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Journal of Cardiology & Current Research

Mini Review

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Common symptoms and joint tests between cardiovascular disease and coronavirus infection: Mini review

Volume 15 Issue 1 - 2022

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Received: November 16, 2021 | **Published:** February 28, 2022

Survey

The pandemic of severe acute respiratory syndrome coronavirus diseases- 2019 (COVID-19) infection is causing considerable morbidity and mortality worldwide. Multiple reports have suggested that patients with cardiovascular diseases (CVD) and heart failure (HF) are at a higher risk of severe disease and higher mortality with COVID-19. Generally, myocardial damage, heart diseases and cardiac arrhythmia is associated with patients with COVID-19. Also, they may have a severe COVID-19 infection if patients have high prevalence of cardiovascular disease. Infection of myocardium due to infection is observed in a considerable percentage of patients with COVID-19. In this case, it should be emphasized that the angiotensin-converting enzyme-2 (ACE2) acts as the main gateway for this infection, although the role of this converting enzyme inhibitors or angiotensin receptor blockers requires further investigation. According to the results of previous studies, the major cardiac abnormalities and complications in the SARS epidemic were hypotension, myocarditis, arrhythmia, and sudden cardiac death. Dealing with COVID-19 infection, except for similar disorders, poses a challenge to heart transplantation that affects donor selection, immunosuppression, and post-transplant management. There are a number of joint tests to recognize and therapies under active investigation to treat and prevent of COVID-19 infection. The main objective of this paper is reviewing the common symptoms and joint tests between CVD/HF and COVID-19 infection.

The relation between COVID-19 and cardiovascular system

Similar finding have expressed for patients with COVID-19 and those with cardiovascular diseases (CVD). Heart failure (HF) and cardiac arrhythmia along with some risk factors such as hypertension and diabetes mellitus are the main common pre-existing conditions in patients with COVID-19 infection, but the description of CVD symptoms used through studies was ambiguous.[1,2] The high spread of these indispositions was confirmed by examining patients referred to the intensive care unit (ICU) and those with common cardiac disorders.[2,3] Common symptoms were arrhythmias, myocarditis, hypotension and death due to sudden cardiac arrest (SCD).[4,5] Importantly, performed diagnostic works showed electrocardiographic changes during previous involvement with SARS infection, along with subclinical left ventricular (LV) diastolic impairment and blood troponin elevation.[6,7] Comparable cardiac symptoms were observed in patients with COVID-19. Myocardial infiltration by interstitial mononuclear inflammatory cells was shown by autopsy of patients with COVID-19 infection that was associated with increased levels of biomarkers due to myocardial damage.[8,9] Findings of different study indicated that several symptoms such as myocardial injuries, increased levels of biomarkers, coronary artery disease (CAD), HF and cerebrovascular disease are likely correlated with infection-induced by COVID-19.[8–10] Also, higher mortality reported due to cardiac injury with elevated troponin T levels. According to the results, most of the patients were men, older and had more comorbidity such as hypertension and coronary heart disease.[11,12] Severe infections of COVID-19 can potentially induce infection-related myocarditis resulted in cardiac arrhythmias. Especially in acute complications, infection of COVID-19 can link with an elevated cardio vascular risk that persist for a long period in patients with symptoms of pneumonia, hypercoagulability and systemic inflammatory activity.[2,4]

Pathophysiology

i. Binding to ACE2 receptor of the host by different types of coronavirus involves SARS-CoV-2 and COVID-19 infection is the main way to entry into cells.

ii. Specific receptor ACE2 as a key member of the renin angiotensin system (RAS) is important in the pathophysiology of CVD/HF. This type of receptor is expressed in the lungs, heart and vessels.

iii. Cardiac disorders and heart failures associated with COVID-19, likely involves dysfunction of the RAS/ACE2 system due to relevant infections and comorbidities such as hypertension.

iv. Cardiac disorders in COVID-19 infection as primary phenomenon or as secondary phenomenon for acute lung injury lead to increased cardiac workload and cardiac arrhythmia which is common in patients with preexisting CVD/HF.

v. Imbalance of T cell activation along with disordered release of cytokines (Cytokine release storm) may contribute to CVD/HF in COVID-19 infection.

