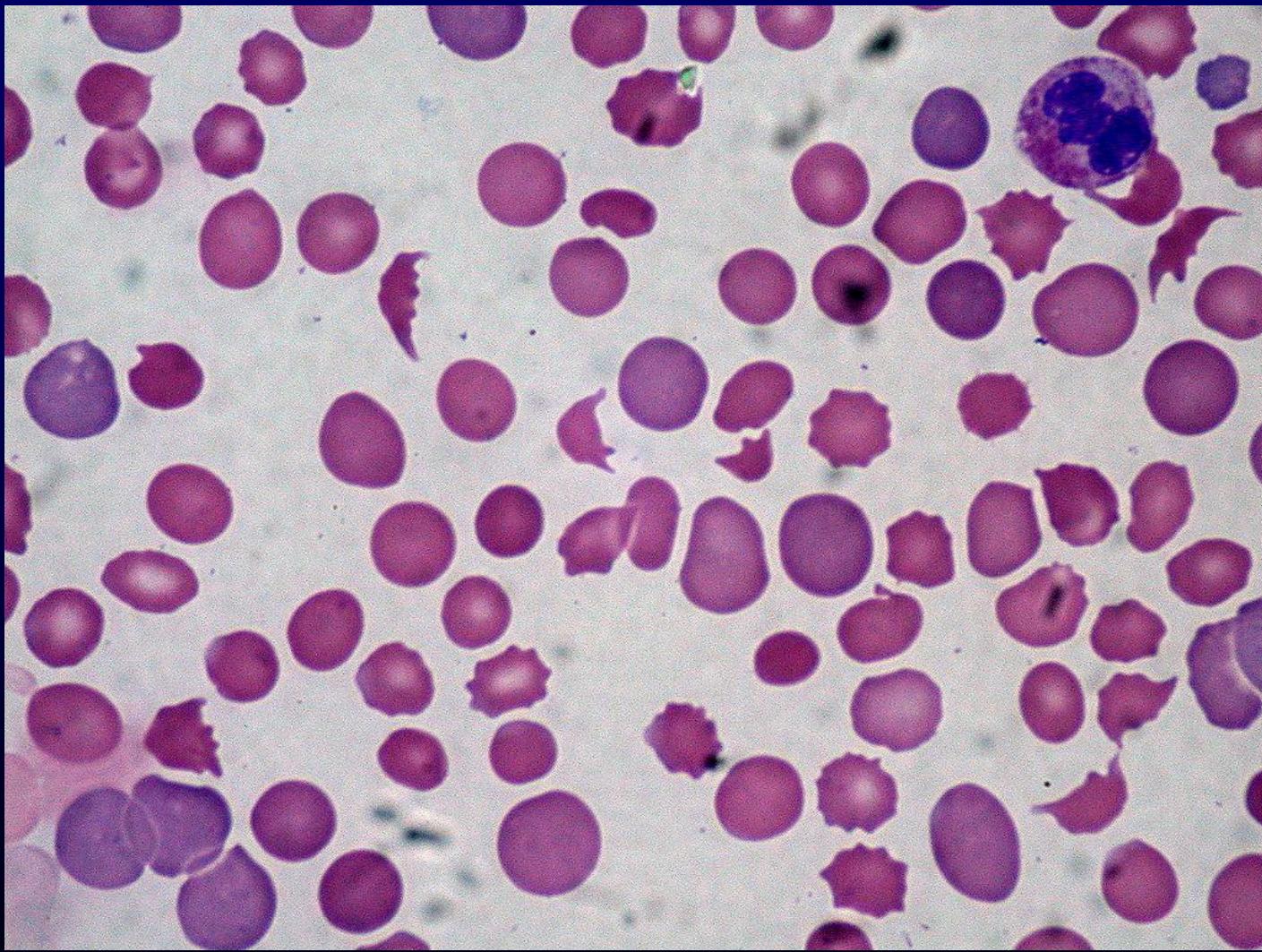
RBC/RET IP Message(s)
Reticulocytosis
Anisocytosis
Anemia

PLT IP Message(s)
PLT Abn Distribution
PLT Clumps(S)?

