Introduction to Red Cell Defects: Morphological Changes and Relevance.

MBChB III Lecture series

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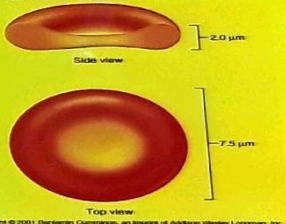
Human Erythrocyte.

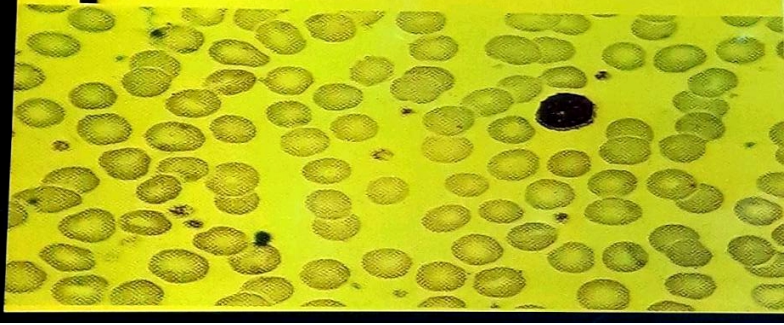
- Normal Size (7.2 – 7.9µm).
- Biconcave shape.
- Normal has haemoglobinized and area of Central pallor <one third of red cell diameter
- No inclusions
- No Nucleus.

The erythrocyte

- 3 dime



Normocytic Normochromic



TBC and Peripheral blood Film

- Comprises the bulk of laboratory tests requested by clinicians
- Either as a baseline evaluation or part of investigation for a suspected haematological or non haematological disorder
- Almost every patient seeking care in most secondary or tertiary H/F will have a TBC & film requested.

The Perpheral Blood Film

- An examination of native blood or blood collected in an appropriate anticoagulant spread on a microscope slide and stained with Romanowsky stains
- Important component of a haematological examination in conjunction with relevant clinical information
- May confirm or usually suggests a possible diagnosis to the clinician

The peripheral blood film Report

- Usually generated by expert morphologist
- Has a universal format that includes red cell, white cell and platelet morphology
- Examination guided by clinical information full blood count generated by the haematology cell counter.

Format of PBF report

Red cells

- Variation in **size** – anisocytosis (Normocytic, Microcytic, Macrocytic) variation in **shape** - Poikilocytosis
- Area of central pallor ie degree of haemoglobinization (normochromic, (hypochromic, hyperchromic)
- Presence of rbc inclusions (eg nuclear material, Iron, abnormal Hb aggregates, parasites etc)

PBF reporting format

White cells

- Differential counts of white cell population and maturity and morphology, inclusions etc

Presence of abnormal cells in circulation

Platelets

- Assessment of numbers, size, clumping ,morphology

Abnormality of red cell morphology

May arise as a result of:

- Abnormal erythropoiesis
- Inadequate haemoglobin formation.
- Damage to, or changes affecting rbc after they leave the marrow
- Effect of splenic function which may be reduced or absent.
- Attempts by Bone Marrow to compensate for anaemia by increasing erythropoiesis.

Defects I Anisocytosis.

Variation in size

- Macrocyte large rbc >8.0µm diameter MCV>97fl

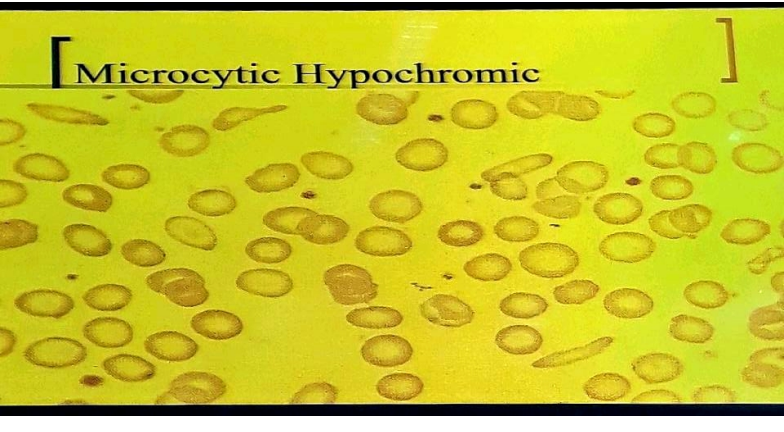
  well haemoglobinized usually lacks area of central pallor can be oval macrocyte(megaloblastic anaemia) or round eg in liver disease).