vi. Activation of immune system or alterations of immune-metabolism may result in plaque instability which resulted in development of acute coronary complications.[4,5,10–12]

Symptoms and signs

Patients with COVID- 19 infection may be have different symptoms with those of heart failure. Therefore, it is important that it be considered as a confuse factor in patients with CVD/HF. So all admitted patients should be tested for COVID- 19 infection as soon as possible.[2,12] Clinical and laboratory screening results as well as pneumonia and pulmonary oedema should be considered as criteria for admission to specific COVID units.[12,13] Symptoms of COVID-19 pneumonia according to clinical signs are very hard and may be different from pulmonary congestion. Symptom such as fever, dry cough, anosmia also pulmonary crackles are more specific for COVID-19 infection, but may be confused when compare with pulmonary symptoms caused by lung congestion.[4] Fever is not the only determinative symptom for a COVID-19 diagnosis, because according to latest findings fever on admission was diagnose only for 44% of patients, although during hospitalization fever developed in 89% of patients.[13] Frequently, COVID- 19 infection may cause profound fatigue and breathlessness, also fever and hypoxaemia may cause tachycardia, which is common in patients with acute HF. Chest pain and angina may observed in normal or COVID-19-related myocarditis patients or takotsubo syndrome.[6,7] Develop dyspnoea and hypoxaemia reported in most patients with severe COVID- 19 from 5 to 10 days after onset of infection, which then rapidly convert to acute respiratory distress syndrome (ARDS) and dysfunction or multiple organ failure.[14,15]

Prevention of COVID-19 in patients with CVD/HF

There is a clinical irregularity to assess and treating CVD/HF patients with COVID-19, because symptoms of both conditions overlapped and reinforce each other to produce. However, to examine and clarify the issue limited data exist in this regard for management of CVD/HF patients with COVID-19.[1,10] These problems pose significant challenges to afford optimal care to patients for clinicians worldwide. It is important that all necessary measures are taken to ensure prevention of disease in crucial CVD/HF patients. If do not need any urgent requirements to patients should avoid routine visits to hospitals. So, virtual visits and contacting CVD/HF patients indirectly should be replaced to elective routine care before their clinic appointments. This type of patients monitoring may also be important to play up patients and reduce their stress. Medical staff should also turn the office into indirect visits if possible, especially with the help of video calls. It is better to some symptoms such as heart rate, heart rhythm and blood pressure be controlled by patients, if necessary equipment is available for patients.[4,12]

Routine laboratory exams and specific joint tests

Because health care professionals involved in caring for patients with Covid-19 may also be unknowingly carriers of the virus, so they should consider routine laboratory examinations and joint tests to ensure the safety of all patients. Health care professionals and medical personnel with symptoms of Covid-19 should isolate themselves as long as their test for infection is negative. It is very important that they strictly follow the regulations. Some biomarkers and specific tests are currently under investigation for their role in determination of prognosis in patients with COVID-19 are introduced below.[1,12]

Routine laboratory exams

Blood cell count

The white blood cell count may be normal or decreased in the early stage of COVID-19, while lymphocyte count is decreased. Both the absolute number of lymphocytes and the ratio of lymphocytes to white blood cells are reduced. The intensity of Covid-19 is inversely related to the number of lymphocytes with a decrease in the number of lymphocytes associated with an increase in mortality.[13,14]

Lactate dehydrogenase level (LDH)

Lactate dehydrogenase (LDH) is an important biomarker of interest, especially since elevated LDH levels have been connected to worse outcomes in patients with other viral infections in the past. The latest data in COVID-19 patients suggests that there is a significant difference in LDH levels between patients without severe disease. Elevated LDH levels related to the severe disease and increased mortality in patients with Covid-19. Although more studies are needed to confirm this results.[1,16]

Troponin

The results of various studies show that the high value of troponin with high sensitivity indicates a negative prognostic index associated with heart damage in patients with COVID-19. More than 20% of hospitalized patients with COVID-19 had myocardial injury. Higher rates of major complications, including cardiac arrhythmia, acute renal injury, ARDS, the need for mechanical ventilation, and death were observed in patients with high troponin levels. These data have been confirmed in more recent studies.[17,18]

