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Profile trends of non-COVID patients admitted to the cardiac intensive care unit during the 2020 COVID pandemic

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ABSTRACT

Background: During the COVID-19 outbreak, numerous reports indicated a higher mortality rate among cardiovascular patients. We investigated how this trend applied to patients admitted to the cardiac intensive care unit (CICU).

Methods: We retrospectively compared CICU patients admitted during the initial peak of the COVID outbreak between February and May 2020 (Covid Era, CE group) to a control group in pre-pandemic time in 2019. We interviewed patients to determine the symptom onset time and the time interval between symptomology and hospital arrival.

Results: The data of 292 patients were used in the analysis (119 patients in the CE group and 173 in the control group). CE patients had a higher incidence of ischemic heart disease (IHD) ($p<.03$), heart failure ($p<.04$), and psychiatric disorders ($p<.001$). During COVID time, more patients were hospitalized with myocarditis (OR: 26.45), arrhythmias (OR: 2.88), and new heart failure (HF) ($p<.001$) and less with STEMI (OR: 0.39; 95% CI: 0.24−0.63). Fewer PCIs were performed in the CE group ($p<.001$), with an overall lower success rate ($p<.05$) than reported in the control group. Patients in the CE group reported a longer period between symptom onset to hospital arrival ($p<.001$, $\chi 2 = 12.42$). The six-month survival rate was significantly lower in CE patients ($\chi 2 = 7.01$, $P = 0.008$).

Conclusions: Among CICU patients admitted to our center during the initial period of the COVID pandemic, STEMI events were less frequent while cases of newly diagnosed HF sharply increased. Patients waited longer after symptom onset before seeking medical care during the pandemic. The delay may have resulted in clinical deterioration that could explain the high mortality rate and the new HF admission rate.

Key Indexing Terms: Covid-19; Cardiac intensive care unit. **[Am J Med Sci 2022;364(2):168–175.]**

INTRODUCTION

The COVID-19 outbreak is a devastating pandemic initiated in late 2019 and is still causing destruction worldwide. The scientific community continuously urges researchers and shares medical information. Numerous reports worldwide have described a significant reduction in hospital admissions due to ST-elevation myocardial infarction and acute coronary syndrome (ACS) during the outbreak.[1-7] In contrast, others pointed toward a trend of delayed arrival of ACS patients to the hospital.[2,8]

We believe that these trends result from patients deferring to seek medical care, possibly influenced by several factors such as mental status, economic considerations, social factors, concerns related to government decisions and limitations, and fear of being infected with COVID-19.[9–11] Under the influence of such factors, the delay in seeking medical care may lead to preventable and unnecessarily poor outcomes for non-COVID patients.

To date, the impact of COVID-19 on cardiovascular disease and related outcomes in Israel remains unclear. Furthermore, the effect of treatment delay in non-COVID CICU patients has not been described previously. We, therefore, performed a retrospective cohort study comparing CICU patients during and prior to the COVID-19 pandemic. We hypothesized that non-COVID patients requiring cardiac intensive

care early in the COVID-19 pandemic faced higher short-term mortality rates than those who required the same care prior to the pandemic. We believe that much of these differences in outcomes are accounted for by a delay in hospital presentation, which may have been influenced by public policy, public advisories, economic considerations, and fear of exposure.

We believe that non-COVID patients requiring cardiac intensive care early in the COVID-19 pandemic faced higher short-term mortality rates than those who required the same care prior to the pandemic. We believe that much of these differences in outcomes are accounted for by a delay in hospital presentation, which may have been influenced by public policy, public advisories, economic considerations, and fear of exposure.

METHODS

We designed an observational cross-sectional retrospective study conducted in the Cardiology Department at Emek Medical Center in collaboration with the Integrative medicine service and the emergency department. The study population included patients admitted to the CICU from February to May 2020. This time interval captured the first period of the COVID-19 outbreak in Israel. The patient's medical information, including baseline characteristics, procedural reports, complications, and mortality, were collected from the Clalit health data system (Orion, Ofek, and Chameleon) and compared to the control period 2019. Inclusion criteria were CICU admission for one or more of the following diagnoses: ST-elevation myocardial infarction, non-ST elevation myocardial infarction, atrioventricular block, supraventricular and ventricular arrhythmias, acute decompensated heart failure, cardiac arrest, and myocarditis.

