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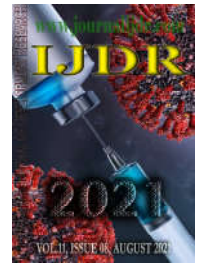
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THE IMPLICATIONS ON THE CARDIOVASCULAR SYSTEM ASSOCIATED WITH COVID-19 IN THE STATE OF MINAS GERAIS: A LITERATURE REVIEW

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ABSTRACT

Worldwide, the beginning of 2020 was marked by a pandemic caused by a type of coronavirus, having its first case registered in December 2019 in the city of Wuhan, province of China. by the new coronavirus, the Minas Gerais state authorities took administrative measures so that the state became alert and prepared to face the pandemic, actions such as social isolation, hand hygiene and respiratory etiquette were strengthened. Considering the relevance of the subject, this article seeks to address, discuss and share evidence that proves the damage generated by Sars-CoV-2 in patients affected by COVID-19. Furthermore, the study also aims to contribute positively to the literature, compiling updated data on COVID-19 and its effect on the cardiovascular system. This is an integrative literature review using the MEDLINE, LILACS and BVS Brasil databases, from January 2020 to July 31, 2021. From the data collected, 80 articles. After removing duplicates and screening titles/abstracts and applying the inclusion and exclusion criteria, 71 full-text articles were retrieved, of which 9 were eligible for inclusion in this review. The cardiovascular system can determine the severity of the disease, especially if the patient has risk factors.

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INTRODUCTION

Worldwide, the beginning of 2020 was marked by a pandemic caused by a type of coronavirus, having its first case registered in December 2019 in the city of Wuhan, province of China¹.

Taking a rapid spread with a high number of cases, being declared in Brazil in late January 2020 by the World Health Organization (WHO) as an emergency condition in world public health^{wo}. Coronaviruses are part of a group of RNA viruses, enveloped with a single replication strategy, enabling them to vary their pathogenicity and

facilitating their adaptation to different environments³. SARS-CoV-2 comes from a new strain identified in December 2019, it is the new agent of the coronavirus, the actions planned to face the pandemic aim to destroy the virus, preventing its transmission⁴. SARS-CoV-2 causes COVID-19 disease, and is responsible for millions of deaths worldwide⁵. Faced with a pandemic and from the first case reported in the country by the WHO caused by the new coronavirus, the authorities of the state of minas gerais took administrative measures so that the state was on alert and prepared to face the pandemic, actions such as social isolation, hand hygiene and respiratory etiquette were strengthened⁶. Although the clinical presentations of the disease are mostly related to the respiratory system, it can also affect other systems⁷. For example, cardiovascular manifestations have been reported as a result of COVID-19, where and there are several mechanisms by which SARS-CoV-2 can cause damage to the myocardium⁸. The presence of angiotensin 2 converting enzyme receptors used by the virus to invade the pneumocyte in cardiomyocytes may be related to the development of myocarditis, which can cause systolic dysfunction and heart failure (HF)⁹.

Another mechanism of cardiac damage could be the great inflammatory activity, where can trigger arrhythmias, especially in individuals with pre-existing comorbidities¹⁰. SARS-CoV-2 precipitates a cytokine storm with increased concentration of interleukins (mainly IL-2, IL-7 and IL-10) and other pro-inflammatory cytokines such as granulocyte colony-stimulating factor and tumor necrosis factor, among other system mediators the local inflammatory response¹¹. It is believed that the development of arrhythmias in patients infected with Sars-CoV-2 is due to inflammation inherent to the viral infectious process, acute damage to the myocardium and/or dysregulation in the patient's metabolism due to the disease¹². This pro-inflammatory storm can reduce the flow to the coronary arteries, as well as destabilize the coronary atherosclerosis plaques, in relation to the hypercoagulable state that precipitates the microvascular thrombosis that causes damage to the myocardium and the consequent increase in troponins, as a result. Patients with cardiovascular diseases have higher morbidity and mortality rates due to COVID-19¹³. Often related situations of hypoxemia or prolonged hypotension, acute myocardial infarction can also occur¹⁵. Finally, stress cardiomyopathy or adrenergic discharge tachycardias, both endogenous and exogenous, are other forms of myocardial injury related to SARS-CoV-2^{7,9}. Considering the relevance of the subject, this article seeks to address, discuss and share evidence that proves the damage generated by Sars-CoV-2 in patients affected by COVID-19. Furthermore, the study also aims to contribute positively to the literature, compiling updated data on COVID-19 and its effects on the cardiovascular system.