ESR

Increased erythrocyte sedimentation rate (ESR) has been reported in confirmed patients with COVID-19. The increase in ESR levels continued for a long time even after the patient recovered from COVID-19, while all the results related to tumor, tuberculosis, rheumatic diseases, anemia, etc. could not explain the abnormal increase in ESR presented in this case. The available evidence cannot explain the exact increase in ESR, possibly linking abnormal pathological changes in some COVID-19 patients with a negative prognosis and providing a clue to the mechanism of progression of the disease in COVID-19 and its prognosis.[1,19]

Ferritin

Elevated blood levels of ferritin were observed in patients with severe COVID-19 compared with patients with non-severe symptoms. Therefore, serum ferritin levels were closely related to the severity of COVID-19. Ferritin is a key mediator of immune disarray especially under extreme hyperferritinemia, via direct immune-suppressive and pro-inflammatory effects, contributing to the cytokine storm. Many patients with diabetes show high serum ferritin levels and are known to have a higher risk of serious complications from COVID-19. Laboratory findings in patients with severe covid-19 confirm cytokine storm-compatible results, including high inflammatory markers such as high serum ferritin level which are associated with vital and life-threatening diseases.[1,20]

Magnesium

Recent findings indicate that hypermagnesemia is an important indicator of disease severity and adverse outcome in SARS-CoV-2 / COVID-19 infections. Patients with hypermagnesemia had significantly less oxygen saturation in room air (80%) than patients with normomagnesemia (87%). Patients with hypermagnesemia received significant dexamethasone and oxygen supplementation. Researchers recommend that serum magnesium be added to the panel of tests typically ordered to assess severe COVID-19 infection.[21]

CPK-mb or Creatine kinase-MB

Elevated levels of creatine kinase-MB (CK-MB) confirmed based on a number of published papers which were correlated with the severity of COVID-19 in patients. Several review articles have

Citation: Kalantar MH, Kalantar M. Common symptoms and joint tests between cardiovascular disease and coronavirus infection: Mini review. *J Cardiol Curr Res.* 2022;15(1):20–23. DOI: 10.15406/jccr.2022.15.00545

recently focused on the association of CK-MB levels with mortality risk in patients with Covid-19. However, the results obtained from various studies are contradictory.[8,9]

D-dimer

D-Dimer in a health blood plasma circulation as a product of fibrin degradation (fibrinolysis) is at low concentration. Since active blood coagulation, resulting in fibrinolysis, is associated with increased plasma D-dimer concentrations, it has been shown to be a clinically useful biomarker for thrombotic disease. The most well-known use of the D-dimer test in patients with suspected venous thromboembolism and its screaming is pulmonary embolism (PE) with increased D-dimer and is widely used to help rule out a diagnosis. New findings indicated that COVID-19 can may be associated with elevated D-dimer.[22,23]

Special joint tests

Brain natriuretic peptides (BNP)

Brain natriuretic peptide (BNP) or N-terminal pro brain natriuretic peptide (NPBP) in high concentration may be found in COVID-19 patients and which indicates a simultaneous dysfunction of the heart and a weaker clinical course. However, they are not specific for the simultaneous detection of CVD / HF in COVID-19. Also low levels of brain natriuretic peptides have a high negative predictive value and may eliminate simultaneous cardiac dysfunction.[4,24]

Markers of inflammation and thrombogenicity

Increased level of C-reactive protein, erythrocyte sedimentation rate, and other markers of inflammation and thrombogenicity such as ferritin, interleukin-6, lactate dehydrogenase, fibrinogen, and D-dimer observed in most patients. The increase in these markers is associated with high mortality. For lowering the risk of mortality and also to identify patients at increased risk of thromboembolic disease, markers of inflammation and the risk of thrombosis should be determined first and repeated every 2 to 3 days if when clinical condition worsens is suspected.[1,4]

Biomarkers of organ damage

Related laboratory and clinical parameters of sequential organ failure assessment (SOFA), was reported as a predictor of poor prognosis in COVID-19 patients. In addition to the increase in serum troponin an increase in serum transaminases and bilirubin, as markers of liver damage, myoglobin and creatine kinase, as markers of skeletal muscle injury, and serum creatinine, as a marker of renal impairment may be associated with COVID-19. Markers of organ injury should be determined at the time of hospitalization and during the clinical course when the patient's clinical conditions worsens.[1,4]

