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Complicated impact of COVID-19 on cardiovascular system

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Abstract
The spread of COVID-19 has become a growing cause of mortalities over the globe since its major outbreak in December 2019. Based on the many studies, the host cell affected by coronavirus 2 (SARS-CoV-2), become corrupted through Angiotensin converting enzyme 2 (ACE2) receptors. Angiotensin converting enzyme 2 is an integral membrane protein and a zinc metalloprotease of the Angiotensin-converting enzyme (ACE) family. This protein consists of 805 amino acids and cleaves angiotensin's I and II as a carboxypeptidase. The interaction between SARS-CoV-2 and ACE-2 has become an interesting subject to deep understanding of COVID-19 disease. One of the most important effects of this interaction is increased risk of cardiovascular diseases (CVD). In this review, we discuss in different stages the various preexisting cardiovascular diseases mechanisms responsible for same with COVID-19 infection.

Introduction
There is a growing body of literature that recognizes the importance of impact and implications of COVID-19 on the cardiovascular system. Since the outbreak of peneumonia which caused by a novel coronavirus in December 2019 resulted in more than 4.4 million SARS-CoV-2 and caused more than 300,000 deaths worldwide [1]. After virus isolation and identification, it has been found that there are big similarity between SARSCoV-2 virus and SARS-CoV-1 in term of structure. However, the disease known 2019 novel coronavirus has unique properties distinct from the other coronaviruses [2, 3, 4]. A much debated question is whether the patients with comorbid conditions more affected by COVID-19 or not. Reports suggested that COVID-19 disease can be mortal in those with and without comorbidities. The clinical observations of disease patterns reveal that the risk of the disease increases with the presence of heart disease. In spite of the clinical manifestations of COVID-19 characterized by respiratory symptoms, some patients have severe cardiovascular damage [6]. Moreover, patients with underlying cardiovascular diseases (CVDs) seem to be associated with higher morbimortality [6]. Therefore, understanding the damage caused by SARS-CoV-2 to the cardiovascular system and the underlying mechanisms is of the greatest importance, so that treatment of these patients can be timely and effective and mortality reduced.

Mechanisms of myocardial injury in COVID-19
The mechanisms of myocardial injury in COVID-19 are likely to be dependent on a number of factors or causes. Although this mechanisms are uncertain to date, many studies showed that acute myocarditis and heart failure can caused by the Middle East respiratory syndrome-related coronavirus (MERS-CoV)[7]. Angiotensin-

converting enzyme 2 (ACE2) is highly expressed in the heart and lungs. Moreover, it plays main function in cardiovascular and immune systems [8]. On the other hand, the affinity of SARS-CoV-2 for (ACE2) receptor has been proved. The spike protein of the virus binds to ACE2 receptor [8]. SARS-CoV-2 mainly infests alveolar epithelial cells and lead to respiratory symptom. Noticeably, These symptoms are more severe in patients with CVD compared with healthy individuals. The Convincing reason may due to increasing the secretion of ACE2 in these patients. In addition, the infection with coronaviruses can result in global myocardial involvement ST-segment elevation myocardial infarction (STEMI), and may lead to severe lift ventricular LV dysfunction [9, 10]. Moreover, it has been observed that patients with acute SARS infection suffer from subclinical left ventricular (LV) diastole. These results may prove that the impairment of LV in the acute phase can be attributed to acute cellular infections invading the body as a result of acute viral infection. As a result, the body is exposed to a large proliferation of lymphocytes and macrophages due to an uncontrolled immune response.

ACE2 mainly contributes to the neuropulmonary regulation of the cardiovascular system. Therefore, ACE2-related signaling pathways may be involved in acute myocardial injury. However, Hwang and PT Al Wong CK. Suggested other mechanisms of myocardial injury induced by SARS-CoV-2 infection have been proposed [6, 12]. This mechanism explains the damage to the heart muscle. Infection with the virus leads to a cellular storm caused by an unbalanced response from Type 1 and Type 2 T helper cells, respiratory dysfunction, and hypoxemia caused by COVID-19, resulting in damage to heart muscle [6,12].

Impact ofCOVID-19 on cardiovascular biomarkers

Many laboratory data showed health consequences in individuals with pre-existing cardiovascular disease increase cardiovascular biomarker in patients with COVID-19.Those biomarkers include high lactate dehydrogenase, hypoalbuminemia, increased C-reactive protein CRP, elevated lactate dehydrogenase, and increased erythrocyte sedimentation rate[13,14]. Further, those studies suggest that a cytokine cascade may function a pathophysiological role in severe illness with increases in interleukin-2, interleukin-6, granulocyte-colony stimulating factor, interferon-γ inducible protein 10, monocyte chemoattractant protein 1, macrophage inflammatory protein 1-α, and tumor necrosis factor-α.Moreover, common abnormality in D-dimer has also been described [15]. According to multiple nonspecific laboratory and biochemical data have been reported that D-dimer increase significantly in COVID-19 patients. These results showed also presence of overt sepsis and disseminated intravascular coagulopathy [16, 17]. Several studies from China have documented that an elevated D-dimer level indicates the severity of SARS-CoV-2 infection. By studying 140 patients with COVID-19, the results showed that patients with debilitating conditions had higher levels of D-dimer compared to uninfected patients. [17, 18]. Furthermore, increased the level of D-dimer associated with the development of acute respiratory distress syndrome ARDS. Based on research so far, patients have high D-dimer level with ARDS seem to be associated to an elevation in in-hospital mortality rate [18]. Other study, recently, in Iraq reported that abnormalities in cardiovascular biomarkers include CRP, LDH and ferritin ±D dimer good indicator for diagnosis of COVID-19[19].

