

Haematology

Team ⁴³¹

3/4



White Blood Cells

Leaders
Team

Shatha almweisheer & Nasser alsaleh

DoneBy

Abdulrahman Alkadhaib & Alaa Alanazi

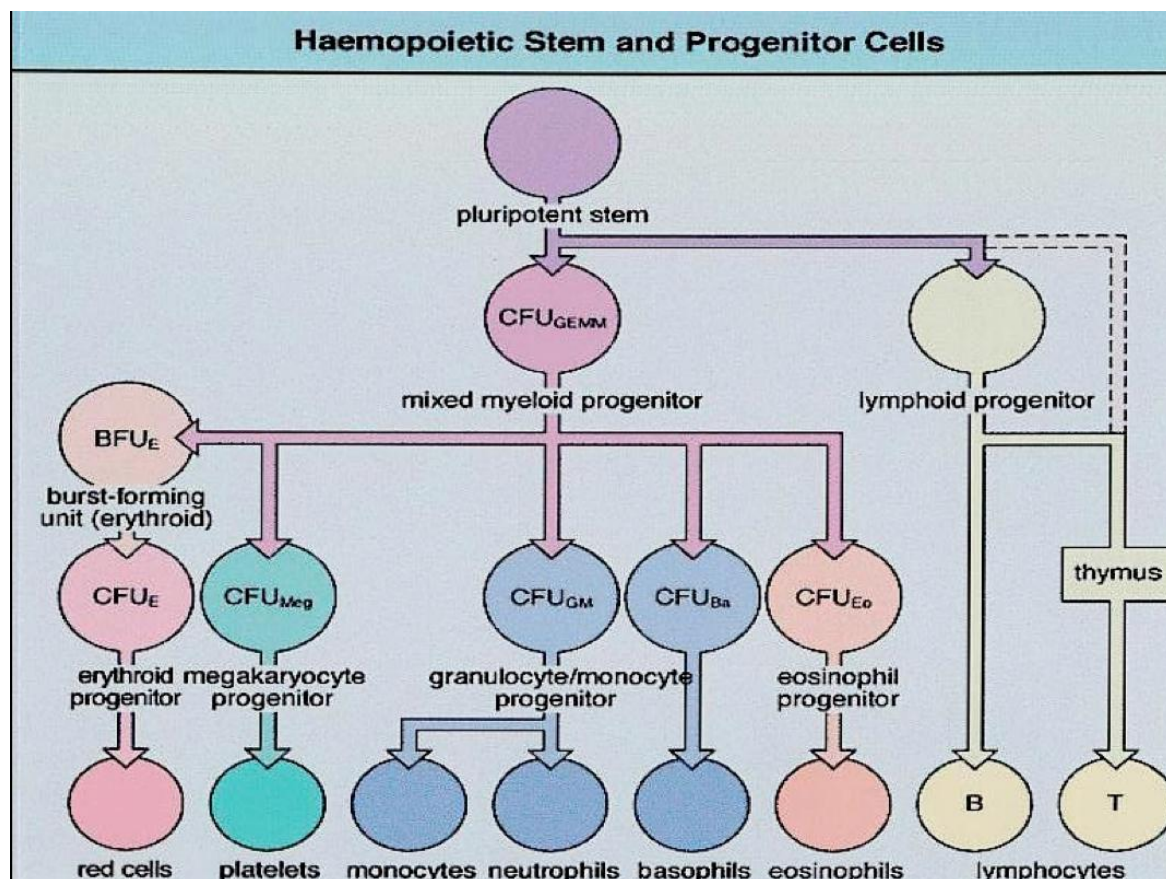
RevisedBy

Mohammed Al-Dhaheri

- Red color = Important information
- Blue color = Additional notes

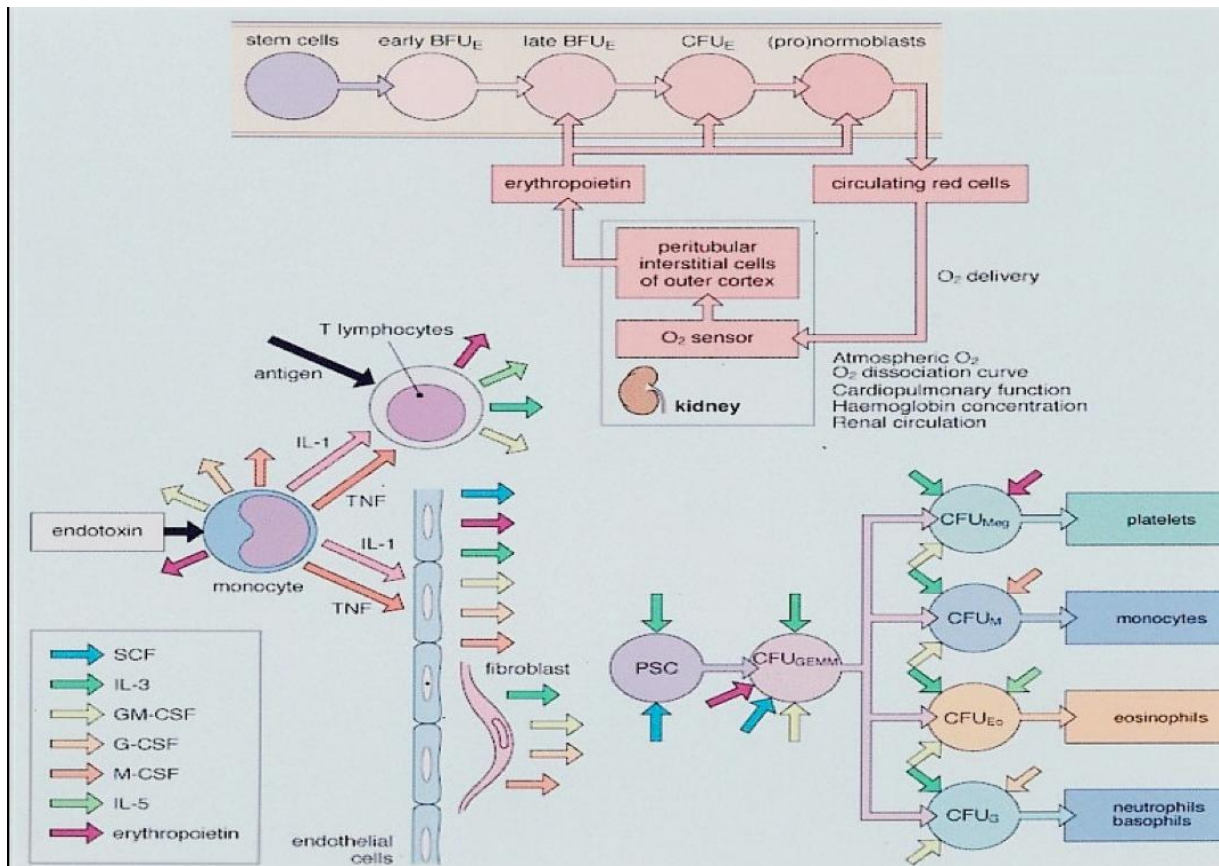
Objectives:

- Identify the types of white blood cells in a normal differential count.
- Know the various leukocyte functions.
- Recognize the abnormalities of the white blood cells and what they imply.
- Interpret the results and correlate the changes with the patient's clinical state (presentation, symptoms and signs, etc....).

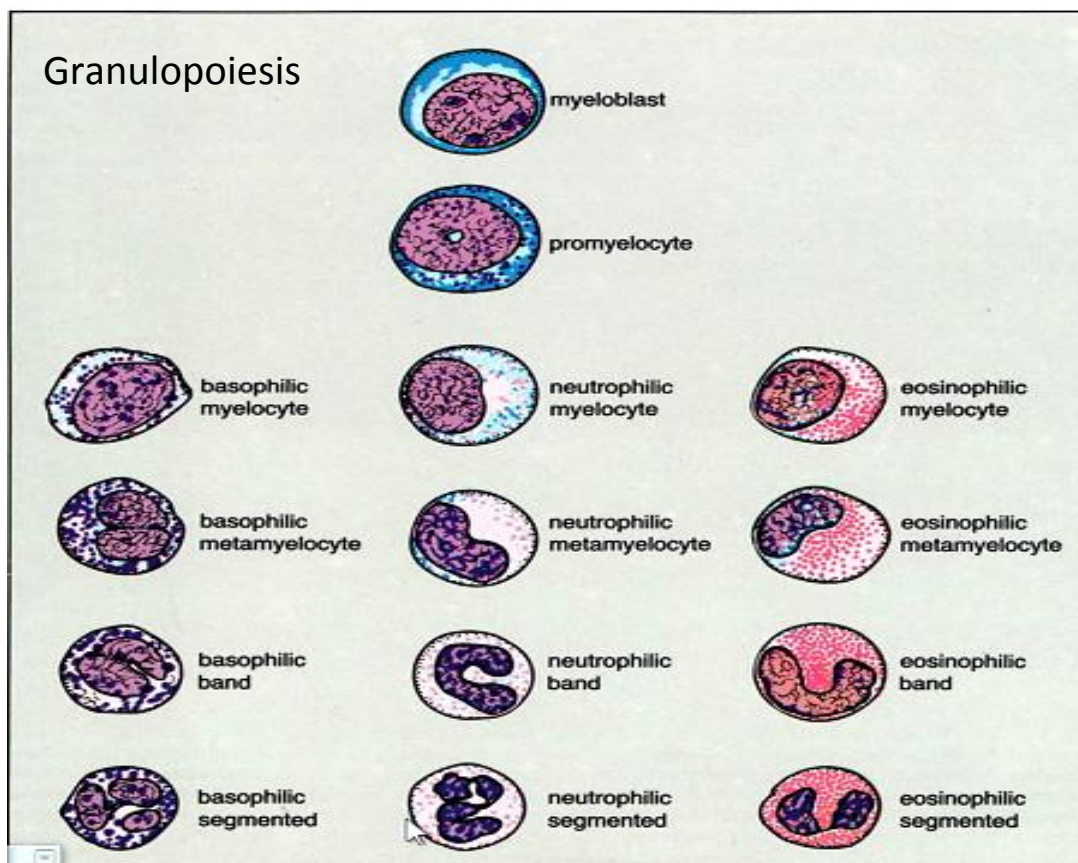


Pluripotent stem cells can differentiate into:

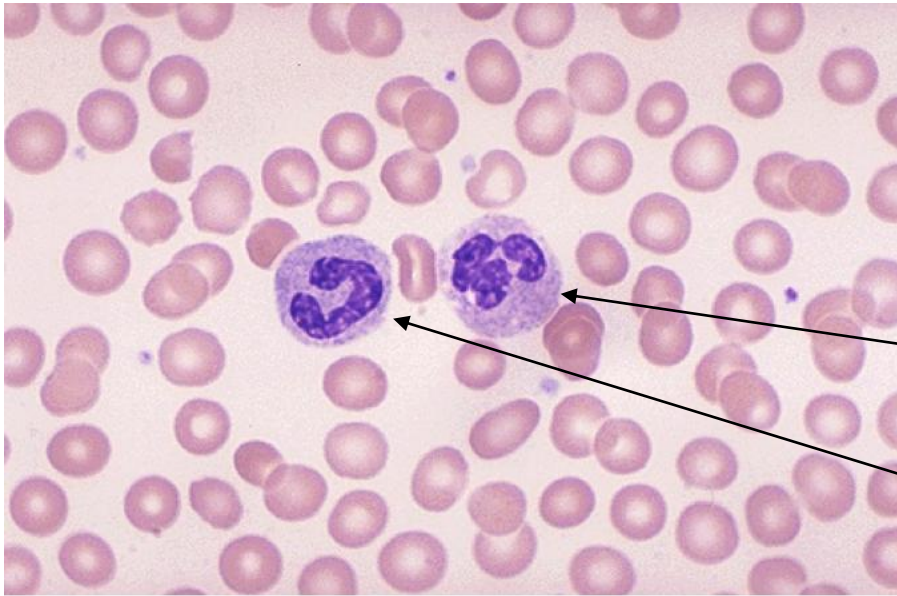
- ❖ Mixed Myeloid Progenitor: produces red cells, platelets, monocytes, neutrophils, basophils and eosinophils.
- ❖ Lymphoid Progenitor: produces T and B lymphocytes.



