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.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Cardiovascular Imaging* author instructions page.

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APPENDIX For a supplemental figure and videos, please see the online version of this paper.

Right Ventricular Dilation in Hospitalized Patients With COVID-19 Infection

Hospitalized patients with coronavirus disease-2019 (COVID-19) infection are at a high risk of progressive respiratory failure, endotracheal intubation, and mortality. The pathophysiology of COVID-19 infection has not been elucidated, but cytokine storm, prothrombotic state, and myocardial dysfunction have been implicated (1). Echocardiography is an essential bedside tool, which allows noninvasive assessment of biventricular function in COVID-19 patients, and echocardiographic findings can significantly influence decision making in the appropriate clinical settings (2). We aimed at studying the association of in-hospital mortality with right ventricular (RV) size measured by a focused, time-efficient echocardiography protocol (2).

In this retrospective study, we enrolled consecutive patients hospitalized to Mount Sinai Morningside Hospital (New York, New York) due to COVID-19 infection who underwent clinically indicated echocardiograms from March 26, 2020 to April 22, 2020. Echocardiograms were performed adhering to a focused, time-efficient protocol with appropriate use of personal protective equipment and limited viral exposure time. Portable ultrasound machines were used: CX50 (Philips Medical Systems, Bothell, Washington) and Vivid S70 (GE Healthcare Systems, Milwaukee, Wisconsin). Echocardiographic studies were interpreted by experienced, board-certified echocardiography attending physicians. RV dilation was defined as basal diastolic RV diameter exceeding 4.1 cm in the right ventricle–focused apical view and/or basal right-to-left ventricular diameter ratio of ≥0.9 in the apical 4-chamber view, and confirmed by visual RV inspection in all obtained views. In-hospital mortality was the study outcome. The comparisons were performed using Student's *t*-test or the Wilcoxon rank sum test for continuous variables, and the chi-square test for categorical variables. Univariate and multivariate regression analysis was used to explore the associations of clinical and echocardiographic variables with mortality. The study protocol was approved by the Mount Sinai Institutional Review Board.

Echocardiograms of 110 consecutive patients were reviewed, and 5 were excluded due to inadequate study quality. The mean age was 66.0 ± 14.6 years, and 38 (36%) patients were women. Thirty-one (30%) patients were intubated and mechanically ventilated at the time of the echocardiographic examination. RV dilation was present in 32 (31%) patients. Patients with RV dilation did not have significant differences in the prevalence of major comorbidities (hypertension, diabetes, and known coronary artery disease), laboratory markers of inflammation (white blood cell count, C-reactive protein), or myocardial injury (troponin I) but were more likely to have renal dysfunction (creatinine >1.5 mg/dl; 72% vs. 41%; p = 0.01) compared with patients without RV dilation. There were no differences between the groups in the use of therapeutic anticoagulation (38% vs. 39%; p = 0.83) at the time of the echocardiographic examination. Similarly, there were no differences in the measures of left ventricular size and function between the groups (mean left ventricular ejection fraction 54% vs. 55%; p = 0.61). RV hypokinesis (66% vs. 5%; p = 0.01) and moderate or severe tricuspid regurgitation (21% vs. 7%; p = 0.05) were more prevalent in patients with RV enlargement. Computed tomography angiography of the chest was obtained in 10 (31%) patients with RV enlargement, and 5 patients had evidence of pulmonary embolism. At the end of the study period, 21 (20%) patients died: 13 (41%) deaths were observed in patients with RV dilation, with 8 (11%) observed in patients without RV dilation (**Figure 1**). On univariate analysis, mechanical ventilation (p = 0.003), vasoactive medication use (p = 0.007), and RV enlargement (p = 0.001) were

