

# White Blood Cells (WBC)

## Interpretive Summary

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**Description:** White blood cells are part of the immune system and defend against infectious diseases and foreign substances.

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## Decreased White Blood Cells

### Common Causes

- Decreased bone marrow production
  - Infection
    - Parvovirus in dogs and cats
    - Feline leukemia virus
    - Toxoplasmosis
    - Rickettsial disease
  - Neoplasia
- Increased tissue demand
  - Sepsis
  - Viral infections
  - Sequestration: collection of cells within an organ system or body compartment: abscess, pyometra, peritonitis, pneumonia, necrotic tumor, etc.
- Toxicity
  - Chemotherapy
  - Estrogens
  - Chloramphenicol, sulfas
  - Idiosyncratic drug reactions, toxicities

### Uncommon Causes

- Decreased bone marrow production
  - Immune-mediated destruction within the bone marrow
  - Bone marrow fibrosis, aplasia
  - Idiopathic
- Peripheral destruction by immune or other mechanisms

### Related Findings

- Decreased bone marrow production
  - Decreases in all three cell lines (red blood cells, white blood cells and platelets) or two of three cell lines may suggest a bone marrow disorder
  - Infection
    - Positive serology or PCR tests for infectious organisms
    - WBC morphologic abnormalities such as toxicity, reactive lymphocytes
  - Neoplasia
    - Nonregenerative anemia, thrombocytopenia, and/or leukopenia
    - Atypical or unclassified cells found on blood smear evaluation
    - Neoplastic cells on bone marrow aspirate cytology or biopsy
- Increased tissue demand
  - Sepsis
    - Toxic neutrophils and/or band neutrophils
    - Increased PT and PTT, decreased platelets and fibrinogen (due to DIC)
    - Positive culture of urine, CSF, joint fluid, blood, tissue, body cavity effusion, other
    - Pleural effusion or pneumonia on thoracic radiographs

- Peritoneal effusion, prostatic abscess/prostatitis, pyometra, or necrotic mass on thoracic or abdominal radiographs, or abdominal ultrasound
- Thickened heart valve on echocardiogram
- Septic effusion on fluid analysis and cytology
- Suppurative inflammation +/- bacteria on cytology or histopathology

## Increased White Blood Cells

### Common Causes

- Inflammatory response (local or systemic)
  - Infections: bacterial, rickettsial, viral, fungal, protozoal, parasitic
  - Immune-mediated disease
  - Tissue necrosis
  - Neoplasia
- Corticosteroid-induced: endogenous or exogenous glucocorticoids

### Uncommon Causes

- Chronic or acute leukemia
- Epinephrine-induced physiologic leukocytosis

### Related Findings

- Inflammatory response
  - Infectious
    - Increased neutrophils, toxic neutrophils and/or band neutrophils
    - Positive culture of urine, CSF, joint fluid, blood, tissue, body cavity effusion, other
    - Evidence of infection on abdominal or thoracic imaging
    - Positive serology or PCR results
    - Septic effusion on fluid analysis and cytology
    - Suppurative inflammation +/- bacteria/fungal organisms on cytology or histopathology
  - Immune-mediated disease
    - Increased neutrophils and monocytes
    - Nonregenerative or regenerative anemia, thrombocytopenia
    - Inflammation found on fluid analysis and cytology of joint fluid, CSF, or body cavity effusion
    - Positive Coombs, ANA titer, or rheumatoid factor
  - Tissue necrosis
    - Increased neutrophils and monocytes, toxic neutrophils and/or band neutrophils
    - Necrotic mass on abdominal or thoracic radiographs, or abdominal ultrasound
    - Evidence of necrosis on cytology or histopathology of a mass or organ
  - Neoplasia
    - Enlarged lymph nodes or mass on abdominal radiographs, abdominal ultrasound, or thoracic radiographs
    - Neoplastic cells on cytology or histopathology
- Corticosteroid-induced
  - Neutrophilia, lymphopenia, monocytosis, eosinopenia, possible thrombocytosis
  - Increased ALP, possible mild increases in GGT, ALT, cholesterol, and glucose
  - Supportive endocrine testing (abnormal urine cortisol: creatinine ratio, ACTH stimulation test, and/or low dose dexamethasone suppression tests)

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## Additional Information

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### Physiology

- White blood cells encompass five different cell lines found in the blood: neutrophils, lymphocytes, monocyte, eosinophils, and basophils.
- Lifespan of most white blood cells in blood is short: half lives are only several hours, so total white blood cell counts and the ratio of cell lines can change very quickly. This makes the white blood cell count potentially an early detector of disease.
- White blood cells are activated and increase in number in response to a myriad of stimuli, such as infecting agents (viral, bacterial, fungal, parasitic, etc), foreign substances, tissue damage, necrosis, and cancers.
- Although activation and increase in numbers of white blood cells occur in response to such stimuli, actual measured white blood cell numbers in the blood may be variable due to the relative numbers in the bloodstream compared to numbers that have left the bloodstream and entered tissues and body cavities.
- White blood cells may destroy infectious agents, damaged tissue, and foreign substances, recruit other white blood cells, and in some cases wall off the abnormal area.
- Ratio of specific types of white blood cells that are activated may depend on the type or location of the stimulus.
- Neoplastic transformation of white blood cells typically involves abnormal unchecked production of a single cell line.

### Diagnostic Methodology

- The white blood cell (WBC) count is the total number of white blood cells contained in a cubic millimeter ( $\text{mm}^3$ ) or microliter ( $\mu\text{L}$ ) of whole blood.
- Neutrophils, band neutrophils, lymphocytes, monocytes, eosinophils, and basophils are included in the white blood cell results.
- Some automated counting instruments will also count nucleated red blood cells (nRBCs) causing a falsely increased WBC count. Most laboratories provide a corrected WBC count on CBC reports
- Morphology evaluation can provide valuable clues as to potential cause of WBC abnormalities (inflammation, infection, neoplasia, etc...)

### References

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