

Hematology

RBC morphology

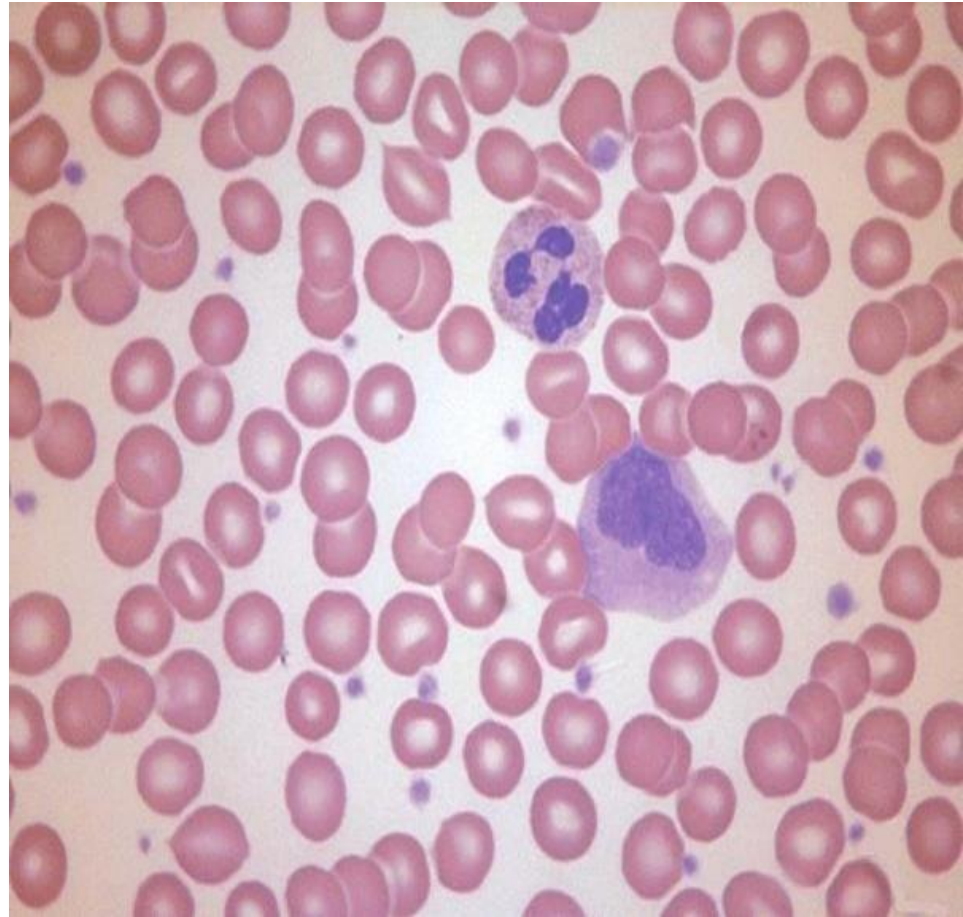


3&4 Lec

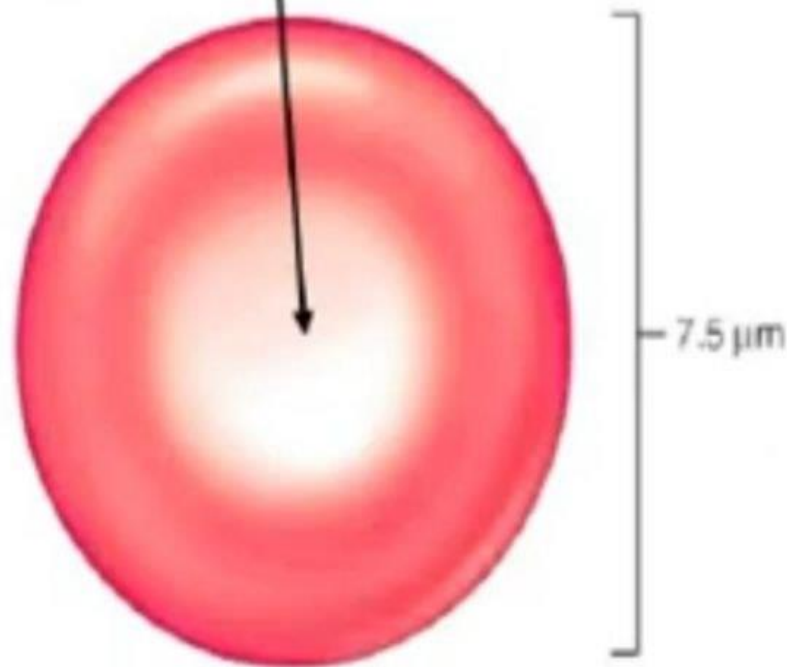
Dr. Mohamed kamel kudi

Normal RBCs

- Size: Diameter of 7-8 μm
- Shape: Appear round with smooth contour
- Color: Pink cytoplasm with an area of central pallor



- **Normal morphology of RBCs**
- Is biconcave disc with various degree of central pallor



Red blood cells



Erythrocytes (mature RBCs) :

- ❖ Lifespan 120 days

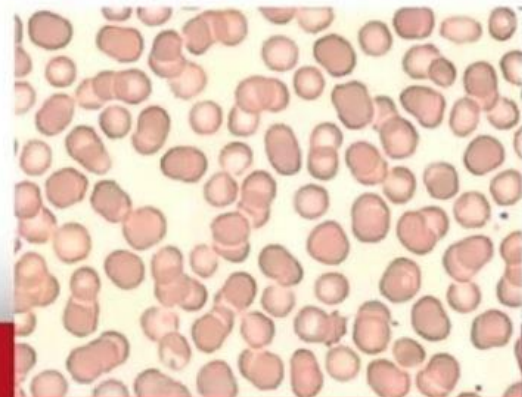
- ❖ Normal range:

Male: 4.7 to 6.1 million cells per microliter

Female: 4.2 to 5.4 million cells per microliter

- ❖ Biconcave shape , not nucleated

- ❖ Contain millions of molecules of hemoglobin.



Abnormal erythrocyte morphology is found in pathological states that may be:

- Variation in size
- Variation in shape
- Abnormal Hemoglobin content
- Inclusions bodies in erythrocyte.

Changes in the Morphology of RBCS

- Abnormalities in size (Anisocytosis)
- Abnormalities in shape (Poikilocytosis)
- Abnormal Hemoglobin content (Hypochromatic, Normochromatic, Hyperchromatic)
- The appearance of erythrocyte inclusions

Variation in RBC size (Anisocytosis)

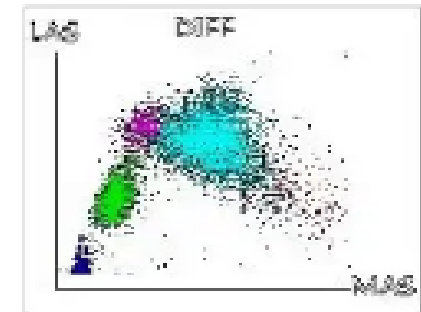
Variation in RBC size

- Microcytic (MCV < 80 fl; diameter < 7 um)
- Normocytic (MCV= 80-100 fl; diameter 7-8 um)
- Macrocytic (MCV > 100 fl; diameter > 8.5-9 um.)

C B C - Tested on Fully automated 5 Part Hematological analyser, USA

		ANALYSED VALUE	UNITS	NORMAL RANGE
Hemoglobin	↓	12.6	g/dL	13.5 - 17.0
White Blood Cells Count				
Total WBCs Count	↑	12780	Cells/Cu.mm	4000 - 10500
Neutrophils	N	69.3	%	40 - 75
Lymphocytes	N	23.5	%	20 - 45
Eosinophils	N	2.2	%	1.00 - 6.00
Monocytes	N	4.9	%	1.00 - 10.00
Basophils	N	0.1	%	0.00 - 2.00
Abs.Neutro in #	↑	8870	Cells/Cu.mm	2000 - 7500
Abs.Lymp in #	N	3000	Cells/Cu.mm	1000 - 4000
Abs.Eosin in #	N	280	Cells/Cu.mm	0 - 500
Abs.Mono in #	N	620	Cells/Cu.mm	200 - 1000
Abs.Baso in #	N	10	Cells/Cu.mm	0 - 200

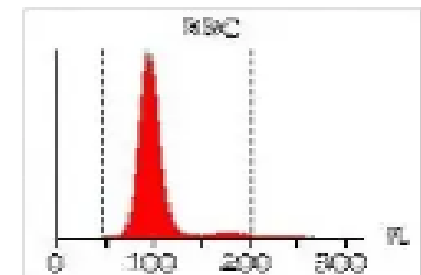
HISTOGRAM



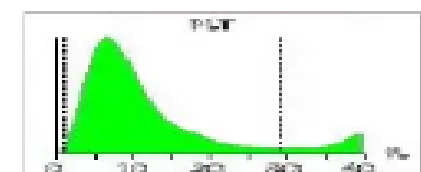
■ Neut
■ Lymp
■ Eosn
■ Mono
■ Baso
■ N-RBCs

Red Blood Cell Count

Total RBCs Count	↓	4.08	million/Cu.m	4.50 - 5.50
HCT (P.C.V)	↓	31.7	%	40 - 50
MCV	↓	77.7	fL	83 - 101
MCH	N	30.8	pg	27 - 32
MCHC	↑	39.6	g/dL	32 - 35
RDWc	N	0.129	%	0.11 - 0.16
RDWs	↑	40.5	fL	0.00 - 0.00

**Platelet Count**

Platelets Count	N	2.27	Lakhs/Cu.m	1.50 - 4.00
MPV	↓	8.3	fL	9.50 - 12.7
P-LCR	N	1.89	%	0.01 - 9.99
PDWc	N	15.9	%	1 - 99



