

INTERPRETATION of LEUCOCYTES PICTURE

By

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Complete blood count

Test Requested	Results	Reference Range	Units
COMPLETE BLOOD COUNT			
WBC	5.9	4.0-15.5	$10^3/\mu\text{L}$
RBC	5.2	4.8-9.3	$10^6/\mu\text{L}$
HGB	11.5 (LOW)	12.1-20.3	g/dL
HCT	34 (LOW)	36-60	%
MCV	67	58-79	fL
MCH	22.4	19-28	pg
MCHC	34	30-38	%
Comment	RBC MORPHOLOGY NORMAL		
Differential			
	Absolute	%	
Neutrophils	3422	58	$10^3/\mu\text{L}$
Lymphocytes	1888	32	$10^3/\mu\text{L}$
Monocytes	295	5	$10^3/\mu\text{L}$
Eosinophils	295	5	$10^3/\mu\text{L}$
Basophils	0	0	$10^3/\mu\text{L}$
Platelet Estimate	Adequate		
Platelet Count	327	170-400	$10^3/\mu\text{L}$

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Types of blood sample

Whole blood



Plasma



Serum



Blood smear

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The White blood cells (RBCs)

Leucocytes or white blood cells are divided into two main categories:

1. Polymorphonuclear (PMN) leucocytes (granulocytes): Neutrophils, Eosinophils and Basophils (Produced in the bone marrow).
2. Mononuclear leucocytes (agranulocytes): Lymphocytes and Monocytes.



Monocyte



Lymphocyte



Neutrophil



Eosinophil



Basophil

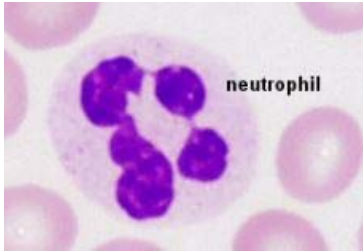

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Granulocytes

A. Neutrophils

The 1st line of cellular defense **Phagocytosis**



Engulf pyogenic bacteria

Elaborate powerful proteolytic enzymes

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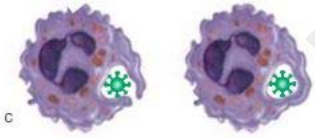

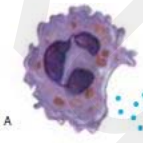
PHAGOCYTOSIS

A. Chemotaxis ----Lymphokines

B. Opsonization

C. Ingestion

D. Digestion



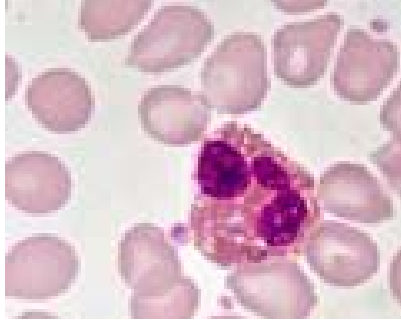
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Granulocytes

b. Eosinophils

Detoxification of protein breaks
down products

Neutralize Histamine
substances



Destroy larval stage of parasite in tissues

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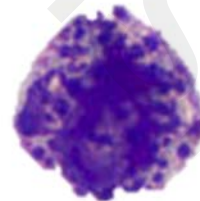
Granulocytes

C. Basophils

Release histamine

Release heparin

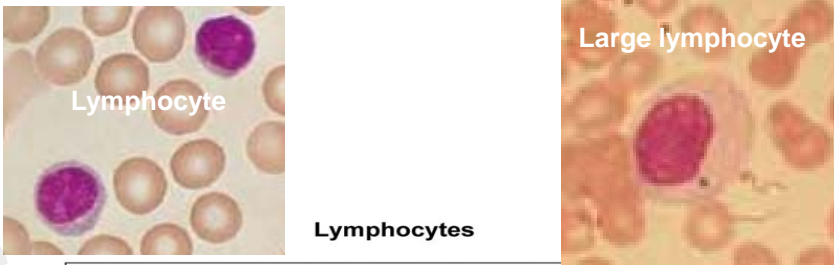
- Stimulate lipoprotein lipase
- clearance of Lipemia



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A. Lymphocytes **Agranulocytes**



The image shows two microscopic views of lymphocytes. The left view shows several small lymphocytes with large, dark purple nuclei and thin rims of light blue cytoplasm, labeled "Lymphocyte". The right view shows a single, larger lymphocyte with a very large, dark purple nucleus and a thin rim of light blue cytoplasm, labeled "Large lymphocyte".

