



Prevalence of Cardiac Complications among Hospitalized Covid-19 Patients in Erbil

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Original Article

Summary

The COVID-19 disease pandemic has accompanied wide range of adverse outcomes affecting many body systems. The cardiovascular complications in COVID-19 disease are frequent with many reports of recorded myocardial infarction, thromboembolism, heart failure, arrhythmias, and acute coronary disorders. This study aimed to measure the prevalence of cardiac complications in hospitalized patients with COVID-19 infection in Erbil city and identify the risk factors of these cardiac complications.

Therefore, a cross-sectional study was carried out in Erbil Hospital of Corona center in Erbil city-Kurdistan region/Iraq during the period from 1st of February to 31st of October, 2021 including 320 hospitalized COVID-19 patients. Cardiac abnormalities was defined according to the American College of Cardiology/American Heart Association Practice Guidelines. Findings of the study showed cardiac complication in 50 (15.6%) hospitalized COVID-19 patients. The more frequently reported cardiac complications were arrhythmias, carditis, and acute coronary syndrome. The cardiac complications are more prevalent in COVID-19 patients with no pre-existing cardiac diseases. In conclusion, the prevalence of cardiac complications in hospitalized COVID-19 patients in Erbil city is within the international range.

Keywords: COVID-19 disease, Hospitalized, Cardiac complications

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1. INTRODUCTION

Since declaration of corona-virus disease (COVID-19) as a pandemic outbreak by the World Health Organization (WHO), hundreds of millions of people have been infected with millions of deaths reported all over the world. COVID-19 disease is attributed to infection with severe acute respiratory syndrome corona-virus 2 (SARS-CoV2) (1, 2). The COVID-19 disease was classified into mild, moderate, severe, and critical with a wide variety of adverse outcomes of disease were detected such as respiratory failure, septic shock, multiple organ failure, and death (3). It tends to be more aggressive in older age patients (4). The cardiovascular complications in COVID-19 disease are frequent with many reports of recorded myocardial infarction, thromboembolism, heart failure, arrhythmias, and acute coronary disorders (4-7).

Many factors play role in the pathogenesis of cardiac complications in COVID-19 disease like SARS-CoV-2 entry into cells, systemic inflammation, the role of interleukin-6, and the role of medications. The entry to cells leads to interaction with angiotensin-converting enzyme 2 (ACE2), destroying host cells, releasing danger signals, and activating immune reactions leading to myocardial injury and myocarditis (8, 9). Many authors revealed that COVID-19 disease is accompanied by a systemic inflammation lead to dysfunction of endothelium and stimulation of complement pathways, platelets, von Willebrand factor, Toll-like receptors, and tissue factor pathway which lead to thrombus formation in arteries and veins (10 in addition to the effect of systemic inflammation in increasing metabolic demand that causes acute coronary syndrome (5,11). Increased level of interleukin-6 plays role in cardiac complication accompanying COVID-19 disease by interaction with neutrophil extracellular traps and development of thrombosis (12) in addition to its cellular causing arrhythmia (13) and acute heart failure (14). Some medications used in treating COVID-19 diseases had cardiotoxicity effects like Chloroquine, hydroxychloroquine (15, 16, and anti-viral therapy (17). Additionally, there are many risk factors that trigger the cardiac complications in COVID-19 disease like fever 18, cardiac therapy cessation due to infection (19), hypoxia, obesity, mechanical ventilation, and others 20. The long COVID-19 signs and symptoms post-infection might also play role in developing cardiovascular complications (21). Thrombosis adverse complications are common in COVID-19 disease (22, 23). It was found that about one-quarter of COVID-19 patients admitted in intensive care units showed signs of venous thromboembolism with a higher incidence of pulmonary embolism. The myocardial ischemia

