

## TEST INFORMATION

### *Hematology, Peripheral Blood Abnormalities*

#### HEMATOLOGY, PERIPHERAL BLOOD ABNORMALITIES

ABNORMAL RED CELL	DESCRIPTION	ASSOCIATED DISEASES
Acanthocyte (spur cell)	Irregularly spiculated RBC with projections of varying length and position and no central pallor.	Abetalipoproteinemia (hereditary acanthocytosis or Bassen-Kornzweig disease)
Agglutination	Irregular overlapping of red blood cells in a clump or cluster.	Cold autoimmune hemolytic anemia, paroxysmal cold hemoglobinuria, malignant lymphoma with monoclonal IgM spike, plasma cell dyscrasias with monoclonal IgM spike.
Anisocytosis	Mixture of red cell sizes. RDW > 15%	Any severe anemia, e.g. iron deficiency, megaloblastic
Basophilic stippling	Fine: pink cytoplasm stippled with a moderate number of fine blue granules. Coarse: pink cytoplasm stippled with a smaller number of coarse blue granules	Hemolytic anemia, punctate stippling seen in lead poisoning (mitochondrial RNA and iron), thalassemia
Echinocyte (burr cell, crenated cell)	A spiculated RBC with short, equally spaced projections over the entire surfaces	Hemolytic anemias, liver disease ("spur cell" anemia), normal infants, uremia and chronic renal disease, pyruvate kinase deficiency,
Elliptocyte (ovalocyte)	Oval to elongated ellipsoid RBC	Hereditary elliptocytosis, iron deficiency
Fragment:	A split RBC	Uremia, carcinoma, hemolytic-uremic syndrome, disseminated intravascular coagulation, microangiopathic hemolytic anemia, toxins (lead, phenylhydrazine), burns, thrombotic thrombocytopenic purpura
Schistocyte	A triangular cell with 3 sharp corners and no central pallor.	
Helmet Cell	A cell in the shape of a half disc	
Heinz bodies	Small round inclusions seen under phase microscopy or with supravital staining	Congenital hemolytic anemias (e.g., glucose 6-phosphate dehydrogenase deficiency), hemolytic anemia secondary to drugs (dapsone, phenacetin), thalassemia (hb H), hemoglobinopathies (Hb Zurich, Koln, Ube, I, etc)
Howell-Jolly bodies	Small, well defined, round, densely staining basophilic inclusion bodies about 1 $\mu$ in diameter.	Hyposplenism, pernicious anemia
Hypochromia	Pale cells with decreased concentration of hemoglobin (MCHC <31 g/dL)	Iron deficiency and iron-loading (sideroblastic) anemia, thalassemia, lead poisoning, transferrin deficiency, anemia of chronic disease
Macrocytosis	> 9 $\mu$ in diameter or MCV >100 fL	Megaloblastic anemia, liver disease, hypothyroidism, hemolytic anemia (reticulocytes), multiple myeloma, physiologic macrocytosis of newborn, myelophthisis
Macro-ovalocytosis	Large (>8 $\mu$ ) oval cells	Megaloblastic anemia
Microcytosis	< 6.5 $\mu$ in diameter or MCV <78 fL	Iron deficiency and iron-loading (sideroblastic) anemia, thalassemia, lead poisoning
Nucleated red cells	Erythrocytes with nuclei still present; may be normoblastic or megaloblastic	Hemolytic anemias, leukemias, myeloproliferative syndrome, polycythemia vera, myelophthisic anemia (neoplastic, granulomatous, or fibrotic marrow infiltration), multiple myeloma, extramedullary hematopoiesis, megaloblastic anemias, any severe anemia
Pappenheimer bodies (siderocytes)	Coarse blue granules measuring up to 2 $\mu$ found in the periphery of the cell. Confirmed by an iron stain	Iron-loading anemias, hyposplenism, hemolytic anemias
Poikilocytosis	Abnormal variation in shape	Any severe anemia - e.g., megaloblastic, iron deficiency, myeloproliferative syndrome, hemolytic; certain shapes are diagnostically helpful (see following: Spherocyte through Teardrop cells)
Polychromasia	RBCs containing RNA, staining a pinkish blue color; stains supravitaly as reticular network with new methylene blue	Hemolytic anemia, blood loss, uremia, following treatment of iron deficiency or megaloblastic anemias
Rouleaux	Linear arrangement of 4 or more red blood cells simulating a "stack of coins".	Multiple myeloma, Waldenstrom's macroglobulinemia, cord blood, pregnancy, hypergammaglobulinemia, hyperfibrinogenemia, chronic inflammatory conditions, chronic infections, malignant lymphoma.

