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Oxygen from the Atmosphere Cannot Pass Through the Lung Tissues and Reach the Bloodstream. The Unexpected Capacity of Human Body to Dissociate the Water Molecule

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Abstract

Oxygen seems of fundamental importance to survival. Thereby, transportation exchange, and regulation of necessary gases is critical. The prevalent dogma indicates that the exchange from atmospheric oxygen in the lungs is by simple diffusion, caused by the differential pressure of gases involved in respiration. Gases tend to move from a high-pressure area to a low-pressure one.

Theoretically, at the end of the process, oxygen passes from the blood to the tissue fluid and carbon dioxide from tissue fluid into the blood. Apparently, blood stream is a well-developed system for the transportation of gases.

However, our finding about the unsuspected intrinsic property of human body to dissociate the water molecule, breaks in thousand pieces the ancient dogma about living beings can absorbs atmospheric oxygen.

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Background

Leaving aside the small detail that lung gas exchange cannot be explained simply by diffusion [1], other theories have been structured that, in turn, try to explain the presence of high levels of oxygen in the bloodstream. For instance, the Haldane´s effect: Mechanism by which the binding of oxygen to hemoglobin tends to displace carbon dioxide from the blood. The combination of oxygen with hemoglobin makes it behave like a stronger acid and, therefore, with less tendency to form carbaminohemoglobin and greater release of hydrogen ions, which, together with bicarbonate, form carbonic acid, which will dissociate into CO_2 and water. Supposedly, when venous oxygen saturation increases because of increased blood flow, changes in venous blood PCO_2 and carbon dioxide content may differ because of the Haldane effect [2]. Furthermore, theoretical mathematical models had been developed trying to explain the highly complex tissue-blood dioxide exchange during hypoxia [3].

Introduction

The purpose of the respiratory system is to perform gas exchange, but only in regards CO_2. At the respiratory membrane, where the alveolar and capillary walls meet, gases move across the membranes, but oxygen cannot enter the bloodstream and only carbon dioxide exiting. Recall that an erythrocyte needs only a second to pass through lung circulation. It is through this mechanism that blood is wiped out from carbon dioxide, the waste product of cellular respiration, which is removed from the body.

Gas molecules exert force on the surfaces with which they are in contact; this force is called pressure. In natural systems, gases are normally present as a mixture of different types of molecules. For example, the atmosphere consists of oxygen, nitrogen, carbon dioxide, and other gaseous molecules, and this gaseous mixture exerts a certain pressure referred to as atmospheric pressure.

Partial Pressures of Atmospheric Gases	
Gas	% total composition/ Partial pressure in mm Hg.
Nitrogen (N_2)	78.6 / 597.4
Oxygen (O_2)	20.9 /158.8
Water (H_2O)	0.4 / 3.0
Carbon dioxide (CO_2)	0.04 / 0.3
Other	0.06 / 0.5
Total composition/total atmospheric pressure	100% / 760.0

In spite the marked physical-chemical difference between Nitrogen and Oxygen, so far it cannot be identified a mechanism capable of separate both gases in lung tissues, in any pulmonated species, that could impel the substantive change observed in blood stream after lung circulation and worst in a whooping time (one second).

Gases tend to equalize their pressure in two regions that are connected. A gas will move from an area where its partial pressure is higher to an area where its partial pressure is lower (simple diffusion). In addition, the greater the partial pressure difference between the two areas, the more rapid is the movement of gases, but still is called simple diffusion.

Two important aspects of gas exchange in the lung are ventilation and perfusion. Ventilation is the movement of air into and out of the lungs, and perfusion is the flow of blood in the pulmonary capillaries. For a CO_2 gas exchange to be efficient, the volumes involved in ventilation and perfusion should be compatible. The main function of ventilation is the expelling of the CO_2 that continuously is formed inside our body.

Oxygen from the atmosphere cannot pass through lung tissue and reach the bloodstream, thereby still is a matter of controversy the origin of oxygen inside human body. The partial pressure of oxygen in alveolar air is about 104 mm Hg, whereas the partial pressure of oxygenated blood in pulmonary veins is about 100 mm Hg, this is: too low the difference in partial pressure. Theoretically, when ventilation is sufficient in volume inspired and frequency, atmospheric air enters the alveoli at a high rate, and the partial pressure of oxygen and nitrogen in the alveoli remains high, but whiting usual values. In contrast, when ventilation is insufficient in volume inspired and frequency, the partial pressure of oxygen and nitrogen in the alveoli drops. Supposedly, without the small difference of 4 mm Hg in partial pressure between the alveoli and the blood, neither nitrogen nor oxygen do not diffuse efficiently across the respiratory membrane. Therefore, almost magically, the body redirects blood flow to alveoli that are receiving sufficient ventilation, but with the main aim of expel CO_2 and not to absorbs neither Nitrogen nor oxygen. This is achieved by constricting the pulmonary arterioles that serves the dysfunctional alveolus, which redirects blood to other alveoli that have sufficient ventilation.

