

# Global Longitudinal Strain and Myocardial Work Index in Post-COVID-19 Syndrome with Mild Symptoms: A Case Series

*Prima Almazini\**, *Amiliana M. Soesanto*

Department of Cardiology and Vascular Medicine, Universitas Indonesia Hospital, Jakarta, Indonesia.

## **Corresponding Author:**

*Prima Almazini, MD. Department of Cardiology and Vascular Medicine, Universitas Indonesia Hospital. Jl. Prof. DR. Bahder Djohan, Pondok Cina, Depok 16424, Indonesia. Email: dr.primz@gmail.com.*

## **ABSTRACT**

*The involvement of the cardiovascular system in COVID-19 is prevalent. The effect of SARS-COV-2 infection in both acute and recovery phases is called a post-COVID-19 syndrome. Considering the high prevalence of cardiac abnormalities after COVID-19, clinicians should continue to monitor cardiac function in COVID-19 patients after hospital discharge. Echocardiography is an accurate and accessible tool to assess cardiac function after COVID-19. Left-ventricle (LV) and right ventricle (RV) longitudinal strains are more sensitive to detecting subtle abnormalities than standard parameters, such as left-ventricle ejection fraction and tricuspid annular plane systolic excursion (TAPSE). Myocardial work index is a novel parameter including afterload to evaluate cardiac function. These parameters can give further information on cardiac function in COVID-19 patients. We presented two cases of COVID-19 with serial cardiac assessment using echocardiography.*

**Keywords:** *echocardiography, post-covid syndrome, longitudinal strain, myocardial work.*

## **INTRODUCTION**

Coronavirus disease 2019 (COVID-19) is a systemic infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). COVID-19 does not solely damage lung but may also affect extrapulmonary organs such as cardiovascular system, kidney, and gastrointestinal tract. Cardiovascular involvement in COVID-19 is prevalent.<sup>1</sup> SARS-CoV-2 infection can affect cardiovascular system both during acute and recovery phases.

Long-term consequences after COVID-19 are called post-COVID syndrome.<sup>2</sup> Several studies have investigated cardiac outcomes after SARS-CoV-2 infection. Among COVID-19 patients who were discharged from hospital, 78% had cardiac dysfunction and 60% had cardiac inflammation.<sup>3</sup> Furthermore, ventricle remodeling was found in 29% of COVID-19 patients three months after discharge.<sup>4</sup> Given the

high prevalence of cardiac abnormalities after COVID-19, it is important to monitor cardiac function in COVID-19 patients after hospital discharge.

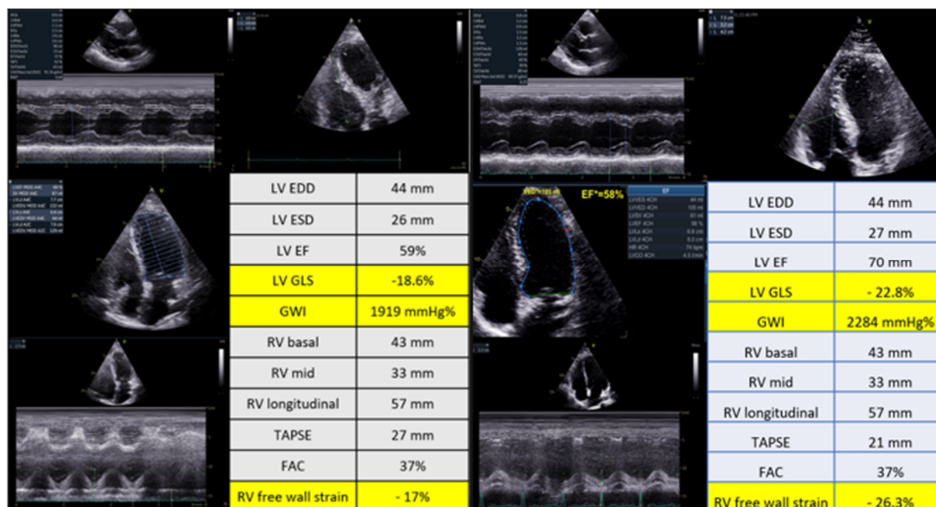
Echocardiography is widely accessible and can accurately assess cardiac function after COVID-19 infection. To detect subtle cardiac abnormalities, left-ventricle (LV) and right ventricle (RV) longitudinal strains are more sensitive than standard parameters such as left-ventricle ejection fraction and tricuspid annular plane systolic excursion (TAPSE).<sup>5</sup> Moreover, myocardial work index is a new echocardiography-based method to assess cardiac function. This index takes afterload into account. It therefore may provide an accurate assessment of cardiac function in COVID-19 patients. Here we presented two cases of COVID-19 with serial cardiac function assessment using echocardiography.

