Literature Review

# Cardiac Complications in Corona Group of Viruses, SARS-CoV, MERS, SARS- CoV2

Berina Divanovic*, Danica Bjelica[1]

1.Danica Bjelica, Polyclinic Hera, Internal Medicine Specialist, Subspecialist Oncologist.

***Corresponding Author: Berina Divanovic**, Polyclinic Mojlab, Cardiology Specialist.

**Received Date:** April 24, 2021

**Publication Date:** May 01, 2021

## Abstract

*While the whole world is affected by the corona disease 2019 (COVID-19) pandemic it is very important to point out complications in an organism caused by Severe Acute respiratory syndrome coronavirus (SARS-CoV2). The novel virus, from the same group as Severe Acute respiratory syndrome coronavirus (SARS) and the Middle East respiratory syndrome (MERS) for a consequence also has cardiac complications. Many studies throughout the years proved, that besides the respiratory organs corona group of viruses has also effects on the heart. With an emerging number of causes reported we can see a similar pattern in SARS-CoV2. The objective of this review was to collect data from many studies and to show the occurrence of cardiovascular complications. What we noticed was that the cardiac complications that occurred in all three coronavirus groups were approximately similar. We can confirm that hypotension happened more in SARS, unlike hypertension, which was more prevalent in the other two coronavirus groups. As each patient is an individual, so the outcome of the cardiac complications in each coronary virus group was different. Through this review, it has been confirmed that the presence of comorbidity has a negative effect on the further course of the disease, especially when associated with cardiovascular complications.*

***KEYWORDS**: Coronavirus, SARS, MERS, SARS-CoV2, cardiac complications.*

## Introduction

The aim of this literature review is to describe the complications of the various types of different coronaviruses on the heart. Coronaviruses are enveloped RNA viruses. The diseases that they cause can be of varying degrees, from the common cold to fatal pneumonia. In 1930, numerous coronaviruses were detected in animals and 7 were detected in humans. In the 21st century, three of the 7 coronaviruses cause sometimes fatal, respiratory infections in humans than other coronaviruses and have caused major outbreaks of deadly pneumonia **(**1**)**.

Severe Acute respiratory syndrome coronavirus (SARS-CoV) was first detected in November 2002 in the Guangdong province of China and subsequently spread to more than 30 countries. During the SARS epidemic, 8098 infected patients were recorded, and 774 patients died with a potential of disease recurrence **(**2, 3**)**.

Middle East respiratory syndrome coronavirus MERS-CoV described in September 2012 in Saudi Arabia. In 2015 occurred in the Republic of Korea, as the largest known outbreak. More than 2,200 cases of MERS-CoV have been reported to the World Health Organization, with more than a third resulting in death **(**4**)**.

SARS-CoV2 appeared in late 2019 in Wuhan, China, which is the cause of coronavirus disease 2019 (COVID-19). A novel coronavirus spread worldwide and has become a pandemic **(**5**)**.

## Cardiac Complications in SARS

The impact of SARS on cardiovascular complications has not been deeply investigated. Alexander et al. and Small et al. showed that SARS has an effect on rabbits, resulting in acute and chronic heart failure. Since rabbits are most similar to human organisms this could be linked with the human strain of coronavirus **(**6, 7**)**. The study conducted by Yu et al. comprised 121 patients diagnosed with SARS. Hypotension, bradycardia, tachycardia, cardiac arrhythmia, and cardiomegaly were detected as cardiovascular complications. Of the total subjects, 61 patients (50.4%) experienced significant hypotension during the whole hospitalization period. During the first week, hypotension was noticed in most cases, 34 patients (28.1%). Echocardiography was performed during hypotension and showed mild global hypokinesia and the ejection fraction was 48%. Tachycardia was detected in 87 (71.9%) patients. During tachycardia, five patients complained of palpitations, and atypical chest pain had four patients. And in one patient, symptomatic tachycardia with palpitation was reported, which worsened in exertion. At follow-up, tachycardia was present in 40% of patients and was the most common condition. Sinus bradycardia was observed in 18 (14.9%) patients. Hypotension was observed in several patients with