is highly reported in hospitalized patients with infection and high cardiac troponin level was evident in absence of ischemic symptoms (24-27). The risk of myocardial injury was aggravated in patients with previous cardiovascular diseases (5,28). The early increase in troponin level through COVID-19 hospitalization is accompanied by a high risk of ventilation difficulties, ventricular arrhythmias, and high mortality rates. Some COVID-19 cases were presented initially with the acute coronary syndrome (ACS) or developed ACS during the hospitalization commonly non-obstructive coronary artery disease (28-31). The arrhythmia was a common cardiac complication recorded in 16.7% of hospitalized COVID-19 patients (4) mainly in patients admitted to intensive care units (32). Malignant arrhythmias complicated hospitalized COVID-19 patients are associated with high mortality rates (33). Heart failure was a common complication of COVID-19 disease (7) that represented about half of the mortality causes in hospitalized COVID-19 patients (34). The clinical presentation of cardiovascular complications accompanying COVID-19 disease like dyspnea and chest pain were commonly overlapped with clinical presentation of COVID-19 disease. Additionally, these complications occurred mainly during the course of the disease. For that, high awareness of cardiac manifestations is required specifically for severe COVID-19 cases and hospitalized cases. Unfortunately, those COVID-19 patients with cardiac complications that required hospitalization and admission to the intensive care unit had a poorer prognosis (3,4, 35-37). Recently, millions of Iraqi people were infected with COVID-19 disease with high mortality rates (38). However, more than half of Iraq-Kurdistan peoples are refusing or hesitant to COVID-19 vaccines 39. Increased COVID-19 hospitalized cases with high reported death rates and scarcity of works of literature discussing the cardiac complications of COVID-19 disease in Kurdistan hospitals urged us to conduct this study that aimed to measure the prevalence of cardiac complications in hospitalized patients with COVID-19 infection in Erbil city and identifying the risk factors of these cardiac complications.

2. PATIENTS and METHODS

The current study design was an observational cross-sectional study that was carried out in Erbil Hospital of Corona center in Erbil city-Kurdistan region/Iraq through a duration period of nine months from first of February to 31st of October, 2021. The study

population was all patients with COVID-19 disease admitted to Corona center during the study duration. Adult patients (age 20-93 years) with positive COVID-19-Reverse transcription polymerase chain reaction (RT-PCR) test that confirmed by laboratory findings and remain in a center casualty from time of admission till cure and discharge were the inclusion criteria. Exclusion criteria were younger age patients, patients in a respiratory care unit (RCU), patients with advanced chronic diseases like carcinoma and end-stage renal diseases, patients admitted to coronary care unit for cardiac diseases since one month ago or less, patients with a known history of pulmonary embolism, patients with baseline rhythm abnormalities and patients refused to participate. The ethical considerations were implemented according to the Helsinki Declaration regarding ethical approval of Health authorities; ethical approval was taken from the Kurdistan Board Ethical Committee, oral informed consent of patients, and responsibility in the management of patients with cardiac complications. A convenient sample of 320 hospitalized COVID-19 patients was selected after eligibility to inclusion and exclusion criteria. The data were collected from patients directly or from their saved records in the Corona center and fulfilled in a prepared questionnaire. The questionnaire was designed by the researchers. The questionnaire included the following information: general characteristics of hospitalized COVID-19 patients (age, gender, and body mass index), clinical history of hospitalized COVID-19 patients (cardiac risk factors like diabetes mellitus, hypertension, dyslipidemia, smoking, preexisting heart disease, and co-morbidity), Electrocardiography findings of hospitalized COVID-19 patients (ECG, conduction abnormality, arrhythmia, types of arrhythmia, carditis and acute coronary syndrome) and Echocardiography and other investigations findings of COVID-19 patients (echocardiography, serum troponin test, chest x-ray, and CT-scan findings). The diagnosis of COVID-19 disease was done in regard to National Guidelines by RT-PCR, imaging, and laboratory tests. Each patient included in this study was examined by the researchers after taking a full history and referred to Radiology for imaging to assess the extent of lung involvement. The treatment protocol of patients was designed according to National Guidelines in management. The patients were followed up from their admission to the discharge. The cardiac complications of hospitalized COVID-19 patients were assessed by the responsible physician in the center through ECG, chest x-ray, laboratory findings like troponin, echocardiography,

angiography, CT-scan, and magnetic resonance imaging. In the current study, cardiac complications like MI, myocarditis, pericarditis, heart failure were diagnosed according to ESC guidelines (European society of cardiology) and arrhythmias according to EHRA (European Heart Rhythm Association) (40,41).