This picture shows the different factors that controls Haematopoiesis (formation of blood cells) such as colony stimulating factors and interleukins.

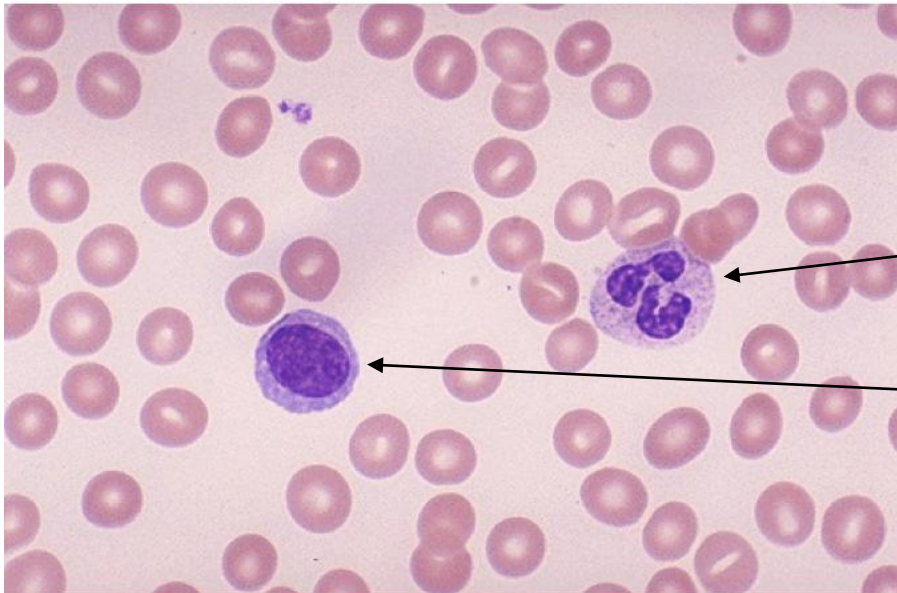


Stages of Granulopoiesis (the formation of granulocytes within the bone marrow).



This normal peripheral smear demonstrates:

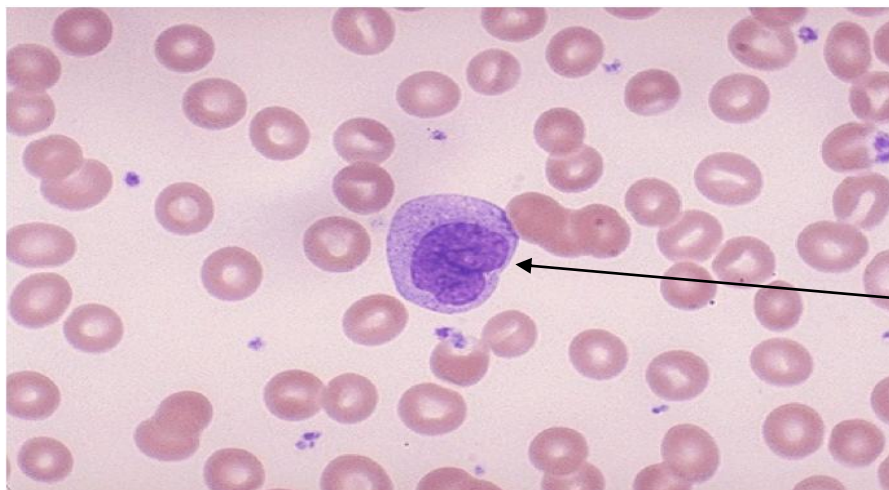
Segmented neutrophil
and
Band neutrophil



This normal peripheral smear demonstrates:

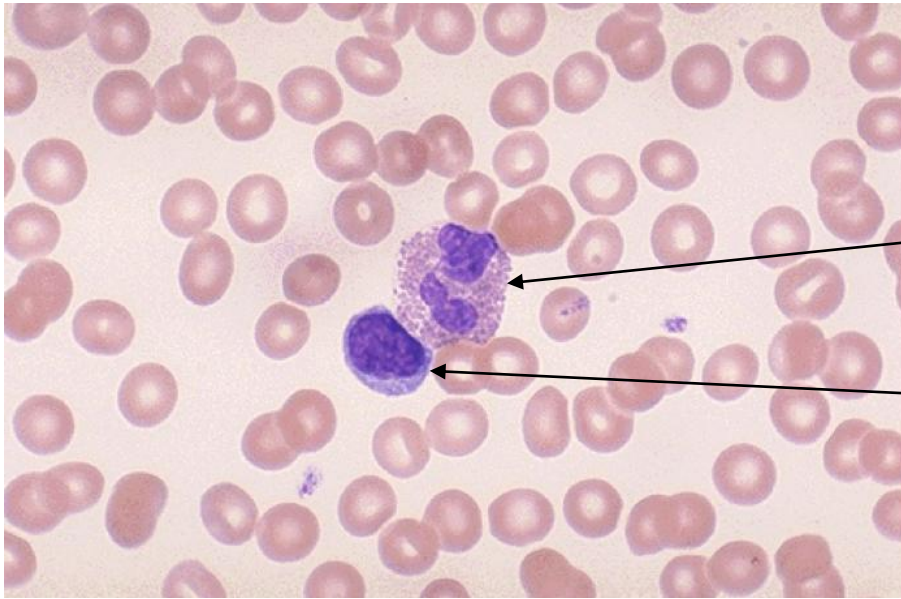
Segmented neutrophil
and
Lymphocyte

Lymphocytes are characterized by a large nucleus



This normal peripheral smear demonstrates:

Monocyte



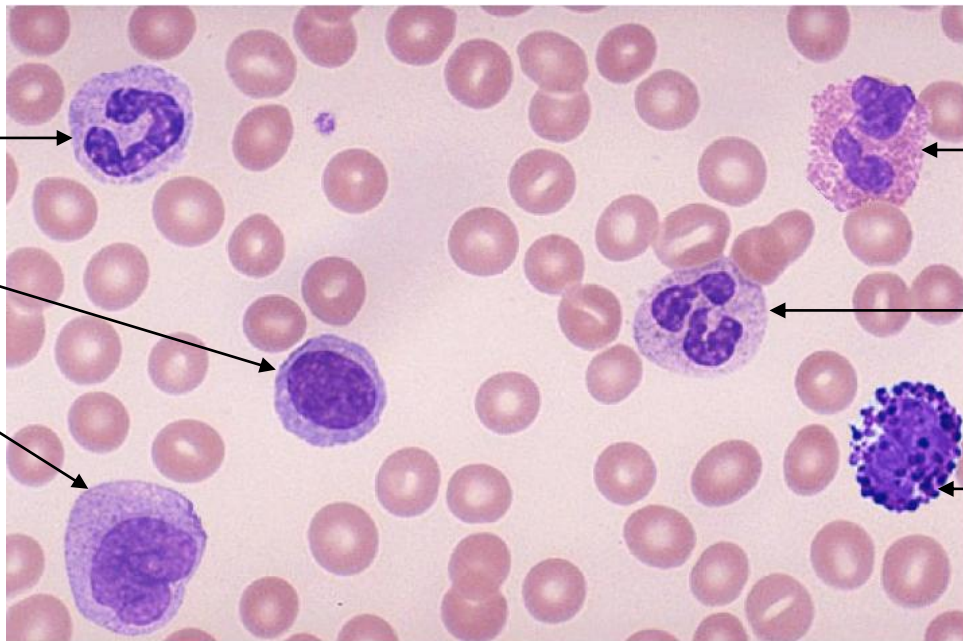
This normal peripheral smear demonstrates:

Eosinophil

and

Lymphocyte.

Normal white blood cells (WBCs)



Band Neutrophil

Lymphocyte

Monocyte

Eosinophil

Segmented Neutrophil

Basophil

Functions of White Blood Cells:

1- Phagocytosis

The neutrophils and the monocytes engulf foreign particles and bacteria through their phagocytic action, thereby destroying their action.

2- Body defense

WBC manufactures anti-bodies and immune bodies to increase the power of resistance against any infection.

3- Formation of fibroblast

Lymphocytes may be converted to fibroblasts in the area of inflammation and help the process of tissue repair and regeneration.

4- Secretion of heparin

The basophile leucocytes are supposed to secrete heparin (a substance of liver), which prevent, intravascular clotting.

5- Anti histamine functions

The eosinophils are believed to defend the body against allergic conditions in which histamine like bodies are produced in excess.

6- Production of thromboplastic substances

Due to the production of such substances, the process of coagulation and the deposit of clot are facilitated.

7- Destroy Cancer Cells

In addition to recognizing and killing virally infected cells, T lymphocytes can also target and kill tumor cells or abnormal cells that may represent the early beginnings of a tumor.

8- Manufacture of trephones:

Leucocytes manufacture certain substances called trephones from plasma protein, which exert great influence on the nutrition, growth and repair of tissues.

White Blood Cells Abnormalities:

❖ Benign

1- Quantitative abnormalities (abnormality in the number of blood cells)

- Leukocytosis (an increase in the number of white blood cells in the blood)
- Leukopenia (a decrease in the number of white blood cells blood)

2- Qualitative Abnormalities (abnormality in the function of blood cells)

3- Leukemia

Laboratory Evaluation of Leukemia:

Morphology

Cytochemistry

Genetic analyses

Chromosomal molecular Immunology

❖ Acute

- Myeloid Leukemia
- Lymphoid Leukemia

❖ Chronic

- Myeloproliferative Disorders
- Lymphoid Leukemia

❖ Myelodysplastic Syndromes

❖ Lymphoma

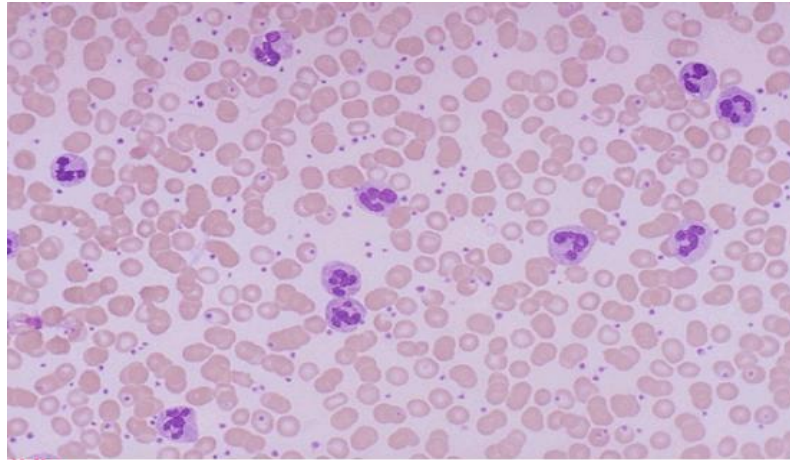
❖ Immunosecretory Disorders (a group of disorders characterized by monoclonal proliferation of immunoglobulin-producing cells that resemble lymphocytes or plasma cells)

❖ Myeloma (a cancer of plasma cells)

❖ Other Plasma Cell Disorders

Neutrophilia

(An increase in number of neutrophils in the blood)