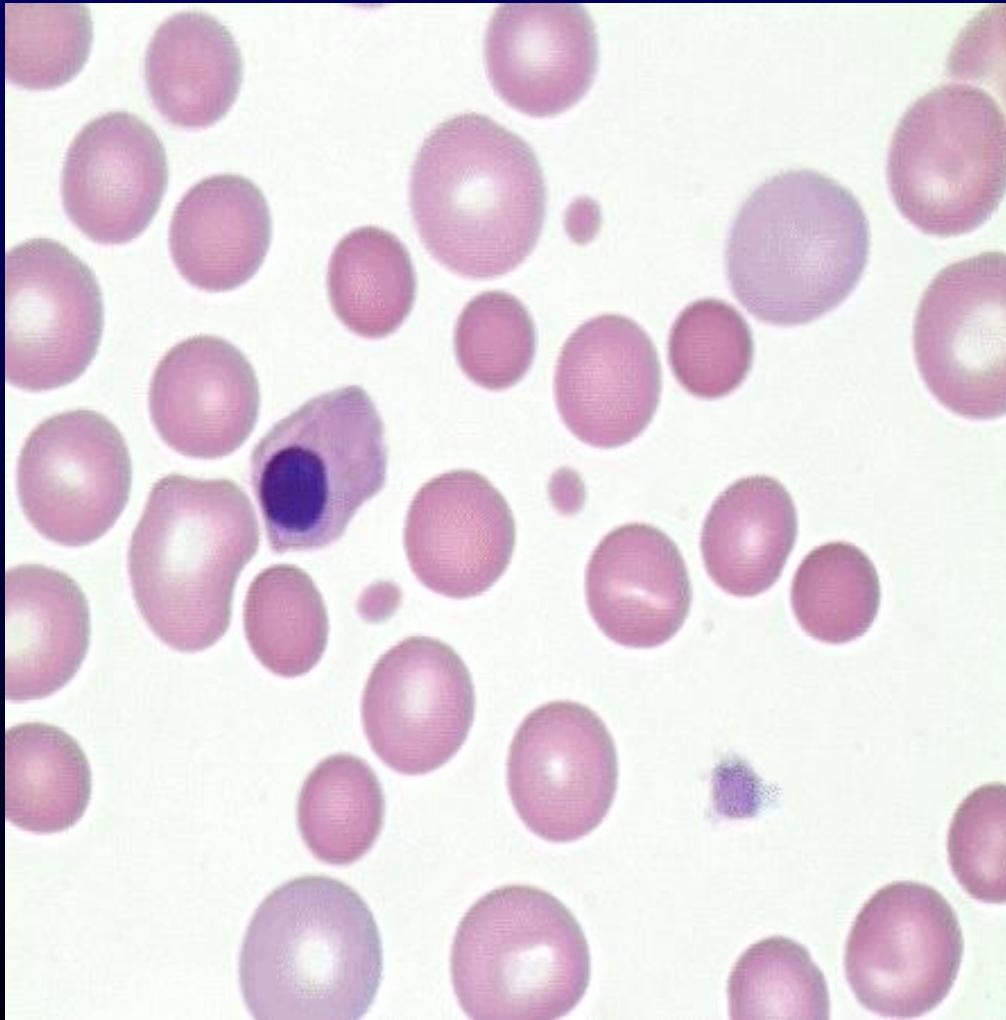
Hemolysis, cold agglutination



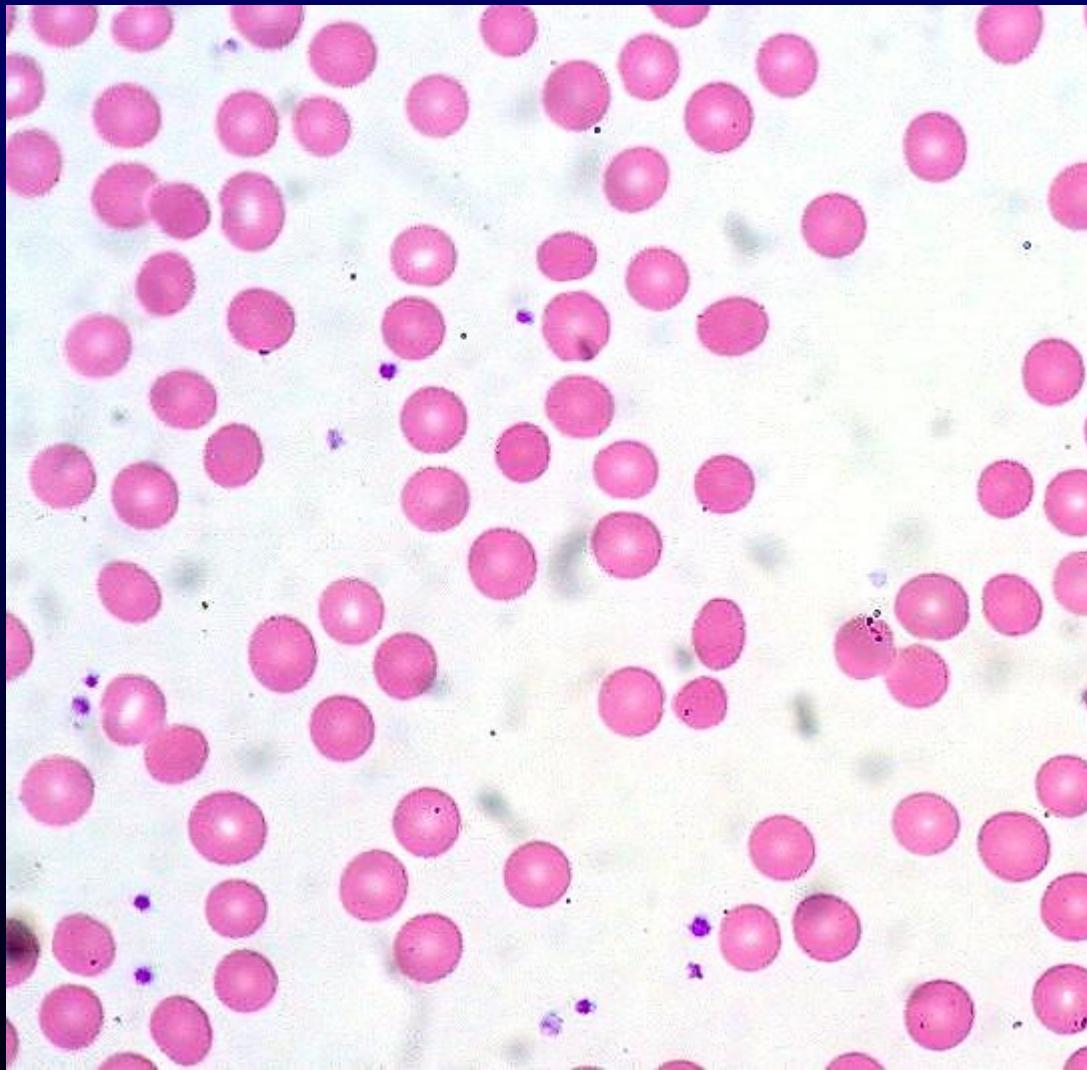
DIC



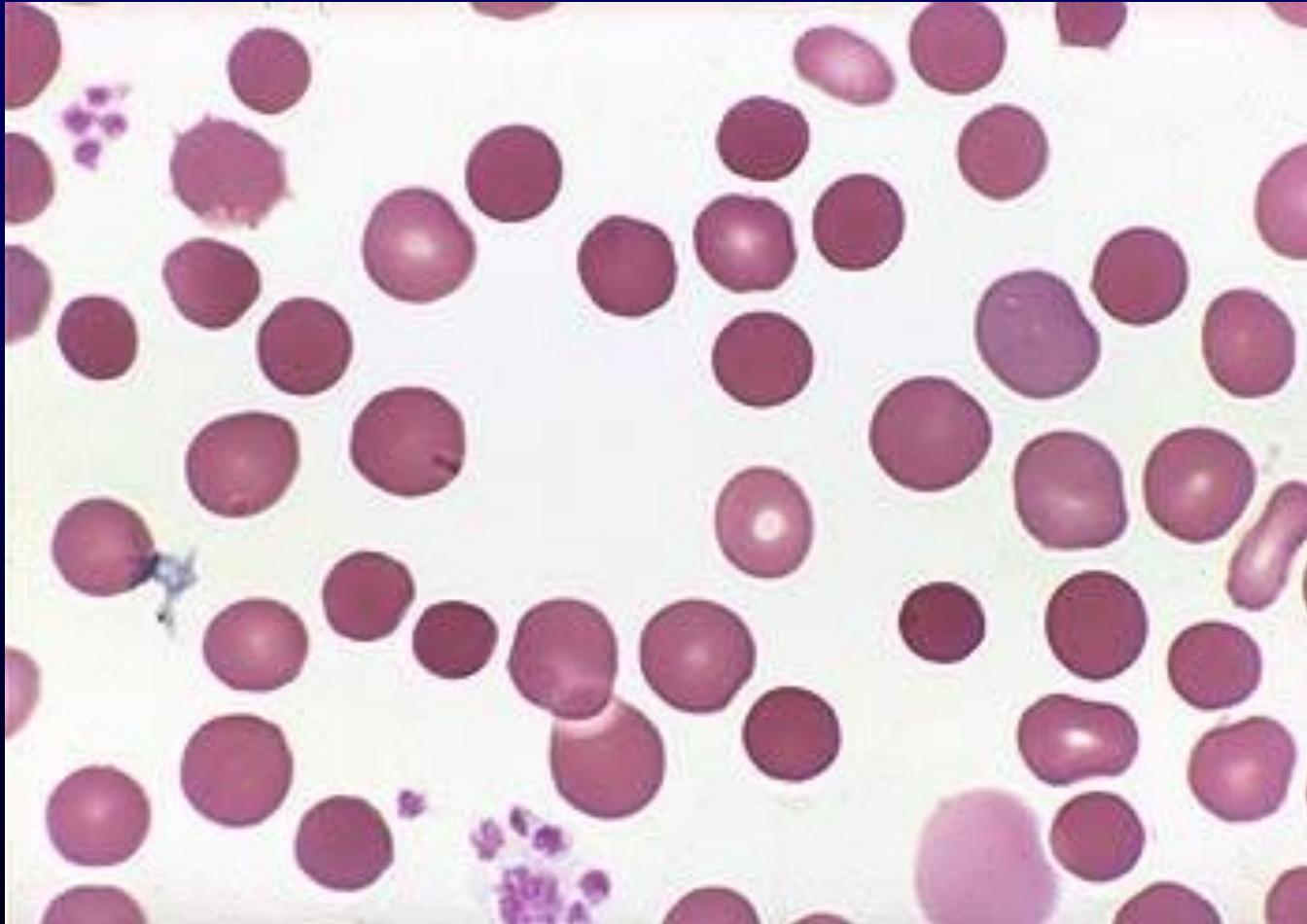
Spherocytosis



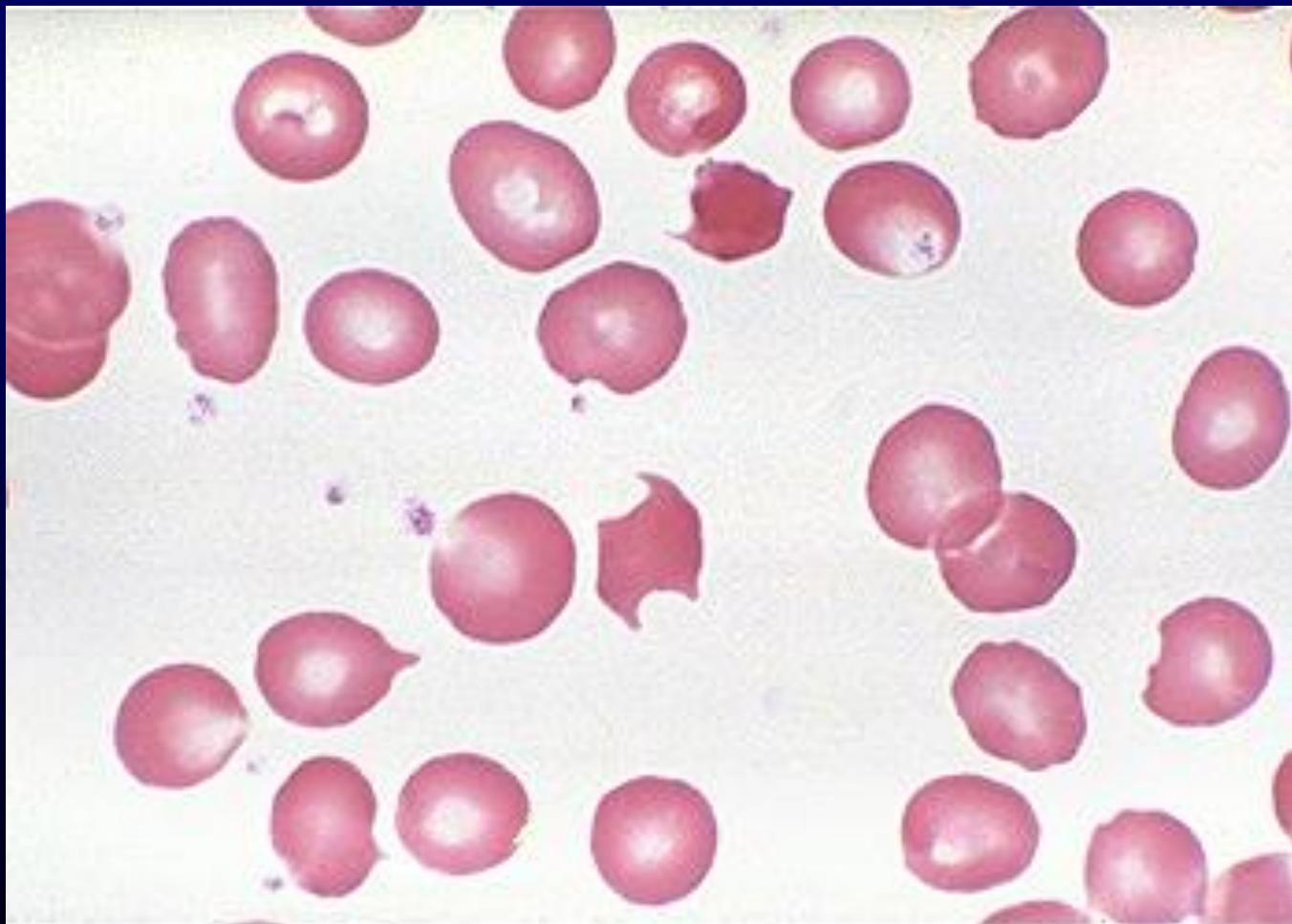