The diameter of the bronchioles is sensitive to the partial pressure of carbon dioxide in the alveoli, but it is sensitive to the partial pressure of oxygen. A greater partial pressure of carbon dioxide in the alveoli causes the bronchioles to increase their diameter as will a decreased level of oxygen in the blood supply but not because atmospheric oxygen can pass through lung tissues, because despite dyspnea, the oxygen of the atmosphere cannot pass through the lung tissues, and this in any living being, since no living entity takes oxygen from the atmosphere. Bronchiolar dilation and selective blood circulation to the alveoli in better conditions, only allow that carbon dioxide to be exhaled from the body at a greater rate. As mentioned above, a greater partial pressure of oxygen in the alveoli, such as when supplemental oxygen is administered, either through a mask or when the patient is intubated, causes the pulmonary arterioles to dilate, increasing blood flow; which only allows CO_2 to be expelled into the atmosphere more efficiently, more quickly; but in no way does it work so that oxygen or nitrogen from the atmosphere is absorbed at least in significant amounts or at least sufficient to explain the large differential between the pressure of atmospheric oxygen and the oxygen present in the bloodstream.

Among the various explanations for why oxygen or atmospheric nitrogen cannot pass through lung tissues and reach the bloodstream is the fact that gases do not combine with water, but rather repel each other, and lungs (alveoli), vascular, and any part of the body tissues have a high-water content (>70%), so they are repelled, rather than attracted.

Since 1897, John Haldane and Lorrain Smith, concluded that the exchange of oxygen which takes place between the atmosphere and the blood cannot be adequately explained by diffusion alone [4].

Therefore, the typical diagram of the textbooks of medicine and physiology must be modified (Figure 1)

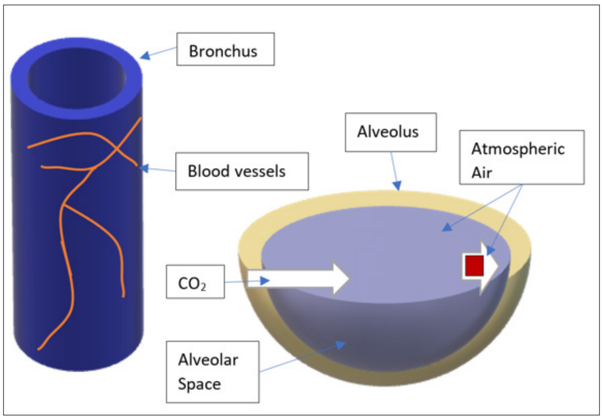

Figure 1) Neither in the bronchi nor in the alveolar space can atmospheric air be absorbed. The only gas exchange that exists between the alveolus and the air it contains, is the CO_2 that the body expels with each ventilation, since its partial pressure changes from 0.04% to 4%, that is, it rises 100 times in the alveolar space.

For a century, the influence of the Bohr effect on the utilization of blood-borne oxygen has been deemed secondary to its influence on the uptake of carbon dioxide by the blood. However, the opposite is the case [5].

The arteriovenous difference in carbon dioxide tension ($DeltaPCO_2$) can be calculated after simultaneous sampling of arterial blood ($PaCO_2$) and of mixed venous blood from the distal of a pulmonary artery catheter ($PvCO_2$). Under physiological conditions, $DeltaPCO_2$ ranges from 2 to 5 mmHg. The $DeltaPCO_2$ depends on carbon dioxide and cardiac output by a complex fashion [6].

From the erroneous theory that oxygen easily crosses the alveolar membrane, other theories and mathematical models have been developed that try to adjust this dogma to the facts that are observed in the laboratory and in clinical practice. But an erroneous theory gives rise to other theories also erroneous.

Just as oxygen cannot enter the tissues of the body, neither can the oxygen inside us leave. Therefore, the question remains: Where does the oxygen that the human body contains inside come from, if atmospheric oxygen cannot pass through the lung tissues and reach the circulatory stream?

The Answer

Circumstantially, during an observational, descriptive study about the three main causes of blindness, and whose working hypothesis was to identify early changes in the vessels that enter and leave the optic nerve and their relationship with glaucoma, diabetic retinopathy, and macular degeneration; we found the answer. This study lasted 12 years (1990-2002) and included ophthalmological studies of 6000 patients [7].

A few weeks after starting the study, we noticed some interesting details at the edges of the optic nerve, which we began to follow, and twelve years later, and six thousand patients later, we could conclude that our body had the ability to transform the energy of

sunlight into chemical energy, just as plants do, that is: by means of the dissociation of the water molecule.
A chemical reaction can be written as follows:

$$2H_2O_{\text{(liquid)}} \rightarrow 2H_{2\text{(gas)}} + O_{2\text{(gas)}} \rightarrow 2H_2O_{\text{(liquid)}} + 4e\text{-}$$

There are several molecules in our body capable of dissociating the molecule from water, such as hemoglobin, whose formula is almost identical to chlorophyll, bilirubin, cytochrome P-450, and myoglobin; but the most efficient of all is undoubtedly melanin; because this molecule is apparently the only one that is capable of dissociating and reforming the molecule of water, and for every two water molecules that are reformed, 4 high-energy electrons are generated.

