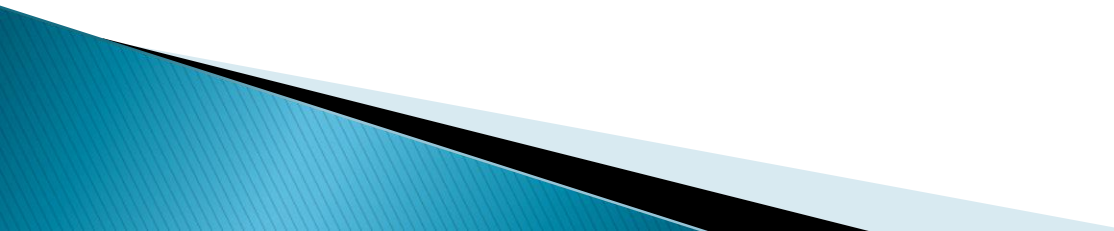


Diyala University – collage of medicine
Hematology –5th stage
Dr.zahraa najah alzuhairi
Lec 2

Hematological investigation

Hematological parameters

1. Complete blood count (CBC)
 2. Blood film (BF)
 3. Erythrocyte sedimentation rate (ESR):
 4. Reticulocyte count
 5. Bone marrow examination
- 

Complete blood count (CBC)

Full blood count including Hb, leucocyte count, Platelets count, red cell indices and leucocyte differential count

ESR (erythrocyte sedimentation rate)

- is the measurement of the sedimentation of red cells in diluted blood after standing for 1 h in an open-ended glass tube of 30 cm length mounted vertically on a stand.
- **Rate of sedimentation** depended on many factors like difference in specific gravity of RBC and plasma, Rouleaux formation, ratio of RBC and plasma
- **depend mainly on plasma proteins** as fibrinogen and other acute phase proteins that increase the red cells Rouleaux and extend of their sinking
- The **ESR value** is influenced by many factors like age and drugs intake
- **Clinically useful** in dx of many disease

Erythrocyte Sedimentation Rate (ESR)

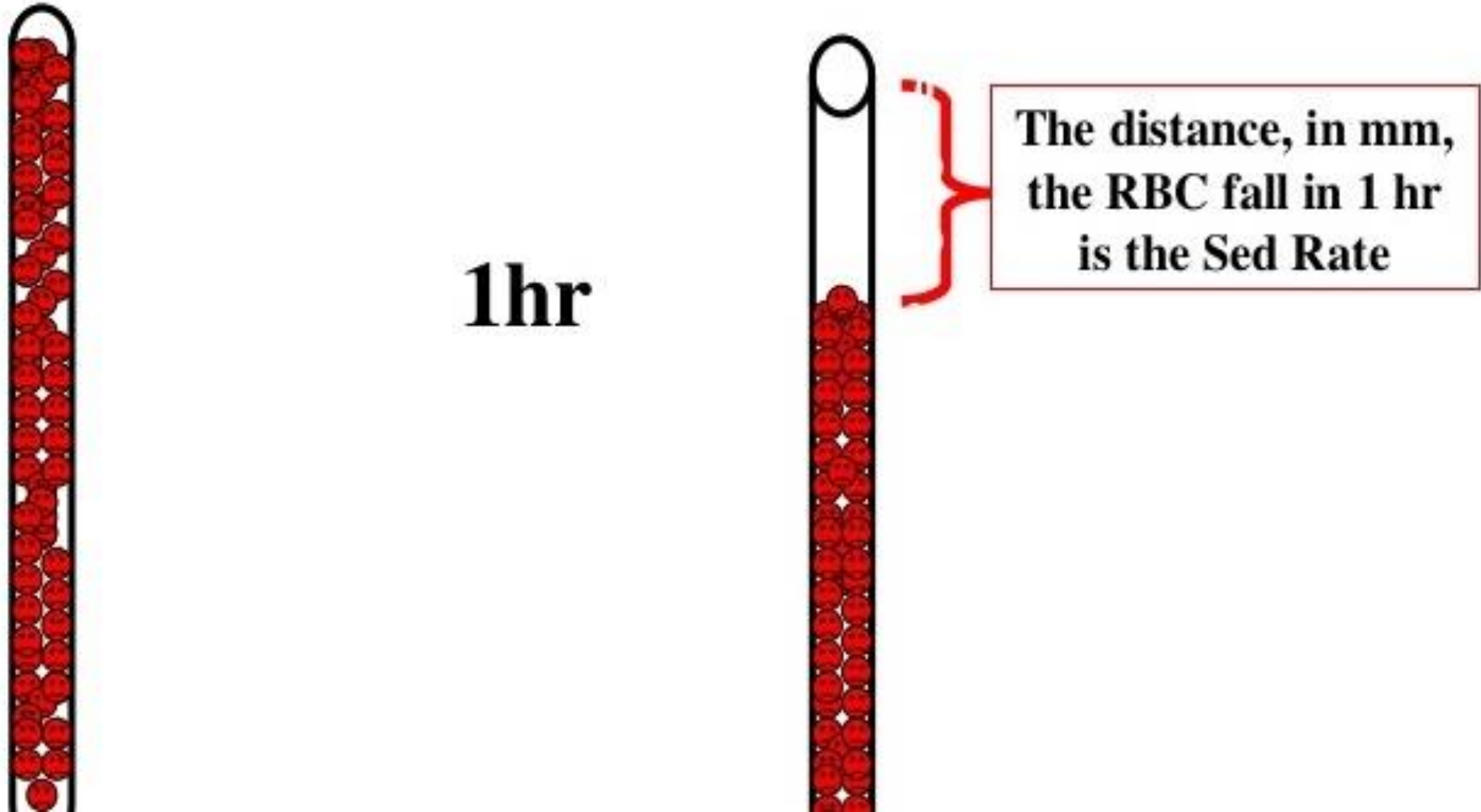


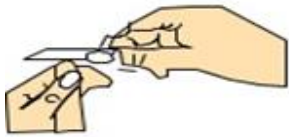
TABLE 6-1**ERYTHROCYTE SEDIMENTATION RATE
RANGES IN HEALTH**

Age Range (Years)	ESR Mean (mm in 1 h)
10–19	8
20–29	10.8
30–39	10.4
40–49	13.6
50–59	14.2
60–69	16
70–79	16.5
80–91	15.8
Pregnancy	
Early gestation	48 (62 if anaemic)
Later gestation	70 (95 if anaemic)

Blood film

- ▶ stained with Leishman stain, is examined for red cells morphology, leucocytes morphology and differential count and for platelets assessment.

Preparing thick and thin films



1. Touch one drop of blood to a clean slide.



2. Spread the first drop to make a 1 cm circle.



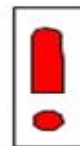
3. Touch a fresh drop of blood to the edge of another slide.



4. Touch the drop of blood by spreader slide at 45 degree angle.



5. Pull the drop of blood across the first slide in one motion.




6. Wait for both to dry before fixing and staining.





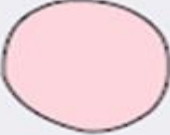











Abnova

Blood Smear

Definition of Terms in hematological disorders:

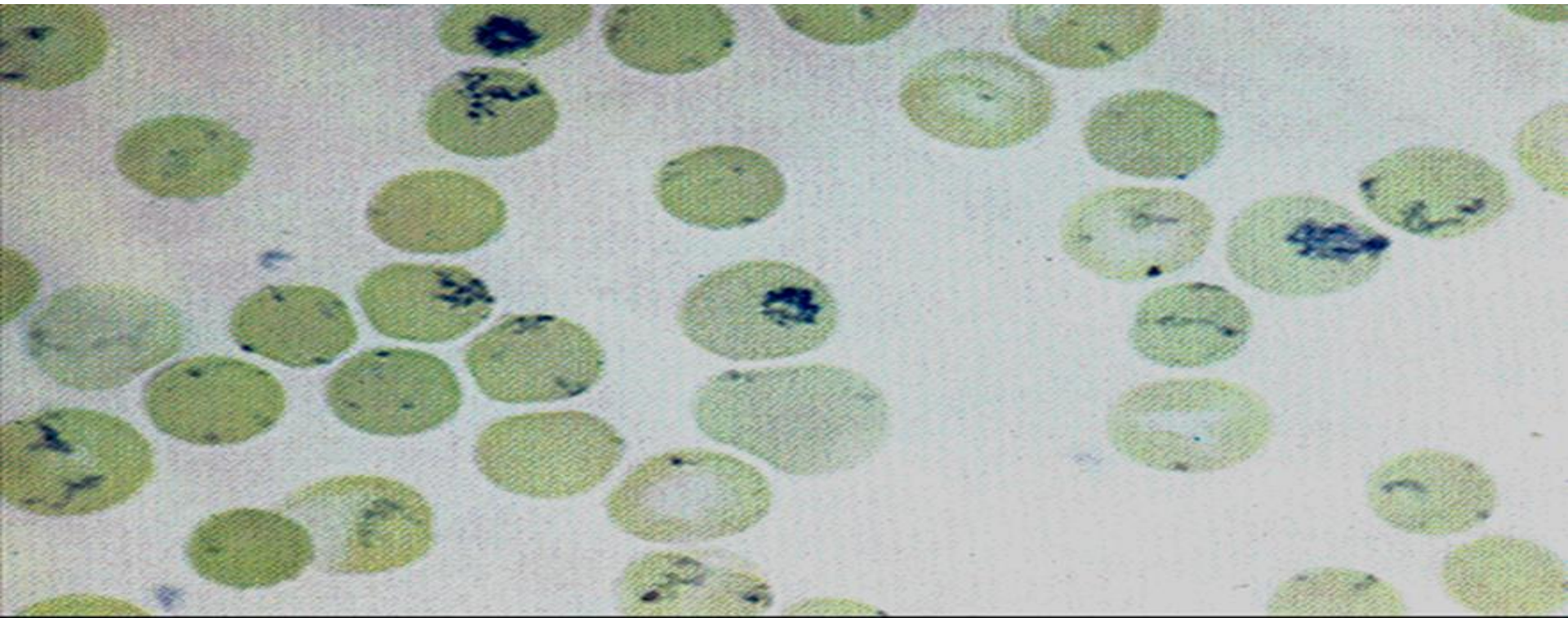
- ❑ Normocytic
 - ❑ Normochromic
 - ❑ Hypochromic
 - ❑ Anisocytosis
 - ❑ Poikilocytosis
 - ❑ Polychromasia
 - ❑ Leukocytosis
 - ❑ Leucopenia:
 - ❑ Thrombocytosis:
 - ❑ Thrombocytopenia:
- 

Red Cells morphology

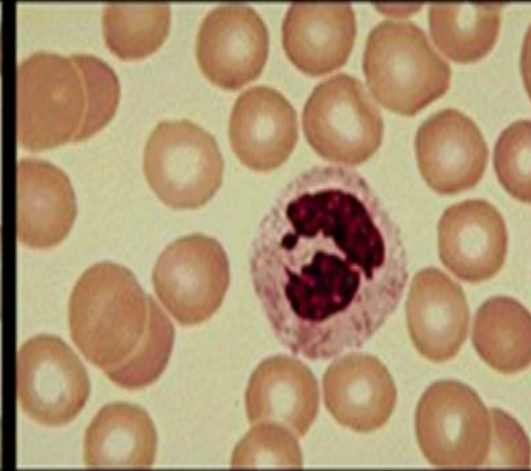
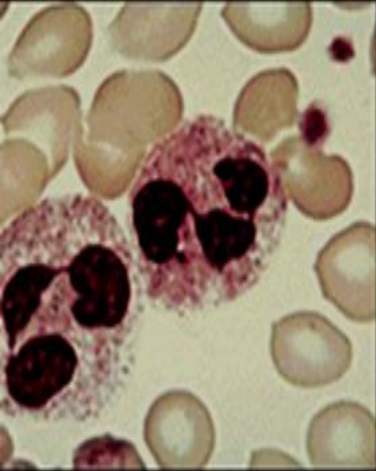
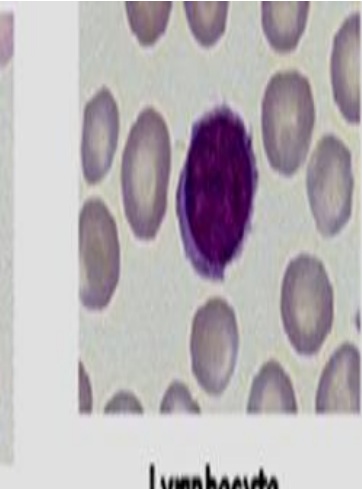
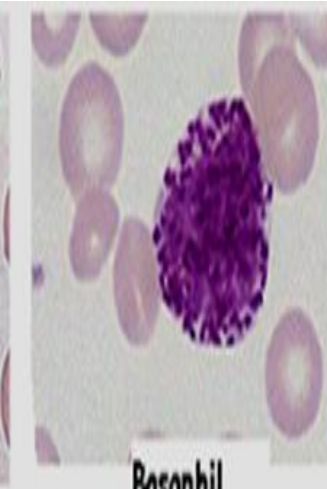
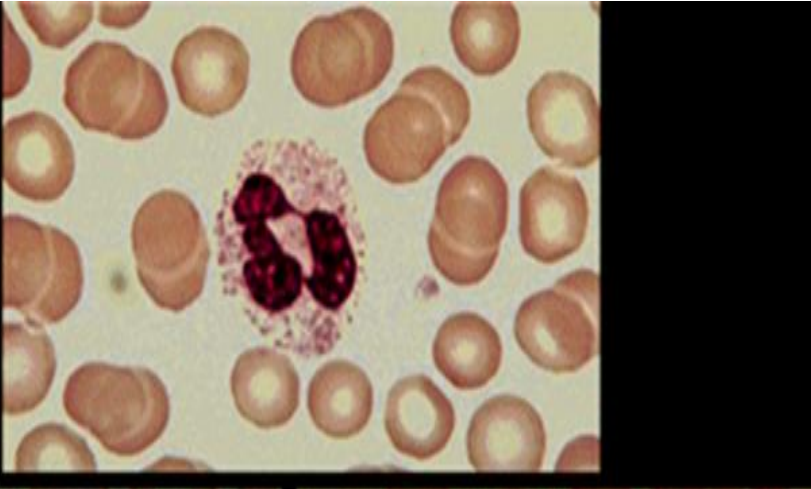
Red cell abnormality	Causes	Red cell abnormality	Causes
 Normal		 Microspherocyte	Hereditary spherocytosis, autoimmune haemolytic anaemia, septicaemia
 Macrocyte	Liver disease, alcoholism. Oval in megaloblastic anaemia	 Fragments	DIC, microangiopathy, HUS, TTP, burns, cardiac valves
 Target cell	Iron deficiency, liver disease, haemoglobinopathies, post-splenectomy	 Elliptocyte	Hereditary elliptocytosis
 Stomatocyte	Liver disease, alcoholism	 Tear drop poikilocyte	Myelofibrosis, extramedullary haemopoiesis
 Pencil cell	Iron deficiency	 Basket cell	Oxidant damage—e.g. G6PD deficiency, unstable haemoglobin
 Echinocyte	Liver disease, post-splenectomy, storage artefact	 Sickle cell	Sickle cell anaemia
 Acanthocyte	Liver disease, abetalipoproteinaemia, renal failure	 Microcyte	Iron deficiency, haemoglobinopathy

