

ORIGINAL RESEARCH

Assessments of COVID-19's impact on cardiovascular functional parameters in patients affected with myocardial infarction

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Abstract

Objective: Corona virus can severely affect the performance and functional parameters of the heart, causing damage to the myocardium and reducing the ejection fraction in patients with this disease. The present study was conducted with the aim of investigating the changes in cardiovascular parameters such as cardiac ejection fraction, blood pressure and heart rate after myocardial infarction in patients with covid-19 and comparing it with non-covid-19 patients.

Materials and Methods: In this case-control study and based on purpose-based sampling, among all the patients' files in Imam Musa bin Jafar (AS) hospital in Qochan city, who were hospitalized with a diagnosis of heart attack and since the beginning of the outbreak of the Covid-19 disease (March 2018). , 90 cases of patients with covid-19 (45 people) and non-covid-19 (45 people) were selected based on the inclusion criteria and the desired parameters were extracted from them. The results were analyzed using SPSS, t-test and Mann-Whitney test.

Results: The statistical analysis of the data of this study did not show any significant difference between mean ejection fraction, heart rate, systolic and diastolic blood pressure in post-heart attack patients with and without covid 19.

Conclusion: Although the statistical analysis of the data of this study did not show a significant difference between the mean ejection fraction, heart rate, systolic and diastolic blood pressure in post-heart attack patients with and without covid-19, due to the emerging nature of the disease, more studies are needed in this area.

Keywords: Cardiac ejection fraction, Heart attack, Blood pressure, Heart rate, Covid-19

Introduction

In December 2019, an unusual pneumonia outbreak caused by a novel coronavirus was reported in Wuhan, Hubei Province, China, which the International Committee on the Classification of Viruses and the World Health Organization classified as a coronavirus and the disease caused by the virus as acute respiratory syndrome coronavirus 2 and coronavirus disease. Called 2019. Patients with coronavirus infection usually present with fever, dry cough, upper airway congestion, sputum production, and shortness of breath, but rarely headache, hemoptysis, and diarrhea. Loss of smell and taste has also been reported^{1, 2}. Almost half of patients with severe pneumonia and nearly one-third of patients with acute respiratory distress syndrome. Despite the urgent need for effective treatment strategies, there is still no specific antiviral treatment for Covid-19, and treatment guidelines for this disease vary between countries³. The extent and severity of the symptoms caused by Covid-19 lead to damage to tissue function, including cardiovascular damage, acute kidney damage, liver failure, and acute respiratory distress syndrome, which can lead to long-term reduction of lung function and cardiac arrhythmia. Finally, some critical cases of the disease in people also lead to death^{4, 5}. At first, the coronavirus was recognized as a disease of the respiratory system, then it was found that it also affects the cardiovascular system, which leads to myocardial damage and cardiac and endothelial dysfunction, mainly through the receptor of angiotensin-converting enzyme 2. In fact, cardiac damage has been observed even without clinical features of respiratory disease^{6, 7}. Myocardial damage, which is associated with increase in serum troponin level, is relatively common in hospitalized patients with Covid-19 and is a predictor of poor prognosis⁸. Several mechanisms have been proposed for cardiac injury, which, based on studies conducted during ongoing epidemics of Covid-19, are part of a systemic inflammatory response and the release of high levels of cytokines (known as cytokine release syndrome) that can affect several tissues, including the vascular endothelium and Damage cardiac myocytes⁹. The interaction of Covid-19 with ACE2 can cause changes in ACE2 pathways that lead to acute lung, heart and endothelial cell damage. A few case reports have shown that Covid-19

may directly infect the myocardium and cause viral myocarditis. However, in most cases, myocardial damage appears to result from increased cardiac metabolic demand associated with systemic infection and persistent hypoxia from severe pneumonia or acute respiratory distress syndrome. Also, studies have shown that the presence of myocardial damage is associated with increased mortality in Covid-19 patients, and the absence of myocardial damage leads to a better prognosis in these patients⁶. As mentioned, Covid-19 has led to myocardial and vascular damage in many patients, and patients experience chest pain, arrhythmia, palpitations, severe peripheral edema, and acute heart failure. Whether myocardial changes are caused by direct viral damage to the heart or vessels or by an infection-related cytokine storm is still debated. Cardiac inflammatory changes caused by the virus can stimulate myocarditis caused by heart failure with preserved ejection fraction and heart failure with reduced ejection fraction¹⁰. In Chinese patients with Covid-19 reported incidence of arrhythmia, both tachy and brady-arrhythmias¹¹. The aim of present study was investigating changes in cardiac ejection fraction after cardiac infarction in patients with covid-19 and comparing it with non-covid-19 patients.

