Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

echocardiography was limited, resolution of LV dysfunction was noted in nine of 11 cases and in eight of nine with troponin ≥ 50 ng/L. We acknowledge that the screening process for echocardiography requests creates important selection bias, and we do not suggest that these findings apply across all patients with COVID-19. Prospective studies, and correlation of echocardiographic data with disease severity, biomarkers, and clinical outcomes, will be required to understand the range of cardiovascular involvement in COVID-19.

Timothy W. Churchill, MD
Philippe B. Bertrand, MD, PhD
Samuel Bernard, MD
Mayooran Namasivayam, MBBS, PhD
Jessica Churchill, RDCS
Daniela Crousillat, MD
Esther F. Davis, MBBS, DPhil
Judy Hung, MD
Michael H. Picard, MD
Echocardiography Laboratory
Massachusetts General Hospital
Boston, Massachusetts

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https://doi.org/10.1016/j.echo.2020.05.030

Echocardiographic Findings in Patients with COVID-19 with Significant Myocardial Injury

To the Editor:

Myocardial injury has been commonly described in patients with coronavirus disease 2019 (COVID-19) and has been suggested to have prognostic significance.[1] Multiple possible mechanisms have been suggested.[2,3] Echocardiography allows the noninvasive assessment of biventricular function and can provide important insights into possible mechanisms.[4] We aimed to describe echocardiographic findings in hospitalized patients with COVID-19 with significant myocardial injury.

In this retrospective study, we enrolled consecutive hospitalized patients with COVID-19 who underwent clinically indicated transthoracic echocardiography at Mount Sinai Morningside Hospital.[5] Echocardiography was performed following a time-efficient protocol with appropriate protective gear. Portable ultrasound machines were used: CX50 (Philips Medical Systems, Andover, MA) and VividS70 (GE Healthcare, Little Chalfont, United Kingdom). Echocardiographic studies were interpreted by experienced, board-certified echocardiography attending physicians. Significant myocardial injury was defined as a peak cardiac troponin I level >1 ng/mL (reference <0.01 ng/mL). Continuous variables are presented as mean ± SD or as median (interquartile range [IQR]) and categorical variables as proportions.

A total of 24 patients with significant myocardial injury were identified among 110 patients who underwent echocardiography (five were excluded because of poor study quality). The mean age was 64.5 ± 13.8 years, and 11 patients (46%) were women. Ten patients (42%) were mechanically ventilated at the time of echocardiography. Five patients (21%) had known histories of coronary artery disease. The median troponin level was 5.0 ng/mL (IQR, 1.8–14.0 ng/mL). Among these 24 patients, three had electrocardiographic findings consistent with ST-segment elevation myocardial infarction, and one patient had diffuse ST-segment elevation consistent with pericarditis. The remaining did not have any distinct clinical or electrocardiographic characteristic to suggest the underlying mechanism of injury. Left ventricular (LV) dysfunction, defined as regional and/or global systolic dysfunction, was present in 13 patients (54%). Eleven (46%) had regional wall motion abnormalities (median troponin level, 12.4 ng/mL; IQR, 5.8–27.0 ng/mL): three confirming aforementioned ST-segment elevation myocardial infarction, two with preexisting wall motion abnormalities, and six with presumed new abnormalities (three of these six had previous echocardiograms depicting preserved LV function). Among patients with new wall motion abnormalities, wall motion pattern was confined to a single coronary territory in four patients and more than single territory in one patient; one patient had a typical wall motion pattern suggestive of stress cardiomyopathy. Only two patients (8%) had diffuse LV hypokinesis. Other findings included isolated right ventricular dysfunction in four patients (17%), with a median troponin level of 1.5 ng/mL (IQR, 1.3–3.1 ng/mL). The presence of more than trivial pericardial effusion was noted in eight patients (33%). Importantly, five patients (21%) had no significant echocardiographic findings with preserved biventricular function and no pericardial effusion (Figure 1). The median troponin level in these patients was 2.1 ng/mL (IQR, 1.3–4.3 ng/mL). Among patients without significant myocardial injury ($n = 81$), 15 patients (19%) had isolated regional or global LV dysfunction, 19 patients (24%) had isolated right ventricular dysfunction, and five patients (6%) had biventricular dysfunction.

This was a small, retrospective, single-center study. The population was selected from the total number of patients with COVID-19 admitted to our hospital during this time period. Confirmatory testing including advanced cardiac imaging and coronary angiography was lacking in most patients.