The data collected were analyzed statistically by Statistical Package of Social Sciences software version 22. Chi-square and Fishers' exact tests were applied for analyzing categorical variables. The level of significance (P. value) of ≤ 0.05 was considered statistically significant.

3. RESULTS

In the present study, three hundred and twenty COVID-19 patients were enrolled with a mean age of (44.6 years) and range of 20-93 years; 18.1% of patients were at age group of fewer than 30 years, 29.4% of them were at age group 30-39 years, 18.1% of them were at age group 40-49 years, 5.3% of them were at age group 50-59 years, 23.4% of them were at age group 60-69 years and 5.6% of them were at age of 70 years and more. Male COVID-19 patients were more than females (60.6% vs. 39.4%). The mean BMI of COVID-19 patients was (27.4 Kg/m²); 24.1% of patients were overweight and 41.6% of them were obese. (Table 1). The cardiac risk factors were positive in 78.1% of COVID-19 patients, commonly dyslipidemia (53.4%), HT (45.3%), DM (38.4%), and at least common preexisting heart diseases (mainly ischemic heart diseases). Clinical co-morbidity was positive in 7.8% of COVID-19 patients (mainly COPD & CKD). (Table 2). The ECG was abnormal in 14.4% of COVID-19 patients. The ECG showed conduction abnormality in 1.9% of COVID-19 patients, while the arrhythmia was detected in 8.8% of them. The arrhythmia included atrial fibrillation (3.4%), supraventricular tachycardia (1.3%), ventricular tachycardia (0.6%), premature atrial contraction (2.2%) and premature ventricular contraction (2.8%). Carditis was shown by ECG in 3.2% of COVID-19 patients (1.3% myocarditis and 1.9% pericarditis). ECG showed acute coronary syndrome in 1.5% of COVID-19 patients (0.9% STEMI and 0.6% NSTEMI). (Table 3). The echocardiography was abnormal in 3.4% of COVID-19 patients. The troponin level was elevated in 57.2% of patients. The chest x-ray findings were abnormal in 91.6% of COVID-19 patients, while the CT-scan findings were abnormal in 88.4% of COVID-19 patients. (Table 4). The cardiac complication was present in 50 (15.6%) COVID-19 patients, while absent in 270 (84.4%) hospitalized COVID-19 patients. (Figure 1)

. There was a highly significant association between the increased age of COVID-19 patients and cardiac complications ($p<0.001$). No significant differences were observed between COVID-19 patients with positive cardiac complications and COVID-19 patients with negative cardiac complications regarding gender ($p=0.39$) and BMI ($p=0.08$). (Table 5). No significant differences were observed between COVID-19 patients with positive cardiac complications and COVID-19 patients with negative cardiac complications regarding cardiac risk factors in general ($p=0.14$), dyslipidemia ($p=0.1$), preexisting heart diseases ($p=0.11$), and comorbidities ($p=0.08$). There was a highly significant association between the DM history of COVID-19 patients and cardiac complications ($p<0.001$). A highly significant association was observed between HT history of COVID-19 patients and cardiac complications ($p<0.001$). Positive smoking history was significantly related to cardiac complications of COVID-19 patients ($p<0.001$). There was a significant association between a negative history of preexisting heart diseases and cardiac complications of COVID-19 patients ($p=0.03$), 72% of COVID-19 patients with negative history of preexisting heart diseases had cardiac complications. A highly significant association was observed between positive clinical comorbidity of COVID-19 patients and cardiac complications ($p<0.001$). (Table 6)

Table 1. General characteristics of hospitalized COVID-19 patients.

