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ASSESSMENT OF LEFT VENTRICLE SYSTOLIC AND DIASTOLIC FUNCTION IN POST-COVID PATIENTS- A PROSPECTIVE, SINGLE-CENTER, OBSERVATIONAL STUDY

Cardiology

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ABSTRACT

Background: The COVID-19 caused by novel single-stranded RNA enveloped severe acute respiratory syndrome coronavirus -2 (SARS CoV-2) first appeared in Wuhan, China. A lot of focus has been given to pulmonary complications. According to several case reports, cardiovascular associated clinical manifestations include myocarditis, arrhythmias, veno-thromboembolic events, acute coronary syndrome (ACS), and pericarditis. Different modalities in diagnosis like 2D, doppler can help in the early diagnosis of left ventricular function.

Objective: This study evaluates the cardiac changes in recovered COVID-19 positive patients by 2D echocardiogram and other modalities

Materials And Methods: In this prospective observational study, 139 participants recently recovered from COVID-19 illness were identified and recruited after obtaining the Informed concerned form (ICF). The patients once enrolled were subjected to 2D echo and ECG as part of routine clinical practice.

Results: Of the 139 patients, 89 (64.03%) were males, and the rest were females. Based on the severity scale, 13 (9.35%) participants had suffered a severe form of COVID-19 infection. The patients once enrolled were subjected to 2D echo and ECG as part of routine clinical practice. Of the 139 patients, 89 (64.03%) were males and the rest were females. Based on severity scale 13 (9.35%) participants had suffered severe form of COVID-19 infection. Left ventricular ejection fraction (LVEF%) was found to be normal in all the 139 participants. Left ventricular global strain (LVGLS) was found to be abnormal in 70 (50.36%) participants.

Conclusion: Our study demonstrates the association between COVID-19 and cardiac changes/ incidence of cardiovascular complications in recovered COVID-19 patients. This study provides first-hand evidence of the incidence of abnormal LVGLS in COVID-19 recovered patients, the LVEF % was normal in all the patients.

KEYWORDS

Post-COVID, Left ventricular function, cardiovascular outcomes, ST elevation, 2D echocardiography

INTRODUCTION:

Coronavirus disease of 2019 (COVID-19) caused by novel single-stranded RNA enveloped Severe acute respiratory syndrome coronavirus -2 (SARS CoV-2) first appeared in Wuhan, China. [1,2] In March 2020, the World health organization (WHO) officially declared it a global pandemic because of the unusually fast rate of spread.[2]

Respiratory symptoms mostly dominate clinical manifestations related to COVID-19 like acute respiratory disease syndrome (ARDS) and systemic inflammatory response syndrome (SIRS), which can lead to multiorgan failure (MOF) and shock.

Although respiratory pathology prevails, COVID-19 determines multiple organ injuries, including cardiovascular (CV) complications, frequently responsible for a fatal outcome, especially in elderly patients with underlying CV diseases. The spectrum of CV complications is very large, ranging from sinus tachycardia or hypotension to various arrhythmias, myocardial ischemia, acute myocarditis with heart failure (HF), or even pulmonary thromboembolism (TEP)[3] and Left ventricular dysfunction (LVD)[4,5]

In many hospitalized COVID-19 patients, the assessment of biomarkers indicating myocardial injury (high-sensitivity cardiac troponin I, creatin-kinase—CK-MB) revealed levels above the upper limit of the reference range [2,14], suggesting acute myocarditis, often accompanied by impaired left ventricular (LV) systolic function (LV-SF) and ischemia.

While a lot of focus has been given to pulmonary complications, clinicians need to equally evaluate the presence of cardiovascular complications, which can be a significant contributor to increased fatality in COVID-19 patients. According to several case reports, cardiovascular associated clinical manifestations include myocarditis[3,4], arrhythmias, veno-thromboembolic events, acute coronary syndrome (ACS)[5] and pericarditis.[6]

An early diagnosis of cardiac injury was seen in Chinese studies reported from the national health commission almost 11.8% of patients without the underlying cardiovascular disease had a cardiac injury during hospitalization, showed by elevated T- troponin (TnT) levels and new onset of electrocardiographic (ECG) /echocardiographic abnormalities.[7]

Currently, the underlying mechanism behind the COVID-19 related cardiac injury is not clearly understood. However, various pathophysiological pathways are proposed; multifactorial direct and indirect mechanisms include[8,9]:

- Downregulation of ACE2 expression in the heart as demonstrated in a murine model of SARS-CoV-2 infection by Oudit et al.[10]
- Cytokine storm
- Cytotoxic effect on macrophages or interstitial cells within cardiac tissue[11]
- Other mechanisms like low blood oxygen levels or hypoxia can lead to an intracellular influx of calcium ions, resulting in the apoptosis of cardiomyocytes.[12]

This background indicates that SARS-CoV-2 infection is associated with a wide range of cardiovascular complications. Hence, this observational study is intended to evaluate Different modalities to assess RV function in post COVID taking STE as a Gold standard.