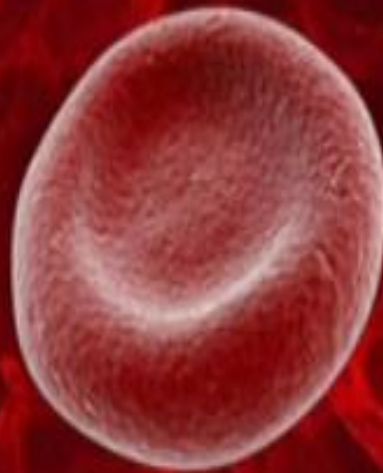
Interpretation : Leukocytosis, Leukopenia, Lymphocytosis, Lymphopenia, Neutrophilia, Neutropenia, Eosinophilia, Myelemia, Large Immature Cells, Atypical Lymphocytes, Nucleated Red Blood Cells, Monocytosis, Basophilia, Blasts, Anemia, Anisocytosis level 1,

Lab Incharge



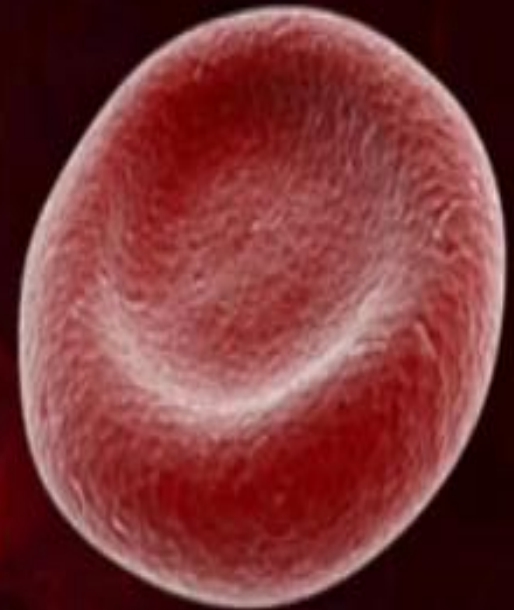
Decreased MCV < 80 fl

Microcytosis



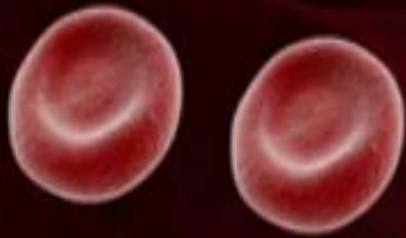
Normal MCV 80-100 fl

Normocytosis



Increased MCV > 100 fl

Macrocytosis



72



75



68



56

Decreased MCV < 80 fl

Microcytosis

Microcytic



88



94



89

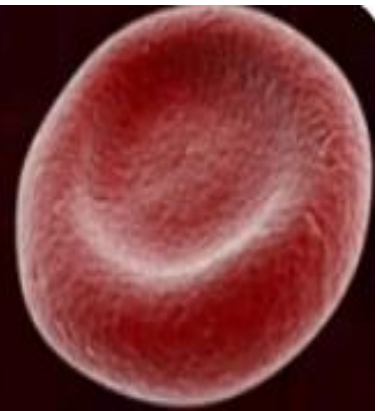


87

Normal MCV 80-100 fl

Normocytosis

Normocytic



122



105

Increased MCV > 100 fl

Macrocytosis

Macrocytic

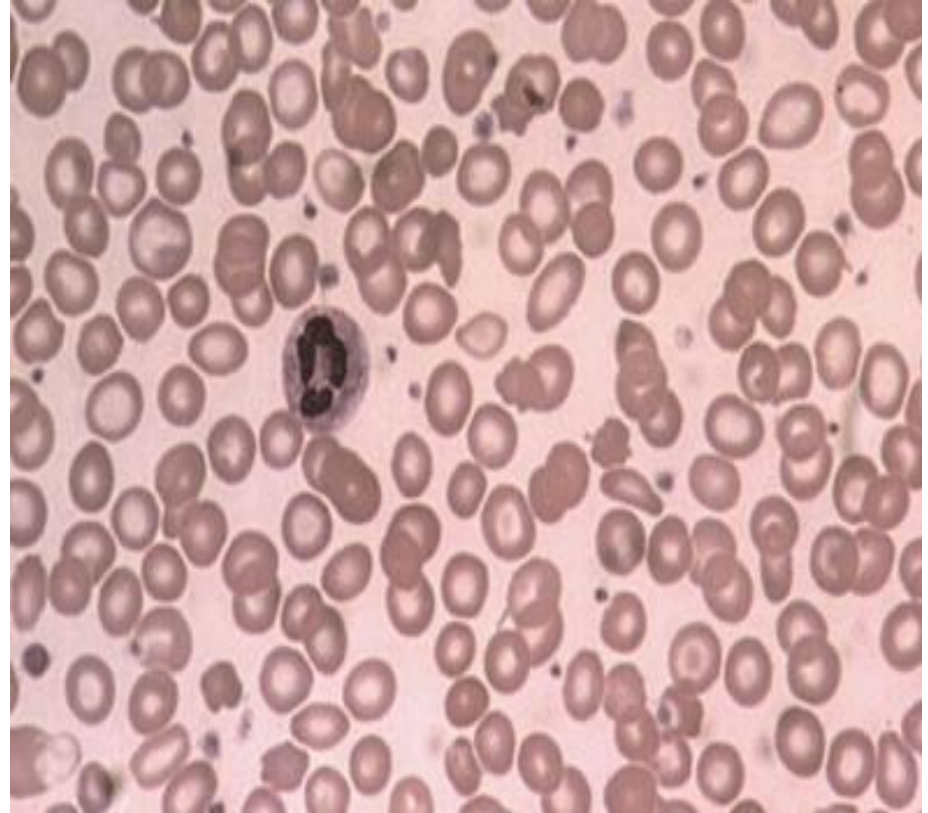
Microcytosis:

Morphology:

Decrease in the red cell size. Red cells are smaller than $7\mu\text{m}$ in diameter. The nucleus of a small lymphocyte ($8,\mu\text{m}$) is a useful guide to the size of a red blood cell.

Found in:

- Iron deficiency anemia.
- Thalassemia.
- Sideroblastic anemia.
- Lead poisoning.
- Anemia of chronic disease.



Macrocytosis:

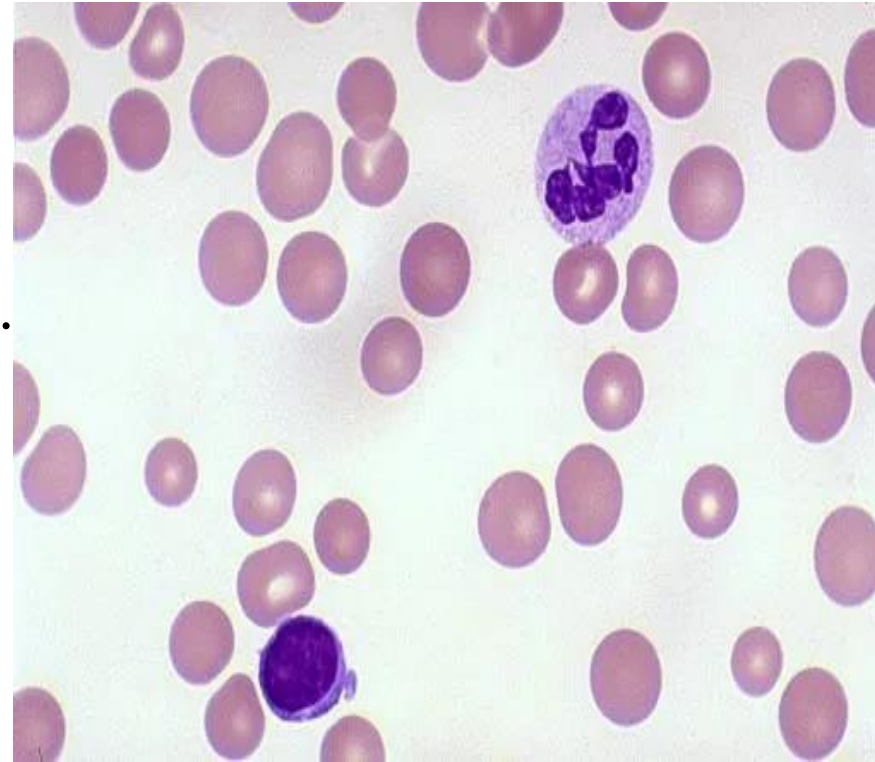
Morphology:

Increase in the size of a red cell. Red cells are larger than $9\mu\text{m}$ in diameter.

May be round or oval in shape, the diagnostic significance being different.

Found in:

- Folate and B12 deficiencies (oval)
- Ethanol (round)
- Liver disease (round)
- Reticulocytosis (round)



Shape variation (Poikilocytosis)

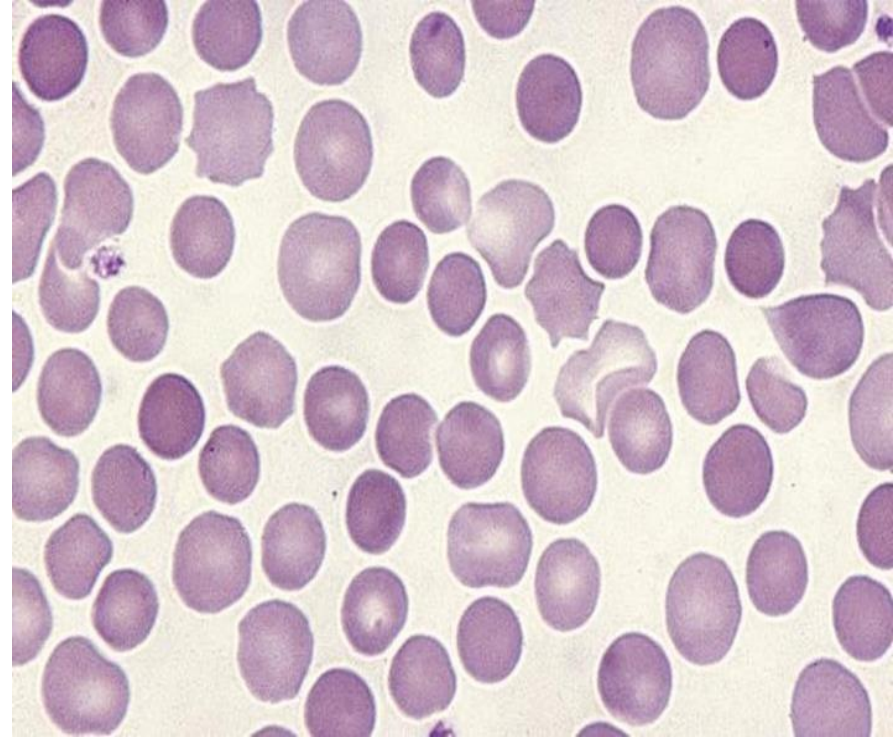
1- Spherocytosis:

Morphology:

Red cells are more spherical. Lack the central area of pallor on a stained blood film.