Patients were excluded if initially hospitalized for an elective procedure or expressed a request not to be included in the study when a hospital coordinator contacted the patient to address incomplete medical information.

Ethics

Emek Medical center IRB approved the study following the Helsinki Convention No. EMC-20−0057 and waived the need for informed consent due to the anonymous use of patients' data and the study's retrospective nature.

Research planning

From February to May 2020, 749 patients were hospitalized in the CICU (CE group), while 691 were hospitalized in 2019 (control group). Six hundred twenty-eight patients in the CE group and 517 patients in the control group were excluded as they did not meet the inclusion criteria.

One hundred twenty-one patients in the CE group and 174 patients in the control group were eligible for the study. We excluded two patients in the CE group and one in the control group from analysis due to incomplete data files (Fig. 1). The patient's medical information was collected from Clalit health data service (Orion, Ofek, and Chameleon).

Sample size

Initial reports of heart failure hospitalization and cardiovascular mortality indicated an increase of 30 to 66% of heart failure hospitalization and an increase of approximately 5% in mortality.[12–16] The margin of error calculated using a cumulative incidence of acute adverse cardiovascular events and mortality was 4.47%, requiring a minimum sample size of 284 patients for a statistical difference of 80% and an alpha of 5% in a two-sided test.

Statistics

Continuous variables were compared between vascular complication versus no complication groups using the 2-tailed student's *t*-test or Man Whitney U test and presented as mean ± standard deviation or median and interquartile range, respectively. Categorical variables were expressed as frequencies and percentages and compared using the chi-square or Fisher exact test.

Multivariable logistic regression was performed using the minimum Akaike Information criteria (minimum AIC) for variable selection using all demographic baseline characteristics with $p<.05$ in the univariate analysis as candidates.

The clinical characteristics were adjusted for sex and significant background variables using binary logistic regression. Cox regression analysis was performed to assess differences between the two time periods in the hospital, one-month, and 6-month mortality. Two-sided p values were considered significant if they were less than 0.05. All statistical analyses were performed using JMP version 15.2.0 (SAS Institute) and SPSS statistical package, version 24.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Seven hundred forty-nine patients were hospitalized in the CICU during the initial COVID-19 outbreak (February to May 2020). Among them, 121 adult patients had at least one of the following diagnoses: myocardial infarction, atrioventricular block, arrhythmias, heart failure, cardiac arrest, and myocarditis and were eligible for the study.

One hundred seventy-four patients were eligible for the study and consisted of the control group. Two patients from the CE group and one from the control group were excluded from analysis due to incomplete data records.

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The mean age was 62.85±15.45 and did not differ among study groups ($p<.62$). There was a slight tendency toward male sex in the control group (83.8 vs. 75.6%; respectively, $\chi2 = 3.01$, $p<.08$). Patients in the CE group had a higher rate of ischemic heart disease ($\chi2 = 4.68$, $p<.03$), heart failure ($\chi2 = 4.42$, $p<.04$), and psychiatric disorders ($\chi2 = 11.06$, $p<.001$) compared to control. The average duration of hospitalization was 3.35 ± 1.8 days in both groups ($p<.8$) (Table 1).

The time from onset of symptoms to hospital arrival was longer and statistically significant in the CE group compared to the control group (t (290) = 4.98, $p<.001$) (Table 2). This difference remained significant after adjusting for sex, smoking, IHD, heart failure, and psychiatric disorders (F (1282) = 24.68, $p<.001$). 76 (63.9%). Patients in the CE group arrived at the hospital after more than 12 h from the onset of symptoms compared to 20 (11.5%) patients in the control group (Fig. 2).

There was a statistically significant difference in the percent of patients diagnosed with STEMI ($\chi^2 = 15.04$, $p<.001$), arrhythmias ($\chi^2 = 8.09$, $p<.005$), and myocarditis ($\chi^2 = 11.96$, $p<.001$). The odds ratio of a STEMI diagnosis in 2020 was 61% less than in 2019 (OR: 0.39; 95% CI: 0.24−0.63). Meanwhile, the odds ratio of myocarditis and arrhythmias was more than 4.5 (OR: 4.45; 95% CI: 1.51−462.86) and nearly 2.9 (OR: 2.88; 95% CI: 1.36 −6.10), respectively (Fig. 3). After adjusting for sex, smoking, IHD, heart failure, and psychiatric disorders, the difference in STEMI remained significant ($\chi^2 = 6.56$, $p<.01$), as did the difference in myocarditis (bootstrap $p<.001$); there was no longer a statistically significant difference in the diagnosis of arrhythmias ($\chi^2 = 2.37$, $p>.12$) (Fig. 3).