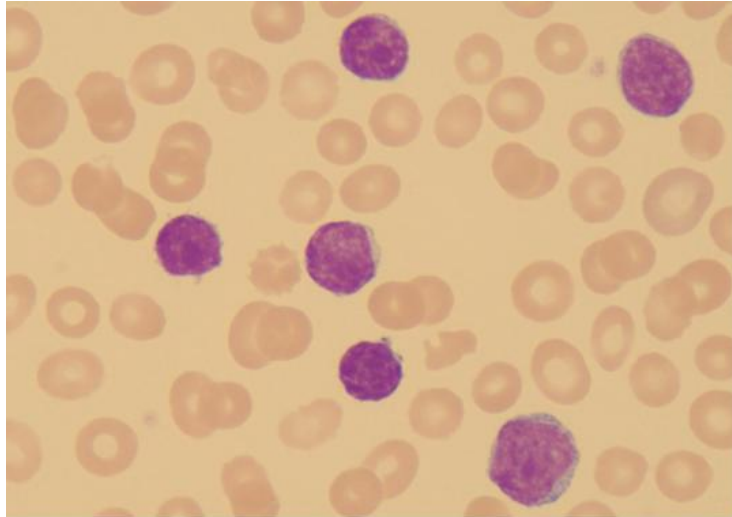


Causes:

Acute infections	Bacterial , viral, fungal, mycobacterial and rickettsial.
Physical stimuli	Pregnancy (the main cause of Neutrophilia) , trauma, electric shock, Anoxia.
Drugs and chemicals	Corticosteroids adrenaline, lead mercury poisoning, lithium
Hematological causes	Acute haemorrhage, acute haemolysis, transfusion reactions, post-splenectomy, Leukemia and myeloproliferative disorders.
Malignant disease	Carcinoma, especially of gastro-intestinal tract, liver or bone marrow
Miscellaneous conditions	Certain dermatoses, hepatic necrosis, chronic idiopathic leucocytosis

Lymphocytosis

(An increase in the number of lymphocytes in the blood)

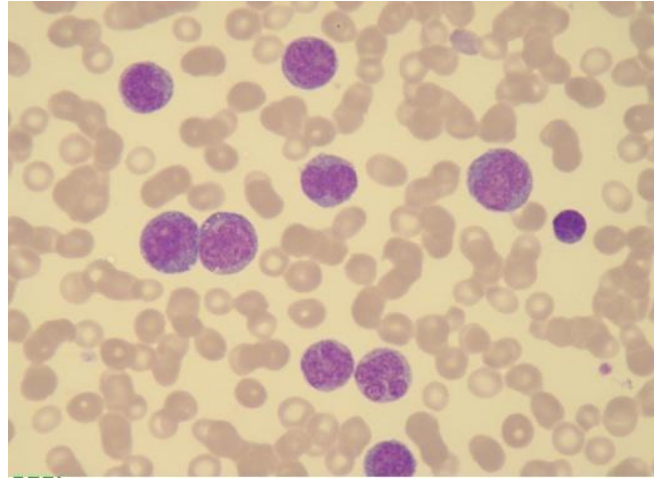


Non-Malignant causes:

<p>Virus infections (main cause)</p>	<p>Infectious mononucleosis Infectious lymphocytosis Cytomegalovirus infection Occasionally mumps, varicella, hepatitis, rubella, influenza</p>
<p>Bacterial Infections</p>	<p>Pertussis Occasionally cat-scratch fever, tuberculosis, syphilis, brucellosis</p>
<p>Protozoal infections</p>	<p>Toxoplasmosis Occasionally malaria</p>
<p>Other rare causes</p>	<p>Hyperthyroidism, congenital adrenal hyperplasia</p>

Monocytosis

(An increase in the number of monocytes in the blood)

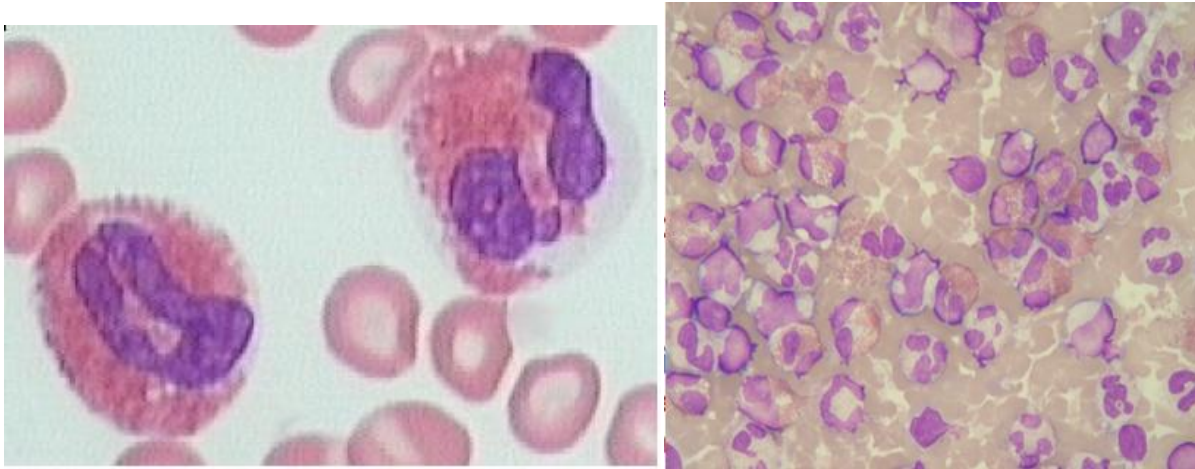


Causes:

Chronic bacterial infections	Tuberculosis, subacute bacterial endocarditis, brucellosis
Other Specific Infections	Malaria, Kala-azar, trypanosomiasis, typhus, Rocky Mountain spotted fever
Malignant diseases	Hodgkin's disease, carcinoma
Leukemia	Acute myeloid leukemia Chronic monocytic leukemia
Neutropenias	Familial benign and severe neutropenia Cyclical neutropenia Drug-induced Agranulocytosis
Miscellaneous	Cirrhosis, systemic lupus erythematosus, rheumatoid arthritis