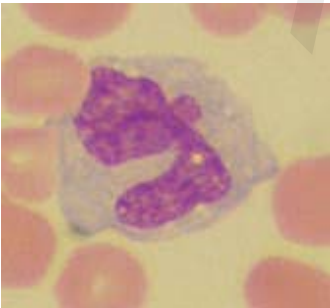
CD8
cytotoxic T cells
Kill virus-infected and damaged cells

CD4
helper T cells
Help cytotoxic T cells and B cells in their immune functions

B cells
Produce antibodies

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B. Monocytes **Agranulocytes**

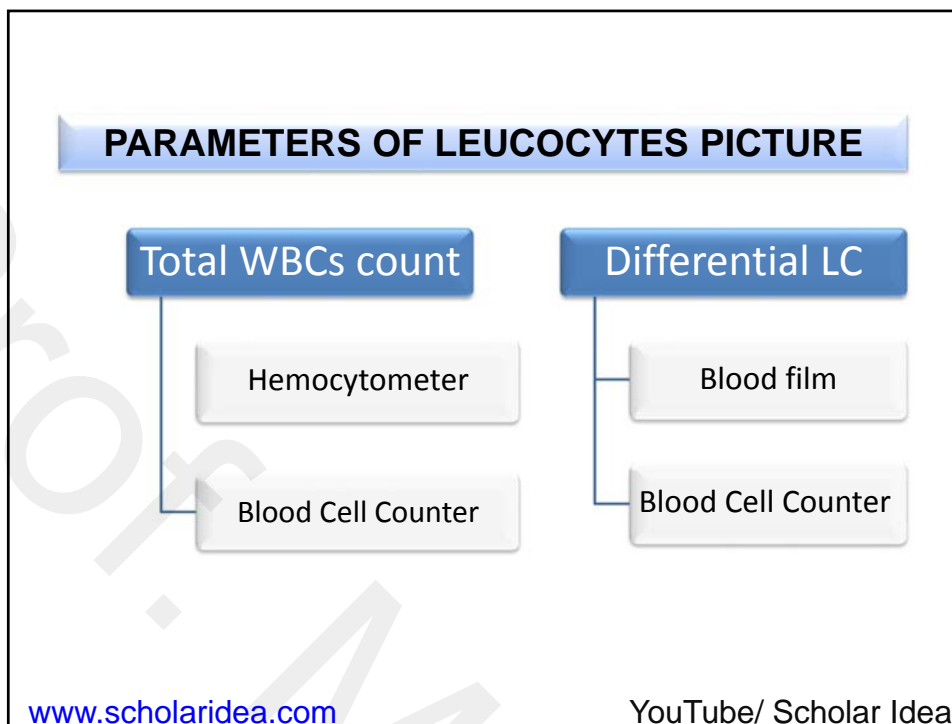


The image shows a single monocyte with a large, kidney-shaped nucleus and a thin rim of light blue cytoplasm, surrounded by other cells.

1- Phagocytosis

2- increase in chronic inflammation and tissue necrosis

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The significance of blood smear examination

1. Identification of different animal species.

Some animal species can be identified by examination of a blood smear, for example blood cells of camel are oval, the blood cells of equines are rounded and form a network, the blood cells of birds are oval and nucleated. However, blood cells from fish are rounded and nucleated.

2. Morphological examination of the erythrocytes and leucocytes.

Blood smear is a major component of the complete blood count, which aimed mainly for evaluating the morphological changes in the erythrocytes and leucocytes. Blood smear can detect abnormalities in shape and stains of erythrocytes, and also can detect immature or abnormal leucocytes.

The significance of blood smear examination

3. Carrying out the Differential leucocyte count.

Differential leucocyte count (DLC) is used to calculate the relative number of the leucocytes in peripheral blood.

4. Diagnosis of leukemia

Microscopic examination of a blood smear is indicated to confirm leukemia.

5. Diagnosis of blood parasites.

Microscopical examination of a blood smear is a basic method for diagnosis of infections with blood parasites either intracellular as Babesia and Theileria, or intercellular as Trypanosoma.

6. Diagnosis of bacterial diseases

Bacteria can be detected during microscopical examination of blood smear as leptospira or in case of bacteremia.

