

**COVID-19 and heart: relationship of cardiac tropism of the new coronavirus in affected patients**

**COVID-19 e coração: relação do tropismo cardíaco do novo coronavírus em doentes afectados**

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**ABSTRACT**

At the end of a year 2019, an epidemic began in China, causing a severe respiratory syndrome, and in the months of March considered a pandemic. A family of this virus, however, has been known in the scientific community since 2002, since SARS. Among the severe forms of the disease, there is an intense systemic inflammatory response caused by COVID-19 that can cause cardiac injuries. In view of this, the global impact caused by the epidemic of the new coronavirus associated with the cardiac manifestations triggered by it has become necessary to carry out studies, aiming to better establish this relationship. Therefore, a bibliographic review was carried out in different databases such as Scielo and PubMed, using the descriptors "COVID-19", "new coronavirus". How results were found several researches were carried out after the evidence of

influencing SARS-COV-19 on the cardiovascular system, including some published materials, which show cases of heart failure initiated in infarction, myocardial infarction, myocardium and cardiac arrest present in patients infected with COVID - 19. In view of the current world scenario that presents a pandemic, patients with previous comorbidities, especially cardiovascular and metabolic diseases, are at a higher risk of developing a serious disease and this requires more frequent monitoring and follow-up under heart failure.

**Keywords:** COVID-19, Myocardium, Cardiovascular system.

## RESUMO

No final de um ano 2019, uma epidemia começou na China, causando uma grave síndrome respiratória, e nos meses de Março foi considerada uma pandemia. Uma família deste vírus, porém, é conhecida na comunidade científica desde 2002, desde a SRA. Entre as formas graves da doença, existe uma intensa resposta inflamatória sistêmica causada pela COVID-19 que pode causar lesões cardíacas. Perante isto, o impacto global causado pela epidemia do novo coronavírus associado às manifestações cardíacas por ele desencadeadas tornou-se necessário para a realização de estudos, com o objectivo de melhor estabelecer esta relação. Assim, foi realizada uma revisão bibliográfica em diferentes bases de dados, tais como Scielo e PubMed, utilizando os descritores "COVID-19", "novo coronavírus". Como foram encontrados os resultados de várias investigações foram realizadas após a evidência de influenciar a SRA-COV-19 no sistema cardiovascular, incluindo alguns materiais publicados, que mostram casos de insuficiência cardíaca iniciada em enfarte, enfarte do miocárdio, miocárdio e paragem cardíaca presentes em doentes infectados com COVID - 19. Tendo em conta o actual cenário mundial que apresenta uma pandemia, os pacientes com comorbilidades anteriores, especialmente doenças cardiovasculares e metabólicas, correm um risco mais elevado de desenvolver uma doença grave e isto requer uma monitorização e acompanhamento mais frequentes sob insuficiência cardíaca.

**Palavras-chave:** COVID-19, Miocárdio, Sistema Cardiovascular.

## 1 INTRODUCTION

The coronavirus, which causes COVID-19, is a single-stranded RNA virus with a high capacity for mutation and recombination<sup>1</sup>. In December 2019 in the city of Wuhan in China, there was a new outbreak of the virus that quickly took over the globe, prompting the World Health Organization (WHO) to declare a state of international emergency on January 31, 2020<sup>2</sup>.

The clinical picture of COVID-19 is similar to that of other respiratory viruses, namely, fever, generally dry cough, fatigue, and, in severe cases (5%), dyspnea, pulmonary bleeding, severe lymphopenia, and renal failure. Symptoms are mild in 80% of cases. Diagnosis of symptomatic cases should be confirmed by testing for the virus via polymerase chain reaction (PCR) of a nasal swab<sup>3,4</sup>. Besides recent data report that the virus can affect the cardiovascular system through several manifestations such as myocardial injury, heart failure, Takotsubo syndrome, arrhythmias, myocarditis and shock<sup>5</sup>.

The COVID-19 infection can cause a systemic inflammatory response that results in cardiac injury which leads to an increase of troponin, D-dimer, procalcitonin, C-reactive protein, ferritin and NT-proBNP<sup>6,7</sup>. According to Guo et al, elevated levels of troponin is associated with markedly higher mortality when compared with patients with normal levels of troponin, respectively 59,6% against 8,9%. Besides patients with elevated troponin present longer prothrombin time, higher with the blood cells and neutrophil counts, lower lymphocyte count, shorter activated partial thromboplastin time and significant higher level of D-dimer<sup>8,9</sup>.

## **2 OBJECTIVE AND METHODOLOGY**

The objective of this bibliographic review is to establish the capacity of the new coronaviruses to infect cardiac cells and in this way lead to cardiovascular problems, thus, aiming to reach the established objectives, we carried out a review of studies in the area, through a thorough bibliographic search in different databases as Scielo and PubMed, using the descriptors/keywords: "COVID-19", "new coronavirus", "heart disease and the new coronavirus", "COVID-19 and cardiovascular system". Therefore, original articles, bibliographic reviews, guidelines and manuals, dissertations and theses were selected.