MATERIALS AND METHODS

This prospective, single-center, observational study was planned to evaluate different modalities to assess RV function post COVID taking STE as a Gold standard. Patients were enrolled in the study only after obtaining written informed consent from them. Recruitment of 139 recovered COVID-19 patients was done to evaluate the association between COVID-19 infection and incidence of cardiovascular complications in recovered COVID-19 patients.

The patients who qualify for the study based on the inclusion and exclusion criteria were enrolled in the study after obtaining written informed consent. As mentioned in case report forms (CRF), medical history, vitals, and other parameters were captured at baseline.

The results were recorded in CRF, and the data obtained were analyzed post-completion of the study for all the patients.

Inclusion Criteria	Exclusion Criteria
• Male and female subjects aged 18 years & above. • Subjects who have tested positive for COVID-19 through the RT-PCR diagnostic test. • Subjects who have recovered from COVID-19 infection and visit the hospital within three months of recovery. • Subjects who underwent treatment for COVID-19 at the hospital or in-home isolation. • Subjects who are willing to undergo the diagnostic tests (2D echo and ECG) • Subjects willing to provide informed written consent.	• Subjects whose cardiovascular condition can be attributed to other cardiac complications except for COVID-19 infection. • Subjects who have pre-existing cardiac conditions. • Subjects with any other illness or health condition in the study investigator's opinion/medical judgment make the subject ineligible to participate in the study.

Statistical Analysis:

Following data collection, the obtained data was transferred from paper CRFs into an excel sheet for analysis. Statistical analysis was performed using the software 'STATA version 15.0'. All data were summarized descriptively. For continuous variables, data was represented using means ± SD. For categorical data, the number and percentages were used in the data summaries.

RESULTS:

A total of 139 COVID-19 recovered patients were enrolled in our study after taking written consent from all the participants for participating in this prospective observational study. The mean age of the participants was 38.57 ± 12.10 years. Among these 139 COVID-19 recovered patients, 64.03% (89) were males, and the rest were females. Thus, a significant proportion of 77.70% (108) study population was reported to have a mild type of COVID-19 severity followed by 12.95% (18) having moderate type and 9.35% (13) suffering from a severe form of COVID-19, as shown in Table 1.

As shown in table 2, 28.78% (40) of the study population was obese. While Hypertension (HTN), diabetes mellites (DM), and hypothyroidism with 27 (19.42%), 12 (8.63%), and 10(7.19%) were the second, third, and fourth most common medical conditions present in our study population, respectively.

ECG was performed on 139 (100.00%) patients, and on only 60 (43.16%) patient's chest X-ray was performed.

The mean LVEF% was 66.29 ± 9.10%, and as shown in table 3, all the 139 (100%) study participants had a normal LVEF%. As we can see clearly from table 3, echocardiogram- 2D speckle imaging (2D-SI) and tissue doppler imaging (TDI) parameters were assessed in all the patients to evaluate the global longitudinal strain for left ventricular function (LVGLS). More than half (50.36%) of the study population was reported to have an abnormal LVGLS.

Normal LV systolic function was observed in 100.00% (139) patients. As table 4 clearly demonstrates, none of the cases were reported for deranged LV diastolic function.

Table 1: Demographic Details Of The Patients.

PARAMETERS	N= 139
Age (years)	38.57 ± 12.10
Gender	
Male	89 (64.03%)
Female	50 (35.97%)
Height (cm)	163.52 ± 9.60
Weight (Kg)	69.56 ± 12.39
Body surface area (m2)	1.70 ± 0.19
Systolic blood pressure (mm Hg)	132.23 ± 17.77
Diastolic blood pressure (mm Hg)	85.14 ± 9.68
Heart rate (Beat/min)	92.56 ± 14.02
Severity in (%)	
Mild	108 (77.70%)
Moderate	18 (12.95%)
Severe	13 (9.35%)

Table 2: Medical History Details Of The Patients.

