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Mini Review
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Abnormal scenes in a blood film

Abstract

Examination of peripheral blood smear is a vital step in assessment of overall health status of the individual. Blood smear examination is part of standard hematologic profiles and as a part of the diagnostic evaluation of apparently ill patient. In addition to differential leucocyte count, blood smear examination may reveal a variety of information of diagnostic value, for instance defective RBC morphology suggests chronic blood loss, endogenous or exogenous intoxication, vascular disorders or immune mediated disorders. Pathomorphological changes in WBCs are the first signs of inflammatory conditions and may be diagnostic for certain inherited conditions and leukemias that can be only are detected through microscopic evaluation of peripheral blood smears. In some cases, infectious agents pathognomonic cellular inclusions, and neoplastic cells are observed on blood films, yielding an immediate, definitive diagnosis. Every complete blood count (CBC) should be followed by blood smear evaluation that provides morphologic confirmation of hematologic parameters, assurance of the quality of values obtained from automated analyzers, and additional important information not given by automated methods. It is very easy and inexpensive to prepare a blood smear and one can acquire experience readily in evaluation of blood smear with regular practice supported by adequate background information.

Keywords: blood smear, vascular disorders, leucocyte count, blood films, hematologic parameters, erythrocyte, poly ribosome's, codocytes, dacrocytes, pelger-huet anomaly

Volume 2 Issue 6 - 2016

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Received: August 13, 2016 | **Published:** November 11, 2016

Abbreviations: CBC, complete blood count; NMB, new methylene blue; HJ, howell-jolly; DIC, disseminated intravascular coagulation; GN, glomerulonephritis

Introduction

Blood cell morphology evaluation is a critical step in thorough examination of a blood smear, which can aid in identifying many metabolic disorders, indicate oxidative damage and can help localize a disease process. Hence, we can say that this technique can reveal many normal and abnormal characters in a blood film out of them all some of them are discussed here.

Acanthocyte

It also known as acanthrocyte or spur cell is a speculated or spiny erythrocyte. The name is derived from a Greek word meaning "thorn". It is an erythrocyte having multiple, randomly spaced irregular projections (generally 2-20) over RBC's membrane. The changes in RBC membrane are associated with high cholesterol content of the membrane expanding the outer layer of the lipid bilayer. Acanthocytes are also formed as a result of fragmentation of RBCs. It is found in peripheral blood smear of animals affected with liver, splenic or renal disorders. Acanthocytes are often seen in peripheral blood smear of patients suffering from vascular neoplasm (Hemangioma and Hemangiosarcoma), liver diseases, portosystemic shunts, glomerulonephritis, high cholesterol diets, DIC and lymphoma.[1]

Anisocytosis

It is a broad term that describes variation in size of erythrocytes. Mild anisocytosis can be found in healthy animals due to presence of reticulocytes. Reticulocytes are usually larger than the mature erythrocytes, hence named as macrocytes. Pathological causes of anisocytosis include feline leukemia virus, myelodysplastic syndromes and some congenital and hereditary conditions.

Band cell

It is a granulocyte with an un-segmented, non filamented and ribbon like nucleus. It is also known as stab cell.

Basket cell

It is a ruptured degenerative cell whose nucleus appears pale stained with no prescribed form or shape.

Basophilic stippling

They are the basophilic granules scattered throughout the cytoplasm of an erythrocyte. They represent spontaneous aggregation of ribosomes and polyribosomes in RBC. In Romanowsky-stained samples, affected RBCs contain uniformly distributed punctate, basophilic structures. These are the landmark suspicion of lead toxicity in absence of anemia and nucleated RBCs. In cattle, dog and cat these are visible in case of regenerative anemia.[2]

Codocytes or target cell

It is an erythrocyte with a central rounded area of pigmented material surrounded by a clear zone without pigment, with a dense ring of cytoplasm about the periphery of the erythrocyte. It resembles a bull's eye. They have an increased amount of cholesterol resulting in an overall increase in the surface area of the erythrocyte membrane. Codocytes are often observed in patients with iron deficiency, cholestatic liver disease and post-splenectomy; however, Codocytes are also frequent findings in regenerative anemias.

