ISSN: 2634 - 6796

Journal of Cardiology Research Reviews & Reports

SCIENTIFIC Research and Community

Case Report

Open Access

The Covid-19 Effects on the Cardiovascular System; A Focus on Myocarditis

Praise Chovwen[1]*, Ibukunoluwa Oshobu[1], Blessing George[1] and Liza Hasso[2,3]

[1]All Saints University School of Medicine, Dominica

[2]Piedmont Hospital, Atlanta, Georgia

[3]Emory Midtown Hospital, Atlanta Georgia

ABSTRACT

The WHO declared COVID 19 a global pandemic on March 11, 2020. The effect the virus has created in various aspects of our lives has made it of primary importance that we understand its pathophysiology, complication, preventive care, and treatment. A significant number of COVID patients develop some form of cardiac injury, whether while infected or after recovery. In this article, we aim to discuss these aspects and expand further on the cardiovascular effects seen in COVID 19 infected patients, emphasizing myocarditis. We discuss the case of a patient who developed cardiac injuries while infected with COVID 19, which she contacted 18 days after receiving the first dose of the COVID mRNA vaccine. This article provides more understanding of the relationship between COVID-19 and the heart.

***Corresponding author**

Praise Chovwen, All Saints University School of Medicine, 444 Highland Avenue NE, ATL, GA 30312, USA. E-mail: Praise.chovwen@gmail.com

Received: July 21, 2021; **Accepted:** July 23, 2021; **Published:** July 28, 2021

Keywords: COVID-19 Myocarditis, COVID Cardiomyopathy, Corona Virus Myocarditis, Covid Vaccine, Post COVID Complications, Covid Vaccine Myocarditis, Myocardial complications.

Introduction

Myocarditis is the inflammation of cardiac myocytes. It could result from a wide range of etiologies, including viruses, medications, and autoimmune disorders. Viral-induced myocarditis is associated with Coxsackievirus, Adenovirus, Hepatitis B, Hepatitis C, and now, the COVID-19 virus. The two main pathophysiologies of COVID-induced myocarditis are inflammation-induced cytokine release and direct viral injury. The inflammation-induced cytokine release occurs during the early, rapidly progressive phase. The immune system and inflammatory response cause a cytokine storm release of IL- 6, IL-7, IL-17, IL-22, etc. After entry into the body, the Protein S component of the SARS-COV2 virus is cleaved by serine-protease, then binds to the transmembrane Angiotensin-Converting Enzyme 2 (ACE2). This ACE2 is homologous to ACE found on various cells, including Type 2 pneumocytes, macrophages, cardiac myocytes, and perivascular pericytes—the binding of Protein S to ACE2 results in direct viral injury.

Additionally, recent reports have shown patients developing symptoms of myocarditis within several days of receiving the COVID-19 mRNA vaccine. However, symptoms are typically mild, and studies are yet to prove an actual causal effect from the vaccine [1]. This sequence of events leads to the different presentations seen in COVID-19 induced cardiomyopathy, such as cardiac dysfunction and failure, disruption of unstable plaques, endothelial and microvascular dysfunction. In hospitalized patients, these findings can be identified earlier, therefore, preventing further complications [2].

Case Presentation

This is a case of a 53 years old female who presented to the Emergency Department with a Chief Complaint of Shortness of Breath and additional symptoms of abdominal pain and diarrhea for six days. She added that the symptoms started a day after exposure to a family member who tested positive for the COVID-19 virus. The patient also stated she recently received the first dose of the COVID-19 mRNA vaccine eighteen days before presentation and was scheduled to receive the second dose in three days. She denied dizziness, syncope, seizure, chest pain, palpitations, diaphoresis, hemoptysis, nausea and vomiting, hematuria, or hematochezia.

Vital Signs: BP; 117/63 (Rt. Arm, cuff size; medium) | Pulse; 116 |Temp; 100.2F (37.9 °C)
(oral) | RR; 37 | Ht; 4'10" | Wt; 79.4 kg | SpO2; 100% | BMI 36.58 kg/m^2.

On examination, the patient was in respiratory distress with conversational dyspnea, tachypneic, breath sounds were diminished with rales present bilaterally, and the patient was tachycardic. All other examination findings were normal.

Bedside 12 lead ECG showed sinus tachycardia with ST and T wave abnormality. Chest X-ray revealed bibasilar atelectasis

with no other significant abnormality. A chest CT angiogram with contrast was performed and revealed ground-glass opacities suggesting mild viral or atypical pneumonitis, mild cardiomegaly with small pericardial effusion, and no evidence of acute pulmonary embolism.