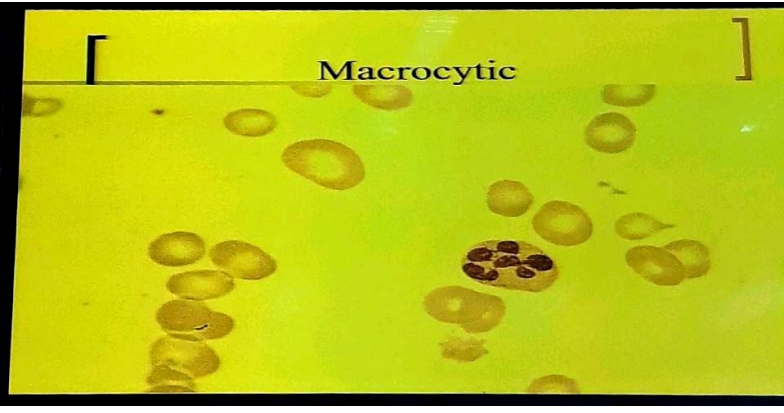
- Microcyte small rbc <6µm diameter MCV<75 fl

Usually increased area of central pallor. Due to decreased haemoglobin concentration

eg iron deficiency, Thalassemia.

Microcytic Hypochromic

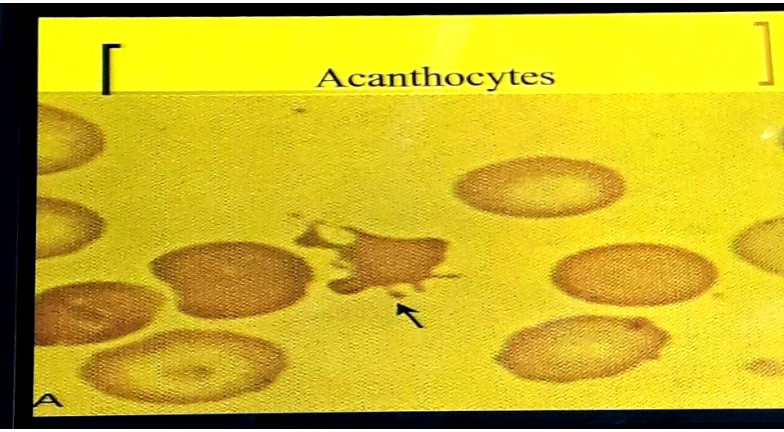



Macrocytic

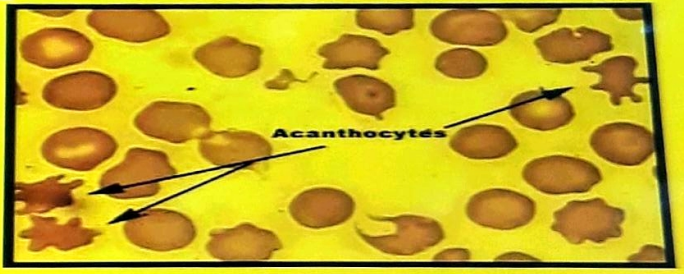
Defects II Poikilocytosis.

Variation in shape of rbc.

- **Acanthocytes** (spur, thorn, spiculated cells)5 – 10 spicules
  (Alcoholic liver disease, postsplenectomy, (abetalipoproteinemia)).


Acanthocytes
A

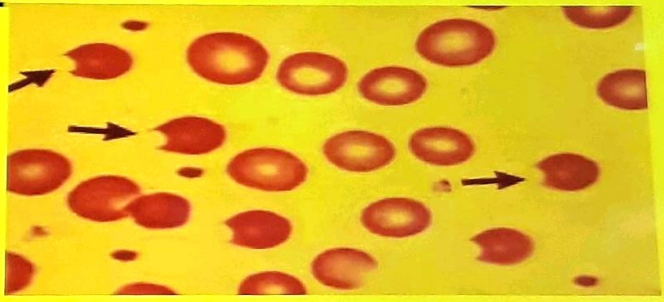
Acanthocytes



Poikilocytosis.

