

Effects of COVID-19 Pandemic on the Treatment Management of ST-elevation Myocardial Infarction

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Abstract

Background: The outbreak of coronavirus disease 2019 (COVID-19) in early 2020 has affected reperfusion time in patients with ST-segment elevation myocardial infarction (STEMI) across the globe.

Aim: The present study aimed to assess the effect of the COVID-19 pandemic on the treatment management of STEMI.

Method: This quantitative cross-sectional descriptive-analytical study investigated medical records of all patients (n=279) with STEMI who were consecutively admitted to Heshmatieh Hospital in Sabzevar city and underwent Primary Percutaneous Coronary Intervention (PPCI) in the last 9 months of 2019 (from April to December) as "Pre-pandemic group" (n=161) and the same period in 2020 as "post-pandemic group" (n=118). The data collection tools were a demographic information form and a checklist for recording treatment information.

Results: The average times from the symptom onset to first medical contact (FMC) and from FMC to the commencement of PPCI were significantly increased in the post-pandemic group, compared to those in the pre-pandemic group (870.50±1397.48 versus 348.80±399.20 min and 73.23±91.87 versus 52.68±27.46 min, respectively). The mean length of stay was reduced after the intervention in the post-pandemic group. Despite the reduction in the number of STEMI patients' referrals in the post-COVID-19 pandemic period, the comparison of the referral of patients by month showed no significant difference between the two study groups before and after the COVID-19 pandemic.

Implications for Practice: The COVID-19 pandemic caused treatment delay and reduced hospital stay among STEMI patients. The results of this study can be used to inform the community and better manage time-dependent diseases, such as STEMI, in the future.

Keywords: COVID-19, Primary percutaneous coronary intervention, ST-elevation myocardial infarction, Time-to-treatments

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Introduction

On December 31, 2019, the cases of unknown pneumonia that initiated to spread in Wuhan, China, were named by the World Health Organization as coronavirus 2019 (COVID-19) (1). Iran was later affected by this virus and the first confirmed case of the disease was reported on February 19, 2020 (2). Since this was an unknown disease, the necessity of following health protocols and public quarantine has had a significant impact on the rate of hospital referral and healthcare center visits by patients (3).

The prognosis of ST-elevation myocardial infarction (STEMI) is a time-dependent process worsened by increased treatment delay. Therefore, a timely diagnosis and appropriate treatment with percutaneous coronary intervention or thrombolytic have been demonstrated to reduce ischemic time, mortality rate, as well as short-term and long-term complications, in these patients (4-6). The COVID-19 pandemic and related limitations can affect ischemic time in patients with STEMI and pose a serious challenge to the treatment of these patients (7). Reports from all over the world have pointed to a marked reduction in admission and an increase in treatment times in STEMI patients in this pandemic period.

Moreover, the fear of Covid-19 infection prevents patients from seeking medical care at an appropriate time and they tend to stay indoors. Consequently, delayed or lack of referral to medical centers for receiving medical care worsens their physical condition (patient delay) (8). Furthermore, the unavailability of optimal prehospital services and the time required to wear personal protective equipment at each level of care provided by the treatment staff cause a delay in diagnosis to restore coronary blood flow by using primary percutaneous coronary intervention (PPCI) in areas affected by the COVID-19 pandemic (treatment delay) (9). The majority of previous studies have reported a reduction in the rate of PPCI and an elevation in treatment time after the COVID-19 pandemic (10-12). Since the performance of the treatment team, including nurses, have a significant impact on the prognosis of STEMI patients, raising their awareness of STEMI treatment time management can contribute to more effective treatment of patients. Therefore, the present study aimed to evaluate the effect of the COVID-19 pandemic on the management of STEMI patients admitted to hospitals.

