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Prevalence of COVID-19 Among Patients Arriving in Pre-arrest/ Cardiac Arrest, at a Tertiary Hospital's ED in the Eastern Province of Saudi Arabia During the COVID-19 Pandemic

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ABSTRACT

Background: COVID-19 pandemic has thrown the healthcare systems into confusion worldwide, resulting in major modifications on the practice due to fear of exposure to this virus and its fatal consequences. **Objective:** the study aimed to establish the prevalence of COVID-19 in cardiac arrest patients. **Methods:** single-centered, Retrospective, observational cohort study that included all patients who presented to ED during the period of the pandemic from January 2021 to May 2022 and documented to have either IN-hospital cardiac arrest (IHCA), specifically within the ED, or OUT-hospital cardiac arrest (OHCA). **Results:** This study analyzed 177 patients. Out of which, 30.5% of the patients were aged more than 70 years old. Those with associated comorbidities, the most frequently mentioned comorbidity was hypertension (40.7%). It was found that the prevalence of positive COVID-19 infection was significantly more common among non-Arab (p=0.019), patients with associated chronic kidney disease (p=0.019) and those who had an in-hospital cardiac arrest (p=0.010). No significant associations were observed between COVID-19 infection in terms of age, gender, nationality, associated comorbidities, symptoms, and trauma (all p>0.05). **Conclusion:** This study showed the prevalence of COVID-19 among cardiac arrest patients within ED and outside the hospital in our study population. Based on the study's results, the major adjustments in practice were not absolutely needed. Also, this study could help in establishing a good mitigation strategy for at-risk patients.

Keywords: COVID-19, Cardiac arrest, prevalence, In-hospital, Out hospital.

1. BACKGROUND

In December 2019, an outbreak of severe pneumonia was observed in Wuhan city of China. A novel coronavirus was isolated in patients who presented to the emergency department (ED) with symptoms and signs of severe pneumonia. This novel coronavirus was named 2019 novel coronavirus (2019-nCoV) but was named severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) later (1). Later, on 11 March 2020, World Health Organization (WHO) declared the COVID-19 pandemic (2). Due to its easy transmissibility with the lack of immunity to this novel virus, it spread all around the globe. With the overwhelming number of sick patients and deaths, collapse/near collapse of the health systems was observed in many developed countries.

OHCA increased considerably during the pandemic compared to the previous year of the pandemic, with a significant drop in survival among OHCA (3, 4). The huge number of cardiac arrest/near arrest of COVID-19 patients forced the European resuscitation council and the American heart association to change some of the previous basic and advanced life support recommendations published before the COVID-19 era (5). OHCA increased in many countries; for example, a dramatic rise of OHCA in London was observed during the first wave of the pandemic compared to the year before,

Study variables	N (%)
Age group	
· ≤30 years	19 (10.7%)
· 31–40 years	20 (11.3%)
· 41–50 years	27 (15.3%)
· 51–60 years	27 (15.3%)
· 61–70 years	30 (16.9%)
· >70 years	54 (30.5%)
Gender	
· Male	135 (76.3%)
· Female	42 (23.7%)
Nationality	
· Saudi	109 (61.6%)
· Non-Saudi	68 (38.4%)
Race	
· Arab	136 (76.8%)
· South Asian	35 (19.8%)
· Asian	03 (01.7%)
· European	02 (01.1%)
· South African	01 (0.60%)
Associated comorbidities	
· No	74 (41.8%)
· Yes	103 (58.2%)

Table 1. Socio-demographic characteristics of the patients (n=177)

Variables	N (%)
COVID-19 test	
· Positive	21 (11.9%)
· Negative	156 (88.1%)
Symptoms	
· Asymptomatic	57 (32.2%)
· Non-respiratory	83 (46.9%)
· Respiratory	37 (20.9%)
Trauma	
· No	158 (89.3%)
· Yes	19 (10.7%)
Specific type of trauma (n=19)	
· MVA	15 (78.9%)
· Fall	01 (05.3%)
· Suicide attempt	01 (05.3%)
· Others	02 (10.5%)
Cardiac arrest	
· In-hospital	26 (14.7%)
· Out-hospital	151 (85.3%)

Table 2. Prevalence of COVID-19 infection, trauma, and cardiac arrest sustained by the patients (n=177)

with a strong correlation between the daily COVID-19 cases and the number of OHCA (6).

