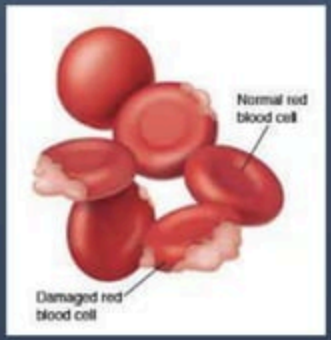
Haemolytic Anaemias

Haemolytic Anaemia

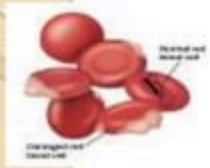
- **Definition:**
  - Anaemias which result from an increase in the rate of red cell destruction.

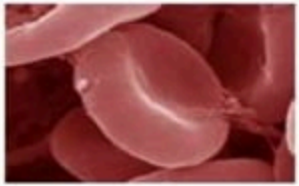


Normal red cell destruction

- A red blood cell survives for 120 days in the circulation; about 1% of human red blood cells break down each day.
- The spleen is the main organ which removes old and damaged RBCs from the circulation

NORMAL RED CELL DESTRUCTION



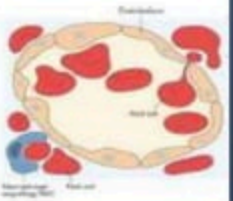


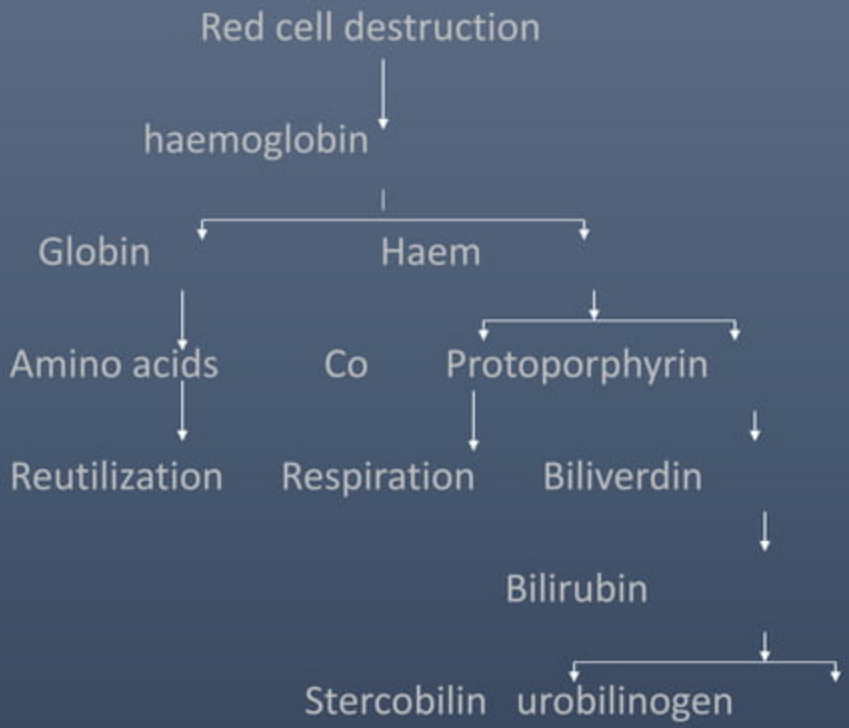
RBC completes 120 days
Of life span

Changes in cell membrane
occurs
Enzyme activity declines

Effete cells less deformable than normal
Recognized by macrophages

Phagocytosis and cell death




Red cell destruction
haemoglobin
Globin
Haem
Amino acids
Co
Protoporphyrin
Reutilization
Respiration
Biliverdin
Bilirubin
Stercobilin
urobilinogen

Definitions

Hemolysis:

- is the destruction or removal of red blood cells from the circulation before their normal life span of 120 days.

Haemolytic anaemias:

- Are a group of anaemias in which red-cell lifespan is shortened.