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The significance of blood smear examination

7. A tool to decide the prognosis of some diseases.

The prognosis of certain diseases can be determined by estimating the number of immature and hypersegmented neutrophils in a stained blood smear (Schilling index).

8. Diagnosis of toxicity with some heavy metals like lead

One of the characteristic effect of lead poisoning is the formation of basophilic stippling in the erythrocytes, which is detected by the microscopical examination of a stained blood smear.

9. Estimation of the degree of anemia

The degree of response of the bone marrow to anemia can be evaluated by the microscopical examination of a blood smear and it depends on the presence of immature or nucleated erythrocytes in the peripheral blood.

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The significance of blood smear examination

10. Diagnosis of certain viral diseases

Certain viral diseases like canine distemper form inclusion bodies in the erythrocytes, which can be detected by the microscopical examination of a stained blood smear.

11. Evaluation of the bone marrow

The degree of response of the bone marrow to anemia can be evaluated by the microscopical examination of a blood smear and it depends on the presence of immature or nucleated erythrocytes in the peripheral blood. The intense response of the bone marrow to infection can be evaluated by the detection of immature neutrophils in the peripheral blood. Also, the presence of leukemic cells in the blood circulation indicates the proliferation of immature granulocytes in the bone marrow.

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The significance of blood smear examination

12. Indirect method for counting of platelets

The indirect method of platelet counting is more practical for routine screening purposes and gives a satisfactory estimate. The platelets per oil immersion field on a stained blood smear are counted and compared with the number of red or white cells. For example, the number of platelets per 100 white blood cells multiplied by the total white count is an estimate of the platelet count. Another method is to simply count the number of platelets per oil immersion field where one /oil is equivalent to 15,000/ul.

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INTERPRETATION OF LEUCOCYTES PICTURE

