

# **EARLY DETECTION OF BONE MARROW DISEASES**

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# EARLY DETECTION OF BONE MARROW DISEASES

## GENERAL CONCEPTS

HISTORY

PHYSICAL EXAMINATION

LABORATORIES

SPECIAL LABS

# **EARLY DETECTION OF BONE MARROW DISEASES**

## **HISTORY**

**CBC-** Hemoglobin, WBW, platelets

**Anemia** – dizziness, SOB, pica, general weakness

**Infections** - fever

**Bleeding disorders** - previous surgeries, family history

**Coagulation Parameters** – bleeding diathesis, history of previous surgeries, labor and/or dental extractions

# EARLY DETECTION OF BONE MARROW DISEASES

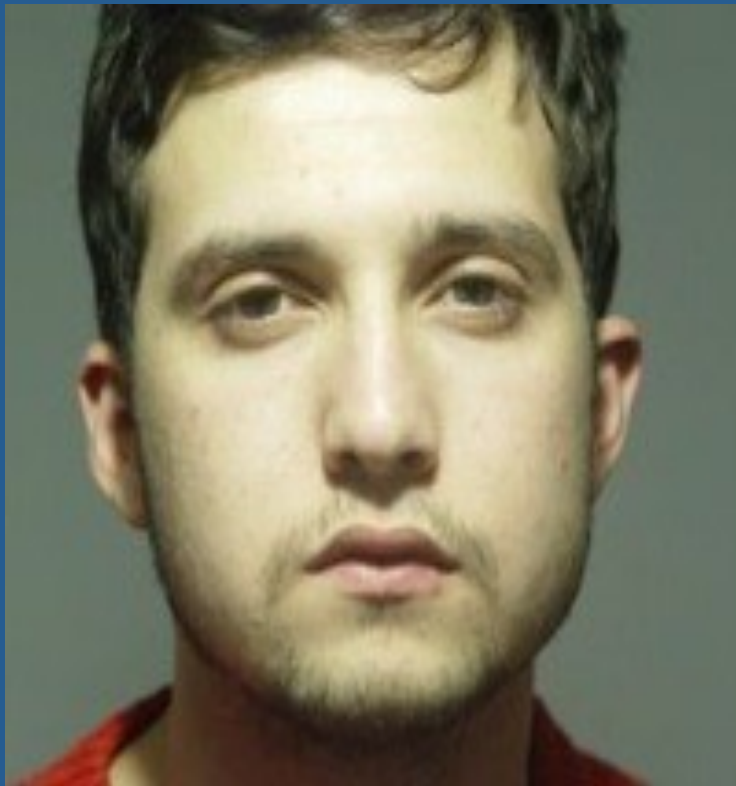
## PHYSICAL EXAMINATION

**Skin appearance** – pale, erythema, yellowish,  
with petechias, ecchymosis, or cyanosis,  
alopecia

**Lymph nodes** – enlarged, hard, movable or not,  
tender or not, skin nodes

**Mucosa** – gingival hypertrophy

# EARLY DETECTION OF BONE MARROW DISEASES



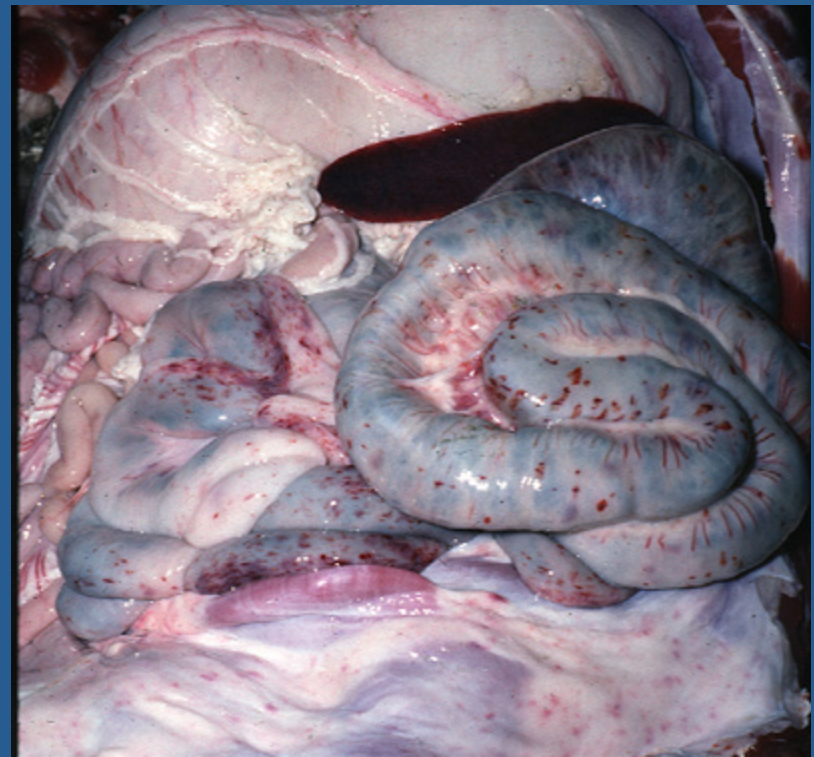
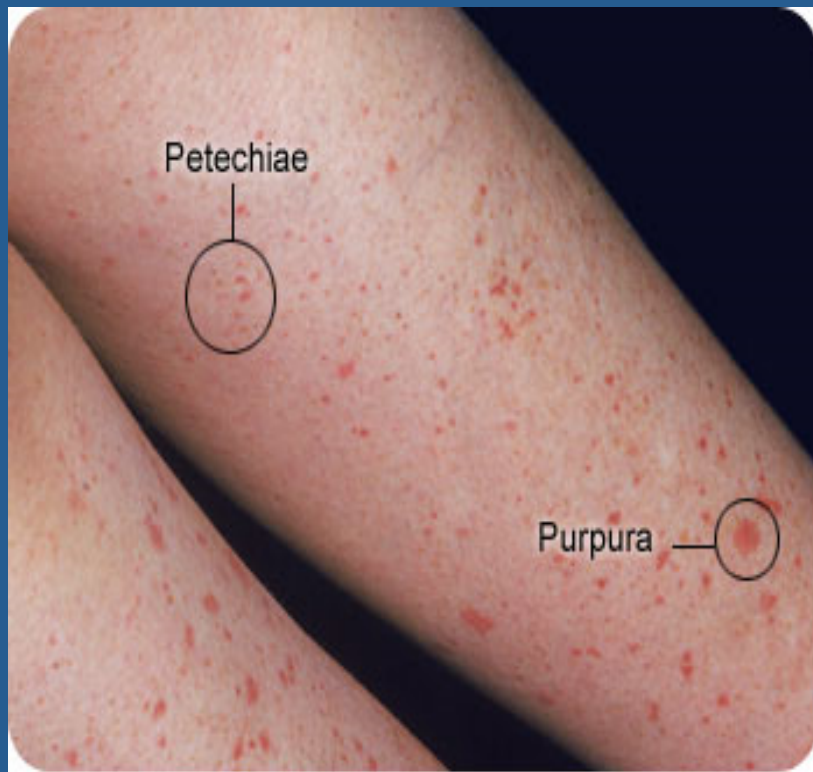
# EARLY DETECTION OF BONE MARROW DISEASES



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# EARLY DETECTION OF BONE MARROW DISEASES



# EARLY DETECTION OF BONE MARROW DISEASES



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# EARLY DETECTION OF BONE MARROW DISEASES



Figure—Prominent gingival hypertrophy.

# **EARLY DETECTION OF BONE MARROW DISEASES LABORATORIES**

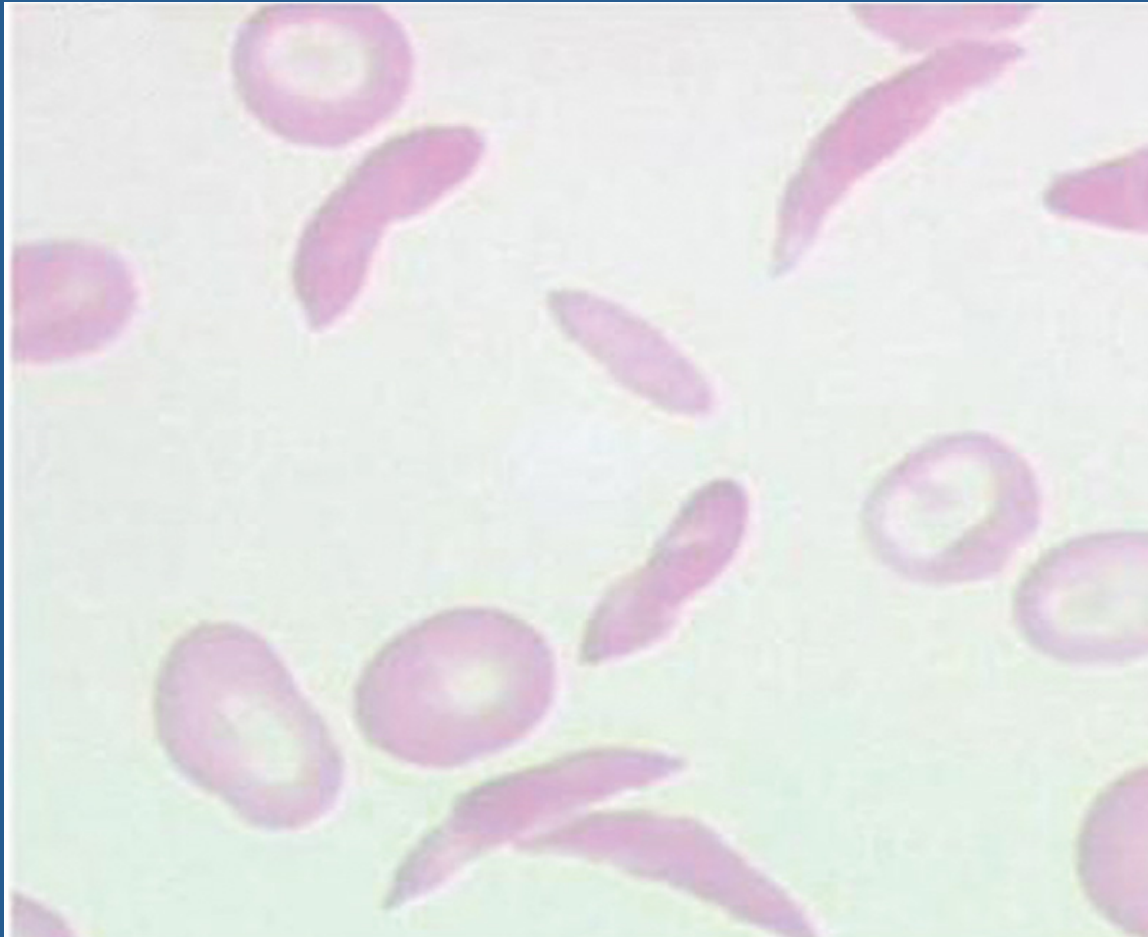
**CBC** – hemoglobin, WBC, platelet count

# EARLY DETECTION OF BONE MARROW DISEASES

## HEMOGLOBIN

Peripheral Smear – anisocytosis, poikilocytosis  
(sickle cell disease, hemolysis, schistocytosis)

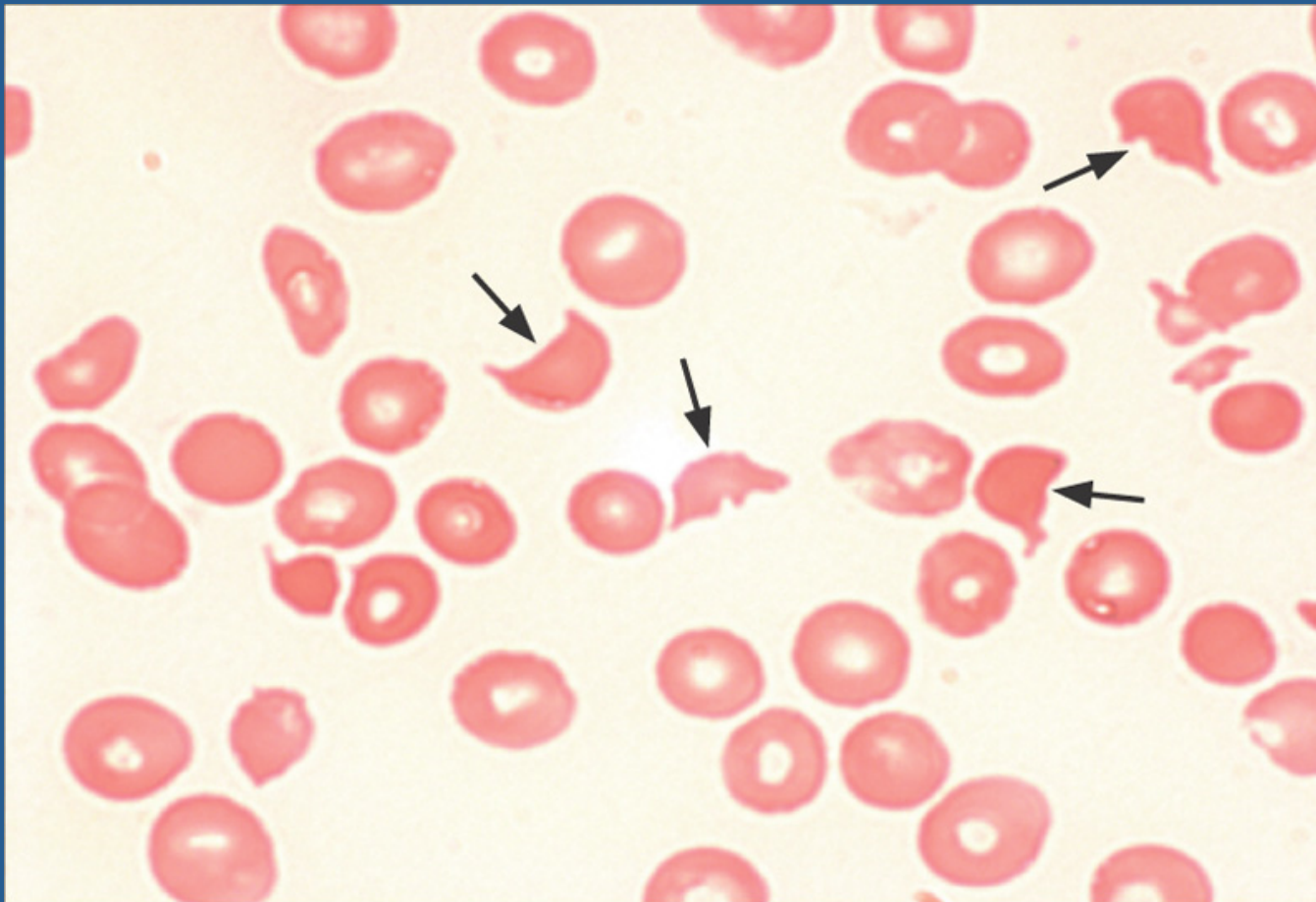
# EARLY DETECTION OF BONE MARROW DISEASES