Eosinophilia

(Increase in number of eosinophil)



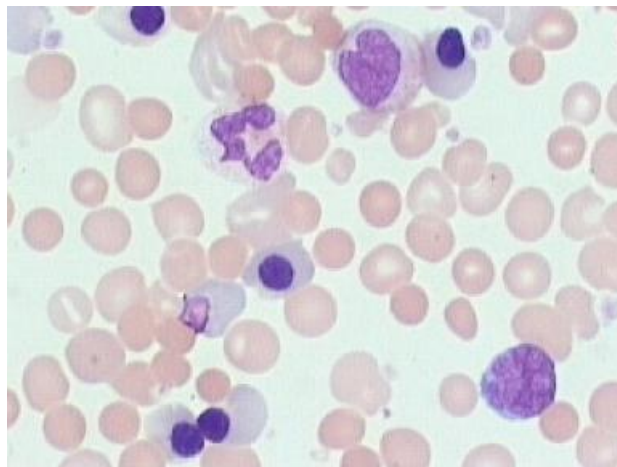
Causes:

Allergic reactions	Asthma, hay fever, urticaria, angioneurotic edema
Parasitic Infestation	Tissue parasites – trichinosis, filariasis, Visceral larva migrans, etc... Intestinal parasites – Ascaris, Taenia, etc. (less regularly)
Skin disorders	Pemphigus, pemphigoid, eczema, psoriasis, (dermatitis herpetiformis)
Drug hypersensitivity reactions	Especially iodides, penicillin, allopurinol, gold salts, tartrazine Loffler's pulmonary syndrome and Loffler's endomyocarditis Tropical eosinophilia (probably filarial)
Malignant diseases	Especially Hodgkin's disease, carcinoma of ovary, lung stomach, angioimmunoblastic lymphadenopathy.
Following irradiation or splenectomy	Hypereosinophilic syndromes Eosinophilic leukemia
Miscellaneous Conditions	Polyarteritis nodosa, ulcerative colitis, sarcoidosis, scarlet fever, pernicious anaemia, chronic active hepatitis, eosinophilic granuloma, familial eosinophilia

Leukemoid Reaction or Leucoerythroblastic Anaemia

Leukemoid Reaction: an increase in white blood cell count (Leukocytosis) caused by an infection or other disease. (It's not a sign of cancer)

Leucoerythroblastic Anaemia: appearance of immature myeloid and nucleated erythrocytes in the blood caused by infiltration of the bone marrow by foreign or abnormal tissue.



Causes:

Severe infections especially in children	a. Pneumonia, septicaemia, meningococcal meningitis b. Infectious mononucleosis, pertussis
Intoxications	Eclampsia, severe burns, mercury poisoning
Neoplasia	Especially with bone-marrow infiltration
Severe haemorrhage or haemolysis	

Neutropenia

(Decreased number of neutrophils)

Causes:

Drugs	<p>Selective neutropenia</p> <p>Agranulocytosis (Aplastic anaemia)</p>
Infections	<p>Viral – including hepatitis, influenza, rubella</p> <p>Bacterial – typhoid fever, brucellosis, military tuberculosis</p> <p>Rickettsial and protozoal infections (Sometimes)</p>
Megaloblastic Anaemia	Vitamin B ¹² or folate deficiency
Chronic neutropenia	<p>Chronic idiopathic neutropenia</p> <p>Immune neutropenia</p> <p>Congenital neutropenias</p> <p>Cyclical neutropenia</p>
Hypersplenism	<p>Primary</p> <p>In association with cirrhosis, Felty's syndrome, etc...</p>
Ionizing radiation and cytotoxic drugs	<p>Radiotherapy</p> <p>Alkylating agents, antimetabolites, others</p>
Malignant disease	<p>Acute leukaemia</p> <p>Leuco-erythroblastic anaemia due to metastatic carcinoma, multiple myeloma or lymphoma</p>
Miscellaneous conditions	<p>Systemic lupus erythematosus, myxoedema, hypopituitarism, iron deficiency, anaphylactic shock</p>

Lymphopenia

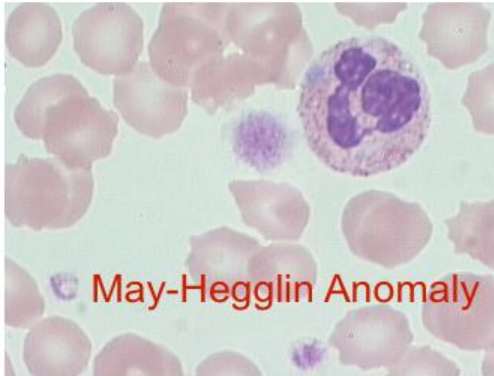
(Decreased number of lymphocytes)

Causes:

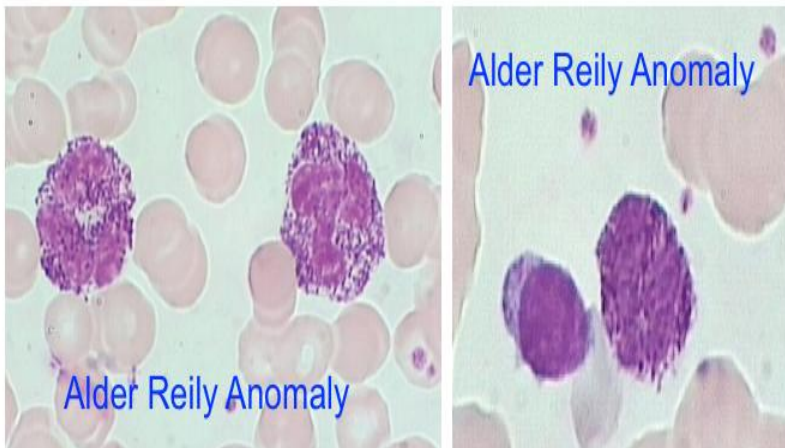
<p>Loss</p>	<p>Mostly from gut as in intestinal lymphangiectasia, Whipple's disease and rarely Crohn's disease Thoracic-duct fistula</p>
<p>Maturation</p>	<p>Primary, or secondary to gut disease Vit B12 or folate deficiency Zinc deficiency</p>
<p>Pharmacological agents</p>	<p>Antilymphocyte globulin Corticosteroids Cytotoxic drugs</p>
<p>Infections</p>	<p>Severe septicaemias Influenza, occasionally other virus infections Colorado tick fever Miliary tuberculosis</p>
<p>Other miscellaneous conditions</p>	<p>Collagen vascular diseases, especially SLE Malignant disease Other conditions with lymphocytotoxins Radiotherapy Graft-versus-host disease</p>

