

Review Article

Open Access, Volume 2

A brief overview of COVID-19 long-term effect on cardiovascular system

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Received: Sep 07, 2021

Accepted: Oct 13, 2021

Published: Oct 20, 2021

Archived: www.jcimcr.org

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Abstract

COVID-19 infection affects multiple organs including cardiovascular system. Besides acute effect in active infection, COVID-19 also has a long-term effect on the cardiovascular system and reporting of these effects are increasing along with increased number of survivors recovering from COVID-19 infection. In this article, we reviewed the current literature available for long-term effects of COVID-19 on the heart.

Keywords: postural orthostatic tachycardia syndrome; cardiac magnetic resonance imaging; angiotensin-converting enzyme inhibitor.

Introduction

SARS-CoV-2 (COVID-19) pandemic has caused significant mortality and morbidity worldwide, with more than 168 million people has been affected so far. Although we have more awareness of acute COVID-19 symptoms, i.e., fever, loss of sense of taste, acute shortness of breath, we know less about chronic symptoms of COVID-19 [1]. Chronic Covid symptoms are described as symptoms lasting more than 12 weeks without any explanation by alternative diagnosis. According to the study, CDC posted more than one-third of patients who had covid infection continue to have symptoms even after three weeks of testing positive [2], collectively these symptoms are known as long covid, and individuals having those symptoms are referred to as covid long haulers. Long covid is a combination of different symptoms ranging from fatigue, lack of concentration, dizziness on standing, palpitations, chest pain, dyspnea, and joint or muscle pain. Since the decline in new cases worldwide after

vaccination, more focus has been directed to long COVID-19 symptoms by clinical researchers. This article focused on the long-term cardiovascular symptoms of covid infection after the resolution of acute infection.

Important cardiovascular symptoms that have been seen in covid long-hauler include chest pain, both exertional and positional, palpitations, dizziness, orthostatic intolerance syndrome including Postural Orthostatic Tachycardia Syndrome (POTS). A brief review of these symptoms is given below.

Persistent chest pain/tightness

One of the leading cardiovascular complaints in post-covid patients is chest discomfort. Chest discomfort found to be present in 12 to 22 percent of patients recovering from COVID-19 [2,3]. It is particularly important while evaluating post covid patients' symptoms to determine the severity of covid infection they acquired and what was their hospitalization course if they

were admitted because according to one study 19.7% of hospitalized patients with COVID-19 found to have a cardiac injury with an elevation of troponin greater than 99th percentile [4].

Evaluation of post-covid symptoms

The extent of evaluation depends on the severity of COVID-19 infection patient acquired, as mentioned earlier, and the nature of chest pain COVID-19 survivors are experiencing. The first step in chest pain evaluation in post COVID-19 individuals is a detailed history, as we do in other patients with chest pain. A detailed history is helpful in classifying chest pain into two broader categories cardiac and non-cardiac causes. Non-cardiac causes of chest pain include pleuritis, musculoskeletal pain, or residual pneumonia. Cardiac causes of chest pain include late presentation of pericarditis, microvascular dysfunction causing angina due to endothelial injury, stress-related cardiomyopathy, and myocarditis.

If the patient has persistent chest tightness or palpitation symptoms, initial evaluation includes a 12-lead electrocardiogram and chest x-ray. Routine transthoracic echocardiogram in post COVID-19 patients without symptoms is unnecessary. However, supposedly if the patient had a history of myocardial injury during active covid infection or suspicion of myocarditis and is currently complaining of dyspnea/chest tightness, in that case, it is reasonable to get a transthoracic echocardiogram as an initial study. A more thorough evaluation is needed for patients with persistent complaints of dyspnea and initial negative cardiac testing (EKG, echo), including pulmonary evaluation to rule out bronchospasm and pulmonary embolism. If the patient has infiltrates on the chest x-ray at acute infection, repeat lung imaging should be done. Usually, chest discomfort is resolved slowly. If the significant effect on lifestyle and sequela of acute myocardial injury (myocarditis, acute MI (Myocardial Infarction), Takotsubo cardiomyopathy) has been ruled out, treatment focus to decrease pain i.e., ibuprofen can be helpful. Patients diagnosed with myocardial injury (myocarditis, acute MI, Takotsubo cardiomyopathy) during the active phase of covid infection need to follow up more closely and mostly need a follow-up echocardiogram.