bradycardia between the first and third week. Regarding cardiac arrhythmia, one patient experienced transient paroxysmal atrial fibrillation eight days after hospitalization. The arrhythmia lasted one day and disappeared spontaneously without treatment. Previously, the patient had no record of heart disease. Cardiomegaly was detected in 13 (10.7%) patients during hospitalization. It was observed that cardiovascular complications were not associated with the occurrence of desaturation or admission to the intensive care unit. Moreover, from 25 patients who had chronic diseases, 12 of them could be linked to cardiovascular causes **(**8**)**.

Yu et al. and Alexander et al. presented that in electrocardiography there is an inversion of the T-wave in front of the anterior thoracic leads from V1 to V4. T-wave inversions associated with coronary artery disease. Deeper T-wave inversions in the right to mid- precordial lead V1 to V4 is the most specific ECG finding seen in the pulmonary embolism patient. From there, patients with dilated cardiomyopathy may have symptoms of acute pulmonary edema, symptoms of systemic or pulmonary embolism, and sudden cardiac death **(**8, 9**)**.

Lau et al. identify in their study, which included 100 patients, observed a four-fold increase in the co-virus antibody titter for SARS. From the total number, 15 patients on resting ECG had a resting heart rate of 90 to 109 beats per minute (BPM). Holter ECG recorded a heart rate faster than 100 BPM during the day (9:00 - 21:00), but not during the night. The underlying causes of tachycardia are deconditioning and anxiety state, in the absence of significant cardiac, pulmonary, thyroid, and hematological dysfunction **(**10**)**.

## Cardiac Complications in MERS

Al-Abdi et al. included patients who had MERS between 26 to 78 years, and 63% were male and were admitted to a referral hospital in Riyadh, Saudi Arabia, from 1 August 2015 to 31 August 2016. In their study was described that death was associated with older age ($p<0.001$), diabetes mellitus (DM) ($p = 0.001$), hypertension ($p<0.001$), cardiac disease ($p = 0.001$), or renal disease ($p = 0.001$) **(**10**)**.

Alanazi et al. showed in the study that DM, hypertension, and chronic obstructive disease have been found to occur frequently in patients infected with MERS-CoV. It was noted that 15 patients with hypertension had concomitant DM. In 10 patients who had cardiovascular disease, five patients had coronary disease, four patients had a stroke, and three patients had a cardiac arrest. From three patients who had heart failure, one patient had coronary artery disease and one patient who had a stroke. It was noted that age was associated with the presence of DM. Also, it was reported that sex was not significantly associated with DM, hypertension, or cardiovascular disease **(**11**)**.

Similar information obtained from Alqahtani et al. where they proved that common underlying conditions associated with the death of MERS-CoV-infected patients: DM, hypertension, heart disease, renal disease, and bronchial asthma. According to this study, an increased risk of death was presented in patients with few comorbidities **(**12**)**.

In the other study, Assiri et al. reported that most patients (45 [96%]) had DM (32 [68%]), hypertension (16 [34%]), chronic heart disease (13 [28%]), and chronic kidney disease (23 [49 %]). From the total 47 patients, only two were previously healthy **(**13**)**.

Alraddadi et al. showed that primary MERS-CoV infection was associated with DM, chronic lung disease, heart disease, and smoking. It was noted that from 30 patients, one was female with primary infection and the rest were males. The fact that men in Saudi Arabia have more contact with dromedaries' camels than women, might explain this observation. We should mention that their study supports a link between contact to dromedary camels and human MERS-CoV illness, and risk factors, such as heart disease, DM and smoking **(**14**)**.

## Cardiac Complications in SARS-CoV-2

SARS-CoV-2 causes the disease by the same mechanism as the SARS coronavirus, resulting in damage to vital organs such as the lungs, heart, liver and kidneys. The leading cause of child mortality affected by SARS-CoV-2 is pneumonia **(**15**)**.

