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Myocardial Injury as a Consequence of Coronavirus Disease 2019

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Abstract: ***COVID-19 which is caused by Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2),and the situation has reached pandemic levels. Mortality and Morbidity have increased with covid-19 disease. People with underlying cardiovascular issues, have more mortality rate. The symptoms would include fever, cough etc., for COVID-19 infected patients. In this paper we will talk about myocardial Injury as a complication of coronavirus infected disease, and also other cardiovascular complications that could arise. We reviewed some research studies on cardiovascular issues form COVID-19.***

Keywords: COVID-19, Cardiovascular Issues, Myocardial Injury

1. Introduction

In December 2019 an unknown aetiology has been reported in Wuhan China [1] , and it is named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by WHO and the illness caused by virus is named as coronavirus disease 2019 (COVID-19) [2]. The virus has spread all over the world and caused the pandemic and public emergency. The disease has spread rapidly from Wuhan to other geographical areas and countries. SARS-CoV-2 has similarity to coronavirus family, it is 80% similar to SARS-CoV and 50% similar to middle east syndrome coronavirus (MERS-CoV). Around 200 countries have confirmed more than 2 million cases so far and the number keeps going up.The name coronavirus is given to it for its spikes on its surface which looks like a crown and they belong to coronavirinae subfamily. This is classified into four different groups α, β, γ, and δ CoVs by phylogenetic clustering, and α, β types of CoV cause human infections [8].Coronavirus has four structural proteins The spike looking protein also called S protein, the nucleocapsid N protein, the membrane protein (M) , and the envelope protein also identified by E protein.

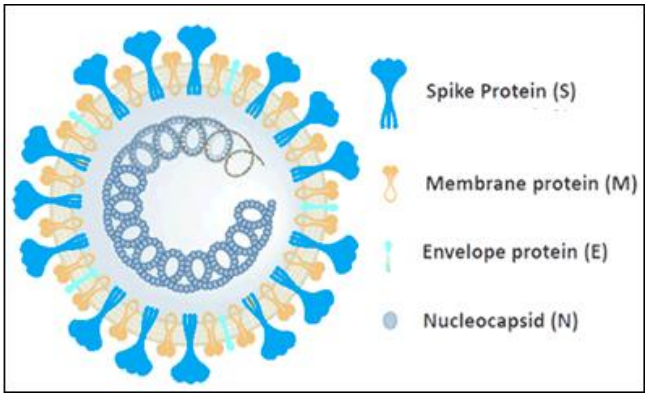

Figure 1: Coronavirus Proteins [13]

The coronavirus first infected humans in 1960s and there are only two types of species present until 2003, but as of today there are seven different types of coronaviruses, and among them severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East Respiratory Syndrome coronavirus (MERS-CoV), and newly identified SARS-CoV-2 could cause respiratory issues in humans and these are the latest identified viruses. Direct or indirect contact with mouth or anywhere on the face, and by touching surfaces that are contaminant is the source of infection occurrence. The common main symptoms of this disease are cough, fever, fatigue etc. Most of the people recovered from the disease but some ill patients reported to high risk of multiorgan failure and death. It is also reported that some people have reported heart failure, myocardial injury.

In the patients who are admitted into hospitals due to COVID-19 pneumonia are in ICU,and some of them are dead and have developed heart failure, arrhythmia and myocardial injury and the percentage of people who are affected with the mentioned issues are 52%,44% and 56% respectively. Early diagnosis in patients who already have cardiovascular issues is important to prevent severity in them. There are several studies that supports mortality in patients who has covid-19 due to cardio issues. COVID-19 can possibly trigger acute myocardial infraction due to rupture of plaque, hypercoagulability with development of microthrombi [6]. In the patients who are old age will have less resistance an are more likely to develop heart issues and respiratory issues. Some studies have supported that patients with preexisting cardiovascular issues has a risk three times more to develop heart issues and respiratory issues, which says that the association between cardiovascular damage and pneumonia is bidirectional [7]. SARS-CoV and SARS-CoV-2 has similarity to each other phylogenetically, could bind to vascular endothelial cells and cardiomyocytes. This was due to ACE2 (angiotensin-converting enzyme 2) identified by spike of protein of SARS-CoV-2 and so gets an entry to virus. This type viral infection which is direct could cause heart damage which causes endothelial dysfunction.

Severe Acute Respiratory Syndrome Coronavirus and Severe Acute Respiratory Syndrome Coronavirus-2:
In 2002 the first SARS-CoV outbreak started in China and is originated from sea animals from markets in China. After that similar viruses like SARS-CoV-2 has been identified in raccoon dogs which is 99.8% similar to human SARS-CoV. SARS-CoV-2 belongs to β-CoVs group and contains ACE2, which is a surface molecule that is on endothelial cells of veins. respiratory tract, and small intestine and immune cells to enter the host [9].Some studies also proved that this virus

has originated in bats which is about 87% similar to SARS-CoV and it is also believed that raccoon dogs acted as intermediated source for the virus to transmit into humans [10]. The incubation period of this virus is 2 to 10 days after getting exposed to virus. The transmission of this virus could be from any of the ways like touching the infected surfaces or people and touching your face, and infection could get to you through your nose, mouth eyes. The ability to get the infection from an infected person is measured by RO. The RO for SARS-CoV is 3, that means one infected person can infect three other people [11].