Fewer PCIs and urgent catheterizations were performed in the CE group ($\chi^2 = 11.81$, $p<.001$, $\chi^2 = 26.94$, $p<.001$; respectively), and the success rate (defined by

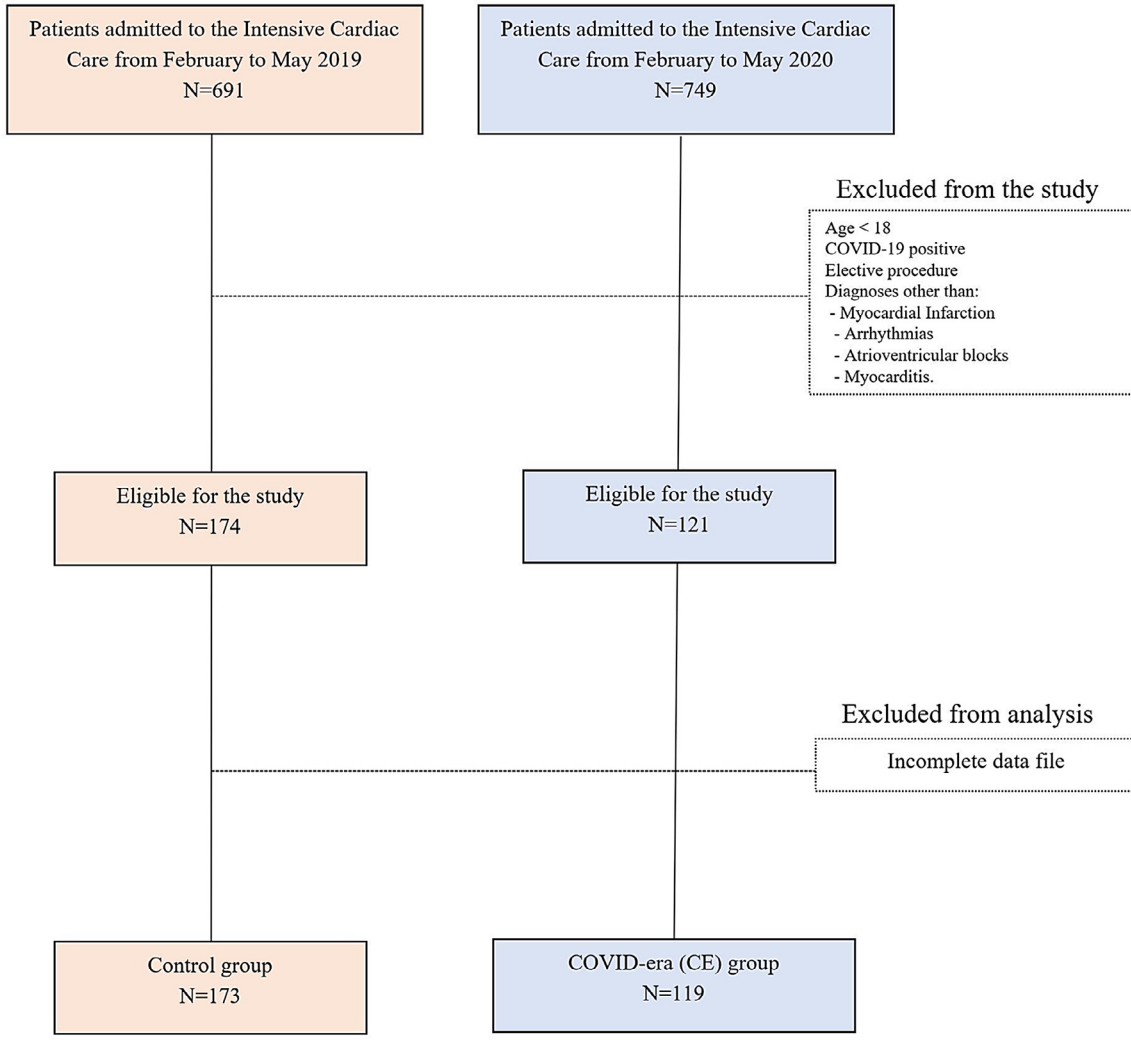

FIG. 1. Study plan.