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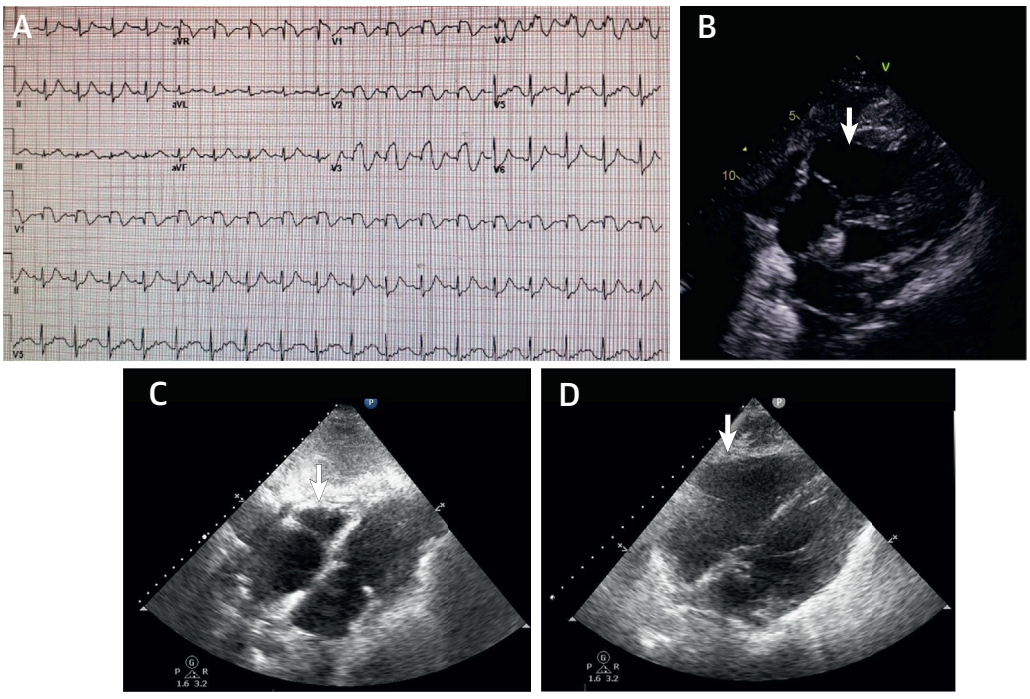
FIGURE 1 Right Ventricular Dilation in Hospitalized Patients With COVID-19 Infection



Patient #1, intubation day 7, not on therapeutic anticoagulation, with rapid hemodynamic deterioration. **(A)** Electrocardiography shows sinus tachycardia with ST-segment elevation in leads V1 to V4. **(B)** Echocardiography in the same patient shows right ventricular dilation **(arrow)**, with a small hyperkinetic left ventricle in the modified subcostal view. The patient expired. Patient #2, intubation day 5, on therapeutic anticoagulation. **(C)** Echocardiography shows normal-size right ventricle **(arrow)** in the modified subcostal view. **(D)** The same patient 3 days later, with rapid hemodynamic deterioration. Echocardiography shows right ventricular dilation **(arrow)** in the modified subcostal view. The patient expired. COVID-19 = coronavirus disease-2019.

significantly associated with mortality. On multivariate analysis, RV enlargement was the only variable significantly associated with mortality (odds ratio: 4.5; 95% confidence interval: 1.5 to 13.7; p = 0.005).

This is a small, retrospective, single-center study from the epicenter city of COVID-19 infection. None of the studies were performed in prone position.

In conclusion, RV dilation was prevalent in the current study of hospitalized patients with COVID-19 infection using a focused, time-efficient echocardiography protocol. The mechanism of RV dilation is likely multifactorial and includes thrombotic events, hypoxemic vasoconstriction, cytokine milieu, and direct viral damage. RV dilation was strongly associated with in-hospital mortality in these patients.

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Necessity of 45-Day Transesophageal Echocardiography After the WATCHMAN Procedure Amid the COVID-19 Pandemic

Amidst the coronavirus disease-2019 (COVID-19) outbreak, elective aerosolizing procedures such as transesophageal echocardiography (TEE) should be deferred as the procedure provokes coughing and gagging, which can cause aerosolization of the virus (1). The American Society of Echocardiography recommends applying personal protective equipment when performing TEE in symptomatic patients with suspected/confirmed COVID-19. The risks and benefits of TEE should be considered for both symptomatic and asymptomatic COVID-19 patients (1).

