

Focus, Not Point-of-Care, Echocardiography in Prone Position: It Can Be Done in COVID-19 Patients



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INTRODUCTION

The novel coronavirus, which was first identified at the end of 2019 in Wuhan, China, has rapidly spread and has now infected more than 4 million people (May 2020) around the world.¹ Myocardial injury has been seen in those who contract the virus. Various forms of myocardial injury include myocarditis, hypoxic injury, ischemic injury from microvascular damage, and stress cardiomyopathy.² Although myocardial injury has been noted in these patients, the major cause of morbidity and mortality is acute viral pneumonitis that evolves into acute respiratory distress syndrome (ARDS).³

CASE PRESENTATION

A 65-year-old man with a past medical history of non-insulin-dependent diabetes mellitus type 2, hypertension, and hyperlipidemia presented to the hospital with a chief complaint of shortness of breath that had been worsening for 1 week. His wife recently had been sick but had since improved. Initial vital signs were blood pressure 157/85 mm Hg, heart rate 111 beats/minute, oxygen saturation 92% on a 100% nonrebreather mask, respiratory rate 36/minute, and temperature 38.8°C. Physical examination was positive for diffuse rhonchi and use of accessory respiratory muscles.

Electrocardiogram showed sinus tachycardia. Chest x-ray was positive for diffuse bilateral airspace opacities (Figure 1). Labs were positive for lymphopenia at 0.7 K/mcl (reference range, 1.0-4.0 K/mcl), D-dimer level 15.12 mg/L (reference range < 0.57 mg/L), ferritin 683 ng/mL (reference range, 26-388 ng/mL), C-reactive protein 39 mg/dL (reference range ≤ 1.0 mg/dL), lactate dehydrogenase level 1,043 units/L (reference range, 86-234 units/L), and interleukin-6 elevated at 13 (reference range ≤ 5). Computed tomography pulmonary angiogram was negative. Troponin I and N-terminal pro-B-type natriuretic peptide were within normal limits. The patient

tested positive for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) after polymerase chain reaction via nasal swab.

The patient was admitted to the intensive care unit and placed on high-flow nasal cannula oxygen therapy, but shortly thereafter he required intubation. A transthoracic echocardiogram (TTE), on a GE Vivid E95 (GE Healthcare, Chicago, IL) machine, in the supine position revealed normal left ventricular (LV) cavity size and systolic function, an ejection fraction of 61% (Video 1), mildly increased right ventricular (RV) size with mildly decreased systolic function, and normal RV free wall longitudinal strain of -24% (Figure 2A); in addition, the global longitudinal strain (GLS) calculation or average of all LV segments was abnormal at -15%, secondary to an abnormal strain pattern in all segments except for the inferior wall (base to apex) and the midventricular segment of the septal wall (Figure 2B). In the supine position, RV basal dimension was 4.2 cm, RV mid-dimension was 3.8 cm, fractional area change was 30%, and tissue Doppler imaging S' was 0.16 m/sec. The patient was treated with doxycycline, methylprednisolone, and tocilizumab and received convalescent plasma. Having both taken the medications and been placed in the prone position, his oxygenation improved and he required less ventilator support. A repeat TTE was performed 7 hours after the patient was placed in the prone position. For this study, the sonographer placed the patient's left arm above his head and right arm at his side, also known as the "swimmer's position." Electrocardiographic patches were placed dorsally, one on each shoulder and one on the left rib cage. A TTE again showed normal LV cavity size, normal systolic function, and an LV ejection fraction of 66% (Video 2); however, RV free wall longitudinal strain had improved to -29% (Figure 3A) and LV GLS to -19% (Figure 3B). In the prone position, RV basal dimension was 3.7 cm, RV mid-dimension was 3.3 cm, fractional area change was 37%, and tissue Doppler imaging S' was 0.17 m/sec. For RV strain, septal segments should be omitted, and only the RV free wall segments should be considered in the calculation, according to the most recent American Society of Echocardiography and European Association of Cardiovascular Imaging guidelines.

The patient had initial clinical improvement with decreased oxygen requirements but ultimately developed a pneumomediastinum and died from ARDS and prolonged mechanical ventilation.