1. Leucocytosis.

2. Leucopenia.

3. Neutrophilia.

4. Neutropenia.

5. Lymphocytosis.

6. Lymphopenia

7. Eosinophilia

8. Eosinopenia

9. Basophilia.

10. Basopenia

11. Monocytosis

12. Monocytopenia

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1. Leucocytosis

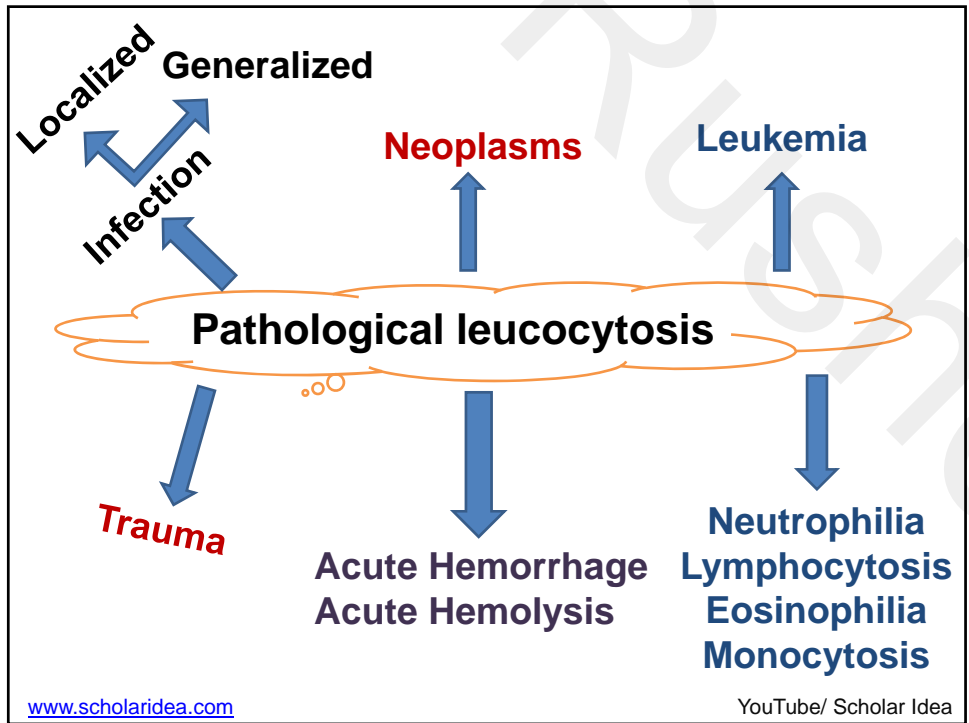
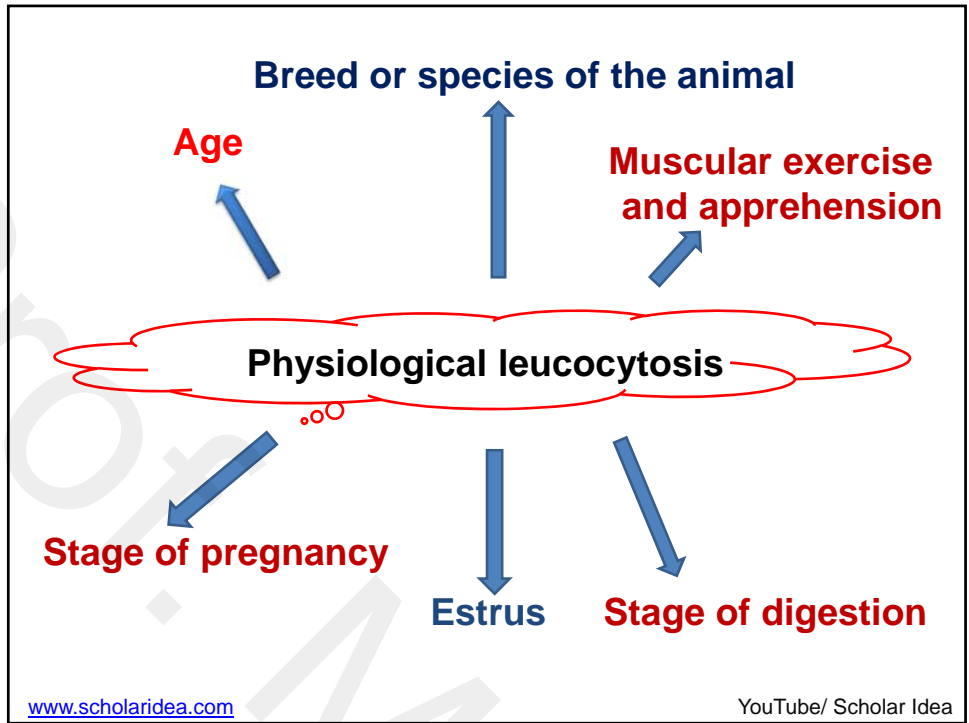
Means increase the total leucocytic count above the normal upper range / unit volume of blood. It is either **physiological or pathological.**

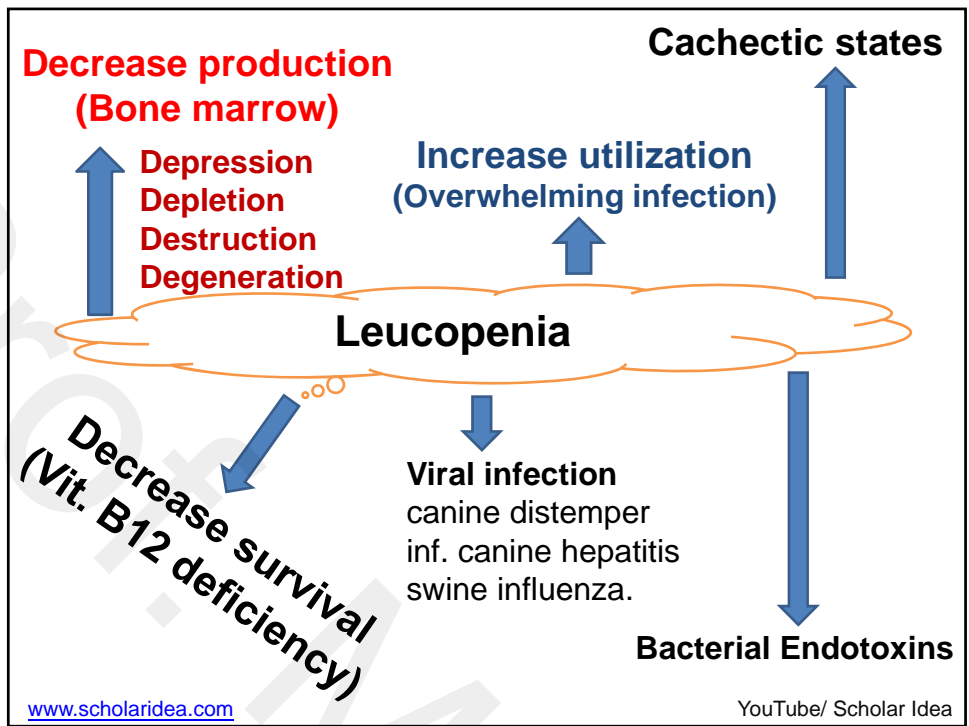
a. Physiological leucocytosis

Causes:

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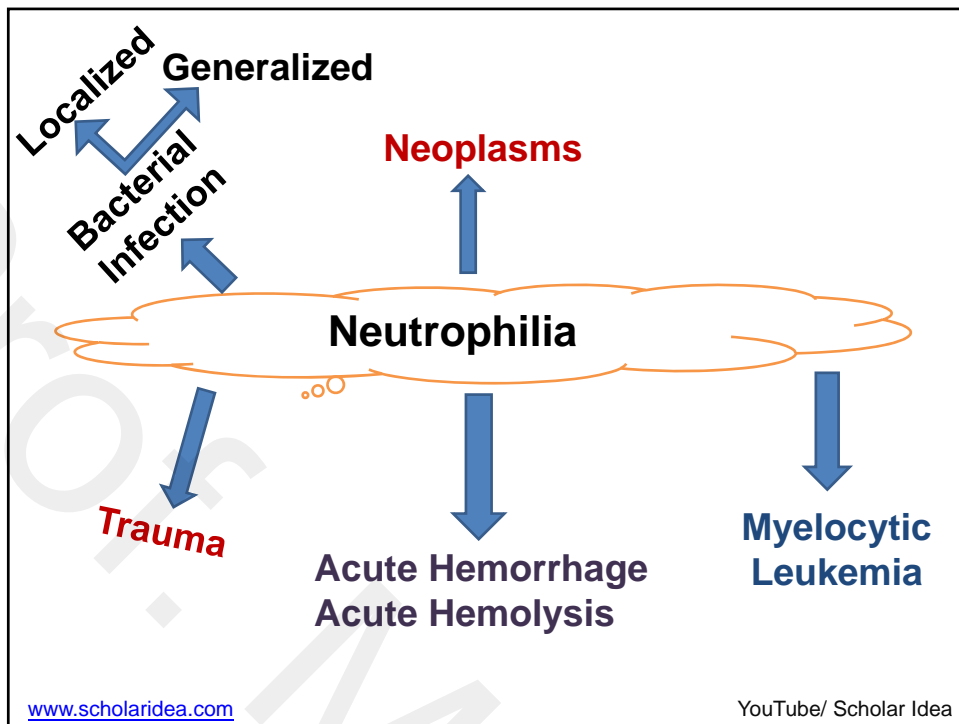


NEUTROPHILIA

Neutrophilia means increase the number of neutrophils in the circulation over about 10^9 / l in monogastric animals and about 4×10^9 /l in ruminants.