Table 1. Patient baseline characteristics among study groups.

	Control-Group (*N* = 173)	CE-Group (*N* = 119)	p-Value
Age	62.4 ± 13.7 (63; 18–93)	63.3 ± 17.2 (65; 18–94)	.62
Sex-male	145 (83.8)	90 (75.6)	.08
Marital status			.20
Married	122 (79.7)	79 (71.2)	
Single	9 (5.9)	12 (10.8)	
Divorced	5 (3.3)	8 (7.2)	
Widow	17 (11.1)	12 (10.8)	
Smoker	82 (47.4)	41 (35.3)	.04
Family history of IHD	41 (23.8)	33 (27.7)	.45
Obesity	51 (29.8)	36 (30.3)	.94
Hypertension	104 (60.1)	74 (62.2)	.72
Hyperlipidemia	120 (69.4)	80 (67.2)	.70
Diabetes mellitus	79 (45.7)	47 (39.5)	.30
Ischemic Heart Disease	61 (35.3)	57 (47.9)	.03
Atrial fibrillation	14 (8.1)	10 (8.4)	.92
Heart failure	15 (8.7)	20 (16.8)	.04
Aortic stenosis	12 (6.9)	7 (5.9)	.72
Psychiatric disorders	7 (4.0)	18 (15.1)	.001
Duration of Hospitalization (days)	3.4 ± 1.9 (3; 1–14)	3.3 ± 1.7 (3; 1–13)	.84
Mode of arrival			.35
Intensive care ambulance	67 (53.2)	40 (46.5)	
Ambulance	24 (19.0)	14 (16.3)	
Self-arrival	35 (27.8)	32 (37.2)	
Unknown	46 (26.6)	33 (27.7)	

Data is mean ± SD (median, range) for continuous data and N (%) for categorical data.

Table 2. Patients' characteristics during hospitalization.

	Control Group (*N* = 173)	CE-Group (*N* = 119)	p-Value	OR (95% CI)	Adjusted OR
Time from symptoms (hours)	1.83±1.11 (2; 0–5)	2.64±1.51 (3; 0–5)	.001	-------	—
Primary diagnosis			.001		
STEMI	111 (64.2)	49 (41.2)	.001	0.39 (0.24–0.63)	0.50 (0.30–0.81)
NSTEMI	31 (17.9)	19 (16.0)	.66	0.87 (0.46–1.63)	—
Heart failure	2 (1.2)	6 (5.0)	.07	4.54 (0.90–22.89)	4.94 (0.95–25.67)
CVA	13 (7.5)	10 (8.4)	.78	1.13 (0.48–2.67)	—
Arrhythmia	12 (6.9)	21 (17.6)	.005	2.88 (1.36–6.10)	2.01 (0.83–4.88)
Myocarditis	0 (0.0)	8 (6.7)	.001	4.45 (1.51–14.86)	4.13 (1.89 – 8.4)
Cardiac Arrest	4 (2.3)	6 (5.0)	.21	2.24 (0.62–8.13)	—
PCI performed	133 (76.9)	69 (58.0)	.001	0.42 (0.25–0.69)	0.54 (0.32–0.94)
Urgent PCI	113 (65.3)	41 (34.5)	.001	0.28 (0.17–0.46)	0.34 (0.20–0.57)
D2B Time (min) for STEMI and primary PCI patients	*N* = 107 45.5 ± 25.7 (40; 15–183)	*N* = 37 45.4 ± 29.1 (41; 17–185)	.87	—	—
Successful PCI	131 (98.5)	63 (92.6)	.05	0.19 (0.04–1.02)	0.18 (0.03–1.03)
Acute Kidney Injury	17 (9.8)	37 (31.4)	.001	4.19 (2.22–7.90)	4.34 (2.20–8.58)
Heart Failure	31 (17.9)	49 (42.1)	.001	3.21 (1.88–5.46)	4.80 (2.65–8.70)
Valvular complication	3 (1.7)	3 (2.6)	.63	1.49 (0.30–7.52)	—
MI complication	0 (0.0)	0 (0.0)	—	—	—

STEMI, ST-elevation myocardial infarction; NSTEMI, Non-ST elevation myocardial infarction; CVA, cerebrovascular accident; PCI, percutaneous coronary intervention; D2B, door-to-balloon time; MI, myocardial infarction.