Materials and Methods

This descriptive; case-control study was done on 90 cardiac infarction patients with and without covid-19 in Imam Musa bin Jafar hospital in Qochan city. After obtaining the approval of the ethics committee of the university and adhering to the principles of maintaining the confidentiality of the names and classified information of the patients, based on purpose-based sampling, from among all the patients' files in the Imam Musa bin Jafar hospital in Qochan city, which Diagnosed with heart attack and hospitalized since the beginning of the outbreak of covid-19, 90 cases of patients with covid-19 (45 people) and non-covid-19 (45 people) were selected based on the inclusion criteria and the desired data were extracted from them. The tool for collecting information in this study was researcher-made questionnaires and included two parts: The first part of demographic information includes age, sex, education, marital status, number of children, occupation, family and genetic history, medical history (diabetes, blood lipids, blood pressure), history of addiction and

smoking, drug use, hospitalization history and the second part of information. Paraclinical and clinical included cardiac ejection fraction, heart rate, blood pressure, covid-19 and cardiac infarction indices (TPI, CPKMB) and the desired information was extracted from the patients' records.

Inclusion criteria to this study were heart attack with MI indicators in all types of MI, which include ECG changes, Cardiac enzymes (TPI, CPKMB), clinical signs in the definition of heart infarction and cardiac ejection fraction variable in the echocardiography performed in the first 6 hours of hospitalization with the diagnosis of heart infarction. And in patients with Covid-19, disease indicators include Positive PCR test of patients. Exclusion criteria were absence of one of the desired indicators for the diagnosis of covid-19 and heart attack.

Statistical analysis

Statistical analysis was performed using SPSS 22. Mann-Whitney tests were used for a pairwise comparison. $P < .05$ was considered statistically significant.

Results

Demographic information of patients diagnosed with heart attack was showed in table1. The results of the study showed that the average age of the participants was (64.1 ± 11.8), fifty-three (58.9%) were male patients, twenty-eight (31.1%) were diagnosed with NSTEMI, and the majority were married. 89 (98.9%), no history of drug use 67 (47.4%), with history of blood pressure 45 (50%), no history of blood lipids 65 (72.2%), with diabetes 48 (53.3%), with history of addiction 48 (53.3 %) and 72 (80%) had no history of smoking.

Table 1. Frequency of demographic characteristics of patients diagnosed with heart attack

Parameter		Mean ±S.E	
Age (41-97)		64.1±11.08	
Genus	Male	53	58.9
	Female	37	41.1
Kind of MI	Ant-MI	29	32.2
	Inf-MI	33	63.7
Marital status	NSTEMI	28	31.1
	Single	1	1.1
Education	Married	89	98.9
	illiterate	42	46.7
History of drug use	elementary	6	6.7
	High school	14	15.6
History of	diploma	24	26.7
	Bachelor's degree	4	4.4
History of	Yes	23	25.6
	No	67	74.4
History of	Yes	45	50

Table 2 was showed the results of comparing the average changes in cardiac ejection fraction, blood pressure and heart rate after heart attack in patients with covid-19 and non-covid-19 patients.

blood pressure	No	45	50
History of blood lipids	Yes	25	27.8
	No	65	72.2
History of diabetes	Yes	20	22.2
	No	70	77.8
History of addiction	Yes	48	53.3
	No	42	46.7
Smoking history	Yes	81	20
	No	72	80

Table 2. Changes in mean cardiac ejection fraction, blood pressure and heart rate after heart attack in covid-19 and non-covid-19 patients.