In conclusion, among hospitalized patients with COVID-19 and significant myocardial injury, 37% had isolated LV dysfunction, 17% had isolated right ventricular dysfunction, 17% had biventricular dysfunction, and remaining 29% had preserved biventricular function. Regional LV dysfunction appears to be the most common

Conflicts of interest: None.

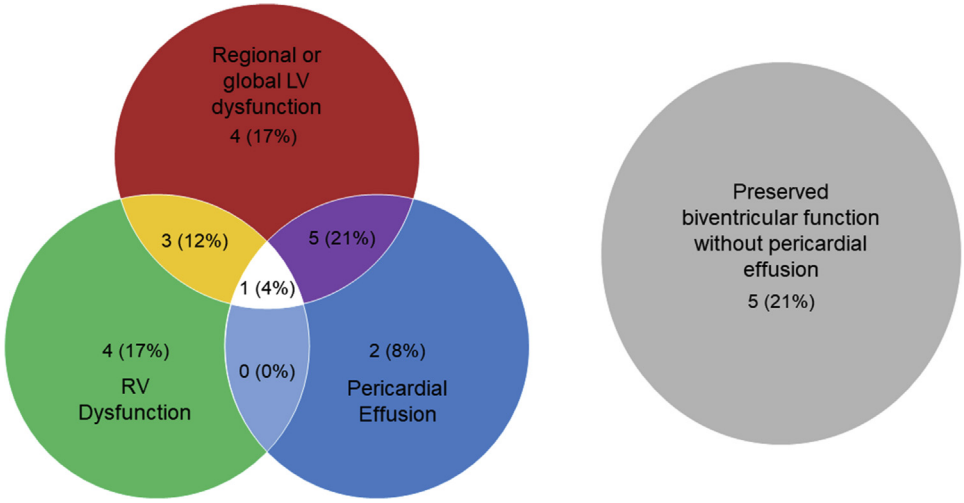

Figure 1 Venn diagram depicting the pattern distribution of echocardiographic findings in patients with COVID-19 with significant myocardial injury. *RV*, Right ventricular.

echocardiographic finding, which suggests that ischemia due to large- or small-vessel obstruction and prothrombotic state may be a common mechanism of injury.

Karan Sud, MD
Birgit Vogel, MD
Chandrashekar Bohra, MD
Vaani Garg, MD
Soheila Talebi, MD
Stamatios Lerakis, MD, PhD
Jagat Narula, MD, PhD
Edgar Argulian, MD
Mount Sinai Heart
Icahn School of Medicine at Mount Sinai
New York, New York

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https://doi.org/10.1016/j.echo.2020.05.030

Tricuspid Longitudinal Annular Displacement for the Assessment of Right Ventricular Systolic Dysfunction during Prone Positioning in Patients with COVID-19

To the Editor:

During the coronavirus disease 2019 (COVID-19) pandemic, many patients have developed severe acute respiratory distress syndrome (ARDS), often requiring prone positioning. Despite "lung-protective" ventilation, the pulmonary vascular dysfunction associated with COVID-19-related ARDS[1] can lead to right ventricular (RV) dilatation and dysfunction, both associated with poor outcomes. RV global longitudinal strain (GLS) assessed on transthoracic echocardiography was recently found to predict mortality more accurately than RV fractional area change (FAC) in patients with COVID-19.[2] However, during prone positioning, the assessment of RV function using transthoracic echocardiography can be very challenging,[3] and transesophageal echocardiography is often necessary. To date, RV FAC is still considered the best parameter for assessing RV systolic function on transesophageal echocardiography,[4] but like RV GLS, it requires that the entire endocardium be clearly visible, which is sometimes difficult in the setting of acute cor pulmonale related to mechanical ventilation.

Tricuspid longitudinal annular displacement (TMAD) is an emerging bidimensional strain echocardiographic parameter, tracking tricuspid annular tissue motion toward the RV apex (Figure 1), allowing an objective quantitative assessment of RV systolic function.[5] TMAD is also angle independent, but its main advantage compared with RV GLS is that it is unaffected by endocardial definition.

Our objective was to assess the feasibility of TMAD and RV GLS and to evaluate their respective performance to diagnose RV dysfunction (defined as RV FAC $< 35\%$) during prone positioning for severe ARDS related to COVID-19. TMAD measurements were performed in the apical four-chamber view, as recommended. Three points were placed, and the software (QLAB CMQ; Philips Medical Systems, Andover, MA) automatically tracked and calculated TMAD at the

Conflicts of interest: None.