Leukocyte Morphological Abnormalities

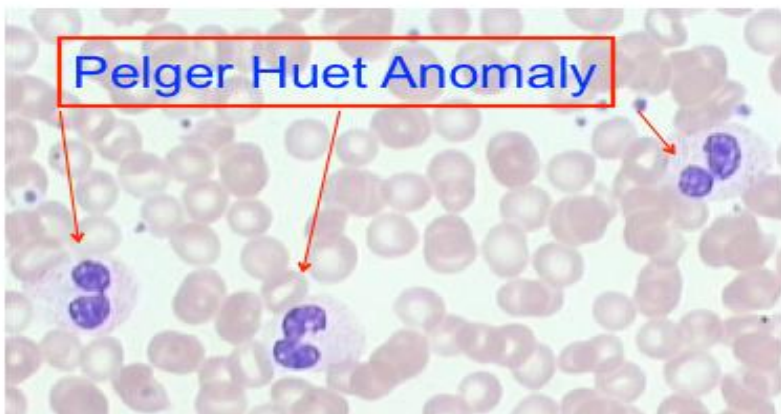
❖ Congenital abnormalities

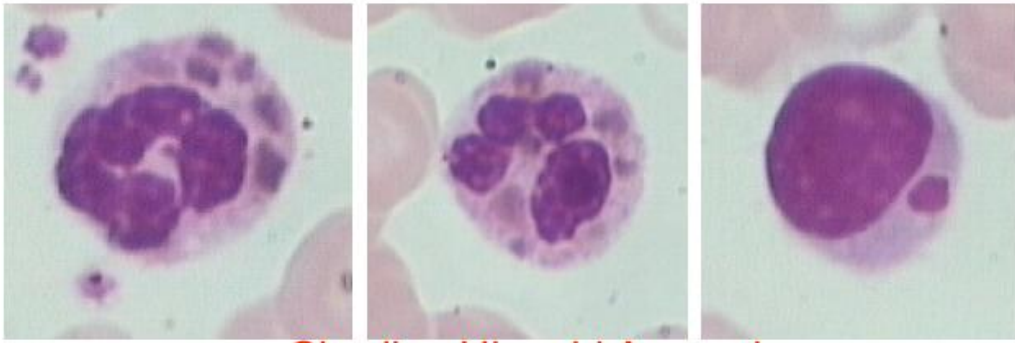


Characterized by giant platelets

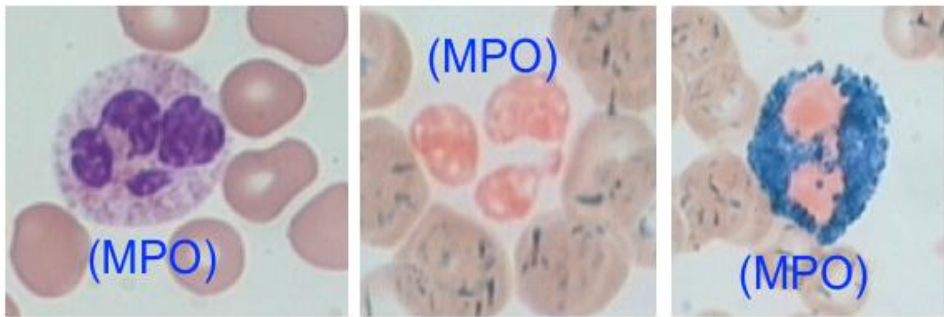


Large granules



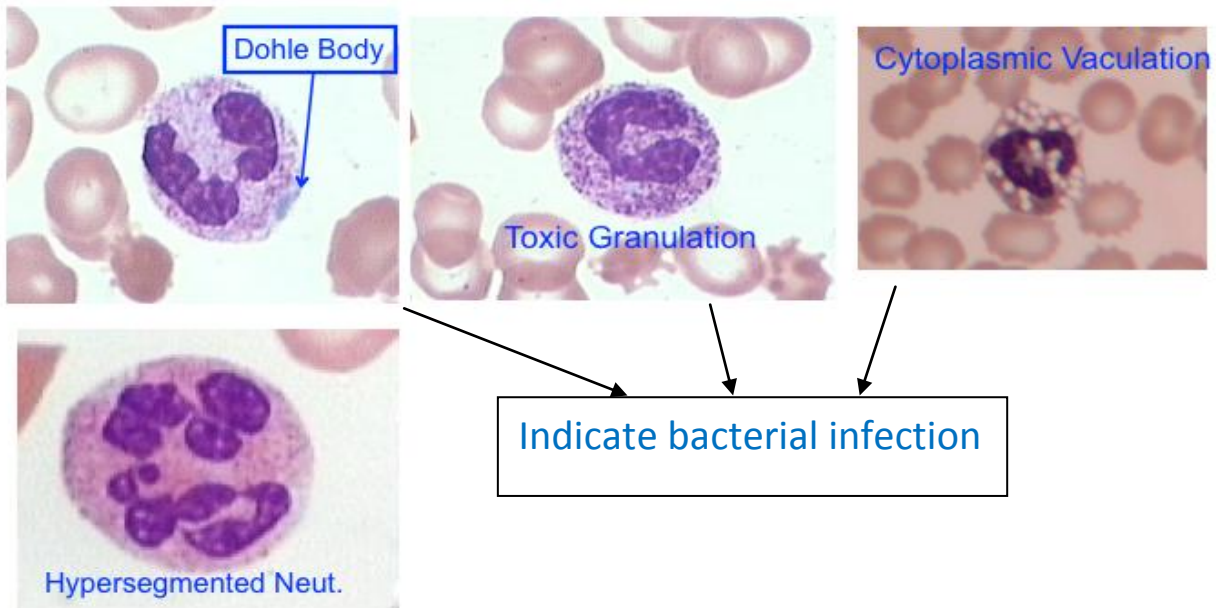


Chediak Higashi Anomaly



Myeloperoxidase (MPO) Deficiency

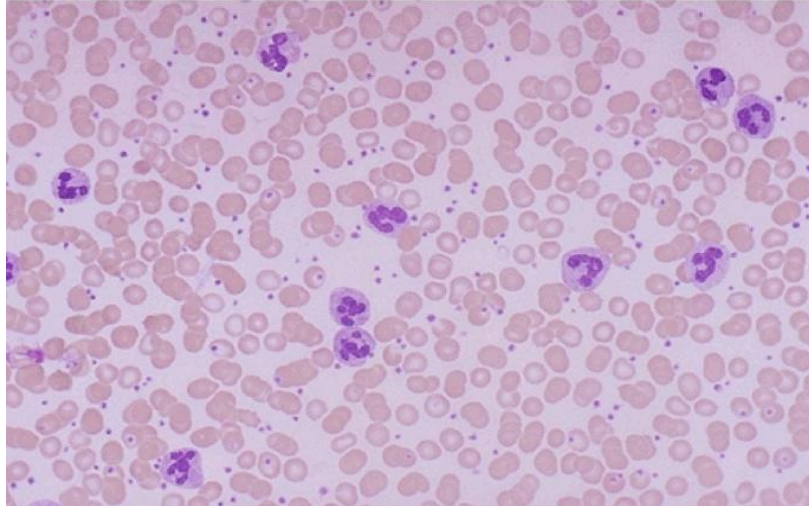
❖ Acquired anomalies:



Case 1

- **History:**

This 20 year old male came to the emergency room with severe abdominal pain in the right lower quadrant. He had a fever of 39 °C. On examination, he had a rigid abdomen & rebound tenderness in the right lower quadrant. There were no other abnormalities.



Urinalysis was within normal limits. A CBC showed Hgb 140 g/l, WBC $25 \times 10^9/L$, and platelet count $350 \times 10^9/L$.

What are the WBCs predominantly seen?

Mainly neutrophils

Notice that the WBC count is higher than in a normal smear.

In addition a small but increased number of **band forms are seen**.

The platelets are moderately increased in number.

What is the name for this type of leukocyte reaction?

This reaction is known as **Neutrophilia**.

What do you think the diagnosis is?

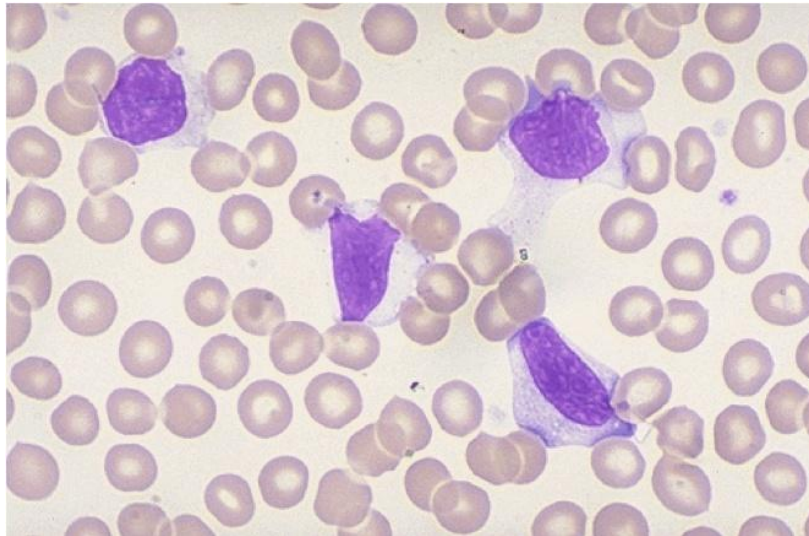
The diagnosis is acute appendicitis.

(Most, but not all, cases of acute appendicitis are associated with Neutrophilia).

