

Metabolism of erythrocyte

The main function of erythrocytes is to transport oxygen to tissues. Therefore, the structure and metabolism of erythrocytes are adapted to this function. Erythrocyte metabolism is unique due to the absence of mitochondria. Therefore, they cannot generate ATP by oxidative phosphorylation. The energy source for the erythrocyte is **D-glucose**. Red blood cells, along with brain cells, are therefore the only cells in the human body that require a continuous supply of glucose. The glucose transporter in the erythrocyte membrane - **GLUT-1** contains 12 transmembrane helical segments that create a channel for the passage of glucose in the membrane. The transporter is not dependent on insulin.

Anaerobic glycolysis

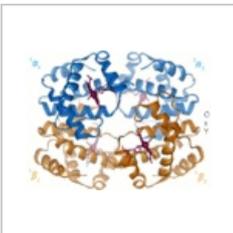
The basic metabolic process taking place in the erythrocyte is anaerobic glycolysis with the formation of ATP by substrate phosphorylation. Glycolysis in the erythrocyte proceeds similarly to that in other cells, but differs in the reaction catalyzed by phosphoglycerate kinase. If the erythrocyte does not need as much ATP, then 1,3-bisphosphoglycerate is short-circuited to 2,3-bisphosphoglycerate. The reaction is catalyzed by the enzyme bisphosphoglycerate mutase. The importance of 2,3-bisphosphoglycerate for erythrocytes lies in the function of hemoglobin. 2,3-bisphosphoglycerate binds to deoxyhemoglobin, which stabilizes and facilitates the release of oxygen in the tissues. The erythrocyte does not have mitochondria, so it gets rid of lactate.)

Pentose phosphate pathway

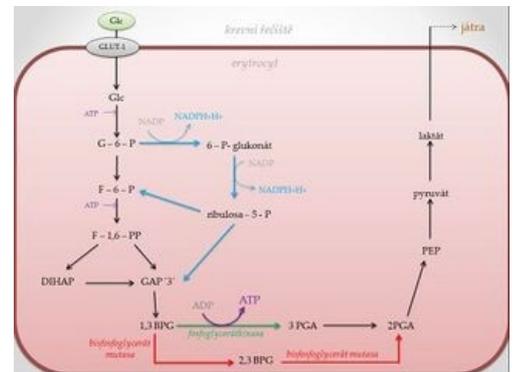
About 5% of glucose is used for the pentose phosphate pathway, in which the reduced form of the coenzyme $\text{NADPH} + \text{H}^+$ is formed. The latter functions as a coenzyme of glutathione reductase, an enzyme necessary for the synthesis of reduced glutathione. Reduced glutathione protects the erythrocyte from the toxic effects of oxidative stress.

Hemoglobin

The main function of hemoglobin in erythrocytes is primarily oxygen transport. It also transports CO_2 and is an important blood buffer. Hemoglobin consists of four subunits, each containing one heme. Heme is mainly synthesized in the bone marrow and liver.



Hemoglobin



Metabolism of the erythrocyte

Erythrocyte membrane

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

1. **integral** - glycoporphins, anion-exchange proteins
2. **peripheral** - spectrin, ankyrin, actin

Glycoporphins are glycoproteins that have their N-terminus protruding above the surface of the erythrocyte. Anion exchange proteins create a channel in the membrane to mediate the exchange of Cl^- and HCO_3^- ions. Spectrins, ankyrin and other peripheral proteins are responsible for maintaining the shape of the erythrocyte.

Erythropoiesis

The formation of red blood cells is controlled by the glycoprotein erythropoietin. Erythropoietin is synthesized in the kidneys, from where it is released into the bloodstream during hypoxia, where it is transported to the bone marrow. Here it binds to the membrane receptor of erythrocyte progenitors.

Links

Related Articles

- Erythrocyte
- Erythropoietin
- Pentose Cycle
- Anaerobic glycolysis
- Hemoglobin
- Oxygen dissociation curve

References

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