Methods

This cross-sectional study investigated medical records of all patients with STEMI who were consecutively admitted to Heshmatieh Hospital in Sabzevar in Khorasan Razavi province and underwent PPCI in the last nine months of 2019 (from April to December) as "Pre-pandemic group" and the same period in 2020 as "post-pandemic group". The inclusion criterion was all medical records of patients with STEMI diagnosis who underwent PPCI during the study period. On the other hand, all medical records of patients who underwent Fibrinolytics or any other conservative treatment due to late referral for PPCI at the designated time were excluded from the study. In general, a total of 279 medical records were gathered. The pre-pandemic group included 161 cases and the post-pandemic group consisted of 118 cases. Data of two groups of medical records were collected and compared.

The data collection tools used in this study were: demographic information form and a checklist for recording treatment information. Demographic information of patients comprised of age, gender, number of children, education level, occupation, place of residence, and marital status. The other patient information which was collected and analyzed included the number of STEMI patients, number of PPCI cases, hospital patient transfer, as well as treatment times, including time between symptoms onset and triage entry, time from triage entry until the physician visit, the time from the physician visit till the PPCI, door-to-balloon time, and the total time from the onset of symptoms to the intervention in two similar times (before and after COVID-19 pandemic). In addition, the present study assessed the effect of the COVID-19 pandemic on the rate of STEMI patients transfer by medical emergency services to hospitals and the length of hospital stay in patients undergoing PPCI by comparing the two times periods (before and after the COVID-19 pandemic). Moreover, the effects of the number of children, occupation, education level, marital status, and place of residence on pre-hospital delay were assessed.

This study was reviewed and approved by the Research Ethics Committee of Sabzevar University of Medical Sciences. The study data were analyzed in SPSS software (version 25.0). Descriptive statistics (relative frequencies, mean, and standard deviation) were used to determine the average of

each time and the frequency distribution of mortality. Furthermore, for statistical analysis, the independent t-test, ANOVA, and Chi-square were used with a 95% confidence interval.

Results

The mean age scores of the patients in the pre and post-pandemic groups were reported as 59.53 ± 12.26 and 61.41 ± 13.36 , respectively. Demographic information, including gender, number of children, education level, place of residence, occupation, and marital status, were consistent in the two groups (Table 1).

Table 1. Demographic characteristics of study participants before and after COVID-19 pandemic

		Pre-pandemic (161) N (%)	Post-pandemic (118) N (%)	p-value*
Gender	Male	115 (71.4%)	77 (65.2%)	0.271
	Female	46 (28.6%)	41 (34.8%)	
Number of children	0-1	11 (7.1%)	6 (5.1%)	0.194
	2-3	51 (32.7%)	28 (23.9%)	
	4-5	50 (32%)	54 (46.2%)	
	6-7	32 (20.5%)	20 (17.1%)	
	7>	12 (7.7%)	9 (7.7%)	
Education level	Illiterate	70 (43.4%)	54 (45.8%)	0.787
	Primary	60 (37.3%)	38 (32.2%)	
	High school	13 (8.1%)	8 (6.8%)	
	Diploma	10 (6.2%)	11 (9.3%)	
	Collage	8 (5%)	7 (5.9%)	
Place of residence	Urban	117 (72.7%)	74 (62.7%)	0.331
	Rural	44 (27.3%)	44 (37.3%)	
Occupation	Freelance worker	84 (53.8%)	48 (41%)	0.203
	Housekeeper	45 (28.9%)	41 (35%)	
	Retired	21 (13.5%)	21 (18%)	
	Employee	6 (3.8%)	7 (6%)	
Marital status	Single	3 (1.9%)	3 (2.5%)	0.440
	Married	140 (86.9%)	96 (81.4%)	
	Widowed	18 (11.2%)	19 (16.1%)	

*Chi-square test

Table 2. Treatment times of the participants in both pre- and post-pandemic groups