Group		Patients after heart attack with covid 19	Patients after heart attack without covid 19
Parameters			
Cardiac ejection fraction	Covid (10-65)	39.44±10.51	41.33±10.08
	Non-covid (20-60)		
Heart rate	Covid (60-120)	87.77±18.87	90±15.85
	Non-covid (60-120)		
Blood pressure	Systolic	Covid (90-140)	116.67±14.14
		Non-covid (100-140)	119.78±12.70
	Diatolic	Covid (60-90)	73.78±10.29
		Non-covid (60-100)	76.45±11.31

The results of the study were not showed the significant differences in ejection fraction, heart rate, systolic and diastolic does not exist. However, mean ejection fraction, heart rate, systolic blood pressure and diastolic blood pressure in post-heart attack patients without covid 19 were higher than patients with covid-19.

Discussion

The purpose of this study was to investigate the effect of covid-19 on cardiovascular functional parameters such as cardiac ejection fraction, heart rate, systolic and diastolic blood pressure in patients with heart attack. Although the statistical analysis of the data of this study did not show a significant difference between the average of ejection fraction, heart rate, systolic and diastolic blood pressure in patients after myocardial infarction with and without covid-19, but as mentioned in the results chapter, the average of all the mentioned cases in patients without covid-19 was more than patients with covid-19, which is clinically valuable. Due to the passage of a short period of time since the beginning of the covid-19 pandemic and the unknown nature of the disease, its complications and treatment, the studies conducted in the field of the effect of the said virus on cardiovascular functional parameters are very limited. Although the results of our study showed that there is no significant difference in cardiac ejection fraction in post-myocardial infarction patients with and without Covid-19.

A systematic review and meta-analysis in 2021 in the United States on 268 patients who were hospitalized with a diagnosis of Covid-19 it showed that myocardial damage was a common phenomenon in these patients and the incidence of heart failure with reduced ejection fraction was significant in covid 19 patients with myocardial damage ⁸. In a prospective cohort study in 2021 in Belgium, showed that myocardial damage was common in covid-19 and left ventricular ejection fraction was below 50% in 19.1% of patients. Increased cardiac biomarkers (high-sensitivity troponin T and natriuretic peptide B-prototype tests and left ventricular dysfunction were significantly associated with mortality ¹².

In another study in 2021 in Germany, 64 consecutives, hospitalized, clinically stable

patients with covid-19 with left ventricular ejection fraction $\geq 50\%$ were evaluated for the possibility of heart failure with preserved ejection fraction ratio using HFA-PEFF tools were investigated. HFA-PEFF scores were higher in Covid-19 patients than in the control group. In Covid-19 patients, HFA-PEFF scores were significantly associated with age, estimated glomerular filtration rate, high-sensitivity troponin T, hemoglobin, QTc interval, left ventricular ejection fraction, mitral E/A ratio, and H2FPEF scores. Patients with myocardial damage showed higher HFA-PEFF scores and more frequent left ventricular diastolic dysfunction compared to patients without myocardial damage ¹⁰.

The results of the study on 78 patients with covid-19 and ST-elevation myocardial infarction in 4 hospitals in Italy, Lithuania, Spain, and Iraq were showed the occurrence of a high rate of thrombotic complications and mortality, as well as the possible need to adapt the management of ST-segment elevation myocardial infarction in patients with covid-19 ¹³. Data from 39 patients admitted for acute pneumonia caused by acute respiratory syndrome corona 2, for whom two-dimensional echocardiography showed that patients who underwent intubation or died had significantly higher respiratory rates, lower hemoglobin levels, higher concentrations of C-reactive protein, higher concentrations of cardiac biomarkers (troponin) compared to survivors. heart with high sensitivity, B-type natriuretic peptide) and lower left ventricular ejection fraction ¹⁴. One of the limitations of this study is the selection of patients from Qochan city hospital, which can be used in other studies to collect samples from patients in different cities or provinces. Also, the emerging and unknown nature of the Covid-19 pandemic and the lack of sufficient studies in this field are the limitations of the present study.

The results of this study did not show a significant difference between the average of ejection fraction, heart rate, systolic and diastolic blood pressure in post-heart attack patients with and without covid-19, but as the average of all the mentioned cases in patients without covid-19 is higher than in patients with covid-19. It was covid-19, which is clinically valuable.

Ethical Approval

The present research had the ethics code IR.MEDSAB.REC.1401.059 of Research Ethics Committee of Sabzevar University of Medical Sciences.

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Conflicts of interest

The authors declare that they have no conflict of interest.