Hong Kong Medical Technology Association
Quality Assurance Programme
Haematology and Serology

RBC Morphology Grading

The MCV parameter must be compatible with the blood film before the microcytosis and macrocytosis are graded.

Grade	+	++	+++
Interpretation	Slight/ A few number	Moderate/ Moderate number	marked/ numerous
Microcytosis	MCV : 70 - 79	MCV : 60 - 69	MCV <60
Macrocytosis	MCV : 100 - 115	MCV : 115 - 125	MCV >125
Hypochromasia	MCH : 23 - 26	MCH : 21 - 23	MCH <20
Polychromasia	3 - 5%	5 - 25%	>25%
Spherocytosis	1 - 5%	5 - 25%	>25%
Schistocytosis	up to 2%	2 - 25%	>25%
Target cells (codocytes)	up to 3%	3 - 25%	>25%
Tear drops	up to 2%	2 - 25%	>25%
Burr cells	1 - 3%	3 - 10%	>10%
Sickle cell(drepanocytes)	3 - 5%	5 - 25%	>25%
Elliptocytosis	1 - 5%	5 - 25%	>25%
Basophilic stipplings	up to 2%	2 - 25%	>25%
Howell Jolly bodies	up to 1%	2 - 3 %	>3%
Anisocytosis	RDW: 16-18	RDW : 18-22	RDW>22

Reference range for the above table: MCV is 80-99 fL, MCH 27-34 pg, MCHC 32-36 g/dL, RDW 11-15 %.

This table is formulated with references to the following guidelines:

(1) Arthur Simmons [Haematology – A combined Theoretical Technical Approach. WB Sauders Company. 1989.] by merging 2+ and 3+ grades of the 4+ system into one grade. The grading of HJ bodies by Simons (4+ system) is 1+= 0-1%, 2+= 2-3%, 3+= 4-5%, 4+=>5%.

(2) A 3+ grading system: The grading of HJ bodies was: 1+ = 2 rbc with HJ bodies per SMEAR, 2+ = 1%; 3+ =>1% and a 2+ = 2-25% for tear drops, schistocytes, pherocytes(5-25%), polychromasia, basophilic stipplings; a 3+ = >50% for hypochromais, target cells, ovalocytes, contracted cells, leptocytes.

(3) Another 3+ system from Med Lab Observer (1982) use 1+ = 1-3%; 2+ = 4-8% and 3+ = >8% for tear drops, spherocyte, polychromasia, target cells, schistocytes, burr cells, except for basophilic stipplings and HJ bodies where 1+ =1%, 2+ =2-3% and 3+ =>3%.

(4) A third 3+ system use 1+ = 2-5% , 2+ = 6-15%, 3+ = >15% for envelope forms, tear drops, bizarre form, tailed forms, target cells, schistocytes, ovalocytes, elliptocytes, burr cells, stomatocytes, blister cells; except for HJ bodies, Cabot ring, basophilic stipplings where 1+ =1-2%,2+ = 3-5% , 3+ =>6%.

RBC Morphology

1. Macrocytes
- RBC with a diameter >8µm (MCV > 99fl)
- RBC thinner than normal (e.g. target cells) with normal MCV may appear as 'macrocytes'
- Found in megaloblastic anemia (oval acrocytes); liver disease, alcoholism, neonates, reticulocytosis

2. Microcytes
- RBC diameter < 6.4µm, MCV<80fl
- Found in iron deficiency anemia, thalassemia, hyperthyroidism

3. Anisocytosis
- RBC of unequal size
- Found in almost all red-cell disorders; non-specific; arked anisocytosis may give normal MCV

4. Elliptocytes
- Oval and elliptical cells
- Found in hereditary elliptocytosis, iron deficiency anemia, myelofibrosis

5. Tear-drop poikilocytes
- Tear-drop appearance
- Found in myelofibrosis, when bone marrow is replaced by non-haemopeitic tissue, and with extramedullary erythropoiesis

6. Sickle cells (drepanocytes)
- Intermmediate sickling : rod-shaped, boat shaped and oat shaped
- Found in sickle cell anemia

