

# A Combination of Hyperbaric Oxygen Therapy and Steroid for Treatment of Severe COVID-19

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## ABSTRACT

COVID-19 is viral infectious disease that appears in Wuhan city in China as severe pneumonia and soon it spread in most of the countries as a pandemic. Although COVID-19 appear as severe pneumonia that through hypoxia result in ARDS, in short time a lot of studies shows pathogenesis differ from real ARDS, and depend on the pathogenesis many trials was done to find treatment.

This study based on pathogenesis theory that shows it is not typical ARDS but the virus removing iron and result in high serum ferritin level that affect the liver, and at same time carboxyhaemoglobin developed and sever hypoxia occur. Same theory shows that NK cell and T- lymphocyte are not involved in the immunity response in COVID.

Presence of fever and lymphopenia plus hyperferritinaemia make this similar to haemophagocytic lymphohistocytosis (HLH) and so steroid will be essential in treatment, and based on formation of carboxyhaemoglobin the role of hyperbaric oxygen therapy will be beneficial. So, the combination of HBOT and steroid will help in resolving hypoxia and its consequences in covid-19 patients.

## Keywords

COVID-19, Infectious disease, China, Pneumonia.

## Introduction

Corona virus is RNA virus from family Coronaviridae and order Nidovirales, this virus causes upper respiratory viral infection as normal sequence, but it may affect the lung parenchyma and even the alveoli and it may affect other systems such as gastrointestinal tract, cardiovascular or even nervous system during its course.

In 2002 corona virus result in outbreak known as Severe Acute Respiratory syndrome (SARS) in which the mortality rate was 10%, and 2012 the virus result in other outbreak known as Middle East Respiratory Syndrome (MERS) that registered a mortality rate of 37% [1]. In December 2019 corona virus presented in different way in Wuhan city in China that observed after several severe pneumonia cases with rapid spread, corona virus was detected in these cases with some structural changes that called novel corona virus 2019 (2019 - ncov), that change latter to COVID- 19 ( corona virus infectious disease 2019). COVID- 19 soon spread out of China and involved most of the countries, so WHO consider it as

global pandemic [1]. COVID -19 spread from person to person through small droplets that produced during cough or sneezing, and it also spread through infected surfaces as the virus may survive to many hours in a solid surface. The incubation period of the virus is varies from two days up to two weeks, but some studies observe an incubation period of more than this period, and unfortunately recently relapse occur.

The common symptoms of COVID -19 are high grade fever of more than 38 c, severe headache, sore throat, dry continuous cough and shortness of breath, but it may presented with other symptoms such as GIT symptoms. In general COVID -19 may resolve without complication but complication may occur mainly in elderly and/ or those with comorbidities such as diabetic, hypertensive, asthmatics, patient of COPD, patients of cardiovascular disease or immunocompromised. These complications include severe pneumonia, thromboembolic disease, ARDS, arrhythmia, myocarditis, neurological complications, impaired renal function, haematological complication and multiple organ failure (MOF) may occur. Whenever complications occur it worse morbidity and increased mortality.

Till now no vaccine detected so the only way to decrease spread rate is to follow protective measures which include avoidance of exposure to infected or even suspected COVID-19 cases, hand wash with alcohol containing soap following hand wash WHO guide procedure [1], if soap not available use sanitizer that contain at least 60% alcohol, avoid touching eye, nose or mouth, keep social distance, wearing face mask and clean when cleaning and disinfect frequently touched surfaces.

As many viruses no specific treatment available but a lot of studies and trials suggest different drugs and different strategies regarding treatment of COVID-19 and its complications these include hydroxyl chloroquine despite its cardiotoxicity [2], antiviral such as Favipiravir [3]. This study discusses the roll of steroid and hyperbaric oxygen therapy as treatment of severe COVID- 19 and its complications.

### Objectives

This study done to discuss the anticipated efficacy of combination of steroid and hyperbaric oxygen therapy in management of COVID-19.

### Methodology

This is prospective anticipated study based on the pathogenesis of novel corona virus.

### Hypothesis

Based on pathological features of COVID-19 that driven by hypoxia and mimicking haemophgocytic lymphohistocytosis (HLH), we suggest a combination of both hyperbaric oxygen therapy (HBOT) and corticosteroid may be of great benefit in treatment of severe COVID-19.



Figure 1: HBOT unit.

### Discussion

Hyperbaric oxygen therapy is a mode of therapy in which the patient breathes 100% oxygen at pressures greater than normal atmospheric pressure. HBOT has many indications such as co

poisoning, gas embolism, vascular insufficiency [4].

Based on recent observation on the pathogenesis of COVID-19 that suggest that SARS-COV2 attack 1- Beta chain of haemoglobin and hunting the porphyrins dissociating the iron from it and releasing iron into the circulation, that result in hypoxia, formation of carboxyhaemoglobin, oxidative damage and increase blood viscosity and hence thrombosis [5]. Hyperferritin that affect the liver and result in elevated liver enzyme mimics haemophagocytic lymphohistocytosis (HLH) which may be secondary to infection and the pathogenesis of HLH which depend mainly on the defective natural killer cell (NK) and cytotoxic T-cell activity may explain why immune response in COVID-19 not like other viruses depend on monocytosis rather than on NK cell and T- lymphocyte like other virus, in HLH failure of NK cell and T- lymphocyte to kill the target cells result in formation of excessive cytokines such as IL and TNF alpha again this looks like the pathology of COVID-19 as IL1 responsible for fever, TNF alpha responsible for hepatic injury and coagulopathy and elevated serum ferritin due to macrophage activation.

So, it is obviously that COVID- 19 can be managed as HLH with steroid and the alveolar involvement that result in hypoxia and formation of carboxyhaemoglobin can be treated with hyperbaric oxygen therapy.

In HBOT breathing 100% Oxygen at 3 ATA Increases the physical solubility of oxygen in the plasma Leading to a state of HYPEROXIA, the action that overcome the hypoxia and its effect on tissue, as hyperoxia induced Vasoconstriction and attenuate reperfusion, beside the antimicrobial activity of hyperoxia.

### Conclusion

Sever COVID-19 mimics haemophagocytic lymphohistocytosis in many aspects, and it same time carboxyhaemoglobin may developed due to the high affinity haemoglobin to carbon monoxide [6], so combination of HBOT and steroid is of great benefit and it may give dramatic response.

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