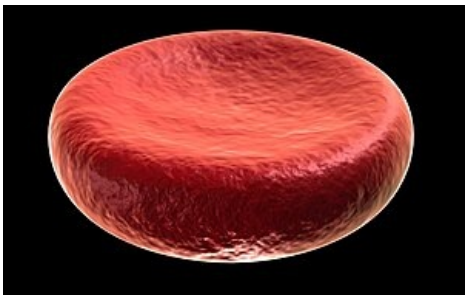
Red blood cells

Red blood cells (erythrocytes) are **non-nuclear** biconcave blood elements. The main component of the erythrocyte is hemoglobin. In a healthy adult, they form in the red bone marrow . They are broken down in the reticuloendothelial system, especially in the spleen. The signal to remove the cell from the circulation is a defective complex of oligosaccharides, which is attached to the proteins of the outer membrane. The lifespan of the erythrocyte in the blood is about 120 days.



Erythrocyte

Development of erythrocytes

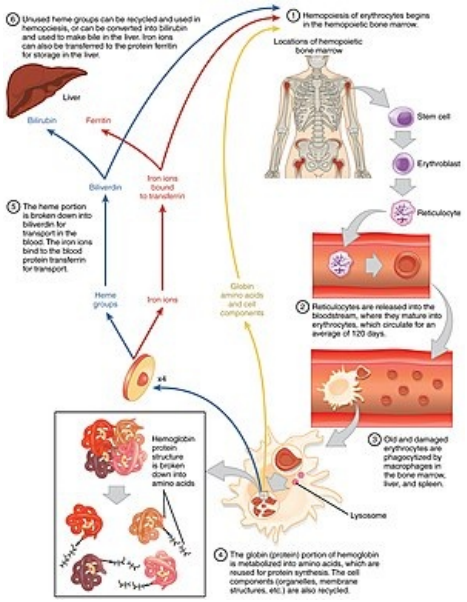
The erythrocyte, like other blood elements, comes from a**stem cell**. The stem cell further differentiates into a red progenitor line in: proerythroblast → normoblast (basophilic, polychromic and orthochromic) → reticulocyte → up to mature erythrocyte. Reticulocyte conversion to mature erythrocyte takes 24-48 hours. During this *maturation*, the cell loses its organelles (mitochondria , ribosomes , cytoplasmic enzymes).

Normal values

Red blood cells are one of the most important cells in the body, especially for their ability to **carry blood gases**. Changes in individual parameters can therefore have serious consequences.

Proportions of erythrocytes

Parameter	Value
Diameter	7,5 µm [1]
Circumference thickness	2,6 µm [1]
Thickness in the middle	0,8 µm [1]
MCV (average erythrocyte volume)	82–102 fl
MCH (average weight of Hb in era)	27–32 pg
MCHC (average Hb concentration in era)	310–360 g Hb/l ery



A life of erythrocyte

The values in the blood

Blood parameter		Value
Erythrocyte count	men	4,3–5,7 × 10^{12}/l
	women	3,8–4,9 × 10^{12}/l
Hematocrit	men	0,39–0,51
	women	0,33–0,47
	newborn	0,45–0,60

Function

1. respiratory gas transport

The main function of erythrocytes is to transfer oxygen from the lungs to the tissues and carbon dioxide in the opposite direction. Oxygen binds to the central atom of iron in hemoglobin, CO 2 binds to hemoglobin in the erythrocytes or is converted to HCO 3 - .

2. Buffering system

The presence of hemoglobin allows erythrocytes to buffer hydrogen cations. In tissues, H + binds to Hb, while in the lungs it is released from the molecule.