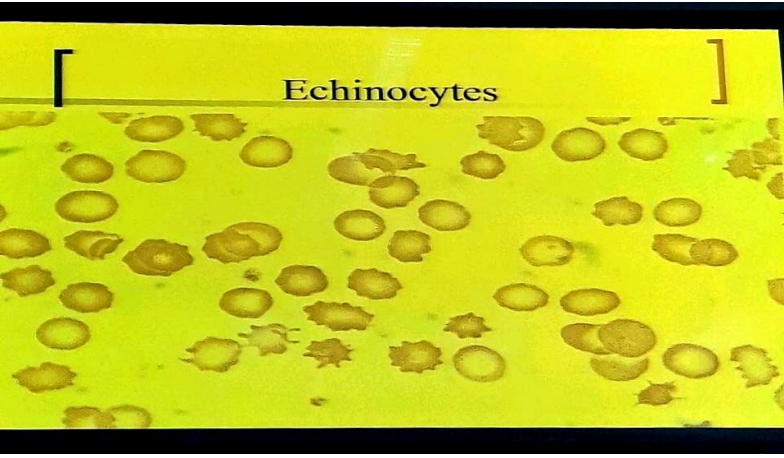
- **Bite cell** – half circle taken from edge of the cell due to pitting action of spleen. (G-6-PD deficiency, drugs e.g. dapsone).

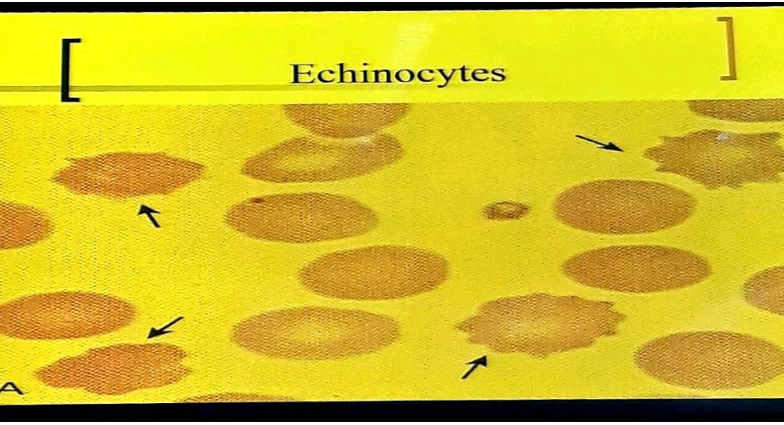
Bite cells



Defects II Poikilocytosis.

- **Echinocyte** – (burr cell) 10-30 short spicules (uraemia, pyruvate kinase deficiency, Peptic ulcer with bleeding, Ca of stomach).


Echinocytes


Echinocytes

Poikilocytosis

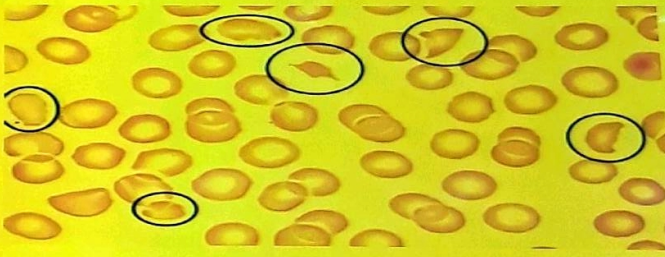
- **Helmet Cell** – loses part of it's membrane as it squeezes through fibrin strands of arterioles. Has 2 or 3 pointed ends as in MAHA (microangiopathic haemolytic anaemia).


Helmet Cells
Helmet

Defects II Poikilocytosis.

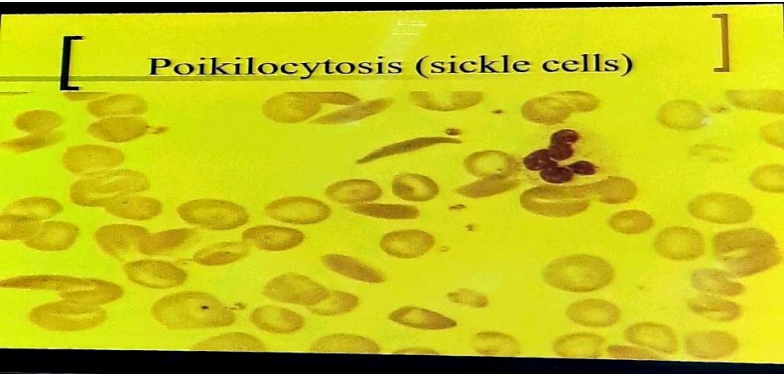
Schistocyte- injured cells(helmet, fragment triangular cell with 2-3 pointed ends (seen in MAHA, burns).