Case 2

- **History:**

This 17 year old female was sent home from summer camp because of weakness, lassitude, and sore throat. On examination she was found to have an inflamed pharynx, enlarged tonsils, several enlarged and slightly tender lymph nodes in the neck, a palpable spleen, and a tender palpable liver edge.



CBC showed Hgb 149 g/l, WBC $12.5 \times 10^9/L$, and platelet count $282 \times 10^9/L$

What are the WBCs predominantly seen?

The predominant cells are lymphocytes with many atypical lymphocytes.

What is your diagnosis in this case?

Infectious mononucleosis.

What is the differential diagnosis?

- Other viral infections including hepatitis and cytomegalovirus.
- It should not be confused with leukemia.

What other laboratory test that may be helpful in arriving at a specific diagnosis?

Serologic test for infectious mononucleosis like Paul-Bunnell (Monospot) test would confirm the diagnosis in most cases.

Questions:

1- What is the WBCs abnormality that can be seen in a patient with pertussis?

- A –Eosinophilia
- B – Monocytosis
- C –Lymphocytosis

2- Lymphopenia is found in patients with :

- A – Millitary TB
- B – Acute leukemia
- C – Carcinoma of the ovary

3- May – Hegglin Anomaly characterized by :

- A- Large granules
- B- Giant platelets
- C- Hyper segmented neutrophil

Answers:

C , A , B