**CASE ILLUSTRATION**

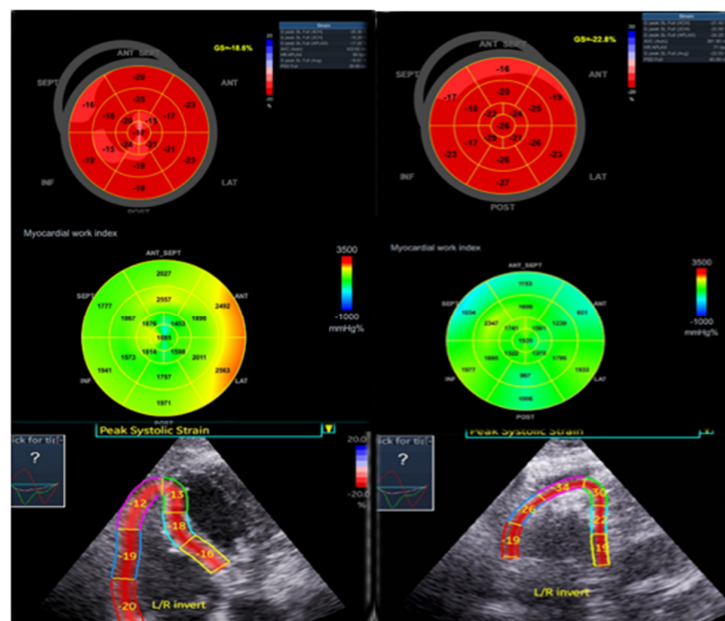
**First Case**

A 49-years-old woman was previously diagnosed with COVID-19 based on a nasopharyngeal Polymerase Chain Reaction (PCR) test after complaining of fever, fatigue, myalgia, headache, and shortness of breath. She had no history of cardiovascular or pulmonary disease. No comorbidities (such as hypertension, diabetes mellitus, and dyslipidemia) were recorded.

Clinical examinations were performed 17 days after negative conversion of SARS-CoV-2 infection. She continued to experience fatigue when doing her daily activities, while other symptoms had been resolved. Blood pressure (BP) was 123/84 mmHg, no abnormal physical findings. Echocardiography revealed normal LV and RV dimensions (according to American Society of Echocardiography (ASE) guidelines), normal LV function, and abnormal RV function indicated by low RV free wall strain.



**Figure 1.** Left. Transthoracic echocardiography at 17 days after negative conversion of SARS-CoV-2 infection; Right. Transthoracic echocardiography results at three months after negative conversion of SARS-CoV-2 infection



**Figure 2.** Left. Global longitudinal strain (upper), myocardial work index (middle), and RV strain result (lower) at 17 days after negative conversion of SARS-CoV-2 infection; Right. Global longitudinal strain (upper), myocardial work index (middle), and RV strain result (lower) at three months after negative conversion of SARS-CoV-2 infection.

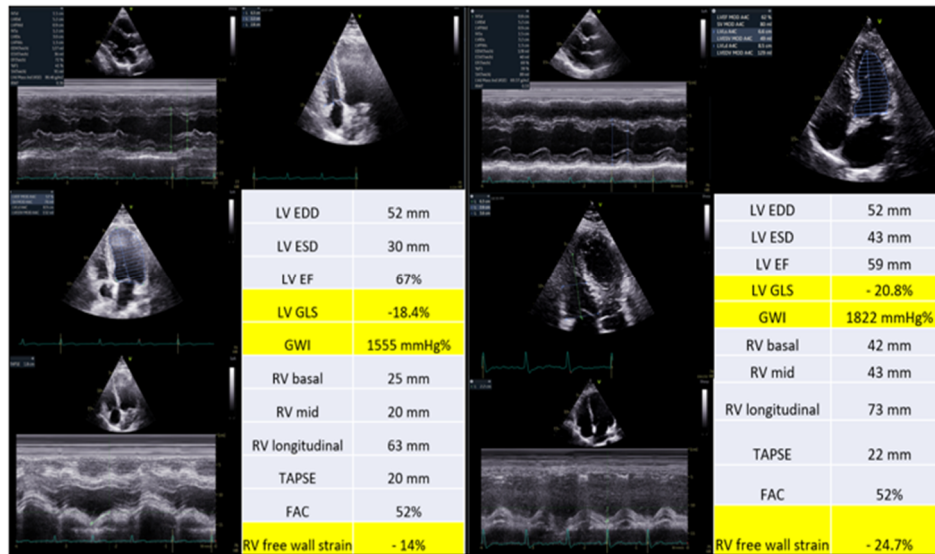
Serial anamnesis and echocardiography were performed three months afterward. At this moment, she had no symptoms. BP was 133/83 mmHg. Echocardiography showed normal LV and RV dimensions and normal LV and RV functions.