Qiu et al. reported that 661 cases by March 1, 2020, of which 36 were children, during the COVID-19 examination. One of the characteristics of COVID-19 is that affects several vital organs like the lungs and heart, resulting in increased amounts of myocardial enzymes, like serum creatine kinase concentrations (11 [31%]). Unlike adults, hypertension, cardiovascular disease and DM are rare in children **(**16**)**.

Huang et al. published that in Wuhan 41 patients were confirmed on 2019-nCoV infection. In the study, the average age was between 25 and 49 years old. From the total number of patients, there were 20 [49%] patients and 14 (34%) patients between 50 and 64 years old, respectively. Also, males were most infected (30 [73%]); and less than half had underlying diseases (13 [32%]), including DM (eight [20%]), hypertension (six [15%]), and cardiovascular disease (six [15%]). In five patients, troponin I (hs-cTnI) was diagnosed with a virus-related cardiac injury diagnosis. The cardiac complication that occurred was acute cardiac injury (five [12%] patients) **(**17**)**.

Li et al. in their study included 1527 patients with COVID-19 where they studied the incidence of CVD and reported a prevalence of hypertension, heart and cerebrovascular disease and DM of 17.1%, 16.4% and 9.7%, respectively. It concluded that patients with earlier cardiovascular metabolic diseases may face a greater risk for developing severe conditions and comorbidities. The prognosis of COVID-19 can be affected by comorbidities and at the same time, COVID-19 can, in turn, exacerbate heart damage **(**18**)**.

COVID-19 infection can be predisposed to exist cardiovascular disease (CVD). Therefore, patients with CVD have an increased risk of adverse outcomes, and cardiovascular complications are associated with infection, and that was showed by Li et al., Zheng et al. and Zhou et al. in their studies **(**18-20**)**.

Porcheddu et al. have presented 888 cases of SARS-CoV-2 infections in Italy. In their study, they described similar mortality rates and an increased risk of death for patients with heart comorbidities. Also, they have shown case fatality rates in China and Italy were identical at 2.3 **(**21**)**.

Govaert et al. and Liu et al. in their studies showed that one of the strongest risk factors for CVD is age, so its sensitivity can be very important for the seriousness of COVID-19. Moreover, this can be seen in the impact of old age on the immune system in patients over 65 years who receive the flu vaccine **(**22, 23**)**.

In the following studies Zidar et al., Libby et al., Tall et al., Saltiel et al. described CVD risk factors such as DM and hyperlipidemia, which affect immune function, and also contributing to the increased CVD risk **(**24-27**)**.

An analysis by Kwong et al. showed that the patients who had acute respiratory infection resources were at higher risk for the subsequent development of acute myocardial infarction after influenza (incidence ratio [IR] 6.1, 95% CI 3.9-9.5) and after non-influenza viral diseases, including other types of coronaviruses (IR 2.8, 95% CI 1.2-6.2) **(**28**)**.

There are also reports of a case of COVID-19 infection among patients undergoing cardiac transplantation described in studies Liu et al. and Aslam et al. Two patients with heart transplantation in China with symptoms typical for COVID-19. Both have given up immunosuppressive regimens and have been aggressively treated with a high dose of steroids, intravenous immunoglobulin, and antibiotics. There was no evidence of allograft rejection and both patients survived **(**29, 30**)**.

Ruan et al. and Yang et al. in their studies showed that in many cases infected with COVID- 19, have been elevated serum troponin levels, as the result of cardiac injury. In the laboratory of Jin, Yin-tan

Hospital has measured serum concentration of hypersensitive cardiac troponin I (hsTNI). It was recorded above the upper limit of the reference range (>28 pg/mL). **(**31, 32**)**.

Ruan et al. presented that of the 150 patients with COVID-19, among 68 deaths, 7% were attributed to myocarditis with interruption of circulation, and in 33% of cases, myocarditis had a significant impact on patient's death **(**31**)**.

Liu with colleagues described the among 137 patients with COVID-19 the major symptoms were fever, coughing and myalgia or fatigue. It was noted that some patients developed initial symptoms in the cardiovascular system. Also, patients with fundamental cardiovascular diseases often demonstrated heart failure. Besides that, palpitations of the heart were observed in 7.3% of patients in the cohort **(**33**)**.