In the case of hemoglobin, chlorophyll, bilirubin, cytochrome P-450, and myoglobin, water dissociation happens irreversibly.

So, the origin of the oxygen that is inside the cells and in the bloodstream, comes from the dissociation of water, not from the atmosphere. But just as oxygen cannot cross the cell membrane, much less the cytoplasm (due to its high-water content), neither can oxygen leave the body, since the barriers work in both directions.

However, Nature found the solution from the beginning of time, each oxygen molecule is joined, bounded; by a carbon atom, forming CO_2, which is significantly more soluble than oxygen in water (25 times), in addition to developing an enzyme that substantially accelerates this process: Carbonic anhydrase.

Carbonic anhydrase activity is absent from plasma (Maren, 1967). This led Roughton (1935) to postulate that confinement of carbonic anhydrase to the red cell interior would lead to disequilibrium between end-capillary plasma and red cell pH. Dissolved CO_2 rapidly leaves both plasma and erythrocyte as blood enters the pulmonary capillary. This upsets the equilibrium between bicarbonate and carbon dioxide, leading to conversion of bicarbonate to CO_2 in both the plasma and red cell. The latter reaction occurs rapidly under the influence of carbonic anhydrase, but in the absence of enzyme the plasma reaction proceeds very slowly at the uncatalyzed natural rate [8].

It is no coincidence that this enzyme is present in all living beings, as well as melanin. The effect of carbonic anhydrase is reversible, because when CO_2 (gas) is secreted by cells into the intercellular space, which contains abundant liquid, carbon dioxide transforms CO_2 into carbonic acid (H_2CO_3), adding a water molecule. Making it soluble in the blood plasm, which contains a greater amount of water than interstitial fluid.

Then, the bloodstream transports carbonic acid or bicarbonate, depending on the number of protons, to the lung, where carbonic anhydrase is especially abundant, but the action of the enzyme is reversible, and therefore, the carbonic acid or bicarbonate ion is dehydrated, transforming CO_2 back to the gaseous state, Which exponentially accelerates the expulsion of CO_2 into the alveolar space, so much so, that the partial pressure of CO_2 in the inspired air, rises from 0.04% to 4.0% (100 times).

Conclusion

The airway epithelium is the only tissue that is exposed to large and rapid CO_2 fluctuations [9]. Respiratory epithelia are covered by a thin~10 µm layer of liquid termed the airway-surface liquid (ASL) [10]. The ASL pH (pHASL) is typically a few tenths of a pH unit more acidic than the plasma pH [11]. Respiratory cycles occur within seconds and therefore pHASL changes are small during breathing. The slow change in pHASL was a result of low carbonic anhydrase activity of the ASL.

Thereby, the pH difference between ASL and the bloodstream is strictly regulated, indicating that it requires energy. The main actor in gas exchange is carbonic anhydrase, an enzyme widely spread in nature, signaling its importance in the biochemical logic of life. But carbonic anhydrase is an enzyme that, to carry out its function, requires energy, like any enzyme.

And it doesn't just require energy to function properly, but even to preserve shape. Carbonic anhydrase is present in the cell membrane of erythrocytes, but these cells do not contain either cell nucleus or mitochondria, so we cannot infer that their energy source is ATP.

Therefore, it is congruent that its energy source is radiant energy through the dissociation of water. And one of the molecules in the human body that carries out this transformation is nothing less than hemoglobin, which is abundant in erythrocytes. And it is logical, given that the similarity between hemoglobin and chlorophyll is more than 99%.

Hemoglobin irreversibly dissociates the water molecule, such as chlorophyll. The reaction is as follows:

$$2H_2O \rightarrow 2H_2 + O_2$$

The dissociation of water in erythrocytes is constant, it is incessant day and night, with the main purpose of producing molecular hydrogen, which is the energy carrier that is released when the water molecule is split, and not only in the erythrocytes but in each and every one of the eukaryotic and prokaryotic cells. Hence the erroneous concept that erythrocytes transports oxygen because oxygen is always present because it is constantly produced, but not because it transports it but because it is a product of the dissociation of the molecule of water.

Incidentally: molecular hydrogen is the energy carrier, par excellence in the entire universe, therefore, our organism cannot be different.

The misleading dogma that living beings take oxygen from the atmosphere, is that it has tried to explain the physiology of breathing, but the results have been unsuccessful, because despite theories and more theories, despite mathematical models, the relationship between CO_2 and O2 was still not understood.

The unsuspected ability of the human body to transform light energy into chemical energy through the dissociation of water, like plants; opens a new era in biology, because it allows us to affirm that neither human being, nor no living being, take oxygen from the atmosphere, but from the water they contain inside, just like plants.

Pulmonology, and biology in general, requires, re-thinking, re-writing, which will benefit the health of people and the planet, because we are now more aware of the enormous importance of the mysterious liquid, we call water.

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