SARS-CoV: The receptor for SARS-CoV is ACE2 and the incubation period is 2 to 11 days, and RO is measured to 3 for this virus. The prevalence of cardiovascular in the SARS-CoV infected patients is 10%.

MERS-CoV: The receptor for MERS-CoV is DPP4 and the incubation period is 2 to 13 days, and RO is measured to be 2 to 5 for this virus. The prevalence of cardiovascular in the MERS-CoV infected patients is 30%.

SARS-CoV-2: The receptor for MERS-CoV is ACE2 and the incubation period is 2 to 14 days, and RO is measured to be 2 to 3 for this virus. The prevalence of cardiovascular in the MERS-CoV infected patients is upto 40%.

On dec 2019, pneumonia clusters were reported in china at first by local health facilities which are later linked to sea animals' market in China, Wuhan. And on January the virus is named as SARS-CoV-2 and is identified as reason for this viral pneumonia. Later this viral disease was named as covid-19 [12].

2. Cardiovascular issues -Myocardial Injury and other Issues

Studies have shown that cardiovascular issues are common comorbidities in COVID-19 infected patients. Author [14] has a study on 144 patients who are infected with SARS and it was identified that prevalence of cardiac disease, and cancer were 8% and 6% respectively. And in MERS with a study on 637 patients for about 12 studies CVD is present in for about 30% of the total number of patients [21]. As we can see there is high percentage of people who are infected with MERS have CVD than SARS, this is due to the fact that the patients infected in MERS are of median age 50 years to that of SARS 39 years. [20] Author had done a study on patients of number 99 and their median age is around 40 to 65 years and 40% of them were to have cardiovascular issues.

With SARS and MERS cardiovascular disease is considered as common comorbidity for both.[15] has reported that around 57 people of 416 patients infected with covid-19 died due to cardiovascular issues. And it was reported that around 4% of these people had heart failure, 10.6% had coronary heart disease. hs-TNI is greater than higher reference limit for around 20% of the patients and they had cardiac injury. An these patients who had elevated levels of hs-TNI are older in age also had other comorbidities and high levels of leukocytes. Patients with cardiac injury had higher incidence of ARDS and also high mortality rate.Another author [16] has studies for about 127 patients who are affected with covid-19 and are hospitalized in China. It was fund that around 35% had cardiovascular issues, and acute myocardial injury was found in 28% of the patients. Mortality is high in patients who had high TnT levels and also it was noted that these group of people are men and of older age, and also have high comorbidities like hypertension, heart issues and kidney issues. [17] Author did a study on 138 patients with a median age of 42 to 68 years and 25% of the people who are in ICU had cardiovascular disease and 10.8% of the patients who are in non -ICU had cardiovascular issues. There are also other comorbidities seen in patients for about 43% of the people had hypertension and 14% had diabetes.[18] This author did a study on 41 patients and their median age is around 41-58 years and 15% of the patients had cardiovascular disease.[24] Author did a research on patient infected with coronavirus in china, and this study is based on 201 patients and 4% of them reported to have cardiovascular issues.[25] author did a study on 187 patients affected by covid-19 in China and 11.2% of the patients are reported to have cardiovascular issues.

[26] did a study on patients in USA and a group pf 7162 patients were taken into consideration for study and about 9% were reported to have cardiovascular issues.

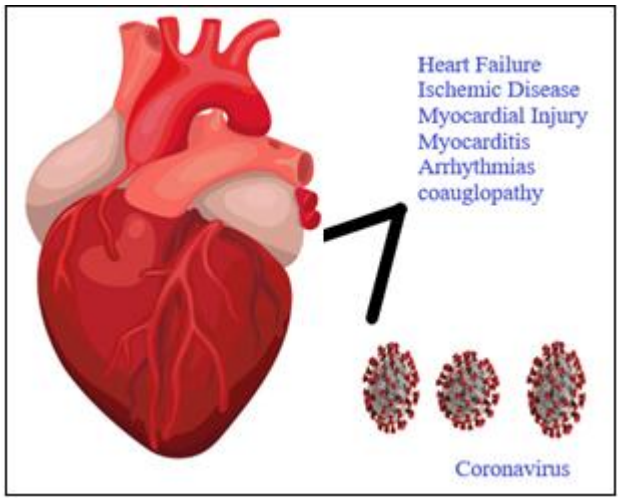

Figure 2: Cardiovascular issues that arise due to Coronavirus

Acute myocarditis: The manifestations in covid-19 patients are, Elevation of myocardial biomarkers levels. Myocardial oedema, ventricular hypokinesis and echocardiography's late gadolinium enhancement or otherwise magnetic resonance imaging. Inflammation of myocardial and genome of SARS-CoV-2 are confirmed by autopsy. [27]

Myocardial injury: The incidence rate in patients is 7% to 40%. The manifestations in covid-19 patients are, Elevation of myocardial biomarkers levels, and there are no particular change on electrocardiography and echocardiography [28].

