Leukocytes

Kinetic and function of leukocytes

Accurate interpretation of leukocyte counts is dependent upon an understanding of the functions of and the kinetics associated with the various types of leukocytes.

Granulocytes

Under normal conditions, granulocytopoiesis is a cell renewal system in which cell production equals cell death. Granulocytes are produced in the bone marrow and subsequently released into the peripheral blood, from which they migrate into the tissues in which they have their principal function.

Neutrophils have multiple nuclear lobes separated by constrictions. In tissue, the principal function of the neutrophilic granulocyte is phagocytosis of small particles. Neutrophils are associated with inflammatory conditions. Neutrophils elaborate powerful proteolytic enzymes that react within the cell to destroy phagocytosed particles or may be liberated and function outside the cell body.

Eosinophils Contain pink granules varies considerably among species. primarily function as detoxifiers. Eosinophilic granules have an affinity for histamines and are therefore capable of removing these chemicals from tissues.

Basophil have round and purple granules . Function basophil has histamine release in allergic reactions. And contain heparin which may be it has a principle function to inhibition clotting mechanism. Basophils have function in promoting clearing of fat from the plasma.

Lymphocytes. The mature cell may be designated as either a large or small lymphocyte. Formation of lymphocytes in the thymus, The principal function of the lymphocyte is its immunological activity.

Monocytes. the nucleus is occasionally the shape of a kidney bean but is often elongated and lobulated. The monocytes migrates into tissues and becomes a macrophage. Monocytes play an important role in inflammation.

Interpretation of leukocyte counts

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Accurate interpretation of leukocyte alterations is dependent upon an understanding of the various factors that influence total and differential leukocyte counts in both healthy and diseased animals. Physiologic factors to be considered in the interpretation of leukocyte counts include:

1. Age of animal.

The age of an animal may influence both total and differential leukocyte counts. In general the total leukocyte count in the dog and calf is high at birth. Young animals may have a differential count that varies from that normally found in the adult. The total lymphocyte count is greater in the young dog that in the adult. The blood of the young pig and calf has fewer lymphocytes than that of the adult.

2. Breed or species of animal.

Species variation is marked, ranging from a predominance of lymphocytes in bovine blood to a preponderance of segmented neutrophils in canine blood.

3. Degree of excitement and muscular activity.

The total leukocyte count may be increased and the number of neutrophils will be greater than normal.

4. Stage of pregnancy.

Cow have an increased leukocyte count in the later stages of pregnancy and in dogs a similar increase occur near term

5. Stage of estrus.

Cow have a slight increase in both total leukocyte and neutrophil counts on the day of heat and the first day thereafter.

6. Stage of digestion

The stage of digestion apparently influences the total leukocyte and neutrophil counts in the dog, has a minimal effect in the horse and exerts no influence in ruminants. Total leukocytes and neutrophils increase about an hour after eating.

Leukocytosis

Leukocytosis is an increase in total leukocyte count above the normal upper limit for the animal species. This increase is usullay a consequence of an increase in the total number of circulating neutrophils, although in some circumstances other cell type

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may also be increased. The alteration in the leukocyte picture can be the consequence of a normal physiologic response or a disease condition.

The general causes of leukocytosis, disease condition, are as follows:

1. Generalized infections
2. Localized infection.
3. Intoxications including those produced by metabolic disturbance, chemicals, drugs, and venoms
4. Neoplasms
5. Acute hemorrhage.
6. Sudden hemolysis.
7. Leukemias.
8. Trauma

Leukopenia

Leukopenia is redication in the leukocyte count below normal values. Leukopenia either may be balanced (i.e., a dercrease in all cellular elements) or may be confined to a single cellular element. The latter is referred to by the more specific name (neutropenia, lymphopenia, or eosinopenia. The general causes of neutropenia are related to alteration in the bone marrow and are known as the three D:

1- Degeneration (ineffective granulopoiesis).

Degeneration of the marrow is usually the result of a condition that causes deficiency in bone marrow activity that results in an inability to mature neutrophils. Such a condition is reflected by a large number of immature neutrophils in the peripheral circulation.

2- Depression (reduced granulopoiesis).

Depression results when the marrow loses its ability to produce neutrophils in response to peripheral demands. This alteration is characterized by a diminished number of neutrophils with zero or very few immature neutrophils in peripheral blood.

3- Depletion (reduced survival in blood).

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Depletion occurs when the demand of leukocytes is such that the marrows storage pool is exhausted and the compensatory functionaly reaction has not yet become manifest.

Destruction of the marrow is usually the result of chemical or physical agents that destroy blood forming elements in bone marrow. Bone marrow destruction is manifest by a decrease in all cell types formed in the marrow. Immature forms of neutrophils are not usually seen in the peripheral blood.

If any of these alteration occur in the bone marrow, the number of neutrophils in the peripheral circulation is decreased.

Conditions that may produce leukopenia are as follows:

1. Viral infections
2. Bacterial infection.
3. Endotoxins from gram negative bacteria
4. Physical agent such as X- ray and radioactive substance.
5. Chemical agents included are some of the antibiotics (chloramphenicol, pencillin, streptomycin, and oxytetracycline); analgesics; inorganic chemicals including lead, bezene, and mercury.
6. Anaphylactic shock.