Variable	No.	%
Age (year)		
<30 years	58	18.1
30-39 years	94	29.4
40-49 years	58	18.1
50-59 years	17	5.3
60-69 years	75	23.4
≥ 70 years	18	5.6
Mean \pm SD: (44.6 \pm 15.9)		
Gender		
Male	194	60.6
Female	126	39.4
BMI		
Normal	110	34.4
Overweight	77	24.1
Obese	133	41.6
Mean \pm SD: (27.4 \pm 4.3) Kg/m ²		
SD: standard deviation of mean, BMI: Body mass index		

Table 2. Clinical history of hospitalized COVID-19 patients.

Variable		No.	%
Cardiac risk factors	Positive	250	78.1
	Negative	70	21.9
DM		123	38.4
HT		145	45.3
Dyslipidemia		171	53.4
Smoking		32	10
Preexisting heart diseases	IHD	51	91.1
	VHD	1	1.8
	CHD	4	7.1
Comorbidities	COPD	8	32
	CKD	2	8
	COPD & CKD	15	60

Table 3. Electrocardiography findings of hospitalized COVID-19 patients.

Variable	No.	%
Abnormal ECG	46	14.4
Conduction abnormality	6	1.9
Arrhythmia	28	8.8
AF	11	3.4
SVT	4	1.3
VT	2	0.6
PAC	7	2.2
PVC	9	2.8
Carditis		
Myocarditis	4	1.3
Pericarditis	6	1.9
ASC		
STEMI	3	0.9
NSTEMI	2	0.6

Table 4. Echocardiography and other investigations findings of COVID-19 patients.

Variable	No.	%
Abnormal echocardiography	11	3.4
Abnormal Troponin level	183	57.2
Abnormal chest X-Ray	293	91.6
Abnormal CT-scan	283	88.4

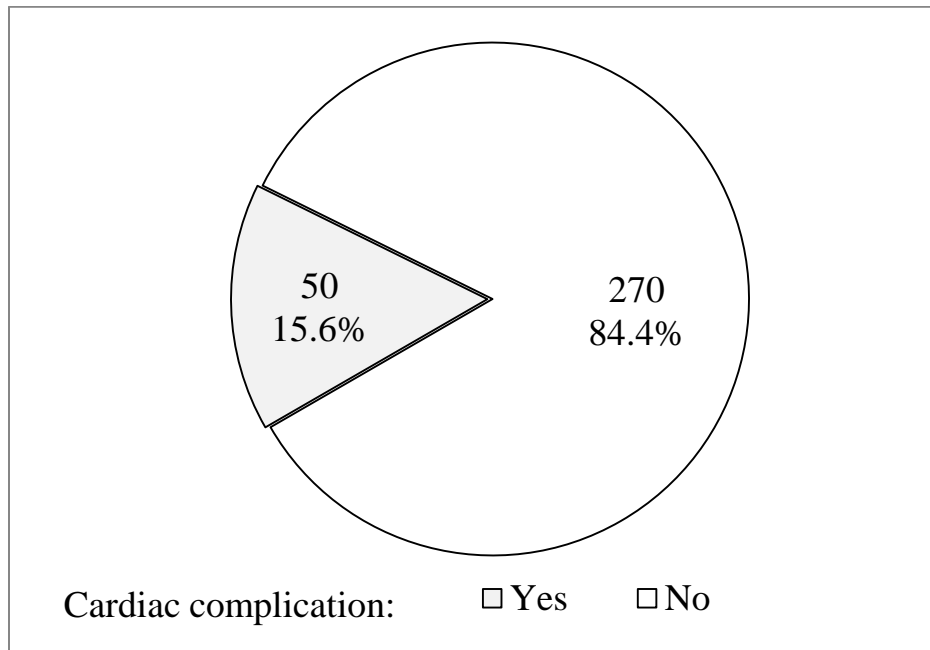


Figure 1. Prevalence of cardiac complication in COVID-19 patients.