## **3 RESULTS AND DISCUSSION**

The interaction between the new coronavirus and the cardiovascular system has been proven and published materials show that cases of acute onset heart failure, myocardial infarction, myocarditis and cardiac arrest are present in patients infected with this virus. In addition, it is also mentioned that cases of damage to myocardial tissue have been found, generating an increase in troponin I, acute cardiac damage, shock and arrhythmia<sup>6</sup>.

The damage to the cardiovascular system is believed to be multifactorial and related to the imbalance triggered by high metabolic demand and low cardiac reserve, in addition to systemic inflammation and thrombogenesis process, and also by direct damage to the myocardium, which occurs in patients who have cardiovascular risk factors or previous cardiovascular disease<sup>10</sup>. Thus, it is concluded that the disease caused by the new coronavirus has a worse prognosis in patients who already have some cardiovascular comorbidity<sup>8</sup>.

A study published by Strabelli e Uip, 2020 corroborates the information citing that the comorbidities present most frequently in patients who died were arterial hypertension, diabetes mellitus, cardiovascular disease and age over 70 years. Therefore, it is noted that patients with hospitalized cardiovascular problems have an increased risk of death when compared to those previously cleaned<sup>9</sup>.

In addition, it is possible to mention that cardiac injury seems to be a prominent feature of the disease, occurring in up to 30% of hospitalized patients and contributing to 40% of deaths. Cardiovascular complications to be mentioned are myocardial injury, arrhythmias, myocarditis, heart failure and shock<sup>10</sup>.

Such information is confirmed by the fact that in the systemic inflammatory response triggered in infections by the new coronavirus, an increase in cytokines that are related to cardiovascular injuries is noted. In addition, there is an increase in troponin, along with D-dimer, ferritin, interleukin-6 (IL-6), lactic dehydrogenase (DHL), C-reactive protein, procalcitonin and leukocyte count<sup>10</sup>.

In severe acute respiratory syndrome (SARS), infection of host cells occurs through ACE2 receptors, expressed in the heart and lungs in large quantities and for this reason, leads to COVID-19-related pneumonia, which can also trigger acute myocardial injury and chronic damage to the cardiovascular system. Therefore, it is noted that due to the systemic inflammatory response mentioned, associated with immunological disorders, there is an increase in cardiovascular symptoms. Thus, patients who previously had cardiovascular diseases and who become infected with the new coronavirus have a more reserved prognosis, and should therefore receive greater protection and attention to the cardiovascular system during the treatment of COVID-19<sup>8</sup>.

As demonstrated, SARS-CoV infection can negatively affect the function of ACE2, which in turn can contribute to some of the disease pathologies, given the ability of viruses to usurp cell surface peptidases and the prevalence of ACE in cardiac tissues, respiratory and others. When ACE2 was overexpressed in non-permissible human cells for viral infection, the entry and replication of SARS-CoV was facilitated; this process was blocked by an ACE2 antibody. In addition to the tissue distribution of ACE2 showing some correlation with the SARS-CoV infection sites and the disease pathology, another zinc peptidase, aminopeptidase N (APN), acts as a receptor for other coronaviruses. Again, with this receptor, its distribution can be correlated with the sites of infection, although APN and ACE2 do not have discernible sequence homology and show a different membrane topology. An example of this is the presence of APN that constitutes > 5% of the membrane protein at the edge of the renal brush<sup>11</sup>.

SARS-CoV-2 and MERS-CoV have similar pathogenic mechanisms and the myocardial damage caused by infection with these viruses increases the complexity of treating the patient. Myocardial injury associated with SARS-CoV-2 occurred in 5 of the first 41 patients diagnosed with COVID-19 in Wuhan, which manifested themselves mainly as an increase in cardiac troponin I levels. In this study, four of the five patients with myocardial injury were admitted to the

intensive care unit (ICU), which indicates the serious nature of the myocardial injury in patients with COVID-19<sup>11</sup>. In another report of 138 patients with COVID-19 in Wuhan, 36 patients with severe symptoms were treated in the ICU. The levels of biomarkers of myocardial injury were significantly higher in patients treated in the ICU than in those not treated in the ICU<sup>12</sup>, corroborating that the cardiac affection increases the severity of the patient's clinical condition.

#### **4 CONCLUSION**

In view of the current pandemic, we know that patients with cardiovascular and metabolic diseases are at increased risk of infection and of developing the severe form of COVID-19, which requires monitoring and follow-up of acute heart failure. Cardiovascular outcome is a real possibility in the clinical experience of the new coronavirus pandemic and it is possible to mention that cardiac injury seems to be a prominent feature of the disease, occurring in up to 30% of hospitalized patients and contributing to 40% From deaths, leading to heart involvement, to cases of acute heart failure that has been identified as one of the main sources of secondary complications, clinical signs should always guide us to advance in these possibilities, in addition to keeping alert to myocarditis.

This virus is potentially serious and has a high propagation rate. As it is a disease still under investigation, current data comes from retrospective studies and should be interpreted with caution. However, heart involvement, leading to acute heart failure, has been identified as one of the main sources of secondary complications, with a reserved result, without specific therapy for treatment, only the classic follow-up of acute heart failure that demonstrates the need for special attention to patients in the risk group and the importance of proper management of cardiovascular complications, with rapid identification and implementation of appropriate treatment.

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