Spherocytosis



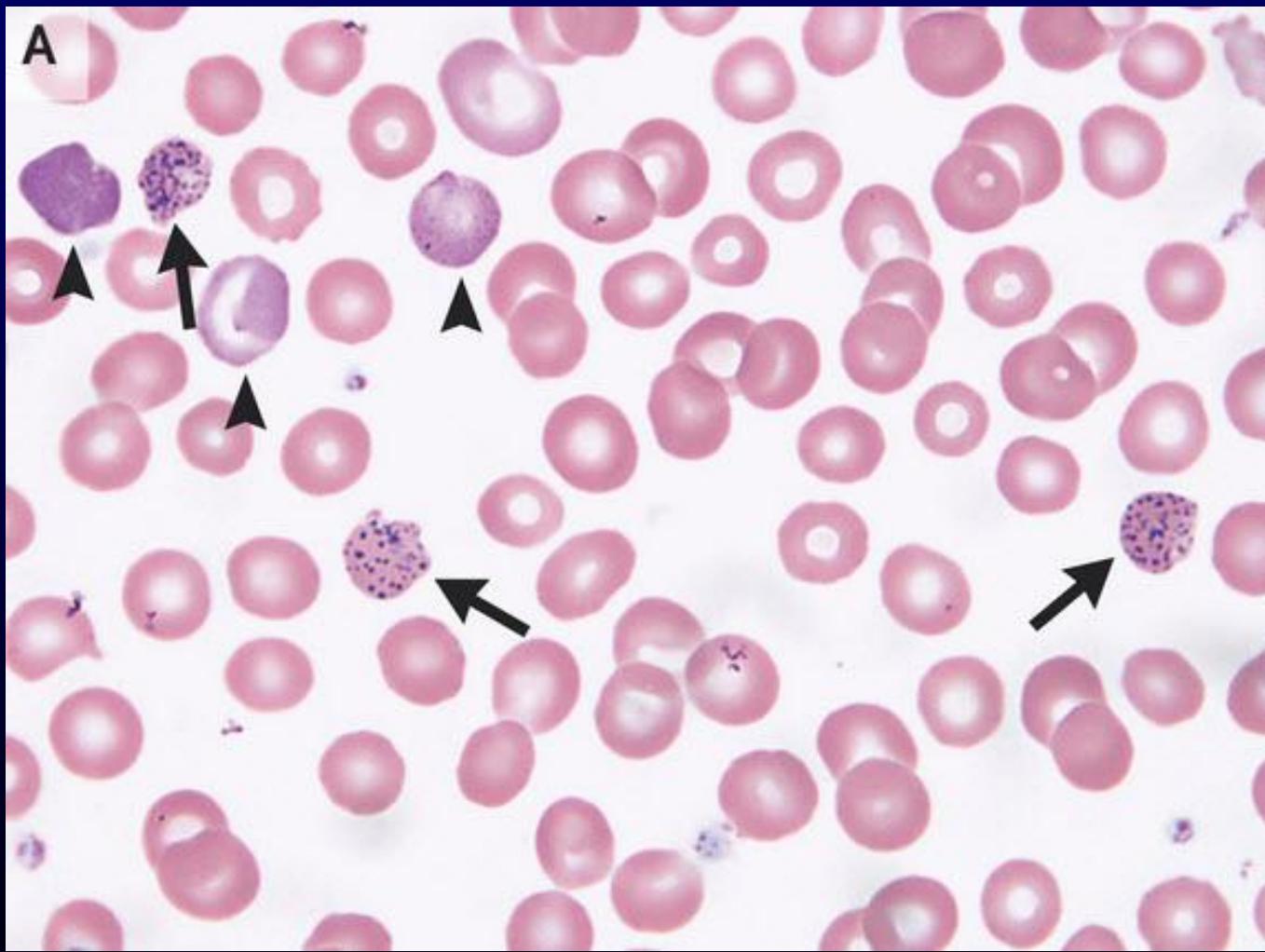
Spherocytosis



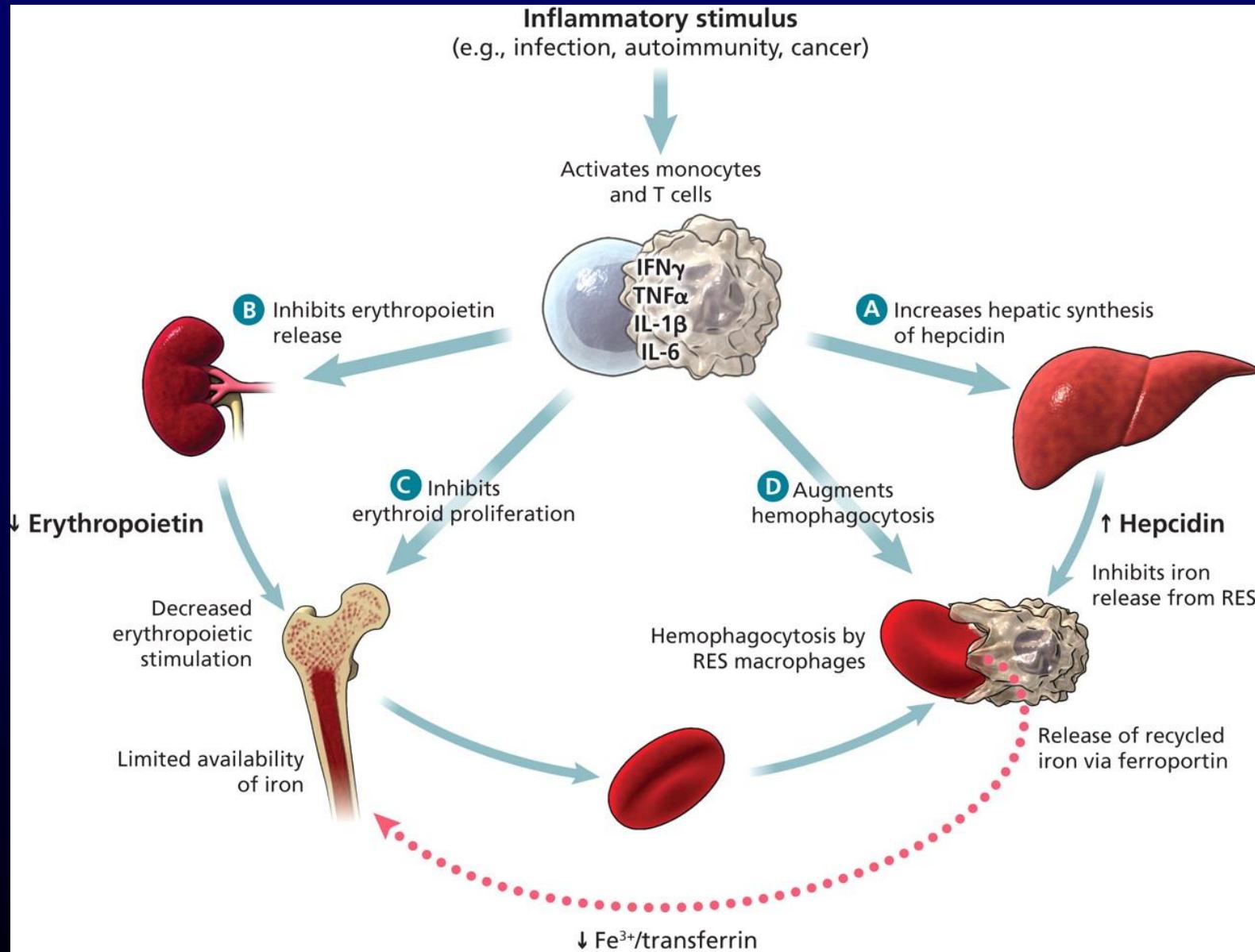
G6PD deficiency



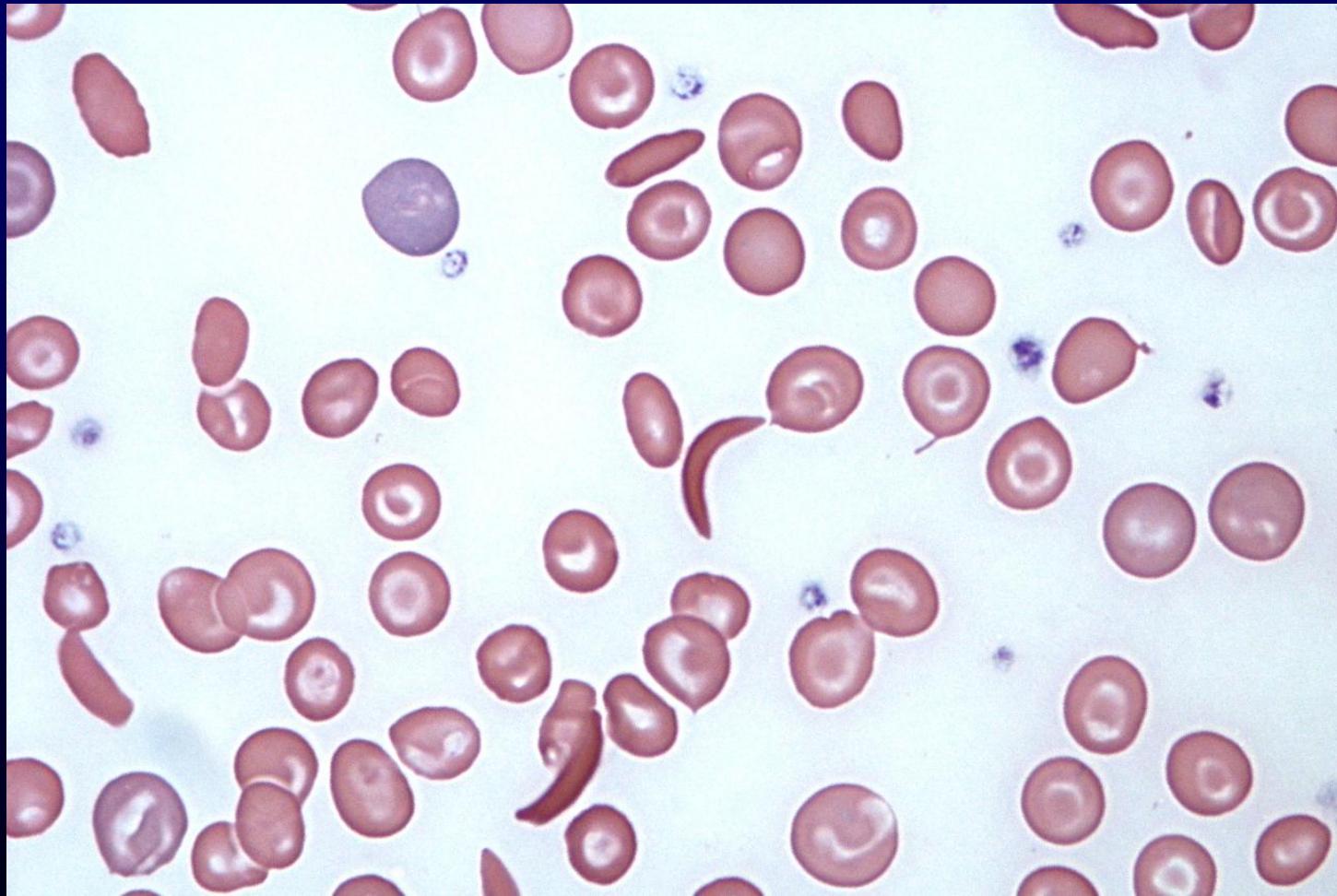
Lead poisoning



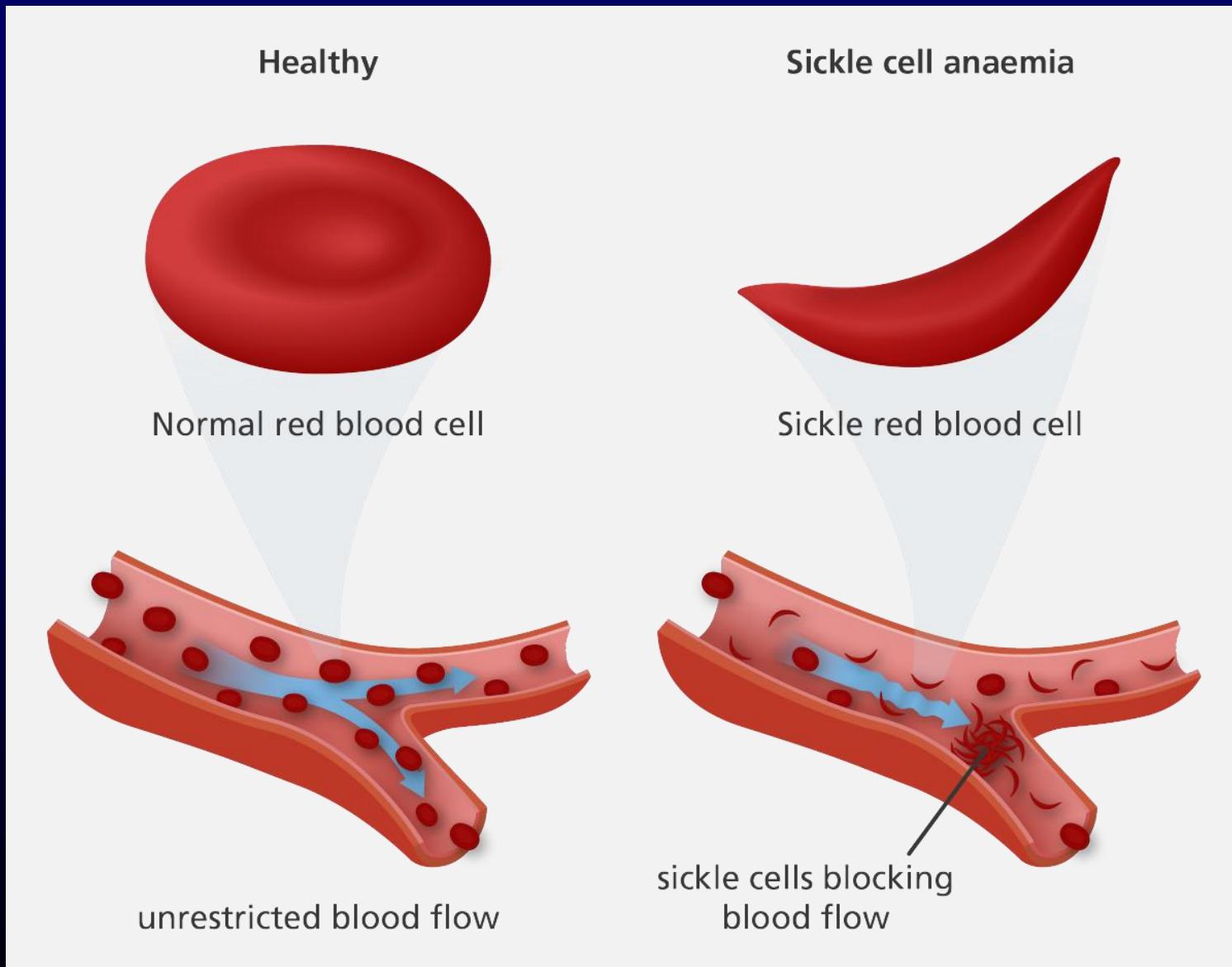
