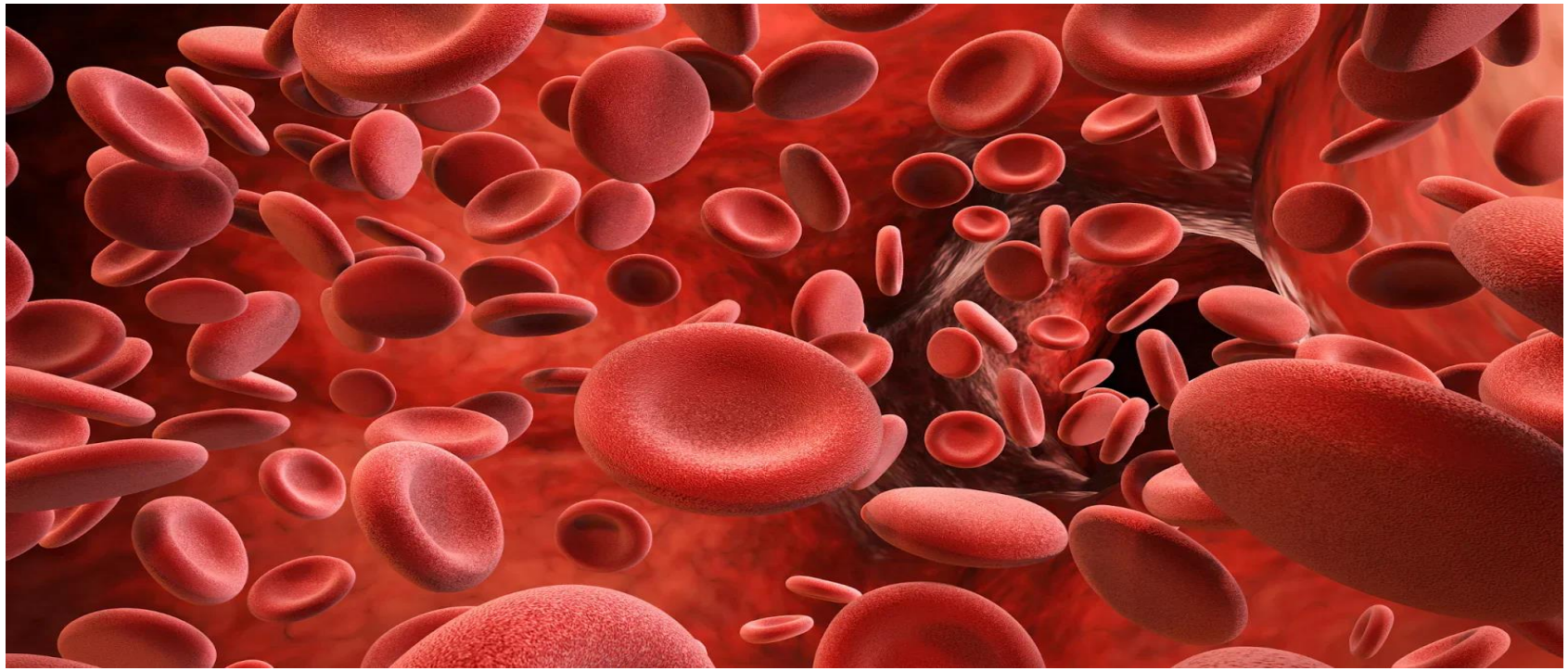
Anemia



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Anemia due to diminished erythropoiesis:

This type includes:

1. Anemias caused by an inadequate dietary supply of substances that are needed for hemopoiesis particularly iron, folic acid, and vit B12

2. Disorders that suppress the bone marrow RBC production like that occurs in aplastic anemia, leukemia and cancer metastasis .

I. Iron deficiency anemia:

- It is the most common cause of anemia. It is estimated to affect 10% of population in developed countries and 25% in developing countries.
- Total body iron content is about 2 gm for women and 6 gm for men. Approximately 80% of functional body iron is found in Hb, with the remainder being found in myoglobin and iron containing enzymes e.g. catalase and cytochromes. Iron storage pool represented by **hemosiderin and ferritin**. Iron stored mainly in liver, spleen, bone marrow and skeletal muscles.

- Iron transported in plasma by protein called **transferrin**. In normal persons, transferrin is about 33% saturated , serum iron about 120 µg/dl in men and 100 µg/dl in women.

- Iron absorption occurs in small intestine. There is no regulated pathway for iron excretion, which is limited to 1-2 mg/day that lost by shedding of mucosal and skin epithelial cells

Causes of iron deficiency anemia:

1. Low iron intake: malnutrition and vegetarian diet
2. Malabsorption syndromes including stomach and small intestine e.g. sprue and celiac disease.
3. Increase demands : pregnancy and infancy
4. Chronic blood loss: this is one of most important causes of iron deficiency anemia. Loss may occur from gastrointestinal tract (peptic ulcers, colonic cancer, hemorrhoids, hook worms).