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# EARLY DETECTION OF BONE MARROW DISEASES



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# EARLY DETECTION OF BONE MARROW DISEASES

## WHITE BLOOD CELLS

LEUKOPENIA

LEUKOCYTOSIS - LEUKEMIAS

# EARLY DETECTION OF BONE MARROW DISEASES

## WBC

Leukopenia – viral, collagen disorder, congenital, bone marrow infiltration (usually with anemia and/or thrombocytopenia)

Leukocytosis – infections, inflammation, drugs (steroids), leukemoid reaction, neoplasms, myeloproliferative disorders, leukemias

# EARLY DETECTION OF BONE MARROW DISEASES

## PLATELETS

**Thrombocytosis –**

reactive

post splenectomy

myeloproliferative disorder (ET, PV, MF, CML)

# EARLY DETECTION OF BONE MARROW DISEASES

## PLATELETS

### THROMBOCYTOPENIA

- \* Decreased production
- \* Increased destruction
- \* Abnormal distribution or pooling

# EARLY DETECTION OF BONE MARROW DISEASES

## PLATELETS

**Thrombocytopenia –**

**Decreased production**

- \*hypocellular bone marrow (AA, drugs...)
- \*bone marrow disorders ( MDS, leukemias)
- \*marrow replacement ( myelofibrosis, metastasis from solid tumors)

# EARLY DETECTION OF BONE MARROW DISEASES

## PLATELETS

**Thrombocytopenia –  
Increased destruction**

- \*\*Immune mediated**

- \*primary – ITP**

- \*secondary – infections, viruses, collagen diseases, heparin, lymphoproliferative disorders (CLL, lymphoma)**

- \*\*Non immune mediated – TTP, DIC, vasculitis, preeclampsia, HELLP syndrome**

# EARLY DETECTION OF BONE MARROW DISEASES

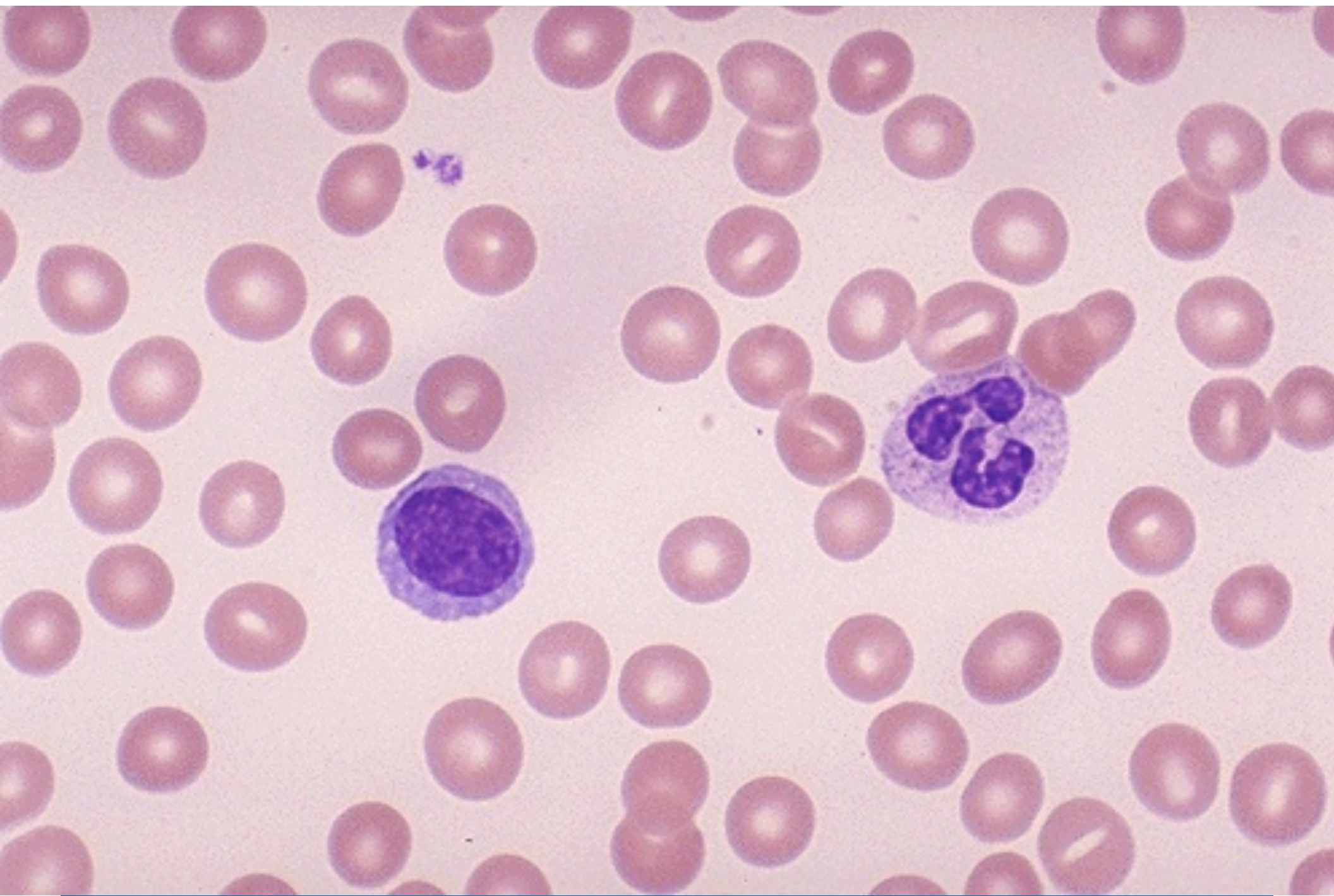
## PLATELETS

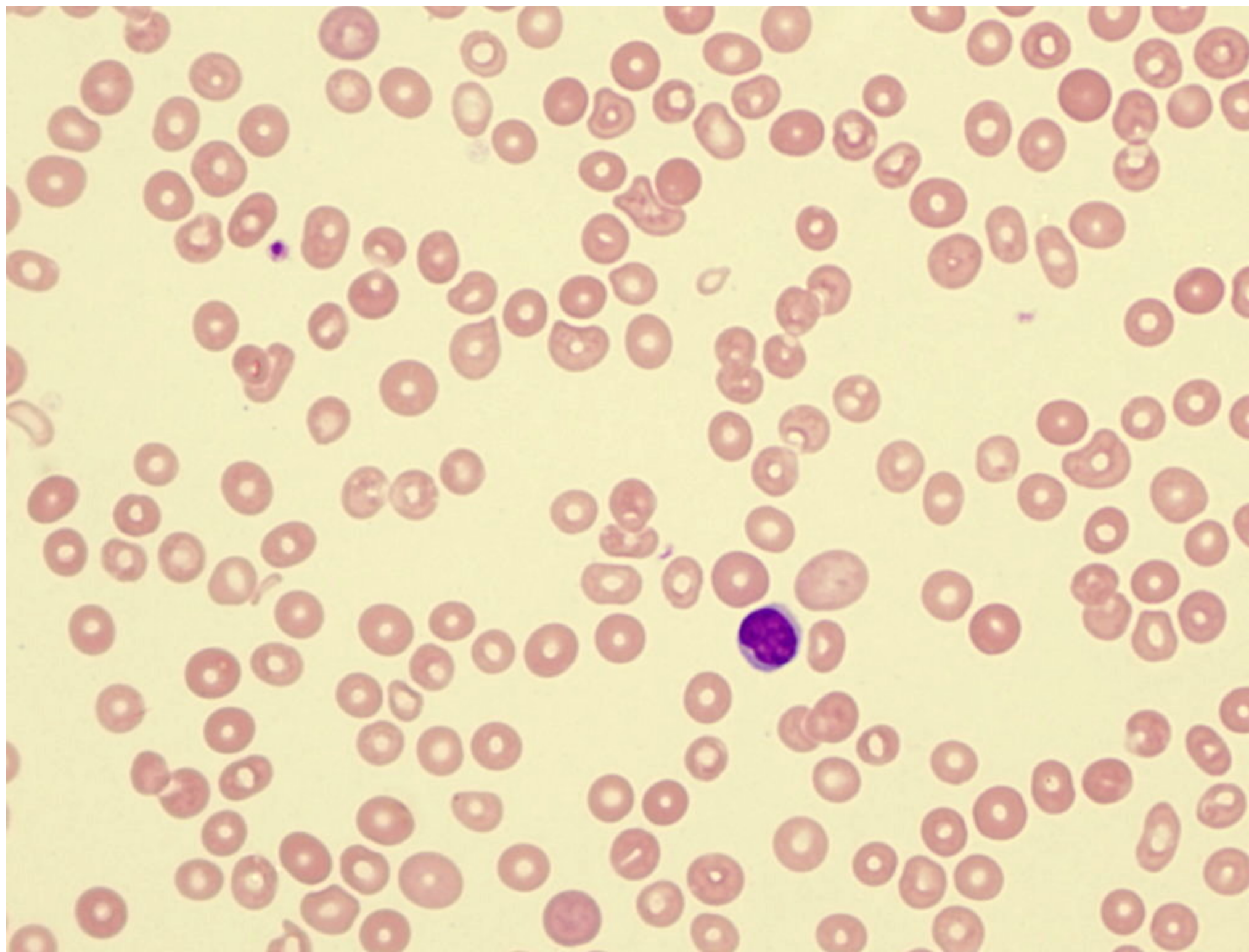
Abnormal distribution or pooling –  
Hypersplenism - sequestration

# EARLY DETECTION OF BONE MARROW DISEASES

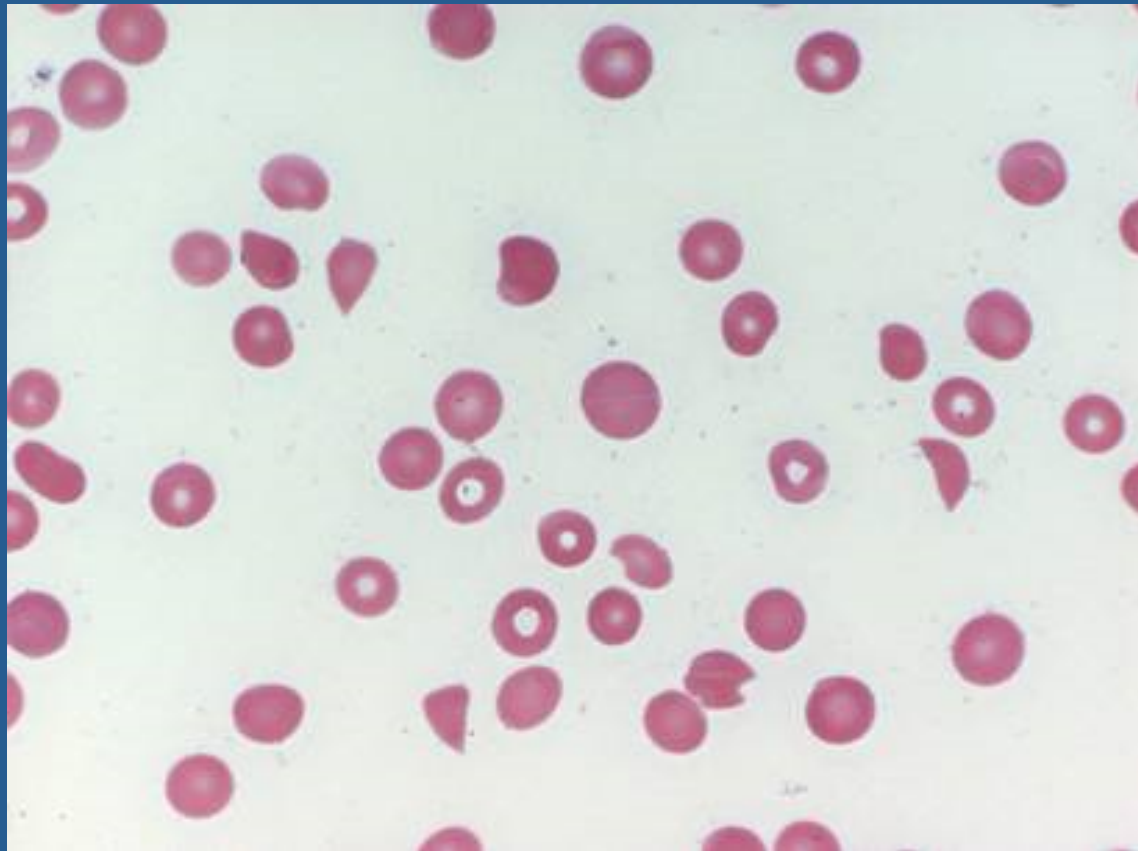
## ANEMIA, LEUCOPENIA, THROMBOCYTOPENIA (PANCYTOPENIA)