Dacryocytes

These are Teardrop shaped cells are formed while passing through the narrow marrow or splenic sinusoids. These cells are found in blood smear of human beings affected with myelo fibrosis and myelophthisis. Blood smear from canines affected with myelo proliferative disorders and hyper splenism are also rich in dacrocytes.

Dohle bodies

These are small (1-2 microns) round or oval, gray-blue bodies in the cytoplasm in the cytoplasm of neutrophilic leukocytes, thought to be due to incomplete utilization of RNA during maturation of the cytoplasm.

Eccentrocytes or hemi ghost erythrocytes

They have eccentrically placed hemoglobin with a pale hemoglobin free area in the center. These cells are formed as a result of oxidative damage to the RBC membrane and cytoskeleton. Red maple toxicity, RBC G-6-PD deficiency and flavin adenine di-nucleotide deficiency in horse causes the presence of eccentrocytes in blood.[3,4] In dogs, poisonings like onion, vitamin K, garlic and acetaminophen leading to oxidative damage are the cause. Eccentrocytes have been reported in dogs affected with diabetes mellitus, T cell lymphoma and severe infections. Animals with intravenously injected hydrogen peroxidase may have circulation eccentrocytes.[5–8]

Echinocytes

It is also known as crenated Erythrocytes or Burr Cells or Berry Cells, are RBCs having evenly dispersed spicules over their surface. They are formed when the outer leaflet of the lipid bilayer of the RBC membrane is expanded relative to the inner layer. The mechanism involved includes depletion of ATP, amphipathic drug administration, calcium loading etc. Echinocytes are classified as type I, II and III based on their particular morphologic features. Echinocytes are sometimes formed as artifact from sample handling, prolonged sample storage or during slide preparation. Glomerulonephritis, lymphoma, hemangio sarcoma and other neoplasm, immune mediated hemolytic anemia, pyruvate kinase deficiency, rattlesnake bite and doxorubicin toxicosis are some conditions of dogs when echinocytes are visible in the blood smear.[9–12] In horses, colitis or exercise causing hyponatremia and hypochloremia can also lead to formation of echinocytes.

Elliptocytes

These are oval shaped non-nucleated RBCs that are normally found in camels. In dogs, glomerulonephritis, myelofibrosis and myelodysplastic disease can lead to formation of elliptocytes. It is hereditary finding in humans with protein band-3 abnormality and in dogs with protein band 4.1 deficiencies.[13]

Erythrocytic Ghosts

These are pale RBC membranes with no or minimal hemoglobin. The presence of erythrocytic ghosts on peripheral blood smears suggests either very recent intravascular hemolysis or in vitro hemolysis. RBC lysis that occurs during smear preparation usually appears as RBC smudges. With lipemia, erythrocytes have increased membrane permeability and fragility, resulting in occasional smudged erythrocytes and erythrocytic ghosts, especially when smears are not made immediately. Fuzzy, ill-defined cell borders characterize smudged erythrocytes.

Heinz Bodies

These are intra-erythrocytic mass of denatured globin, irregular in shape and appearing as refractile granules when slightly out of focus. This latter property is responsible for their being called erythrocyte refractile bodies. With Romanowsky stains, the Heinz bodies are pale but with new methylene blue (NMB), they are bluish-green and much more obvious. They are commonly encountered in blood smears of anemic animals where hemolysis is caused by toxic materials like onion, benzocaine copper inflicting oxidative injury to the RBCs.

Howell-Jolly (HJ) bodies

These are round, deeply basophilic nuclear remnants found in the cytoplasm of RBCs. The spleen normally removes them but, in horses and cats having non-sinusoidal spleen, few HJ bodies are normally seen in smear.[14–16] Increased numbers of HJ bodies can be seen as part of a regenerative response to anemia, in animals with hypo functioning spleens, or in splenectomized patients. There also are reports of increased numbers of HJ bodies in non-anemic miniature and toy poodles with hereditary macrocytosis.