Reticulocytes count

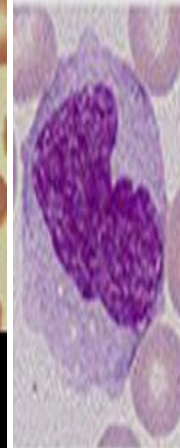
- ▶ is the percentage of immature circulating RBC as detected by a special stain for them (New Methylene blue stain),
- ▶ normal range 0.2–2.5%.



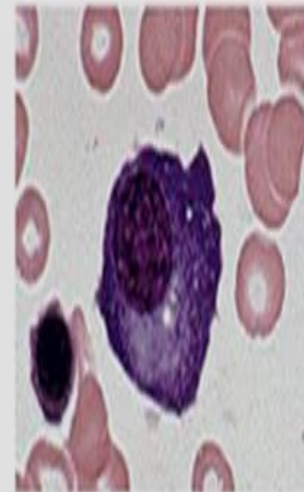
Blood leucocyte morphology



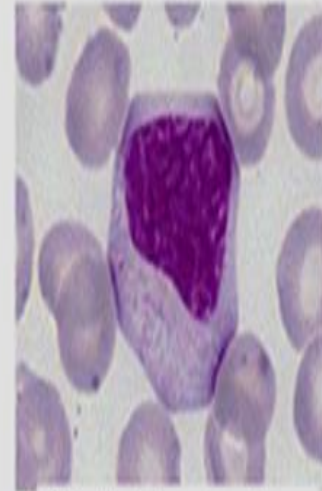
Neutrophils



Monocyte

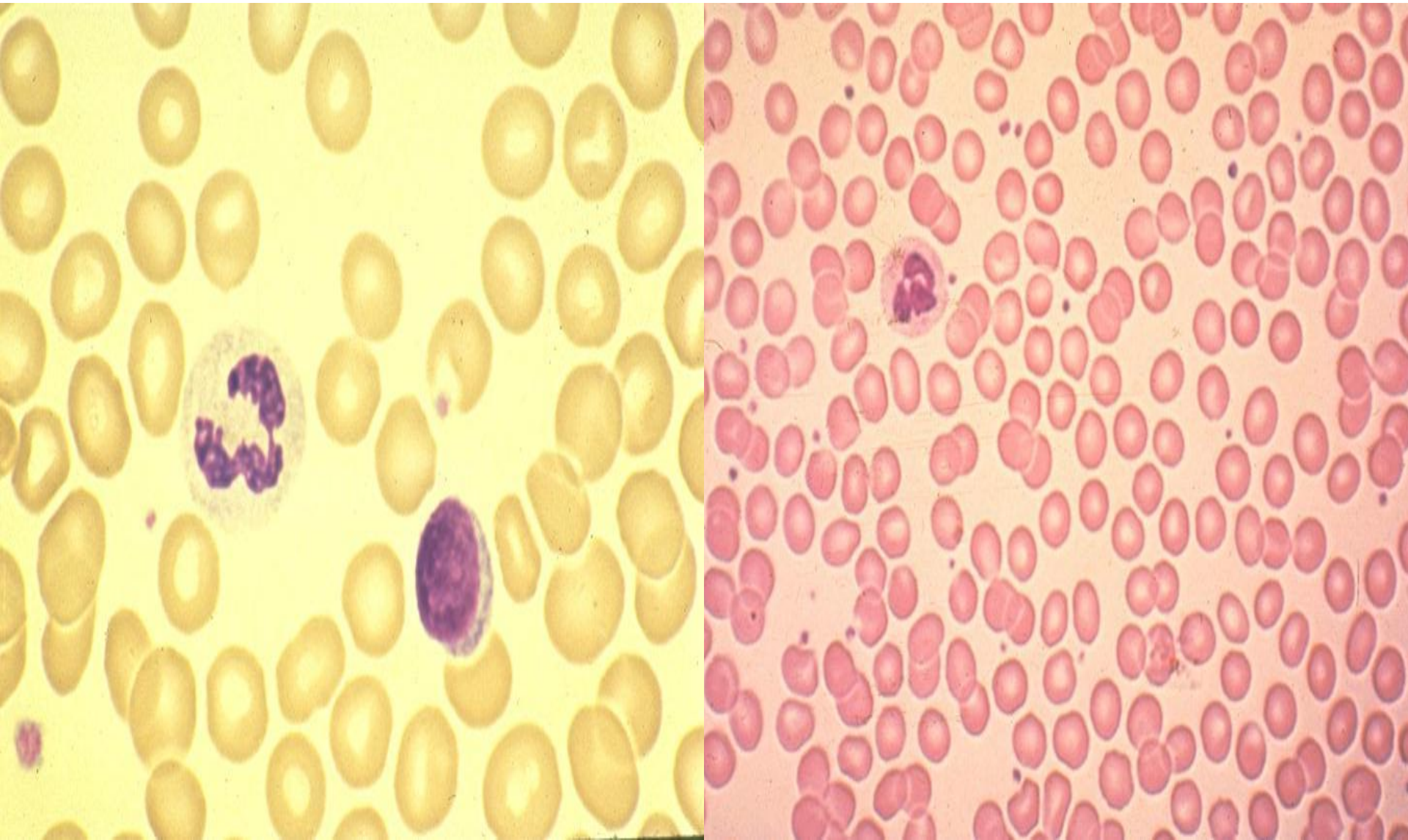


Plasma cell

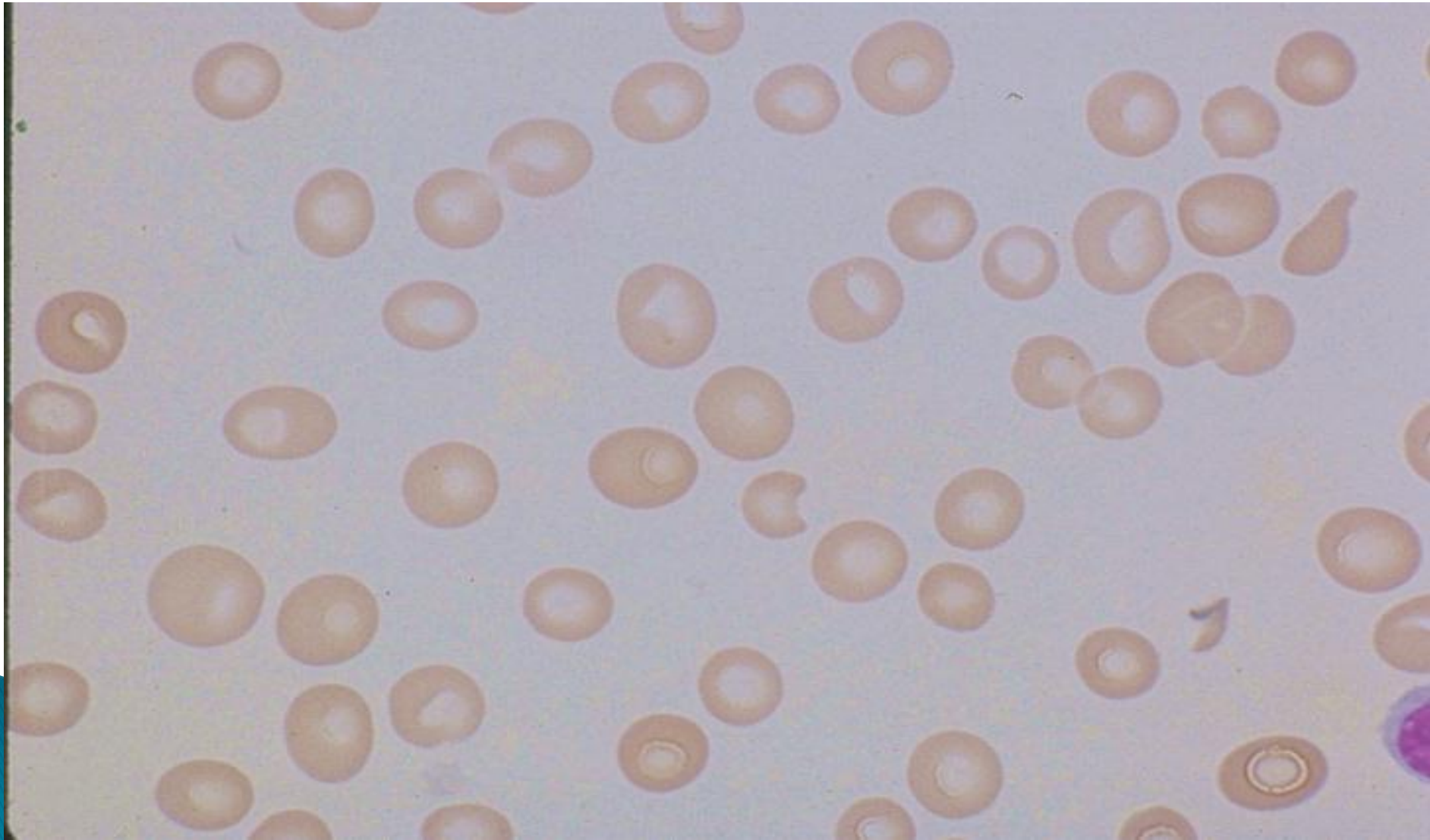


Atypical lymphocyte

Normal blood films



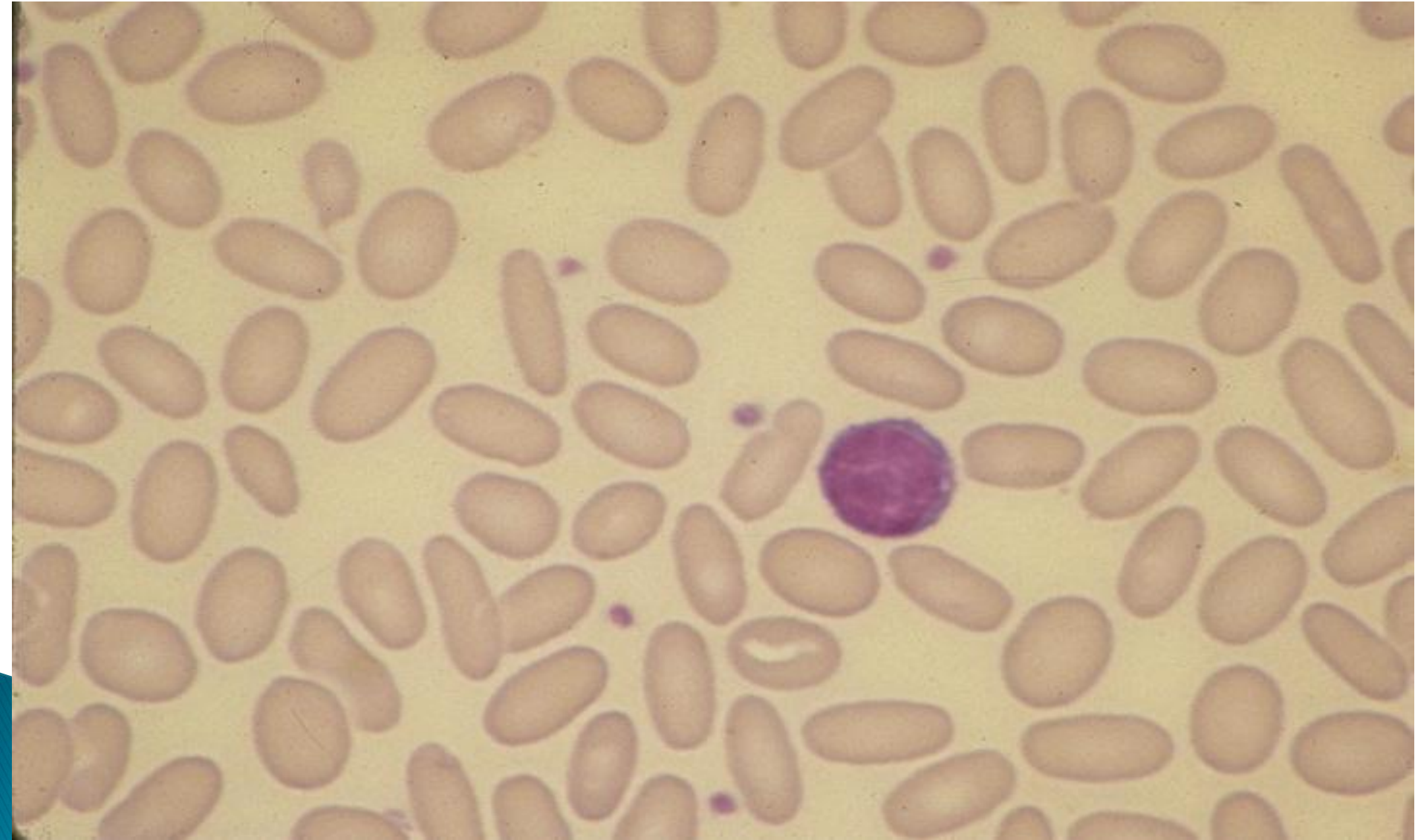
Hypochromic and microcytic anemia



peripheral blood in a patient with severe iron deficiency anemia.