The following labs were ordered; CBC, CMP, ABG, Lactate levels, COVID/FLU/RSV by PCR. Pertinent results include; HCT; 33.4, K+; 3.1, Cl-; 112, CO2; 20, Glucose; 103. Additionally, the patient tested positive for the SARS COV-2.

Subsequently, the patient was diagnosed with Pneumonia due to the COVID-19 virus and she was admitted to the hospital. Contact and respiratory isolation precaution per COVID-19 protocol was observed. Administration of supplemental oxygen was initiated, and the patient was started on Decadron and Remdesivir with the patient's consent. Other medications administered included; IV Rocephin, Zithromax, Potassium, Albuterol MDI prn, Tylenol prn, and Mucinex. Her hyperglycemia was controlled with insulin Lispro and Levemir. The patient was encouraged to lay in the prone position per protocol and use an incentive spirometer. The patient remained admitted for six days to manage and treat all above with no worsening symptoms or complications.

On discharge day, the patient was in a stable condition, her presenting symptoms had resolved, and all abnormal lab results were corrected. She completed the dosage of Remdesivir, Levaquin was discontinued, and she was discharged on 3L of oxygen as her oxygen saturation had gone down to 95% during hospitalization. Additional discharge medications included Dexamethasone tablets, antitussives, and mucolytics PRN. The patient was advised to continue prone positioning, use an incentive spirometer, and follow up with her PCP.

The patient's symptoms had completely resolved at the follow-up visit, except for mild tachycardia of 105bpm at rest and 120bpm after walking for 5 minutes. Echocardiography was ordered to further evaluate the CT findings, at the ER. The patient was still using supplementary oxygen as needed and was weaning off it. Her oxygen saturation at the visit was 93% while she was off the supplemental oxygen.

Echocardiography showed;
- Estimated left ventricular ejection fraction of 45-50%,
- Normal left atrial pressure with Grade 1 diastolic dysfunction,
- Small pericardial effusion
- Borderline low right ventricular function.

The patient denies any symptoms. Repeat CMP was done to confirm the resolution of lab abnormalities. Repeat CT in three months was ordered.

Discussion

Myocarditis is the inflammation of cardiac myocytes. It could result from a wide range of etiologies, including viruses, medications, and autoimmune disorders. Viral-induced myocarditis is associated with Coxsackievirus, Adenovirus, Hepatitis B, Hepatitis C, and now, the COVID-19 virus. The two main pathophysiologies of COVID-induced myocarditis are inflammation-induced cytokine release and direct viral injury. The inflammation-induced cytokine release occurs during the early, rapidly progressive phase. The immune system and inflammatory response cause a cytokine storm release of IL- 6, IL-7, IL-17, IL-22, etc. After entry into the body, the Protein S component of the SARS-COV2 virus is cleaved by serine-protease, then binds to the transmembrane Angiotensin-Converting Enzyme 2 (ACE2). This ACE2 is homologous to ACE found on various cells, including Type 2 pneumocytes, macrophages, cardiac myocytes, and perivascular pericytes—the binding of Protein S to ACE2 results in direct viral injury.

Additionally, recent reports have shown patients developing symptoms of myocarditis within several days of receiving the COVID-19 mRNA vaccine. However, symptoms are typically mild, and studies are yet to prove an actual causal effect from the vaccine [1]. This sequence of events leads to the different presentations seen in COVID-19 induced cardiomyopathy, such as cardiac dysfunction and failure, disruption of unstable plaques, endothelial and microvascular dysfunction. In hospitalized patients, these findings can be identified earlier, therefore, preventing further complications [2].

The patient above initially presented with non-specific symptoms, with the most severe being shortness of breath. The initial workup targeted ruling out pulmonary embolism because of her symptoms of shortness of breath, tachycardia, and obesity. On reviewing CT results, the above-stated cardiac changes were observed. It is unclear whether these symptoms were secondary to her COVID-related pneumonia (meaning her cardiac changes were asymptomatic) or if the cardiac findings observed contributed to her presentation. At one-month follow-up visit, cardiac changes seen on CT at the ER persisted in echocardiography, but the patient had no symptoms. This raises the question of how many COVID-infected patients may have underlying cardiac injuries and could lead to long-term cardiovascular consequences.

COVID 19 affects a wide range of populations. A few studies have shown that it has a higher prevalence in men, older adults, and hypertensive patients. A study of 14 cases with myocarditis secondary to COVID-19 was followed from December 12, 2019, until June 30, 2020. This study showed a high prevalence in the male population with an average mean age of 50.4 years, and one-third of the cases, less than 40 years of age. About 50% of these patients did not have any comorbid conditions, and in the other half, Hypertension was prevalent in 33% of the patients. Amongst these hypertensive patients, 33% of them had dyspnea [3].

