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Spectres of Covid: A Survey of Post - Recovery Impacts of Covid on Oxygen Absorption

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Abstract: ***The COVID - 19 pandemic has affected millions worldwide and has dramatically affected people's health and financial well - being. Although many people died from the disease, milder symptoms were more common. Those who developed mild to moderate symptoms recovered entirely after about a week. However, persistent or new symptoms have developed after recovery from COVID - 19, even in those who initially had mild illness. This is called post - COVID syndrome. This paper aims to look in - depth into the Post - Covid Syndrome, also called the Long COVID. In the first section, we look at the COVID - 19 Pandemic, the virus causing the disease, analysing the impact of the virus on the human body. In the second section, we introduce the Post - Covid/Long Covid Syndrome and delve deep into its symptoms. In the third section, we go into detail and analyse the syndrome's effect on the various systems of the human body, such as the Respiratory System, the Cardiovascular System and the Neurological System. Finally, we analyse the shortcomings in the current healthcare system and talk about how we can prepare ourselves to deal with such health crises in the future.***

Keywords: COVID - 19, Long COVID Symptoms, Respiratory System, Cardiovascular System, Public Health Crisis, Health Management

1. Introduction

The World Health Organization (WHO) in March 2020 announced that the Coronavirus Disease 2019 (COVID - 19) was a pandemic, fast forward to 2023, and the pandemic had caused 771, 407, 061 cases and 6, 972, 139 confirmed deaths (Our World in Data, 2023), with approximately 20% of patients infected requiring hospitalisation and 6% in critical care and needing invasive ventilatory assistance. Early epidemiological reports showed that 8.2% of cases presented with rapid and progressive respiratory failure. (Torres - Castro, 2023)

A variant of the coronavirus caused the COVID - 19 disease and is called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS - CoV - 2). In 2002, SARS - CoV emerged in Guangdong Province, China and spread to 37 countries, and the subsequent global epidemic resulted in over 8000 cases and 774 deaths. Ten years later, the Middle East Respiratory Syndrome Coronavirus (MERS - CoV) has spread to 27 countries, causing 2, 494 cases and 858 deaths worldwide (Li et al., 2020). The current variant, SARS - CoV - 2, is the third highly pathogenic CoV discovered, with a fatality rate of 2%, which is much lower than SARS - CoV (10%) and MERS - CoV (37%). However, the infectivity of 2019 - nCoV is higher; the average R0 (R0 is used to estimate the infectivity of a virus) of 2019 - nCoV ranged from 3.3 to 5.5 and appeared to be (slightly) higher than SARS - CoV (2–5) and MERS - CoV (2.7–3.9).

The symptoms of SARS - CoV - 2 infection are similar to that of SARS - CoV and MERS - CoV. On chest CT scans, most patients present with fever, dry cough, shortness of breath, and bilateral ground - glass opacities. However, patients with SARS - CoV - 2 infection rarely developed respiratory symptoms, suggesting that the virus primarily infects the lower respiratory tract. Additionally, approximately 20 - 25% of SARS - CoV - 2 patients experience gastrointestinal symptoms and signs (e. g., diarrhoea) similar to MERS - CoV or SARS - CoV (Li et al., 2020). In severe cases of SARS - CoV - 2 infection, symptoms include acute respiratory distress syndrome (ARDS), which involves septic shock, metabolic acidosis, and blood and clotting disorders. It is worth noting that critically ill patients may have a moderate or low fever during the illness, even without the obvious signs of fever. In addition, SARS - CoV - 2 infections, like SARS - CoV and MERS - CoV, cause high levels of cytokine production. SARS - CoV - 2 is thought to spread through droplets, close contact, aerosol, and possibly faecal and oral routes, and during the incubation period, patients can transmit the virus to other people. The distribution of viral receptors can explain the pathogenic mechanisms, clinical manifestations and transmission routes of SARS - CoV - 2. In addition to inhalation and body contact, faecal - oral transmission is a possible route of SARS - CoV - 2 infection. On average, the symptoms of COVID - 19 last 11.5±5.7 days. However, many patients remained unwell during follow - up after hospital discharge. In the United Kingdom, a study based on a smartphone application showed persistent symptoms of COVID - 19 in about 10% of patients three weeks after the onset of the disease; in some patients, symptoms persisted for several months (Zoe Health Study).