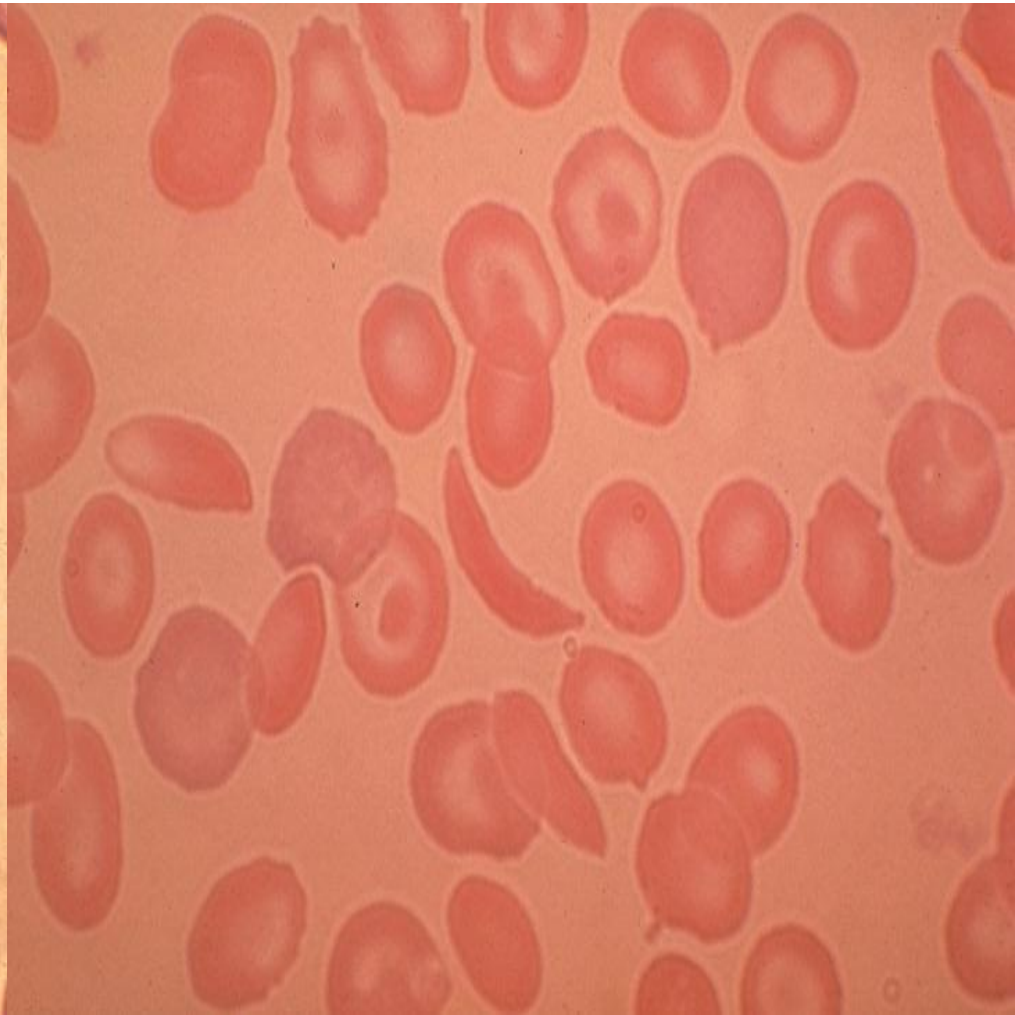


Hereditary elliptocytosis.

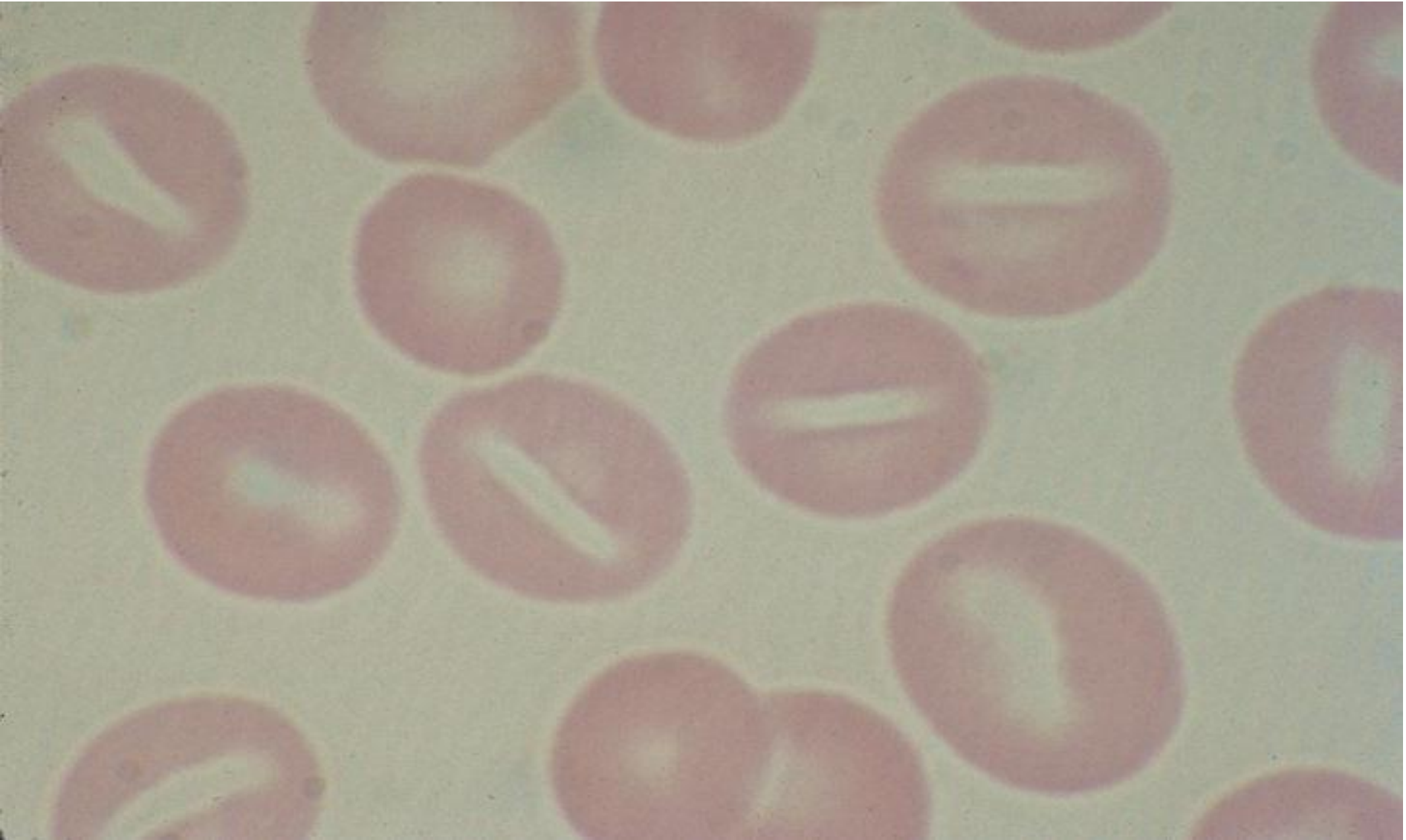


**homozygous beta
thalassemia**

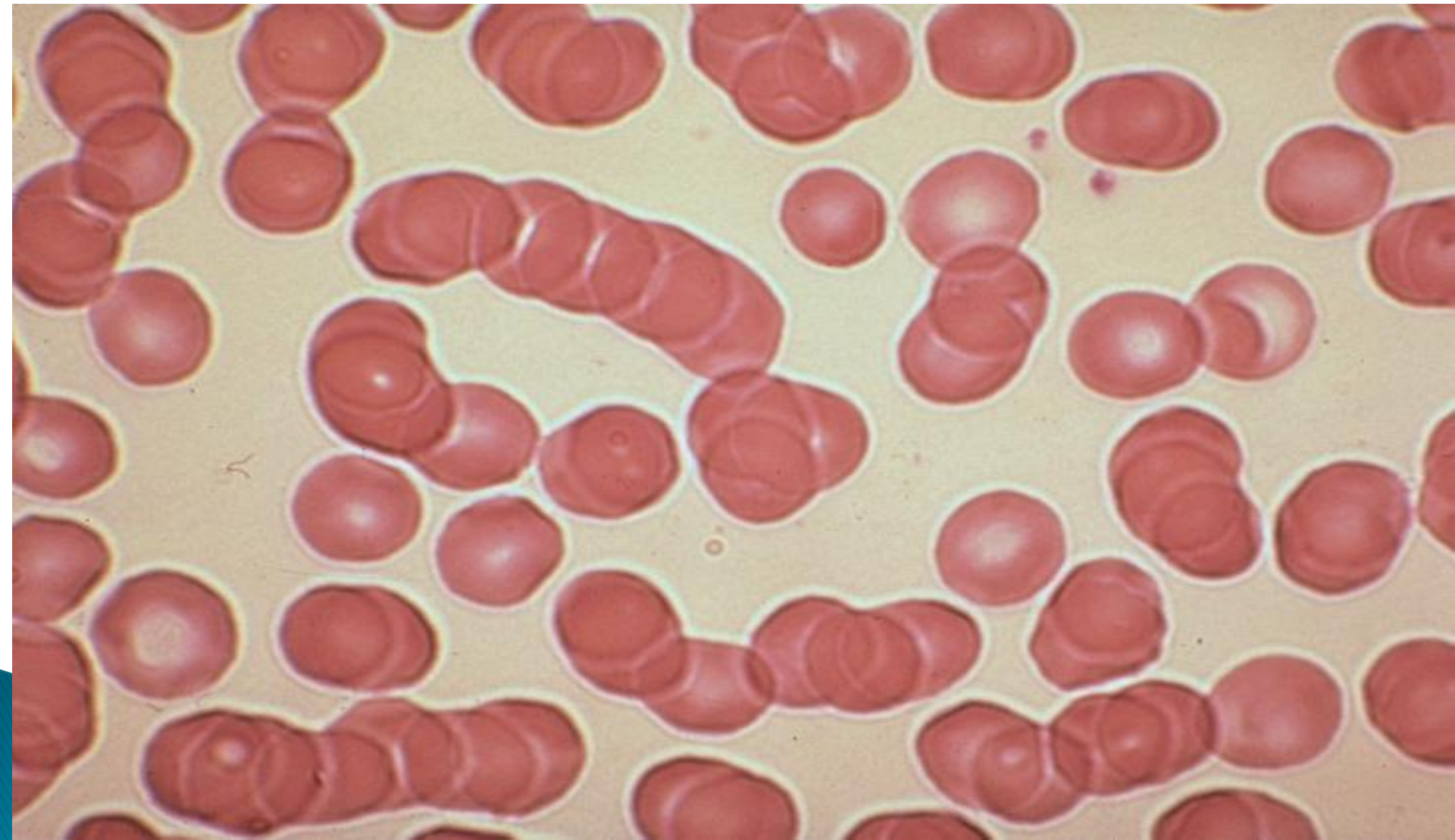
**peripheral blood smear
in a patient with sickle
beta thalassemia.**