Found in:

- Hereditary spherocytosis
- Immune haemolytic anemia
- Zieve's syndrome
- Microangiopathic haemolytic anemia



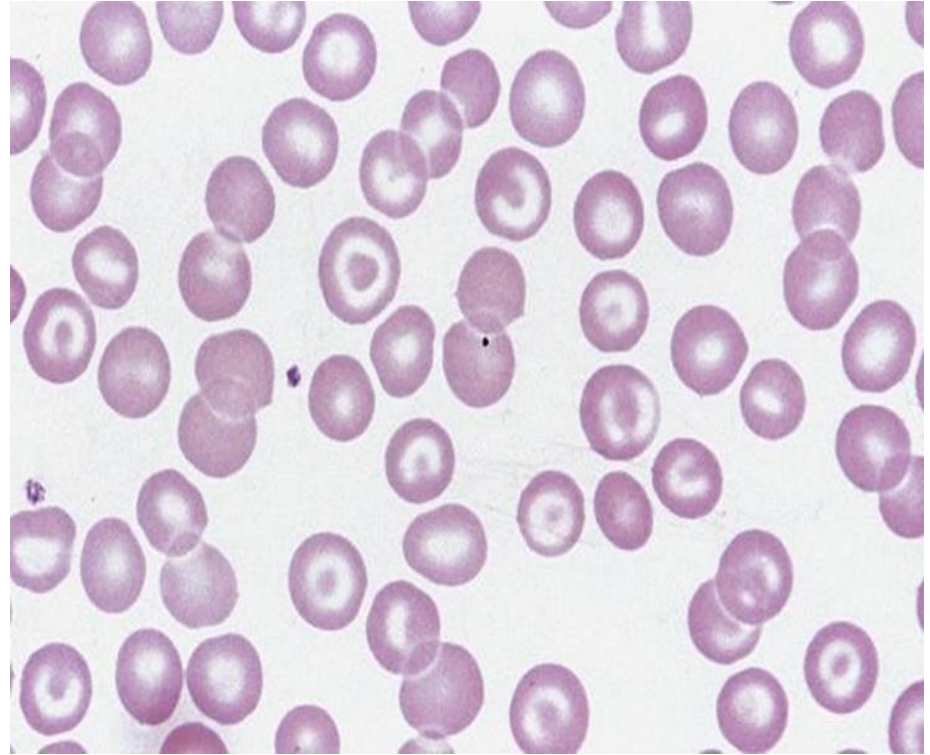
2- Target Cells:

Morphology:

Red cells have an area of increased staining which appears in the area of central pallor.

Found in:

- Obstructive liver disease
- Severe iron deficiency
- Thalassaemia
- Haemoglobinopathies (S and C)
- Post splenectomy



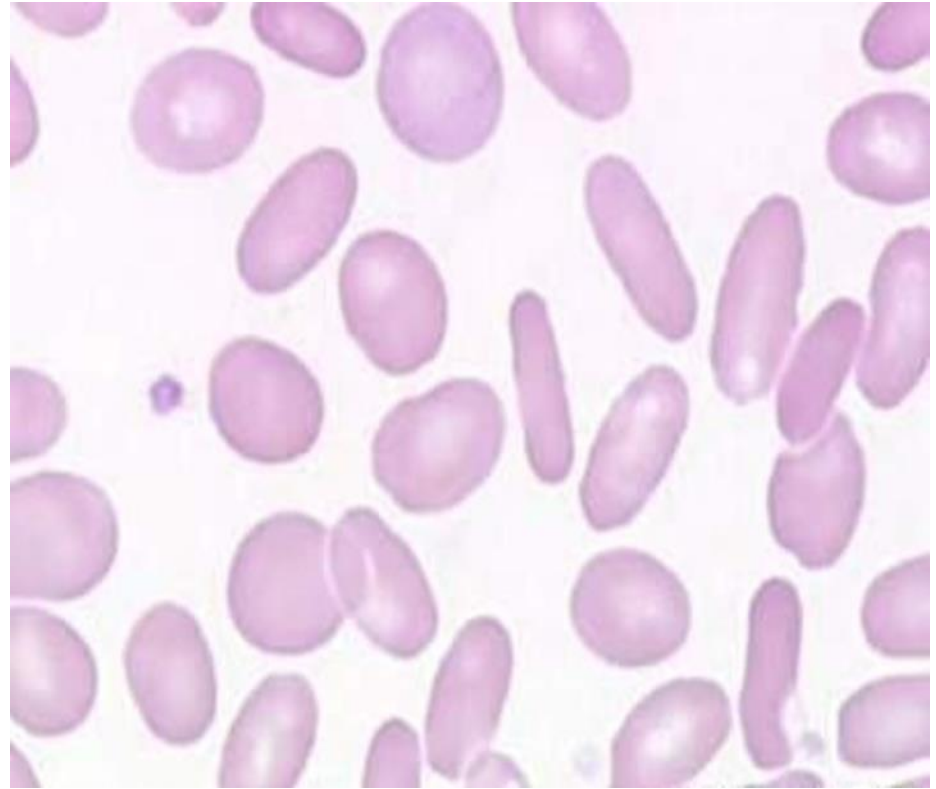
3-Ovalocytes and Elliptocytes:

Morphology:

oval shape red blood cell, Hb appears to be concentrated at the two ends of the cell, leaving a normal central area of pallor.

Found in:

- Thalassaemia major.
- Hereditary ovalocytosis.
- Sickle cell anemia
- Iron deficiency



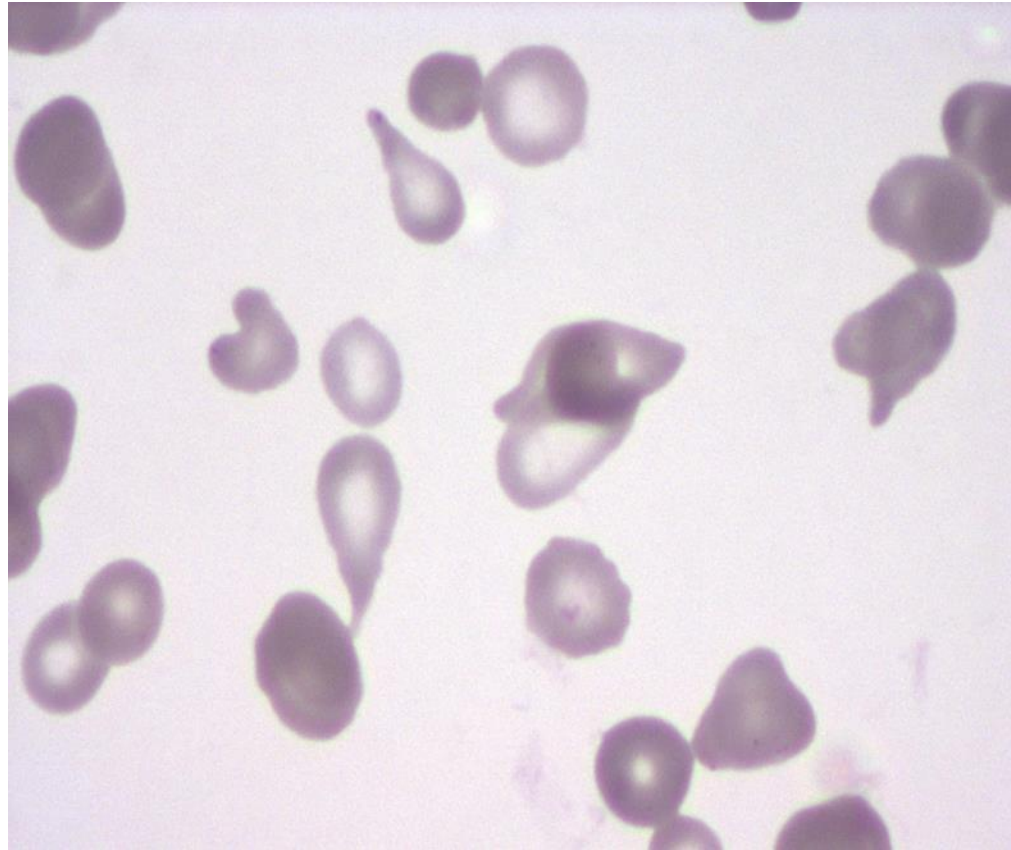
4- Tear Drop Cells:

Morphology:

Red cells shaped like a tear drop or pear

Found in:

- Bone marrow fibrosis
- Megaloblastic anemia
- Iron deficiency
- Thalassemia



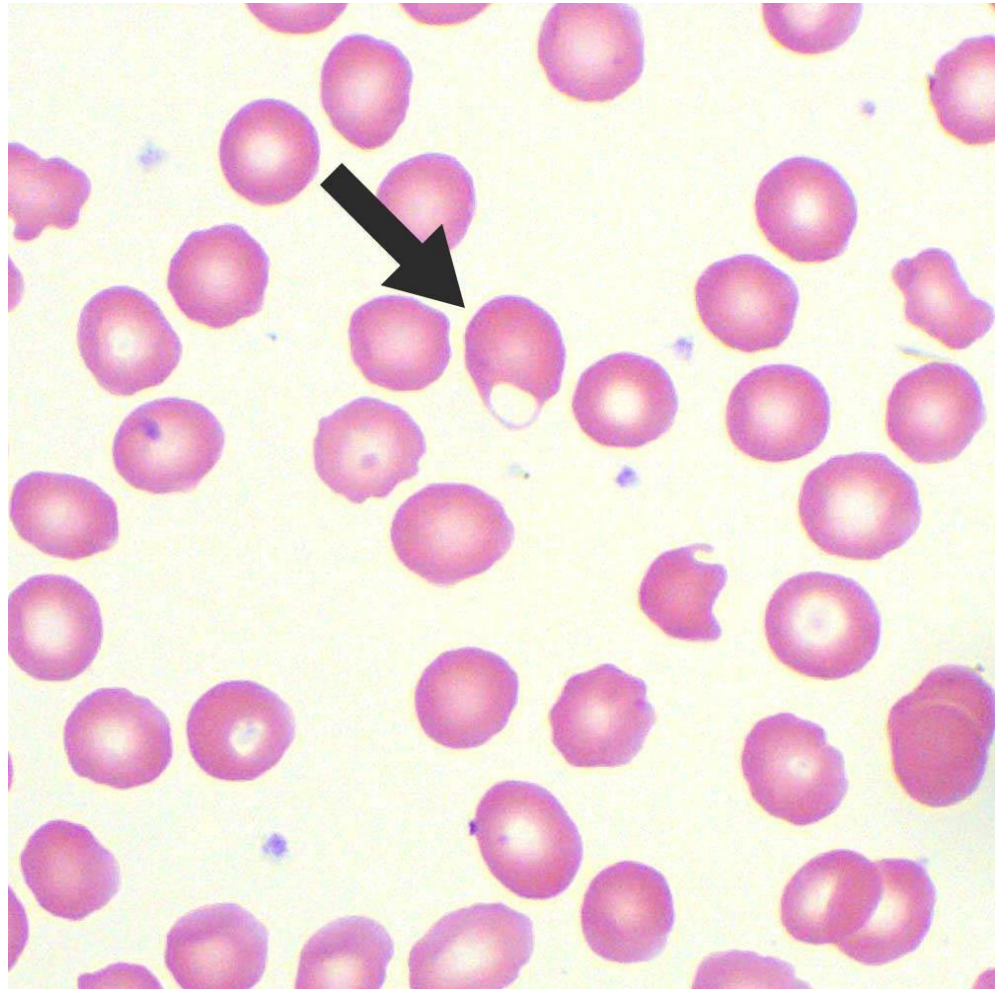
5- Blister cell:

Morphology:

Have accentric hallow area.

Found in:

Microangiopathic hemolytic anemia



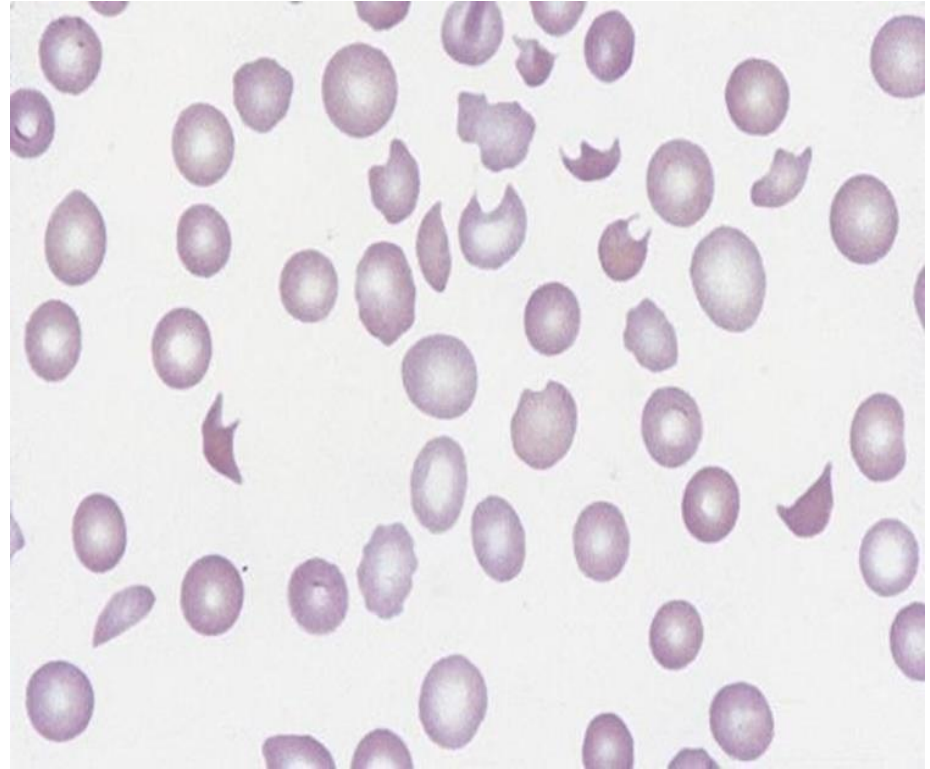
6- Schistocytosis:

Morphology:

Fragmentation of the red cells.

Found in:

- Disseminated intravascular coagulation (DIC)
- Micro angiopathic haemolytic anemia
- Mechanical haemolytic anemia



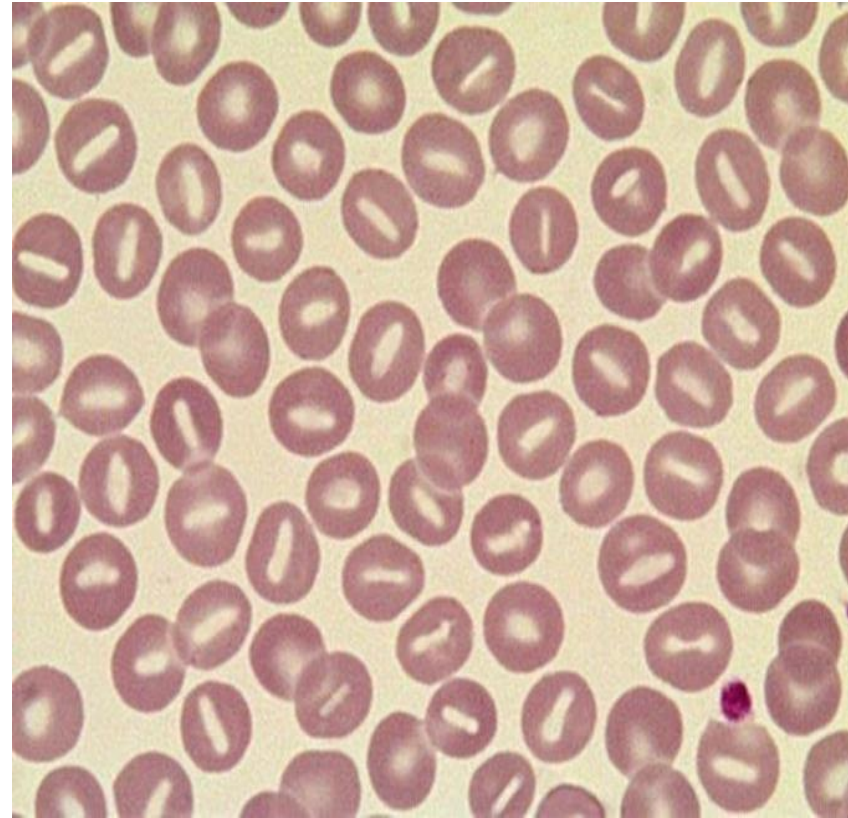
7-Stomatocytosis:

Morphology:

Red cells with a central linear slit or stoma. Seen as mouth-shaped Results from a variety of membrane abnormalities but probably essentially from expansion of the inner leaflet of the lipid bilayer that comprises the red cell membrane

Found in:

- Alcohol excess
- Alcoholic liver disease



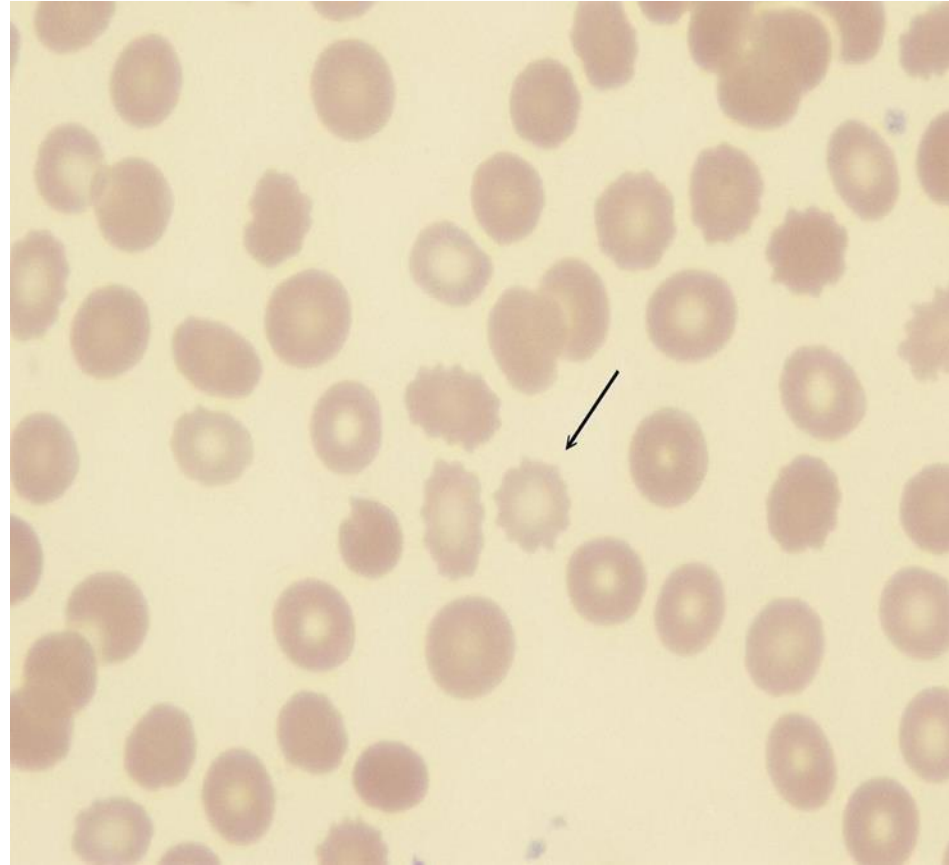
8- Burr (crenation) cell:

Morphology:

Red cell with uniformly spaced, pointed projections on their surface.