The manifestations of cardiac arrhythmias and cardiac arrest have also been described in patients with COVID-19 infection. Wang et al. informed of 138 patients in the Chinese COVID-19 positive cohort. Of the total number of patients, 26% required ICU care (Intensive Care Unit), 34.1% were discharged, 6 died (4.3%), and 61.6% remained hospitalized. Arrhythmia and shock were major complications during hospitalization. It was noted that cardiac arrhythmia in 16.7% of patients was more common in patients who underwent ICU versus non-ICU patients (44.4% vs. 6.9%) **(**34**)**.

Yeming et al. found that 41 patients were positive for 2019-COV. Most patients with confirmed infection were men (30 [73%]). Less than half of the patients had underlying disease (13 [32%]), including DM (eight [20%]), hypertension (six [15%]), and cardiovascular disease (six [15%]). A total number of 41 patients were reported that they have pneumonia with abnormal findings on chest CT. Complications that occurred were acute respiratory distress syndrome (12 [29%]), anaemia (six [15%]), acute cardiac injury (five [12%]), and secondary infection (four [10%]) **(**17**)**.

Hua and colleagues reported a case in a patient with life-threatening tamponade who was positive for SARS-CoV2, a 47-year-old female patient who reported in March 2020. She has previously been diagnosed with myopericarditis. In 2017, an angiogram was performed, showing undisturbed coronary arteries. At the admission, she was breathless with chest pain and shortness of breath, had dry cough and fever (36.9° C) hypotensive (80/50 mmHg). ECG showed tachycardia (110 b.p.m.) and concave inferolateral elevation of ST. Troponin T levels were 225 and 253 ng / Left Pulmonary congestion was seen on X-ray chests. Troponin T levels were 225 and 253 ng / L, respectively. Normal left ventricular function and global pericardial effusion with a maximum depth of 1.1 cm and no tamponade were seen on echocardiography. The finding of the nasopharyngeal swab was negative for viral respiratory pathogens except for SARS-CoV2**(**35**)**.

Sala et al. described a 43-year-old woman who had chest pain and dyspnea. Firstly, the dynamic 3D reconstruction of the volume suggested a reverse pattern of Tako-Tsubo syndrome (TTS). There was observed hypokinesia of the middle and basal segments of the left ventricle with normal apical contraction. Further studies found that the concluding diagnosis was acute viral-negative lymphocytic myocarditis related to respiratory infection with SARS-CoV-2**(**36**)**.

Sulemane et al. published a case with a 60-year-old man, who was positive SARS-CoV-2. Early on he had hypertension and hypercholesterolemia, elevated troponin I of 593 ng/L and C-reactive protein of 360 mg/L, D-dimer levels were elevated at 32 228 ng/L, and in patients was showed the presence of McConnell's and 60/60 sign, and both signs are sensitive markers for acute pulmonary embolism. Furthermore, they found a small, highly mobile mural thrombus within the right ventricle-free wall. CT pulmonary angiogram was performed and described the presence of multiple filling defects in the inferior lingula, and in the segmental pulmonary artery branches to the lateral segment of the right middle lobe**(**37**)**.

## Conclusion

To sum up, according to different studies conducted earlier it is evident that cardiac complications in the corona group of viruses were presented and were approximately similar in those three groups. In patients with SARS, tachycardia was the most common cause of cardiac complications. Hypotension was presented in patients with SARS, on the other hand, hypertension was noted in patients diagnosed with MERS and COVID-19. In those three groups of coronaviruses complications like cardiac arrhythmia, and cardiomegaly were presented in few cases. Moreover, DM as leading comorbidity was described in many studies. Furthermore, cardiac arrhythmia, myocarditis, and pulmonary embolism were linked with those three types of coronaviruses. COVID-19 pandemics still affect almost all countries worldwide. The rapid increase in the number of cases could bring us more fatalities, therefore it is important to observe and document links with chronic diseases and their symptoms. Follow-up studies and more specific information would be needed in order to describe the effects of a group of coronaviruses on cardiac diseases, and vice versa.