Table 5. Distribution of COVID-19 patients' general characteristics according to cardiac complication.

Variable	Cardiac complications				P
	Yes		No		
	No.	%	No.	%	
Age					<0.001 ^S
<30 years	5	10	53	19.6	
30-39 years	3	6	91	33.7	
40-49 years	7	14	51	18.9	
50-59 years	8	16	9	3.3	
60-69 years	17	34	58	21.5	
≥70 years	10	20	8	3	
Gender					0.39 ^{NS}
Male	33	66	161	59.6	
Female	17	34	109	40.4	
Body mass index					0.080 ^{NS}
Normal	11	22	99	36.7	
Overweight	12	24	65	24.1	
Obese	27	54	106	39.3	

S=Significant, NS=Not significant.

Table 6. Distribution of COVID-19 patients' clinical history according to cardiac complication.

Variable		Cardiac complications				P
		Positive		Negative		
		No.	%	No.	%	
Cardiac risk factors	Yes	43	86	207	76.7	0.14 ^{NS}
	No	7	14	63	23.3	
DM	Yes	33	66	90	33.3	<0.001 ^S
	No	17	34	180	66.7	
HT	Yes	33	66	112	41.5	0.001 ^S
	No	17	34	158	58.5	
Dyslipidemia	Yes	32	64	139	51.5	0.100 ^{NS}
	No	18	36	131	48.5	
Smoking	Yes	19	38	13	4.8	<0.001 ^S
	No	31	62	257	95.2	
Preexisting heart disease	Yes	14	28	42	15.6	0.030 ^S
	No	36	72	228	84.4	
Preexisting heart diseases types	IHD	13	92.9	38	90.5	0.110 ^{NS}
	VHD	1	7.1	0	-	
	CHD	0	-	4	9.5	
Co-morbidity	Yes	16	32	9	3.3	<0.001 ^S
	No	34	68	261	96.7	
Co-morbidities	COPD	7	43.8	1	11.1	0.080 ^{NS}
	CKD	2	12.5	0	-	
	COPD & CKD	7	43.8	8	88.9	

S=Significant, NS=Not significant.

4. DISCUSSION

The emergence of COVID-19 disease leads to unpredictable health complications globally. Although the lung is the main body organ attacked by COVID-19 disease, the cardiovascular system is largely affected by the disease with high rates of co-morbidities and mortalities (42).

In the present study, the cardiac complication was present in 15.6% of hospitalized COVID-19 patients. This prevalence is higher than the cardiac complications prevalence of (11.6%) in COVID-19 patients reported by Linschoten et al. (43) study on 3011 hospitalized patients from 79 centers in 13 different countries. However, our study prevalence of (15.6%) is lower than the results of Guo et al. (44) retrospective

single-center case-series study on 187 hospitalized patients with COVID-19 disease which found that 35% of patients developed co-existing cardiac complications. These differences in cardiac complications prevalence in hospitalized COVID-19 patients might be attributed to differences in health infrastructure, diagnostic techniques availability, and medical facilities between different countries and centers in addition to differences in study methodology and sample size between different studies. Generally, many kinds of literature reported cardiovascular complications among COVID-19 patients in a range of 15% to 40% (7, 45-48).