	Pre-pandemic (n=161) Means±SD	Post-pandemic (n=118) Means± SD	95% Confidence Interval	P-value*
Symptom onset to triage entry (min)	348.80±399.20	870.50±1397.48	[-752.14, -295.26]	0.001
Triage entry to ECG (min)	3.75±2.87	5.91±6.11	[-3.24, -1.08]	0.001
ECG to physician visit (min)	19.62±16.99	20.56±17.65	[-5.06, 3.18]	0.654
Physician visit to PPCI (min)	29.32±20.90	47.76±91.47	[-32.12, -2.77]	0.020
Door-to-balloon (min)	52.68±27.46	73.23±91.87	[-35.63, -5.46]	0.008
Symptoms onset to PPCI (min)	401.48±400.58	945.73±1405.48	[-773.94, -314.55]	0.001
Length of stay after PPCI (day)	4.39±6.02	3.22±1.64	[0.05, 2.28]	0.042

*Independent t test min: Minute

As displayed in Table 2, treatment times, from the onset of symptoms until admission to triage, arrival at triage to obtaining an electrocardiogram (ECG), and physician visit to PPCI, were significantly increased in the post-pandemic group, compared to those in the pre-pandemic group, while the time between ECG gathering and physician visit was not significantly different before and after the COVID-19 pandemic. Moreover, overall times, including door-to-balloon time and the time from the

onset of symptoms to the PPCI, were significantly longer after the COVID-19 pandemic, as compared to those before the pandemic. In addition, the results of statistical analysis indicated that the mean length of stay after PPCI was significantly reduced in the post-pandemic period, compared to that in the pre-pandemic era (Table 2).

The results of the Chi-square test demonstrated that despite the reduction in the rate of PPCI in 2020, compared to 2019 (118 vs. 161 cases), there was no statistically significant difference in the monthly rate of PPCI between the two periods, before and after the COVID-19 pandemic ($P=0.177$; Figure 1). Moreover, there was no significant difference in the rates of in-hospital mortality ($P=0.820$) and transfer of patients with STEMI by medical emergency services ($P=0.090$) between the two periods of pre-and post-pandemic (Table 3).

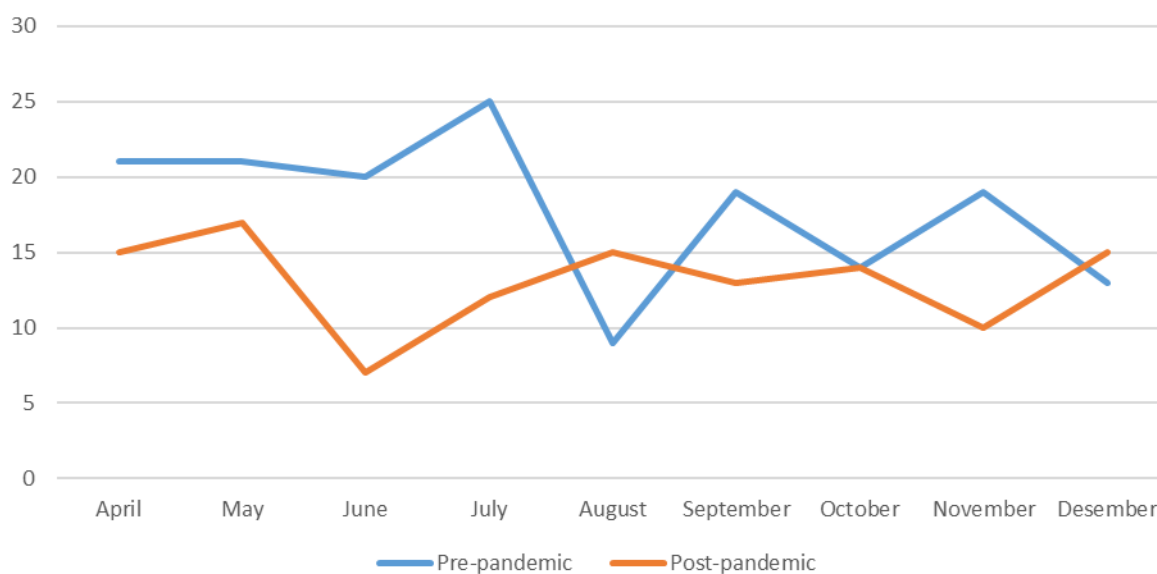


Figure 1. Frequency distribution of STEMI patients, before and after COVID-19 pandemic by month