This surge of OHCA during the pandemic suggests a larger number of COVID-19 cases in whom tests were not performed, with more unknown cases of COVID-19 patients.

As the pandemic spreads globally, it affected Saudi Arabia. The number of patients increased daily, with a subsequent increase in critical patients. Saudi Arabia was among the first to respond to the pandemic with fast and evidence-based strategies to reduce the number of cases early during the pandemic (7), which led to the stabilization of the number of cases after two months of the first COVID-19 wave within the country with a subsequent reduction in mortality rate by 6.4% (8). However, the exact number of COVID-19 patients who presented to ED during the pandemic with OHCA or near arrest within the country without respiratory complaints was not measured, leaving a possibility of a larger number of infected patients with unknown COVID status.

2. OBJECTIVE

The aim of this study was to investigate the prevalence of COVID in cardiac arrest patients during the pandemic in Saudi Arabia.

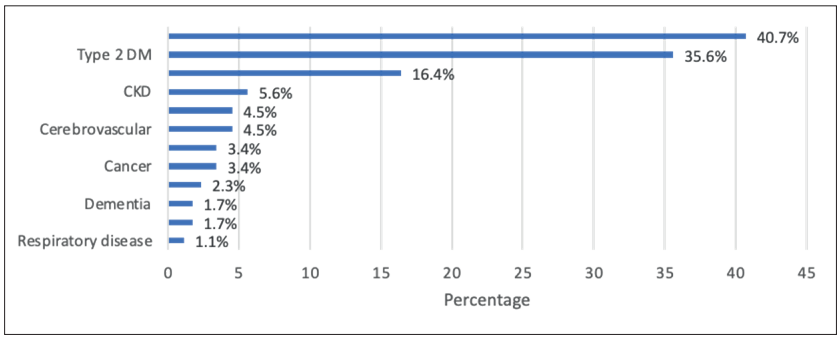

Figure 1: Specific associated comorbidities of the patients

3. MATERIAL AND METHODS

Study design and setting

This single-centered, retrospective, observational cohort study conducted in Saudi Arabia, specifically Imam Abdulrahman bin Faisal University in AL-Khobar, included all patients who presented to ED during the period of the pandemic from January 2021 to May 2022 and documented to have either IN-hospital cardiac arrest (IHCA), specifically within the ED, or OUT-hospital cardiac arrest (OHCA). The study followed the ethical standards of the institutional and national research committees and the Helsinki Declaration. Ethical approval for this study was obtained from the institutional review board at Imam Abdulrahman bin Faisal University.

Selection of participants

All patients who presented to ED during the period of study and got a pre-cardiac arrest or cardiac arrest within the ED were included in the study. After which, the selected participants who had COVID-19 tests were involved in the study as the main sample of interest in our study. Those who are documented to have a cardiac arrest and either confirmed positive or negative COVID-19 statues were selected for the analysis after

excluding the participants with significant data missing, unknown or unconfirmed COVID-19 statues and those who had cardiac arrest in any other area within the hospital other than the ED. The eligible patients' data were collected through reviewing the hospital registry system after documenting the case upon arrival to ED then the collected data were analyzed.

Outcome

The primary outcome of this study was establishing the prevalence of COVID-19 in cardiac arrest patients. The secondary outcomes included: a) Identifying the correlation between the risk factors and the risk of developing COVID-19; b) Establishing the correlation between having IN-hospital or OUT-hospital cardiac arrest and having COVID-19 infection.

Statistical analysis

The data were presented by numbers and percentages for all categorical variables. The association between COVID-19 infection in terms of the socio-demographic and clinical characteristics of the patients had been conducted using the Chi-square test and Fischer Exact test. Based on the significant results, a multivariate regression analysis was subsequently performed to determine the independent significant predictor associated with positive COVID-19 with corresponding odds ratio as well as a 95% confidence interval were also being reported. A P-value of less than 0.05 was taken as statistically significant. All data analyses were performed using the Statistical Packages for Software Sciences (SPSS) version 26 Armonk, New York, IBM Corporation.