Of all risk factors associated with COVID-induced myopathy, the patient's age has been shown to be the most significant risk factor. Older patients (mean age 63 years and a range of 53–71 years) are at a higher risk of complications such as ending up in the ICU, requiring mechanical ventilation, and death. [2] Based on currently available studies, the incidence of myocarditis or any form of myocardial involvement in hospitalized COVID 19 patients is unknown. A study was conducted at Wuhan University, China, of which 82 of the 416 patients had cardiac injuries. Cardiac involvement among this cohort of patients showed a hazard ratio of 4.26 [4].

There are numerous cardiovascular complications of the COVID-19 virus, including; myocarditis, myocardial infarction, stress-induced cardiomyopathy, malignant arrhythmias, heart failure, and thromboembolic events. The symptoms of COVID-19 induced myocarditis do not vary in presentation from myocarditis of other etiologies. They range from mild to severe, while others may be asymptomatic. The most common symptoms include; fever (58%), dyspnea (42%), cough (42%), and chest pain (25%), in addition to nonspecific COVID-19 symptoms; respiratory illness (predominant), fatigue, myalgia, diarrhea, nausea, and vomiting. Some patients may progress to fulminant myocarditis [3].

The development of myocardial injury in COVID patients is an indication of a worse prognosis. It is always important to note that these patients could also present with no respiratory symptoms. All the above further emphasize the variability in its presentation [5]. The true prevalence of fulminant myocarditis is unknown due to the novelty of the COVID-19 virus. Poorly managed fulminant myocarditis can result in death. Most patients diagnosed with COVID-induced myopathy (whether clinical or confirmed by CMRI or biopsy) are hospitalized patients [6].

The initial workup depends on the presenting complaint of the patient. After narrowing down the differentials to cardiac etiologies, the diagnostic workup includes ECG, echocardiography, and cardiac enzymes. A chest x-ray may precede echocardiography, especially in patients presenting with dyspnea. The cardiac enzyme frequently measured is Troponin as CK-MB is not as sensitive. Elevated troponin levels have been noted in patients with COVID-induced myocarditis, and higher levels are associated with worse outcomes and more severe diseases [3]. Troponin is preferred for identifying symptomatic and particularly severe cases as levels may be normal in milder cases.

ECG of the patient with COVID-induced myocarditis is similar to typical myocarditis with nonspecific ST-segment, T-wave changes, and AV block [3]. Serial ECGs may be done to monitor the patient and identify the development of MI.

An echocardiogram enables the assessment of structural and functional changes of the heart. The results from multiple studies show that most patients have evidence of hypokinesis, decreased ejection fraction and pericardial effusion, left ventricular dilation consistent with echocardiographic findings of typical myocarditis [7]. Echocardiography is also used to rule out other cardiac pathologies like heart failure.

In patients with severe chest pain, the presentation can mimic Acute Coronary Syndrome, and angiography may be done to rule out an MI. The widespread inflammation and edema seen in some of these patients can cause an arterial plaque to dislodge, resulting in an MI as well as MI with Non-Obstructive Coronary Arteries (MINOCA). Patients with isolated myocarditis without CAD will have no obstruction on angiography, as in the case presented above. Hence, it is not uncommon for COVID-19 infected patients with myocarditis to develop other cardiac pathologies concurrently [2].

Cardiac MRI (CMRI) is a diagnostic modality that assesses the structural and functional integrity of the heart. It is indicated in patients with acute chest pain, unobstructed coronary arteries, and signs of systemic viral infection. CMRI is reserved for hemodynamically stable patients but it is not routinely done due to the cost and relative lower availability. Myocarditis may be found incidentally when carrying out imaging for other comorbidities like PE. CT is not routinely used to diagnose myocarditis; however, this pathology may be identified incidentally.

The current standard for diagnosis of myocarditis is clinical, and with imaging, an Endomyocardial biopsy is required for definitive diagnosis of COVID-induced myocarditis. It is rarely done as it is highly invasive. In recent studies, A few biopsies have been recorded that showed the presence of COVID 19 virus within myocytes [8]. Additional investigations to rule out other COVID-related injuries are determined on a case-by-case basis but frequently include; d-dimer, AST and ALT, BNP, LDH, ESR, and CRP, CPK, PTT/PT, Ferritin and Procalcitonin, ABG.

