

Evaluating Common White Blood Cell Patterns

Eric Morissette DVM, Dipl. ACVP (Clinical Pathology)



Changes in total and differential white blood cell (WBC) counts are usually grouped into patterns, which facilitate interpretation.

These patterns include:

- I. Stress leukogram
- II. Physiologic leukocytosis
- III. Inflammatory leukogram
- IV. Leukemoid reaction

I. Stress Leukogram

Causes:

- Endogenous stress: Chronic or acute increase in endogenous corticosteroids (expected in sick animals)
- Hyperadrenocorticism: Excess endogenous corticosteroids
- Corticosteroid medication administration

Pattern: The classic stress leukogram pattern includes neutrophilia, lymphopenia, monocytosis, and eosinopenia. The most consistent finding is mild mature neutrophilia (generally with no left-shift), followed by a lymphopenia.

II. Physiologic Leukocytosis

Causes:

This leukogram pattern is due to epinephrine or norepinephrine release. It is also called a “flight or fight” response.

Pattern: The classic physiological leukocytosis pattern is mild neutrophilia (mature cells with no left-shift) and lymphocytosis, sometimes called a “physiologic lymphocytosis.”

III. Inflammatory Leukogram

The inflammatory leukogram pattern depends on the timing of sample collection and represents the balance between tissue consumption and bone marrow production of WBC. The neutrophil numbers in inflammation can vary from severely depressed to markedly increased. A left-shift indicates the presence of immature neutrophils in blood and usually, but not always, indicates an inflammatory leukogram.

Acute inflammation (Regenerative left-shift)

Segmented and immature neutrophils.

Pattern: Variable neutrophilia with varying degrees of left-shift and toxic changes.

Chronic inflammation

Pattern: Neutrophil counts may be normal or only marginally increased. Left-shift is only mild or absent since the bone marrow adequately supplies the demand. Toxic changes are generally not observed.

Peracute, severe overwhelming inflammation (Degenerative left-shift)

Pattern: Normal or decreased number of neutrophils with a left-shift, which may include more immature forms than bands.

- Some patients may have more immature than mature/segmented neutrophils (degenerative left-shift)
- Moderate to severe toxic change in neutrophils should be present
- Other WBC involved in an inflammatory leukogram pattern:
 - Monocytosis
 - Lymphopenia

Causes of inflammation include:

- Infectious agents: Bacteria, viruses, protozoa, fungi
- Immune-mediated conditions: Auto-immune disease, vasculitis, polyarthritis, etc.
- Neoplasia: Due to host response to the tumor, tumor necrosis, or cytokine production by the tumor cells (paraneoplastic response)
- Necrosis: Hypoxic injury, trauma, infarct, tissue burns, etc.
- Foreign body

Evaluating Common White Blood Cell Patterns

IV. Leukemoid Reaction

Causes:

- Focal suppurative lesions (pyometra, pleuritis or pyothorax, peritonitis, prostatitis, pneumonia, and abscesses)
- Hemolytic anemia (especially immune-mediated)
- Canine babesiosis
- Canine hepatozoonosis (*Hepatozoon americanum*)
- Paraneoplastic neutrophilia
- Neutrophilia of leukocyte adhesion deficiency (LAD)
- Granulocyte colony stimulating factor (G-CSF) administration

Pattern: This leukogram is characterized by a marked neutrophilic leukocytosis (>50 000 cells/ μ L) with a concurrent, orderly left-shift. Toxic changes may or may not be present. It is called “leukemoid reaction” since it resembles granulocytic leukemia but is caused by some other process. It is also referred to as extreme neutrophilic (granulocytic) leukocytosis.

Magnitude of Change in White Blood Cell Concentrations

Leukogram Patterns						
	NEU	Left-Shift	Toxic Δ	LYM	MON	Inflammation
Stress	↑	No	No	↓	↑ (K9 > feline)	+/-
Physiologic	↑	No	No	↑ (mostly feline)	Normal	Unlikely
Mild/Chronic Inflammation	↑	+/-	No	Normal or ↓	↑ (chronic)	Likely
Acute Inflammation	↑	↑	Frequent	↓	Normal or ↑	Yes
Overwhelming Inflammation	↓	↑ to ↑↑	Present	↓	N	Yes
Leukemoid Reaction	↑↑↑	+/-	Occasional	Normal or ↓	Normal or ↑	?

References

1. Weiss, DJ., *Schalm's Veterinary Hematology*, 2010, pp. 112-117 (v1.0).
2. Stockam, SL, Scott, MA., *Fundamentals of Veterinary Clinical Pathology*, 2008, pp. 53-106 (v1.0).

