ORIGINAL ARTICLE

Analyzing Electrocardiography Abnormalities in COVID-19 Patients Admitting to Emergency Department

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Abstract

Background: One of the groups affected at the highest level by the outbreak with the highest mortality rate is individuals with known cardiovascular diseases. Proinflammatory mediators play an important role in the pathophysiology of the disease cause cardiac and arrhythmic complications. This article aims to provide practical recommendations by evaluating ECG data in the follow-up and management of the disease to the Emergency Medicine workers to whom patients affected by COVID-19 first apply.

Methods: We randomly collected the ECG data of the patients applying to our Hospital Emergency Medicine Clinic green, yellow and red areas who were positive for viral RNA in throat swabs were carried out.

Results: The ECGs of 502 patients diagnosed with COVID-19 were collected in the 2-week period between June 15, 2020, and July 15, 2020. The study included 287 males (57.17%) and 215 females (42.83%). Normal sinus rhythm was detected in 241 patients (48.01%) at ECG. A total of 3 ECG patterns, which suggested ST elevation, and 11 ECG patterns, which suggested ST depression, were decisive in terms of emergency intervention. The number of patients with atrial fibrillation was 17 (3.39%).

Conclusions: This infection was associated with multiple, direct, and indirect cardiovascular complications, including acute myocardial damage, myocarditis, arrhythmias. Sinus tachycardia was determined to be 30.08%, LVH 5.38%, and VES 4.18% in our study. As a result, we believe that our initial ECG recommendation is that cardiac monitoring will play an important role in treatment planning.

Keywords: COVID-19, Electrocardiogram, Comorbidity, Emergency Department.

INTRODUCTION

After the COVID-19 disease, which is caused by the novel coronavirus (Severe Acute Respiratory Coronavirus-2 (SARS-CoV-2), which emerged in Wuhan, Hubei, China, in December 2019, and rapidly spread to nearly 200 countries around the world, was also detected and declared officially in our country on March 11, 2020, the number of cases has increased rapidly. One of the groups affected at the highest level by the outbreak with the highest mortality rate is individuals with known cardiovascular diseases (1). SARS-CoV-2 infection is associated with several proinflammatory diseases. Proinflammatory mediators play an important role in the pathophysiology of the

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disease cause cardiac and arrhythmic complications (1, 2). Electrocardiography (ECG) changes due to microvascular damage (ST elevation, non-specific ST-T segment changes, and rhythm disorders), rise in cardiac biomarkers (troponin and natriuretic peptide levels), and accompanying myocardium involvement can be detected in patients with respiratory distress and admitted to the emergency department due to COVID-19 (1-5).

This article aims to provide practical recommendations by evaluating ECG data in the follow-up and management of the disease to the Emergency Medicine workers to whom patients affected by COVID-19 first apply.

MATERIALS AND METHODS

Our hospital is a 3200- bed tertiary referral hospital in the central region of Turkey. This prospective study was conducted from June 15 to July 15, 2020, at the Emergency Department (ED) of our hospital. The current study was approved by the Ankara City Hospitals' Ethics committee (Date: 21.05.2020, No: E1-20-599), and permissions were obtained. After ethical approval, we randomly collected the ECG data of the patients applying to our Hospital Emergency Medicine Clinic to the green, yellow, and red areas who were positive for viral RNA in throat swabs were carried out.

Patients who were at and above the age of 18 were included in the study. The study was conducted 24 hours, seven days a week. After patients' admission to the emergency department with COVID-19 symptoms, throat swap was collected for viral RNA. Positive patients' ECG data were collected and loaded to the SPSS database. All the ECG results were evaluated by an emergency medicine specialist who was also an ECG trainer. Continuous data are expressed as mean standard deviation (SD) and categorical data as number (percentage). All statistical analyses were performed using SPSS version 26.0 (IBM Corporation, Armonk, NY).

RESULTS

The ECGs of 502 patients diagnosed with COVID-19 were collected in the 2-week period between June 15, 2020, and July 15, 2020. The study included 287 males (57.17%) and 215 females (42.83%). The mean age was 50.45± 19.14 years (18-98 years).