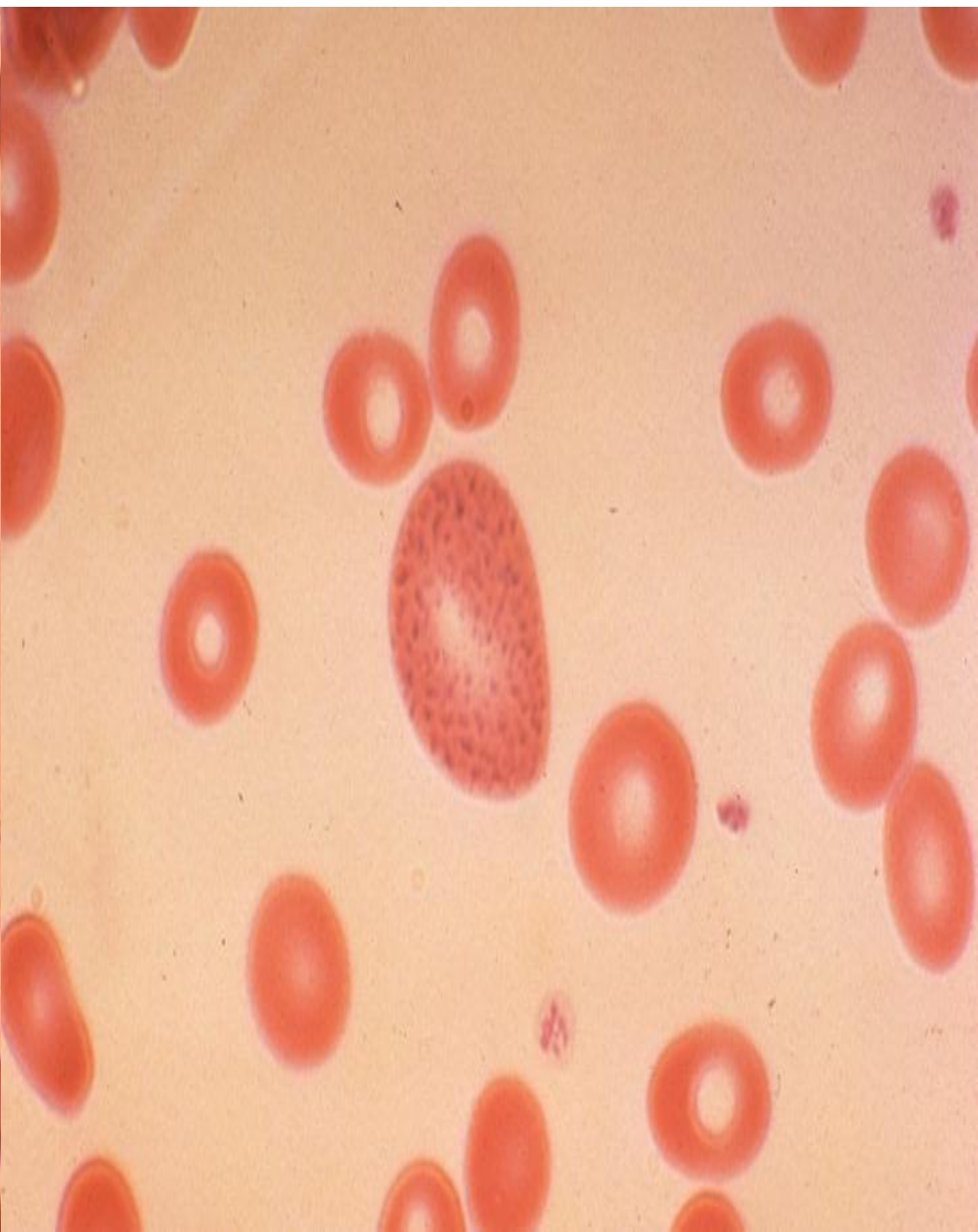
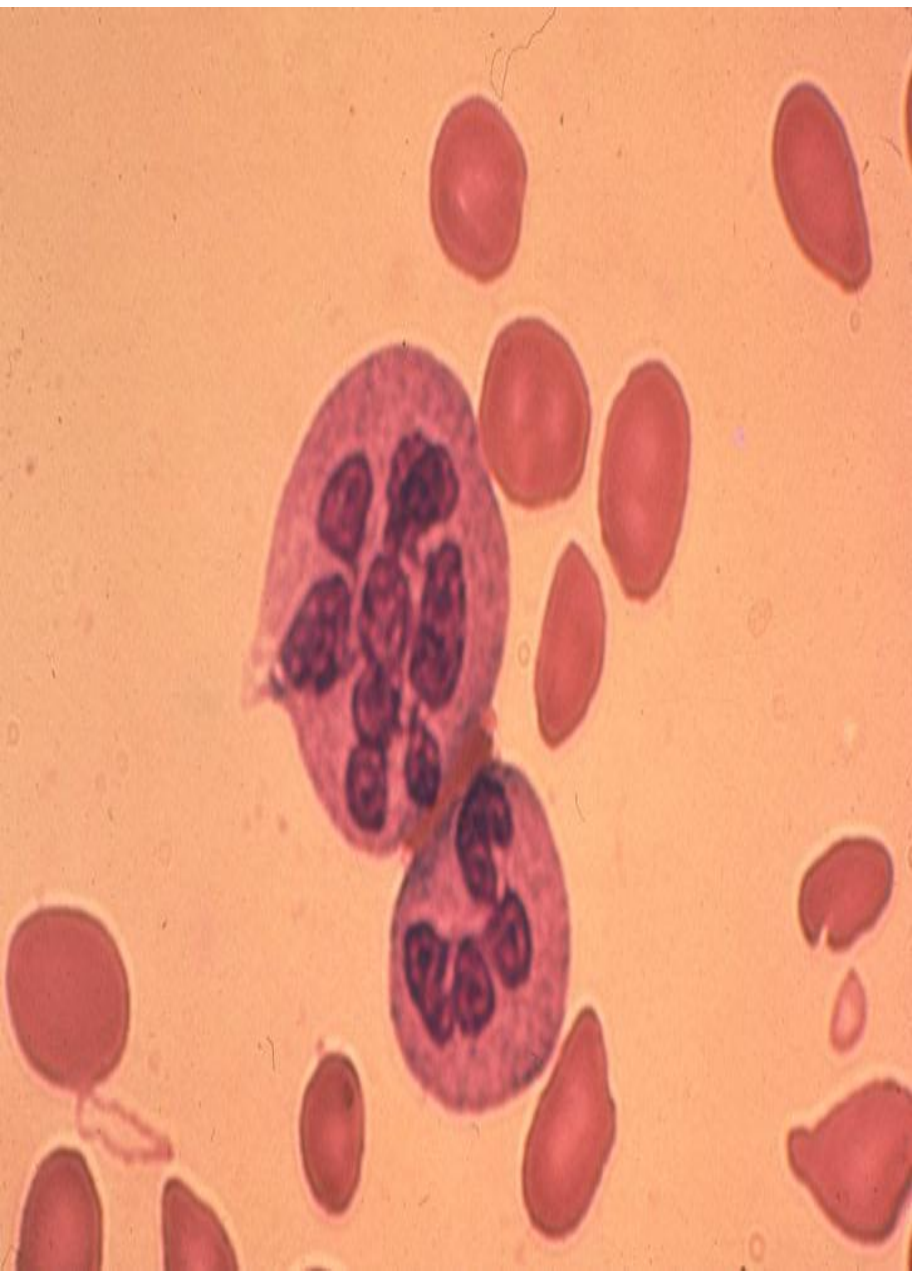


Stomatocytes

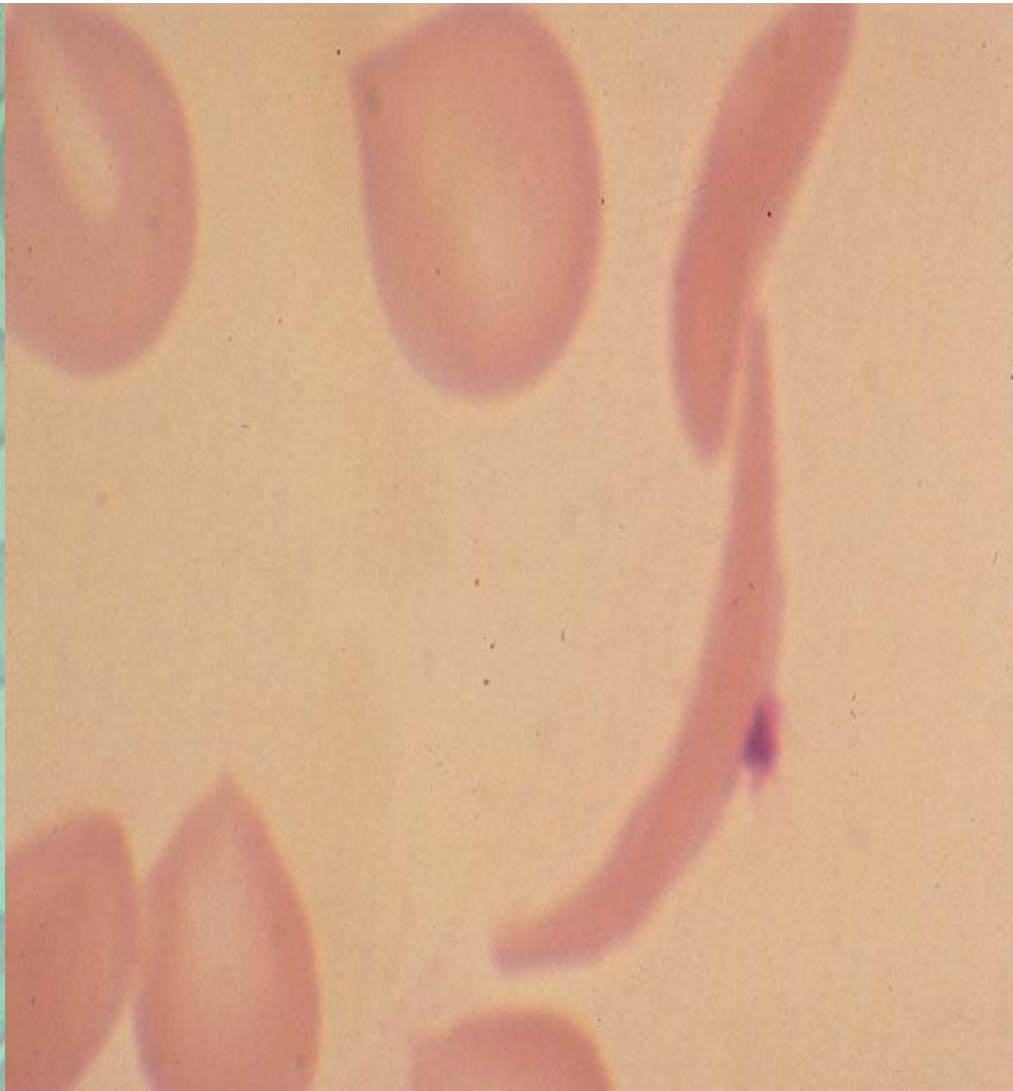
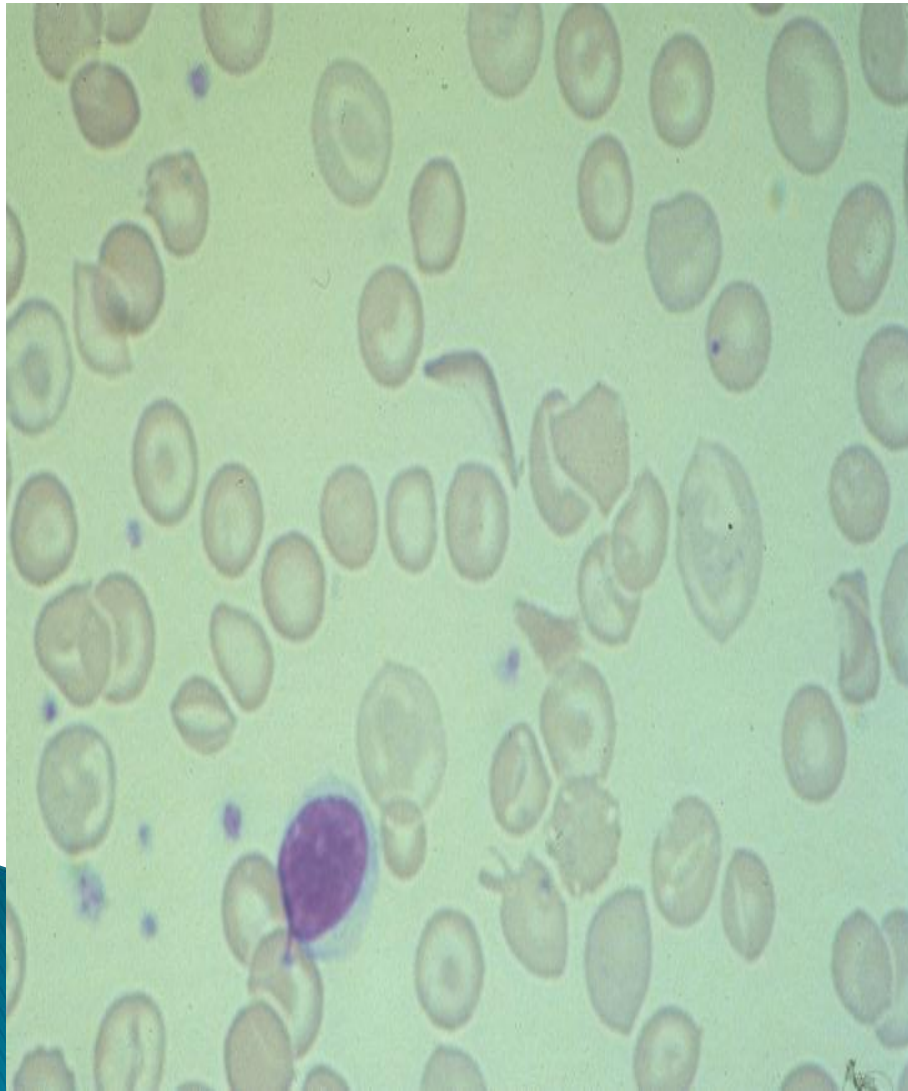


An example of a hypoproliferative anemia is seen in this patient with multiple myeloma.