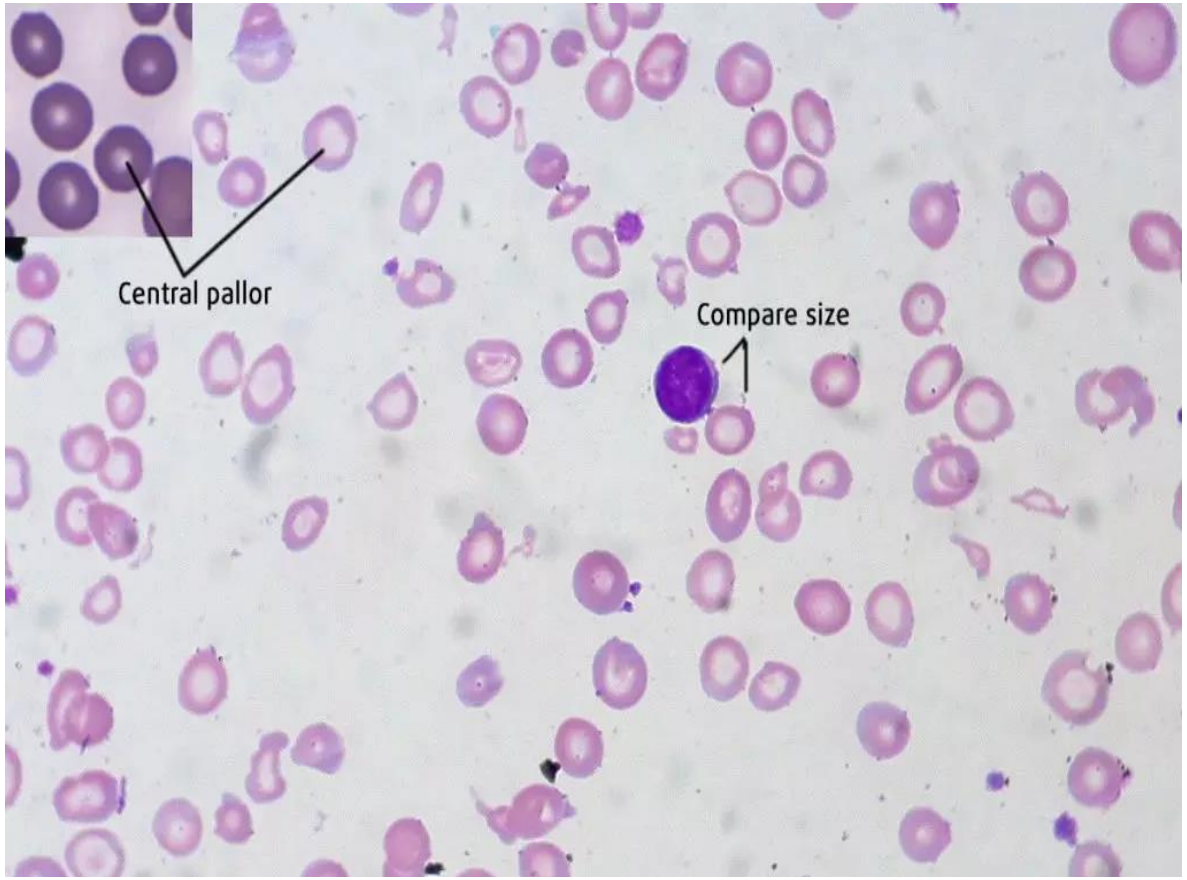
Diagnostic criteria for iron deficiency anemia:

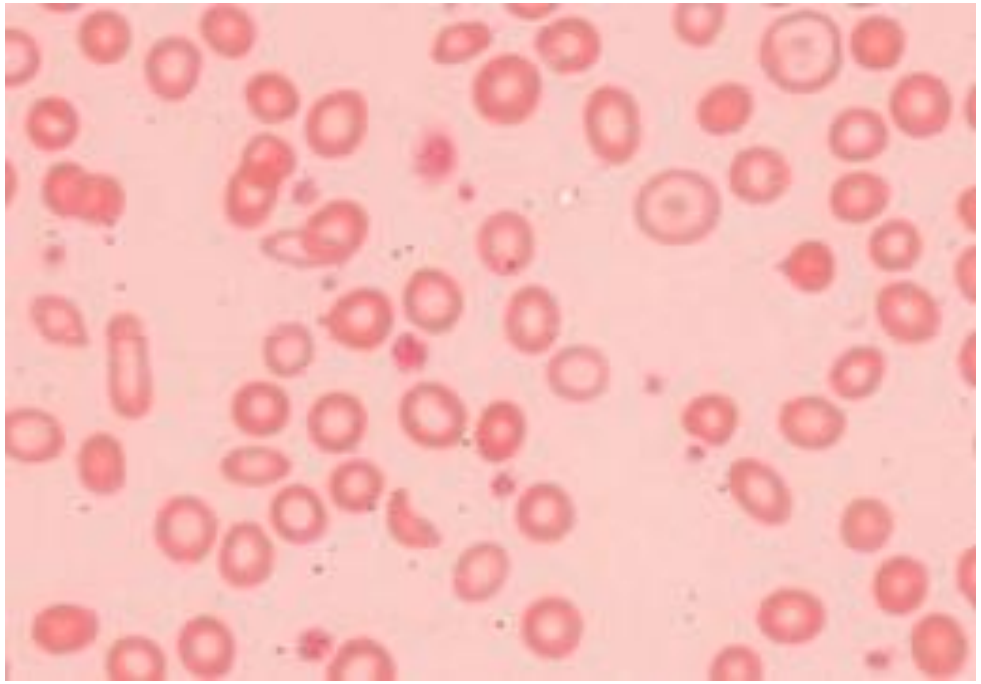
a. Hypochromic microcytic anemia

b. Low serum iron and low serum ferritin

c. Low transferrin saturation

d. Increase total iron binding capacity


Central pallor
Compare size



II. Anemia of chronic disease:

- This is the most common form of anemia in hospitalized patients. It superficially resembles the anemia of iron deficiency, but it come from inflammation-induced sequestration of iron within the mononuclear phagocytic (reticuloendothelial) system.

- To differentiate anemia of chronic disease from iron deficiency anemia: iron store increases, so there is **high serum ferritin**

III. Megaloblastic anemia:

- This type of anemia occurs due to deficiency of either folic acid or vit.B12 or both. These vitamins are required for DNA synthesis. The RBC size increase (macrocyte) the other blood cell precursors in the bone marrow are also affected.