4. RESULTS

This study analyzed 177 patients. As described in Table 1, 30.5% of the patients were aged more than 70 years old. More than three-quarters of the patients were males (76.3%) while approximately 61.6% were of Saudi nationality and 76.8% were of Arab race. The proportion of patients with associated comorbidities was 41.8%.

In Figure 1, of those with associated comorbidities, the most frequently mentioned comorbidity was hypertension (40.7%), followed by type 2 diabetes (35.6%) and CAD (16.4%), with respiratory diseases being the least mentioned (1.1%).

Factor	COVID19 test		P-value §
	Positive N (%) (n=21)	Negative N (%) (n=156)	
Age group			
· <60 years	09 (42.9%)	80 (51.3%)	0.469
· ≥60 years	12 (57.1%)	76 (48.7%)	
Gender			
· Male	16 (76.2%)	119 (76.3%)	0.993
· Female	05 (23.8%)	37 (23.7%)	
Nationality			
· Saudi	11 (52.4%)	98 (62.8%)	0.356
· Non-Saudi	10 (47.6%)	58 (37.2%)	
Race			
· Non-Arab	09 (42.9%)	31 (20.0%)	0.019 **
· Arab	12 (57.1%)	124 (80.0%)	
Associated comorbidities			
· No	09 (42.9%)	65 (41.7%)	0.917
· Yes	12 (57.1%)	91 (58.3%)	
Specific associated comorbidities †			
· Type 2 DM	08 (38.1%)	55 (35.3%)	0.799
· Hypertension	10 (47.6%)	62 (39.7%)	0.490
· Seizure disorder	01 (04.8%)	02 (01.3%)	0.317 ‡
· Cerebrovascular	0	08 (05.1%)	0.598 ‡
· Dementia	0	03 (01.9%)	1.000 ‡
· Coronary artery disease	02 (09.5%)	27 (17.3%)	0.535 ‡
· Heart failure	02 (09.5%)	06 (03.8%)	0.242 ‡
· Valvular heart disease	0	02 (01.3%)	1.000 ‡
· Respiratory disease	01 (04.8%)	09 (05.8%)	1.000 ‡
· Chronic kidney disease	05 (23.8%)	12 (07.7%)	0.019 **
· Psychiatric disorder	0	04 (02.6%)	1.000 ‡
· Cancer	0	06 (03.8%)	1.000 ‡
· Other	01 (04.8%)	05 (03.2%)	0.537 ‡
Symptoms			
· Asymptomatic	06 (28.6%)	51 (32.7%)	0.111
· Non-respiratory	07 (33.3%)	76 (48.7%)	
· Respiratory	08 (38.1%)	29 (18.6%)	
Trauma			
· No	19 (90.5%)	139 (89.1%)	1.000 ‡
· Yes	02 (09.5%)	17 (10.9%)	
Cardiac arrest			
· In-hospital	07 (33.3%)	19 (12.2%)	0.010 **
· Out-hospital	14 (66.7%)	137 (87.8%)	

Table 3. Association between COVID-19 infection according to the socio-demographic and clinical characteristics of the patients (n=177)

In Table 2, the prevalence of patients who had been diagnosed with positive COVID-19 infection was 11.9%. Non-respiratory symptoms constitute 46.9%. Patients who had trauma were 10.7%. Of them, the most frequently reported incidence of trauma was MVA (78.9%). In addition, out-hospital cardiac arrests were reported by 85.3% of the patients.

When measuring the association between COVID-19 infection in terms of the socio-demographic and clinical characteristics of the patients (Table 3), it was found that the prevalence of positive COVID-19 infection was significantly more common among non-Arab (p=0.019), patients with associated chronic kidney disease (p=0.019) and those who had an in-hospital cardiac arrest (p=0.010). No significant associations were observed between COVID-19 infection in terms of age, gender, nationality, associated comorbidities, symptoms, and trauma (all p>0.05).