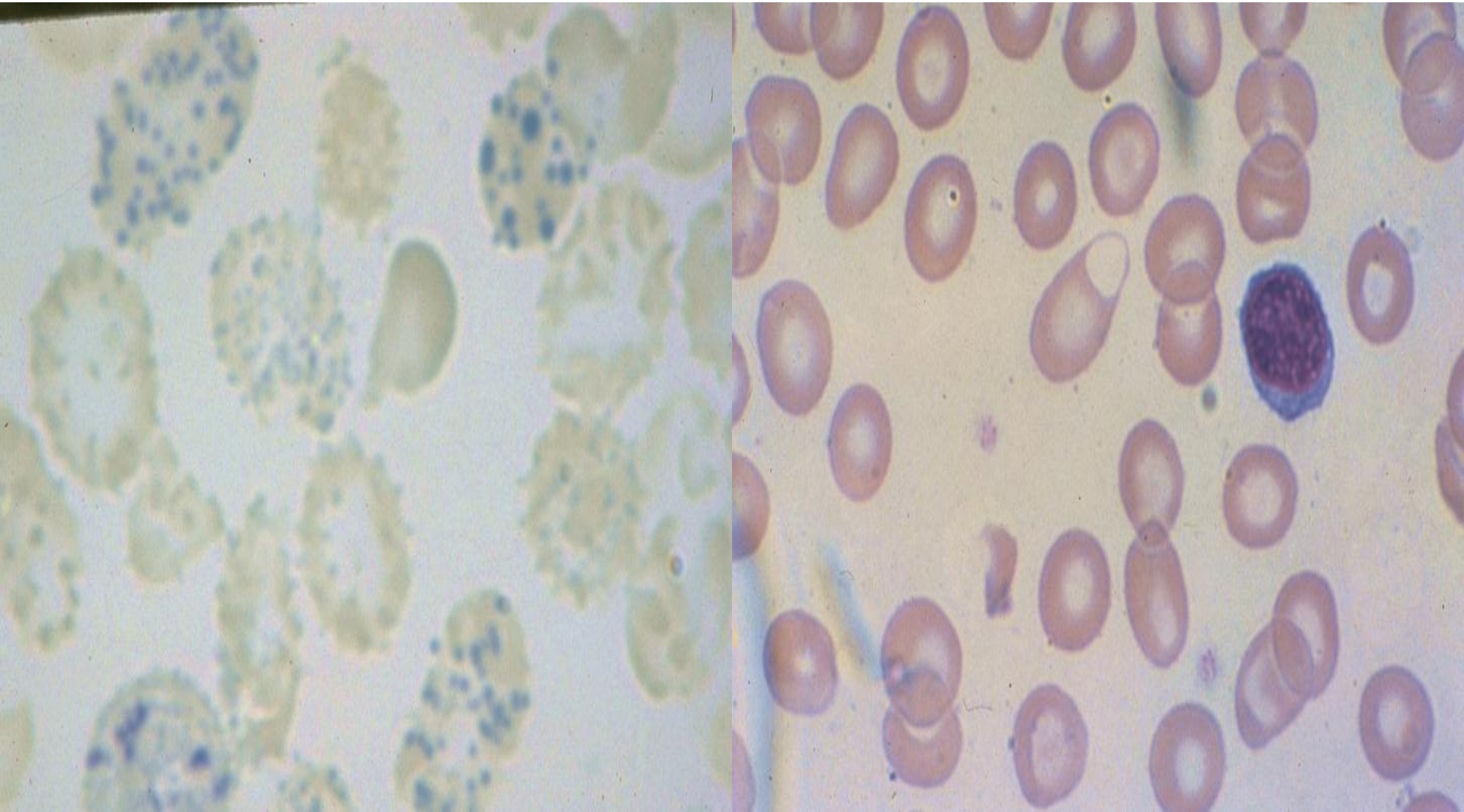




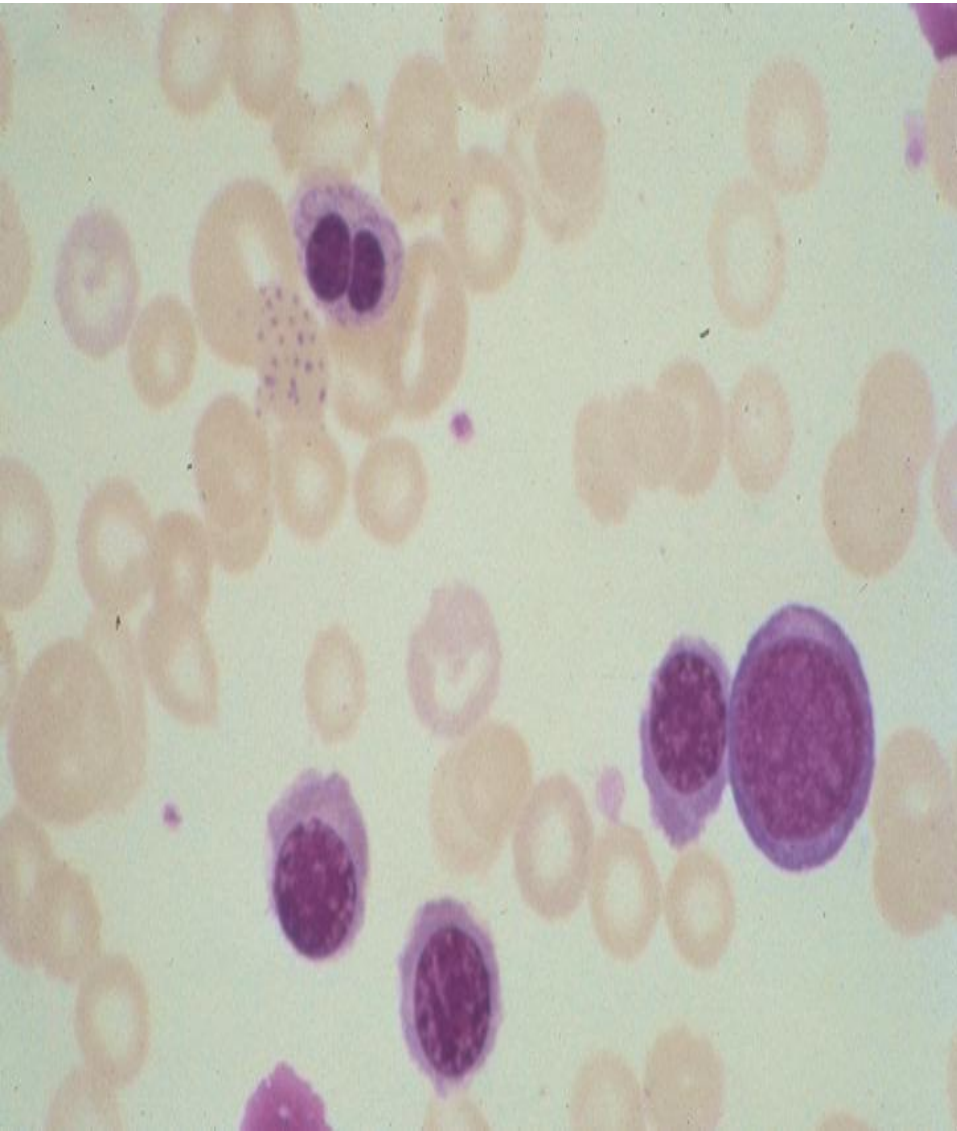
peripheral blood smear shows sickle cells in a patient with homozygous sickle cell disease



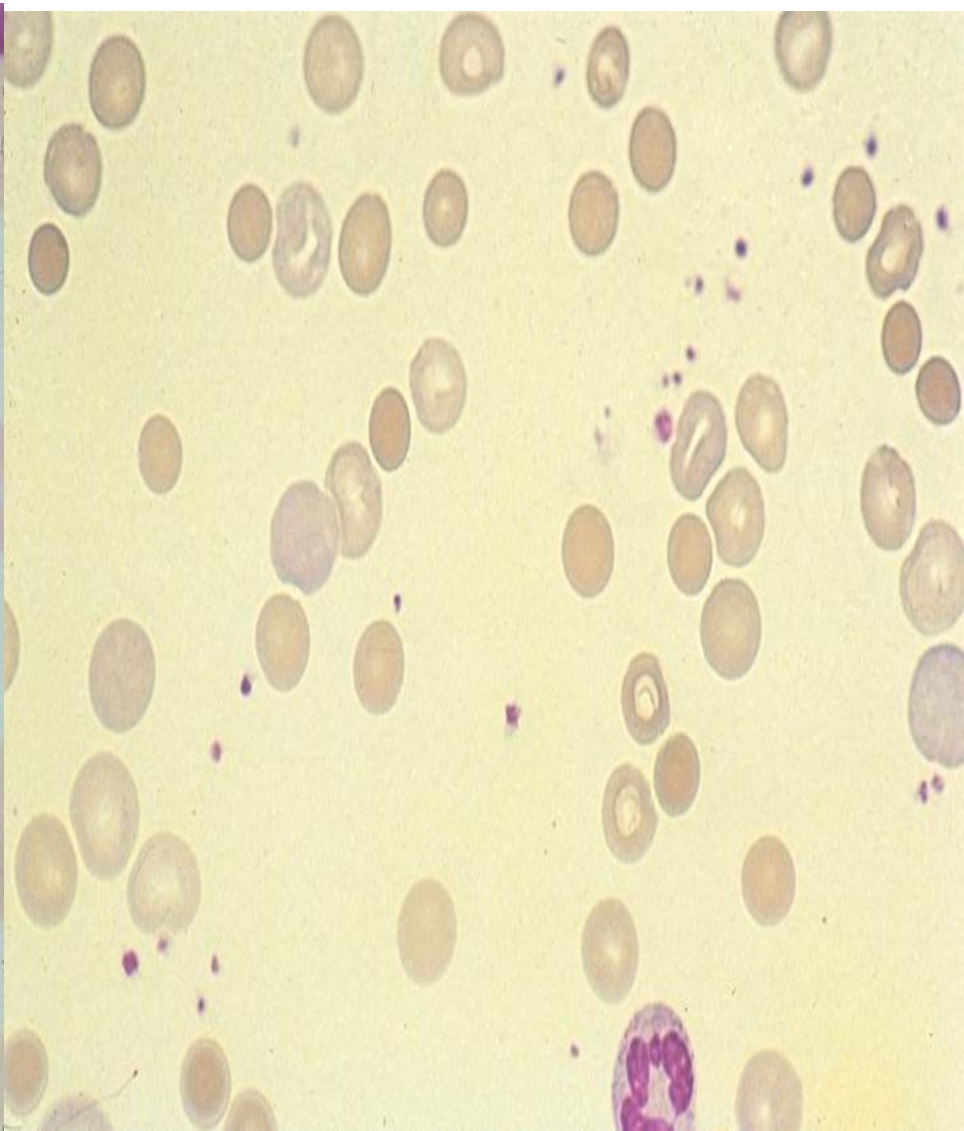
This new methylene blue preparation is from a patient with G-6-PD deficiency