METHODOLOGY

This is an integrative literature review based on: 1) elaboration of a research question to guide the search strategy; 2) variety of sources for locating studies; 3) definition of inclusion and exclusion criteria; and 4) evaluation of the methodological quality of the recovered productions. The survey of articles was carried out in three databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), Latin American Literature in Health Sciences (LILACS) and Colecion SUS consulted through the Virtual Health Library (BVS Brasil), in the period from January 2020 to July 31, 2021. To select the studies, the descriptors were used Severe Acute Respiratory Syndrome, Risk Factors, COVID-19, SARS-CoV-2 and DCardiovascular diseases present in Health Sciences Descriptors (DeCS). These were paired using the Boolean operator "AND" which defines relationships between terms in a search. Works published anywhere in the world, between 2020 and 2021, in Portuguese, Spanish and English and available in full were included. As exclusion criteria, book chapters, editorials, and other text formats were disregarded, as they did not go through a rigorous peer review process, as occurs with scientific articles. Theses, dissertations, monographs, incomprehensible studies when translated and articles repeated in more than one database were also excluded, in this case, it

was considered only when it appeared for the first time for analysis. The survey of bibliographic data was carried out by two authors/researchers, based on the established inclusion criteria. The first stage of selection of productions was carried out by reading and analyzing the titles and abstracts of all identified articles. After this initial screening, in the second stage, the full reading of the selected studies was carried out, which allowed that other texts were also excluded for not meeting the proposal of the review. In the third stage, the main information from the articles was synthesized in a spreadsheet so that they could guide the descriptive and critical analyzes of the selected studies. As this work is an integrative review, it is exempt from ethical review. Data were managed and analyzed using simple descriptive statistics using the Microsoft Office Excel 2010 software and the Statistical Package for the Social Sciences (SPSS) program for Windows, version 25 (Chicago, IL, USA). Pursuant to Resolution 466/12 of the National Health Council, this study dispensed with the appreciation and approval of the Research Ethics Committee, as it is secondary data, of public domain and access, and because there is confidentiality about the identification of patients involved.

RESULTS AND DISCUSSION

From the data collected, 80 articles. After removing duplicates and screening titles/abstracts and applying the inclusion and exclusion criteria, 71 full-text articles were retrieved, of which 9 were eligible for inclusion in this review (Figure 1). The articles analyzed were published in international journals. Five studies are observational in nature, two are multicenter studies and two are clinical trials. All studies included in this systematic literature review were published from January 2020 to June 2021.