Supplementary exams

ECG

Heart damage is associated with more detrimental consequences in patients with Covid-19. All of these effects exacerbate heart damage and may be detected in different patterns on the electrocardiogram (ECG). So far, only a small number of patients have had a complete set of blood and ECG tests. Therefore, not all biochemical markers were included in the detection process. The correlation between ECG pattern change, increased troponin and LV function in echocardiography may help to better explain ECG changes in patients with COVID-19.[17]

Transthoracic echocardiography

COVID-19 patients with a history of CVD/HF may often show worsening heart function during the course of the disease due to infection-induced myocardial damage. Some patients without a history of heart disease may develop thickening and myocardial edema and decreased left ventricular systolic function. Therefore, echocardiography should be considered in all patients with CVD/HF and suspected COVID-19 to assess cardiac function.[1,4,6,7]

Lung ultrasound

Lung ultrasound (LUS) is useful for diagnosing and estimating pulmonary congestion and pulmonary infiltration. Of course, LUS images are considerably abnormal, making it difficult to detect CVD/HF and COVID-19. Bilateral B lines are common for CVD/HF and COVID-19. Compared to CVD/HF, the distinguishing features of COVID-19 are pleural line thickening and freezing. It should be noted that detecting these changes requires more skills than the standard LUS approach. Therefore, LUS can only be useful to rule out significant pulmonary involvement in patients suspected of having COVID-19 and CVD/HF infection.[4,25]

Coronary angiography, tomography scan, cardiac magnetic resonance imaging

Patients with COVID-19 and CVD/HF may sometimes show concomitant coronary artery disease. Coronary angiography indicators and intervention methods for coronary artery disease are suggested. In patients with suspected myocarditis, coronary angiography is recommended to rule out acute coronary syndrome. Magnetic resonance imaging of the heart may also be considered in COVID-19 patients with suspected cardiac involvement. Endomyocardial biopsy may be limited to severe or refractory CVD/HF cases, and histological diagnosis may influence treatment decisions.[1,4,26]

Differential diagnosis

Differences between new-onset CVD/HF and COVID-19 are very important. It is noteworthy that the symptoms of shortness of breath (dyspnoea), cough and fatigue are properly differentiated between the two diseases. Some cases need further investigation, including patients who have had epidemiological contact or people with fever and respiratory symptoms, features of chest X-ray and/or CT-19 imaging, normal or decreased white blood cell count in the early stages, decreased lymphocyte count, positive for nucleic acid Virus or gene sequencing should be considered for COVID-19. In cases where Covid-19 infection is associated with myocardial injury or underlying cardiovascular disease, it can be detected by echocardiography through a variety of methods, including signs, symptoms, biomarkers, as well as structural and functional abnormalities of the heart. It should also be distinguished from other lung diseases, pulmonary embolism, pericardial disease, severe anemia, and the other cases.[27,28]

Conclusion

New challenges were posed by the prevalence of COVID-19 worldwide for physicians and people around the world through the communities. Cardiovascular diseases are common in patients with COVID-19 or with CVD/HF who are prone to infection. Therefore, it is necessary for this group of patients to take careful preventive measures. In addition, CVD/HF patients are at higher risk of serious complications after contracting any type of infection, and therefore will experience more severe illness and mortality if they develop COVID-19 infection. The recent research results show that myocardial damage, heart disease and cardiac arrhythmias are observed during COVID-19 infection. Tracing symptoms and conflict with COVID-19 infection is important in any hospitalized CVD/HF patient who is hospitalized because symptoms may overlap significantly. Due to the expansion of research and scientific results, it should be emphasized that the existing recommendations are mainly based on the current

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epidemic of the disease and due to the significant changes in the signs and symptoms of COVID-19 infection around the world need constant updating. To be more confident, specialists should consider the routine laboratory examinations and specialized tests mentioned in this article as specific joint tests to ensure the safety of all patients.

Acknowledgment

None.

Conflicts of interest

The authors report no conflicts of interest regarding this work.

Funding

None.

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