Keratocytes

It is also known as horn cells or helmet cells, are RBCs undergoing fragmentation and having only 1-2 spicules. Their formation is associated with microvascular injuries due to deposition of fibrin strands. They are found in dogs and cats with hemangiosarcoma and in doxorubicin toxicity.[17]

Leptocyte

It is a thin erythrocyte of decreased volume in relationship to its diameter, often characterized also by abnormality of shape. It can be found in iron deficiency and cholestatic liver diseases.

Pelger-huet anomaly

It is a rare hereditary condition identified in dogs, cats, horses, rabbits and humans associated with stem cell defect where neutrophils have lack the usual nuclear segmentation and lobulation. Pelger-huet bodies are the neutrophils with dumbbell-shaped bi-lobed nuclei, a reduced number of nuclear segments, and coarse clumping of the nuclear chromatin. Sometimes it may be mistaken for infection or early stage leukemia. Acquired Pelger-huet bodies are found associated with different pathological states like Myelodysplastic syndrome, acute mylelod leukemia, HIV, TB and mycoplasma as well as with certain infections and drugs like Tacrolimus, Ganciclovir, Co-trimoxazole, Itraconazole Fludarabine, Rituximab, Citalopram and Lorazepam

Poikilocyte

It is an erythrocyte with an abnormal shape, not to be confused with distortion that results from faulty technique. It can be found in a variety of conditions so it is non-specific. Avian species, members of camelidae and reptiles have oval erythrocytes as their normal shape.[18]

Reticulocyte

It is any non-nucleated cell of the erythrocytic series containing RNA, which when supravitally stained with new methylene blue or brilliant cresyl blue will have discernible granules or a diffuse network of fibrils.

Ring Sideroblast

These are the cells in which many iron-containing granules surround the nucleus. They can be demonstrated by Prussian blue staining. They are found in patients suffering from myelophthisisc anemia.

Schistocytes

These are RBC fragments formed due to physical damage as a result of vascular abnormalities or turbulent blood flow. Disseminated Intravascular Coagulation (DIC), Glomerulonephritis (GN), hemangiosarcoma, myelofibrosis, dyserythropoiesis, and chronic doxorubicin toxicosis in dogs can lead to microangiopathic fragmentation. In cats and horses schistocytes are not commonly found.[19–23]

Sideroblast

It is a nucleated erythroid precursor with iron containing granules. These cells have been reported with myelodysplastic syndromes and myeloproliferative disorders and in inflammatory diseases in dogs and cats.

Siderocyte or Pappenheimer Body

It is a mature erythrocyte in which blue granules of ferric iron, 1-20 or more in number, can be demonstrated by the Prussian blue reaction. It is consistently seen in equine infectious anemia, myeloproliferative disorders and lead toxicity.[24]

Smudge cell

It is a ruptured leukocyte seen in a blood film if a smear preparation from a blood sample is delayed.

Spherocyte

It is a spheroid erythrocyte of decreased diameter in relationship to its volume and having the microscopic appearance of a hyper chromatic microcyte. These RBCs lose their biconcave shape and become round like a sphere. In a blood smear, these cells have lost their central pallor appear little darker and smaller. IMHA is a common cause of spherocytosis. In cattle, anaplasmosis, Coral snake, rattle snake and bee sting bite causes spherocytes formation. Spherocytes are most obvious in dogs but rare in cat and horse.

Stomatocyte

It is an erythrocyte with a linear rather than central area of pallor resembling a mouth on dried blood smears. Some dog breeds have been identified with hereditary stomatocytosis, including Alaskan Malamutes with concurrent chondrodysplastic disease, Drentse patrijshond with stomatocytosis-hypertrophic gastritis and Miniature and Standard Schnauzers.

Toxic neutrophil

It is a neutrophil characterized by toxic granules, basophilia of the cytoplasm, vacuoles, or condensation of nuclear chromatin. They are developed in bone marrow of animals facing acute sever inflammation.[25–38]

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

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