**Second Case**

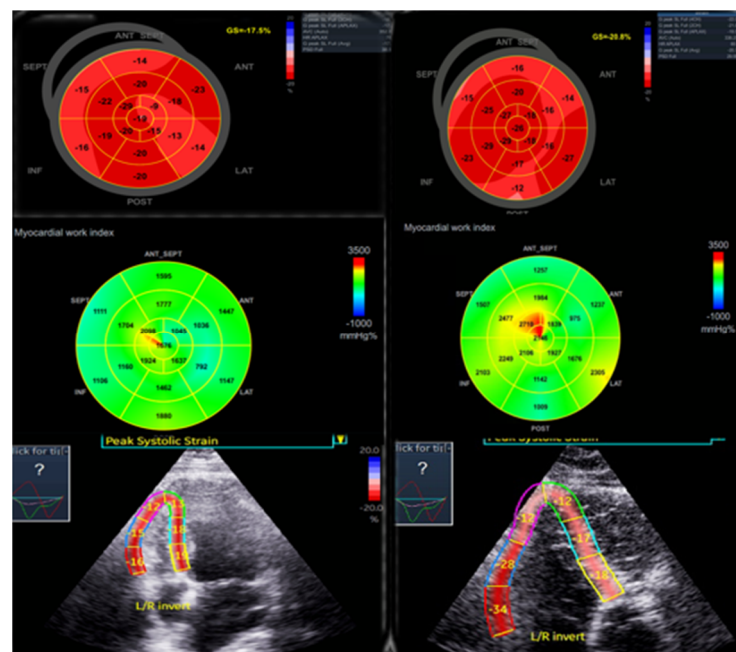
A 34-year-old man was formerly admitted to the hospital due to COVID-19 with symptoms

of fever, fatigue, myalgia, anosmia, headache, and chest pain. COVID-19 was confirmed by nasopharyngeal PCR test. He was discharged after a negative PCR conversion. He had neither history of cardiovascular disease, pulmonary disease, nor comorbidities (such as hypertension, diabetes mellitus, and dyslipidemia).

We performed anamnesis, physical examination, and echocardiography 17 days after



**Figure 3.** Left. Transthoracic echocardiography result at 17 days after negative conversion of SARS-CoV-2 infection; Right. Transthoracic echocardiography results at three months after negative conversion of SARS-CoV-2 infection.



**Figure 4.** Left. Global longitudinal strain (upper), myocardial work index (middle), and RV strain result (lower) at 17 days after negative conversion of SARS-CoV-2 infection; Right. Global longitudinal strain (upper), myocardial work index (middle), and RV strain result (lower) at three months after negative conversion of SARS-CoV-2 infection.

negative conversion of SARS-CoV-2 infection. He reported fatigue, particularly during daily activities. Physical examination was normal with a BP of 120/80 mmHg. Echocardiography revealed normal LV and RV dimensions (according to ASE guidelines), normal LV function, and abnormal RV function indicated by low RV free wall strain.

Three months after, serial anamnesis and echocardiography were performed. No symptoms were reported. BP was 116/62 mmHg. Echocardiography showed normal LV and RV dimensions and normal LV and RV functions.

## DISCUSSION

Data on echocardiographic profiles of COVID-19 survivors remain scarce. It may be because echocardiography is still not recommended for routine evaluation of COVID-19 survivors. Some survivors of COVID-19 with mild symptoms have shown reduced right ventricle function that was indicated by low RV-free wall strain values. These findings were speculated as residual myocardial injury after COVID-19. Myocardial injury in COVID-19 was generated by cytokine and immune-inflammation response, direct invasion of SARS-CoV-2, and respiratory damage caused by oxidative stress-induced hypoxia.<sup>6</sup>

In this case series, two weeks after seronegative conversion both patients had low RV free wall strain, borderline LV global longitudinal strain, and normal global work index. At three months after seronegative PCR test, the RV free wall strain and LV global longitudinal strain were recovered to normal (RV: -17% to -26.3%; LV: -18.6% to -22.8% in the first patient) (RV: -14% to -24.7%; LV: -18.4% to -20.8% in second patient). The global work index increased in both patients (1999 to 2284 mmHg% in the first patient, 1555 to 1822 mmHg% in the second patient).

Both patients had no history of cardiovascular disease or comorbidities. An abnormal RV and LV function found in this case series might be due to COVID-19. Both patients had fatigue persisted after discharge. Recent literature suggested that this symptom was associated

with the inflammation process in the post-acute viral illness. Taken together, it is possible that the abnormal cardiac findings are caused by the ongoing inflammation process in the early recovery phase of COVID-19 disease.

The risk for cardiac complications is higher in COVID-19 survivors compared to those without SARS-CoV-2 infection. Some literature reported cardiac involvement in post-COVID-19 syndrome, but risk factors for cardiac involvement are still unknown due to limited data.<sup>7</sup> The case series indicated recovery of ventricle functions and no progression to non-ischemic cardiomyopathy among patients with post-COVID-19 syndrome and mild symptoms.

Our cases suggested that some individuals may experience symptom sequelae in the early recovery phase of COVID-19, with subclinical myocardial dysfunction according to echocardiography findings. In some cases, symptoms are alleviated over time and both LV and RV functions are gradually improved, as indicated by LV global longitudinal strain, global work index, and RV free wall strain.

## CONCLUSION

Echocardiography is an accurate and accessible tool to assess cardiac function after COVID-19. Left-ventricle (LV) and right ventricle (RV) longitudinal strains are more sensitive to detecting subtle abnormalities than standard parameters, such as left-ventricle ejection fraction and tricuspid annular plane systolic excursion (TAPSE). Myocardial work index is a novel parameter including afterload to evaluate cardiac function. These parameters can give further information on cardiac function in COVID-19 patients.

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