- Aplastic Anemia
- Vit B12 deficiency
- Viral infections
- Myelodysplastic Syndromes
- Leukemias
- Lymphomas

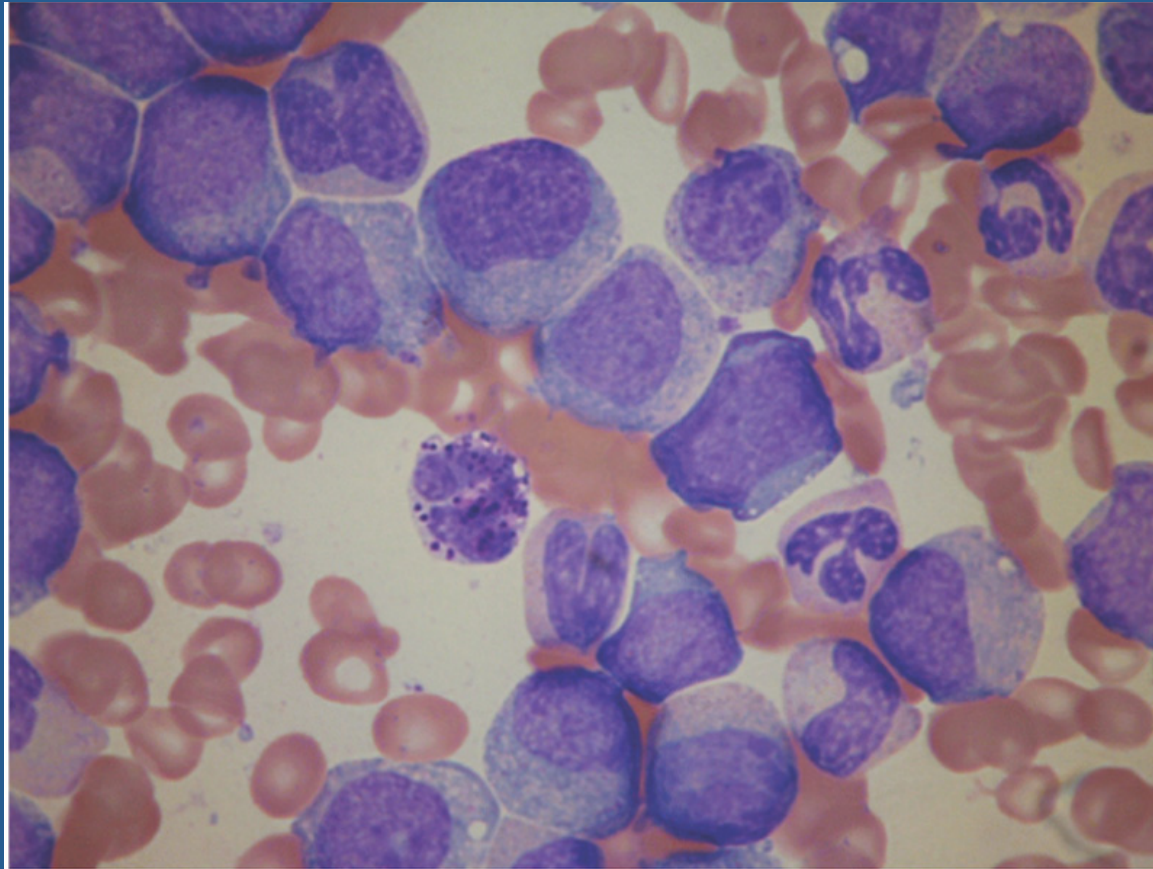




# Thrombocytopenia



# EARLY DETECTION OF BONE MARROW DISEASES - leukocytosis



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# EARLY DETECTION OF BONE MARROW DISEASES

## SPECIAL LABORATORIES

**Platelet aggregation studies** – evaluates platelets dysfunction

**Bone marrow aspiration and biopsy** -

**Cytogenetics** (study of the chromosomes)

**FISH** - cytogenetic technique used to detect and localize the presence or absence of an specific DNA sequence on chromosomes

**PCR** – a technique that amplifies a single or a few copies of a piece of DNA

**Flow cytometry** - a technique used to count and exam microscopic particles suspended in a stream of fluid, in order to analyze the characteristics of a single cell passing through the “eye” of the instrument

# EARLY DETECTION OF BONE MARROW DISEASES

## BONE MARROW

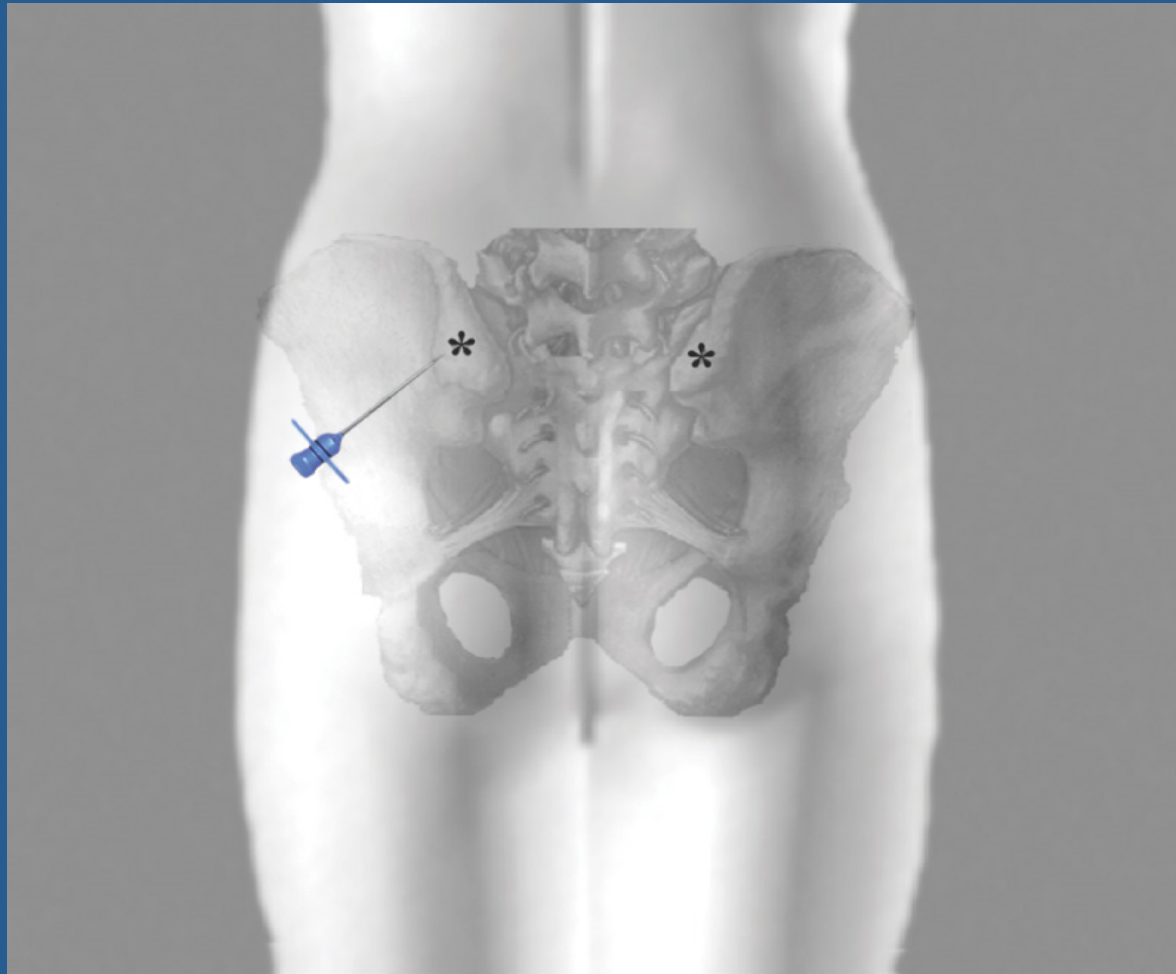
- Is a soft fatty tissue found inside of the body's bones
- It is responsible for producing new blood cells
- Contains the stem cells, pluripotent cells which can differentiate to become a particular cell , as needed

# **EARLY DETECTION OF BONE MARROW DISEASES**

## **BONE MARROW ASPIRATION AND BIOPSY**

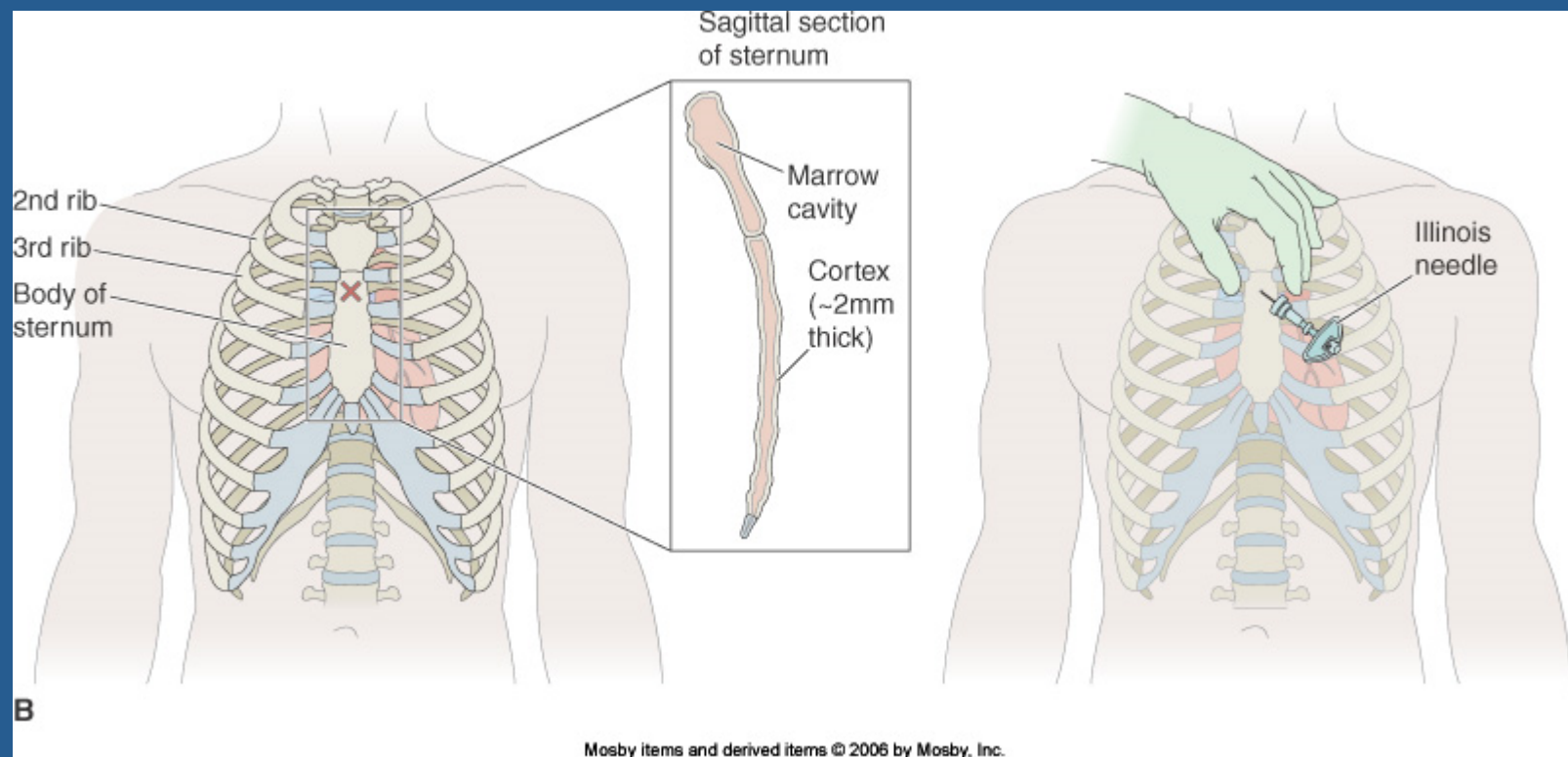
The bone marrow aspiration and biopsy is performed when it is necessary to evaluate the elements present in the marrow, if they should be there or not, evaluates the presence of foreign cells, the maturation of the cells in the marrow, the under or over production of marrow cells,