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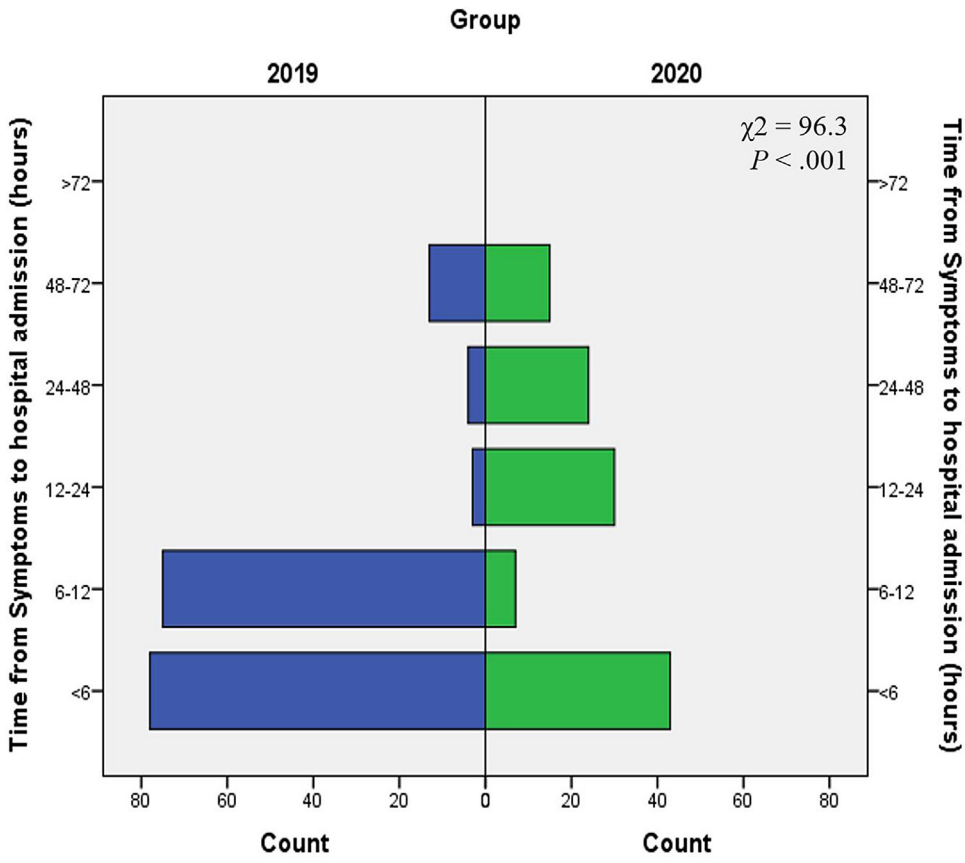

FIG. 2. Time from onset of symptoms to hospital arrival among study groups.

an opened infarct-related artery) was significantly lower (92.6% and 98.5%, respectively, $\chi^2 = 4.69$, $p<.05$) compared to control group (Table 2).

Patients presented with new heart failure on admission were significantly higher in CE-group ($\chi2 = 19.17$, $p<.001$), This remained statistically significant after