Causes

As leucocytosis

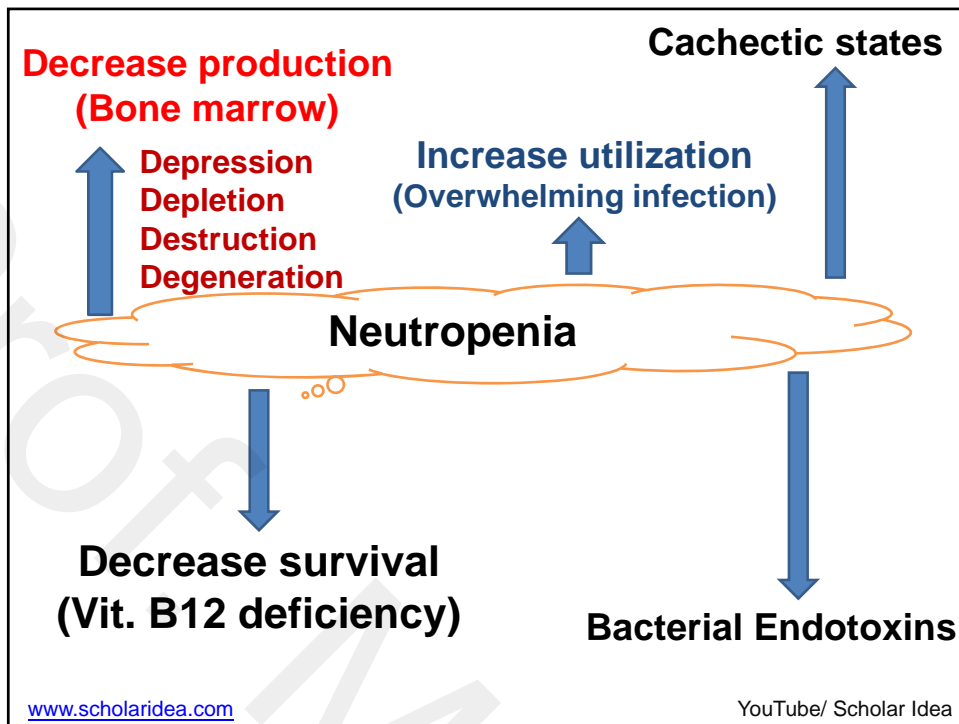


NEUTROPENIA

Neutropenia means decrease the number of neutrophils in the circulation under about $4 \times 10^9 / l$ in monogastric animals and about $1 \times 10^9/l$ in ruminants.

Causes

As leucopenia except viral infection



LYMPHOCYTOSIS

Lymphocytosis means increase the number of lymphocytes in the circulation over about $6 \times 10^9 / l$ in monogastric animals and about $9 \times 10^9/l$ in ruminants.

Causes

1. Viral infection.
2. Following vaccination.
3. Hypoadrenocorticism.
4. Decrease level of ACTH.
5. Lymphocytic leukaemia.

LYMPHOPENIA

Lymphopenia means decrease the number of lymphocytes in the circulation under about $1 \times 10^9 / l$ in monogastric animals and about $3 \times 10^9/l$ in ruminants.

Causes

- Hyperadrenocorticism in stress, steroid therapy.
- Some viral infection as canine distemper, canine hepatitis and infectious feline enteritis.
- Ionizing radiation or immunosuppressive drugs.

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EOSINOPHILIA

Eosinophilia means increase the number of eosinophils in the circulation over about $1 \times 10^9 / l$.

Causes

- Allergy.
- Parasitic infection.
- Adrenocortical insufficiency.
- Granulocytic leukaemia.

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EOSINOPENIA

Eosinopenia means decrease the number of eosinophils in the circulation under about $0.1 \times 10^9 / l$.

Causes

- Stress.
- After administration of ACTH or corticoids as a therapeutic measure.
- Hyperactivity of adrenal gland.

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BASOPHILIA

Basophilia means increase the number of basophils in the circulation over about $0.5 \times 10^9 / l$.

Causes

- Adrenocortical insufficiency.
- Basophilic granulocytic leukemia.
- Hypothyroidism.

BASOPENIA

Basopenia means decrease the number of circulating basophils. Since it is quite normal to find no basophils at all in a blood film, the theoretical possibilities of Basopenia are not worth considering in clinical situation.

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MONOCYTOSIS

Monocytosis refers to an increase the number of circulating monocytes above about $0.5 \times 10^9/l$.

Causes

- Chronic diseases.
- Monocytic leukaemia.
- Listeriosis in swines.
- Hyperadrenocorticism.
- ACTH and corticoid treatment in dog, cow and cat.

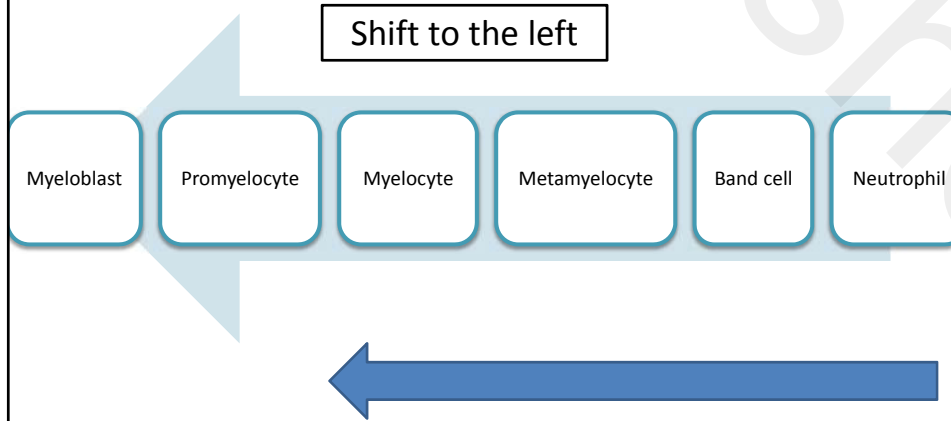
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SCHILLING INDEX