# EARLY DETECTION OF BONE MARROW DISEASES



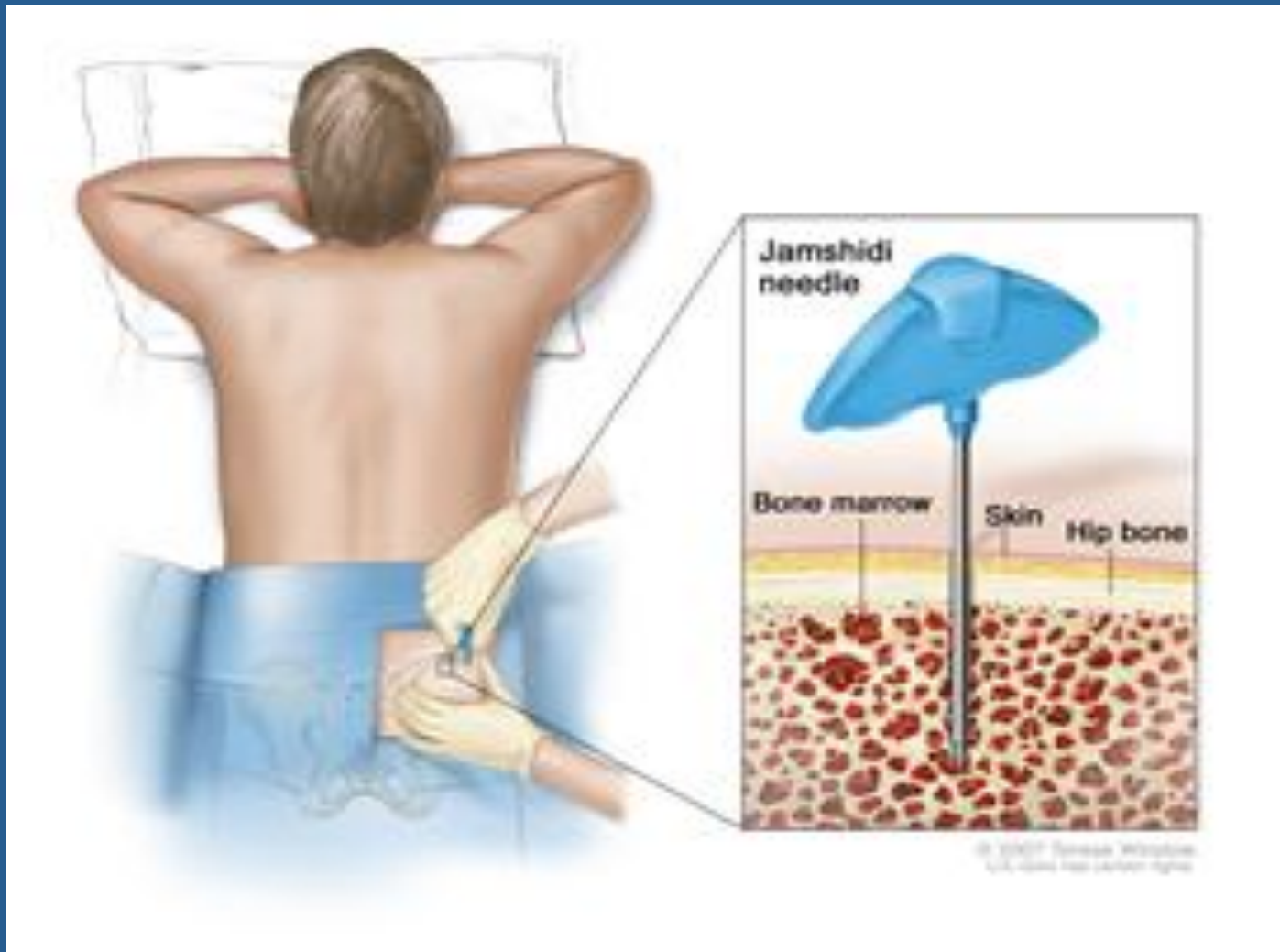
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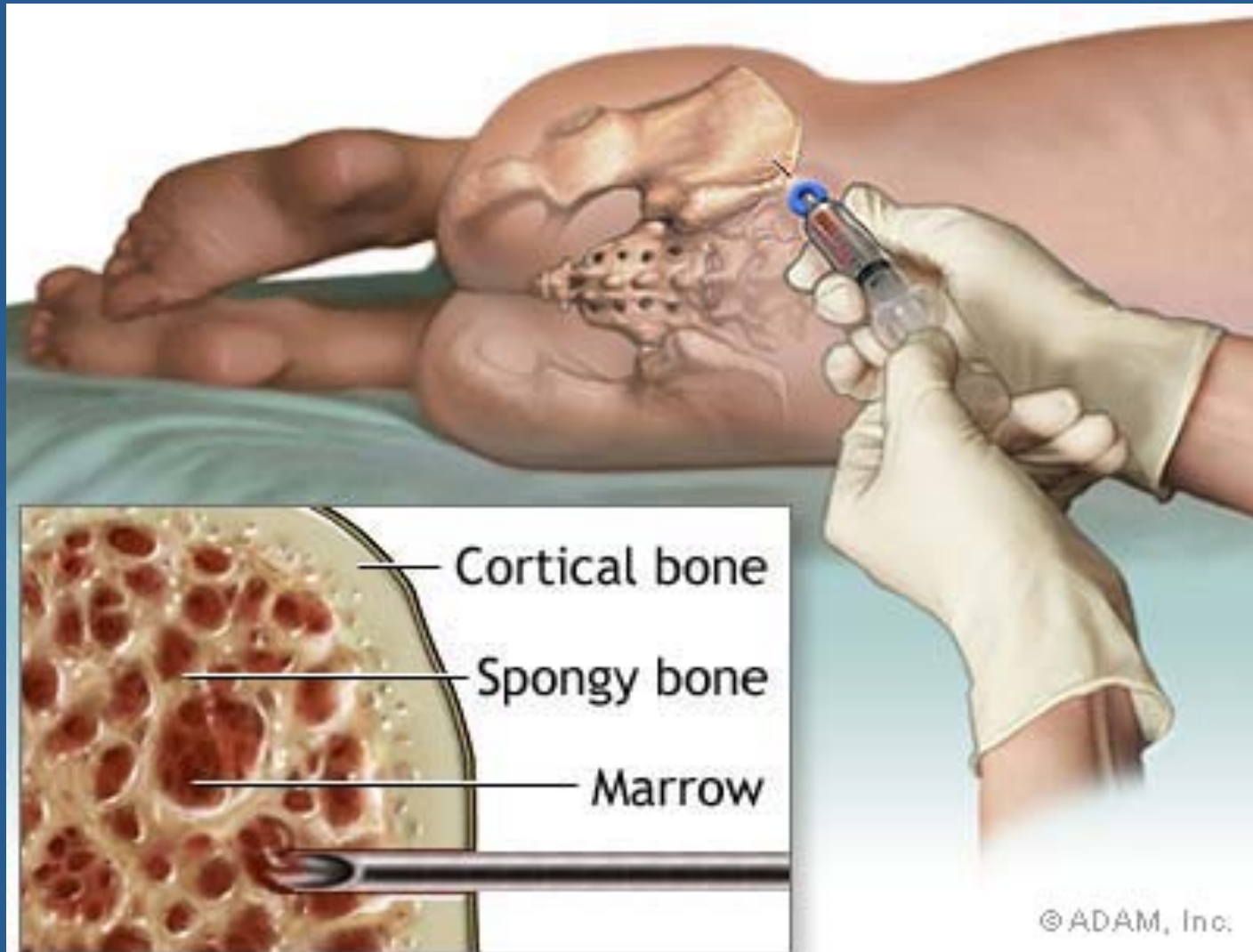
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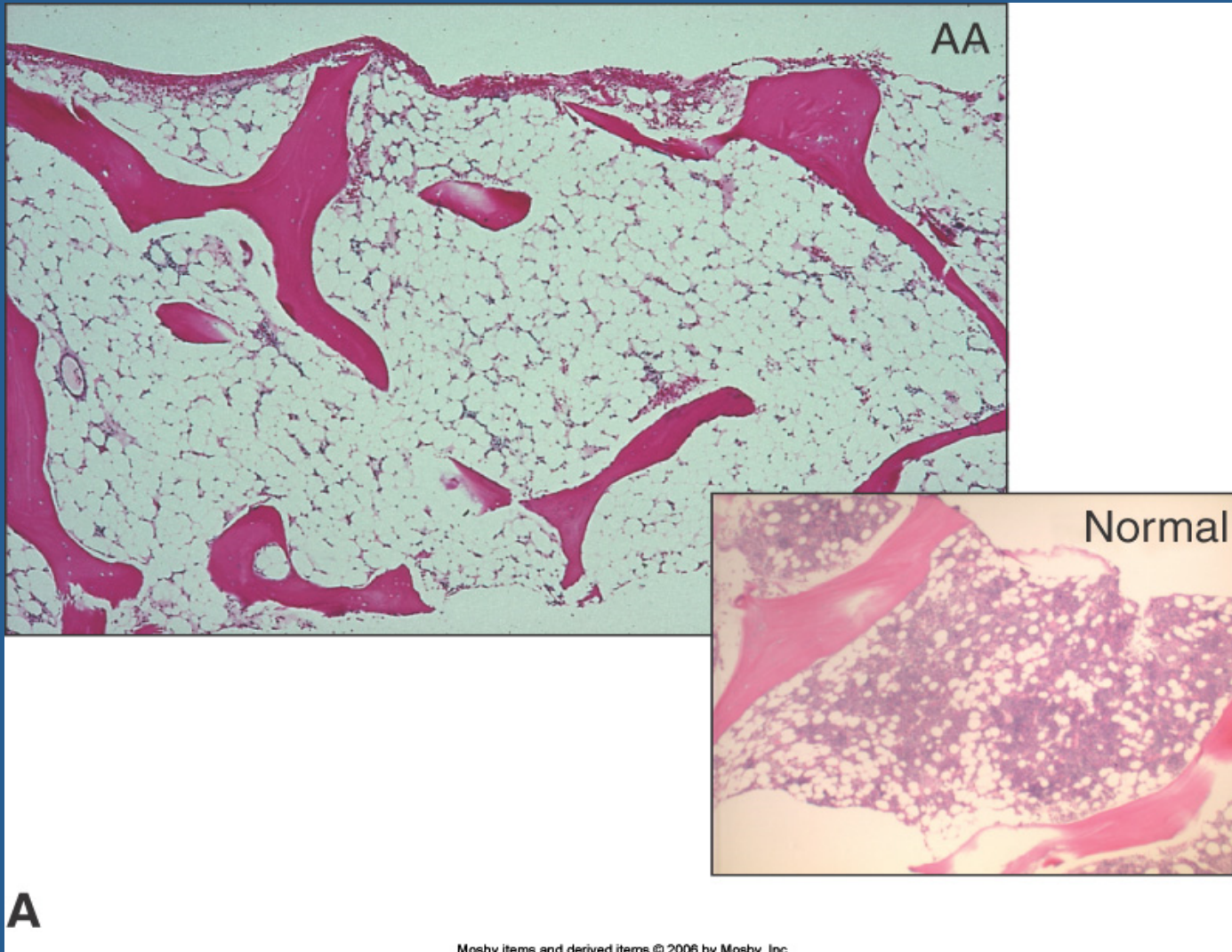
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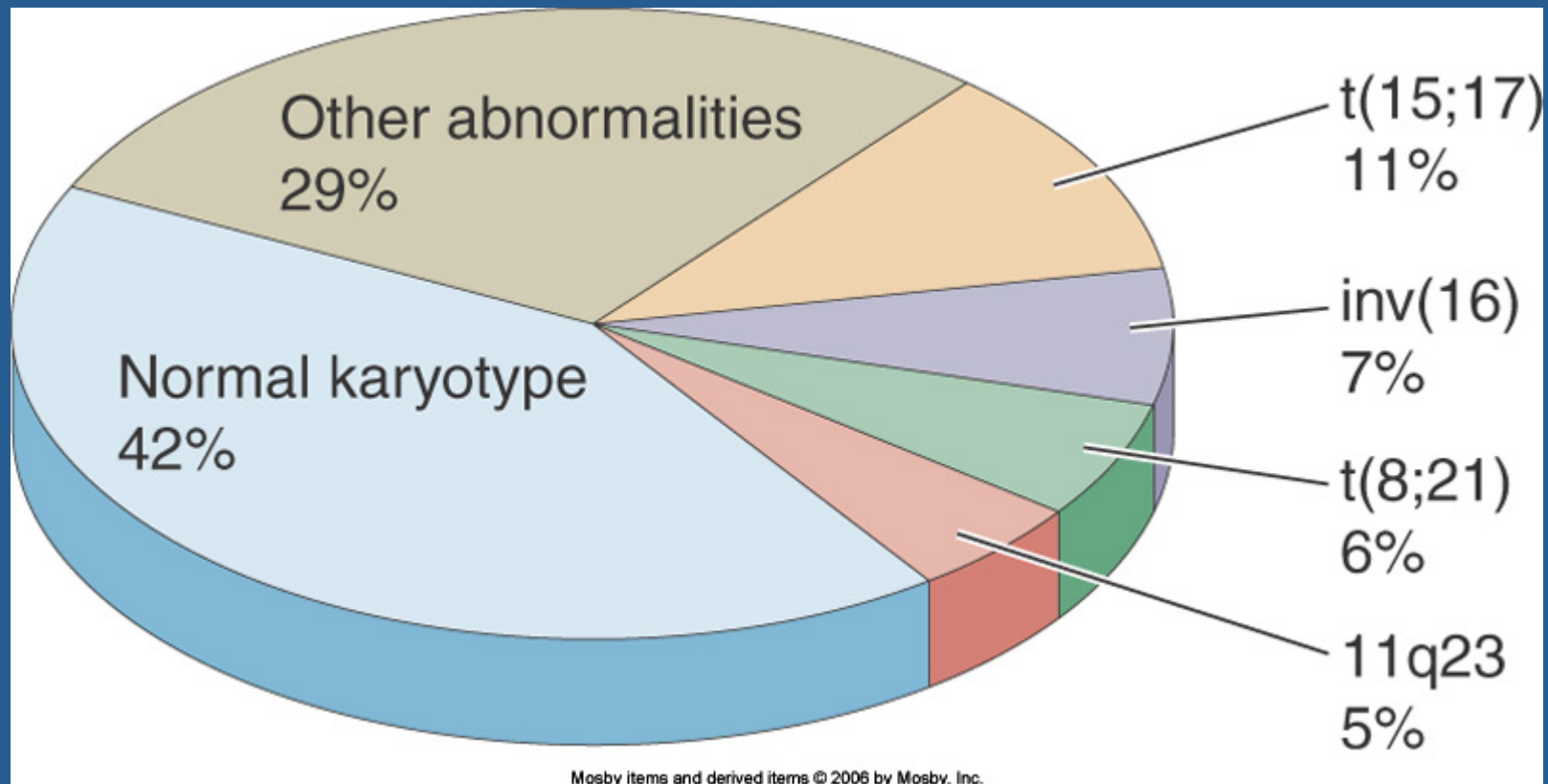