While mentioning long covid symptoms, it is important to discuss myocarditis. Early on since start of pandemic, there was a lot of focus on the incidence of COVID-19 myocarditis because initial studies showed abnormal cardiac MRI (Magnetic Resonance Imaging) findings in 60% of the patient affected with Covid [5]. The exact significance of these findings is unknown. It is especially challenging to prove that COVID-19 causes these changes (inflammation or scar), or these were pre-existed in addition to that the same findings demonstrated in the past in critically ill patients. Later more extensive studies proved that the incidence of COVID-19 myocarditis is incredibly low <1% [6].

Resumption of sports activities

Since many athletes suffered from Covid infection, health healthcare professionals have to make a crucial decision when it is safe to resume activities, especially physically exertional activities like sports. Elevated risk individuals, i.e., athletes, need more screening than the general population because of the potential risk of adverse outcomes. Sports associations internationally and in the U.S developed a return to play algorithms

for athletes. The expert consensus is to start initial screening with EKG, echocardiogram, and troponin depending upon the severity of COVID-19 symptoms. Cardiac MRI should be done if the initial screening test showed any abnormality, and if cardiac MRI showed a possibility of myocarditis, an affected individual should not take part in competitive sports for 3 to 6 months. According to one recent study by Martinez and colleagues in which more than eight hundred sport professionals underwent CMR as evaluation before return to sports activities, myocarditis was only found in 0.6% of the population [7,8].

Orthostatic intolerance syndrome

One of the primary cardiovascular long-term manifestations of COVID-19 that is frequently reported is autonomic instability. Many of these patients complained of palpitation, dizziness on standing up, episodes of fatigue along with recurrent presyncope. Orthostatic intolerance syndrome is comprised of orthostatic hypotension, POTS (Postural Orthostatic Tachycardia Syndrome), and vasovagal syncope. The most probable cause of autonomic dysfunction in post-Covid patients is the cytokine effect on sympathetic activation. There is also a hypothesis that the interaction of autoantibodies with alpha, beta and muscarinic receptors also might play a role, especially in orthostatic hypotension and POTS. Studies have also shown ACE (angiotensin-converting enzyme inhibitor2) receptors presence on neurons has played a role in dysautonomia because initial lab research showed SARS-CoV-2 specifically affects those receptors [7]. It has also been demonstrated in the past that prolonged head-down bed rest in patients with deconditioning can down-regulate the baroreceptor reflex and can result in orthostatic intolerance syndromes in the recovery phase after acute illness. Among all cardiovascular post covid symptoms, Postural Orthostatic Tachycardia Syndrome (POTS) is of particular importance because increased cases have been reported in individuals recovering from COVID-19 infection. A normal response to a healthy person standing is increased sympathetic tone to compensate for the blood pooling in legs resulting in reduced venous return. Increase sympathetic tone results in increased tachycardia and splanchnic vasoconstriction of vessels that lead to increase venous return. In POTS, there is an exaggeration of normal physiological response resulting in an increase in heart rate of greater than 30 bpm without evidence of orthostatic hypotension within 10 minutes of assuming an upright position [9-11].

Management of orthostatic syndromes

There are many management options available to treat POTS and orthostatic hypotension. The most important thing is the education of patients and lifestyle modification. Gradual increases in exercise, especially starting with non-upright exercise, for example, rowing or swimming, are encouraged. If exercise intolerance is the issue, a small dose of short-acting beta-blocker one hour before exercise has been beneficial, liberal salt intake along with plenty of fluid also effective non-pharmacological treatment before considering pharmacological therapies. Pharmacological treatment includes the use of fludrocortisone. While using fludrocortisone, monitoring for fluid retention and hypokalemia should be done. Midodrine is an alpha-1 agonist and increases vasoconstriction is also helpful if baseline blood pressure is low normal. Usually, with mido-

drine to prevent supine hypertension, it is more advisable to take the last dose early in the evening rather than take it close to bedtime. Other pharmacological option includes off label use of ivabradine [11,12].

Conclusion

COVID-19, in addition to causing acute cardiac injury, also causing a long-term effect on the cardiovascular system. Among these long Covid symptoms, the predominant cardiovascular symptoms are palpitation, presyncope with signs of dysautonomia, and chest pain. More research and dedicated post covid infection follow-up clinics after discharge of patients need to be established to understand this virus's long-term effects better.

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