The mechanism of the post - illness syndrome can be defined as follows: (1) the persistence of signs and symptoms of the disease after the results of the removal of the COVID - 19 virus on the 14th day after the initial positivity along with no fever for three days; Improved respiratory symptoms, lung imaging clearly showing inflammatory takeover, and hospitalisation not required for any pathology or physician evaluation; (2) onset of symptoms within one month of initial clinical and virologic improvement; (3) increase in severity of previously experienced chronic conditions such as migraine, psychiatric disorders, bronchial asthma and rheumatological diseases within one month after recovery from COVID - 19. A study

in Bangladesh that analysed the effects of the virus after the recovery phase found that 46% of patients in a sample of 400 patients developed post - COVID - 19 symptoms, with post - viral fatigue being the most common symptom in 70 % of cases. Symptoms of COVID - 19 persisted after recovery in about 17% of cases, while they developed after seven days of recovery in 43% of cases.105 (30%) patients had at least one post - COVID - 19 symptom, while 57 (16%) had multiple symptoms. Post - viral fatigue was the most common symptom at 33 per cent. Other characteristics were persistent cough in 8.5%, shortness of breath after physical exertion in 7%, headache in 3.4%, dizziness in 2.3% and sleep - related disturbances in 5.9% (Mahmud et al., 2021).

The paper's focus will now shift towards the conditions of post - recovery from the virus and the subsequent impact of Covid post - recovery and other related facets of the pandemic.

2. Background

The respiratory system is most commonly affected in people who develop clinical illness because of the SARS - CoV - 2. However, the virus can affect any organ of the body. In critically ill patients, it is often seen that multiple organs are affected. The virus binds to angiotensin - converting enzyme - 2 (ACE2) receptors found in vascular endothelial cells, lungs, heart, brain, kidneys, intestines, liver, pharynx, and other tissues (Jain, 2020), thereby causing direct damage to the organs. Additionally, systemic disorders caused by the virus can often lead to organ dysfunction. When caring for a patient, it is essential to assess multiple organ involvement. Coagulation and vascular endothelial disorders are standard but may not cause symptoms in the early stages, but in the long run, they can damage many organs. Cardiac and renal dysfunction are joint in patients who die from post - COVID complications. Organ damage may become apparent after the acute infection has resolved. In the case of COVID - 19, cardiac complications may precede and occur without pulmonary and other complications. Cardiac injury can occur in patients with coronary artery disease (CAD) and those without signs of CAD. The leading causes of the first two are plaque rupture and thrombosis (Jain, 2020). Viral pneumonia is the most common severe clinical manifestation of COVID - 19, mainly presenting with fever, cough, shortness of breath, hypoxemia, and bilateral infiltrates on chest X - ray. A dry cough tends to be more common than a productive cough. Shortness of breath appears after an average of 5 to 8 days. Severe hypoxic respiratory failure, consistent with the Berlin definition of acute respiratory distress syndrome (ARDS), occurs in many patients with COVID - 19 pneumonia (Brosnahan, 2020).

The paper will now focus on analysing the post - Covid situation and its effects on the human body. Long COVID, also known as "post - acute sequelae of COVID - 19, " is a multisystem disease with severe symptoms that often occur after infection with Coronavirus 2 (SARS - CoV - 2). At least 70 million people worldwide have Long - COVID, a number which is based on a conservative estimate of 10% of those infected, which currently stands at over 770 million cases. This number could be much higher due to many undocumented cases. Incidence is estimated at 10% to 30% of non - hospitalised cases, 50 to 70% of hospitalised cases and around 10 to 12% of vaccinated cases. The syndrome is characterised by the persistence of clinical symptoms lasting more than four weeks from the onset of acute symptoms. The Centre for Disease Control (CDC) has formulated "post - Covid conditions" to describe health issues that continue for more than four weeks after being infected with COVID - 19. These include (1.) Long Covid or persistent post - Covid syndrome (PPCS); (2.) Multiorgan effects of COVID - 19; (3.) Effects of COVID - 19 treatment/hospitalisation. The syndrome was described for the first time in May 2020 as a result of a survey of prolonged COVID - 19 symptoms run by the Patient - Led Research Collaborative (PLRC). Soon after the first COVID - 19 cases evolved, it was observed that COVID - 19 patients had symptoms persisting for several weeks after acute infection (Maltezou et al., 2021).