Normal red cell destruction

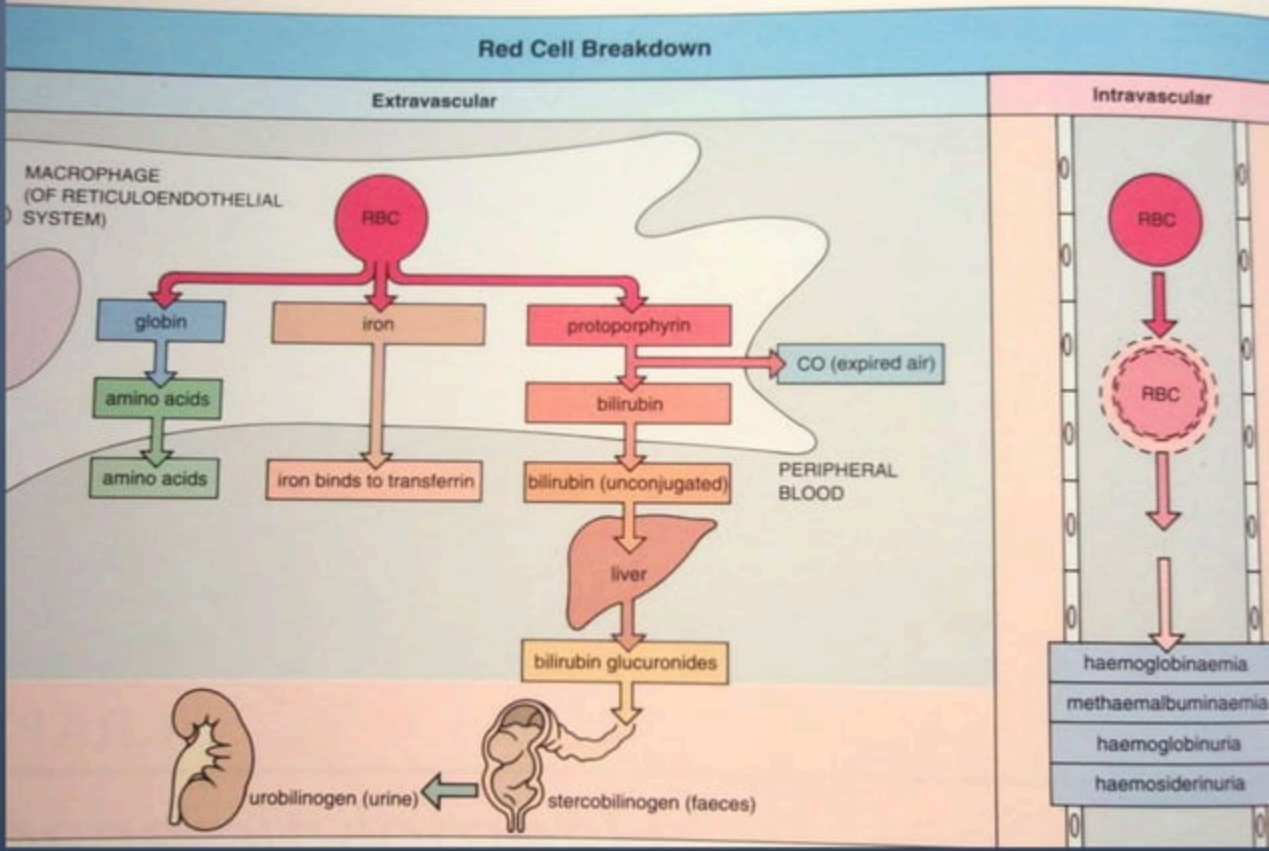
- As RBCs have no nucleus, enzymes are degraded and not replaced, red cell metabolism gradually deteriorates and the cell become non-viable.

RBCs breakdown

- When the rate of breakdown increases, the body compensates by producing more RBCs
- The normal adult marrow, after full expansion, able to increase erythropoietic activity 6-8 times normal
- This may occur before the patient get anemic (compensated hemolytic disease)

Mechanisms of hemolysis

- Extravascular
  - ✓red cells destruction occurs in reticuloendothelial system
- Intravascular
  - ✓red cells destruction occurs in vascular space .