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Sickle cell (drepanocyte)	Crescent-shaped RBC; usually no area of central pallor, the edges are smooth and the ends must be pointed	Sickle cell hemoglobinopathies
Spherocyte	Small spherical RBC which appears round and completely filled with hemoglobin	Hereditary spherocytosis, Coombs-positive hemolytic anemia; small numbers are seen in any hemolytic anemia and after transfusion of stored blood
Stomatocytosis	Red cells with slit-like instead of circular areas of central pallor	Hereditary stomatocytosis, lead poisoning, liver disease, artifact
Target cell (codocyte)	A thin, flattened RBC which has peripheral and central zones of hemoglobin with an empty intermediate zone, giving the appearance of a target	Liver disease, thalassemia, hemoglobinopathies (S, C, SC, S-thalassemia)
Teardrop cell (dacrocyte)	RBC with a single elongated or pointed extremity (resembling a tear drop)	Myeloproliferative syndrome, fibrotic marrow infiltration, anemia with extramedullary hematopoiesis or ineffective erythropoiesis

ABNORMAL LEUKOCYTES	DESCRIPTION	ASSOCIATED DISEASES
Alder's anomaly	Prominent azurophilic granulation seen in all mature leukocytes; seen better with Giemsa stain	mucopolysaccharidoses
Auer Rods	Rod-like, 1-6 $\mu$ long, red-purple inclusions in blast cells	Acute myelocytic leukemia
Chediak-Higashi granules	Large, coarse and irregularly shaped. Gray-green to gray-orange in color	Chediak-Higashi syndrome
Dohle bodies	Small (1-2 $\mu$ ) blue staining cytoplasmic inclusions in neutrophils; often seen with toxic granulation	Infections or inflammatory diseases, burns, myelocytic leukemia, myeloproliferative syndromes, cyclophosphamide therapy
Hypersegmented neutrophil	Mature neutrophils that contain more than five distinct lobes; usually larger in size	Megaloblastic anemia, hereditary constitutional hypersegmentation of neutrophils; rarely, iron deficiency anemia, malignancy or infection
Leukocytosis	WBC count $> 11 \times 10^9/L$	Any physiologic or pathologic stress, corticosteroids
May-Hegglin inclusions	Basophilic, cytoplasmic inclusions; usually larger and have more sharply defined borders than Dohle bodies	May-Hegglin syndrome (hereditary), includes thrombocytopenia and giant platelet
Myeloid <i>shift to left</i>	Presence of bands, myelocytes, metamyelocytes, or promyelocytes	Infections, intoxications, tissue necrosis, myeloproliferative syndrome, leukemia (chronic myelocytic), leukemoid reaction, pernicious anemia, hyposplenism
Neutropenia or granulocytopenia	Neutrophil count $< 1.7 \times 10^9/L$	Drugs, infection, congenital megaloblastic anemia, aplastic anemia, leukemia, lupus erythematosus, post-irradiation hypersplenism, myelophthitic anemia
Neutrophilic leukocytosis (granulocytosis)	Neutrophil count $> 8.3 \times 10^9/L$	Infection, intoxication, tissue necrosis, myeloproliferative syndromes, leukemia (e.g. chronic myelocytic), leukemoid reaction, hemorrhage, hemolysis.
Pelger-Huet changes	Neutrophil with monolobed or bilobed nucleus. Chromatin is coarse and cytoplasm is pink with normal granulation	Hereditary, myelocytic leukemias, myeloproliferative syndromes, myelodysplastic syndromes.
Reactive lymphocytes	Greater than 15 $\mu$ . Nucleus: may be round, oval, elongated, indented, or stretched; lightly to intensely staining purple; chromatin pattern variable nucleoli may or may not be present. Cytoplasm: basophilic, azurophilic granules may be increased in number and or size	Infectious mononucleosis, viral hepatitis and other viral infections, tuberculosis, drug (e.g. penicillin) sensitivity, post-transfusion syndrome
Toxic granulation	Coarse, deeply staining basophilic or blue-black cytoplasmic granules	Infections or inflammatory diseases

Source: Adapted from: PR Reich, MD, Hematology: Hysiopathologic Basis for Clinical Practice, Boston, MA: Little, Brown & Company Inc, 1984. Eric F Glassy, MD, Color Atlas of Hematology: An Illustrated Guide based on Proficiency Testing, Northfield, IL: College of American Pathologists, 1998.

Revised 3/09 by Michael Gunderson

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