Table 3. Hospital patient transfer and final outcome in both pre- and post-pandemic groups

		Pre-pandemic (N=161) N (%)	Post-pandemic (N=118) N (%)	P-value*
Hospital patient transfer	Personal vehicle	46 (50.5)	45 (49.5)	0.090
	Referral from lower levels of care	43 (58.9)	30 (41.1)	
	Emergency medical service	53 (58.2)	38 (41.8)	
	Inter-hospital transport	19 (79.2)	5 (20.8)	
Patient outcome	Expired	9 (64.3)	5 (35.7)	0.820
	Discharged	149 (57.5)	110 (42.5)	
	Accommodated to other centers	3 (50)	3 (50)	

*Chi-square test

Discussion

As evidenced by the results of this study, the treatment times were increased in STEMI patients in the post-pandemic group. Moreover, the COVID-19 pandemic was demonstrated to have no effect on patient transfer method and in-hospital mortality among STEMI patients in either pre-or post-pandemic period. In addition, the obtained results pointed to a reduction in the mean hospitalization time after PPCI, and no significant difference was observed between the number of MI patients by month in the pre-pandemic period, compared to that in the post-pandemic era.

Furthermore, it was found that the average time from the onset of symptoms to admission to triage, which is referred to as patient-related time, significantly increased in the post-pandemic group, compared to that in the pre-pandemic group. Moreau et al.(12) reported a significant elevation in the

time between the onset of symptoms and the first medical contact in the post-COVID-19 pandemic period. Moreover, Rodriguez-Leor et al.(13) reported that the COVID-19 pandemic increased ischemic time before hospitalization. In addition, according to a study by Korhan et al.(14), the number of patients with time from symptom onset to first medical contact of more than 120 min (SO to FMC > 120 min) has increased during the pandemic of COVID-19. The patient's delay during the COVID-19 pandemic could be ascribed to the fear of coronavirus in the hospital, traffic restrictions announced by the government, or patients' beliefs that fewer hospital visits help the country's health care system to better manage the COVID-19 crisis.

According to the results of the present study, the average door-to-balloon time (including the times between triage entry and obtaining ECG, ECG gathering and the physician visit, and physician visit and the intervention) was significantly increased in the post-pandemic period, compared to that in the pre-pandemic era. Rattka et al.(15) reported a significant elevation in door-to-balloon time in the post-pandemic period. Nonetheless, Garcia et al. (16) reported an increase in the time between the emergency room entrance and the balloon angioplasty in March 2020 and then back to normal in April 2020.

According to the literature, the increase in average door-to-balloon time is due to several reasons, one of which is the time spent by the treatment team to wear personal protective equipment when visiting the patient to prevent possible coronavirus infection transmission. The second reason is the administration of diagnostic tests for some MI patients who have suspected symptoms of COVID-19 to rule out COVID-19 infection. In addition, during the COVID-19 pandemic, patients are also admitted to neurological, poisoning, and internal medicine wards, and this interferes with the results of the study and may be one of the reasons for increased time between the triage entry and undergoing PPCI.

Another important finding of this study was a reduction in the average length of stay after PPCI in the post-pandemic group, as compared to that in the pre-pandemic group. In the same context, Korhan et al. (14), reported a reduction in the length of stay of STEMI patients after the COVID-19 pandemic, compared to prior to the pandemic. This reduction in hospitalization time can be attributed to two reasons. Firstly, due to the prevalence of COVID-19 pandemic and the crisis of bed limitation in hospitals and according to the policy of the Ministry of Health and Medical Education for better management and treatment of COVID-19 patients, it is recommended to use reverse triage and discharge the patients who can be treated at home. Secondly, due to the fear of infection transmission, patients may make an attempt to persuade the physician to leave the hospital earlier, and the physician may allow patient discharge in advance.