The current study showed that ECG was abnormal in 14.4% of hospitalized COVID-19 patients. This finding is close to the results of Yuan et al. (49) retrospective study in UK on 455 hospitalized COVID-19 patients which reported ECG abnormality in (12.8%) of patients. The conduction abnormality was detected in 1.9% of hospitalized COVID-19 patients. This finding is consistent with the results of Alareedh et al. (50) cross-sectional study in Iraq which revealed significant changes in repolarization and conduction abnormalities in hospitalized COVID-19 patients. Our study found that arrhythmia was detected in 8.8% of hospitalized COVID-19 patients. Zareini et al. (51) study in Denmark on 54 hospitalized COVID-19 patients found that 27.8% of them developed arrhythmias. Present study found that arrhythmia included atrial fibrillation (3.4%), supraventricular tachycardia (1.3%), ventricular tachycardia (0.6%), premature atrial contraction (2.2%) and premature ventricular contraction (2.8%). These findings are lower than the results of Reynbakh et al. (52) prospective cohort study in the USA on 103 hospitalized COVID-19 patients which reported arrhythmias in 72.9% of patients, mainly SVT (59.3%) and AF (22.0%). These differences may be due to lower risk factors of arrhythmia in our study patients or due to the unavailability of patch-based mobile telemetry devices monitoring in our study. Carditis in our study was shown by ECG in 3.2% of COVID-19 patients (1.3% myocarditis and 1.9% pericarditis). Boehmer et al. (53) study reported that hospitalized patients with COVID-19 disease had a 15.7 times risk of developing carditis as compared to patients without COVID-19. The ECG in our study showed acute coronary syndrome in 1.5% of COVID-19 patients (0.9% STEMI and 0.6% NSTEMI). This finding is lower than the results of Rashid et al. (54) observational cohort study in the UK which revealed that

4% of hospitalized COVID-19 patients had the acute coronary syndrome. The echocardiography findings in our study were abnormal in 3.4% of COVID-19 patients. Vieira et al. (55) study in Brazil found that 54% of echocardiography findings for COVID-19 patients were abnormal. The low proportion of ACS and abnormal echocardiography might be related to differences in inclusion criteria and hospitalization duration between studies. In our study, the troponin level was elevated in 57.2% of hospitalized patients. Nuzzi et al. (56) study in Italy reported that troponin level was elevated in 59% of hospitalized COVID-19 patients and measuring serum troponin level is helpful in predicting mortality.

The current study found a highly significant association between the increased age of COVID-19 patients and cardiac complications ($p < 0.001$). This finding coincides with the results of Puttegowda et al. (57) study in India which reported that advanced age is an independent risk factor for cardiovascular complications and mortality of hospitalized COVID-19 patients. Our study found a highly significant association between positive DM and HT history of COVID-19 patients and cardiac complications ($p < 0.001$). This finding is in agreement with reports of Guzik et al. (58) review study in the UK which stated that co-morbidity of COVID-19 patients with DM and HT increased the risk of cardiac complications of COVID-19 disease. The present study revealed that positive smoking history was significantly related to cardiac complications of COVID-19 patients ($p < 0.001$). This finding is consistent with the results of Zhang et al. (59) study in China. The interesting finding of the current study was the significant association between a negative history of preexisting heart diseases and cardiac complications of COVID-19 patients ($p = 0.03$). This finding is similar to the results of Rodriguez-Gonzalez et al. (60) systematic review study in Spain which found a significant impact of COVID-19 disease on the cardiovascular system of children with no pre-existing cardiac diseases. In the present study, there was a highly significant association between positive clinical co-morbidity of COVID-19 patients and cardiac complications ($p < 0.001$). This finding is parallel to reports Sanyaolu et al (61) study in Nigeria.

5. CONCLUSIONS

This study concluded that the prevalence of cardiac complications in hospitalized COVID-19 patients in Erbil city is within the international range. The common cardiac complications of hospitalized COVID-19 patients are arrhythmias, carditis, and acute coronary syndrome. The cardiac complications are more prevalent in COVID-19 patients with no pre-existing cardiac diseases. Our study recommended cardiovascular assessment for hospitalized COVID-19 patients, especially with ECG, troponin measurement, and echocardiography.

Ethical Clearance: Ethical clearance and approval of the study are ascertained by the authors. All ethical issues and data collection were in accordance with the World Medical Association Declaration of Helsinki 2013 of ethical principles for medical research involving human subjects. Data and privacy of patients were kept confidentially.

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