## References

1.Hudson CB, Beaudette FR. "Infection of the cloaca with the virus of infectious bronchitis". Science. 1932;76(1958):34-.

2.Enserink M. “The big question now: Will it be back?” : American Association for the Advancement of Science; 2003.

3.Boulos MNK. “Descriptive review of geographic mapping of severe acute respiratory syndrome (SARS) on the Internet”. International journal of health geographics. 2004;3(1):2-.

4.Al-Omari A, Rabaan AA, Salih S, Al-Tawfiq JA, Memish ZA. “MERS coronavirus outbreak: Implications for emerging viral infections”. Diagnostic microbiology and infectious disease. 2019;93(3):265-85.

5.Du Y, Tu L, Zhu P, Mu M, Wang R, Yang P, et al. “Clinical features of 85 fatal cases of COVID-19 from Wuhan: A retrospective observational study”. American Journal of Respiratory and Critical Care Medicine. 2020(ja).

6.Alexander LK, Small JD, Edwards S, Baric RS. “An experimental model for dilated cardiomyopathy after rabbit coronavirus infection”. Journal of Infectious Diseases. 1992;166(5):978-85.

7.Small JD, Aurelian L, Squire RA, Strandberg JD, Melby Jr EC, Turner TB, et al. “Rabbit cardiomyopathy associated with a virus antigenically related to human coronavirus strain 229E”. The American journal of pathology. 1979;95(3):709.

8.Yu CM, Wong RSM, Wu EB, Kong SL, Wong J, Yip GWK, et al. “Cardiovascular complications of severe acute respiratory syndrome”. Postgraduate Medical Journal. 2006;82(964):140-4.

9.Alexander LK, Keene BW, Small JD, Yount B, Baric RS. “Electrocardiographic changes following rabbit coronavirus-induced myocarditis and dilated cardiomyopathy”. Coronaviruses: Springer; 1994. p. 365-70.

10.Al-Abdely HM, Midgley CM, Alkhamis AM, Abedi GR, Lu X, Binder AM, et al. “Middle East respiratory syndrome coronavirus infection dynamics and antibody responses among clinically diverse patients, Saudi Arabia”. Emerging Infectious Diseases. 2019;25(4):753.

11.Alanazi KH, Abedi GR, Midgley CM, Alkhamis A, Alsaqer T, Almoaddi A, et al. “Diabetes Mellitus, Hypertension, and Death among 32 Patients with MERS-CoV Infection, Saudi Arabia”. Emerging infectious diseases. 2020;26(1):166-8.

12.Alqahtani FY, Aleanizy FS, Mohamed RAEH, Alanazi MS, Mohamed N, Alrasheed MM, et al. “Prevalence of comorbidities in cases of Middle East respiratory syndrome coronavirus: a retrospective study”. Epidemiology & Infection. 2019;147.

13.Assiri A, Al-Tawfiq JA, Al-Rabeeah AA, Al-Rabiah FA, Al-Hajjar S, Al-Barrak A, et al. “Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: a descriptive study”. The Lancet infectious diseases. 2013;13(9):752-61.

14.Alraddadi BM, Watson JT, Almarashi A, Abedi GR, Turkistani A, Sadran M, et al. “Risk factors for primary Middle East respiratory syndrome coronavirus illness in humans, Saudi Arabia, 2014”. Emerging infectious diseases. 2016;22(1):49.

15.Dagan R, Bhutta ZA, de Quadros CA, Garau J, Klugman KP, Khuri-Bulos N, et al. “The remaining challenge of pneumonia: the leading killer of children”. The Pediatric infectious disease journal. 2011;30(1):1-2.

16.Qiu H, Wu J, Hong L, Luo Y, Song Q, Chen D. “Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study”. The Lancet Infectious diseases. 2020.

17.Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China”. The Lancet. 2020;395(10223):497- 506.

