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Effect of Hypoxia on the Liver and its Types

Umurov Erkin Utkirovich [1]

[1] Department of Pathological Physiology, Bukhara State Medical Institute, Uzbekistan

Abstract:

Hypoxia affects the organism. Information about the reasons and mechanism of their classification has been provided. Hypoxia is identified with several types. Information about oxygen absorption processes has been provided. The oxygen supply to liver cells and tissues in the organism has been studied.

Keywords: pathological, hypoxic, respiration, vessel, circulatory, tissue, loading, substrate-dependent pneumothorax, pleural space, exudates, and intermittent hypoxia.

Hypoxia process is considered as a decrease in the amount of oxygen in all organs and tissues. It is observed when the inhaled air lacks oxygen (for example, at high altitudes), during physical exertion, during obstruction of the airways, and in other conditions such as bronchial spasms. Hypoxia can manifest in various ways. Various pathological conditions are its basis. Hypoxia occurs quickly, even within a moment, and can be chronic. The classification of hypoxia is based on their reasons and mechanisms. Several types of hypoxia are distinguished: hypoxic, respiratory, vascular, circulatory, tissue, loading, substrate-dependent, and intermittent hypoxia. The etiology and pathogenesis of hypoxia. Tissue respiration - its oxygen absorption process is considered. In the oxygenation of tissues, blood circulation, blood, and external respiration systems are involved. Each of these systems may deteriorate to various degrees, of course, tissue respiration is essential. However, the dysfunction of some of these systems and the compensation by others are noted. In this way, the continuity of respiration in the tissue is estimated. In hypoxemia, the speed of blood flow increases even when the oxygen saturation of the blood decreases. In the organism, it is possible to obtain the required amount of oxygen in unit time. During insufficiency in blood circulation, the speed of blood flow decreases, and the demand for oxygen in the tissue increases. This leads to a decrease in the oxygen saturation of the blood. When the partial pressure of oxygen decreases, the speed of blood flow in the alveoli increases, and the oxygen saturation of the blood

may increase due to erythrocytosis. These compensatory processes occur when the demand exceeds and the ability to utilize oxygen in the tissue is impaired, leading to tissue hypoxia - a state of hypoxia. Hypoxic or exogenous hypoxia. This type of hypoxia develops when the partial pressure of oxygen in the inhaled air decreases. An example of this is altitude sickness, where a person may appear visibly tired at high altitudes. Exogenous hypoxia is simulated experimentally using a barocamera and by using mixtures with reduced oxygen content as breathing agents.. Oxidative lesions to the respiratory system, such as lung parenchyma, pleural cavities, aquatic structures, and airways, are examples of disorders in the oxygen supply system during surgery and anesthesia. Respiratory (breathing) hypoxia. Respiratory hypoxia occurs in the lungs due to impaired gas exchange. Factors contributing to hypoxia:

1. Impairment of air passage in the airways (bronchospasm, inflammatory processes, bronchitis, tracheitis), obstacles to proper lung expansion (pneumothorax, accumulation of exudates in the pleural cavity), and ventilation compromise in other respiratory diseases.
2. Blood flow in the lungs and impaired gas exchange in the alveoli result in ventilation-perfusion ratio impairment. Due to arteriovenous anastomoses (shunts) within the venous circulation of the lungs, possibly allowing blood to bypass the alveoli, when large areas of the circulation bypass the arterial system, blood flows from the artery to the vein within the lung and is diverted to the left side without being exposed to oxygen. The delivery of oxygen to the organism is insufficient. Oxygen passes through the blood flowing through the lungs, resulting in a noticeable decrease in oxygen in the arterial blood. Hypoxia typically accompanies hypercapnia and metabolic acidosis. Circulatory (cardiovascular) hypoxia.

Circulatory hypoxia develops due to local and systemic impairment of blood circulation, potentially leading to ischemia and stagnant blood flow. If circulatory dysfunction occurs within the larger circulation, blood oxygenation in the lungs may be sufficient, but oxygen delivery to the tissue may be compromised. If circulatory dysfunction occurs within the smaller circulation, oxygenation of arterial blood becomes impaired. Circulatory hypoxia may arise not only from absolute deficiency but also from relative inadequacy of blood circulation. This condition may be observed when the tissue's demand for oxygen exceeds the amount delivered, possibly exacerbated by emotional states leading to increased adrenaline affecting arteriolar dilation, thus significantly increasing the demand for oxygen in the myocardium. It's also conceivable to attribute a decrease in tissue oxygenation to circulatory hypoxia resulting from microcirculatory impairment due to compromised tissue perfusion and alterations in the permeability of cell membranes, leading to reduced oxygen transfer.