When conducting a multivariate regression model (Table 4), it was observed that having chronic kidney disease and having in-hospital cardiac arrest were the

Factor	AOR	95% CI	P-value
Race			
· Non-Arab	Ref		
· Arab	0.333	0.122 – 0.908	0.032 **
Chronic kidney disease			
· No	Ref		
· Yes	4.675	1.358 – 16.093	0.014 **
Cardiac arrest			
· In-hospital	3.356	1.146 – 9.830	0.027 **
· Out-hospital	Ref		

Table 4: Multivariate regression analysis to determine the factor associated with COVID-19 (n=177) AOR – Adjusted Odd Ratio; CI – Confidence Interval. ** Significant at p<0.05 level.

independent significant predictors of increased risk for COVID-19 infection while being an Arab race was the independent significant predictor of decreased risk for COVID-19 infection. This further indicates that compared to patients without CKD, the risk of COVID-19 infection among CKD patients was predicted to increase by at least 4.7 times higher (AOR=4.675; 95% CI=1.358 – 16.093; p=0.014). Compared to out-hospital cardiac arrest patients, patients who had in-hospital cardiac arrest were predicted to increase the risk of COVID-19 infection by at least 3.36-fold higher (AOR=3.356; 95% CI=1.146 – 9.830; p=0.027). On the other hand, compared to the non-Arab race, the risk of COVID-19 infection among the Arab race was predicted to decrease by at least 67% (AOR=0.333; 95% CI=0.122 – 0.908; p=0.032).

5. DISCUSSION

Our study describes the prevalence and the association of positive covid-19 test upon arrival of the patients to the hospital in cardiac pre-arrest or arrest state.

Out of the total 177, most of the involved patients were older than 50 years old (62.7%) with the highest number of patients being among "older than 70 years old" age group (30.5%). The highest proportions of gender, nationality, race, and the association with comorbidities are seen in the patients who are Male, Saudi, Arab and having comorbidities, constituting 135 (76.3%), 109 (61.6%), 136 (76.8%) and 103 (58.2%) out of the total number of patients, respectively.

Likewise in the Sweden study, it shows that the IN-hospital cardiac arrest group's mean age in the pre-pandemic period was 70.1 years, as compared with 67.8 years during the pandemic (9). Female gender was less common compared to males during the pandemic vs. pre-pandemic period (36.1% vs. 38.6%). Cardiac arrest in the emergency department (ED) was more common during the pandemic vs. pre-pandemic period (16.2% vs. 10.2%) (9).

While in the OUT-hospital cardiac arrest group, 930 cases were registered before the pandemic period and 1016 cases during the pandemic, of which 422 had data on COVID-19 status. COVID-19 cases were around 4 years younger than patients without the infection (9). Overall age during the pandemic was 69.6 years, as compared with 70.8 years pre-pandemic (9). Females constitute minority of numbers with a 33.3% of COVID-19-positive cases, 28.4% of COVID-19-negative cases, and 33.6% of cases with unknown COVID-19 status. COVID-19-positive cases suffered cardiac arrest at home in 87.5% of cases, as compared with 76.9% among COVID-19-negative cases (9).

To break down the primary results, this study demonstrated the whereabouts of cardiac arrest among the 21 (11.8%) confirmed COVID-19 cases and showed that the OUT-hospital cardiac arrest is described to be 14 (66.7%) while the IN-hospital cardiac arrest is 7 (33.3%).

In a French population, confirmed and suspected cases of COVID-19 accounted for only 30% of the observed increase in the incidence of OUT-hospital cardiac arrest (10). Other findings from New York in the US reports that the IN-hospital cardiac arrest in among COVID-19 patients' rates from 3%-7%.(11). Supporting the previously stated rates is a multicenter study from the United States, in which out of 5014 severely diseased patients who were having COVID-19 virus, 701 (14%) patients had IN-hospital cardiac arrest (12).