Infections



Sickle cell disease



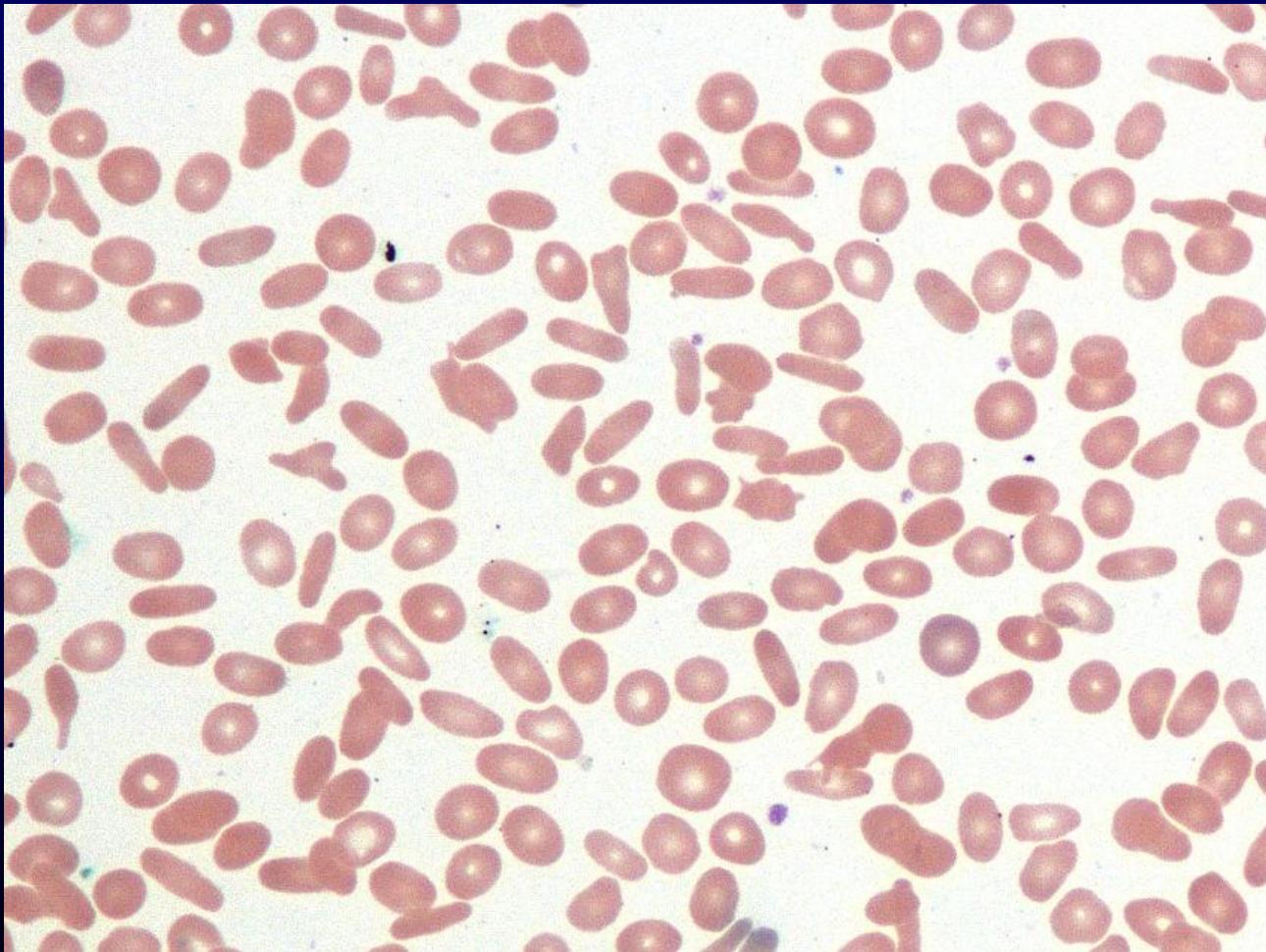
Sickle cell disease



Stomatocytosis



Elliptocytosis



Macrocytic anemia

Patient ID:
Name:
Comments:

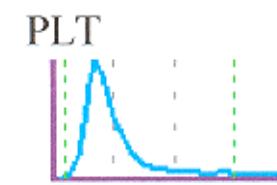