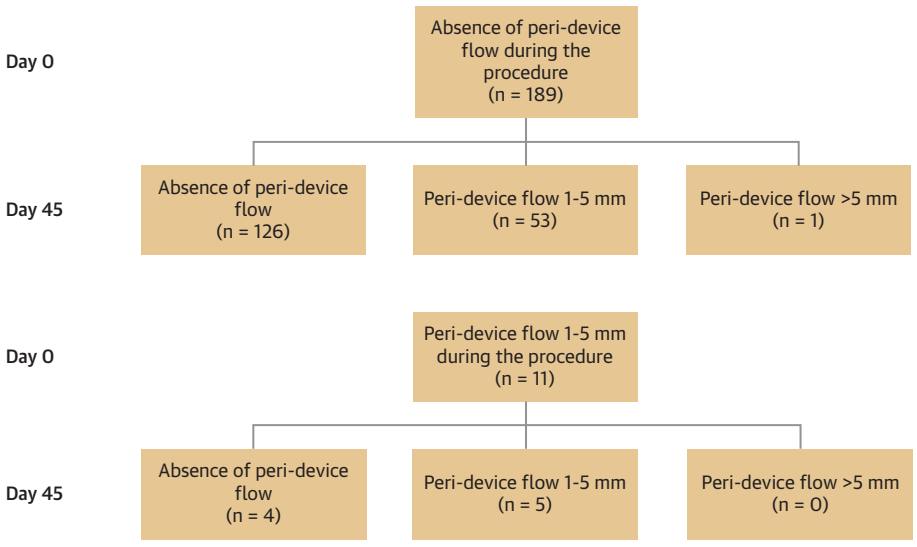
In atrial fibrillation patients undergoing left atrial appendage closure (LAAC), TEE is typically performed at 45 days to assess peri-device flow <5 mm and an absence of device-related thrombus (DRT) before oral anticoagulation (OAC) is discontinued. We sought to investigate whether a 45-day TEE is absolutely necessary for patients who underwent LAAC amid the COVID-19 pandemic (2).

We retrospectively studied 200 patients who underwent a successful WATCHMAN procedure in a tertiary hospital (from June 2016 to June 2019). Upon discharge, patients were maintained on OAC and aspirin. We aimed to assess TEE measured peri-device flow at the time of implantation and at 45 days. Institutional review board approval was obtained. The mean age was 75.9 ± 8.3 years, and 42.9% of patients were women. The mean CHA_2DS_2-VASc and HAS-BLED scores were 4.8 ± 1.6 and 2.9 ± 0.9, respectively. Patients were discharged more frequently on direct oral anticoagulants (DOACs) (77.5%) as opposed to warfarin (22.0%). At the time of the WATCHMAN procedure, 189 of 200 patients (94.5%) had an absence of peri-device flow, and 11 of 200 (5.5%) had peri-device flow 1 to 5 mm.

Among 189 patients without peri-device flow during the procedure, 180 underwent TEE at 45 days; where 126 of 180 patients (70.0%) had an absence of peri-device flow, 53 of 180 (29.4%) had flow 1 to 5 mm, and 1 of 180 (0.6%) had significant peri-device flow >5 mm (**Figure 1**). Among 11 patients with peri-device flow 1 to 5 mm at the time of the procedure, 9 underwent TEE at 45 days; where 4 of 9 patients (44.4%) had an absence of peri-device flow, 5 of 9 (55.6%) had flow 1 to 5 mm, and 0 of 9 (0%) had peri-device flow >5 mm. No patients had DRT on 45-day TEE.

In the PROTECT-AF (WATCHMAN Left Atrial Appendage System for Embolic PROTECTion in Patients With Atrial Fibrillation) trial, peri-device flow >3 mm was observed in 13% and 12% of patients on 45-day and 1-year TEE, respectively. However, the more recent EWOLUTION (Evaluating Real-Life Clinical Outcomes in Atrial Fibrillation Patients Receiving the WATCHMAN Left Atrial Appendage

FIGURE 1 **Peri-Device Flow During the Procedure and at 45 Days**



Among 189 patients who underwent 45-day transesophageal echocardiography, only 1 patient had peri-device flow >5 mm.