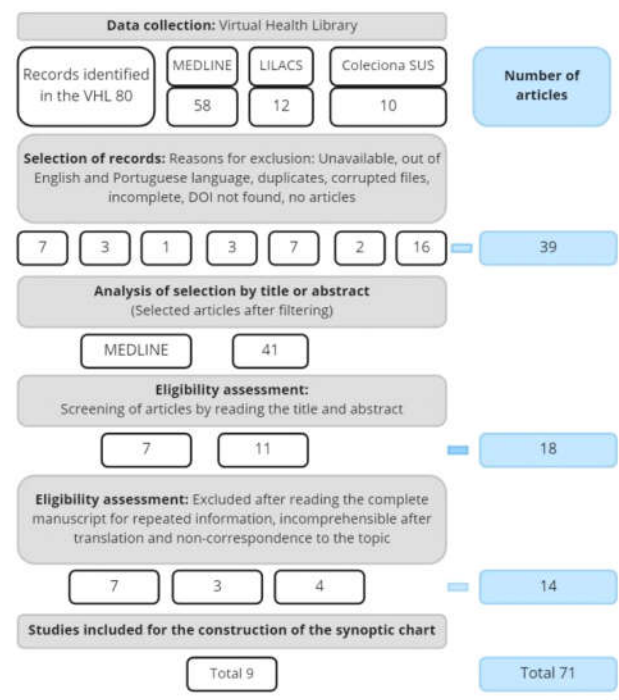


Figure 1. Analysis diagram of the selection process of articles for integrative review, Minas Gerais, 2021

The works were separated by title, authorship, year of publication and objectives, method used in the study and analyzed outcome, as shown in Tables 1. By analyzing the data, it was shown that COVID-19 is directly related to sequelae to the cardiovascular system, which can lead to irreversible damage. According to DENG Q et al. 2020, in their recent autopsy studies of patients with Severe Acute Respiratory Syndrome demonstrated the presence of fibrin thrombi within small vessels and distended capillaries of patients who had COVID-19 infection, in addition to an extensive fibrin deposition extracellular,

Table 1. Information table of articles studied for analysis of the proposed theme, publications made in 2020 and 2021

No.	title of the work	Author	Year	Goals
01	Implications of COVID-19 on the cardiovascular system: prognosis and interurrences	Martins.J,D,N.et al	2021	Describe the implications of COVID-19 on the cardiovascular system: prognosis and complications.
02	Cardiovascular Implications in Covid-19 Infected Patients and the Importance of Social Isolation to Reduce Disease Spread	Coast JA.et al	2021	Show the cardiovascular implications in patients infected by COVID-19 and the importance of social isolation as an alternative to curb the spread of the disease.
03	Implications of cardiovascular diseases in the evolution of prognosis in patients with Covid-19	Cavalcante.I,S. et al	2021	Identify and present the relationship between cardiovascular diseases and the outcomes in patients affected by COVID-19.
04	COVID-19 pandemic and its relationship with cardiovascular disease: an integrative review	Deng Q. et al	2020	Identify current scientific evidence in the literature on the relationship between COVID-19 and cardiovascular disease
05	Position on Cardiology Pre-Participation Assessment after Covid-19: Guidelines for Returning to Exercise Practice	Colombo, CS, SSet al	2020	Warn about the risk of cardiac impairment and its possible sequelae in COVID-19 and advise on the need for cardiac assessment after the disease before returning to sports, proposing strategies for the prevention of SD through a pre-participation assessment (APP) targeted cardiologic therapy.
06	Biomarkers of Myocardial Injury and Cardiac Complications Associated with Mortality in Patients with COVID-19	Son, PRP et al	2020	To perform a synthesis of quantitative evidence from clinical data, biomarkers of myocardial injury and cardiac complications associated with in-hospital death in patients with COVID-19.
07	Relationship of biochemical and pharmacological elements with the development of cardiac complications in patients with COVID-19: Literature Review	Gomes, BKG ET AL	2020	Describe the biochemical and pharmacological elements and their relationship with the development or worsening of cardiac alterations in patients with COVID-19.
08	Cardiologic Complications from Sars-Cov-2 Infection	Mendonça, BTO et al	2020	Understand the main cardiac implications of this disease to ensure the best patient management
09	HEART MANIFESTATIONS IN SARS-COV-2 INFECTION	Mayara dos Santos Claudiano, SM et al	2020	Identify the main complications of COVID-19 in the cardiac system, contribute to the update and make it possible to respond to new questions you have m emerged with the pandemic.