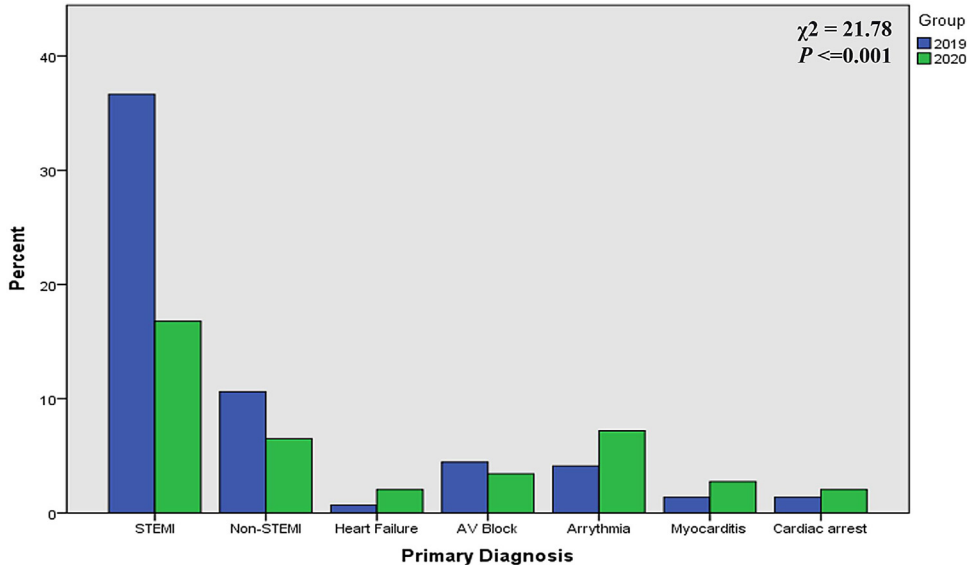

FIG. 3. Prevalence of primary diagnosis among study groups.

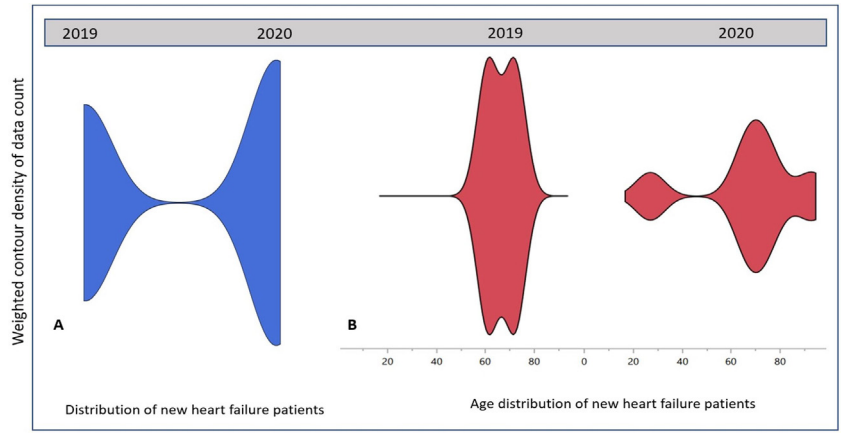

FIG. 4. Distribution of new heart failure patients among study group with and without correlation to age distribution.

correcting for sex, smoking, IHD, heart failure, and psychiatric disorders ($\chi 2$ = 17.85, p<.001, $\chi 2$ = 26.76, p<.001, respectively). Age distribution density pattern among new heart failure patients in 2020 reveals three peaks, with the highest in the early sixties (Fig. 4). Coronary artery disease was the most common reason for the new HF cases in the CE group and was significantly higher than the control group (83% vs. 50%, 2020 vs. 2019 respectively, p<.001) (Fig. 4).

Cox regression survival analysis revealed a statistically significant difference in 30-day mortality rate (95% CI, 0.253 – 0.913, P = .04) and a 6-month mortality rate (95% CI 0.218 – 0.842, p = .01) between the study groups (Figs. 5-6).

DISCUSSION

Our cohort study describes the experience of a single-center university-affiliated medical center in northern Israel that serves about 700,000 residents of the adjacent region. The medical center is part of the largest HMO in Israel, Clalit health service.

Hospital policy was strongly affected by the pandemic progress. Elective procedures were rescheduled, the length of hospital stay was shortened, patients were advised to defer medical care only in case of severe symptoms or uncontrolled situations, and only severe cases resulted in hospital admission.[17–20] This policy was standard in the early phases of the pandemic. In a cardiology department's daily life, this policy resulted in postponing annual pacemaker's interrogation, delaying invasive and non-invasive tests such as coronary angiography, cardiac CT, stress echocardiogram, and myocardial perfusion stress for patients with stable angina.[21–23] As the pandemic progressed and the evidence from clinical studies started to show that "ignoring" the cardiac patients may result in devastating and unnecessary damage, the policy has been changed and encouraged patients with any cardiovascular symptoms to seek medical care without delay.[24–30]

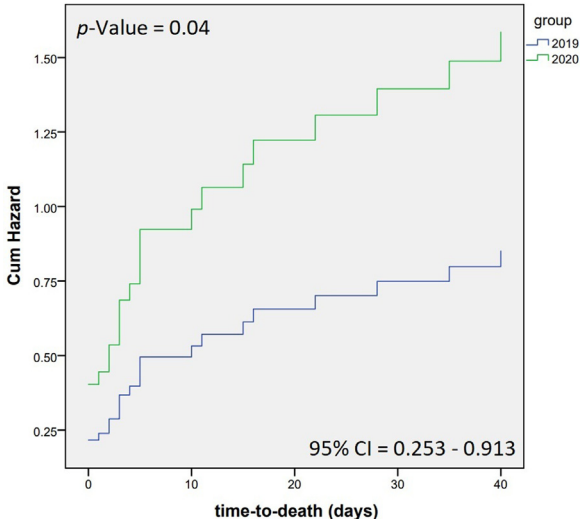

FIG. 5. A 30-day Cox-regression survival curve.