Red Cell Breakdown
Extravascular
Intravascular
MACROPHAGE
(OF RETICULOENDOTHELIAL
SYSTEM)
RBC
globin
iron
protoporphyrin
CO (expired air)
amino acids
bilirubin
amino acids
iron binds to transferrin
bilirubin (unconjugated)
PERIPHERAL
BLOOD
liver
bilirubin glucuronides
urobilinogen (urine)
stercobilinogen (faeces)
RBC
RBC
haemoglobinaemia
methaemalbuminaemia
haemoglobinuria
haemosiderinuria

Classification

I- Hereditary

II- Acquired

Classification

1. Intracorpuscular

2. Extracorpuscular

Intrinsic haemolytic anaemia

Intrinsic Defects

- Hereditary
  - Membrane defect
  - Haemoglobin defect
  - Enzyme defect
- Acquired
  - Paroxysmal nocturnal haemoglobinuria .

Intrinsic Haemolytic anaemias

1. Membrane defect:

- Hereditary spherocytosis.
- Hereditary elliptocytosis.

Intrinsic Haemolytic anaemias

Haemoglobin defect

- Sickle cell disease.
- Thalassaemia
- Hb-C, Hb-D, Hb-E….etc

Intrinsic Haemolytic anaemias

Enzyme defect:

- G6PD deficiency.
- Pyruvate kinase (PK) deficiency.

Extrinsic haemolytic anaemia

Extrinsic haemolytic anaemias

- **Hereditary**

1. LCAT deficiency.
2. Abetalipoproteinemia.

Extrinsic haemolytic anaemias

- **Acquired**

1. **Immune mediated H.A**
2. **Non-immune mediated HA:**

- Mechanical
- Infectious agent
- Hypersplenism
- Thermal

Immune mediated H.A

- Autoimmune H.A.
- Alloimmune H.A.
- Drug induced mediated I.H.A (hapten mechanism).

Intravascular Haemolysis

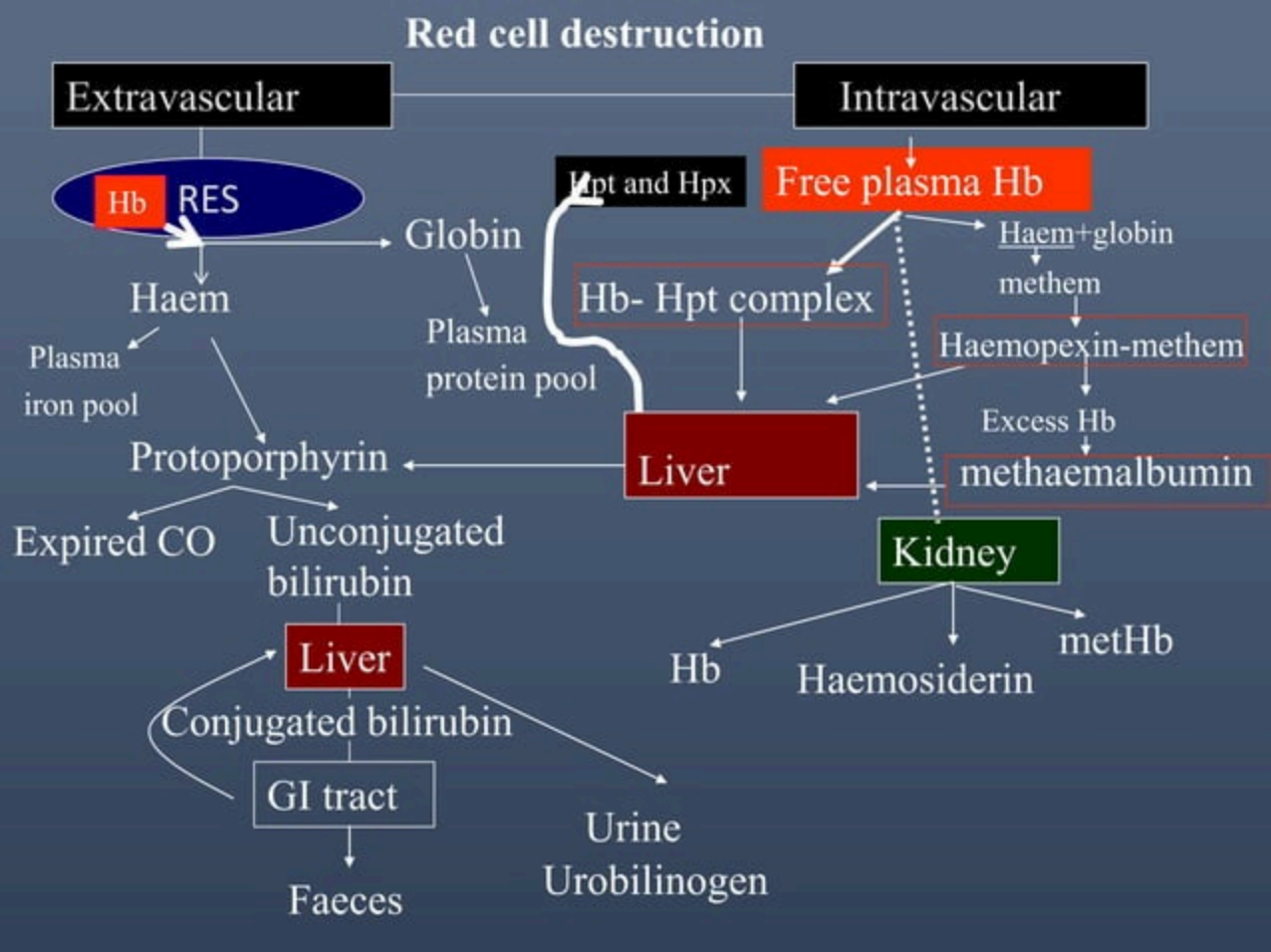
- Hb binds to **haptoglobin** and the complexes are rapidly taken up by hepatocytes.
- Haptoglobin also play a role in extravascular haemolysis due to the escape of some Hb from macrophages when they phagocytosed damaged red cells.