raising the hypothesis that COVID-19 may trigger "cytokine storms", causing coagulation disorders, which may increase the risk of thromboembolism, a risk factor for sepsis, upper and lower limb deep vein thrombosis (DVT) and pulmonary embolism (EP). These injuries can be observed during and after the patient's recovery, being in some cases the cause of death. Electrocardiographic changes are more related to the ST segment, while echocardiographic changes demonstrate a reduction in the left ventricular ejection fraction, and finally, the most common cardiovascular complications in patients who had cardiac damage caused by COVID-19 are: myocarditis, infarction myocardial infarction, shock, HF and arrhythmias. Our study demonstrates an increase in cardiovascular diseases in the population of Minas Gerais associated with SARS-CoV-2 attended by the SUS during the period of the COVID-19 pandemic, which had as consequences the increase in the in-hospital lethality rate resulting from these. Our results are similar to the data shown in the epidemiological bulletin of the Minas Gerais State Department of Health of 07/29/2021, which demonstrated that patients with heart disease were 21,285, compared to the bulletin of 02/01/2021 which showed a rate of 7,012. Also, a reduction in the number was found of deaths with comorbidity, precisely with (67%), compared to the period 02/01/2021 which was from (73%), of deaths with comorbidity. Other studies carried out in different states reported similar findings. Regarding the number of hospitalizations in our study, there was a change in the profile of age groups and, consequently, an increase, where previously the age group most affected by the disease was greater than or equal to 60 years. Today, the age group affected by the disease corresponds to 41 years, possibly a reflection of vaccines in the fight against COVID-19. The reallocation of human resources in the fight against COVID-19 was similar in several states of the country, despite their heterogeneity in their health systems. States such as Pernambuco, Bahia, São Paulo, in order to prepare the hospital to provide care to a large volume of patients with COVID-19, maintained a supply of surgical care limited to high-priority emergency and elective cases.

Currently, the idle capacity of small hospitals is relatively high, around 80% on average, compared to 20% in large hospitals. For general beds, it is reasonable to expect that the current idle capacity is well above historical values, since the Minas Gerais state secretariat determined in March 2020 the suspension of all elective surgeries, due to efforts to fight the pandemic. Still regarding the clinical picture, with the rise of the new coronavirus, it has become a concern for patients with inflammatory changes incited by SARS-CoV-2 infection, which raises the serum levels of substances such as: troponin, brain natriuretic peptide (NT-proBNP), D-dimer, interleukin 6 (IL-6), C-reactive protein, procalcitonin, among others. Consequently, there is the release of both pro-inflammatory substances and substances that are markers of cardiac injury, causing local and systemic reactions. Its effects can result in cardiovascular complications such as myocarditis, heart failure among others and even in death. Cardiovascular pathologies resulting from COVID-19 are frequent and their mechanisms are still poorly understood. Thus, further research is invaluable to clarify the causes of cardiac injury and its relationship to preexisting comorbidities.

FINAL CONSIDERATIONS

Although respiratory involvement is the dominant clinical manifestation of COVID-19, a significant number of patients confirmed for COVID-19 have cardiovascular dysfunction during the course of the pathology. Thus, the association of COVID-19 with the cardiovascular system can determine the severity of the disease, especially if the patient has risk factors. A healthy patient can have cardiac involvement in the same way, with outcomes in arrhythmias, heart failure, among others. In general, all patients with COVID-19 are likely to have cardiac involvement, a fact that may depend on pre-existing history, inflammatory response and biochemical releasers. Furthermore, studies report cases of patients who developed secondary cardiac lesions after COVID-19 infection. However, research is still insufficient in this area if we consider what has been discovered and proven so far. Studies are still needed to

elucidate the demonstrations provoked and the correlation between SARS-CoV-2 and cardiovascular diseases in patients who were positive for COVID-19. The recognition of cardiovascular alterations as a possible complication associated with COVID-19 can be useful for monitoring affected patients and also for deepening the knowledge of these complications for planning and creating public policies. Finally, this study fulfills its purpose of observing and reporting the characteristics of SARS-CoV-2 infection in COVID-19 positive patients who developed cardiologic manifestations, either before or after the viral infection.

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