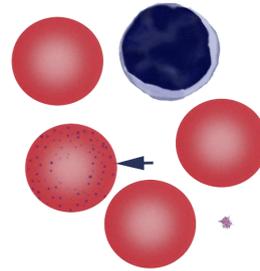


# Red cell morphology guide



This is designed as a printed reference that can be used together with our Red Cell Morphology webpages (accessed by scanning the QR codes using a mobile device).

We would value any comments or suggestions, please use this link:

Email to: [feedback@haematologyetc.co.uk](mailto:feedback@haematologyetc.co.uk)

***USE:** Your mobile device may already have a QR code reader that will link you to the associated web page. If not, then you will need to install one. There are plenty of free versions but we suggest that you chose one that is not associated with adverts. I personally use the **Kaspersky QR code Scanner** (available as a free app).*

***Scan the code below (for our main red cell index), or use the individual QR codes associated with each cell description for each specific cell type***

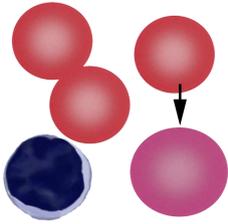
**RED CELL GUIDE**



## Cells with altered maturation, size or haemoglobin content

Red cells with these characteristics are frequently encountered in the laboratory. None indicates a single specific diagnosis and diagnosis often requires consideration of additional features:

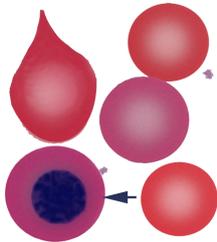
**Polychromatic cells:** look for the blue tinge of the cytoplasm, often also increased size



*These are cells released into blood at early stages of maturation and are normal blood constituents. When numbers are increased a cause should be sought. Consider causes such as a reaction to red cell destruction or bone marrow infiltration: other features of the blood film are important.*



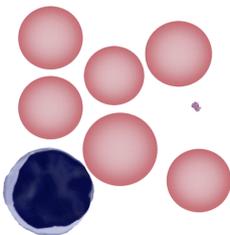
**Nucleated red cells:** nucleated cells cytoplasm resembles red cells (with variable blue tinge)



*These may sometimes circulate in reactive states, but their presence in blood is significant. Context is very important - look particularly for signs of reduced red cell survival or of bone marrow infiltration. Very early forms with basophilic cytoplasm may be a challenge to recognise.*



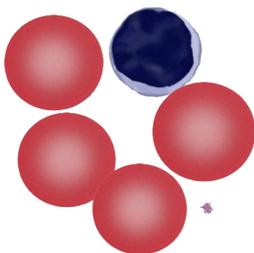
**Microcytes:** Recognised by their reduced size (smaller than the nucleus of a small lymphocyte)



*Microcytic cells are generally also hypochromic and in clinical practice they almost always indicate either iron deficiency or thalassaemia (although rare causes are recognised). It is often not possible to distinguish between these causes in mild cases although there are morphological clues.*



**Macrocytes:** Recognised by their increased size (larger than the nucleus of a small lymphocyte)



*Macrocytes are a diagnostically challenging group - arising in a range of conditions (including nutritional, metabolic, inherited or neoplastic causes). The degree of macrocytosis can be a valuable indicator as very large forms have a limited range of causes - consider also the context.*



## Abnormal cells with regular shape

Cells with abnormal, but regular, form arise as a result of congenital or acquired defects affecting the cell membrane, (the exception being pencil cells that arise in iron deficiency). The causative disorders range from the trivial to the very serious - cause should always be carefully considered.

**Spherocytes:** round dense cells with diminished or absent central pallor, reduced size



*Effectively, loss of membrane turns the normal biconcave disc form progressively to a sphere—when flattened this appears smaller, but dense and circular (intermediate forms may also be seen). Membrane instability may be inherited, or acquired - most usually from antibody-mediated damage.*



**Ovalocytes:** Slight elongation, giving an ovoid shape (length less than twice the diameter)



*Cells with a slightly elongated form are often encountered as part of the spectrum of disorders such as hereditary elliptocytosis. The most important causes being either the macrocytic ovalocytes of megaloblastic anaemias, or the oval stomatocytes of South East Asian ovalocytosis. A careful look at associated features will generally allow recognition.*



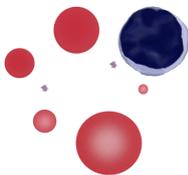
**Elliptocytes:** substantially elongated cells forming an ellipse (length more than twice the diameter)



*Elliptocytes are a common finding in many conditions as part of a spectrum of abnormalities. However, when they are the dominant or sole abnormal form then they usually arise from an inherited membrane defect - hereditary elliptocytosis.*



**Microspherocyte:** very small spherocytes, some may have central pallor



*Combined membrane and content loss arises from cytoskeletal instability in: severe membrane disorders, heat damage, or specific toxins. The result is very small round erythrocyte fragments many of which lack any central pallor.*



**Pencil cell:** usually formed in iron deficiency these are pale and very elongated cells



*Very long (length generally more than four times the diameter) and typically hypochromic. These cells arise most frequently in iron deficiency.*



## Abnormal cells with irregular shape

Irregular cells do not circulate in significant number in normal individuals so imply an abnormal process – there is not always a single possibility so it is important to consider their form and context.