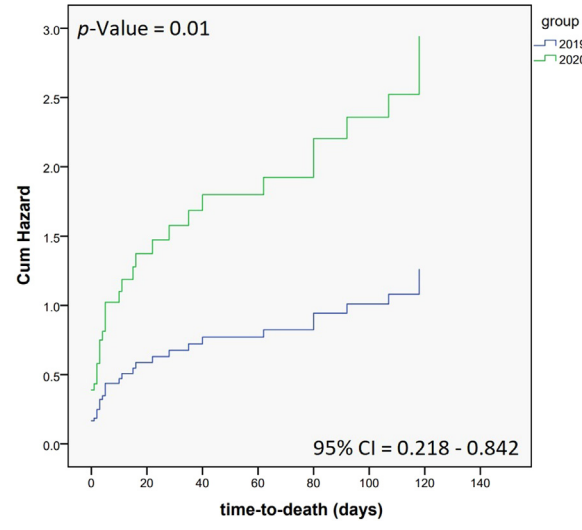

FIG. 6. A 6-month cox-regression 1 - survival curve.

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Our study reflects the clinical impact during the pandemic and reveals a different cardiovascular risk profile of patients hospitalized in cardiac intensive care during the COVID period compared to 2019. We treated more severe patients with a higher prevalence of ischemic heart disease, heart failure, and anxiety disorders at the CICU.

Patients in the COVID-era group, especially the STEMI patients, sought medical care 12 h to days from the onset of symptoms, directly impacting the necessity of primary PCI and the revascularization success rate. Furthermore, a significant proportion of patients showed well-established myocardial infarct with less chance for reversible myocardial salvage (Q wave on ECG, bundle branch block, a myocardial scar on echocardiogram).

We believe that the delay in hospital arrival is directly linked to the increased incidence of new heart failure patients seen in the COVID-era group, strengthening the importance of early revascularization.

The mortality rate, seen up to six months from admission, should alert health policy management. The poor outcomes could be easily prevented if adequately addressed on time. Further studies are needed to explore the long-term clinical impact of delayed hospital arrival of non-COVID patients.

LIMITATIONS OF THE STUDY

Our study is a single-center experience and does not reflect a national state. Moreover, each region has its profile of patients, and the national publicity strategy differs significantly; however, during this outbreak, we thrive on rapid reports from all over the world to prevent, if possible, unnecessary harm.

The study population constitutes approximately 75% to 80% of non-elective CICU patients. We intended to explore a more severe and complicated subgroup of patients, which we believe faithfully reflects the general population in our CICU. We included patients hospitalized in the CICU with a specific diagnosis and not the entire CICU patients.

CONCLUSIONS

Our study revealed trends in the cardiovascular profile of non-COVID patients admitted to the intensive cardiac care unit during the pandemic. There were significantly more patients with newly diagnosed myocarditis, arrhythmias, and heart failure and fewer STEMI cases than in 2019.

The short and long-term mortality rate from non-COVID-related causes was much higher than in 2019. A concerning effect of a significant extended period between symptom onset to hospital arrival was noticed. Patients with cardiovascular symptoms may have been influenced by health policy and avoided medical contact even in the case of a medical emergency. They sought medical care hours and days from symptoms, usually with progressive heart failure where primary coronary revascularization seems ineffective in myocardial salvage and accompanied by a lower success rate. Our results may partially support the mortality rate reported worldwide. Health care policy leaders should be alert of the consequence of absolute restrictions and the influence of patients' own medical decisions.

AUTHOR CONTRIBUTIONS

OK and MS conceived and designed the study. OK, wrote the manuscript. AS, SAR, and MB collected the data and were involved in the analysis. DB and ALR assist in the revision process. ER, YT and EM review the final version.

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DECLARATION OF COMPETING INTEREST

The authors report no relationships that could be construed as a conflict of interest.

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