PARAMETERS	N = 139
Diabetes mellitus, n (%)	12 (8.63%)
Hypertension, n (%)	27 (19.42%)
Smokers, n (%)	16 (11.51%)
Alcoholics, n (%)	12 (8.63%)
Obese, n (%)	40 (28.78%)
Hypothyroid, n (%)	10(7.19%)
Snoring, n (%)	56 (40.29%)
ECG performed, n (%)	139 (100.00%)
X-ray (chest) performed, n (%)	60 (43.16%)

Table 3: Parameters Used For Assessment Of LVef And Left Ventricular Strain.

PARAMETERS	RESULT (N= 139)
LVEF %	66.29 ± 9.10 %
Normal , n (%)	139 (100%)
Echocardiogram- 2D speckle tracking	
GLPS PLAX (%)	17.81 ± 4.17 %
GLPS AP4C (%)	18.04 ± 4.20
GLPS AP2C (%)	17.38 ± 3.99
GLPS Ave (%)	17.78 ± 3.81
Echocardiogram- Tissue Doppler Imaging	
Medial Annulus	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	3 (2.16 %)
Normal	136 (97.84 %)
Lateral Annulus	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	3 (2.16 %)
Normal	136 (97.84%)
Anterior Annulus	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	2 (1.44 %)
Normal	137 (98.56%)
Inferior Annulus	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	1 (0.72 %)
Normal	138 (99.28%)
Posterior Annulus	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	4 (2.88 %)
Normal	135 (97.12 %)
RV free wall Annulus (N >9.5)	
Peak Velocity (S wave) cm/s, n (%)	
Abnormal	0 (0.00%)
Normal	139 (100%)
Left Ventricular GLS	-18.11 ± 4.13
Abnormal	70 (50.36)
Normal	69 (49.74%)

Table 4: Assessment Of LV Systolic And Diastolic Dysfunction And Right Ventricular Dysfunction By Color Flow Mapping And Doppler Studies.

PARAMETERS	RESULT (N= 139)
Normal LV systolic function	139 (100.00 %)
Deranged LV systolic function	0 (0.00%)
Deranged LV diastolic function	0 (0.00%)
LV E/e'	5.90 ± 1.94
Normal	139 (100.00 %)
Abnormal	0 (0.00%)
RV E/e'	4.43 ± 1.47
Normal	103 (74.10%)
Abnormal	36 (25.90 %)

DISCUSSION:

In this prospective observational study of predominantly COVID-19 recovered patients, Echocardiography allows the noninvasive assessment of biventricular function and can provide important insights into possible mechanisms.[13]

LV dysfunction, defined as either LV ejection fraction < 50% or global systolic dysfunction, was not reported in any patient, and LVEF% was normal in all the study subjects. A recent meta-analysis conducted on 7 studies concludes that lower LVGLS were independently associated with poor outcomes in COVID-19 recovered patients[14]. In our study, 50.36% of the COVID-19 recovered patients were having reduced/ abnormal LVGLS.

Lassen et al. also reported lower LV-GLS in patients with COVID-19 compared to those without it[15] A smaller study showed that there was no significant difference in terms of LV-GLS between those without COVID-19, with COVID-19, and COVID-19 + increased cardiac troponin.[16]

Croft et al. study showed no significant difference in LV-GLS in non-survivors compared to survivors; this is likely due to the high prevalence of hypertension in the patients. As hypertension is expected to reduce the LV-GLS.[17,18]

As most of the studies conducted in this research area of research[19-21], our study population was also middle-aged, predominantly male (64.03%) with 77.01% mild COVID-19 severity. As seen in previously reported studies, this study population also has a high prevalence of co-morbidities like obesity (28.78%), hypertension (19.42%), diabetes mellitus (8.63%), and hypothyroidism (7.9%). Smoking and alcohol consumption was seen more frequently in our study population when compared to other studies.[19,20]

In our study population, a total of 72 (51.80%) COVID-19 recovered patients were found to have abnormal RV strain; various studies revealed that it is a strong prognostic indicator for various cardiovascular diseases, [23-25] and also TV dysfunction is not only a sign of increased pulmonary pressure but also directly contributes to cardiac insufficiency.

CONCLUSION:

Our study demonstrates the association between COVID-19 and cardiac changes/ incidence of cardiovascular complications in recovered COVID-19 patients. Although this study clearly shows abnormal LVGLS in COVID-19 recovered patients, the LVEF % was normal in all the patients.

Moreover, this study will guide the clinicians to closely monitor the right ventricular function, which will help manage cardio-vascular complications early**.**

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