Lymphocytosis

Increase in the absolute number of circulating lymphocytes occur occasionally in domestic animals and may be caused by one or more of the following conditions:

1. All conditions that have an associated neutropenia.
2. Lymphocytic leukemias.
3. During recovery stages of certain infections.
4. Adrenocortical insufficiency.
5. Lymphocytosis sometimes occurs following vaccination.
6. Hyperthyroidism.

Lymphopenia

Decrease of the lymphocytes my be caused by:

1. Certain viral disease such as canine distemper, infection canine hepatitis, parvovirus gastroenteritis, coronavirus enteritis.
2. Stress.
3. The injection of adrenocortical hormones or ACTH.

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4. Ionizing radiation or immunosuppressive drug.

Monocytosis

1. Chronic disease examples are fungal infection.
2. Certain infectious disease (listeriosis, brucellosis)
3. Monocytic leukemias.
4. ACTH and corticoid treatment.
5. In association with stress reaction.
6. Hyperadrenocorticism.

Eosinophilia

Eosinophilia is an increase in the number of circulating eosinophils in the peripheral blood. It seen in the following conditions:

1. As a reflection of hypersensitivity conditions such as parasitism and allergic reaction.
2. In adrenocortical insufficiency.
3. Granulocytic eosinophilic leukemias.
4. Neoplasms of the ovary, and bone.

Eosinopenia

A decrease in the number of circulating eosinophils is difficult to detect. Decrease may occur in:

1. Stress
2. After administration of ACTH or corticoids.
3. Hyperactivity of the adrenal gland.

Basophilia

An increase in the absolute number of basophils is rare

Classification of the leukocytic response.

Certain terms are commonly used to describe alterations that occur in the total and differential leukocyte count in domestic animals. These alterations are often referred

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to in interpreting counts, thus an understanding of these changes and their mechanisms is important in interpretation.

Shift to the left

Is a term used to enote an increase in the number immature neutrophils in the peripheral circulation. Two types of shift to the left have been described.

A regenerative left shift

Is characterized by an absolute increase in neutrophils accompanied by the appearance of immature neutrophils in the peripheral circulation.

A degenerative left shift

Is one in which there is a normal, low, or falling total leukocyte count accompanied by a moderare to marked shift to left, with absolute number of immature neutrophils frequently exceeding the number of mature neutrophils. This alteration is a result of the inability of bone marrow to produce mature cells in response to infection.

Toxic neutrophils

Are abnormal and their presence in the blood reflects a toxic condition there are several criteria used to identify such cells (the appearance of very few to many blue black granules in the cytoplasm of the neutrophils, and presence of vacuoles located in the cytoplasm).

Interpretation of leukocyte alteration

In general it may be said that the extent of leukocytosis indicates the degree of an individuals **resistance** and that the degree of left shift indicates the **severity of the infection**. In keeping with this concept, asimultaneous fall in total leukocyte count and an increase in immature neutrophils are **unfavorable prognostic signs**.

Essentially three factors in relation to a disease condition can be elicited by interpretation of the leukocyte picture:

1. Severity of the condition
2. Duration of the process
3. Prognosis.

The severity of a disease is judged by the following:

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1. A neutrophilia with a slight left shift and persistence of the eosinophils is suggestive of a mild infection.
2. A high total leukocyte count consisting mainly of neutrophils is indicative of a more severe condition with good bone marrow response.
3. A neutrophila with a coexistent lymphopenia and eosinopenia is indicative of moderately severe to severe condition.
4. If toxic neutrophils are present that condition is severe.
5. If immature neutrophils are present in excess of the number of mature neutrophils the condition is severe.

The duration of the disease process may be estimated by an examination of the leukocyte alteration. These however is probably the most difficult factor to evaluate accurately in interpreting a leukocyte count.

1. Acute disease conditions may be accompanied either by a regenerative shift to the left with the characteristic appearance of immature neutrophils or by a leukopenia.
2. As the disease regresses, the number of immature neutrophils decreases although the total neutrophil count may continue to be high the majority of the cells are mature.
3. In chronic disease, one of the most characteristic alterations is an absolute increase in monocytes. Some chronic conditions may also be typified by the appearance of a degenerative left shift or bone marrow depression.

The prognosis of disease is facilitated by proper interpretation of leukocyte counts. The prognostic significance of these determinations is of more value if several leukocyte counts of the patients blood are available for evaluation.

Unfavorable prognostic signs are:

1. Degenerative shift to the left.
2. Persistent lymphopenia.
3. Increase in the toxicity of neutrophils.
4. The absence of eosinophils over period of time.
5. A persistent leukopenia with decreased numbers of all types of cells.

Favorable prognostic signs are:

1. Falling total leukocyte count with reappearance of lymphocytes and eosinophils.
2. Disappearance of toxic neutrophils.

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3. A decrease of immature neutrophils.
4. Reappearance of eosinophils.
5. Temporary increase of monocytes.
6. Occurrence of regenerative left shift in an animal that has had a leukopenia.

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