

## **A case report of the use of hyperbaric oxygen therapy in the treatment of severe cases of COVID-19**

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Clinical reports and anatomical findings show that progressive hypoxemia is the cause of the deterioration in patients with COVID-19. Five severe cases of COVID-19 were treated in Wuhan and it was shown to be excellent therapy.

The improvement in the pathophysiological mechanisms obtained with hyperbaric oxygen therapy (HBOT) is better than the one obtained by breathing oxygen with mechanical ventilation techniques.

It is suggested that HBOT should be promoted as a treatment for critically ill patients with COVID-19 since it would generate greater efficiency in treatment, reduce pressure on health personnel and the risk of infection, as well as decrease the mortality rate of critically ill patients. This treatment is important to accelerate victory against this pandemic, achieving more effective treatment and preventing possible contagion.

### **Efficacy evaluation**

Zhong Yangling, director of the Department of Hyperbaric Oxygen in Wuhan Yangtze River Shipping General Hospital, carried out the successful treatment of five patients. Two had critical conditions and Three had severe symptoms. The data obtained shows that regarding the treatment of hypoxemia it was observed:

1. Rapid relief of hypoxia symptoms: after the first session, dyspnea and chest pain were reduced. After the second session, the respiratory rate decreased and the difficulty in breathing was alleviated more slowly.
2. Rapid correction of hypoxemia: A blood sample from each patient was analyzed at the beginning of the session. They all showed low oxygen saturation. At the end of the session, the low saturation was immediately reversed. From the 5th day of session, oxygen saturation was greater than 95% in all patients. At the end of the treatment, saturation was greater than 93%, and even arterial values recovered significantly.

### **Analyzing the treatment**

1. The gastrointestinal symptoms that characterize the condition were reduced and appetite was restored. The headaches disappeared and the mental state improved.
2. Blood cell count and coagulation parameters were gradually recovered. Improvement in the liver and cardiac functionality parameters was obtained.

3. It was evidenced an improvement in the pulmonary architecture because after the hyperbaric oxygenation treatment the computed tomography showed lower levels of inflammation in the tissue.

### **Hyperbaric Oxygenation Therapy mechanisms**

The difference between atmospheric pressure therapy and overpressure therapy lies in the increased efficiency of oxygen transport to tissue cells. The advantage of using hyperbaric oxygen therapy is explained by the physical characteristics of the gas. Dalton's law allows us to explain the increase in the partial pressure of oxygen in the blood plasma and, according to Henry's law, the increase in gas dissolution due to the increase in the working pressure.

### **The advantages of using HBOT are:**

- By inhaling oxygen at high pressures, it is obtained a greater range of gas diffusion and a higher concentration. This allows the thickening of the tissue to be overcome, due to inflammation and fibrosis of the lung tissue.
- It is more effective to increase the partial pressure of oxygen with HBOT, than the oxygenation index with mechanical ventilation. Hyperbaric oxygenation treatment should be preferred when the oxygenation index is significantly reduced, breathing is clean, and mechanical ventilation should be increased 1.5-fold. HBOT is also recommended when the improvement obtained in the oxygenation index with the use of mechanical ventilation is less than double that normal breathing.
- HBOT allows greater oxygen consumption by the cell. Although mechanical respiration allows gas exchange in the lung tissue and hemoglobin saturation, it is not as effective compared to inhaling high-pressure oxygen. The oxygen concentration exceeds the transport capacity of hemoglobin, therefore increasing the concentration of dissolved oxygen in plasma. This allows an increase in the diffusion distance. Even gas accesses tissues damaged by hypoxia or showing signs of inflammation.
- Hyperbaric oxygen therapy does not cause damage to the respiratory tract.
- Hyperbaric chamber treatment does not interfere with the pharmacological treatment or the care in the ICU. HBOT is not the direct treatment against the virus, but it treats associated symptoms such as hypoxia. Patients received daily hyperbaric chamber sessions of 95-120 minutes. There is no conflict between treatments. HBOT can support the effectiveness of other treatments.

### **When should HBOT use as a treatment?**

- Patient with clinical signs of hypoxia and refractory hypoxia. Although hyperbaric chamber treatment is widespread for different pathologies, the fundamental requirement is that they present hypoxia (does not interfere with the indication to other pathologies).
- Hypoxia is manifest. In numerous published works, it has been shown that patients develop hypoxemia as a manifestation of lung deterioration, due to COVID-19.

### **Security**

HBOT has been widely used and maintains security standards for approximately a century. The risk of contracting an infectious disease from the use of the hyperbaric chamber is not higher than in hospital facilities.

In the hyperbaric chamber, the pressure valve and the release valve actuate at the same time. When the air enter equals the exit, constant oxygen pressure is obtained. The gas flows in a unidirectional manner, similar to laminar flow from the security booths, so there is no retrograde flow. In addition, the device has air purification systems.

The patient breathes the oxygen through a mask in the hyperbaric chamber. The exhaled air is poured into the external exhaust line, so the operator does not breathe the air exhaled by the patient in treatment.

The pressurization of the chamber is done with “fresh air”. The air that professionals breathe is relatively independent of that breathed by the patient in the hyperbaric chamber. Therefore, the possibility of contagion is less than in a room.

As for the air coming from the exhaust valve, it was filtered through a disinfecting solution to prevent the virus from spreading to the ambient air.

## **Conclusion**

The treatment of the five patients showed that the deterioration due to hypoxia ceased and the general condition gradually improved. There is an innumerable bibliography that demonstrates the benefits of hyperbaric oxygen therapy, so its application does not need clinical verification as other oxygen therapy treatments do. HBOT in the treatment of hypoxia is clearly superior compared to other methods such as mechanical ventilation and extracorporeal membrane oxygenation (ECMO).

Therefore, it has been demonstrated that hyperbaric oxygen therapy is strongly recommended for the treatment of COVID-19 positive patients since short-term results are obtained and the contagion rate would be reduced as well as mortality.