Normal sinus rhythm was detected in 241 patients (48.01%) at ECG. As a result of ECG examinations of the patient, many rhythm disorders were detected in the remaining 261 (51.99%). A total of 3 ECG patterns, which suggested ST elevation, and 11 ECG patterns, which suggested ST depression, were decisive in terms of emergency intervention. The number of patients with atrial fibrillation was 17 (3.39%). As a result of the follow-ups of 502 patients in the Emergency Department: 1 patient died in the Emergency Department, 142 (28.29%) patients were admitted to the intensive care unit, and 246 (22.5%) patients were admitted to isolated COVID services. The other 263 (44.42%) patients who had COVID-19 positive but without symptoms and complaints were guided to isolated accommodation with medical advice accompanied by paramedics. Three patients were admitted to the Cardiology Coronary Care Unit for invasive intervention and follow-up purposes. The ECG of the patient who died in the Emergency Department was compatible with inferior MI.

Table 1. Emergency Department Admittance of COVID-19 Patients: Electrocardiography Evaluations (n: 502)

Variable	n	(%)
Sinus rhythm	241	48.01
Sinus tachycardia	151	30.08
Sinus bradycardia	14	2.79
ST elevation	3	0.60
RHV	19	3.78
LVH	27	5.38
Atrial fibrillation	17	3.39
LBBB	8	1.59
RBBB	12	2.39
Ventricular early systole	21	4.18
Anterior ischemia	2	0.40
Inferior ischemia	11	2.19
AV Block 1^0	2	0.40
QT extension	0	0.00

LVH: Left Ventricular Hypertrophy, RVH: Left Ventricular Hypertrophy
LBBB: Left bundle branch block, RBBB: Right bundle branch block

The three most common diseases in the comorbidities of the patients were hypertension in 127 patients (25.30%), cardiovascular disease in 112 patients (22.31%), Diabetes Mellitus in 109 patients (21.71%). The top three symptoms were weakness in 51.00% of patients, cough in 50.60%, fever in 42.03%, respectively.

Table 2. Comorbidities in the Cases

Comorbidities	n	(%)
Diabetes Mellitus	109	21.71
Hypertension	127	25.30
Cardiovascular Disease	112	22.31
Chronic Lung Disease	106	21.12
Chronic Kidney Disease	33	6.57
Chronic Liver Disease	47	9.36
Malignancy	74	14.74
Cerebrovascular Disease	68	13.55

Table 3. Frequency of Symptoms

Symptoms	n	%
Chest Pain	116	23.11
Fever	211	42.03
Cough	254	50.60
Palpitation	102	20.32
Shortness of Breath	186	37.05
Weakness	256	51.00
Headache	165	32.87
Anosmia	9	1.79
Ageusia	12	2.39
Diarrhea	24	4.78
Asymptomatic	223	44.42

DISCUSSION

The main characteristics of SARS-CoV-2, the new member of the Coronavirus family, are that it easily binds especially to lung Type 2 alveoli cells, ACE2 receptor in myocardia, kidney proximal tubules esophagus, intestinal epithelial cells, and bladder urothelial cells in humans (7). COVID-19, which has a high infectious characteristic, is spread especially through droplets and direct contact. The average incubation period is 5.5 days; however, it is also known to last up to 14 days (5). The symptoms of the disease usually appear within the first 14 days. In symptomatic cases, the most common symptom is fever, dry cough, weakness, muscle pain, sore throat, less frequent nausea-vomiting, and diarrhea (9). Although it is reported in the literature that the most frequent and higher rate symptom was fever in COVID-19 patients with lung infection at a rate of 31-89% (9,10), the most common complaint was weakness in our study at a rate of 51.00%, and high fever was 42.03% ranking the 3rd frequent symptom. It is also important to question and follow-up on the ageusia and anosmia disorders and diarrhea complaints reported in the literature in COVID 19 patients (11-13). As a matter

of fact, 4.78% of the patients who were admitted to our Emergency Department had diarrhea, 1.79% were unable to smell, and 2.39% and 2.39% complained that they could not taste.

Patients with underlying medical problems like the elderly, hypertension, cardiovascular disease, or diabetes are more likely to develop serious diseases. Individuals from all age groups may be infected with COVID-19, but adults of middle age and older are more frequently affected and are more likely to experience the disease more severely. In the literature, the median age of patients diagnosed with COVID-19 in hospitals ranges between 49 and 56 (9-11). In our study, the mean age was 50.45± 19.14 years.