Intravascular Haemolysis

- Haem is released from the Hb and rapidly oxidized to '**haematin**'.
- Haematin binds to **haemopexin** and the complexes are removed by hepatocytes.
- **When haemopexin saturated, the haematin bind to albumin to form methaemalbumin.**

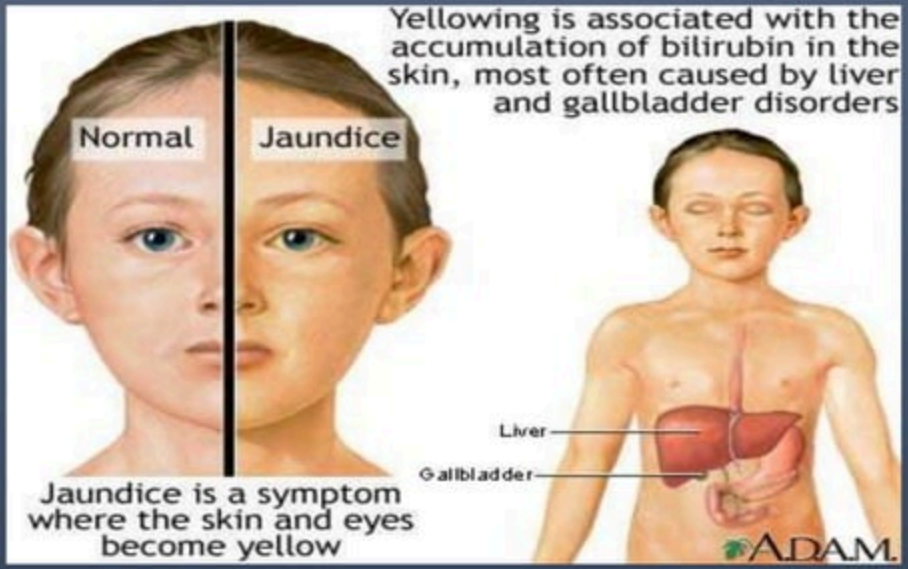
Intravascular Haemolysis

- When haemoglobinaemia is present, some of the free Hb dissociate to dimers and the dimers pass through the glomerulus causing **haemoglobinuria**.
- Some of the dimers are taken up by renal tubular cells and converted to haemosiderin which can be detected in urine (**haemosiderinuria**).


