Bone Marrow Cytology

DEFINITION

Cytologic evaluation allowing assessment of blood precursor cell production and morphology

TYPICAL NORMAL RANGE

Marrow particles should contain 25%-75% hematopoietic cells, with all cell lines exhibiting orderly, complete maturation and normal shape, size, and features (morphology). The normal myeloid/erythroid (M:E) ratio is approximately 1:1, but can range from 0.6:1 to 4:1.

PHYSIOLOGY

Bone marrow contains trabecular bone with marrow spaces containing capillaries, hematopoietic cells, and adipocytes. Hematopoietic activity occurs in response to peripheral demand. Bone marrow aspiration is indicated when there are unexplained cytopenias (nonregenerative anemia, neutropenia, and/or thrombocytopenia), hyperglobulinemia, suspicion of neoplasia, or as part of staging of confirmed lymphoma and systemic mastocytosis cases.

CLINICAL APPLICATIONS

CAUSES OF ABNORMALLY HIGH LEVELS: Hyperplasia of one or more cell lines may occur secondary to increased peripheral demand for cells due to cell destruction, increased utilization, or loss. Neoplasia such as acute or chronic leukemia (with or without maturation and morphologic abnormalities) results in high marrow cellularity and effacement of normal marrow tissue. Lymphocytes and plasma cells may be increased in marrow because of antigenic stimulation or neoplasia. Iron stores may be increased with anemia of chronic disease and hemolytic anemia. Inflammation, infiltrating neoplasia, or hemophagocytic disease also results in increased cellularity of the marrow.

NEXT DIAGNOSTIC STEP TO CONSIDER IF LEVELS HIGH: Dependent on differential diagnosis based on history, physical exam findings, and results of CBC, serum biochemistry profile, and other diagnostic tests.

CAUSES OF ABNORMALLY LOW LEVELS

- Marrow hypoplasia indicates decreased cell production. Causes include anemia of chronic disease, chronic kidney disease, ehrlichiosis (dogs), drug-induced or immune-mediated destruction of precursor cells in the marrow, toxic insult (e.g., sulfa antibiotics, albendazole, phenylbutazone), viral infection (i.e., feline leukemia virus, parvovirus, canine distemper), myelofibrosis.
- Maturation arrest and dysplastic changes of red blood cells occur with viral infection, iron deficiency, myelodysplastic syndrome, or toxic insult.
- Iron stores are decreased with blood loss and iron deficiency.

NEXT DIAGNOSTIC STEP TO CONSIDER IF LEVELS LOW: Dependent on differential diagnosis based on history, physical exam findings, and results of CBC, serum biochemistry profile, and other diagnostic tests. Bone marrow aspiration often is the final diagnostic step for confirming hematopoietic disorders.

IMPORTANT INTERSPECIES DIFFERENCES: Iron stores are not usually visible in cat bone marrow and cannot be evaluated cytologically.

SPECIMEN AND PROCESSING CONSIDERATIONS

SPECIMEN: Aspirated marrow should immediately be made into fresh smears and also placed in an EDTA (lavender-top) tube. Proper collection and preparation of slides are essential for accurate interpretation. Hematopoietic cells degenerate rapidly after collection. Slides must be prepared immediately (before a clot forms) or within 30 minutes after collection if anticoagulant is used. A good bone marrow aspirate has several marrow particles for evaluation, with spreading of the cells in a monolayer for evaluation of morphology.

RELATIVE COST: $$, plus cost of aspiration procedure

PEARLS

- Bone marrow aspirates must be interpreted concurrently with CBC results.
- An accompanying bone marrow core biopsy may help in the interpretation of overall cellularity of the bone marrow, which complements the evaluation of morphology and maturation sequence from the marrow aspirate.
- A fresh smear of the marrow aspirate should be stained and examined for the presence of marrow spicules/cells while the animal is still sedated/anesthetized; if spicules are not adequate, the procedure may be repeated immediately.

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Pricing Information

$: <$20
$$: $21-75
$$$: $76-150
$$$$: >$150