# EARLY DETECTION OF BONE MARROW DISEASES

## BONE MARROW – THINGS TO GO WRONG

- Overproduction of one cell....production of other cells
- Production of abnormal cells
- Predominant one cell line because it fails to die at a normal rate
- Decrease production of cells or rapid loss because they are fragile
- Disease affecting the marrow, therefore affecting cell production and maturation

# EARLY DETECTION OF BONE MARROW DISEASES



# EARLY DETECTION OF BONE MARROW DISEASES

- Anemias
- Acute Leukemias
- Chronic Leukemias
- Myelodysplastic Syndromes
- Myeloproliferative Disorders
- Lymphomas
- Multiple Myeloma
- Metastatic Carcinomas

# EARLY DETECTION OF BONE MARROW DISEASES

## ANEMIAS

Aplastic

Normocytic , Normochromic

Macrocytic , Microcytic

Hemolytic : hereditary, acquired

Refractory (Myelodysplastic Syndromes)

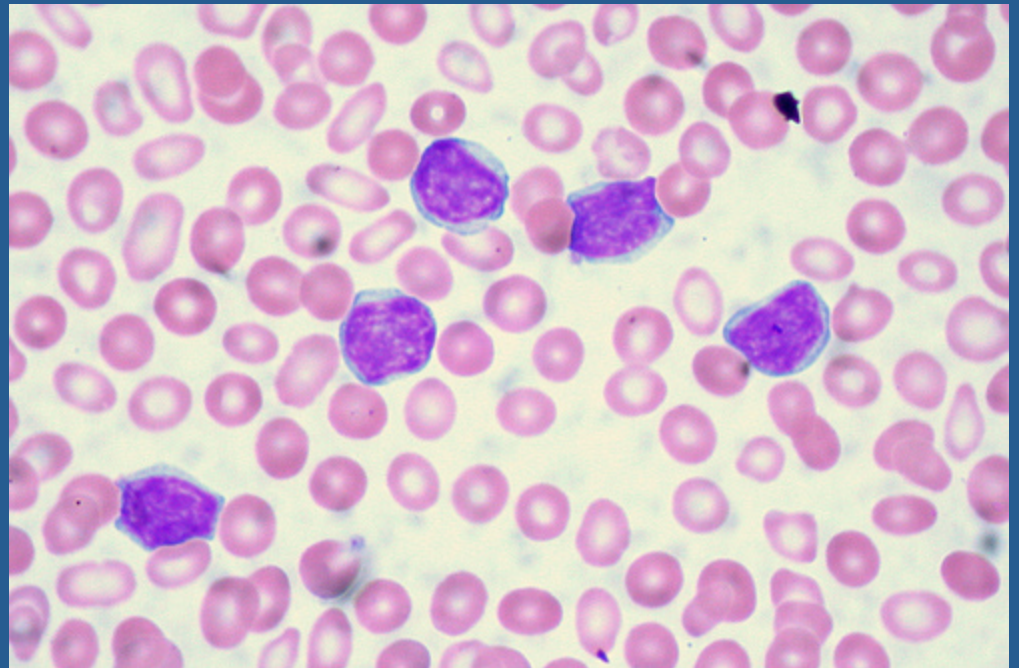
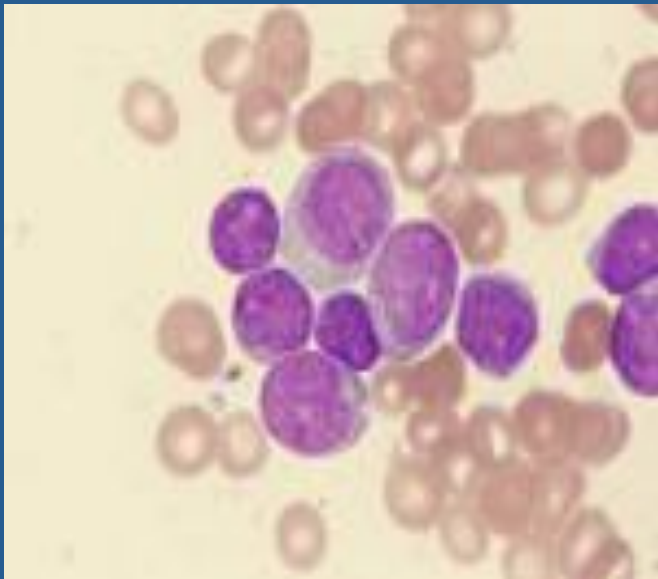
# EARLY DETECTION OF BONE MARROW DISEASES

## DISORDERS OF THE BONE MARROW

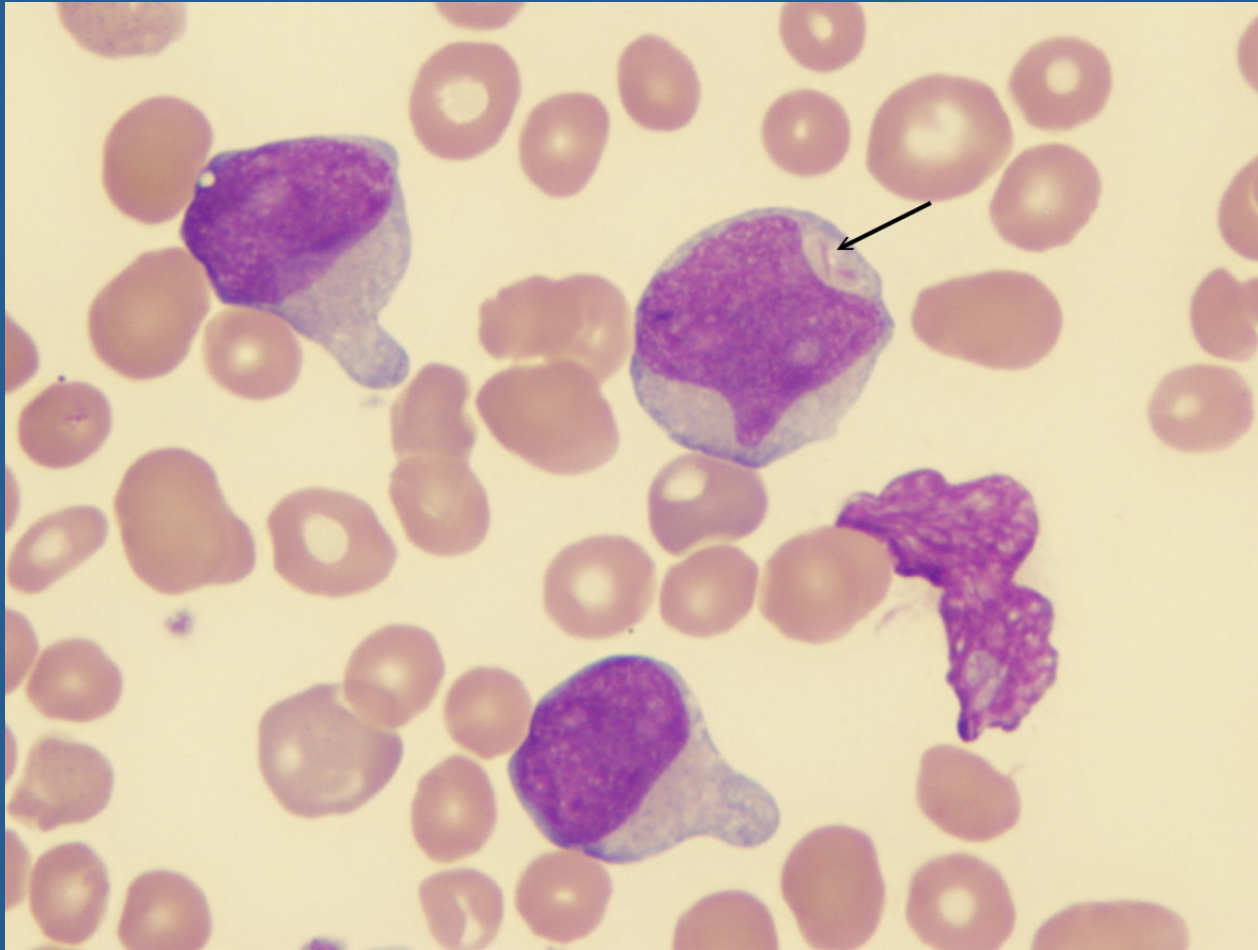
### Leukemias –

- \*clonal proliferation of an hematopoietic precursor
- \*characterizes by a rapid growth
- \*failure to mature
- \*delayed cell death
- \*accumulates in the marrow interfering with the production of normal blood cells