Causes of folate deficiency:

a. Elderly and persons with poor diet

b. Increase metabolic needs (pregnant women and patients with chronic hemolytic anemia)

c. Patients on anti-epileptic drugs e.g. phenytoin and other drugs that inhibit folate absorption.

d. For vit. B12 deficiency usually caused by autoimmune disease (pernicious anemia) in which there is anti-parietal cell antibodies (parietal cells are present in the gastric fundal mucosa responsible for intrinsic factor production) resulting in decrease in production of intrinsic factor which is essential for vit.B12 absorption.

Pathogenesis of megaloblastic anemia:

- The morphological hallmark of megaloblastic anemia is an enlargement of erythroid precursor (**megaloblast**) which gives rise to abnormally large red cells (**macrocytes**).
- The underlying cellular enlargement is due to impairment in DNA synthesis, which results in delay in nuclear maturation and cell division. Because the synthesis of RNA and cytoplasmic elements precede at a normal rate the erythroid precursors (megaloblasts) show nuclear/cytoplasmic asynchrony.

- Precursors of other blood cells in the bone marrow also affected and if the condition sever the bone marrow output for other cells (granulocytes, platelets) also diminished and the patient present with **pancytopenia** and **hypersegmented neutrophiles**.

Diagnostic features of megaloblastic anemia:

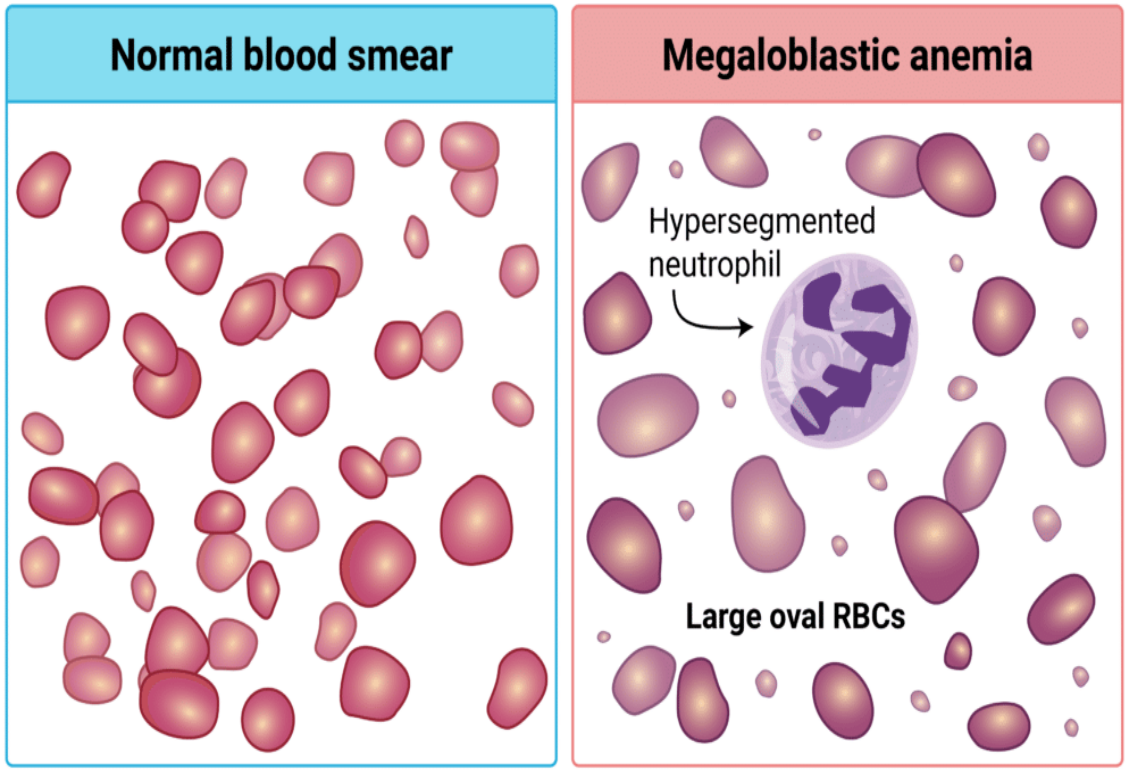
1. In both folate megaloblastic anemia and pernicious anemia the patient present with pallor and tiredness, palpitation, changes in hair and fingers