Fragments (Schistocytes)

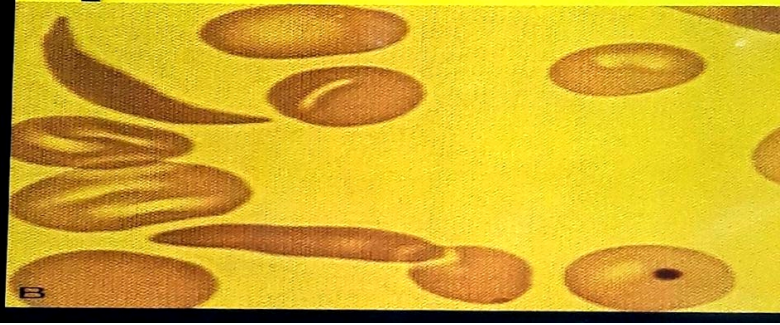


Defects II Poikilocytosis.

- **Sickle cell** – (drepanocyte). thin elongated erythrocyte with a point at each end no central pallor L, S, V shapes. Seen in sickle Hb.


Poikilocytosis (sickle cells)

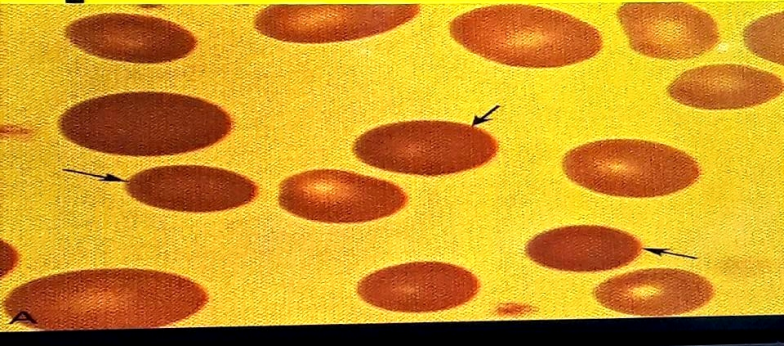
Poikilocytosis (sickle cells)



Spherocytes

- **Spherocyte** – spherical cell with dense appearance (no area of central pallor)thick cell with decreased diameter. (found in hereditary spherocytosis, acquired haemolytic anaemia, after transfusion, burns venoms, chemical injury immune haemolytic anaemia).

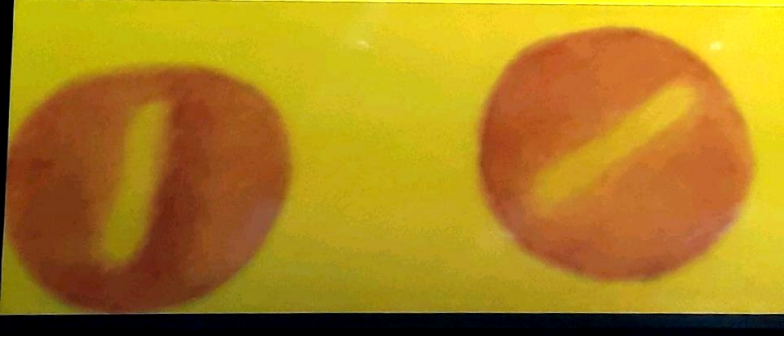
Spherocytes



Defects II Poikilocytosis.

- **Stomatocyte** – mouth or cuplike area of central pallor seen in hereditary membrane disorder of stomatocytosis, alcoholism, liver cirrhosis, obstructive liver disease.

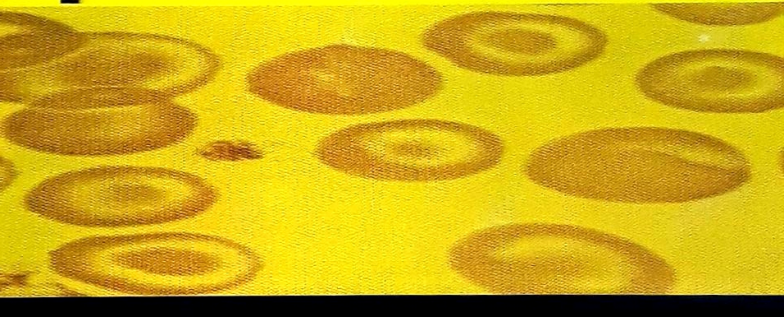
Stomatocyte



Defects II Poikilocytosis.