The COVID-19 outbreak presented several difficulties in terms of cardiovascular emergencies. The risk of disease severity and death increased in COVID-19 patients with previous cardiovascular disease. This infection was associated with multiple, direct, and indirect cardiovascular complications, including acute myocardial damage, myocarditis, arrhythmias, and venous thromboembolism. The most important characteristic that makes COVID-19 infection so dreadful is that it causes respiratory failure, especially in high-risk cases; and it can severely disrupt the cardiac hemodynamic with direct myocardial development. ECG changes (ST elevation and non-specific ST-T segment changes) and elevation in cardiac biomarkers (i.e., troponin, etc.) are detected in COVID-19 patients with respiratory distress admitting to Emergency Department. It was reported in a previously published patient series that 40% of patients admitted due to COVID-19 positivity had cardiovascular or cerebrovascular diseases, 17% might develop arrhythmia, and 7% might develop acute cardiac damage. In a case reported, however, it was reported that the initial admission in COVID-19 might be acute-onset heart failure, acute Myocardial Infarction (ME), myocarditis, and sudden cardiac arrest (14,17,18). The cardiovascular disease rate in terms of comorbidity was reported between 14.5% and 40%, hypertension 14.6% and 31.2%, and diabetes 10.1 and 19.5% in some publications (9). In our cases, in line with the literature, the cardiovascular rate was 22.31%, hypertension 25.30%, and diabetes 21.71%.

The clinical impact of COVID-19 infection will be greater with advanced age and comorbidities. In this sense, it was reported that previously cardiovascular patients accounted for 22.7% of all the morbidities (19). Most

patients suspected of COVID-19 and especially patients with severe diseases or those with the probability of QT-extension should undergo ECG after admitting to the Emergency Department (20); ideally, this may be a 12-lead ECG (21). This will allow that the initial QRS-T morphology is documented in case symptoms develop, suggesting myocardial damage or acute coronary syndrome in the patient. In our study, we find no QT extension patients.

There are no adequate publications in the literature about cardiac rhythm disorders in COVID 19 patients. Arrhythmias were reported in 17% of patients and in 44% of patients admitted to the Intensive Care Unit in a study conducted with a total of 138 patients with pneumonia associated with Wuhan-induced COVID-19 (14). It was reported in another study that atrial arrhythmias were more common in patients requiring mechanical ventilation (22), and the frequency of ventricular tachyarrhythmias was also mentioned (23). There were T-wave depression and inversion, ST-segment elevation or depression, and Q waves among the coronary ECG abnormalities reported in patients with COVID-19 (24-27). In case of ST-segment elevation, other diagnostic examinations are necessary to distinguish MI from other causes of myocardial damage (25-27). In a series that included 18 COVID-19 patients with ST-segment elevation, MI developed clinically due to coronary obstruction in 8 patients (coronary angiographies that confirmed obstructive coronary disease were carried out in 6), and the remaining 10 patients were diagnosed with non-coronary myocardial damage (27), 4 of the patients with MI and 9 of those with non-coronary myocardial damage died in hospital. Obstruction was confirmed with Coronary Angiography in two of our three patients with ST-elevation, and one died despite the advanced cardiac life support.

The most common arrhythmia in COVID-19 patients is sinus tachycardia; however, atrial fibrillation, atrial flutter or ventricular tachycardia might also occur (27). Sinus tachycardia was determined to be 30.08%, LVH 5.38%, and VES 4.18% in our study.

An important issue that should not be ignored in this process may be that physicians might focus on symptoms and complaints of this disease because of primary COVID 19 diseases and neglect the presence of cardiac problems, incomplete diagnosis, or delayed diagnosis. A significant problem in MI patients who require medical care may

also occur for emergencies where admissions of patients are made separately because of delays in diagnoses and treatments. Since the delay of specific treatments of acute coronary problems can cause cardiovascular emergencies, standardization is also needed for interventional cardiology.

Our study showed that ECG plays an important role in diagnosing, following up, and treating patients admitted with COVID 19 pre-diagnosis. There are several limitations to consider when interpreting the results of our study. Firstly, the study duration was short (1 month), and the study included only one hospital; for this reason, more studies are needed to generalize the results.

It is necessary to determine the treatment process by considering cardiovascular complications and non-COVID emergencies for COVID-19 patients. Continuous ECG monitoring is not required for the patient if the cardiac arrhythmias are documented if there are no suspicious myocardial ischemia or other standard indications. However, as part of the infection control mechanisms for patients with or suspected COVID-19, continuous ECG follow-up by many hospital nurses instead of standard vital parameter follow-ups requires that clinical staff are also careful about the risk of infection.

Emergency Medicine workers must be cautious and consider the intense distribution of ACE2, which is the binding point of SARS-CoV-2, in cardiomyocytes and monitor changes in the ECG in the Emergency Department step and see the problems. As a result, we believe that our initial ECG recommendation and cardiac monitoring will play important roles in treatment planning.

Declarations

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