A Sweden study demonstrated that the prevalence of COVID-19 among OUT-hospital cardiac arrest group and IN-hospital cardiac arrest group are 20.9% (88 out of 422) among cases with available information and 20.2% (72 out of 357), respectively (9).

In our analysis, the most frequent risk factors for death during the COVID pandemic were hypertension (40%.7), diabetes mellitus (35.6%), coronary artery disease (16.4%), and chronic kidney disease (CKD) (5.6%). Less frequently occurring diseases include respiratory illness, cancer, neurovascular illness, and cerebrovascular illness.

Likewise, seven studies with 1,576 infected individuals were included in the meta-analysis conducted by Jing Yang et al. to determine the prevalence of comorbidities in COVID-19 patients. In their meta-analysis, most patients have HTN, DM, and CVD which constitute 21.1%, 9.7%, and 8.4% out of all comorbidities, respectively (13).

Furthermore, in a cross-sectional study by Pamela H. Lai et al., mortality increased considerably with HTN and DM (53.5% and 35.7%) in 5325 patients who experienced out-of-hospital cardiac arrests (14).

A total of 136 patients participated in Phatthranit Phattharapornjaroen et al, a single-center, retrospective cohort study in Thailand to evaluate the characteristics and prognosis of patients who experienced out-of-hospital cardiac arrest during and before the COVID-19 pandemic (15). Hypertension and diabetes were present in 46.67% and 25% of people, respectively (15).

Furthermore, our study demonstrates that the presence of HTN and DM has no effect on COVID-19 positive or negative mortality. Moreover, 23.8% of patients

who tested positive for COVID-19 also had chronic renal disease, which suggests that CKD may increase mortality in COVID-19-positive cases.

Jennifer E. Flythe et al. studied the link between the severity of underlying renal disease and in-hospital outcomes in critically sick COVID-19 patients with and without pre-existing chronic kidney disease (CKD) (16) A retrospective cohort analysis of 4,264 COVID-19 patients in critical condition was conducted. In 68 hospitals across the United States, 3,600 people without pre-existing CKD were admitted to intensive care units (ICUs), along with 143 people who had pre-existing kidney failure and were receiving maintenance dialysis, 521 people who had pre-existing non-dialysis-dependent CKD, and people who did not have CKD. According to the findings, people with severe kidney disease have a high mortality rate (16).

In our study, COVID-19 testing was negative in the majority of cardiac arrest patients. In patients where COVID-19 was positive, respiratory symptoms predominated. Furthermore, non-respiratory symptoms (46.9%) are the most often reported symptom for cardiac arrest patients during the COVID-19 pandemic. The prevalence of traumatic cardiac arrest is 10.7%, and the most common type of trauma recorded was a motor vehicle accident (78.1%).

As shown by Magdalena J. Borkowska et al. retrospective study of 527 patients found to have a cardiac arrest, the reasons for calling EMS were unconsciousness (29.2%), sudden cardiac death (25.4%), and dyspnea (12.7%) (17). This study was conducted in Poland to evaluate how well EMS teams treated OHCA during the COVID-19 pandemic (17).

This study is the first of its kind in the Middle East area, rendering it the basis for further studies in the future that would address the risk factors, the management upon arrival to the ED, and the outcome of a certain management on the patients.

The prevalence of cardiac arrest appears to be low among the COVID-19 patients, which makes the fear exhibited by health care providers and the subsequent modifications in the practice to avoid death due to COVID-19 infection impractical.

The study is conducted to be a pioneer in paving the way for further studies but is limited to its low sample number, and susceptibility to cohort selection bias in which the chosen sample may favor a specific outcome over the other.

6. CONCLUSION

This study addressed the prevalence of COVID-19 among cardiac arrest patients within ED (33.3 %) and outside the hospital (66.7%) out of 21 COVID-19 positive patients. Suggesting that the understandable fear of healthcare providers exposure and the infection from this population might not have required the major adjustment in practice. CKD patients were associated with increased risk of having COVID-19 infection. Therefore, this study could be the basis for further research that addresses specific mitigation strategies to protect high-risk populations.

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