7. Schistocytes (red cell fragments)
- The fragment are small and often appear spherical, triangular or irregular, deeply stained with irregular outline
- Found in haemolytic anemia, burns, thalassemias, megaloblastic anemia, iron deficiency anaemia, elliptocytosis, DIC, thrombotic thrombocytopenic purpura, drug and toxins

8. Crenated RBC = echinocytes
- Multiple short symmetric projection (10-30 spicules of equal length) due to disc-sphere transformation
- Found as artifact (in stored blood, alkaline pH), in gross electrolyte imbalance

9. Acanthocytes =spiny cells
- Irregular, unequal spicules (8-12 pointed projections) with a-beta-lipoproteinemia with markedly reduced lecithin content in cell membrane
- Found in splenectomy, McLeod phenotype of Kell blood group

10. Burr cells
- Irregular asymmetric projections, small cells or fragments

- Found in uremia

11. Spur cells
- RBC with long irregularly spaced projections
- Found in liver disease, normal infants, uremia, DIC, thrombotic thrombocytopenic purpura

12. Spherocytes
- Loss of bi-concavity (loss of surface membrane lipid, excessive sodium influx), smaller diameter, dense-staining
- Found in hereditary spherocytosis or induced by chemicals or bacterial toxins or antibodies

13. Target cells
- Increased surface area (due to increased cholesterol and lecithin) with same volume
- Found in obstructive liver disease, Hb C, D and E diseases; iron deficiency anemia

14. Stomatocytes
- RBC with narrow slit-like area of central pallor
- Found in hereditary stomatocytosis, liver disease with alcohol abuse; in Rh-null genotype

15. Nucleated red cells
- Erythrocytes with nuclei
- Found in severe anemia(except aplastic), myelofibrosis, severe heart failure, hemolytic anemia.

16. Hypochromia
- Pale staining of RBC due to thin cell and low Hb conc
- Found in iron deficiency, thalassemia, sideroblastic anemia

17. Polychromasia
- Reticulocytes with residual RNA have affinity for basic components of stain (blue)
- Found in response to blood loss, haemolysis or haematinic therapy

18. Dimorphism , anisochromasia
- Presence of two populations of RBC : hypochromic with normochromic, macrocytic/ microcytic with normocytic
- Found in sideroblastic anemia,megaloblasltic anaemia/iron deficiency anemia after treatment and after transfusion, Cooley′ s aneamia after transfusion

19. Red cell inclusions

a. Reticulocytes
Aggregate ribosomes RNA.

b. Howell-Jolly bodies:
DNA nuclear remnants, single deep purple of varying size; found in post-splenectomy, hyposplenism, megalobalstic anaemia, haemolytic anaemia.

c. Pappenheimer bodies:
Ferric compound complexed with protein; small dark blue bodies of uniform size, usually occur singly with absent splenic function.

d. Basophilic stippling = punctate basophilia
Aggregates of Ribrosomes, Multiple blue black inclusions evenly distributed; found in lead poisoning, thalassemias.

e. Heinz bodies
(by supravital staining, better with methyl violet, brilliant green is specific to Heinz bodies) Single round cell structure of denatured Hb at cell margin, as white unstained areas in MGG stain if haem is lost); found in post-splenectomy, due to oxidant stress of drugs and chemicals on unstable Hb (G6PD deficiency).

f. Hb H inclusion bodies

(supravital stain with new methylene blue, brilliant cresyl blue)
Precipitate tetramers of beta-globin chains;
Golf-ball appearance.

g. Siderocytes

RBC with aggregates of ferritin or hemosiderin , demonstrated by Prussian blue.

h. Sideroblast

Nucleated red cell containing ferritin molecules (up to 5 or more); found in iron deficiency and infection, "ringed" sideroblast is a characteristic feature of sideroblastic anaemia.

i. Cabot ring and chromatin dust

Remnants of mitotic spindle of nuclear membrane, altered microtubules;
Found in failure of erythropoiesis or in extramedullary blood formation.

j. Microorganism (Bartonella bacilliformis) **and protozoa** (Malaria parasite)

Prepared by HKMTAQAP Haematology & Serology Panel on November 2002.
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