DISCUSSION

Prone ventilation has proven beneficial in patients with ARDS.⁴ Prone positioning allows for optimization of alveolar recruitment, improvement of gas exchange, decrease of pulmonary shunting, and reduction of extravascular lung water.⁵

In patients with ARDS, RV failure is caused by the co-occurrence of acute pulmonary hypertension and the harmful effects of mechanical ventilation. These patients are prone to developing acute cor pulmonale due to uncoupling of the RV and the pulmonary circulation.⁶ Transesophageal echocardiography can be performed safely and

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VIDEO HIGHLIGHTS

Video 1: Echocardiogram in supine position. An echocardiogram done with the patient in the supine position shows normal LV cavity size and systolic function, an ejection fraction of 61%, and mildly increased RV size with mildly decreased systolic function.

Video 2: Echocardiogram in prone position. An echocardiogram done with the patient in the prone position shows normal LV cavity size, normal systolic function, and a LV ejection fraction of 66%.

View the video content online at www.cvcasejournal.com.

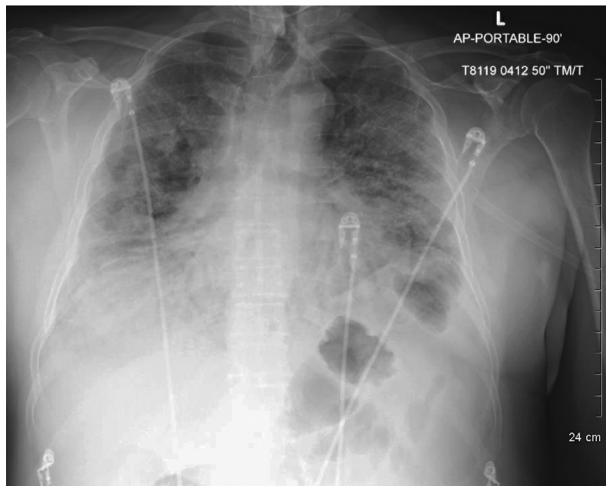


Figure 1 Chest x-ray on admission. Chest x-ray depicts diffuse bilateral airspace opacities.

efficiently in the prone position in the ARDS population.⁷ In this case, we show that prone positioning was beneficial to oxygenation and biventricular function in a patient infected with COVID-19 pneumonitis. We recommend following established protocols⁸ to help guide management as well as to reduce risk to frontline sonographers.

A recent study published from Wuhan, China, showed that reduction in RV free wall longitudinal strain is a powerful predictor of mortality.⁹ Thus, optimizing RV function is essential in this patient population, and prone positioning, by offloading RV pressure, is one method to improve function. Pulmonary vascular resistance is elevated in the supine position, resulting in decreased RV contractility and poor LV filling. The prone position helps to decrease pulmonary vascular resistance, thereby decreasing RV volume and pressure overload and improving LV preload.¹⁰ This case demonstrates the importance of obtaining focused echocardiographic imaging in the supine and prone positions in this patient population.

Transthoracic echocardiographic imaging in patients who are mechanically ventilated is known to be difficult due to the “curtain effect” of the left lung. In this case we show that it is feasible to collect echocardiographic data in the prone position.¹¹ By placing the patient’s left arm above the head and the right arm at the patient’s side, the patient assumes the swimmer’s position, allowing us to obtain adequate images.¹¹ A recently published paper by Giustiniano *et al.*¹² analyzed eight intubated prone patients without placing the patient in the swimmer’s position; rather, they deflated the hospital bed, allowing for adequate probe placement in the prone position. The clinicians were successful in attaining only the apical four-chamber view in seven out of eight cases.

CONCLUSION

COVID-19 infection has been associated with both cardiovascular and pulmonary complications. We show that prone positioning improves both pulmonary and cardiovascular function. Clinicians should be cognizant of the importance of prone positioning and implement this technique early in the patient’s clinical course.