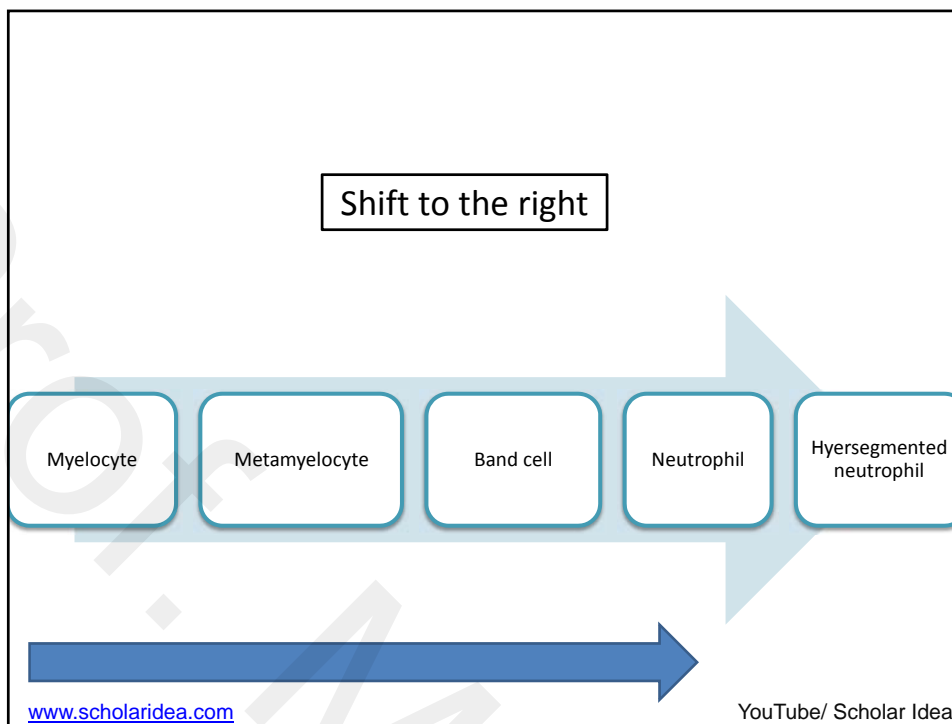
It is an index used for classification of neutrophils depending on maturation of neutrophils.

Shift to the left



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Shift to the left

Shift to the left is used to denote an increase in the number of immature neutrophils in the peripheral circulation i.e. more than 7 % band cells.

a. Regenerative shift to the left: This shift is characterized by a leucocytosis, neutrophilia and with the appearance of immature neutrophilic granulocytes in peripheral blood, it is either:

1. A slight shift to the left: It is limited to the occurrence of band neutrophils.
2. A moderate shift to the left: It includes both band and metamyelocyte neutrophils.
3. A marked left shift: Would bring myelocytes and progranulocytes into peripheral blood

Prognosis: Good prognosis.

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b. Degenerative shift to the left

- There is normal, low total leucocytic count accompanied by moderate to marked shift to the left.
- This alteration is a result of inability of bone marrow to mature cells in response to infection and as a result increase the number of immature forms appear in the blood which show toxic changes.
- A degenerative left shift is common in septicemia.
- Toxic neutrophils are considered abnormal cells and are present in the blood as a reflection of toxic condition.

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Toxic neutrophils appear as:

- Signs of toxemia are seen in neutrophils in diseases accompanied by depression of granulopoiesis.
- Appear in acute inflammatory diseases as peritonitis, pericarditis, mastitis and metritis.
- The appearance of blue black granules.
- The presence of vacuoles located in the cytoplasm along the periphery of the cell.
- Toxic granulation results from precipitation of the basophilic ground substance to form blue black granules.

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LEUKAEMOID REACTION

- A blood picture exhibiting a marked leucocytosis with a considerable number of immature WBCs. It is similar to left shift of the regenerative type in which there is an extreme leucocytosis simulating that observed in leukemic leukaemia.
- Leukaemoid reaction indicates extreme Leucocytosis. With severe left shift to metamyelocyte and myelocytes but no signs of hemopoietic neoplasia and indicate severe inflammation.

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