The most common post - COVID symptoms include fatigue, shortness of breath, smell and taste disorders, chest pain, muscle pain, sleep and mental disorders. Symptoms can last several months and disrupt the occupational activities and quality of life of those affected. An estimated 10 - 35% of patients who do not require hospitalisation will develop post - COVID symptoms, regardless of comorbidities. In comparison, up to 80% of incidence rates have been reported in hospitalised patients and several patients with serious illnesses that overlap, causing long COVID. Several hypotheses for its pathogenesis have been proposed, including the existence of SARS - CoV - 2 reservoirs in tissues; immune dysregulation with or without reactivation of underlying pathogens, including herpes viruses such as Epstein - Barr virus (EBV) and human herpesvirus 6 (HHV - 6), among others; the impact of SARS - CoV - 2 on the microbiome, including viruses; autoimmunity and priming of the immune system from molecular mimicry; microvascular coagulation with endothelial dysfunction; and dysfunction of signalling in the brain stem and vagus nerve (Davis, 2023).

Post - COVID syndrome can include a wide variety of symptoms and debilitating conditions. The incidence of specific symptoms may vary depending on the acute infection's severity and the follow - up duration. Fatigue is the most common post - COVID symptom, with a prevalence ranging from 17.5% to 72% in hospitalised patients, persistently persisting for more than seven months after illness onset and leading to significant disability (Maltezou et al., 2021). Chest pain has been reported in 22% of COVID - 19 patients two months after discharge. Gastrointestinal symptoms may persist in 30% of patients two months after discharge. Smell and taste dysfunction may persist for more than a month after onset and affect up to 11% and 9% of patients six months after discharge, respectively, and up to 9% and 3.7 % of patients eight months after mild COVID - 19. Sleep and psychiatric disorders, such as anxiety and depression, can affect approximately 26% and up to 40% of patients, even six months after COVID - 19 illness. Manifestations may include obsessions and compulsions, decreased social activity, poor concentration, aggression, irritability, and substance use (Maltezou et al., 2021).

3. Discussion

In this section, we will look at the impact of Long Covid/Post - Covid Symptoms on the human body. **Post - Covid impact on the cardiovascular system:** A study by Nalbandian et al. revealed that chest pain was reported in 20% of COVID - 19 survivors after 60 days of follow - up, while palpitations and persistent upper body pain were reported in 9% and 5% of the participants respectively after six months follow - up. A higher incidence of stress - induced cardiomyopathy was observed during the COVID - 19 pandemic compared to the pre - pandemic period (7.8 vs.1.5–1.8%, respectively). However, the lower rates of death and rehospitalisation were similar in these patients. Preliminary data from cardiac magnetic resonance imaging (MRI) suggest that ongoing myocarditis may occur up to 60% more than two months after COVID - 19 diagnosis at a testing centre COVID. However, the reproducibility and consistency of these data have been demonstrated and are debated. In a study of 26 college athletes with mild or asymptomatic SARS - CoV - 2 infection, cardiac MRI showed diagnostic features of myocarditis in 15% of participants and muscle damage from previous heart attacks in 30.8% of participants. (Rajpal et. al, 2021). Many long Covid patients have difficulty engaging in physical activity after their first infection; symptoms return if they exercise. Early studies suggest circulatory system dysfunction may reduce oxygen flow to muscles and other tissues, limiting aerobic capacity and causing severe fatigue.