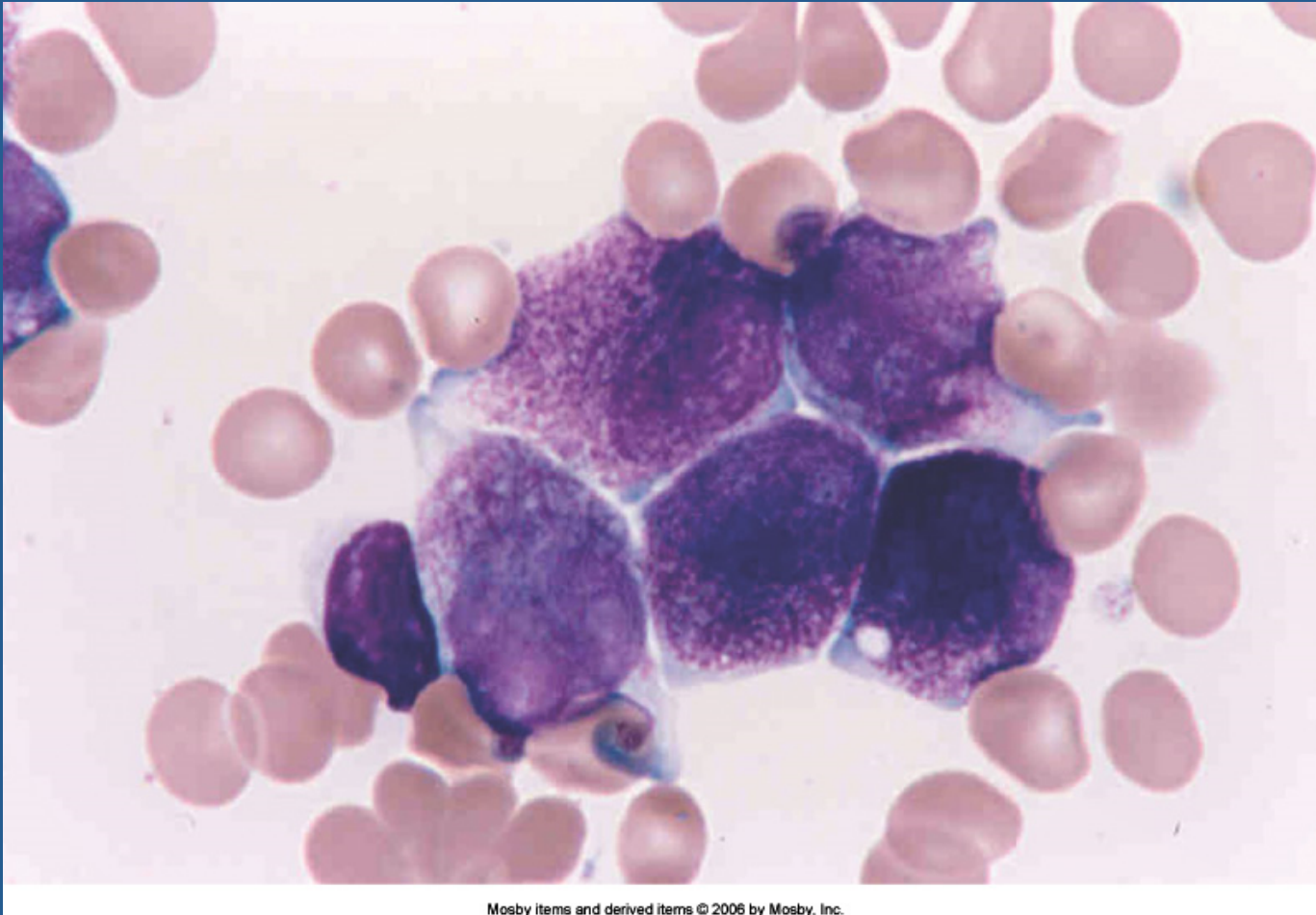
# Acute Myelogenous Leukemia



# AML – Auer Rods

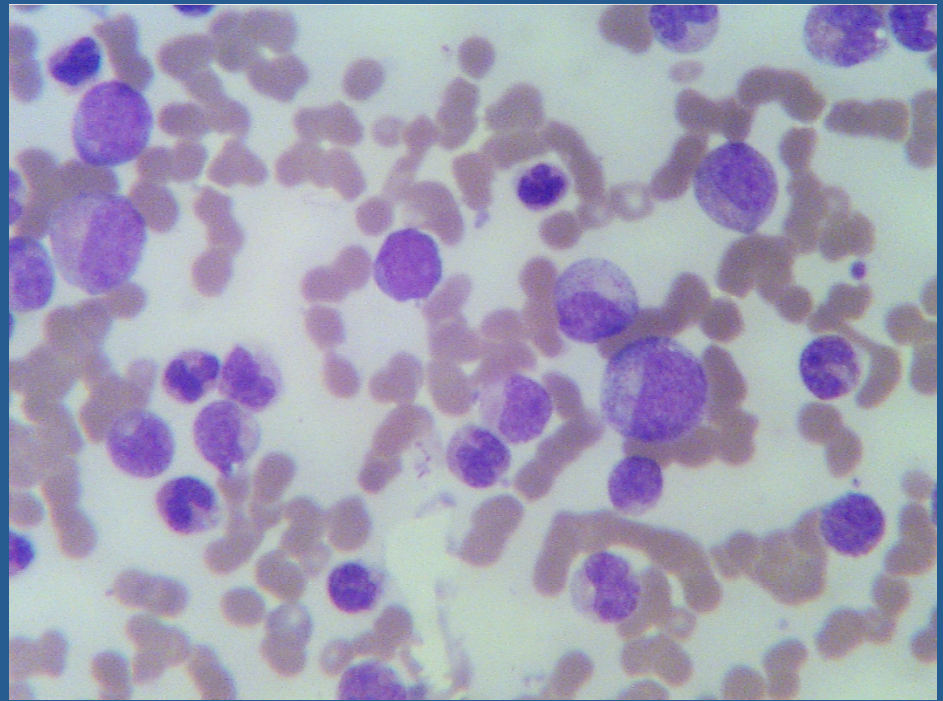
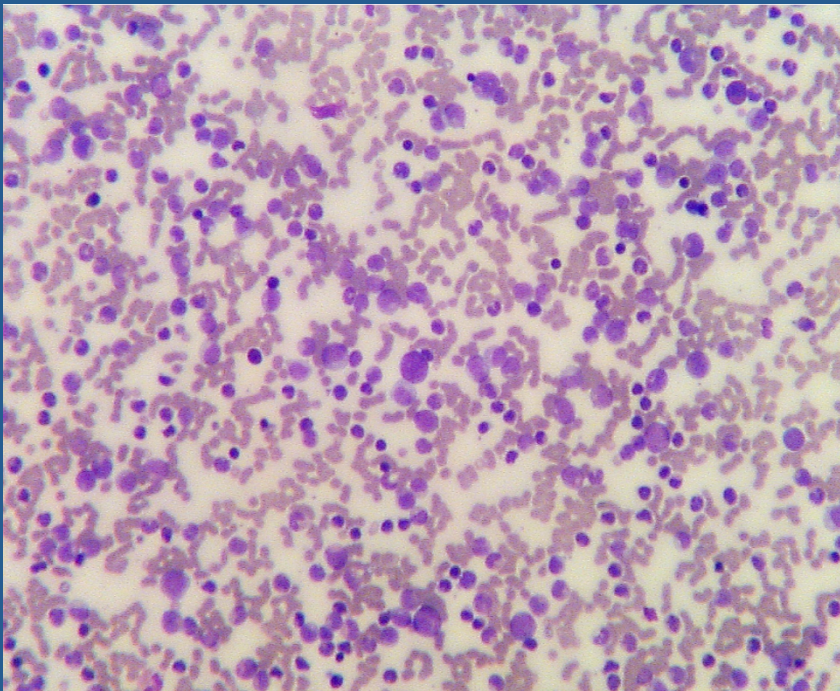


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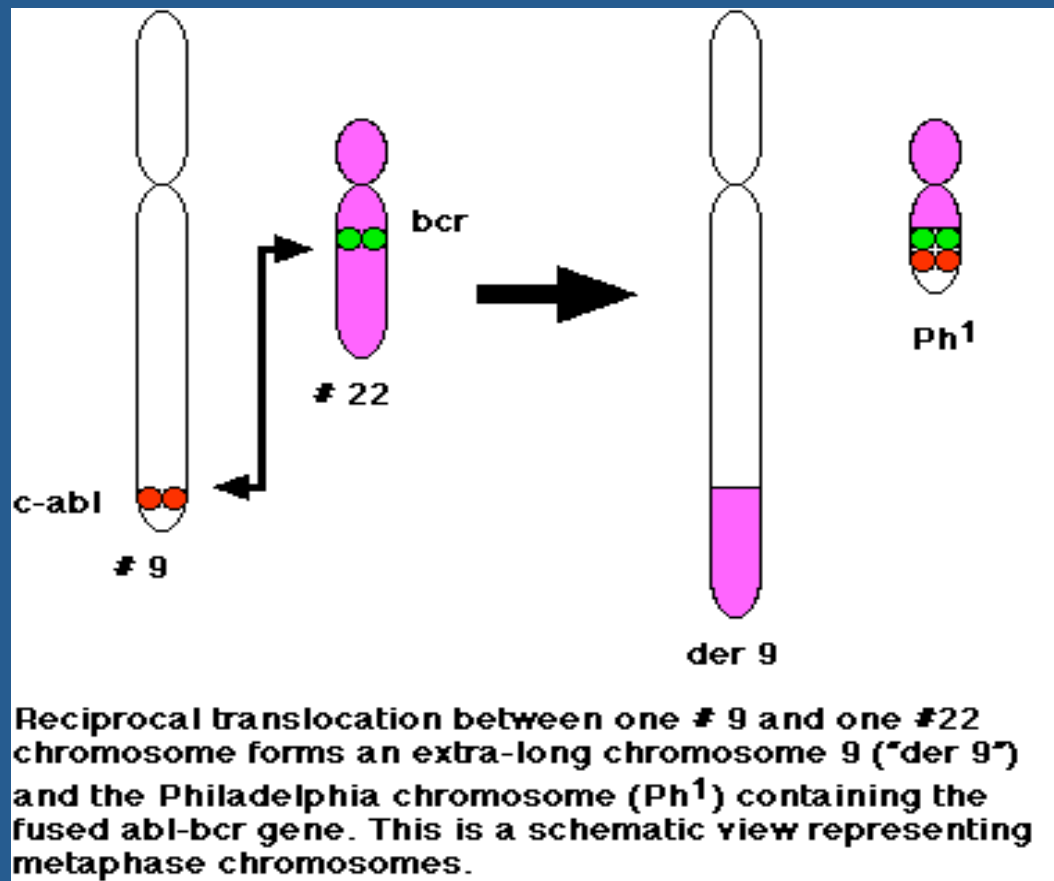


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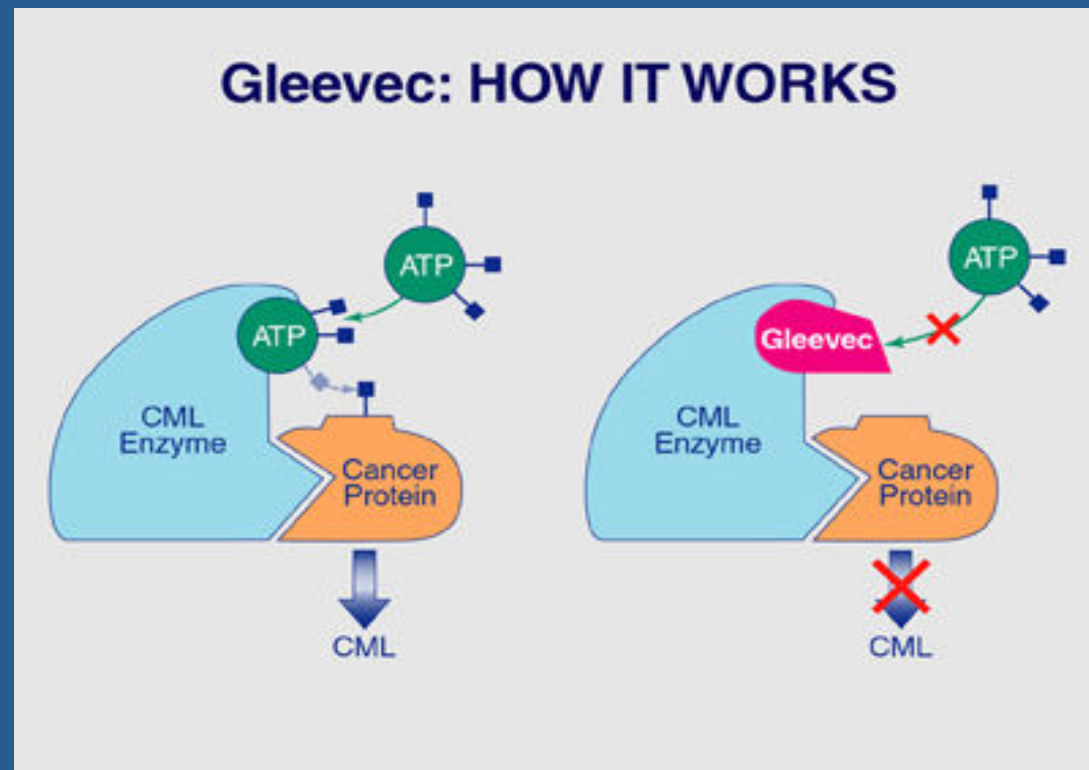
# Chronic Myelogenous Leukemia



# CML – t(9,22)



# Gleevec: Tyrosine Kinase Inhibitor



# EARLY DETECTION OF BONE MARROW DISEASES

## MYELOYDYSPLASTIC SYNDROMES – MDS

- \*Originally called pre-leukemia
- \*Stem cells disorders causing ineffective hematopoiesis (ineffective erythropoiesis, ineffective leukopoiesis, and ineffective thrombopoiesis)
- \*Presence of cytopenias
- \*Associated with numerous cytogenetic abnormalities (5q-, 7q-, +8)
- \*Anemia, thrombocytopenia, leukopenia with/without blasts

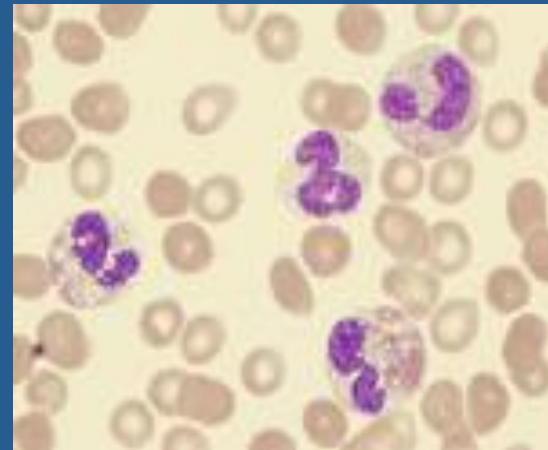
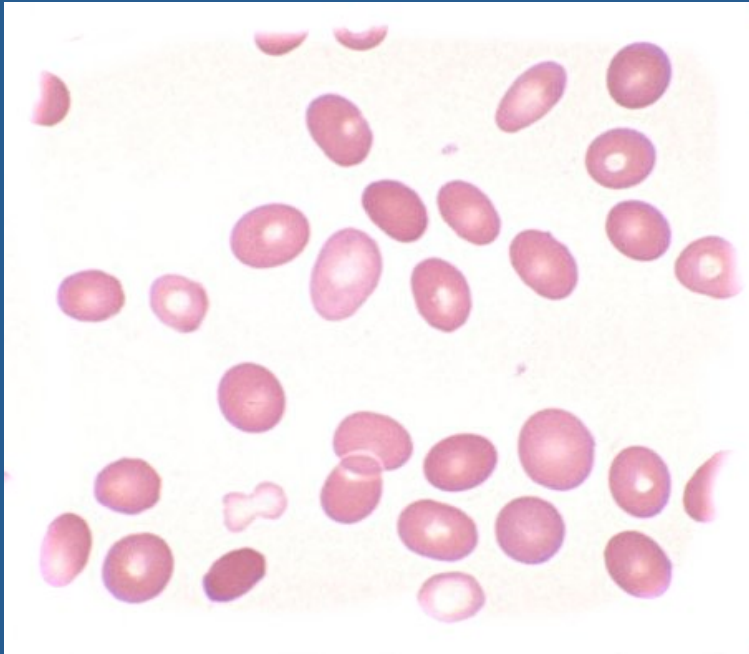
# **EARLY DETECTION OF BONE MARROW DISEASES**

## **MYELODYSPLASTIC SYNDROMES – MDS**

**DIAGNOSIS** – BM asp and Bx, cytogenetics, flow cytometry

**TREATMENT** – supportive ( growth factors), azacitidine (Vidaza), lenalidomide (Revlimid), decitabine (Dacogen),

# Myelodysplastic Syndromes - MDS



# EARLY DETECTION OF BONE MARROW DISEASES

## MYELOPROLIFERATIVE DISORDERS - MPD

- \* Clonal disorder characterized by abnormal proliferation of the blood cells (red blood cells, white blood cells, and platelets)
- Include:
  - Polycythemia Vera
  - Essential Thrombocythemia
  - Myelofibrosis
  - Chronic Myelogenous Leukemia – CML