Although, in general, the number of patients undergoing PPCI after the COVID-19 pandemic had decreased, compared to the post-pandemic period, data analysis revealed no significant difference in the rate of referrals per month before and after the pandemic. Boeddinghaus et al. (4) reported a 31% reduction in STEMI patient visits in the first two months after the COVID-19 outbreak, while Xiang et al. (10) found a 26% reduction in the mean total number of weekly admission of STEMI patients during the COVID-19 pandemic across China and a 62% reduction in the total number of admitted STEMI patients in Hubei Province, China. This reduction can be ascribed to several factors. Firstly, during the COVID-19 pandemic, patients who were referred to medical centers with atypical symptoms of MI, such as shortness of breath, were suspected of having COVID-19. They should be transferred to an infectious ward, and in some cases, the ECG should not be taken due to the existing bias, reducing the number of documented clients with symptoms of MI. Secondly, due to fear of COVID-19 during the pandemic, patients and their families prefer to use home care services in case of disease symptom manifestation, which increases the demand for nursing and home visits during the post-pandemic period. This increases delayed patient referral and worsens the prognosis for time-related illnesses, including heart attacks.

According to the results, the rate of in-hospital mortality was not significantly different before and after the COVID-19 pandemic. In a similar vein, Wilson et al. (17) reported that despite a numerical increase in STEMI mortality in the hospital, it was not statistically significant. In addition, according to the results of a meta-analysis conducted by Rattka et al., in-hospital mortality was not significantly different between the two groups (pre-and post-pandemic). Elevated treatment time is demonstrated to worsen the prognosis of patients and increase the mortality, as well as short-term and long-term complications, of MI patients (18). In all these studies, including the present research, the follow-up

of patients was limited to the length of stay, and the outcome of patients has not been monitored for a long period of time after discharge. Therefore, the results of these studies cannot precisely help to evaluate the effect of COVID-19 on mortality and complications of MI.

In contrast to the researcher's initial perception that community fears of contaminated ambulances during the COVID-19 pandemic would reduce emergency medical contact and ambulance transport to the hospital, the results of the present study showed no statistically significant difference in patient transfer method before and after the COVID-19 pandemic. Nevertheless, Korhan et al. (14) demonstrated an elevation in patients' transmission by emergency services in the post-pandemic period. Although fear of contaminated ambulances during the COVID-19 pandemic has reduced patients' contact with medical emergency services, it is believed that consistency in the rate of ambulance transport of cardiac patients to hospitals may be due to government-imposed traffic restrictions on public transport, which motivates patients to be transported to medical centers by ambulance. Furthermore, changes in hospital admissions during the pandemic period and the allocation of some hospitals to the COVID-19 response program may make patients more willing to use pre-hospital emergency services to avoid discomfiting and unnecessary referrals. The retrospective nature of this study which results in the lack of accurate monitoring of file records was the most notable limitation of the present study.

Implications for practice

According to the results of this study, the outbreak of the COVID-19 pandemic had a negative effect on the treatment management of STEMI patients and elevated treatment times. It was found that the outbreak of the COVID-19 pandemic has negatively affected treatment times, as well as patient and health system delays. In addition, the COVID-19 pandemic has led to an overall reduction in the number of MI patients requiring PPCI in the COVID-19 pandemic period, as compared to that in the same period before the pandemic. These results can be used to inform the community and better manage time-dependent diseases, such as STEMI, in the future.

Acknowledgments

This study was reviewed and approved by the Ethics Committee of Sabzevar University of Medical Sciences as a thesis (IR.MEDSAB.RIC.1400.003) and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and all subsequent revisions. This study was supported by Heshmatieh Hospital Research Center. In this way, the authors would like to thank all the persons who help us in this study.

Conflicts of interest

The authors declare that they have no conflict of interest.

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