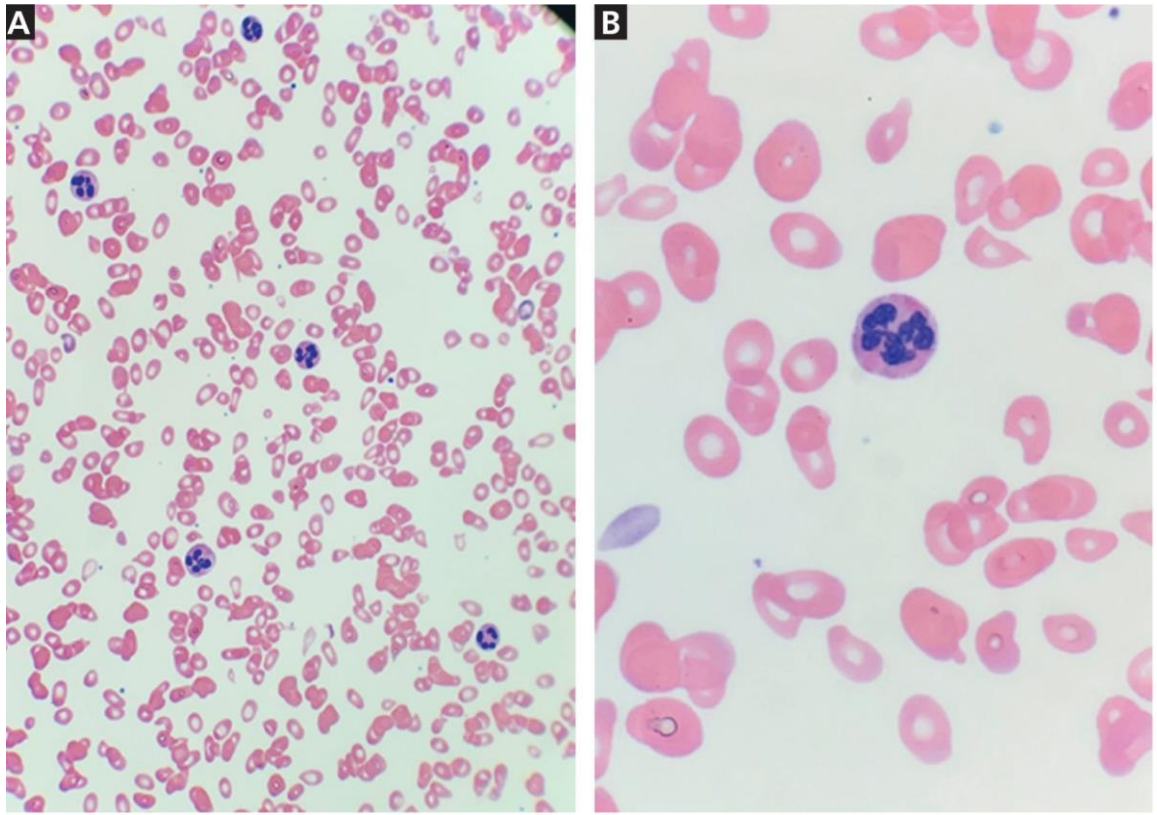
2. Decrease hemoglobin and MCV. There is decrease in number of platelets and granulocytes

3. On blood film there is **macrocytic red cells** and **hypersegmented neutrophils**

4. To differentiate folate deficiency from pernicious anemia (vit B12 deficiency) the patients with pernicious anemia have **normal serum folate and decrease in vit B12 with anti-parietal cells and anti- intrinsic factor antibodies in their serum.**

Megaloblastic Anemia





Aplastic anemia AA:

- AA is a disorder in which multipotent bone marrow stem cells are suppressed leading to marrow failure and pancytopenia.

Etiology and pathogenesis:

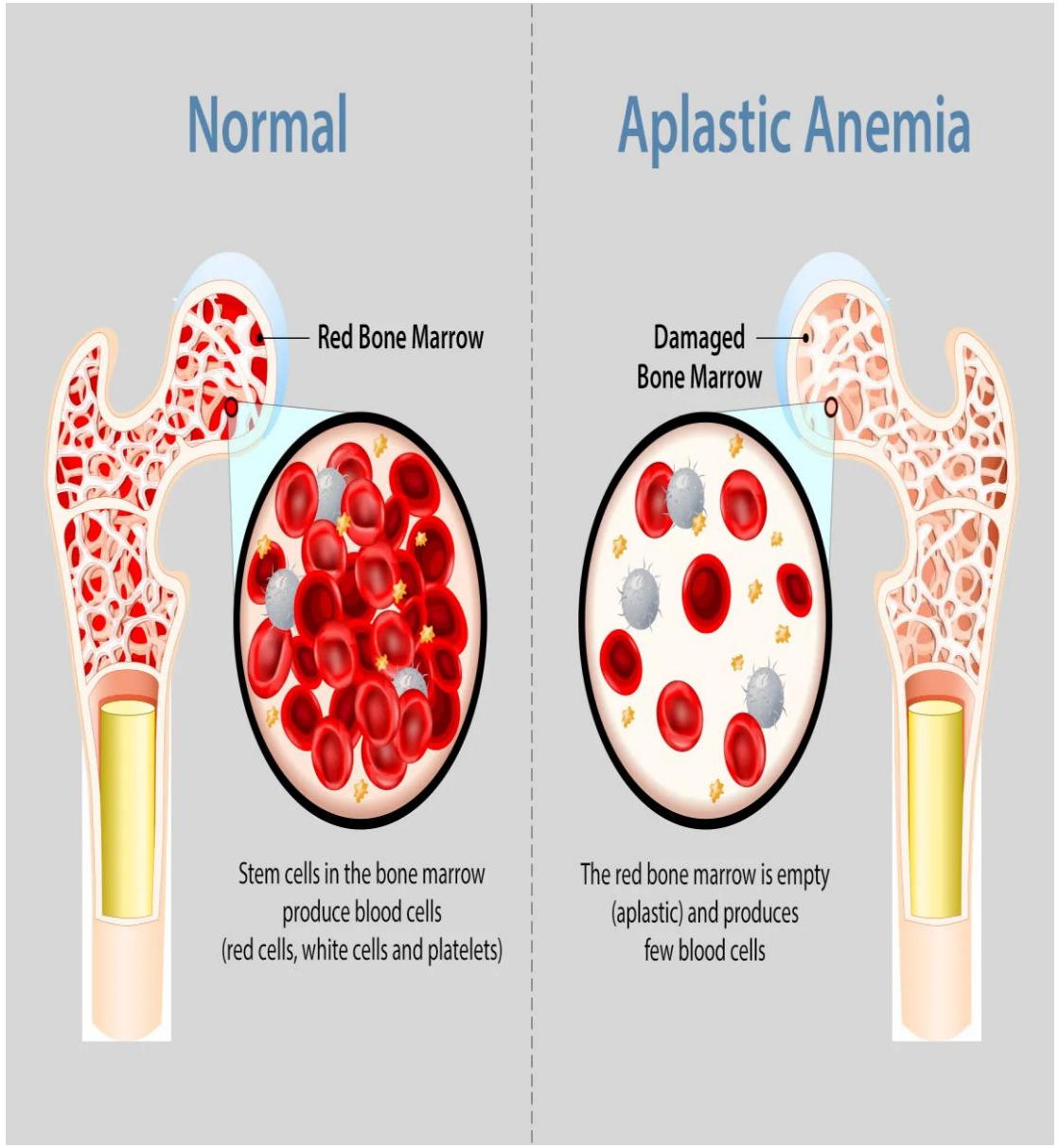
- Primary (idiopathic) 50% of cases.
- Secondary to bone marrow damaging agent e.g neoplastic drug (chemotherapy), benzene antibiotics like chloramphenicol. Viral infection also an important cause for AA : e.g. EBV

