COVID: Hemoglobin and hypoxia.

Previous studies revealed the abnormal phenomenon of hemoglobin-related biochemistry in patients with COVID-19. The patients presented low levels of hemoglobin and neutrophils in most cases, and the significant elevation of serum ferritin, erythrocyte sedimentation rate, C-reactive protein, albumin and lactate dehydrogenase. These results imply a decrease in hemoglobin but an increase in the heme group, which would lead to harmful iron deposits, causing inflammation, elevation of C-reactive protein and albumin.

A study by Wenzhong et al used bioinformatic programs to evaluate conserved domains, homologous sequences and molecular coupling to analyze the biological roles of the viral proteins of the new coronavirus and its relationship with the structure of the heme group of hemoglobin.

Using sequences obtained from the database of The National Center for Biotechnology Information (NCBI) and molecular models obtained with different software, they studied the protein structure and its junctions with molecular coupling technology. Structurally, the new coronavirus is a positive RNA strand. Its structural proteins include: a transmembrane protein (S), envelope protein (E), membrane proteins (M), and nucleocapsid phosphoproteins. It also features nonstructural proteins: orf1ab, ORF3a, ORF6, ORF7a, ORF10, and ORF8.

With informatic tools, the authors discovered that coronavirus proteins bind strongly to different sites of the heme group porphyrin hemoglobin. The virus can bind both deoxyhemoglobin and oxyhemoglobin, preventing the normal transport of oxygen and carbon dioxide. Due to the accumulation of gases that is generated, the lung tissue becomes inflamed and is seen on radiographic images as ground glass lesions.

The results of this study demonstrate that surface proteins and ORF8 could combine with porphyrin to form a complex. While orf1ab, ORF10, ORF3a would attack the beta 1 chain of hemoglobin in a coordinated manner, dissociating the iron atoms of the porphyrin molecule.The authors conclude that the direct action of the coronavirus on porphyrin interferes with its metabolism and oxygen transport, contributing to favoring hypoxemia and systemic hypoxia.

If destruction of hemoglobin occurs, which is the primary route of oxygen transport in normobaric oxygenation, hyperbaric oxygen therapy could contribute by providing diluted oxygen in plasma independently of hemoglobin. This contribution is based on the dissolution of oxygen in plasma by a different and more effective mechanism than mechanical ventilation (dependent on hemoglobin, which is diminished and destroyed by infection with the new coronavirus).

Source: Wenzhong, Liu; Hualan, Li (2020): COVID-19: Attacks the 1-Beta Chain of Hemoglobin and Captures the Porphyrin to Inhibit Human Heme Metabolism. ChemRxiv. Preprint. https://doi.org/10.26434/chemrxiv.11938173.v5