Stroke: The incidence rate of stroke among patients is 25%. And the manifestations in covid-19 patients are Hemiplegia, lesion infracted on tomography, facial weakness [15].

Cardiac arrest: The incidence rate of cardiac arrest among patients is 7 to 11%. And the manifestations in covid-19

patients are sudden demise, Ventricular tachycardia which lasts more than 30s or ventricular fibrillation on electrocardiography [16].

Acute Heart Failure: The incidence rate of cardiac arrest among patients is 19.4 to 52%. And the manifestations in covid-19 patients are NT-pro BNP levels elevation, radiography in chest, pulmonary oedema, left ventricular fraction reduction on echocardiography [15].

3. Myocardial Injury

Myocardial Injury applies to any person who has at least one cardiac troponin concentration above 99th percentile upper reference limit. Cardiac biomarkers of elevated levels are identified in patients with COVID-19, particularly in patients with severe conditions [23]. The patients who has covid-19 even though they don't have any respiratory issues, they had cardiac issues [22]. Myocardial Injury is defined as cardiac biomarkers at elevated levels, and 5 out of 41 patients were having myocardial injury in patients infected with covid-19 in Wuhan. This issue is more evident in patients who are in ICU than compared to non-ICU patients.

[15] and [16] reported that patients with covid-19 are associated with myocardial injury which means they have elevated levels of TnI or TnT. Patients who are at risk of myocardial Injury are of older age and have high prevalence of hypertension, heart failure, and diabetes. There are also other issues seen in patients like inflammation, which includes greater leukocyte counts and c-reactive protein at high levels and procalcitonin and other biomarkers which cause myocardial injury and stress. Patients who are infected with covid-19 and has myocardial injury have high acuity, and also acute respiratory distress syndrome. Some clinical studies were done on people with myocardial injury an author [29] did a study on 138 patients in Wuhan China and 10 out of 138 people which is 7.2% have suffered myocardial injury, out of which 22 % are ICU patients and 2% are non-ICU patients with myocardial injury. And TNI levels are 11 inn ICU patients and 5.1 non -ICU patients. Another author [30]. who did a study on 191 patients and the mortality rate is seen as 28%, among which 24 patients out of 145 patients which is 16.6% has myocardial injury which means they have elevated hs-Tnl levels above the 99th percentile or they have abnormalities on echocardiography and among these patients 46% are non survivors and 11% are survivors.hs-Tnl levels are 22.2 in non survivors and 3 with survivors.

Another author [31] did a study on 112 number of patients in Wuhan, China and the mortality ratee is 12.5% and 42 out of 112 patients which is 37.5%. Peak Tnl and NT pro BNP levels are present HR 8.9 for the risk of death. Tnl levels are 0.10 vs 0 in severe vs non severe patients. NT- pro BNP levels are seen as 1142 in severe patient's vs 101.9 in non-severe patients. Electrocardiography levels are seen as 19.6% and 29.5% tachycardia in all paternal abnormalities are explained by conditions that are underlying apart from a small amount of pericardial effusion. The author [32] did a study on 150 patients and 22 out of 150 people have suffered myocardial injury which is about 14.5% .TnI levels are 68.5 in severe and 4.5 in non-severe patients. NTpro BNP levels are seen as 1030 in severe patients and 83 in non-severe patients.

Two Chinese cohorts were studied with the association of myocardial injury and the patients are rapidly escalating with the cardiovascular issues. primary issues were notes as respiratory issues and nor all the people had cardiac issues like echocardiography, coronary angiography. Patients who has atherosclerotic cardiovascular disease along with long term coronary artery disease had a high risk of developing acute coronary syndrome infections which has been shown before in clinical studies like influenza [32] and also acute inflammatory infections. The coronary events that are acute could cause severe myocardial damage that is triggered by infection that can participate in infraction or myocardial injury. Alsoduring a severe systemic inflammatory stress, the cytokines that are released could lead to atherosclerotic plaque rupture and instability.SO patients who are of older age have cardiovascular issues and they are more susceptible of adverse outcomes during severe inflammatory responses to covid-19 than individuals with out cardiovascular issues or younger ones. Along with that acute myocarditis is also expected to happen with middle east respiratory syndrome and so might also happen with SARS-CoV-2 as they have same pathogenicity.

4. Conclusion

Patients who are affected with covid-19 and who already have cardiovascular issues, are facing more mortality than others. So its good to check the websites of US center for disease control and prevention for guidance, and tips on taking care. There are lot of researches who are actively working on finding vaccines and medications for COVI-19, while they work on that its our responsibility to keep ourselves and others who are around us.

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