3. Maintaining blood viscosity

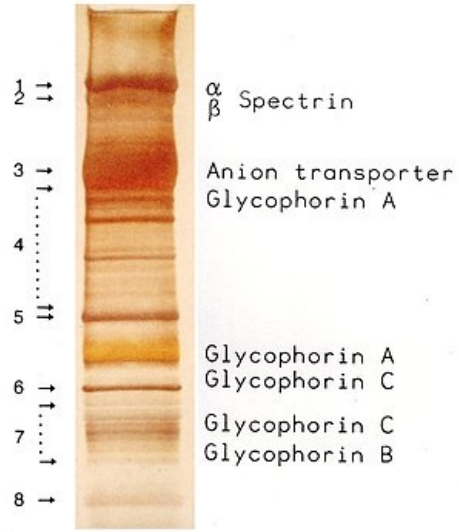
4. Protection against free radicals

RBC Morphology

We **do not find the nucleus and most organelles** in the mature erythrocyte, so it is not capable of proteosynthesis. The cell has **typical biconcave (sponge-shaped) shape**, which appears in the blood smear as a brightening in the middle. The main advantage of this shape is **the increase in the diffusion area for gas exchange** (up to 30% compared to the spherical shape). The cell surface consists of a solid elastic membrane (plasmalema) permeable to water and electrolytes. The membrane is deformable, so blood cells can easily pass through the capillary regions. Erythrocytes are made up of 40% lipids , 10% carbohydrates , 50% proteins. About half of the lipid bilayer proteins are integral transmembrane proteins. Transmembrane proteins together with intracellular fibrillar proteins **form a solid support** for erythrocyte shape. Fibrillar proteins form a network under the membrane. Peripheral proteins then form mainly *the glycocalyx* , which is the basis of the existence of blood groups. Some proteins (actin, tropomyosin and other actin binding proteins) form a *junction complex* between the fibers of the spectrin. The interconnection between several connecting complexes has the ability **to contract** , which facilitates the passage of the erythrocyte through the capillary.

Membrane proteins

Protein	Additional information
spektrine	main cytoskeletal protein, forms tetramers, has a high molecular weight, has 4 binding sites → for ankyrin, actin, band 4.1 and the spectrin itself (autoassociation)
ankyrin	anchoring the spectrin to the cytoplasmic membrane (on integral membrane proteins)
capnophorin (strip 3)	anion channel - transfer of chloride ions from the cytoplasm to the environment and vice versa (Hamburger shift)
actin	F-filamentous actin chain - has binding sites for spectrine and band 4.1
strip 4.1	forms the so-called ternary complex = actin + spectrin, anchors to the membrane (binds to glycophorins A, C)
glycophorins A, B, C, D	determine the individual's affiliation to the MN system, interesting: glycophorin A - has binding sites for malaria agents



Membrane proteins

Terms according to erythrocyte parameters change

Parameter	Term	Importance	Cause
Number	Erythropenia (erythrocytopenia, oligocytemia)	decreased number of ery	anemia
	Polycythemia	increased number of erythrocytes	eg. when adapting to higher altitudes
Size	Mikrocytes	ery < 7 µm	eg. in iron deficiency – sideropenic anemia
	Makrocytes	ery > 9 µm	eg. in case of lack of vit. B12, B6 and folic acids
	Anisocytosis	unequal cell size	
Face	Drepanocytes	crescent-shaped ery	hemoglobinopathy
	Spherocytes	spherical shape	Hereditary spherocytosis
	Echinocytes	thorny protrusions	
	Poikilocytosis	irregular shape of the ery	
Hb content	Hypochromia	reduced Hb content	
	Anisochromia	unequal Hb content	

Jones-Price's curve

There are normally blood cells smaller and larger than normal in the blood, which is called **physiological anisocytosis** . The Price-Jones curve is a **graphical presentation of the erythrocyte size distribution**. The curve shifts in different pathological conditions.

Erythrocyte metabolism

The only source of energy for erythrocytes is **glucose**, which is transported into the cell via the **GLUT-1 transporter**. Inside the cell, it is processed by enzymes in the cytoplasm. Erythrocyte production itself is affected by the hormone **erythropoietin** , which is produced in the kidneys and liver .

Erythrocyte membrane

The erythrocyte membrane is composed of ten main proteins, which can be divided into two groups:

1. **integral** – gglycophorins, anion exchange proteins - eg.: Capnophorin (band 3, Cl^- kanál)
2. **peripheral** – spektrin, ankyrin, actin

Glycophorins are glycoproteins that have an N-terminus protruding above the surface of the erythrocyte. Anion exchange proteins form a channel in the membrane to mediate the exchange of Cl- and HCO3- ions. Spectrin, ankyrin and other peripheral proteins are responsible for maintaining the shape of the erythrocyte.

Links

Related articles

- Blood
- Blood count
- Hemocoagulation
- Blood clotting test
- Bleeding examination
- Hematopoiesis (histology)
- Disease conditions from increased erythrocyte count
- Anemia
- Transport of CO2 through blood
- Oxygen transport through the blood
- Erythropoiesis

1. **Cite error: Invalid <ref> tag; no text was provided for refs named `Junquiera`**