Found in:

- hemolytic anemia
- Uremia.
- Megaloblastic anemia



9- Keratocytes (horn cell):

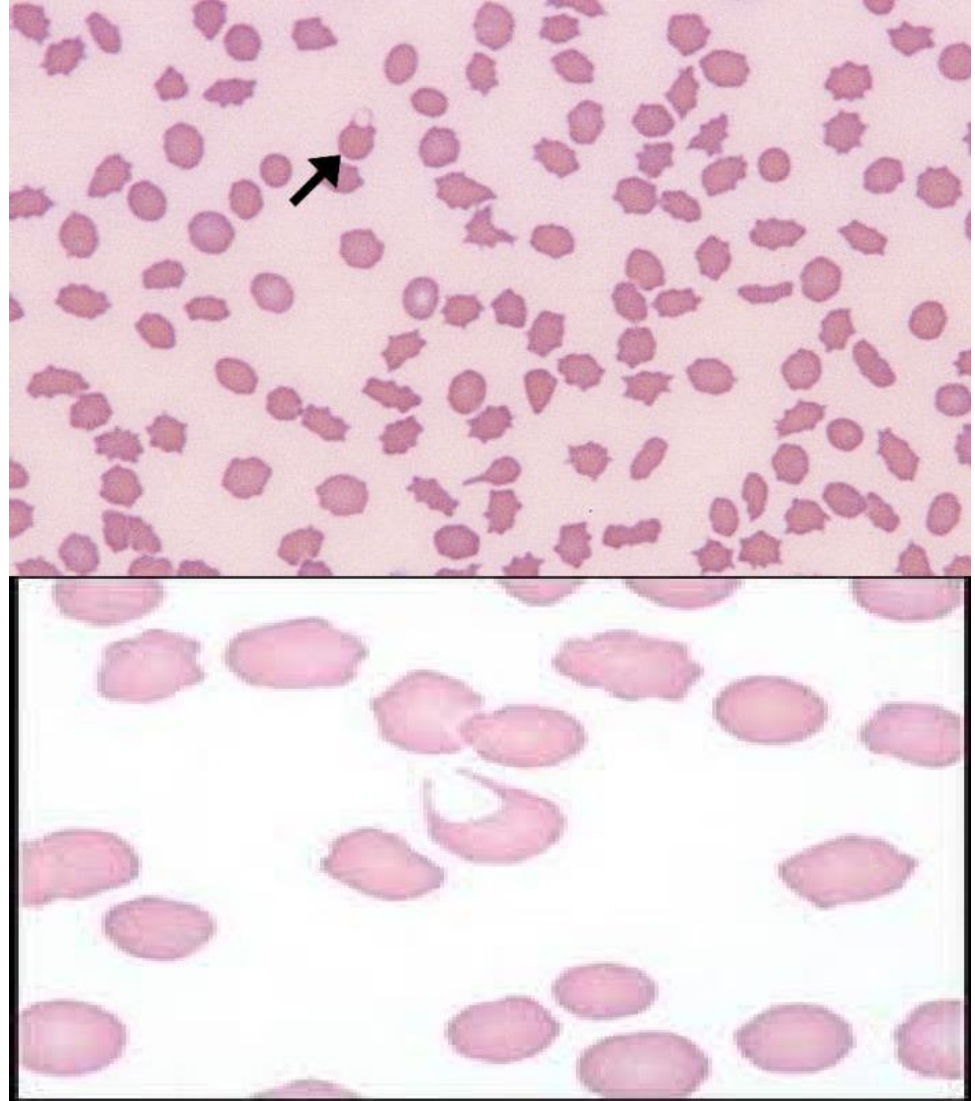
Morphology:

Part of the cell fuses back leaving two or three horn-like projections.

The keratocyte is a fragile cell and remains in circulation for only a few hours.

Found in:

- Uraemia
- Severe burns
- EDTA artifact
- Liver disease



10- Acanthocytosis:

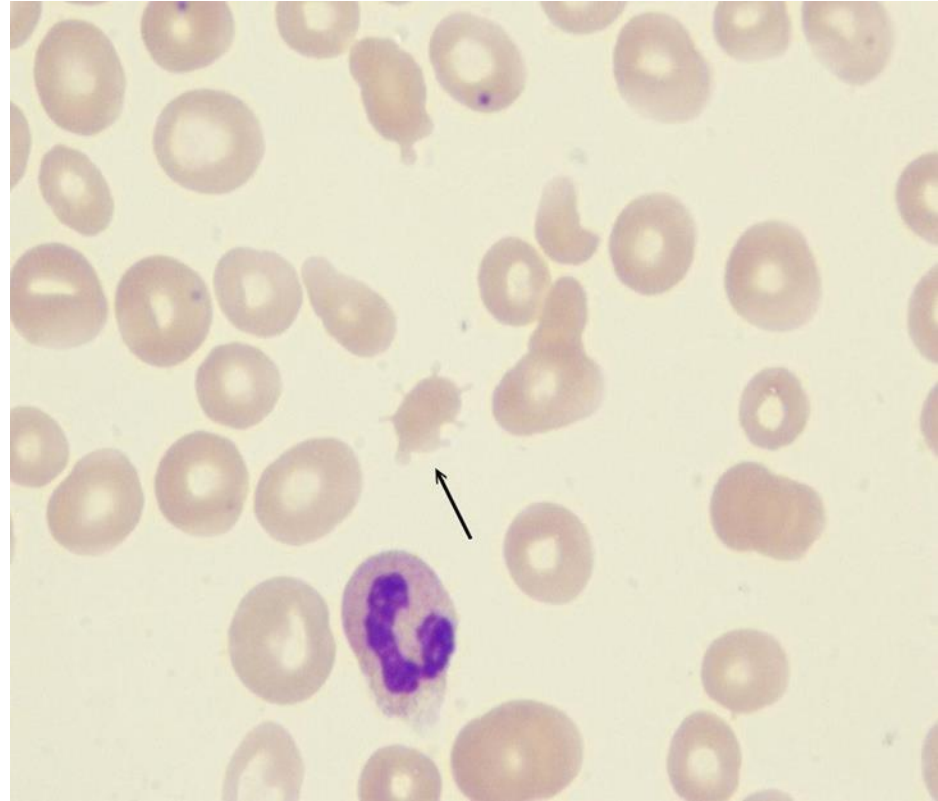
Morphology:

are red blood cells with irregularly spaced projections, these projections vary in width but usually contain a rounded end,

Caused by changes in membrane lipids

Found in:

- Liver disease
- Post splenectomy
- Anorexia nervosa and starvation



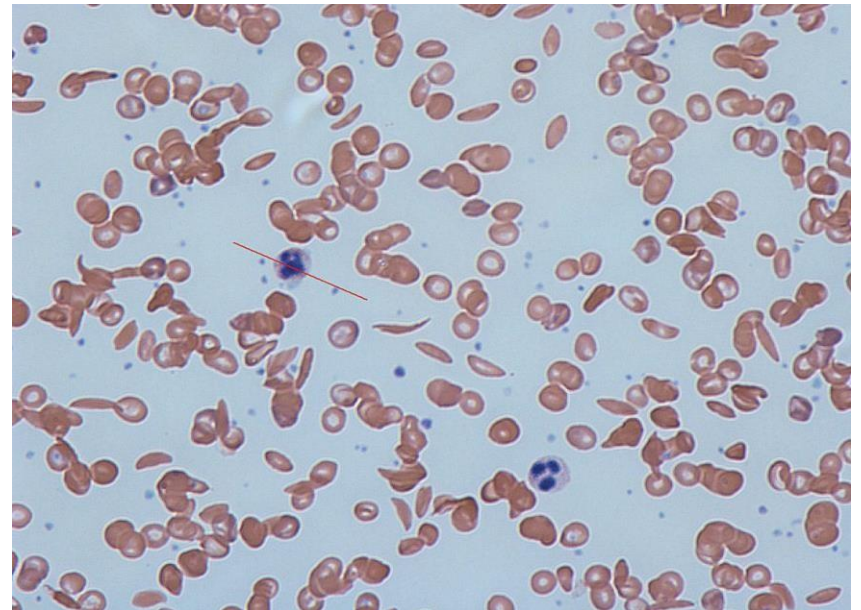
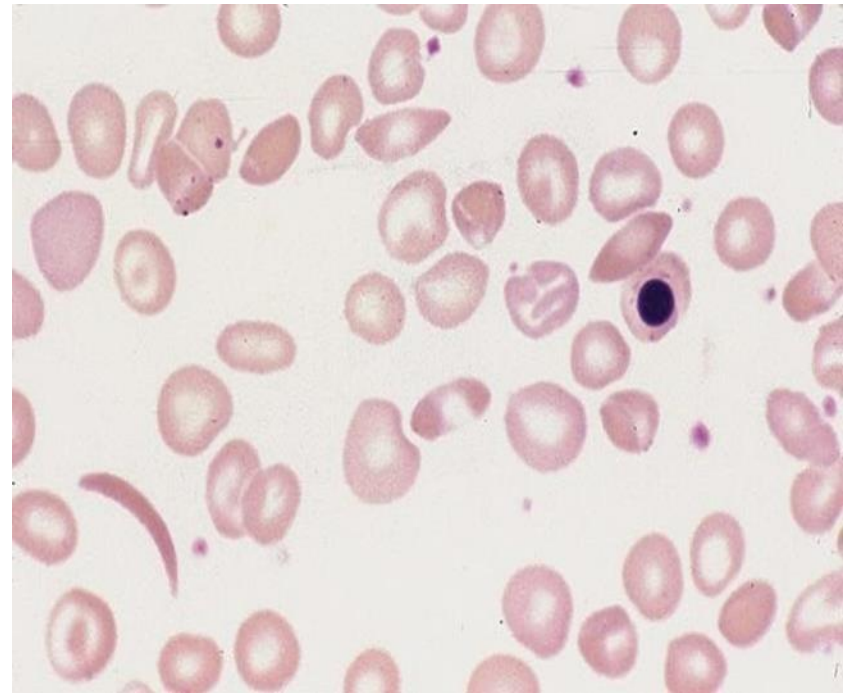
11- Sickle Cells:

Morphology:

Sickle shaped red cells

Found in:

Hb-S disease



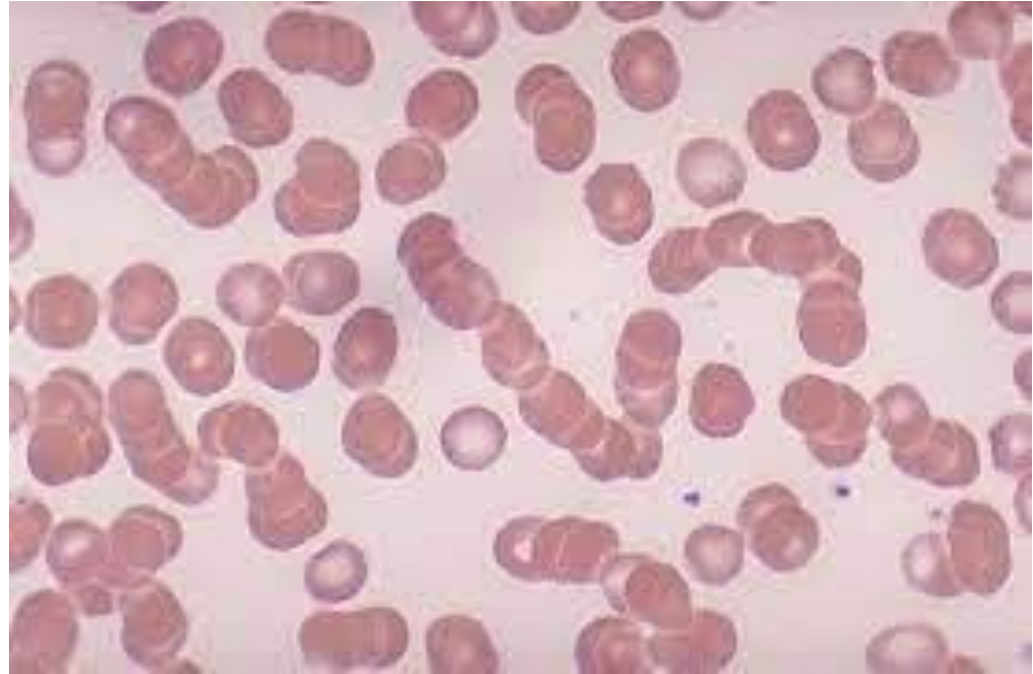
12-Rouleaux Formation:

Morphology:

Stacks of RBC's resembling a stack of coins.

Found in:

- Hyperfibrinogenaemia
- Hyperglobulinaemia



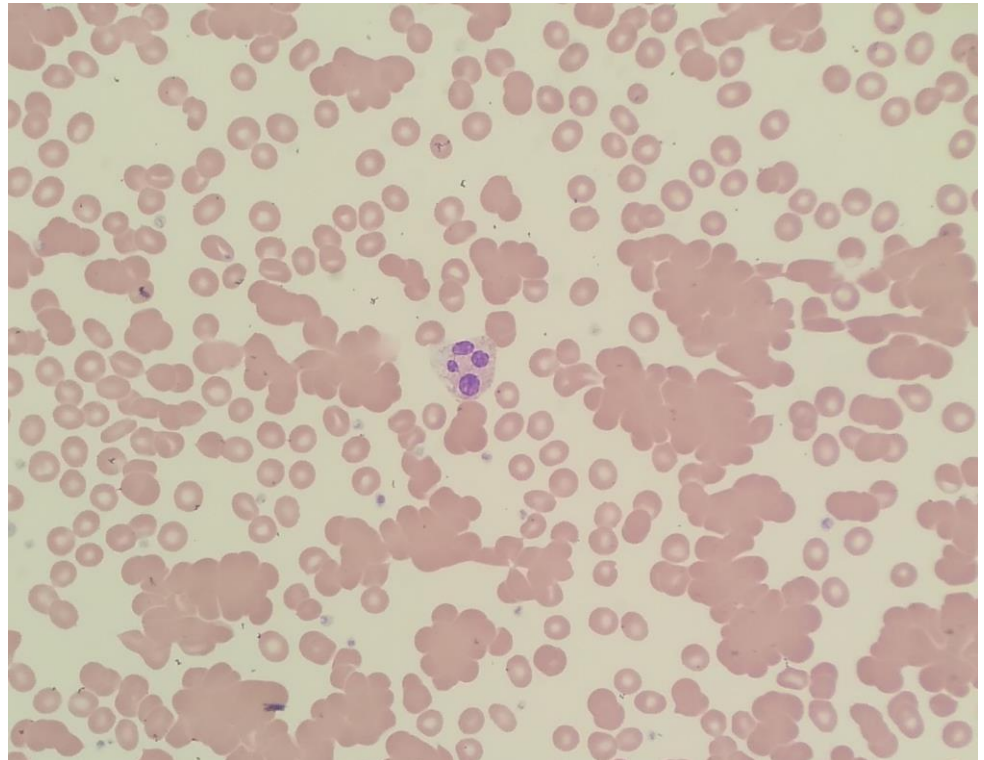
13- Red cell-agglutination:

Morphology:

Irregular clumps of red cells

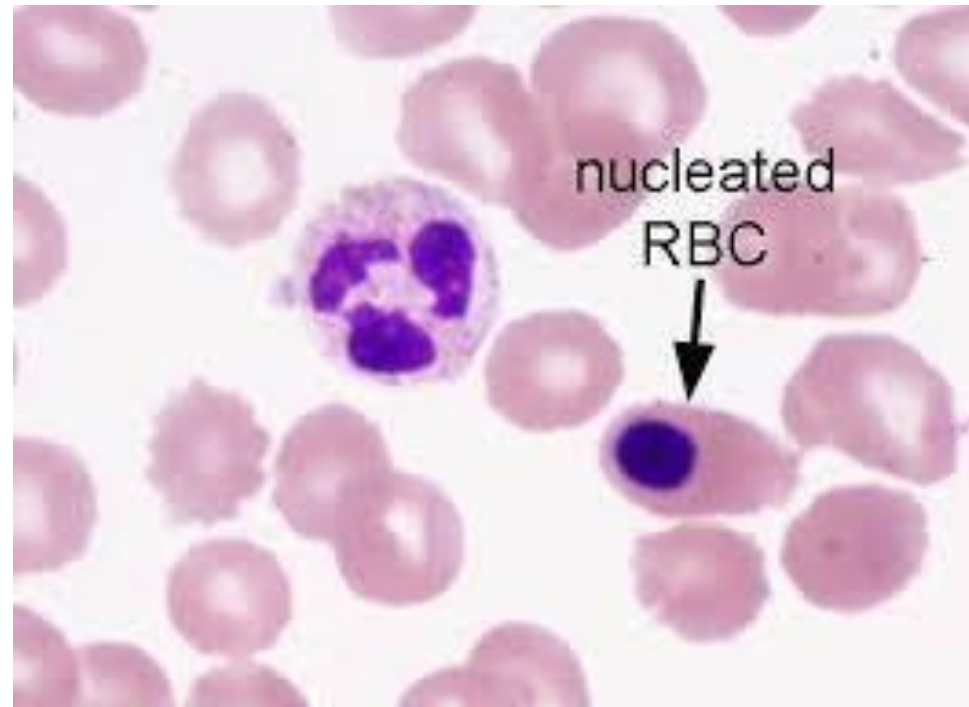
Found in:

- Cold agglutinins
- Warm autoimmune hemolysis



14- Nucleated red blood cells.

These red blood cells are released from the bone marrow early into the blood stream, due to the need for oxygen. Normal red blood cells do not contain a nucleus on a peripheral smear.



Abnormal hemoglobin content

1-Hypochromatic:

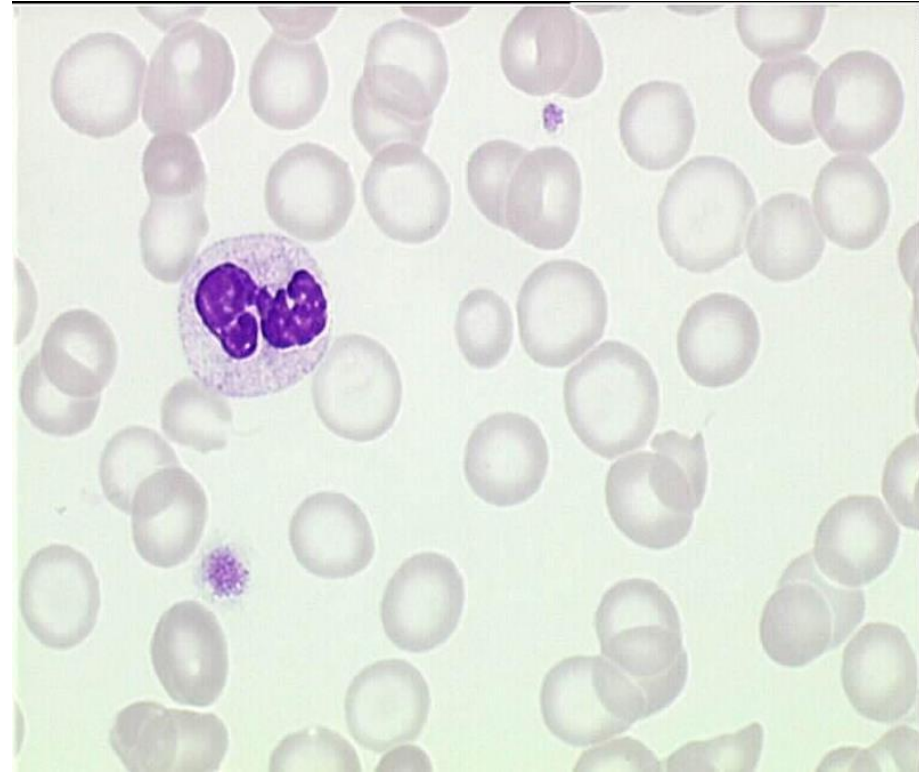
Morphology:

Increase in the red cells' central pallor which occupies more than the normal third of the red cell diameter.