- **Target cell** – target with central spot of Hb surrounded by a pale area and then a peripheral rim of haemoglobin (haemoglobinopathies, liver disease post splenectomy).

Target Cells



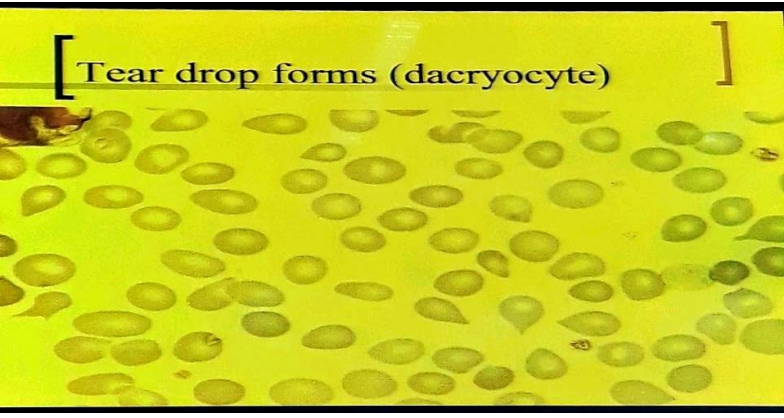
Defects II Poikilocytosis.

- **Tear drop cell – tear shaped.**

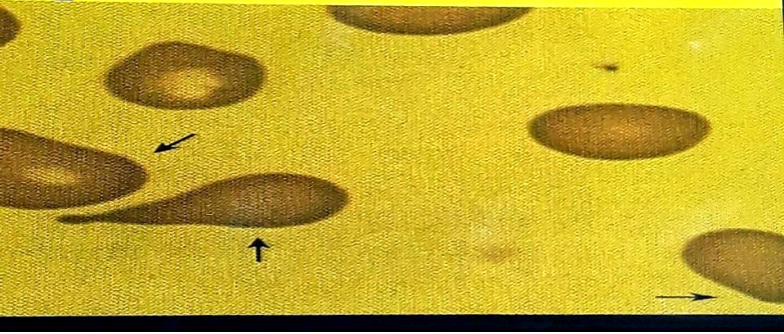
-megaloblastic anaemia (folate or vitamin B12 deficiency),

- bone marrow infiltrative disorder (eg myelofibrosis, metastatic disease to bone marrow)

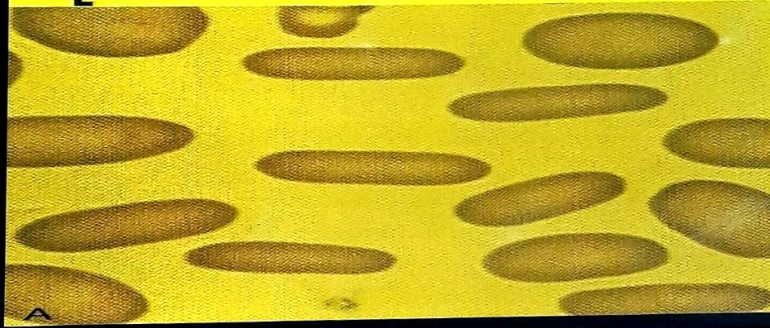
-clonal disorders eg myelodysplasia


Tear drop forms (dacryocyte)

Tear drop forms (dacryocyte)



Elliptocytes



Defects III Anisochromia.

Variation in color of rbc due to unequal hb content.

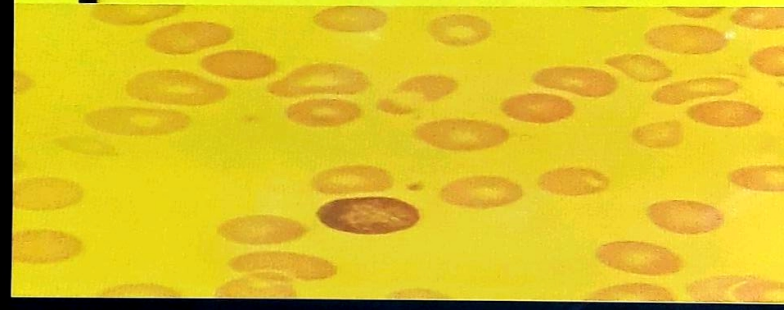
- Hypochromia – increased pale central area with only a small thin peripheral rim of Hb - poor haemaglobinization.
- Hyperchromia - lack area of central pallor (macrocyte, spherocyte).