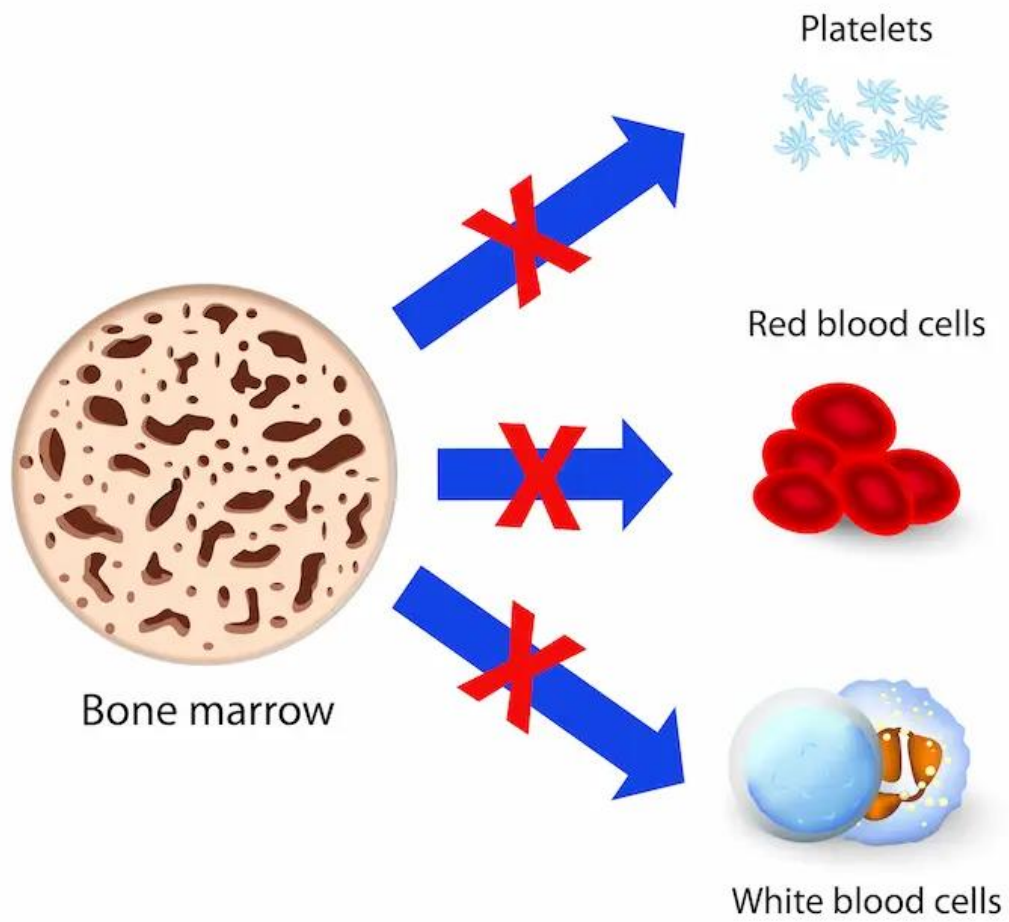
Pathogenesis:

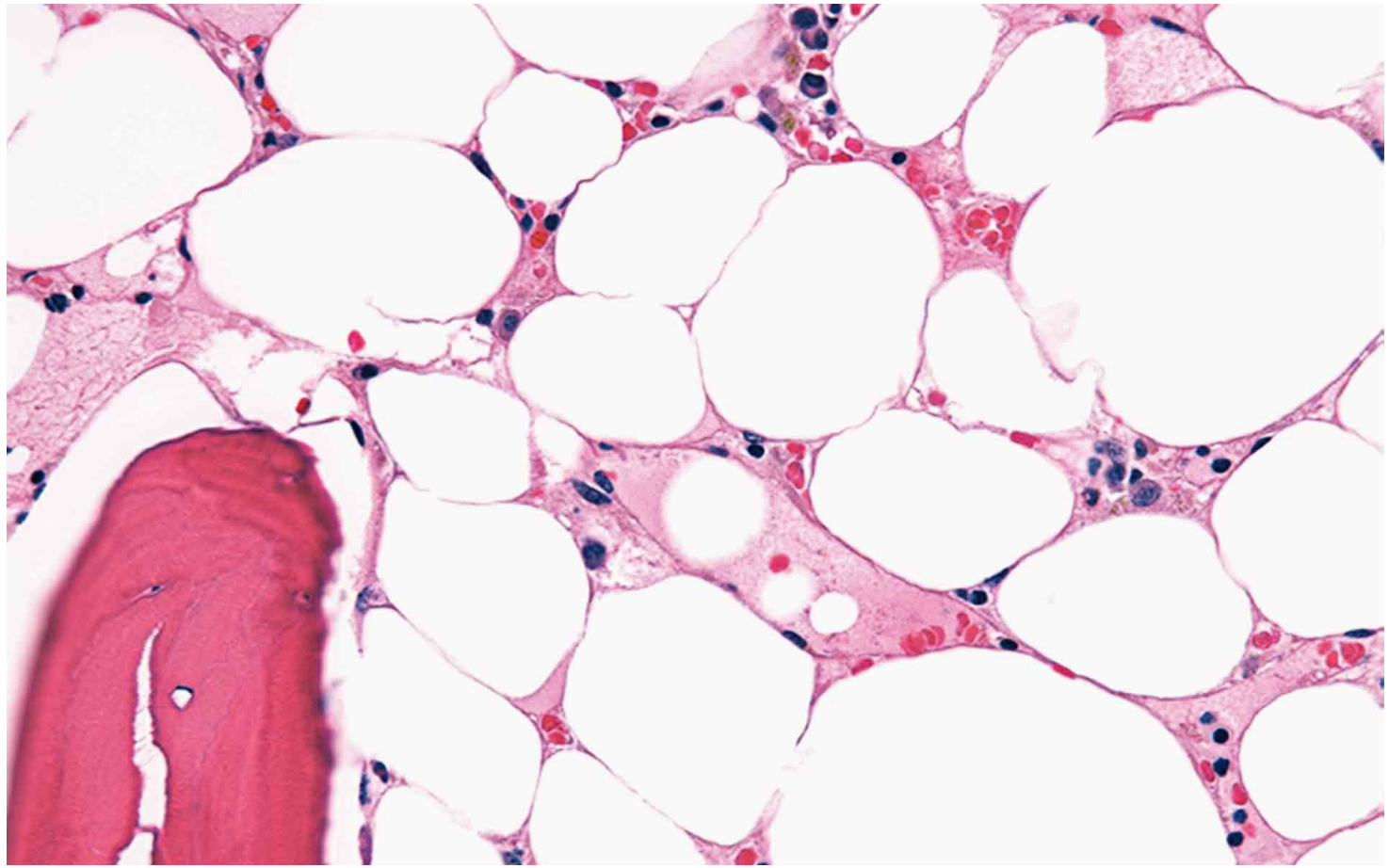
- Autoreactive T lymphocytes play an important role. Perhaps viral Ag, drug derived haptens and/or genetic damage creates neoantigens within myeloid stem cells that serve as target for T lymphocytes.
- 70-80% of cases of AA respond to immunosuppressive drugs against T lymphocytes.

Features for diagnosis:

- Patients present with Anemia (low Hb) and recurrent spontaneous subcutaneous bleeding (ecchymosis) due to thrombocytopenia
- CBC (complete blood count) and Blood film show pancytopenia except lymphocytes.
- Bone marrow biopsy is hypocellular except lymphocytes and plasma cells


Normal
Aplastic Anemia
Red Bone Marrow
Damaged
Bone Marrow
Stem cells in the bone marrow
produce blood cells
(red cells, white cells and platelets)
The red bone marrow is empty
(aplastic) and produces
few blood cells


APLASTIC ANEMIA
Platelets
Red blood cells
Bone marrow
White blood cells



Neoplastic proliferation of white blood cells:

- Neoplastic disorders represent the most important white cell disorder. They can be divided to: lymphoma and leukemia.

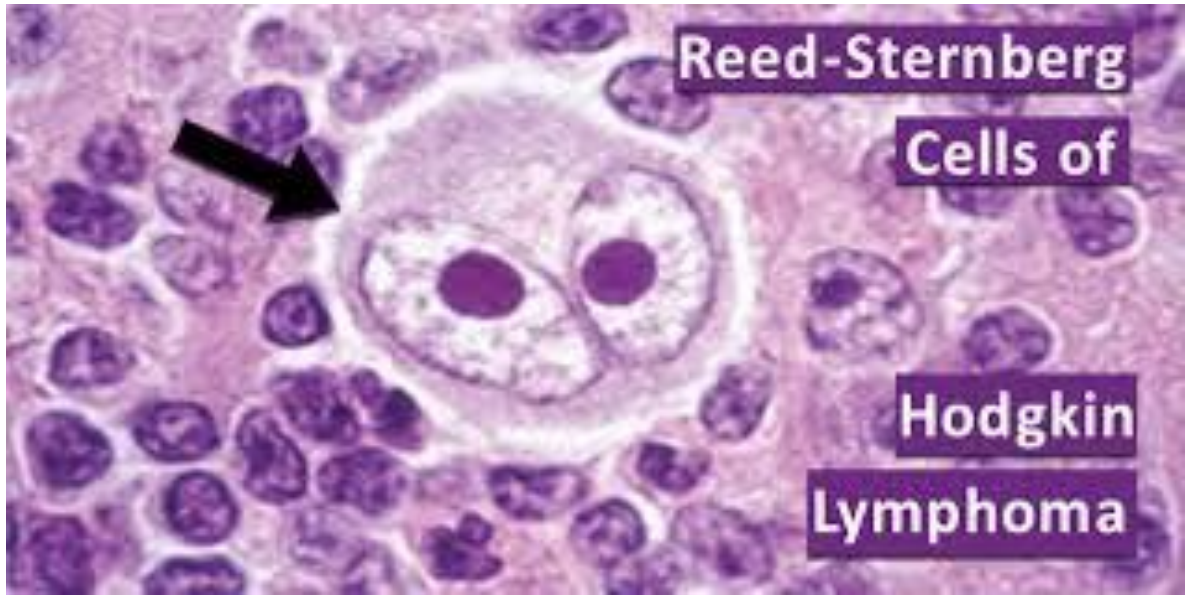
Causes:

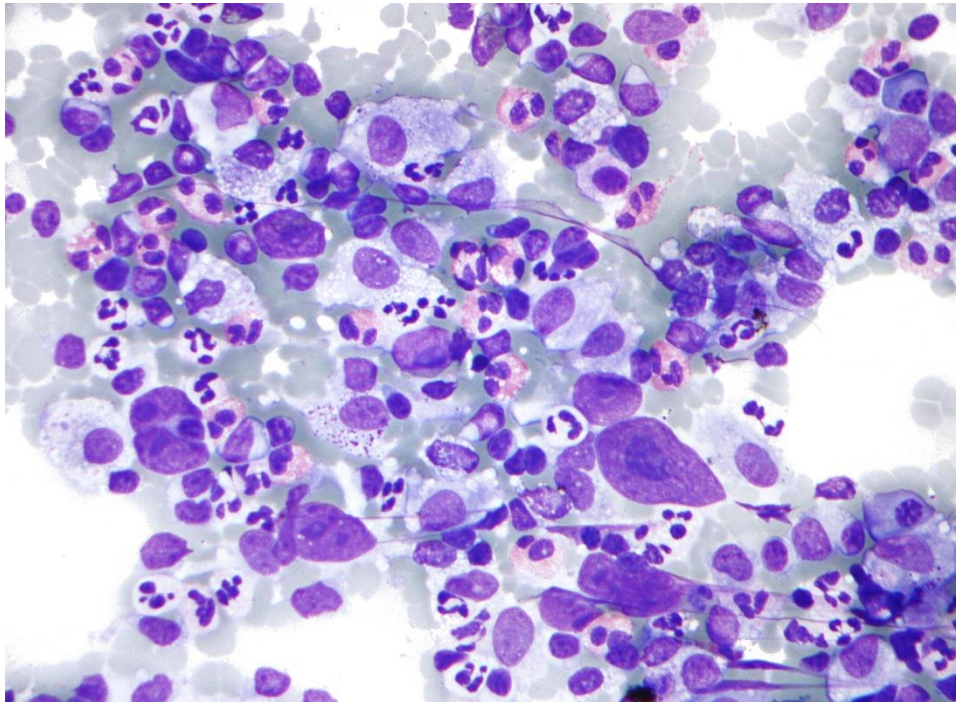
1. Ionizing radiation
2. Chemical agents: benzene, alkylating agents (cytotoxic drugs)
3. Genetic disorder: 90% of chronic myelocytic leukemia patients have **Philadelphia chromosome** which is BCR-ABL translocation between chromosomes 22 and 9, t(22-9) BCR-ABL
4. Oncogenic viruses: human T cell leukemia viruses HTL-V, EBV, Hepatitis viruses, …..

1. Lymphoma:

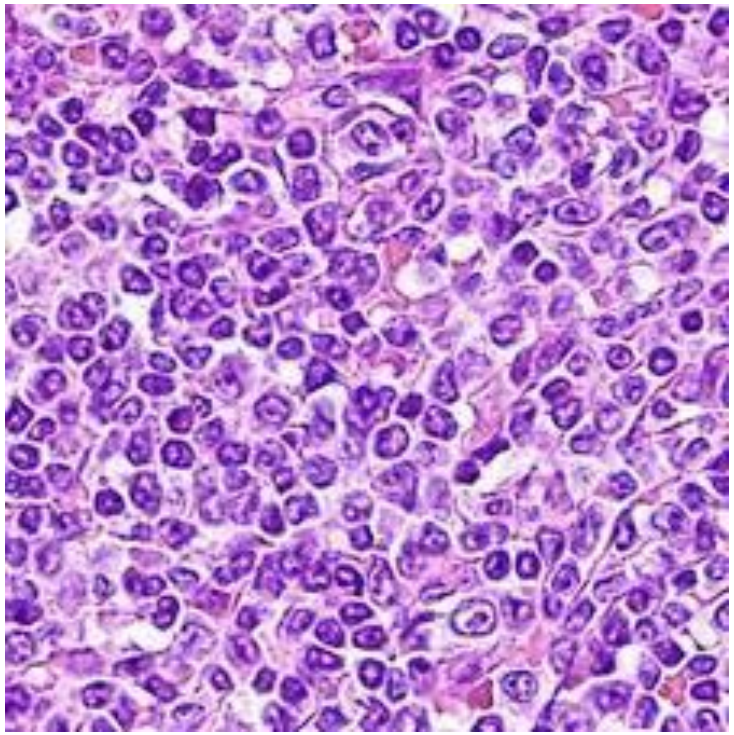
- It is neoplasia of lymphocytes **(T lymphocytes &B lymphocytes)** which are called **Hodgkin's** and **non-Hodgkin's** lymphoma.

Hodgkin lymphoma	Non-Hodgkin's lymphoma
Hodgkin's lymphoma is marked by the presence of Reed-Sternberg cells, which are mature B cells that have become malignant	Derived from B cells or T cells and no Reed-Sternberg cells
Arise in the lymph nodes	Arise in the lymph nodes as well as other organs.
Less common	More common
The median age of occurrence is 35 years old	The median age of occurrence is 60 years old
Hodgkin's lymphoma tends to progress in an orderly fashion, moving from one group of lymph nodes to the next	Non-Hodgkin's lymphoma progresses in non-order fashion
Considered one of the most treatable cancers, with more than 90 percent of patients surviving more than five years.	Survival rates for patients with non-Hodgkin's lymphoma tend to be lower