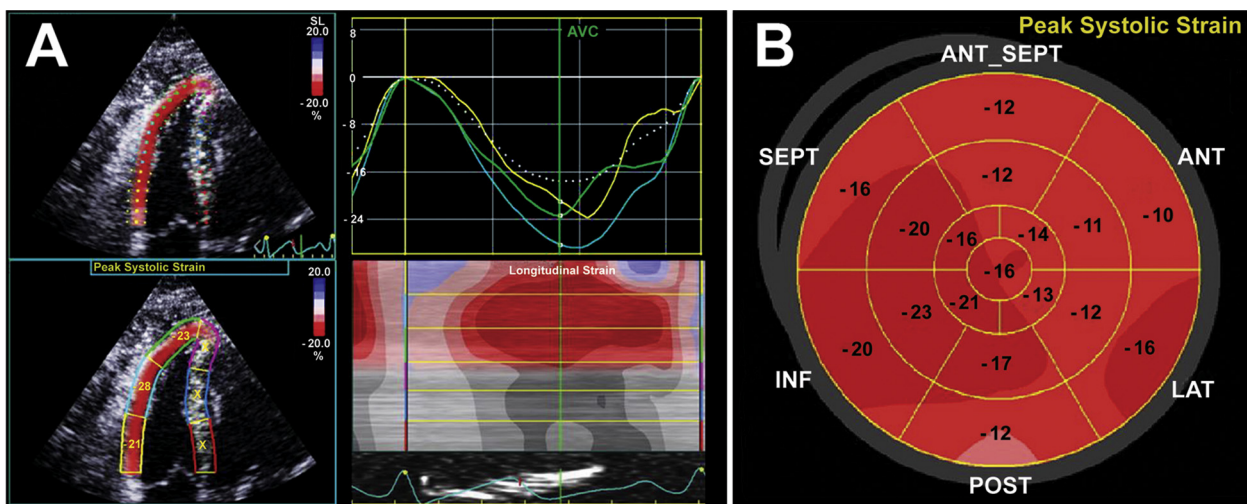


Figure 2 Supine echocardiography. The patient’s initial echocardiogram, done in the supine position, depicts RV free wall longitudinal strain of -24% (this technique excludes the septum; **(A)**) and reduced LV GLS of -15% (**(B)**). The inferior segments (base-apex) show normal longitudinal strain percentages, but the remaining segments of the LV are decreased. The GLS calculation or average of all LV segments is -15% .

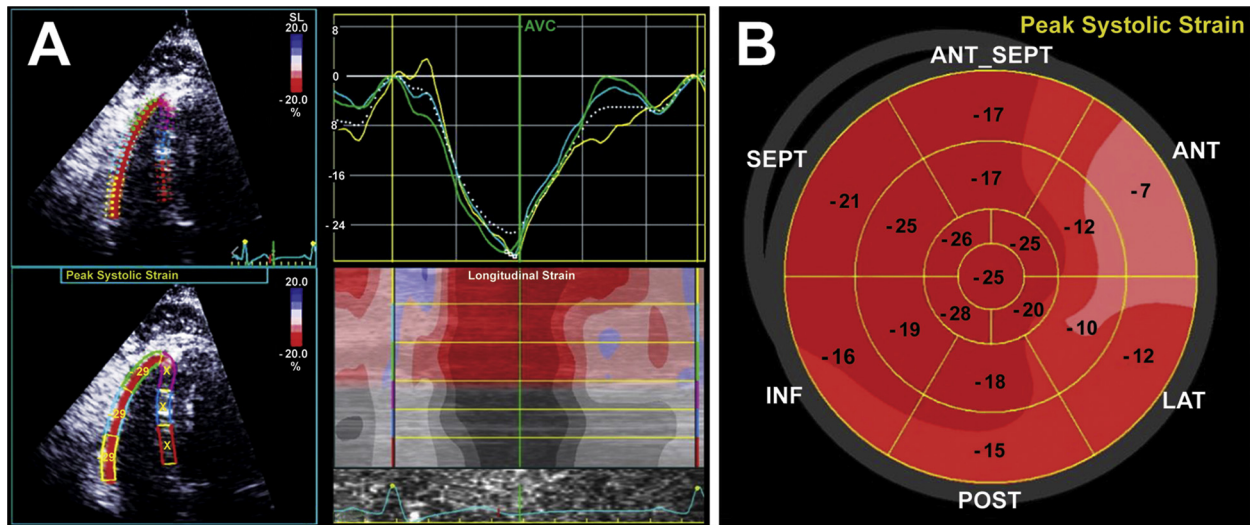


Figure 3 Prone echocardiography. An echocardiogram done in the prone position shows an improvement in RV free wall longitudinal strain to -29% (**A**) and LV GLS to -19% (**B**). While the inferior segments continue to show normal longitudinal strain percentages, we now see improvement in the septal, anterioseptal, and the entirety of the apical segments. The remaining segments of the left ventricle continue to show a decreased longitudinal strain percentage. The GLS calculation or average of all LV segments is normal and improved at -19% .

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.case.2020.10.007>.

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