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EDITORIAL

Cardiac manifestations in critically ill patients with COVID-19: do we really know what hit us?

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Since the first wave of coronavirus disease 2019 (COVID-19) researchers and clinicians have been learning much and modifying treatments as understanding of this disease and its primary and secondary manifestations have continued. Initially, in the intensive care unit (ICU), the respiratory symptoms have been the most apparent with patients presenting with severe hypoxemia. The COVID-19 lung injury fulfilled the criteria for acute respiratory distress syndrome (ARDS), and we, therefore, applied the evidence based treatment guidelines for ARDS. However, as we now know, the COVID-19 lung is affected in many ways that can change over time and include diffuse pneumonitis with inflammation, severe fibrosis and restrictive physiology; destructive pneumonitis with much sensitivity to lung injury from large tidal volume, spontaneous or mechanical, ventilation [1, 2]. COVID-19 can also induce severe inflammation which can be associated with secondary lung injury with increased lung water and micro- and macrovascular inflammation and pulmonary thrombo-emboli [3]. Secondary infection with a range of organisms including Aspergillus, Stenotrophomonas and Acinetobacter, seem to occur much earlier often after administration of anti-inflammatory drugs which is hardly surprising given their immunosuppression. Also, the renal injury in COVID-19 may be more persistent than that of acute kidney injury (AKI) of other infectious causes [4] and contribute to lung injury. Patients with chronic obstructive pulmonary disease have substantially increase mortality [5] as do younger patients with increased body mass index (BMI) [6].

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The cardiac manifestations in critically ill patients with COVID-19 are now being extensively studied. Huang et al. recently published the findings of the ECHO-COVID study on echocardiography findings in ICU patients with COVID-19 [7]. The study was an international retrospective observational study of 677 ICU patients from eight countries with COVID-19 who had an echocardiography performed in the ICU (range of day 1–4, median at day 2). The echocardiography exams were performed on clinical indication and not standardized which inferred some selection bias and some missing data. None the less, there is much interesting and valuable data to be gathered from the study. Over one-third of patients had abnormal ventricular function on their first ECHO and 23% had left ventricular systolic dysfunction (LV) and 22.5% had right ventricles (RV), but just 41% received vasopressors or inotropic agents. Acute cor pulmonale was seen in 17% and seemed to be associated with hypercapnia, mechanical ventilation and pulmonary embolism, but, interestingly, not related to the severity of hypoxemia or plateau pressure. Of note, acute cor pulmonale, but not visual LV or RV dysfunction, was associated with increased mortality. Thus, a substantial proportion of the cardiac manifestations in COVID-19 seemed to be associated with respiratory issues which is supported by the presentation of COVID-19 patients with primarily severe respiratory dysfunction. Like many ICU patients, a history of cardiovascular disease is a substantial risk factor for poor outcome in patients with COVID-19 [8]; more importantly, a recent large study reported an illness severity-dependent substantially associated with an increased risk range of cardiovascular outcomes in patients with COVID-19 1 year after infection [9].

The respiratory issues of COVID-19 change with time and so too naturally will the echocardiographic findings. The cardiovascular system is likewise severely affected in many primary and secondary ways. These include,

Table 1 Unanswered questions on the cardiovascular consequences of COVID-19

What is the pathophysiology behind increased long term cardiovascular risk after COVID-19?
Trajectory of echocardiographic findings during and following acute illness?
Do vaccines and immunomodulatory drugs have a modifying effect on the long-term risk?
Could prophylactic treatment with known cardiovascular drugs improve outcome following COVID-19?

similar to other ventilated patients with sepsis, an initial LV hyperdynamic cardiac phase and later left heart dilatation and/or cardiogenic shock. The RV will be involved but particularly susceptible to pulmonary events and likely to change over time. Huang et al. studies show data on early RV function that is fascinating but likely to change over time with progressive lung disease or pulmonary thrombo-embolism. Early cor-pulmonale strongly suggests fulminant lung disease or severe thromboemboli, but it is important to remember that we now, are well aware of the multiple primary and secondary insults that can occur with COVID-19 to the heart. An excellent article by Helms et al. on COVID-19 and the heart, highlights some of the pathophysiology and relates it to clinical manifestations seen in ICU al [10]. Lawal et al. highlight the point that the cardiovascular system expresses the angiotensin-converting enzyme-2, which as we know is the receptor used by COVID-19 for binding, making it vulnerable to infection by the virus [11]. The severe inflammation or cytokine storm previously experienced by COVID-19 patients, many of which are now prevented or managed by dexamethasone and other anti-inflammatory drugs can also impact on the normal functioning of the cardiovascular system [11].

Direct myocardial injury can also be caused by myocarditis, systemic or local inflammation with fibrosis and endotheliitis with micro- and macrovascular thrombosis. In a recent case report of cardiogenic shock in a COVID-19 patient, the coronary angiography was normal and the endomyocardial biopsy demonstrated coronary endotheliitis with multiple microvascular thromboses but no lymphocytic infiltrate and a negative polymerase chain reaction for COVID-19 [12]. Also similar to other intensive care patients, high-sensitivity cardiac troponin can be elevated early and is associated with increased mortality.

The authors acknowledge the multiple limitations, however, this does not detract from the value of data. A more inclusive standardised study may change the frequency of the findings but so too will the timing of the ECHO and the severity of illness. Our understanding of the cardiovascular consequences of COVID-19 is still rapidly increasing, but we still need better understanding of the pathophysiology to improve the care for these patients (Table 1). This study provides useful information on a large group of COVID-19 ICU patients in the first few days of their illness. It provides a very important starting point in the echocardiographic evaluation of cardiac function of COVID-19 patients in the intensive care. However, data on regularly repeated and standardised ECHOs are required to further elucidate the trajectory of the cardiac manifestations. Nevertheless, it seems prudent that all survivors of intensive care receive long-term follow-up for cardiac function as well as all the other consequences of COVID-19 and prolonged stay in the ICU.

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Declarations

Conflicts of interest
PBH has nothing to declare. WB has nothing to declare.

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