Hypoxia in the blood, known as hemoglobin hypoxia, occurs primarily due to pathological changes in the blood system, resulting in a decrease in the effective oxygen saturation of blood. Hemoglobin hypoxia can be subdivided into hypoxias resulting from decreased oxygen availability and impaired hemoglobin function. In pathological conditions, such accumulations of hemoglobin may occur, indicating their role in oxygen transport. Examples include carboxyhemoglobin, which represents the accumulation of hemoglobin with carbon monoxide (CO), indicating a significant increase in the affinity of hemoglobin for carbon monoxide, which is highly toxic; carbonation in the air. Nitrate, nitrite, and aniline products can lead to the formation of methemoglobin during carbonation, which holds iron in its trivalent (Fe3+) state and cannot bind oxygen. Tissue hypoxia. Tissue hypoxia is the impairment of adequate oxygen utilization in tissues**.** In cases where tissues are adequately supplied with oxygen but biological oxidation is impaired, tissue hypoxia occurs. The primary cause of tissue hypoxia is the decreased activity or quantity of respiratory enzymes, as well as the impairment of oxidation and phosphorylation processes. An example illustrating the severity of tissue hypoxia may be the inhibition of cytochrome oxidase, the last enzyme in the respiratory chain, by cyanide monoxide acetate. Even when alcohol and other narcotic substances (ether, urethane) are carbonated, dehydrogenases may be inhibited, leading to tissue hypoxia.

Deficiency in the synthesis of respiratory enzymes that induce tissue hypoxia is observed in avitaminosis, particularly in riboflavin and nicotinic acid deficiency, as they may enter the prosthetic group of flavin enzymes and the composition of dehydrogenases. Impairment and reduction in oxidation and reduction lead to a decrease in the efficiency of biological oxidation, resulting in free energy being released as heat. The decrease in macroergic compound synthesis is observed due to the inhibition of resynthesis. There is an increase in energy consumption and metabolic shifts. Free radical oxidation activity is of great importance in tissue hypoxia. In this case, organic molecules undergo non-enzymatic oxidation by molecular oxygen, leading to the oxidation of lipids in mitochondria and membrane destabilization in lysosomes. The increase in free radical oxidation, as well as its natural inhibitors, may also be observed in tissue hypoxia when oxygen demand exceeds supply due to factors such as atmospheric pressure changes during ionizing radiation exposure. The severity of hypoxia depends on its type. This type of hypoxia occurs when tissue is supplied with adequate or excessive amounts of oxygen. However, increased tissue activity and a significant increase in oxygen demand may lead to inadequate oxygen supply, resulting in metabolic changes specific to the actual oxygen deficiency. For example, in sports, excessive physical activity or intense heavy labor can lead to increased oxygen demand, resulting in metabolic changes specific to tissue oxygen deficiency. Substrate-dependent hypoxia. This hypoxia is associated with the availability of substances (substrates) that are essential for normal biological oxidation. In practice, this hypoxia is often associated with glucose deficiency. Depletion of glycogen and impaired availability of fatty acids also contribute to this type of hypoxia. Intermittent hypoxia. This type of hypoxia is characterized by the temporary impairment of the activity of several systems that supply tissue with oxygen. For example, during severe injuries, the volume of blood circulating at one time decreases (circulatory hypoxia), breathing becomes shallow and rapid (respiratory hypoxia), resulting in impaired gas exchange in the alveoli. If blood loss occurs due to surgery, then blood hypoxia may also be observed. Hypoxia diagnostics. The method of diagnosing hypoxia conditions not only increases the organism's adaptability but also exacerbates many other uncomfortable factors, including physical exertion, changes in ambient temperature, infection, and relative humidity. In other words, diagnosing hypoxia increases the overall nonspecific adaptability of the organism.

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