**Irregularly contracted cells:** dense cells with irregular outline and patchy haemoglobin distribution



*This appearance most frequently reflects damaged or de-natured haemoglobin. They most frequently arise in haemoglobinopathy or oxidative damage.*



**Tear drop cells:** an otherwise intact red cell but shaped like a drop of water  
(also known as *dacrocyte*)



*These cells indicate a “packed marrow environment” which may arise from infiltration, but also hyperplasia (for example in thalassaemia).*



**Sickle cells:** elongated cells, typical forms are curved with sharp ends



*Often accompanied by intermediate forms. Sickle cells are specific either for typical sickle disease or its variant forms.*



**Boat-shaped cells:** appear like a canoe viewed from above  
(sometimes known as “kissing lips” cell)



*Straight with sharp ends and usually some central pallor, less narrow than sickle cells. Causes are similar to sickle cells although the appearance is less specific*



**SC-poikilocytes:** dense cells and generally elongated with branched protruding areas.



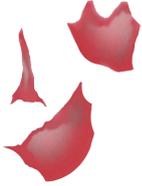
*These are seen in HbSC disease.*



## Abnormal cells with projections

These are cells affected by extrinsic disease, this is primarily physical in the case of fragments or keratocytes, and metabolic in the case of the spiculated cells (echinocytes and acanthocytes). The number of abnormal forms is generally important for these cell types.

**Sharp or blunt fragments:** small damaged parts of red cells may have rounded or sharp ends  
(also known as **schistocytes**)



*Rounded or sharp ended fragments arise by different processes. Although there is an overlap, sharp fragments tend to form from fibrin-induced damage (“slicing”), blunt fragments more often arise from abnormal fragile red cells.*



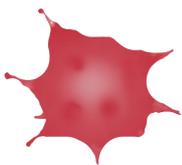
**Keratocytes:** two (or occasionally more) projections surrounding a depression—said to resemble horns  
(also known as **bite cells**, **horned cells** or **helmet cells**)



*This cell reflects mechanical damage by fibrin, with the horned area representing a “burst vacuole” as the cells seals itself after traumatic slicing (the same process as sharp fragmentation). A second mechanism is the removal of Heinz bodies after removal of damaged haemoglobin.*



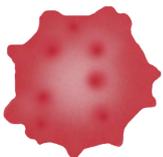
**Acanthocytes:** long, sharp or bulbous projections irregularly spaced over the erythrocyte surface  
(also known as **spur cells** or **sputnik cells**)



*These cells arise from expanded lipid in the outer membrane, either when plasma lipids are disturbed (liver disease or abetalipoproteinemia), or in aging cells post-splenectomy (smaller numbers)*



**Echinocytes:** frequent, short and generally blunt projections, numerous and evenly spaced  
(also known as **burr cells**)



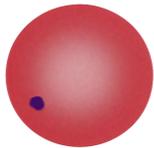
*These cells generally reflect a cell change caused by electrolyte disturbance—arising as artefact (water on film), extrinsic disease such as renal failure, or cell exhaustion and pump failure - cell ageing or metabolic abnormality*



## Red cells with intracellular inclusions

Inclusion bodies within red cells are easily overlooked and may require a specific search to notice them, causes can vary considerably, but identifying their presence can help explain findings (particularly hyposplenic states) that may otherwise be difficult to explain, or may lead to a precise diagnosis.

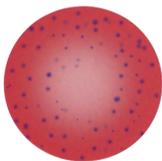
**Howell Jolly bodies** purple, single, rounded retained nuclear fragments, offset but not peripheral



*Following extrusion of the nucleus, any remaining fragments are removed by the spleen so are rare in normal circulation, they are increased in the absence of a spleen, or in hyposplenic conditions (that include pregnancy). Generally placed “off centre” but not peripheral.*



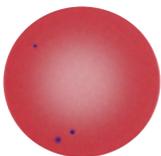
**Basophilic stippling** multiple blue inclusions fairly evenly distributed in erythrocyte cytoplasm.



*Stressed haematopoiesis results in precipitated organelles (predominantly ribosomes) within the erythrocyte. Common in a range of conditions including neoplastic, reactive, congenital or toxic states. The stippling may be fine or coarse.*



**Pappenheimer bodies** grey/blue (usually) peripheral inclusions that are rounded or sharp



*Like basophilic stippling these represent retained organelles – in this case mitochondria are the predominant component so can be confirmed using iron-stains. Generally represent conditions with hyposplenism or iron overload.*



## Abnormal cells recognised by altered haemoglobin distribution

An altered haemoglobin distribution for a flattened stained cell may reflect the effects of “flattening” of a cell with altered shape during film preparation (stomatocytes or target cells), or may reflect a genuine change to haemoglobin (crystals or ghost cells). The causes of these appearances are therefore diverse.

**Target cells:** a red cell with a separate haemoglobin accumulation in the area of central pallor  
(also known as **codocytes**)



*Essentially a “floppy cell” in which membrane exceeds cellular haemoglobin (in circulation it has a cup-like form), arising in a range of disease states, but most often associated with thalassaemias, particular abnormal haemoglobins or liver disease.*



**Stomatocytes:** a red cell where the area of central pallor appears as a “slit”  
(sometimes described as “**coffee bean cells**” - particularly if slightly ovoid or elongated)



*Particularly associated with artefact, hereditary cell membrane disorders or excess alcohol. Cell size can be important as an indication of cause of stomatocytosis.*



**Hemighost or ghost cells:** haemoglobin condensed to one pole with an empty membrane blister  
(also known **blister cells**)



*These cells arise where haemoglobin becomes denatured, generally by oxidative damage caused by drug or deficiency of the enzyme G6PD, although they may also be seen in unstable haemoglobins.*



**Haemoglobin crystals:** a dense area of solid haemoglobin which may have a rhomboid shape



*Particular abnormal haemoglobins (notably haemoglobin C) have a low solubility and a tendency to precipitate in the form of a solid mass that may have a crystal-like appearance.*