Hodgkin's Lymphoma



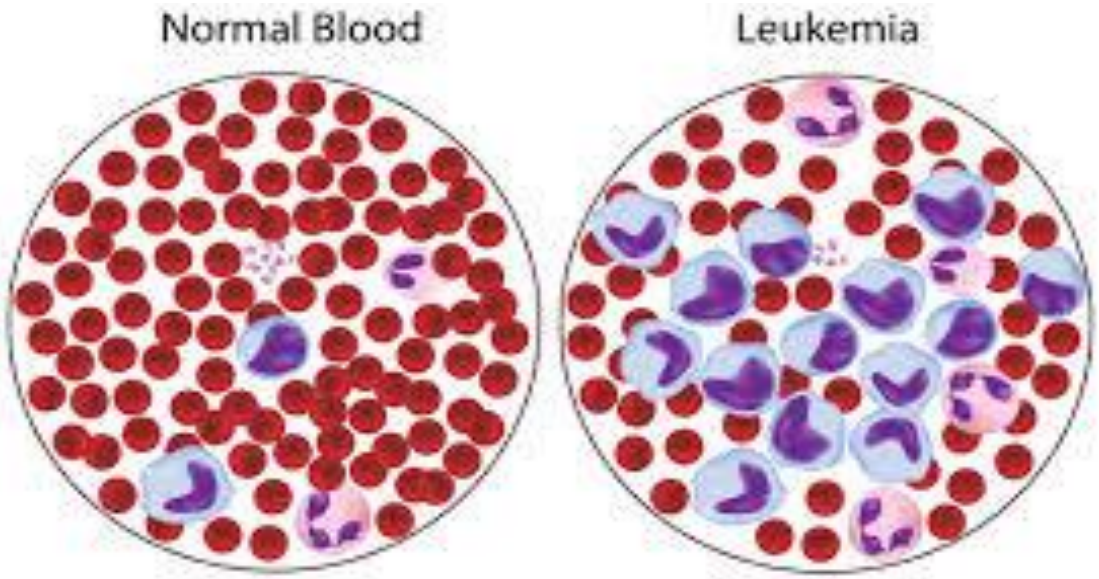
Non-Hodgkin's Lymphoma

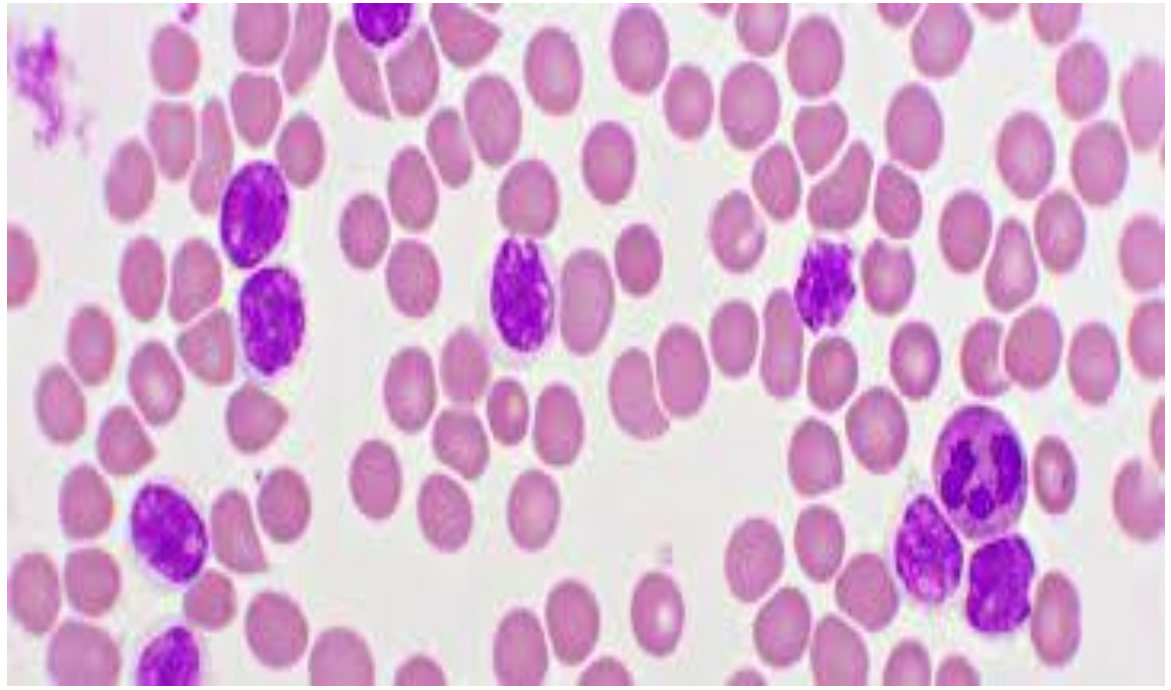
2. Leukemia:

- It is neoplasia that arises from stem cells in the bone marrow that give rise to granulocytes, red cells and platelets (MYLOID LINEAGE) and stem cells that give rise to lymphocytes (LYMPHOID LINEAGE). It is divided to acute lymphocytic leukemia ALL, chronic lymphocytic leukemia (CLL), acute mylocytic leukemia AML, chronic myelocytic leukemia CML. These types of malignancy show an increase in **blast cells** in the bone marrow and peripheral blood.

ALL (acute lymphocytic leukemia):

- The incidence of ALL is highest at 3-7 years old. 85% of cases are of B cell type (B-ALL) which has an equal sex incidence. The patient presents with **anemia** (pallor and lethargy) , **neutropenia** (recurrent infection), **thrombocytopenia** (ecchymosis, and easily bleeding gum). The bone marrow shows >20% immature blast cells and spillage of these cells to the peripheral blood (**blast cells in the blood film**).





ALL

LEUKEMIA SYMPTOMS