18.Li B, Yang J, Zhao F, Zhi L, Wang X, Liu L, et al. “Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China”. Clinical research in cardiology : official journal of the German Cardiac Society. 2020.

19.Zheng Y-Y, Ma Y-T, Zhang J-Y, Xie X. “COVID-19 and the cardiovascular system”. Nature reviews Cardiology. 2020;17(5):259-60.

20.Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. “Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study”. The Lancet. 2020;395(10229):1054-62.

21.Porcheddu R, Serra C, Kelvin D, Kelvin N, Rubino S. “Similarity in Case Fatality Rates (CFR) of COVID-19/SARS-COV-2 in Italy and China”. Journal of infection in developing countries. 2020;14(2):125-8.

22.Govaert TM, Thijs CT, Masurel N, Sprenger MJ, Dinant GJ, Knottnerus JA. “The efficacy of influenza vaccination in elderly individuals. A randomized double-blind placebo- controlled trial”. JAMA. 1994;272(21):1661.

23.Liu WM, van der Zeijst BAM, Boog CJP, Soethout EC. “Aging and impaired immunity to influenza viruses: Implications for vaccine development”. Human Vaccines. 2011;7(sup1):94-8.

24.Zidar DA, Al-Kindi SG, Liu Y, Krieger NI, Perzynski AT, Osnard M, et al. “Association of Lymphopenia With Risk of Mortality Among Adults in the US General Population”. JAMA Netw Open. 2019;2(12):e1916526.

25.Libby P, Ridker PM, Hansson GK. “Inflammation in atherosclerosis: from pathophysiology to practice”. J Am Coll Cardiol. 2009;54(23):2129-38.

26.Tall AR, Yvan-Charvet L. “Cholesterol, inflammation and innate immunity”. Nature reviews Immunology. 2015;15(2):104-16.

27.Saltiel AR, Olefsky JM. “Inflammatory mechanisms linking obesity and metabolic disease”. The Journal of clinical investigation. 2017;127(1):1-4.

28.Kwong JC, Schwartz KL, Campitelli MA, Chung H, Crowcroft NS, Karnauchow T, et al. “Acute Myocardial Infarction after Laboratory-Confirmed Influenza Infection”. The New England Journal of Medicine. 2018;378(4):345-53.

29.Li F, Cai J, Dong N. “First Cases of COVID-19 in Heart Transplantation From China”. The Journal of Heart and Lung Transplantation. 2020.

30.Aslam S, Mehra MR. “COVID-19: Yet another coronavirus challenge in transplantation”. The Journal of heart and lung transplantation : the official publication of the International Society for Heart Transplantation. 2020:S1053-2498(20)31468-6.

31.Ruan Q, Yang K, Wang W, Jiang L, Song J. “Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China”. Intensive care medicine. 2020.

32.Yang X, Yu Y, Xu J, Shu H, Xia Ja, Liu H, et al. “Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study”. The Lancet Respiratory medicine. 2020.

33.Liu K, Fang Y-Y, Deng Y, Liu W, Wang M-F, Ma J-P, et al. “Clinical characteristics of novel coronavirus cases in tertiary hospitals in Hubei Province”. Chinese medical journal. 2020:1.

34.Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. “Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China”. JAMA. 2020;323(11):1061.

35.Hua A, O'Gallagher K, Sado D, Byrne J. “Life-threatening cardiac tamponade complicating myo-pericarditis in COVID-19”. European heart journal. 2020.

36.Sala S, Peretto G, Gramegna M, Palmisano A, Villatore A, Vignale D, et al. “Acute myocarditis presenting as a reverse Tako-Tsubo syndrome in a patient with SARS-CoV-2 respiratory infection”. European heart journal. 2020.

37.Sulemane S, Baltabaeva A, Barron AJ, Chester R, Rahman-Haley S. “Acute pulmonary embolism in conjunction with intramural right ventricular thrombus in a SARS-CoV-2- positive patient”. European heart journal cardiovascular Imaging. 2020.

**Volume 2 Issue 5 May 2021**

**©All rights reserved by Berina Divanovic**