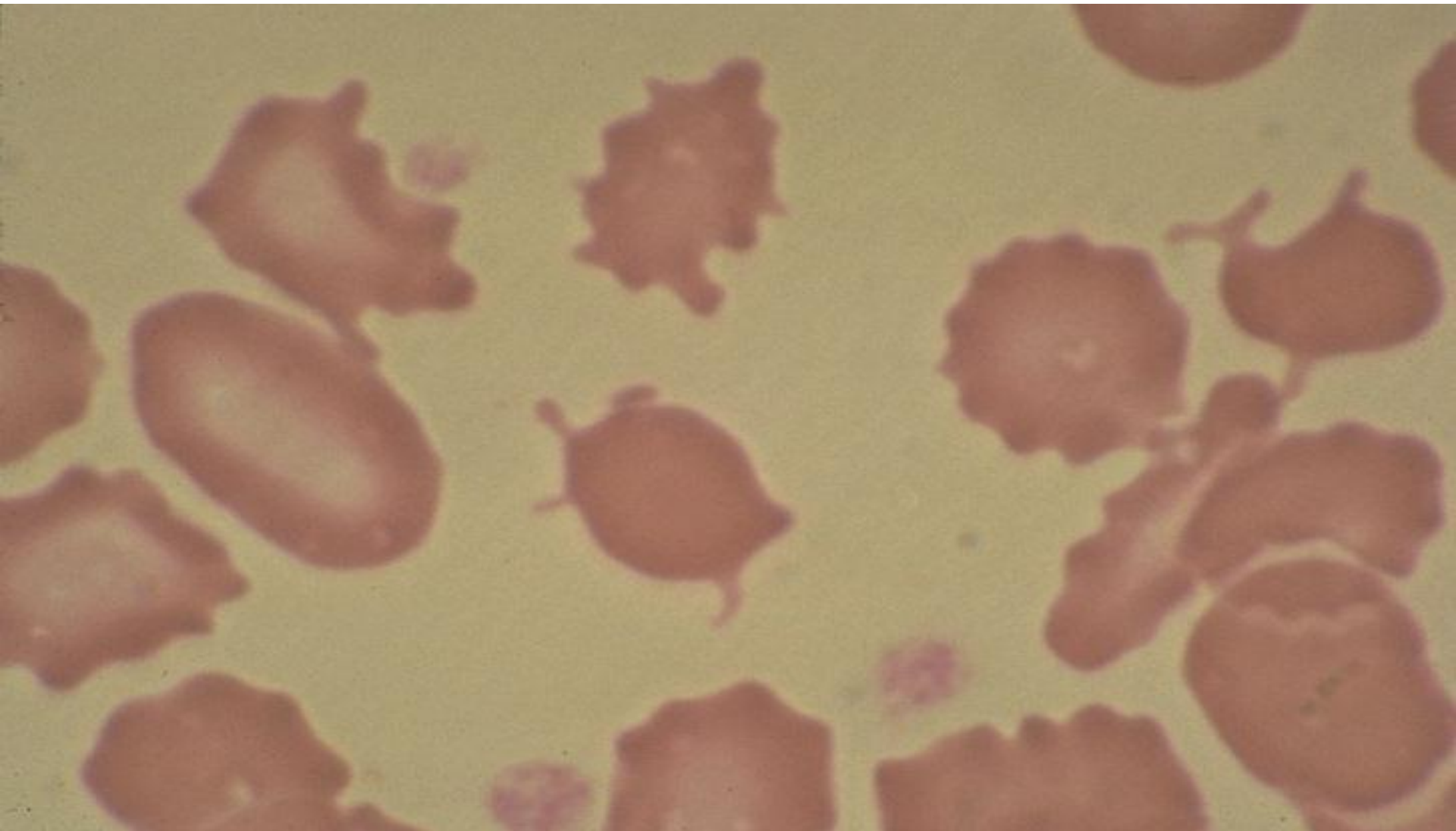
Acquired autoimmune hemolytic anemia



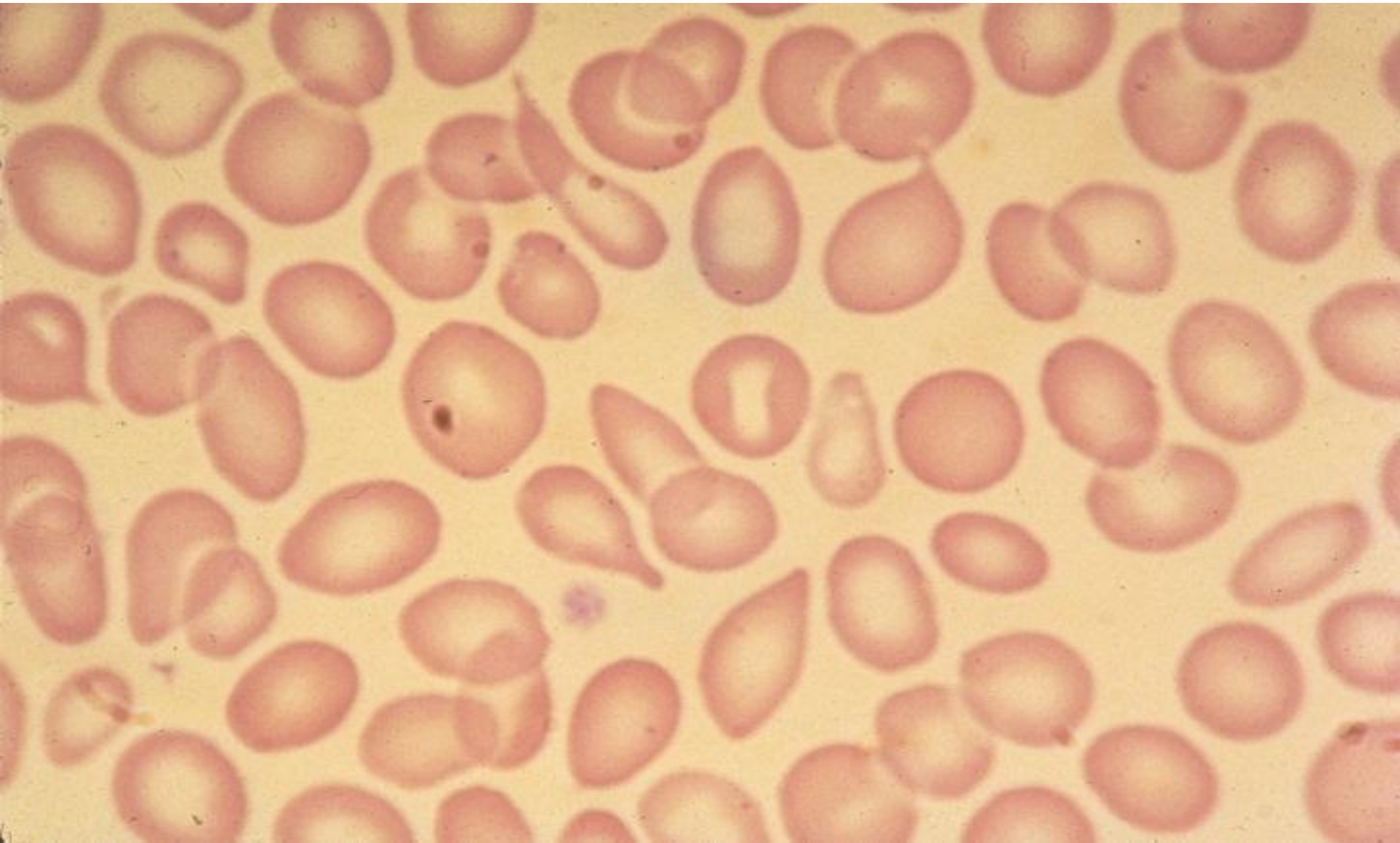
peripheral blood is from a patient with marked acquired autoimmune hemolytic anemia,



Striking "burr" and "spur" cell abnormalities

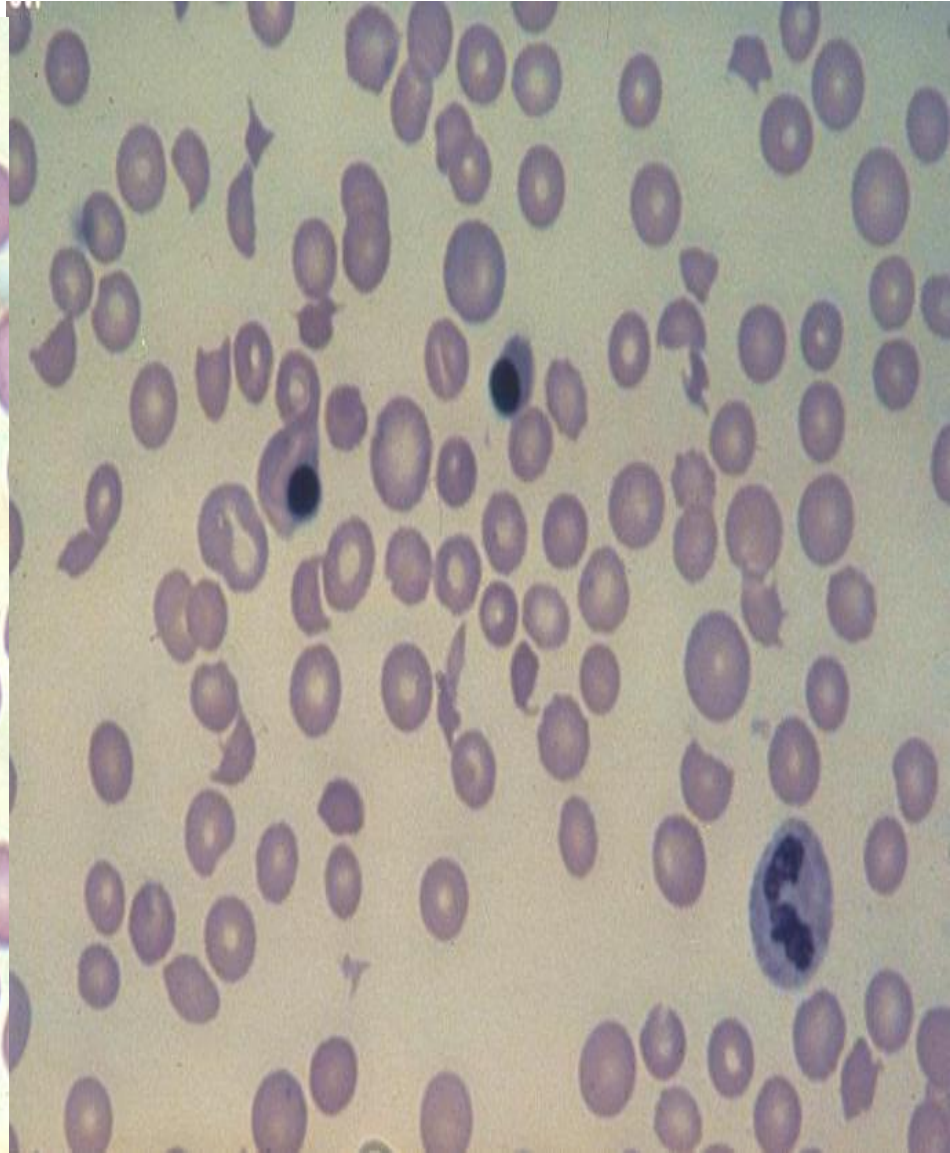
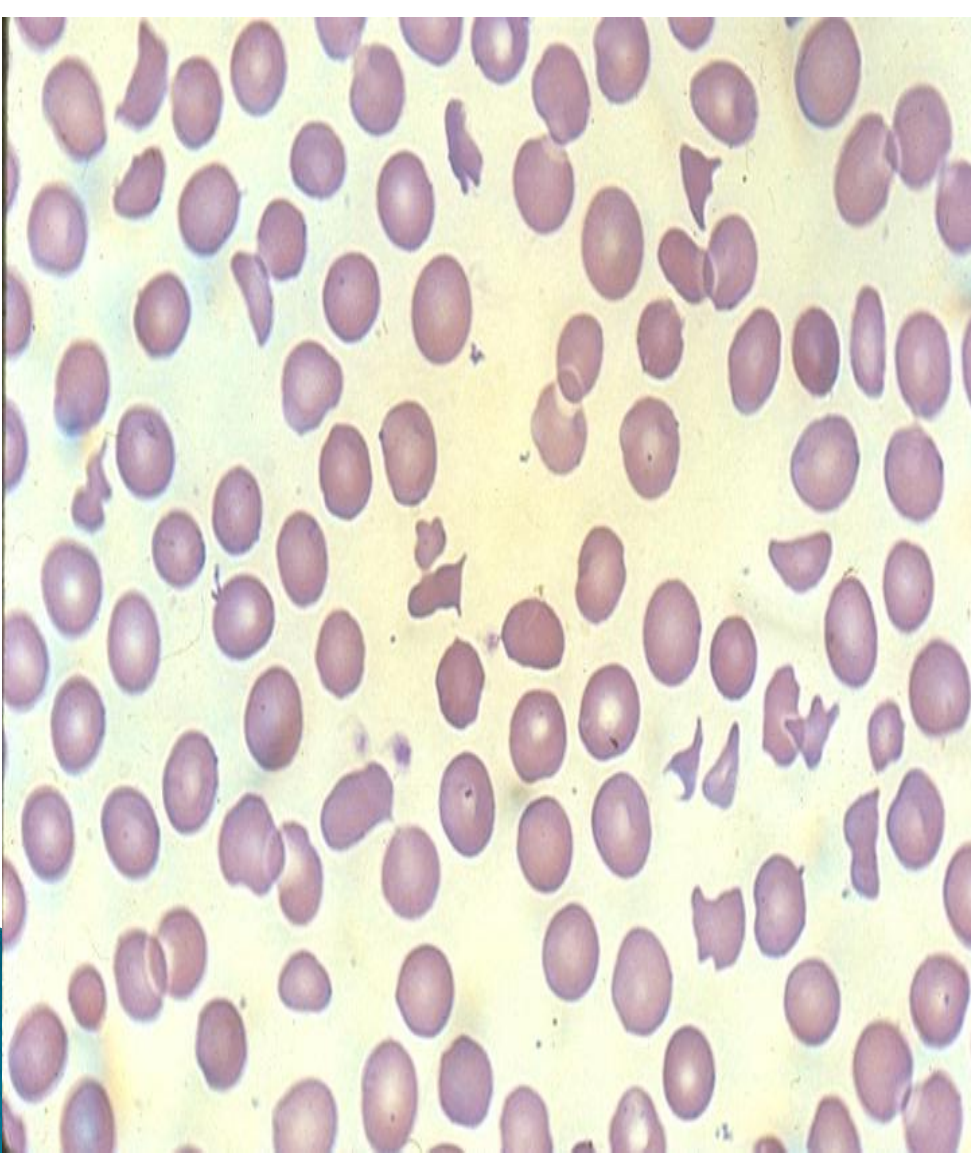


This low oil magnification view of the peripheral blood shows moderate variation in size and shape of the red cells as well as some variation in their degree of hemoglobinization. Several teardrop cells are seen in this field



Microangiopathy:MAHA

Thrombotic thrombocytopenic purpura (TTP)