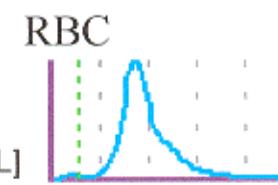
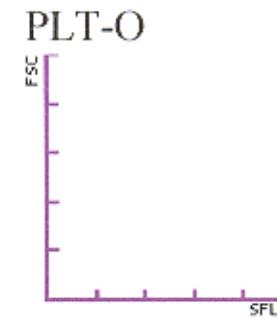
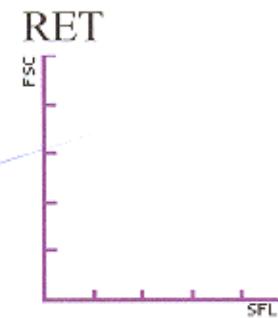
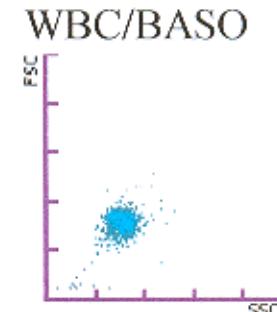
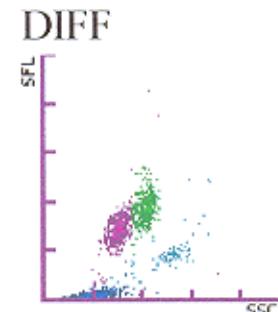
Ward:

Br.:
Birth: Sex:
Inst.ID:XT-2000i-1

Positive

Diff. Morph.
Count

WBC	1.78 -	[10 ⁹ /L]
RBC	3.12	[10 ¹² /L]
HGB	94	[g/L]
HCT	28.6	[%]
MCV	91.7	[fL]
MCH	30.1	[pg]
MCHC	329	[g/L]
PLT	342	[10 ⁹ /L]
RDW-SD	62.7 +	[fL]
RDW-CV	21.0 +	[%]
PDW	8.4 -	[fL]
MPV	9.2	[fL]
P-LCR	17.2	[%]
PCT	0.31	[%]
NEUT	0.08 -	[10 ⁹ /L]
LYMPH	0.87 -	[10 ⁹ /L]
MONO	0.83 +	[10 ⁹ /L]
EO	0.00	[10 ⁹ /L]
BASO	0.00	[10 ⁹ /L]
RET	[%]	
IRF	[%]	
LFR	[%]	
MFR	[%]	
HFR	[%]	