Defects III Anisochromia.

- **Polychromasia** – bluish central pallor due to presence of reticulin material (RNA remnants) usaully larger than rbc. Refered to as reticulocyte when stained with methlyne blue. Matures un circulation after two days. Adult blood contains less than 2% of reticulocytes,
- Increased in
  - Haemorrhage
  - Haemolysis
  - Response to haematinics

Decreased in hypoplastic marrow states.

Polychromasia

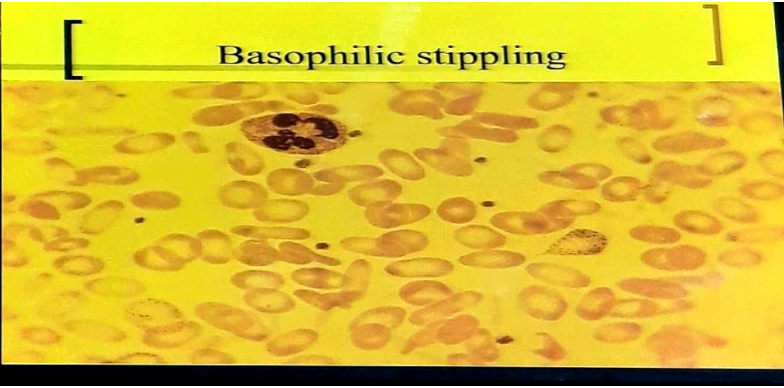


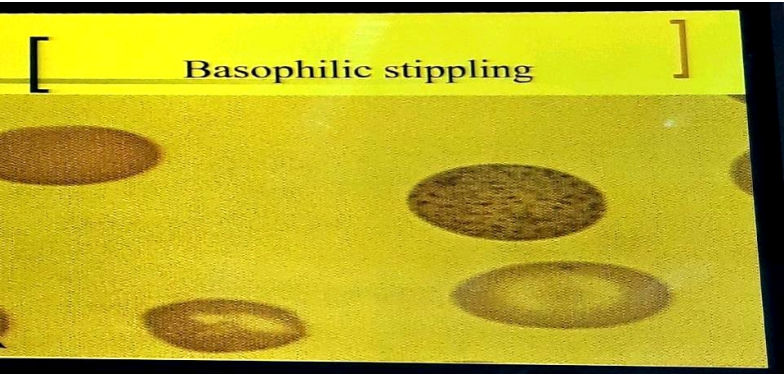
Red Cell Defects. Inclusions.

Basophilic stippling.

- precipitation of ribosomes of varying size and number appear deep blue with wright stain.

(lead and other heavy metal intoxication, nutritional deficiencies and after use of drugs eg cytotoxics).


Basophilic stippling


Basophilic stippling

Red Cell Defects.

- Cabot ring – dark blue ring. (wright stain) or blue granules in a linear array originate from spindle material or figure eight form, in abnormal mitosis, megaloblastic anaemia.

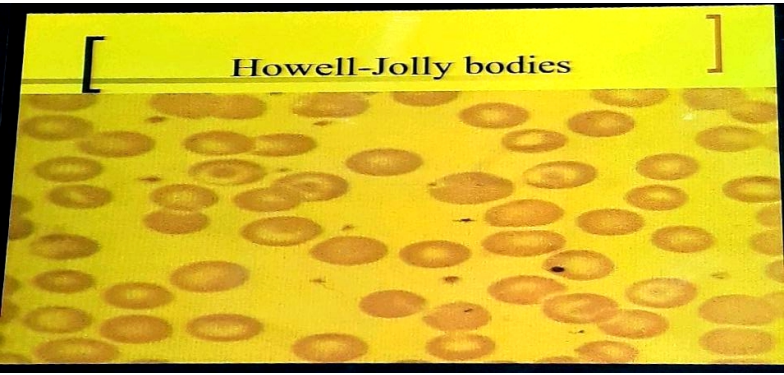
Red Cell Defects.

Heinz Body – are denatured Hb. round blue precipitates or inclusions in rbc (after supravital staining) seen after drugs (phenylhydrazine, primaquine (drugs which cause oxidative dematuration of Hb.), G6PD deficiency ,unstable haemoglobinopathies (Hb zurich).