Bone marrow examination

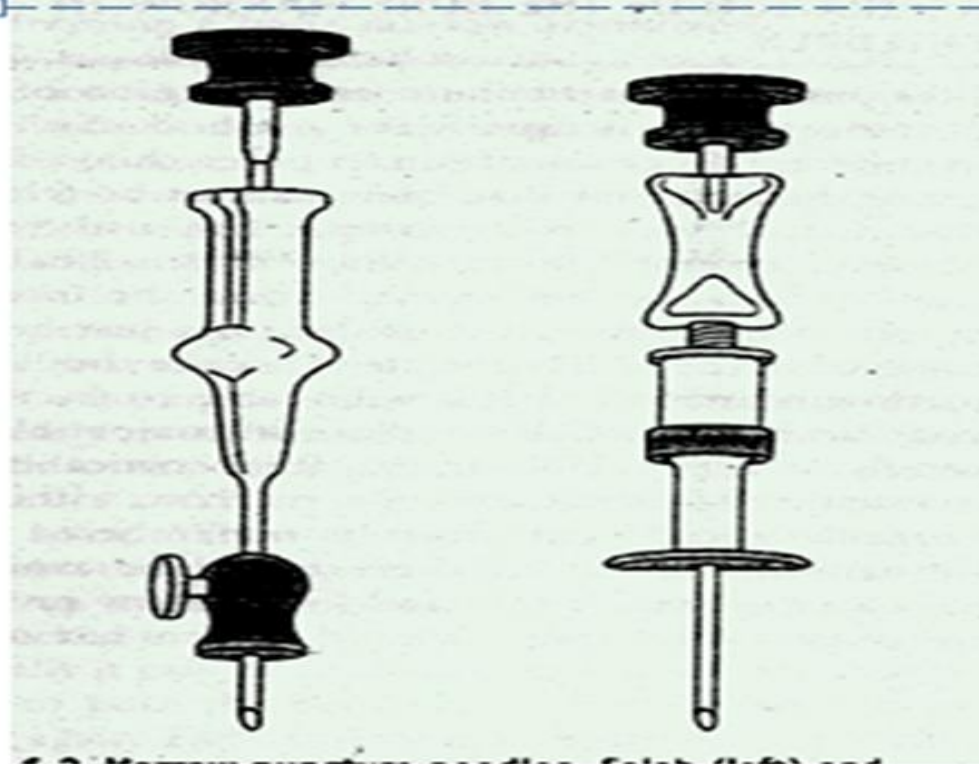
- There are two types of marrow procedures:

Bone marrow aspirate:

- ▶ Bone marrow sets

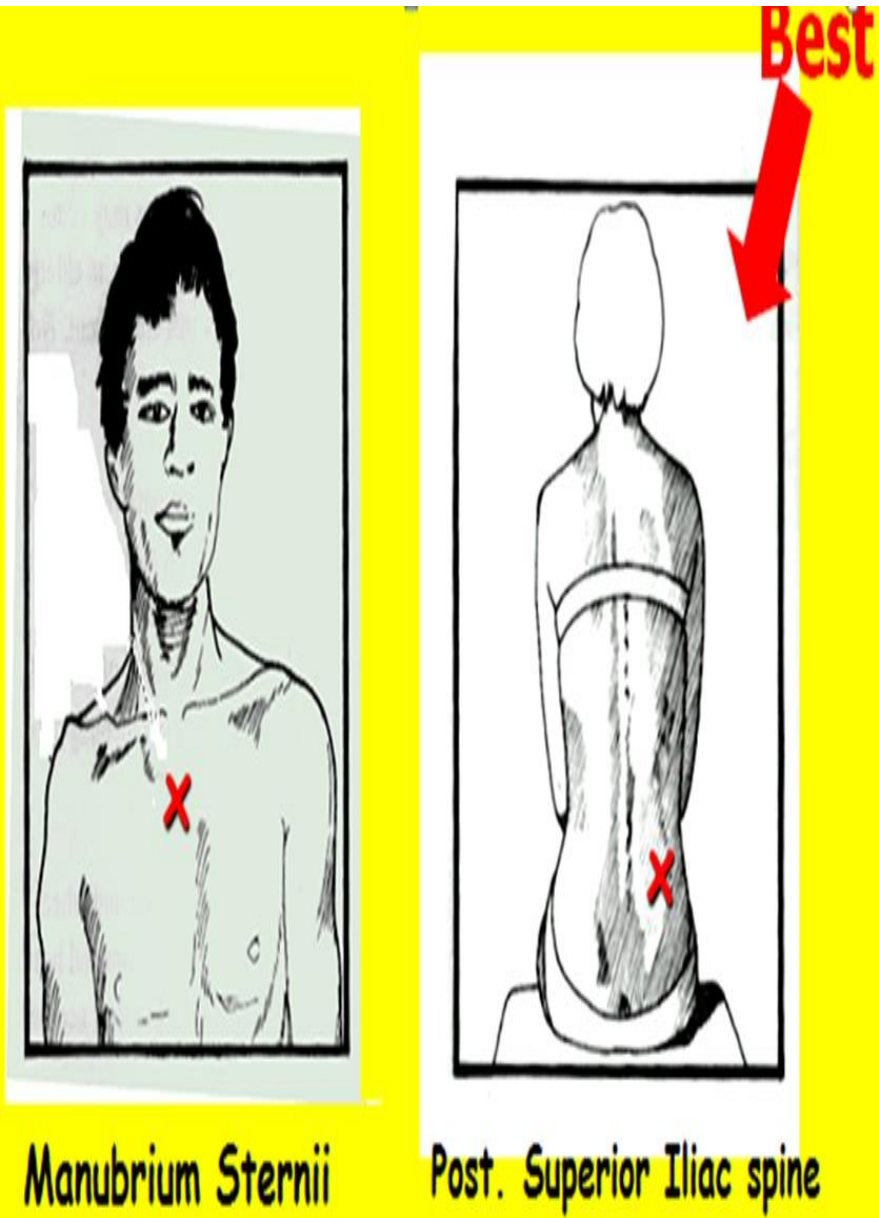


Biopsy Set

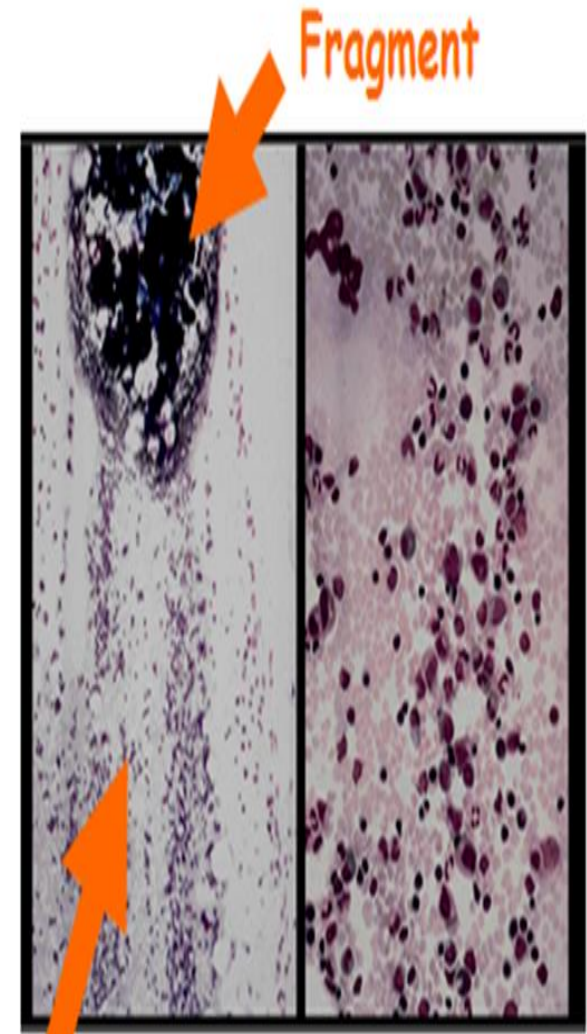


Aspirate Set

Common sites for Bone marrow procedures in adults



Bone marrow aspirate smear



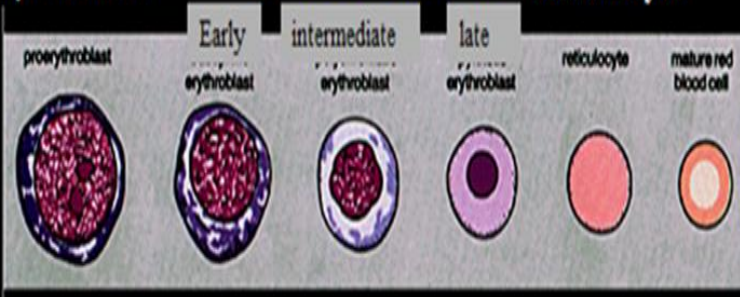
Cells seen in bone marrow

Erythroblasts or normoblasts

Proerythroblast

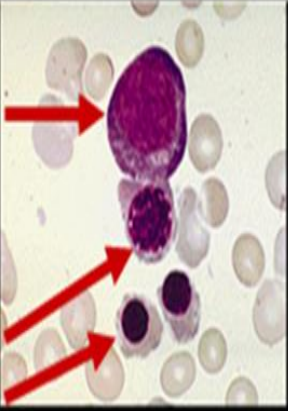
Reticulocyte

Mature RBC



Proerythroblast

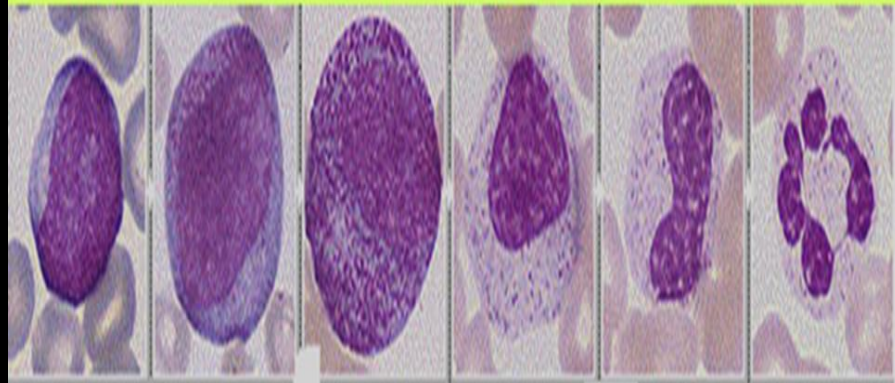
Normoblasts
Intermediate
Late



Red Cell precursors (in marrow)

Stages of Maturation of the Granulocytic Series

In the bone marrow



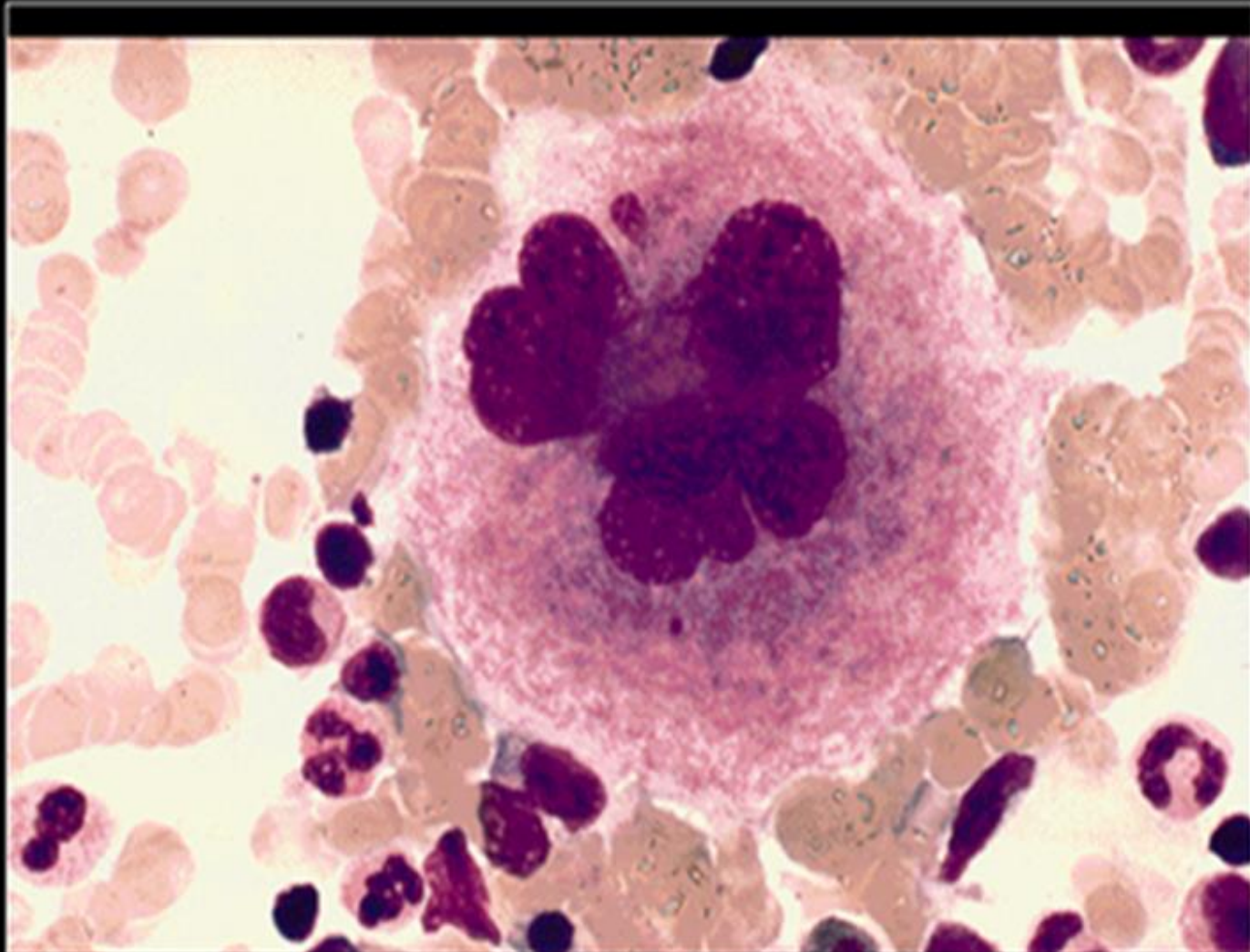
Blast Promyelocytes Myelocyte Metamyelocyte neutrophil