Impact on the nervous system: Long Covid patients appear to have a disrupted immune system compared to Covid patients who recovered fully. Many researchers believe chronic dysfunction after a coronavirus infection can cause a cascade of symptoms. One possibility is that the body continues to fight off the remnants of the coronavirus. Researchers have found that the virus spreads widely during the initial infection and that the virus's genetic material can persist in tissues – in the intestines, lymph nodes and elsewhere for several months. (The New York Times, 2022)

Impact on the lungs: Using a specialised MRI scan, researchers found evidence of respiratory system damage in a group of long Covid patients who were never hospitalised (Grist et al., 2022). Detailed analyses of their lung function showed that most patients absorbed oxygen less efficiently than healthy people, even though their lung structure appeared normal. The researchers caution that a larger group of participants will be needed to confirm these findings with surety. If the results are confirmed, possible explanations for the observed shortness of breath include small blood clots in lung tissue or thickening of the blood - air barrier that regulates oxygen uptake in the lungs. Post - Covid research has found that athletes with mild symptoms post - Covid - 19 will have increased respiratory and metabolic demands. The study found that, despite negligible differences in performance, athletes who survived COVID - 19 still experienced significant muscular and respiratory strain during exercise. Despite mild disease, unlike uninfected athletes, athletes still demonstrated significant aerodynamic loading to achieve similar exercise performance. This may be because COVID - 19 progresses to long COVID - 19, regardless of disease severity. Even in athletes, which are considered to have a greater capacity of the cardiovascular system than sedentary people of the same age, studies have reported a decrease in the occurrence of aerobic threshold (Stavarou, 2023).

Impact on the Neurological System: Survivors of COVID - 19 have reported a post - viral syndrome characterised by chronic malaise, diffuse myalgia, depressive symptoms, and non - restorative sleep. Other acute post - acute manifestations of COVID - 19 include migraine - like headaches and late - onset headaches due to high cytokine levels. In a follow - up study of 100 patients, approximately 38% had persistent headaches after six weeks. Loss of taste and smell may persist after other symptoms have resolved in approximately one - tenth of patients up to 6 months of follow - up. Cognitive impairment has been observed with or without fluctuations, including brain fog, which may manifest as difficulties with concentration, memory, receptive language, and executive function (Nalbandian et al., 2022).

4. Conclusion

COVID - 19 has wreaked havoc around the world, overwhelmed healthcare systems and will continue to threaten global public health until most of the world's population is vaccinated against the disease. The global impact of the pandemic is striking, with significant social, political, economic and health impacts in many countries. The impact of the pandemic on human lives coupled with suffering, the psychosocial impact and the economic slowdown are strong reasons to transform the lessons learned into actionable solutions, not only to prevent similar future crises but to improve the health and well - being of the whole population health care delivery. All patients with COVID - 19 should be closely monitored during recovery to develop a result - based approach to understanding and managing such a complex and evolving health crisis. To prepare the next generation of healthcare providers and researchers, medical schools must advance their education about pandemics, viruses, and infectious diseases such as chronic COVID - 19 and myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS). As of 2013, only 6% of medical schools thoroughly covered ME/CFS in areas of care, research and curriculum, creating barriers to care, accurate diagnosis, research and therapy (Peterson et al., 2013).

Managing post - acute COVID - 19 syndrome requires a comprehensive and interprofessional team approach, which includes medical professionals from various departments (primary care, pulmonology, cardiology, infectious diseases), psychiatrists, behavioural experts, physical and occupational therapists and social workers. Survivors of COVID - 19 need rehabilitation that focuses on cardiopulmonary disease, psychological burden and fatigue of the current global pandemic. The COVID - 19 outbreak serves as a reminder that proactive planning for healthcare emergencies and an intensified commitment to global public health preparedness remain necessary. The lessons learned on the limitations of existing healthcare systems and their capacity to react to infectious disease epidemics in the 21st century should be considered, enabling the transformation of

future healthcare. The realisation that technologically empowered solutions can be implemented and work well should constitute the benchmark for the greater integration of such technologies as part of routine healthcare design and provision. Optimal outcomes can be attained when patients and healthcare providers actively participate. However, for that to be achieved, ethical, regulatory, and legal concerns that emerged during this pandemic need to be addressed.

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