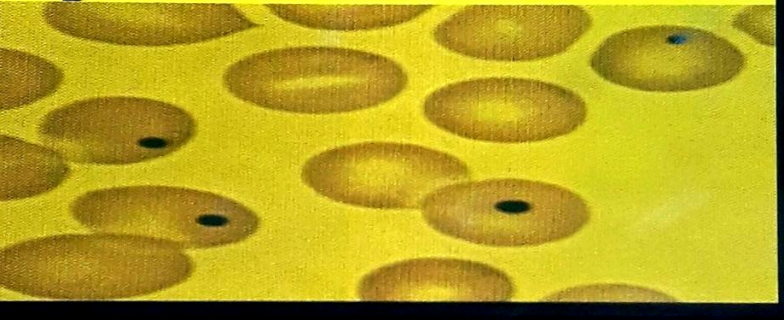
Red Cell Defects

Howell Jolly Body.

- small round dense nuclear fragment composed of DNA 0.5μm


Howell-Jolly bodies

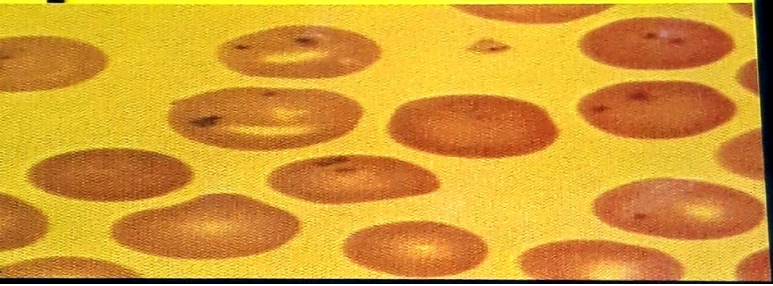
Howell-Jolly bodies



Pappenheimer Bodies

- Iron (siderotic) granules found near periphery of rbc membrane. (appear basophilic with wrights stain).

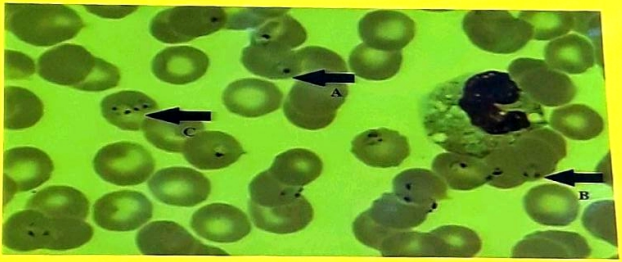
Pappenheimer bodies



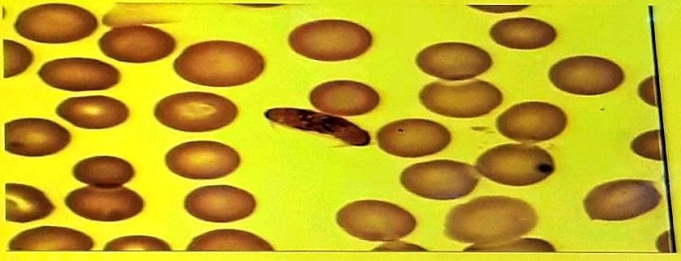
Siderocyte

- Mature rbc with one or more siderotic (iron) granules. (usually demonstrated by prussian blue stain)

Malaria Parasites



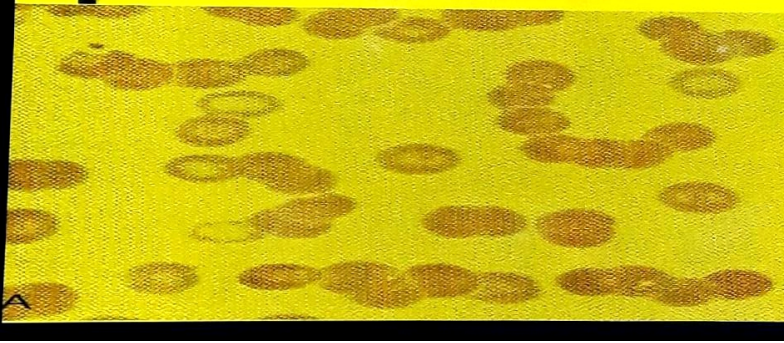
Malaria Parasites



Rouleaux

- **Rouleaux** – aggregates of erythrocytes assembling as a stack of coins. (paraproteinemias myeloma, chronic infection)

Rouleaux



RBC MORPHOLOGY ON A PERIPHERAL SMEAR