Found in:

- Iron deficiency
- Thalassemia
- any of the conditions leading to

Microcytosis



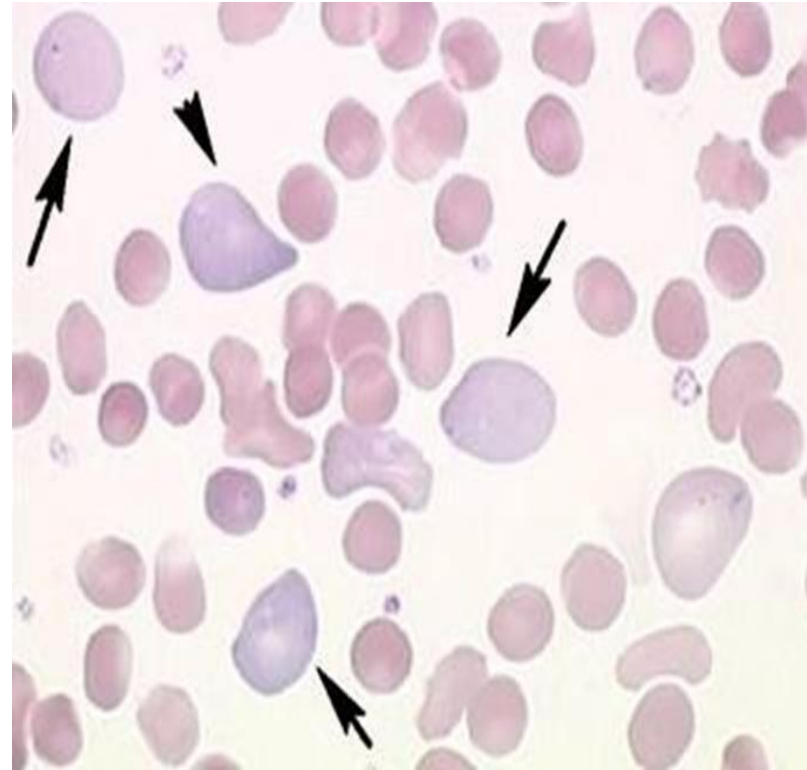
2-hyperchromatic :

Morphology:

Red cells stain shades of blue-gray as a consequence of uptake of both eosin (by hemoglobin) and basic dyes (by residual ribosomal RNA). Often slightly larger than normal red cells and round in shape - round macrocytosis.

Found in:

Any situation with reticulocytosis, for example bleeding, hemolysis or response to haemostatic factor replacement.



Inclusions bodies in erythrocyte.

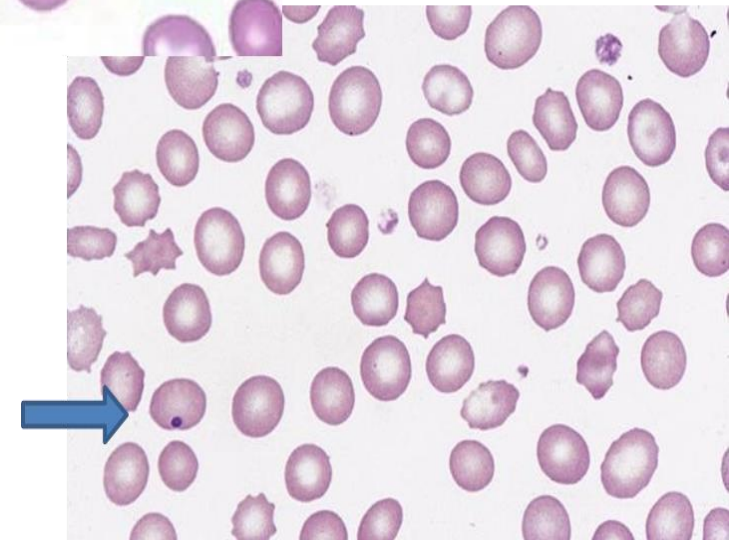
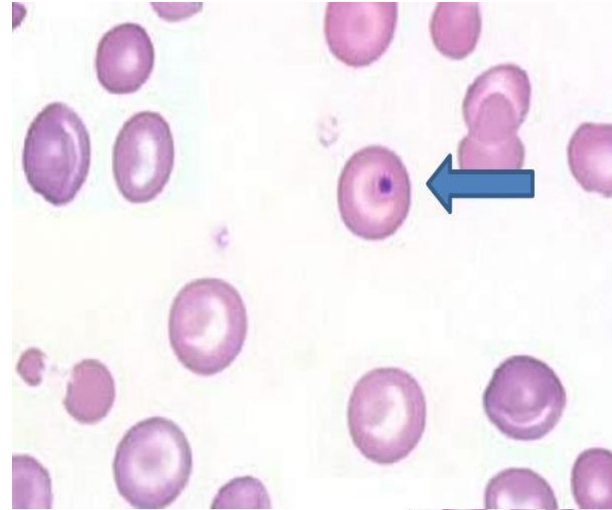
1- Howell-Jolly Bodies:

Morphology:

Small round cytoplasmic red cell inclusion with same staining characteristics as nuclei

Found in:

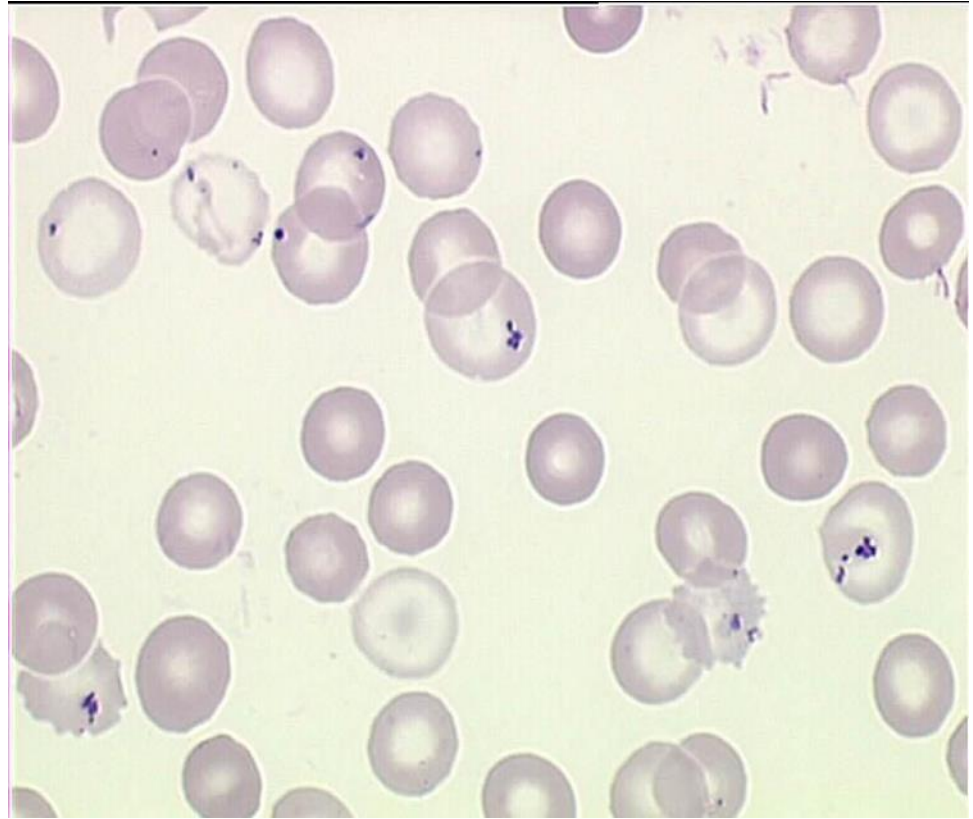
- Post splenectomy
- Megaloblastic anemia



2- Siderotic Granules

(Pappenheimer Bodies)

RBCs which contain hemoglobin iron granules. They appear as dense, blue-purple granules within the RBC and there are usually only one or two, located in the cell periphery in Wright stained. Pappenheimer bodies can be increased in hemolytic anemia, infections and post-splenectomy.

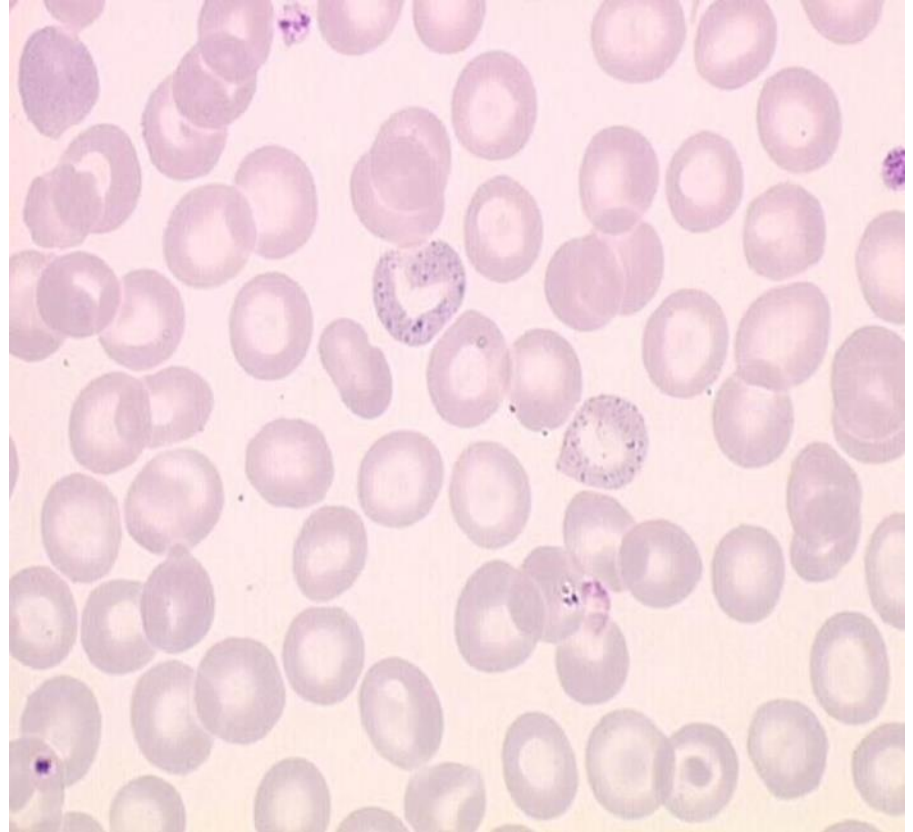


3- Basophilic stippling:

Morphology: Considerable numbers of small basophilic inclusions in red cells.