Red cell destruction
Extravascular
Intravascular
Hb
RES
Hpt and Hpx
Free plasma Hb
Globin
Haem+globin
methem
Haem
Hb- Hpt complex
Haemopexin-methem
Plasma
iron pool
Plasma
protein pool
Excess Hb
Protoporphyrin
Liver
methaemalbumin
Expired CO
Unconjugated
bilirubin
Kidney
Liver
Hb
Haemosiderin
metHb
Conjugated bilirubin
GI tract
Urine
Urobilinogen
Faeces

Clinical Manifestations in Summary

- Symptoms and signs of anemia
- Jaundice
- Splenomegaly
- Cholelithiasis (gall stones)
- Leg ulcers (sickle cell)
- Skeletal abnormalities (thalassemia)


Yellowing is associated with the accumulation of bilirubin in the skin, most often caused by liver and gallbladder disorders
Normal
Jaundice
Jaundice is a symptom where the skin and eyes become yellow
Liver
Gallbladder
A.D.A.M.

Evidence of haemolysis

- The lab. Findings are divided into 2 groups:

1- Features of increased red cell breakdown.

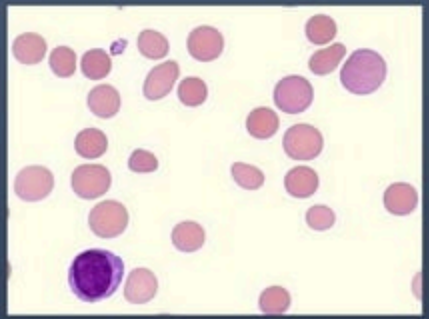
2- Features of increased red cell production.

Features of increased red cell destruction

- **Serum bilirubin:** high
- **Serum LDH:** high
- **Urine urobilinogen:** high
- **Serum haptoglobins:** absent

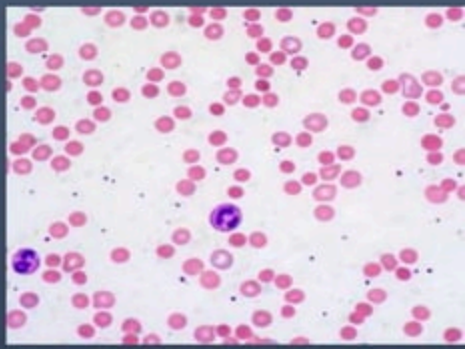
Features of increased red cell production

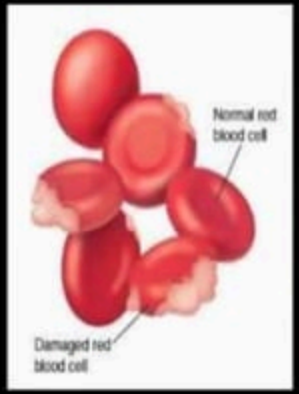
- **P.B:** Reticulocytosis and Circulating nucleated red cells
- **B.M:** Erythroid hyperplasia.

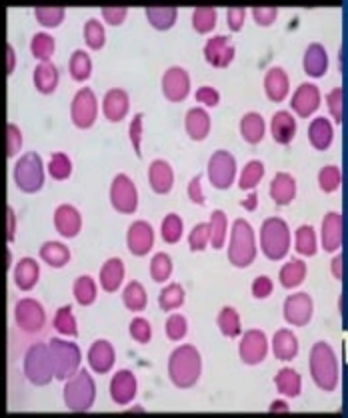


Damaged red cells

- **Morphology:** microsphercytes, fragments,…etc
- **Shortened red cell survival.**
- **Special tests:** osmotic fragility,




Normal red blood cell
Damaged red blood cell




1.0%
0.85%
0.46%
0.51%
0.3%
0%
1.0%
0.85%
0.46%
0.51%
0.3%
0%

Main features of Intravascular Haemolysis

- Haemoglobinaemia
- Haemoglobinuria
- Haemosiderinuria
- Methaemalbuminaemia

Thanks