Chronic cardiovascular damage in COVID-19 patients

The infection by SARS-CoV can aggravate cardiovascular diseases CVD. The result of a follow-up survey for 12 years of 25 patients who recovered from SARS-CoV infection revealed that 68% had hyperlipidaemia, 44% had cardiovascular system abnormalities and 60% had glucose metabolism disorders [20]. This study suggested that lipid metabolism in patients with a history of SARS-CoV infection was dysregulated. There are significantly increased in serum concentration of free fatty acid, which include lysophosphatidylcholine, lysophosphatidylethanolamine and phosphatidylglycerol in comparison with individuals without a history of SARS-CoV infection[20]. In term of structure SARS-CoV-2 has a similar structure to SARS-CoV. Therefore, the novel virus might also cause chronic damage to the cardiovascular system.

Patients with underlying CVD are more likely to be infected by MERS-CoV [21]. It is apparent from many results that old people, with comorbidities, are more likely to be infected with SARS-CoV-2, especially those with hypertension, coronary heart disease or diabetes. Moreover, cardiovascular patients seem to be developing severe symptoms when infected with SARS-CoV-2. According to mortality data patients underlying CVD account for a large proportion of deaths from COVID-19

Conclusion

Since December 2019, the COVID-19 pandemic has continued to grow globally and affected millions of people worldwide. This essay has discussed the reasons for the most contemporary literature on the relationship of the cardiovascular system and COVID-19. Based on research so far, Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infects host cells through ACE2 receptors, resulting in coronavirus disease (COVID-19) and, at the same time, leading to acute myocardial injury and chronic damage to the cardiovascular system. Although the specific mechanisms are uncertain, Patients with underlying CVD and SARS-CoV-2 should be given particular attention during treatment for COVID-19.

Reference

1. World Health Organization. https://www.who.int/emergencies/ diseases/novel-coronavirus-2019 2020.

2. Petrosillo N, Viceconte G, Ergonul O, et al. COVID-19, SARS and MERS: are they closely related? Clin Microbiol Infect. 2020.

3. Ou X, Liu Y, Lei X, et al. Characterization of spike glycoprotein of SARS-CoV-2 on virus entry and its immune cross-reactivity with SARS-CoV. Nat Commun ;11(1):1620,2020

4-Zhou, P. et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature https://doi.org/10.1038/ s41586-020-2012-7 (2020)

5.Fang Z, Yi F, Wu K, Lai K, Sun X, Zhong N, et al. Clinical characteristics of coronavirus pneumonia 2019 (COVID-19): an updated systematic review. medRxiv. 2020: 2020.03.07.20032573.

6.Huang, C. et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395, 497–506 (2020)

7.Alhogbani, T. Acute myocarditis associated with novel Middle East respiratory syndrome coronavirus. Ann. Saudi Med. 36, 78–80 (2016).

8. Turner, A. J., Hiscox, J. A. & Hooper, N. M. ACE2: from vasopeptidase to SARS virus receptor. Trends Pharmacol. Sci. 25, 291–294 (2004).

9. Inciardi RM, Lupi L, Zaccone G, et al. Cardiac Involvement in a Patient With Coronavirus Disease 2019 (COVID-19). [published online ahead of print, 2020 Mar 27]. JAMA Cardiol 2020, https:// doi.org/10.1001/jamacardio.2020.1096
10 Hu H, Ma F, Wei X, et al. Coronavirus fulminant myocarditis saved with glucocorticoid and human immunoglobulin. [published online ahead of print, 2020 Mar 16]. Eur Heart J 2020, ehaa190, https:// doi.org/10.1093/eurheartj/ehaa190.
11. Li SS, Cheng CW, Fu CL, et al. Left ventricular performance in patients with severe acute respiratory syndrome: a 30-day echocardiographic follow up study. Circulation 2003;108(15):1798-803
12. Wong, C. K. et al. Plasma inflammatory cytokines and chemokines in severe acute respiratory syndrome. Clin. Exp. Immunol. 136, 95–103 (2004).
13. Mehta P, McAuley DF, Brown M, et al. COVID-19: consider cytokine storm syndromes and immunosuppression. Lancet 2020;395 (10229):1033-4
14. Pedersen SF, Ho YC. SARS-CoV-2: a storm is raging. J Clin Invest 2020;130(5):2202-5, https://doi.org/10.1172/JCI137647.
15. Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med 2020;382(18):1708-20, https://doi.org/10.1056/NEJMoa2002032.
16. Tang N, Li D, Wang X, et al. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost 2020;18(4):844-7.
17. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020;395(10229):1054-62.
18. Zhang JJ, Dong X, Cao YY, et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan. Allergy: China. 2020.
19. Ahmed N. Kaftan, Majid K. Hussain, Abdulhussein A. Algenabi, Farah H. Naser, Muslim A. Enaya. Predictive Value of C–reactive Protein, Lactate Dehydrogenase, Ferritin and D-dimer Levels in Diagnosing COVID-19 Patients: a Retrospective Study ORIGINAL PAPER / ACTA INFORM MED. 2021 MAR 29(1): 45-50.
20. Wu, Q. et al. Altered lipid metabolism in recovered SARS patients twelve years after infection. Sci. Rep. 7, 9110 (2017).
21. Badawi, A. & Ryoo, S. G. Prevalence of comorbidities in the Middle East respiratory syndrome coronavirus (MERS-CoV): a systematic review and meta-analysis. Int. J. Infect. Dis. 49, 129–133 (2016)