The Severe Acute Respiratory Syndrome-Coronavirus-2(SARS-CoV-2) is a great challenge for the healthcare community across the globe. Each day, there are new publications with recent discoveries, and due to this, it has been difficult to precisely determine the ideal treatment option. It has been difficult to establish a standard therapy for myocarditis; however, there are different management modes in practice, and the American Heart Association's (AHA) recommendations for treatment of COVID induced myocarditis are in line with these [9].

A recently published case report showed that the use of Steroids, IVIGs and neuraminidase inhibitors has proven effective [2]. However, this contradicts the standard guidelines for managing acute myocarditis, and there are ongoing clinical trials to evaluate this [4]. Furthermore, it has been published that the administration of medications discovered to effectively treat the COVID-19 virus has also proven effective in managing myocarditis. These medications include Remdesivir, Tocilizumab, Ribavirin, human recombinant ACE2(rhACE2), convalescent plasma, amongst others [2].

Patients who do not respond to these medications often progress to heart failure, but the primary cause is yet to be determined, as numerous factors could lead to heart failure in a patient with the virus [4]. Guidelines from the European Society of Cardiology Working Group on Myocardial and Pericardial Diseases recommended that heart failure resulting from myocarditis should be managed with diuretics, ACE inhibitors, beta-adrenergic blockade, temporary pacing, and extracorporeal membrane oxygenation [7].

Currently, CMRI may be used to monitor the course of the disease and the use of contrast for follow up CMRI is not highly indicative. At the moment, it is difficult to access who and when to scan for cardiac injuries in COVID infected patients. Repeat scans should be ordered every 3-6 months. Patients with significant cardiac injury are also advised to abstain from competitive sports or strenuous, aerobic activities for 3-6 months until CMR is normal [10].

Conclusion

The cardiovascular manifestations of COVID 19 are deemed important due to their potential to lead to chronic cardiac disease. Recent studies have shown patients worldwide developing some sort of cardiac pathology during active infection and even several weeks to months after the resolution of the infection. Additionally, there have been reports of patients developing myocarditis and other cardiovascular injuries after receiving the COVID-19 mRNA vaccine. It is unclear what these findings will result in the long term. The COVID-19 pandemic is relatively new, and the plan of care is yet to be standardized, but different management plans have been effective. There is a need for a unified means of management, including stratification of patients into high and low risks for cardiac complications. These patients can then be screened, identified early, and adverse outcomes prevented.

References

1. Myocarditis and Pericarditis Following mRNA COVID-19 Vaccination Internet Document (2021) CDC, https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/myocarditis.html.
2. Guzik TJ, Mohiddin SA, Dimarco A, Patel V, Savvatis K, et al. (2020) COVID-19 and the cardiovascular system: implications for risk assessment, diagnosis, and treatment options. Cardiovasc Res 116: 1666-1687.
3. Sawalha K, Abozenah M, Kadado AJ, Battisha A, Al-

Akchar M, et al. (2021) Systematic Review of COVID-19 Related Myocarditis: Insights on Management and Outcome. Cardiovasc Revasc Med 23: 107-113.

4. Pirzada A, Mokhtar AT, Moeller AD (2020) COVID-19 and Myocarditis: What Do We Know So Far? CJC Open 2: 278-285.
5. Rehman M, Gondal A, Rehman NU (2020) Atypical Manifestation of COVID-19-Induced Myocarditis. Cureus 12: e8685.
6. Gul M, Inci S, Aktas H, Yildirim O, Alsancak Y (2021) Hidden danger of COVID-19 outbreak: evaluation of subclinical myocardial dysfunction in patients with mild symptoms. Int J Cardiovasc Imaging, Advance online publication 1-8.
7. Ho JS, Sia CH, Chan MY, Lin W, Wong RC (2020) Coronavirus-induced myocarditis: A meta-summary of cases. Heart Lung 49: 681-685.
8. Escher F, Pietsch H, Aleshcheva G, Bock T, Baumeier C, et al. (2020) Detection of viral SARS-CoV-2 genomes and histopathological changes in endomyocardial biopsies. ESC Heart Fail 7: 2440-2447.
9. Hendren NS, Drazner MH, Bozkurt B, Cooper LT (2020) Description and proposed management of the acute COVID-19 cardiovascular syndrome. Circulation 141: 1903-1914.
10. Shchendrygina A, Nagel E, Puntmann VO, Valbuena-Lopez S (2020) COVID-19 myocarditis and prospective heart failure burden. Expert Rev Cardiovasc Ther 19: 5-14.