Found in:

- Thalassaemia
- Megaloblastic anemia
- Hemolytic anemia
- Liver disease
- Heavy metal poisoning.



4-Heinz Bodies:

Represent denatured hemoglobin

(methemoglobin - Fe⁺³)

within a cell. With a supravital

stain like crystal violet, Heinz

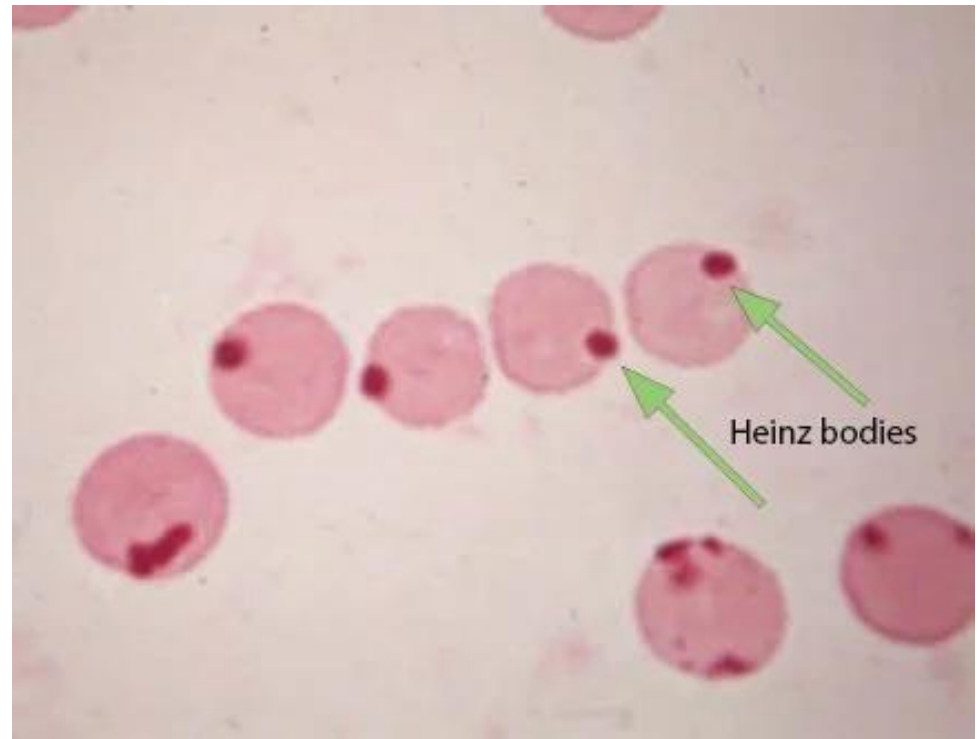
bodies appear as round blue

precipitates. Presence of Heinz

bodies indicates red cell injury

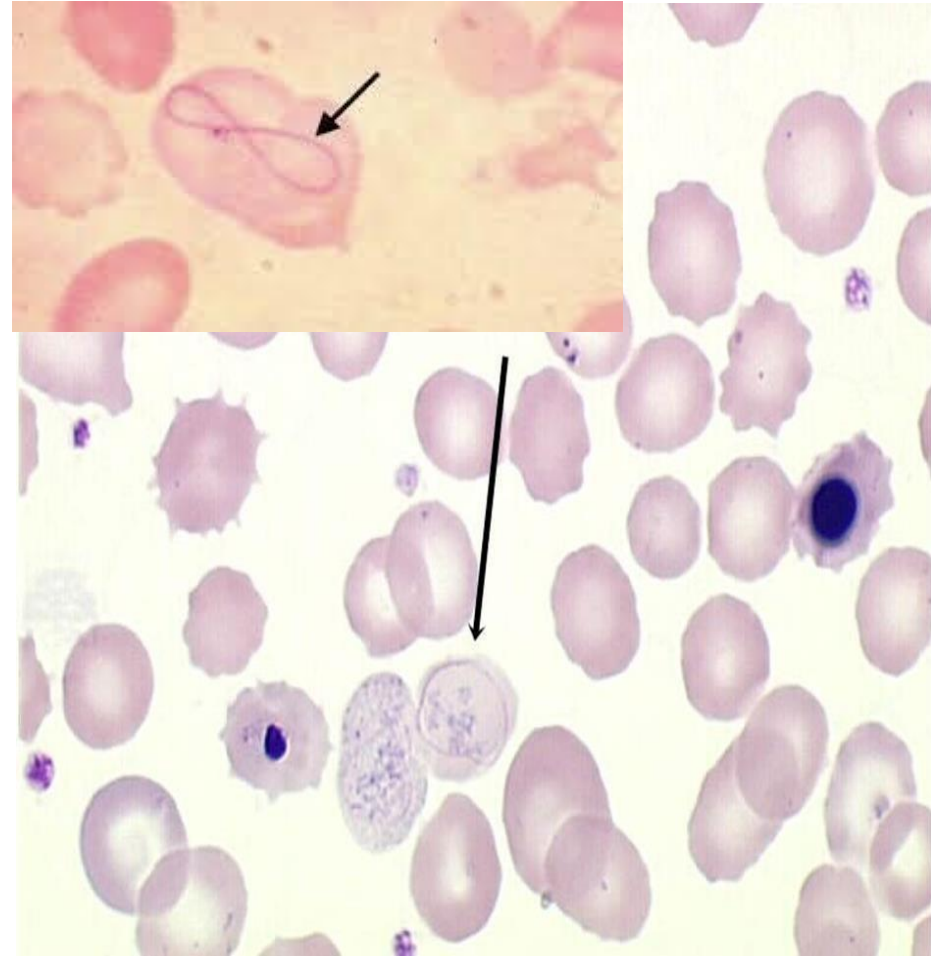
and is usually associated with

G6PD-deficiency.



5- Cabot Rings:

Reddish-blue thread like rings in RBCs of severe anemia's. These are remnants of the nuclear membrane and appear as a ring or figure 8 pattern. Very rare, finding in patients with Megaloblastic anemia, severe anemia's, lead poisoning, and dyserythropoiesis.

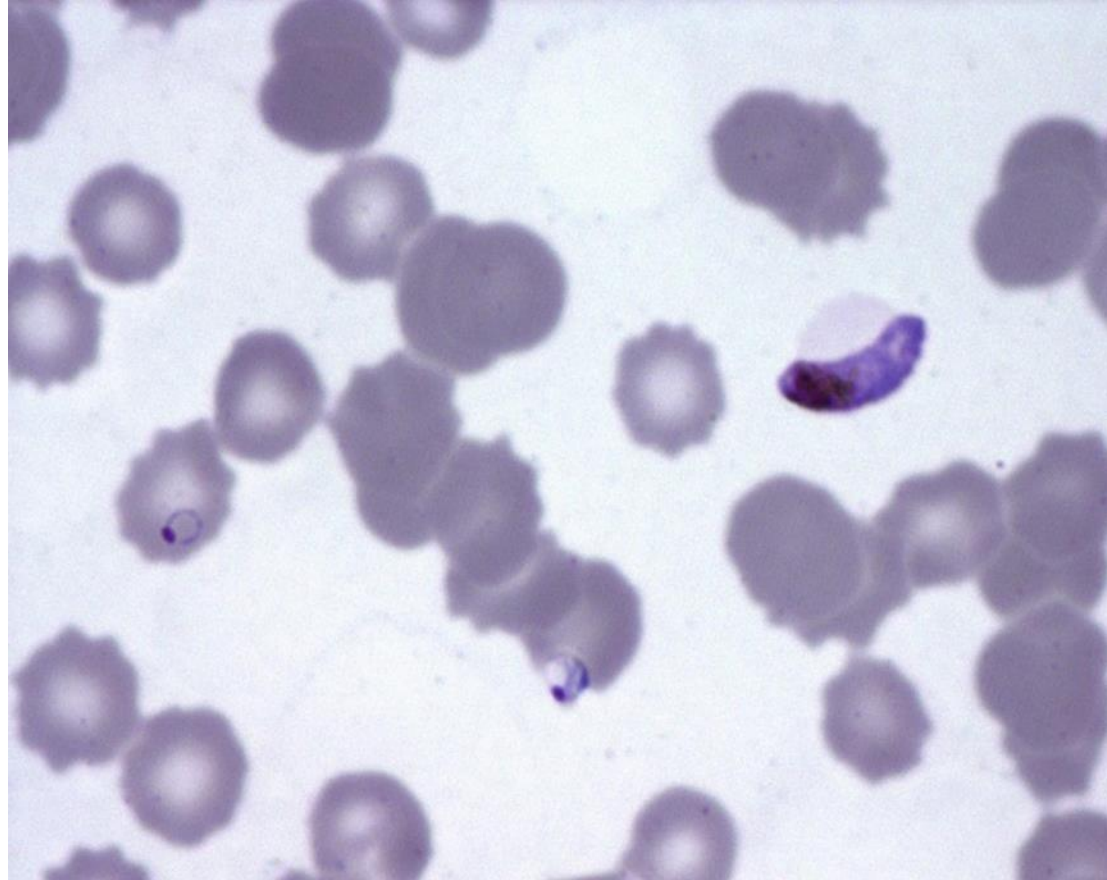


6- Parasites of Red Cell :






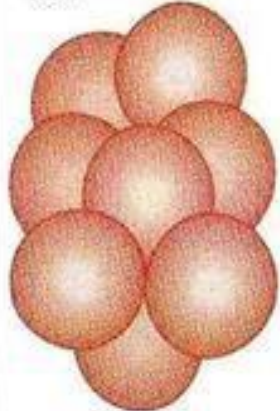








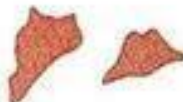











* Malaria

are protozoan parasites which occur in many species of birds and are the cause of avian malaria.

Transmitted by mosquitoes, infection with *Plasmodium* can be a cause of hemolytic 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 	Polychromasia (Reticulocyte) 	Sickle cell 	Burr cell 		



Thank You