Bone marrow

Blood



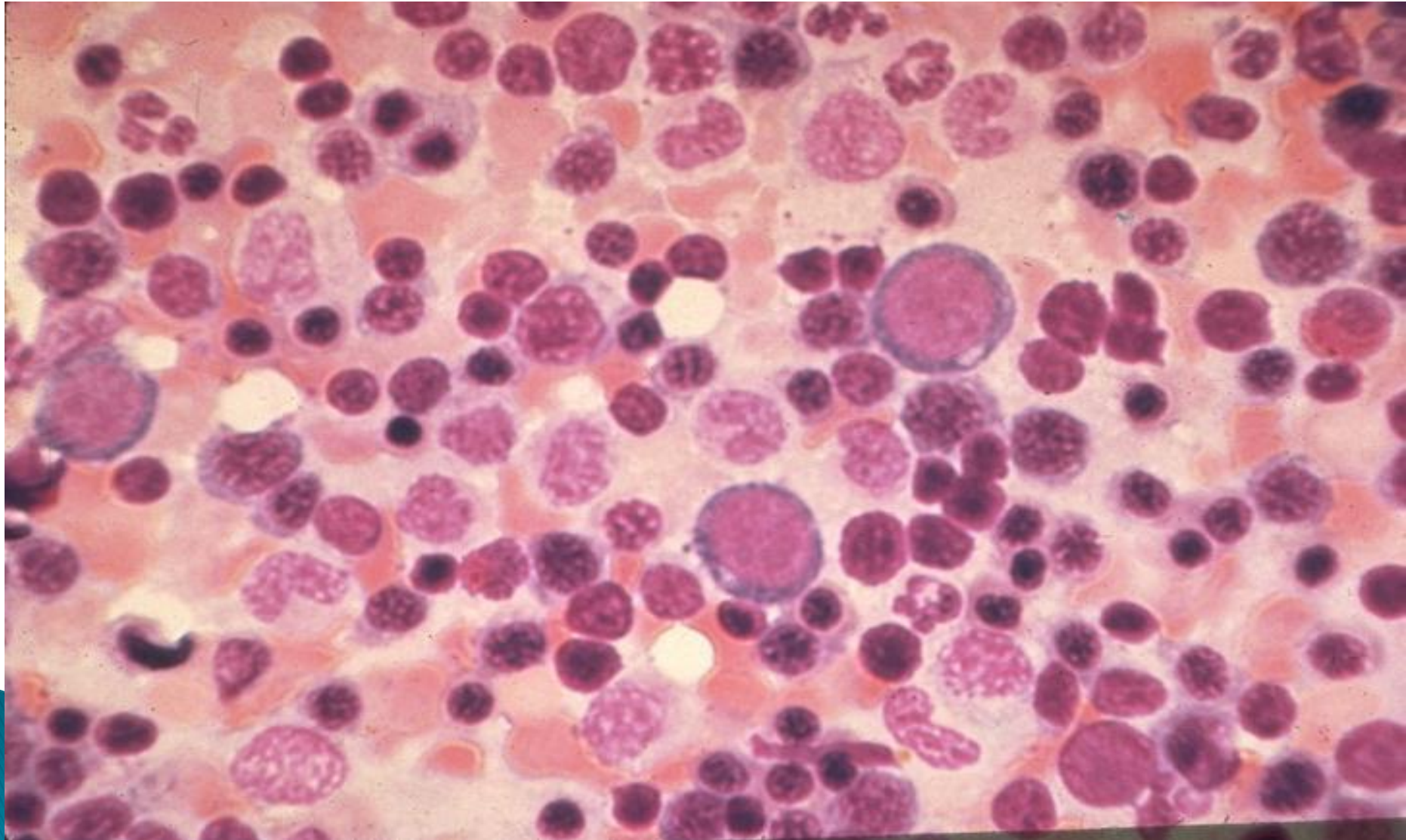
Megakaryocyte : the precursor of Platelets in the marrow



NORMAL RANGES FOR DIFFERENTIAL COUNTS ON ASPIRATED BONE MARROW

	95% Range	Mean*	Mean [†]
Myeloblasts	0–3	0.4	1.4
Promyelocytes	3–12	13.7 [‡]	7.8
Myelocytes (neutrophil)	2–13	—	7.6
Metamyelocytes	2–6	—	4.1
Neutrophils	22–46	35.5	32.1 ^M ; 37.4 ^F
Myelocytes (eosinophil)	0–3	1.6	1.3
Eosinophils	0.3–4	1.7	2.2
Basophils	0–0.5	0.2	0.1
Lymphocytes	5–20	16.1	13.1
Monocytes	0–3	2.5	1.3
Plasma cells	0–3.5	1.9	0.6
Erythroblasts [§]	5–35	23.5	28.1 ^M ; 22.5 ^F
Megakaryocytes	0–2		0.5
Macrophages	0–2	2.0	0.4

bone marrow aspirate shows relatively normal distribution of both erythroid and myeloid precursors. The former are identified by their somewhat clumped nuclear chromatin in a majority of cases



Indication of BMA

- ▶ in virtually all patients with suspected ALL, AML CML, myelodysplastic syndrome (MDS) or multiple myeloma ,However, a bone marrow aspirate is not necessary for the diagnosis of CLL.
- ▶ The diagnosis of promyelocytic leukaemia may be more readily made on an aspirate than on the peripheral blood
- ▶ The characteristic cytological features of AML with $inv(16)$ or $t(16;16)$ are apparent in the bone marrow
- ▶ In the acute leukaemias and in CML and other myeloproliferative neoplasms, a bone marrow aspirate provides material for cytogenetic analysis as well as for morphological assessment

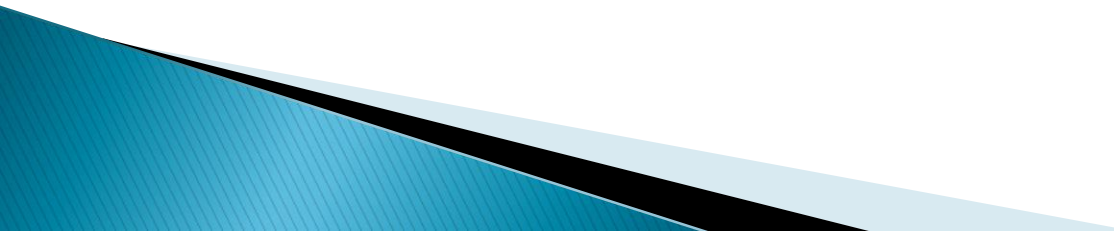
Bone marrow biopsy

- ▶ here a core of bone marrow tissue is taken, and processed and stained as in histopathological specimens (H&E stain)
- ▶ it should be performed only when there is a clear clinical indication.
- ▶ only a trephine biopsy shows the architecture of the bone marrow and permits the detection of an abnormal distribution of cells, bone marrow granulomas, and focal lymphoid infiltrates

▶ **Definite (indications)**

1. Investigation of suspected Hodgkin's disease and non-Hodgkin's lymphoma
2. Staging of non-Hodgkin's lymphoma
3. Diagnosis and follow up of hairy cell leukemia
4. Evaluation and follow up of chronic lymphocytic leukemia
5. Diagnosis of suspected metastatic carcinoma

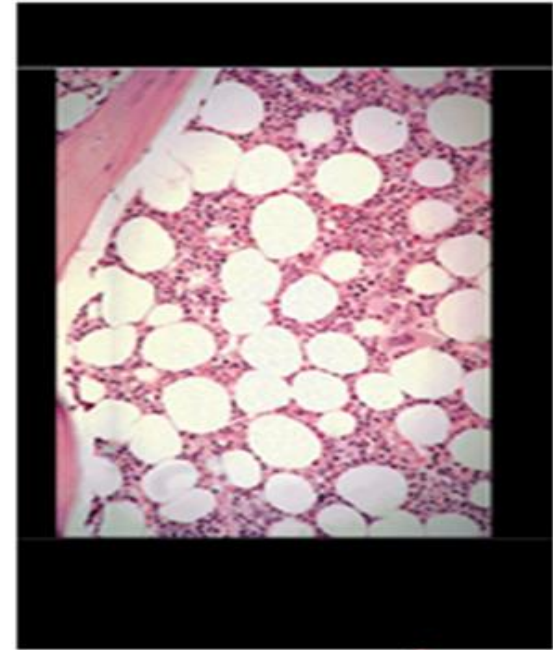
➤ **Possible indications**

1. Investigation of suspected acute myeloid leukemia
 2. Investigation of suspected myelodysplastic syndrome
 3. Staging of Hodgkin's disease
 4. Evaluation of chronic myeloid (granulocytic) leukemia
 5. Investigation of suspected primary amyloidosis
- 

➤ Components of the normal bone marrow trephine

1. Bone
2. Stroma: vessels, reticulin, fibroblasts, fat, iron
3. Hematopoietic tissue: granulocytic, erythroid, Megakaryocytic
4. Other cells: lymphoid, plasma cells, mast cells

Bone marrow biopsy slide-core of BM



**Bone marrow section stained
with H&E stain**

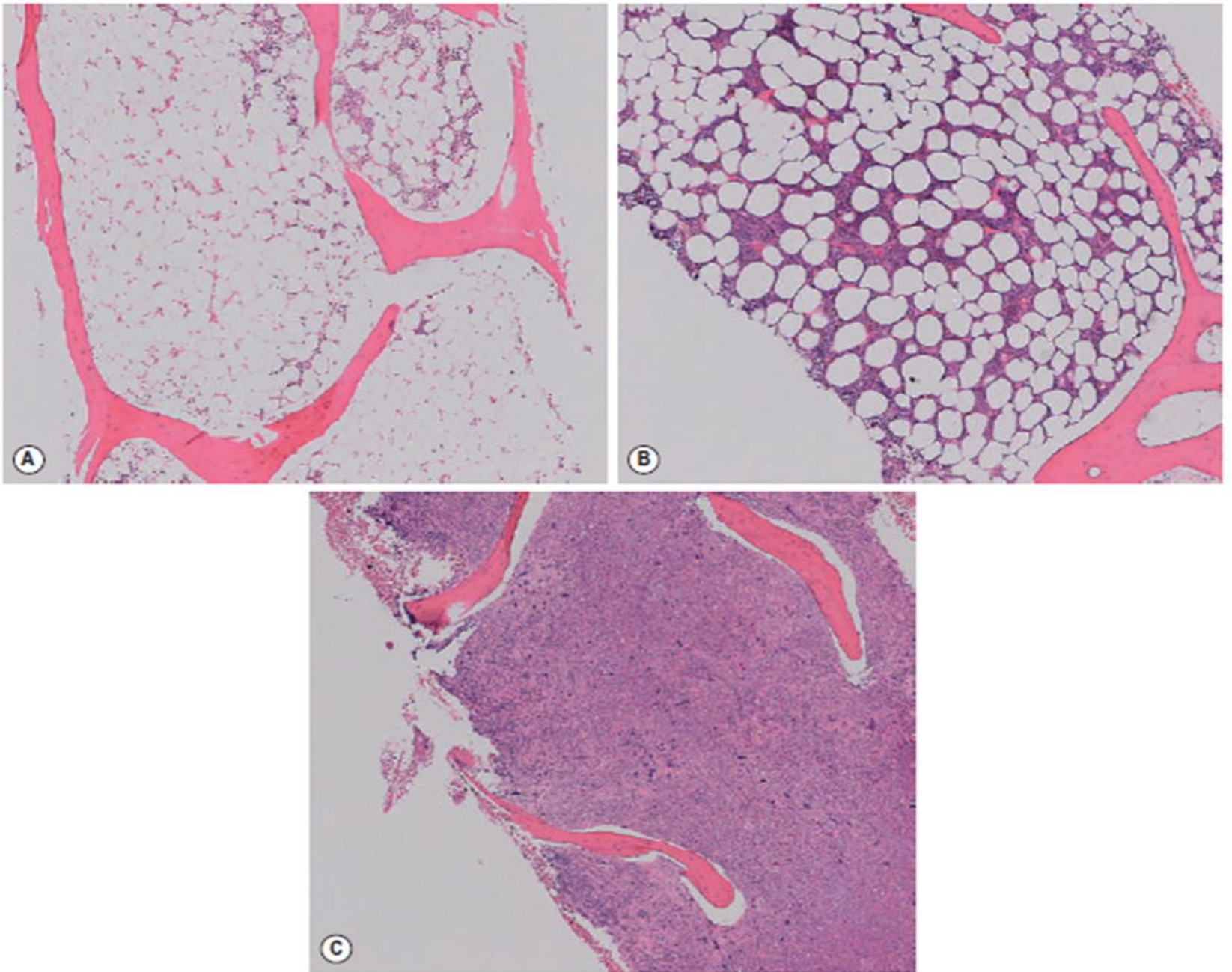


FIGURE 7-14 Photomicrographs of sections of bone marrow. Iliac crest bone marrow: illustrating the range of cellularity. (A) Hypocellular marrow; (B) normal cellularity; (C) hypercellular marrow.

A photograph of a male doctor in a white lab coat and a red, white, and blue striped tie. He is looking down at a patient who is lying in a hospital bed, partially covered by a white sheet and a maroon blanket. The doctor is performing a procedure on the patient's arm. In the background, there is a wall-mounted medical device, possibly a blood pressure cuff, and some black cables hanging from the ceiling. The text "Performing the Bone Marrow Aspiration & Biopsy" is overlaid in white with a drop shadow effect.

Performing the
Bone Marrow
Aspiration & Biopsy

A photograph of a 'Thank you' card. The card is white with the words 'Thank you' written in a black, elegant cursive font. It is placed on a brown paper envelope. The scene is decorated with gold and pink streamers and confetti scattered around the envelope. The background is a light-colored, marbled surface. The overall composition is festive and celebratory.

Thank you