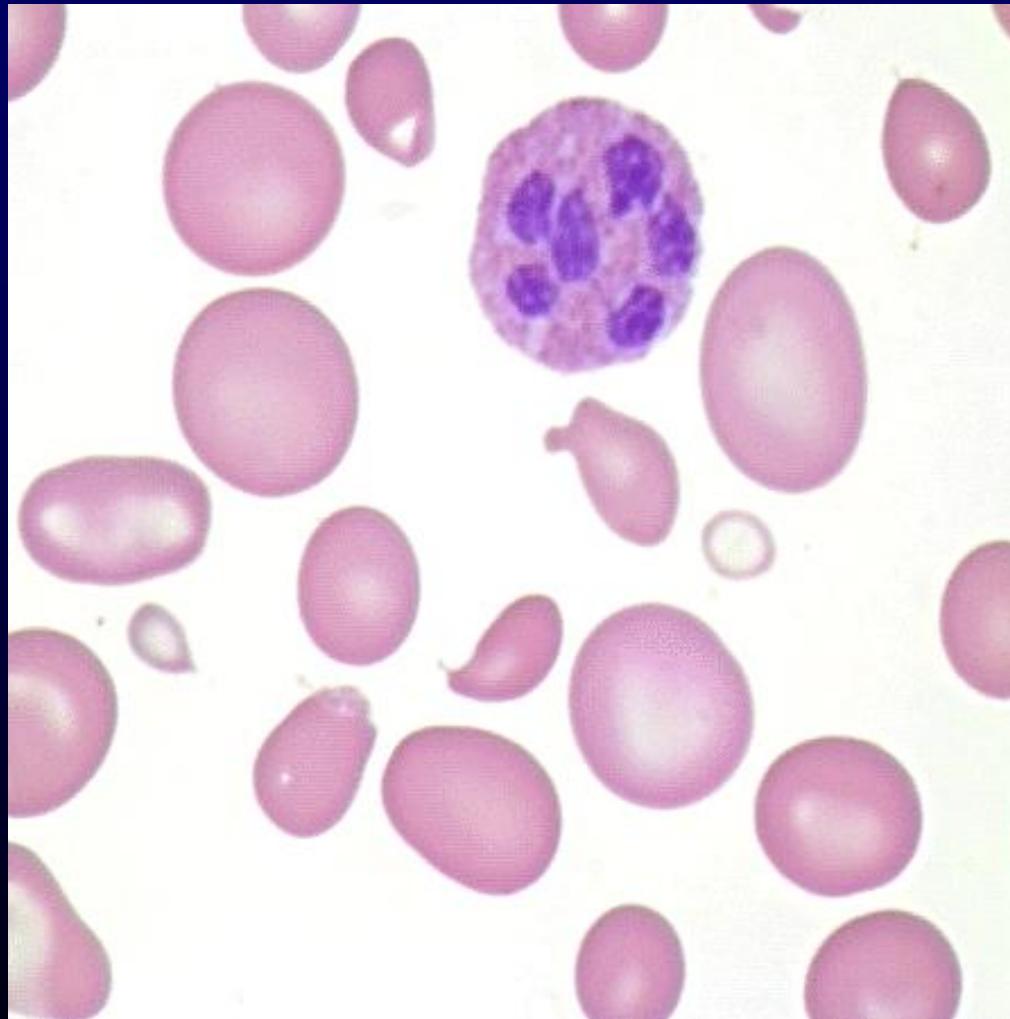


WBC IP Message(s)
Neutropenia

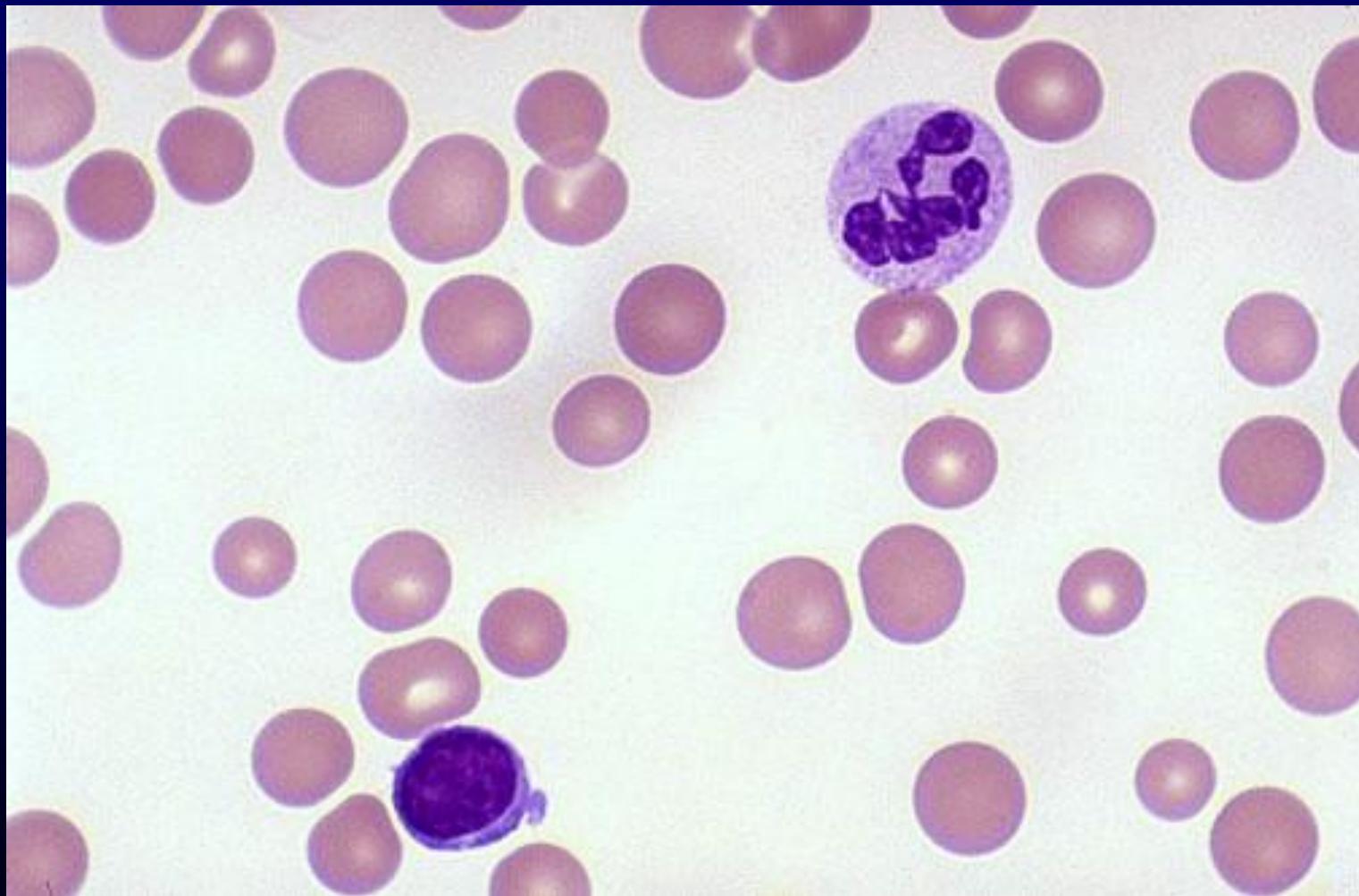
RBC/RET IP Message(s)
Anisocytosis

PLT IP Message(s)

Macrocytosis



Megaloblastic anemia



RED BLOOD CELL MORPHOLOGY

Size variation	Hemoglobin distribution	Shape variation		Inclusions	Red cell distribution
Normal	Hypochromia 1+	Target cell	Acanthocyte	Pappenheimer bodies (siderotic granules)	Agglutination
Microcyte	2+	Spherocyte	Helmet cell (fragmented cell)	Cabot's ring	
Macrocyte	3+	Ovalocyte	Schistocyte (fragmented cell)	Basophilic stippling (coarse)	Rouleaux
Oval macrocyte	4+	Stomatocyte	Tear drop	Howell-Jolly	
Hypochromic macrocyte (Reticulocyte)	Polychromasia	Sickle cell	Burr cell	Crystal formation	
				HbSC	HbC

If a single teacher can't teach us all the subjects,
then: How could they expect a single student to
learn all subjects ?