# EARLY DETECTION OF BONE MARROW DISEASES

## MYELOPROLIFERATIVE DISORDERS – MPD

### DIAGNOSIS –

- Bone marrow aspiration and biopsy

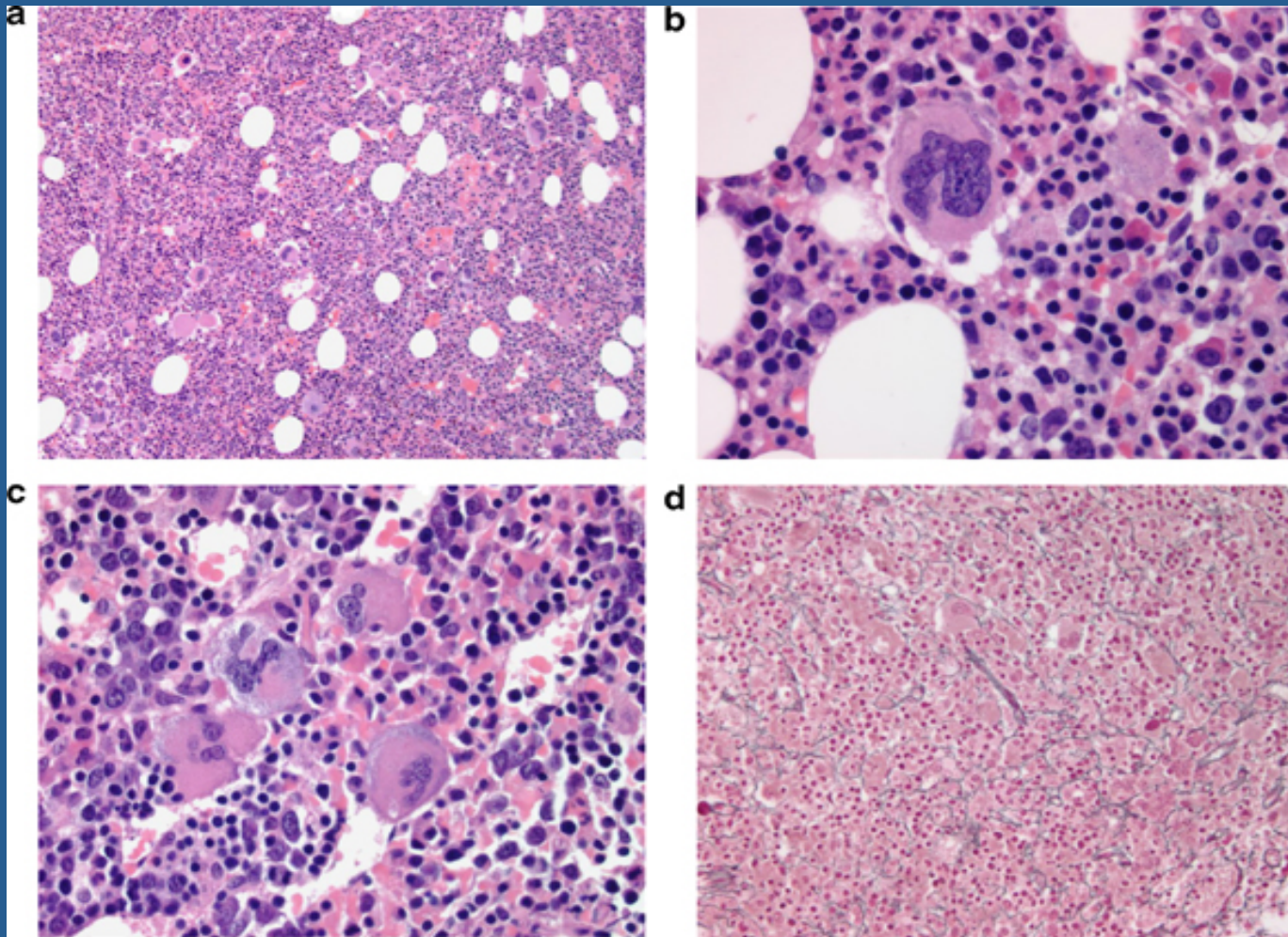
- Cytogenetics

### TREATMENT – NO CURE

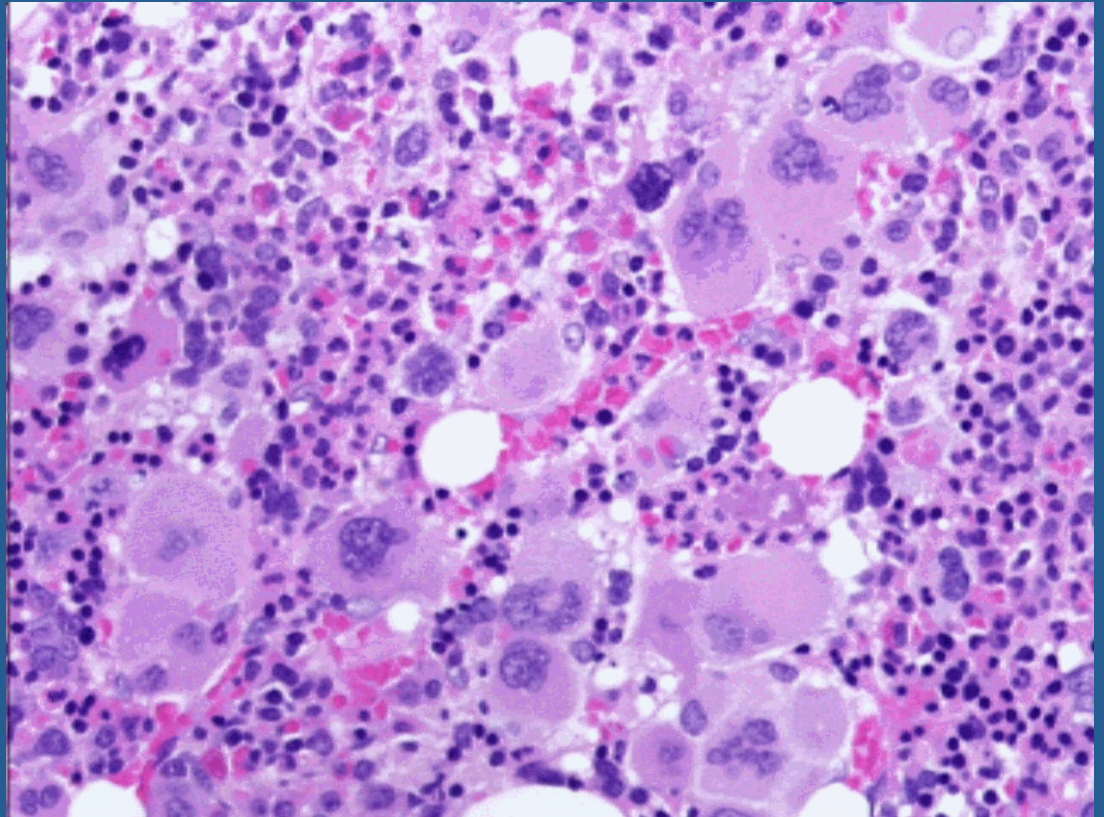
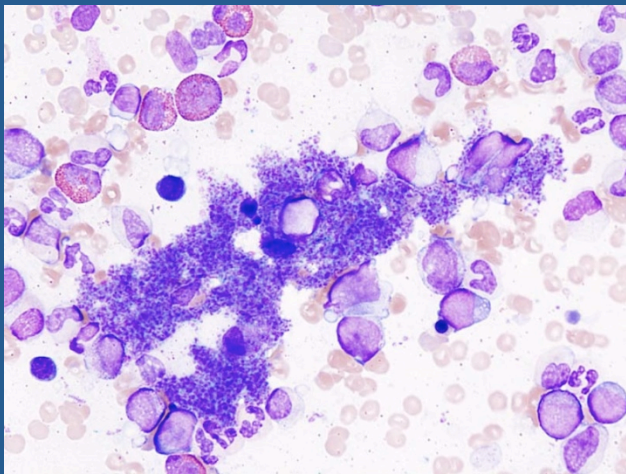
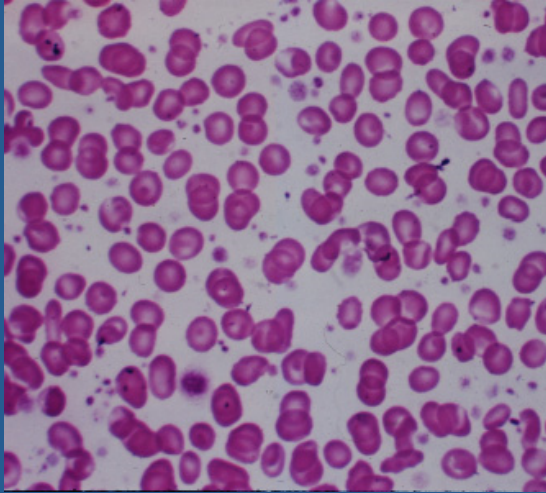
- PV, ET, MF – lower counts or treat symptoms as necessary

- CML – Gleevec, Sprycel, Tasigna, BMT

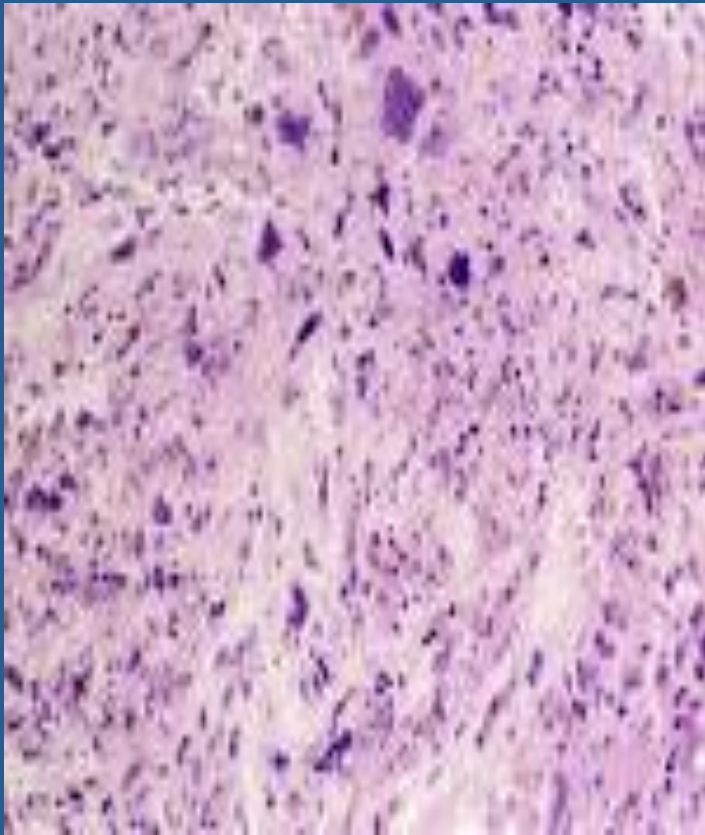
# MPD- Polycythemia Vera



# MPD – Essential Thrombocythemia



# MPD - Myelofibrosis



# EARLY DETECTION OF BONE MARROW DISEASES

## LYMPHADENOPATHY

Characteristics of the enlarged node

- Size
- Tenderness
- Induration
- Redness
- Duration , pattern of growth

# EARLY DETECTION OF BONE MARROW DISEASES

## LYMPHADENOPATHY

### Etiologies:

- Viral – HIV, EBV, hepatitis, measles
- Bacterial – Strep, Staph, TB, leptospirosis
- Fungal or Parasitic – Histoplasmosis, Toxoplasmosis, coccidioidomycosis
- Neoplasm – lymphomas, leukemias, metastasis from solid tumors

# EARLY DETECTION OF BONE MARROW DISEASES



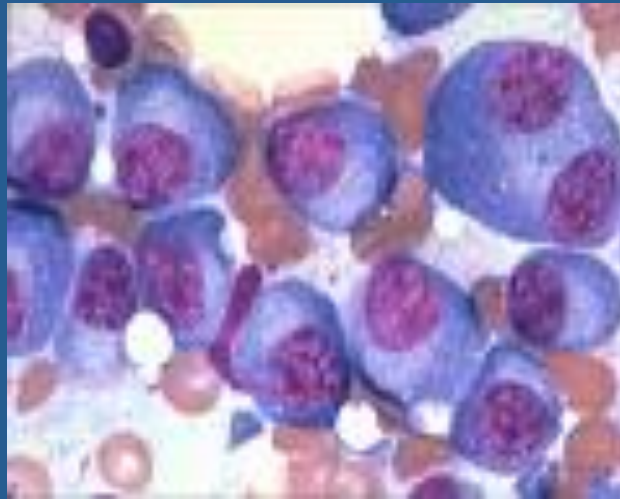
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# EARLY DETECTION OF BONE MARROW DISEASES

## Multiple Myeloma

Cancer of the plasma cells

Raises the number of plasma cells in the  
marrow → blood

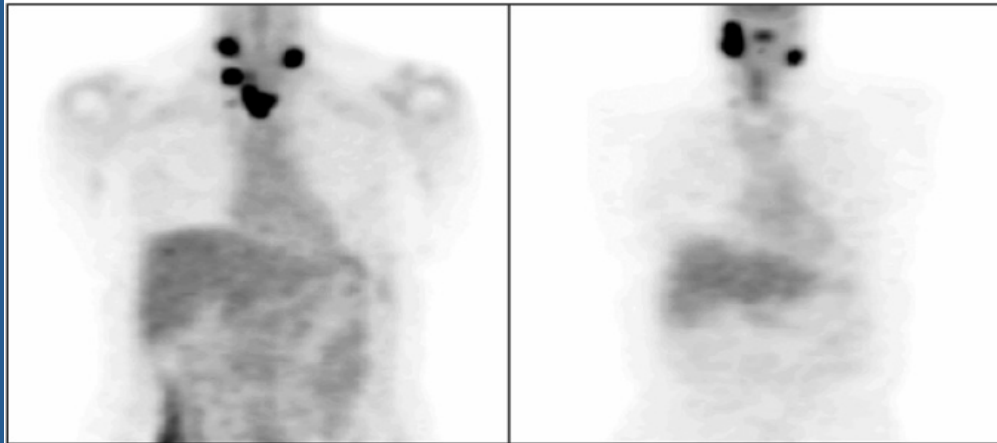


# EARLY DETECTION OF BONE MARROW DISEASES

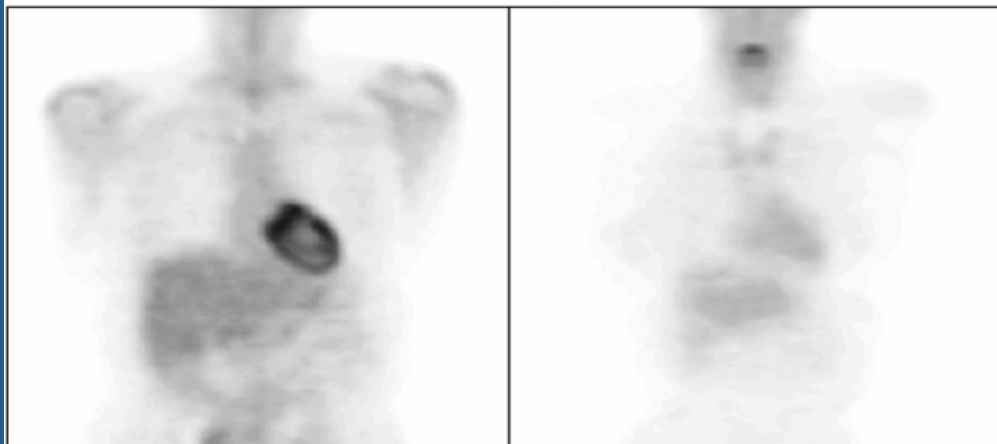
- Lymphoma is a cancer of the lymphatic system ( nodes spread through the body)
- Two main types:
  - Hodgkin's Lymphoma
  - Non Hodgkin's Lymphoma (Malignant Lymphomas)
- Characterized by enlarged lymph nodes

# EARLY DETECTION OF BONE MARROW DISEASES

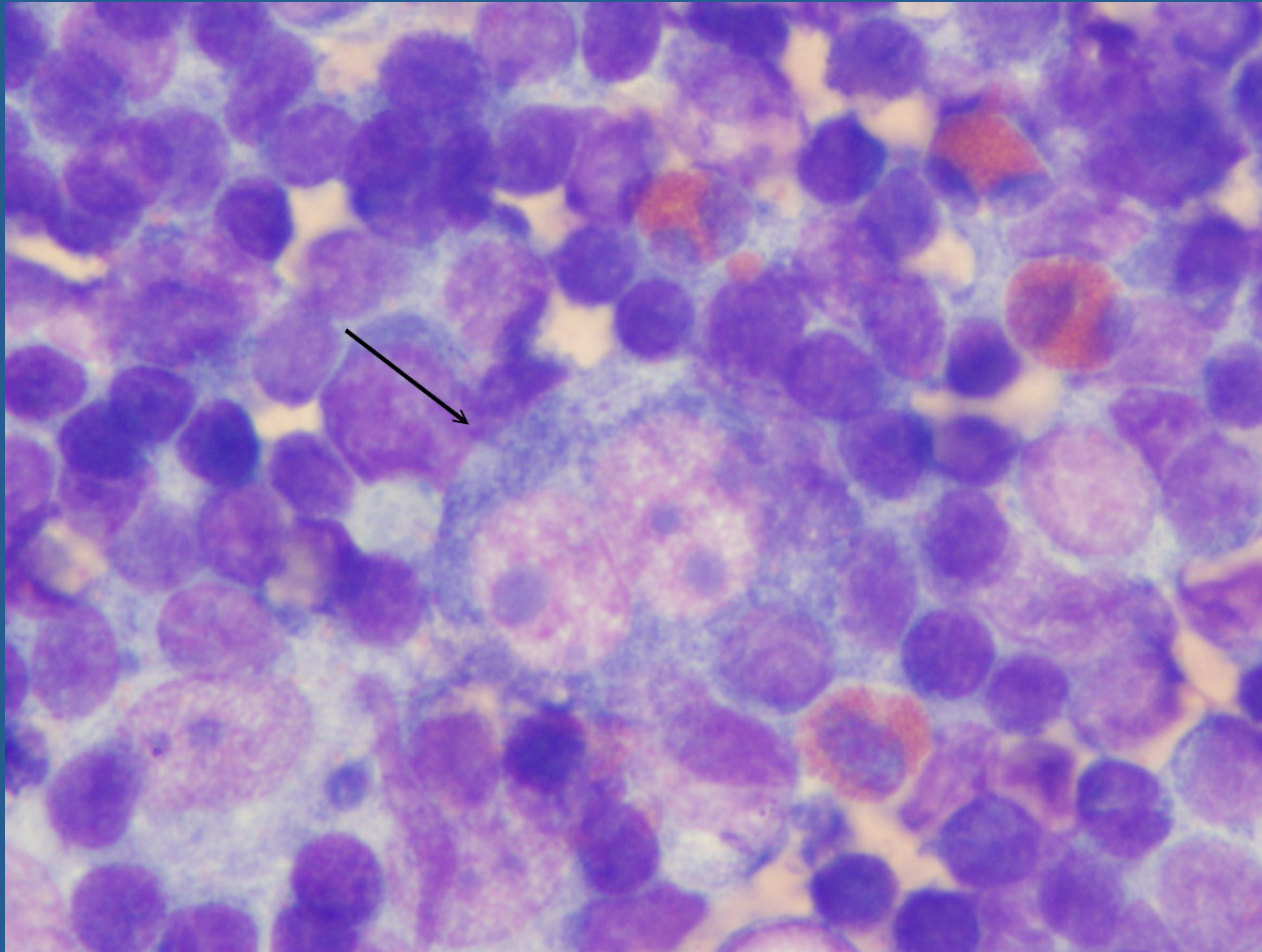
FDG-PET at diagnosis



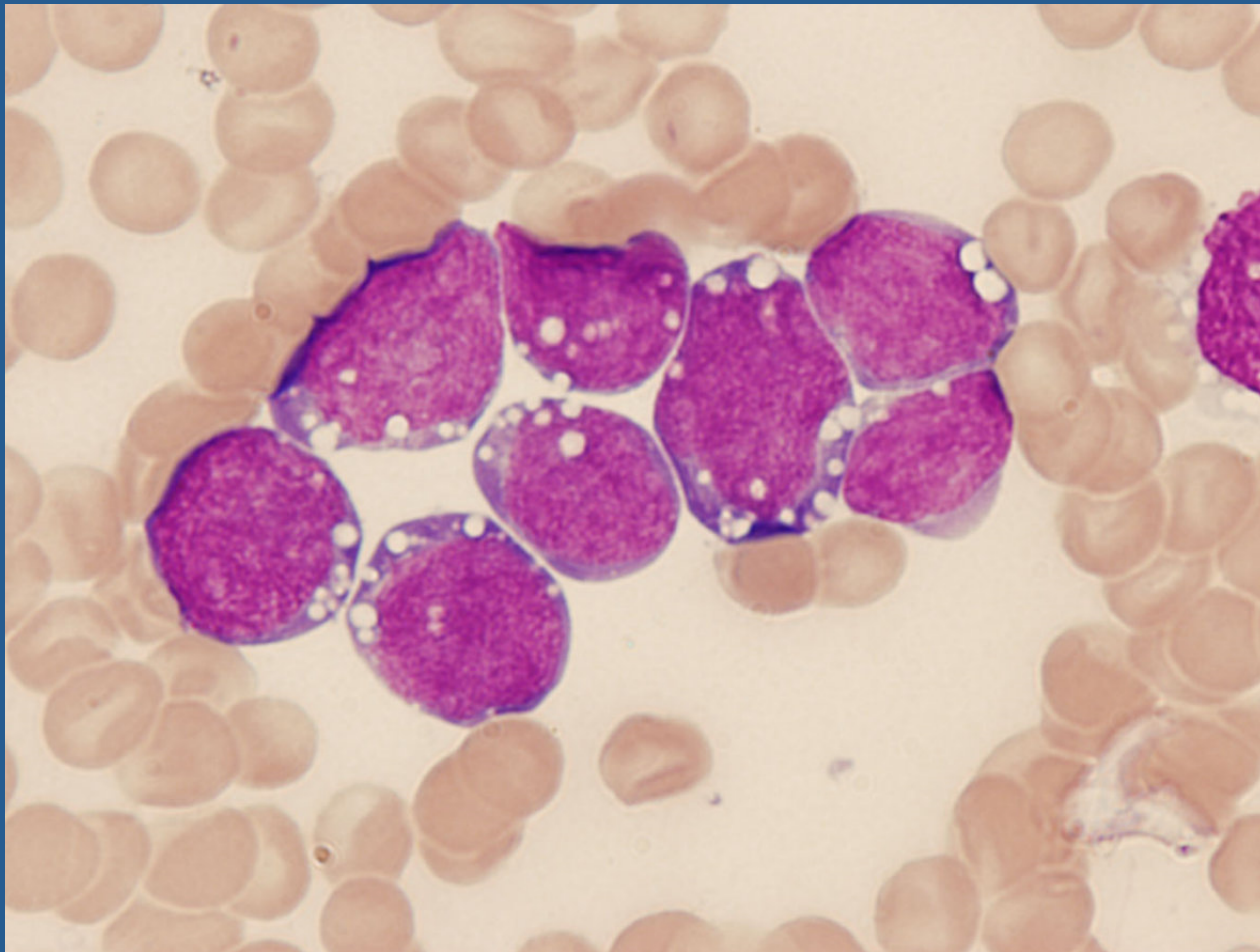
FDG-PET 2 months later after 3 cycles of R-CHOP



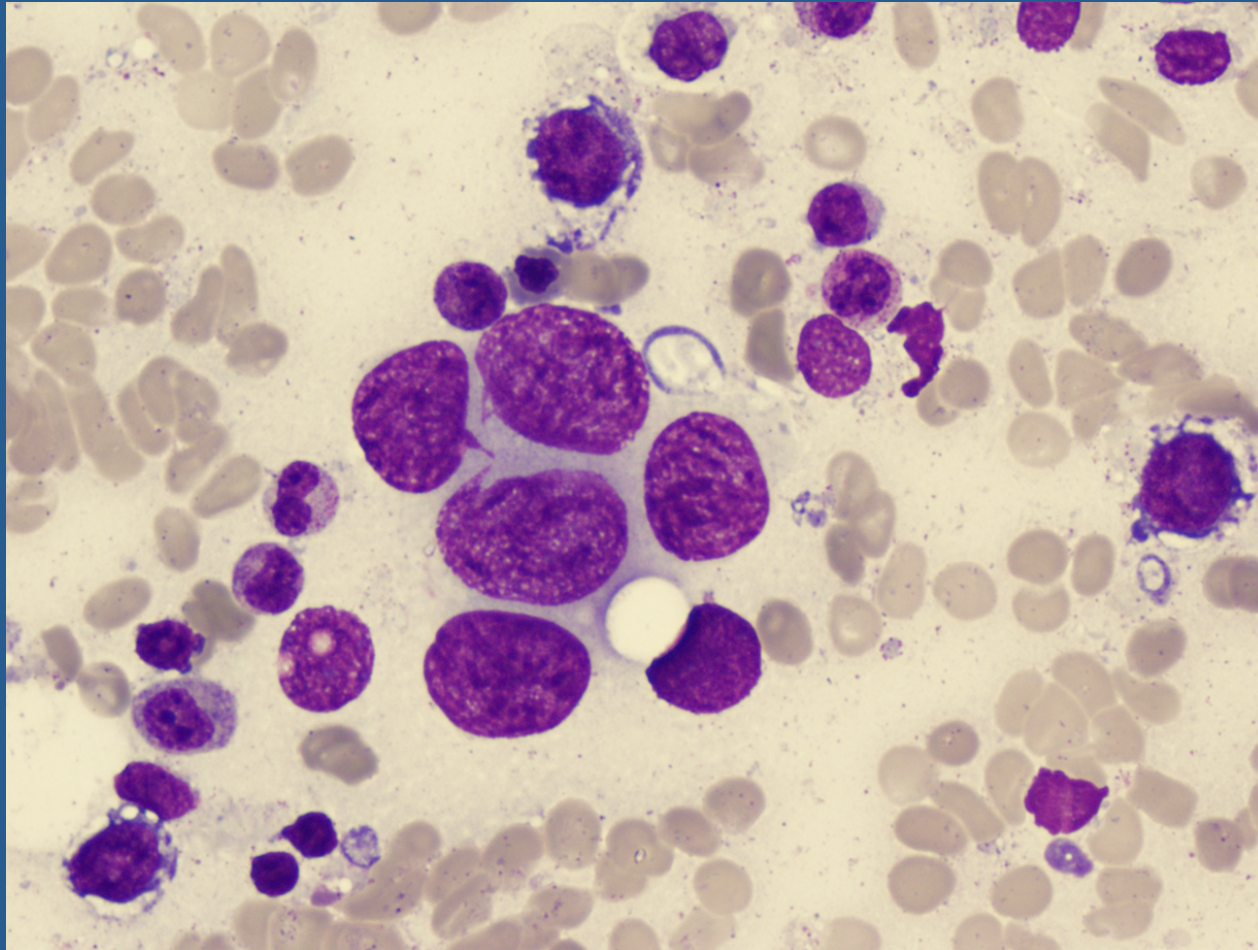
# Hodgkin's Lymphoma



# Burkitt's Lymphoma



# Metastatic Carcinoma to the Bone Marrow



# EARLY DETECTION OF BONE MARROW DISEASES

Bibliography

Sources cited:

Clinical Hematology, Neil Young