





Management of Patients with ST-Segment Elevation Myocardial Infarction during the COVID-19 Pandemic

Arafat Yildirim , Ozge Ozcan Abacioglu , Salih Kilic , Serafettin Demir 

Department of Cardiology, University of Health Sciences, Adana Research and Training Hospital, Adana, Turkey

ABSTRACT

Objective: Elective operations had to be postponed due to the COVID-19 pandemic that emerged in the last quarter of 2019 and affected the whole world in a short time. However, for emergencies such as myocardial infarction (MI), unfortunately, this is not possible. We aimed to evaluate the management of ST-segment elevation myocardial infarction (STEMI) before and during the COVID-19 pandemic.

Methods: One hundred and eleven consecutive patients with STEMI between April 2020 and May 2020 and 149 patients with STEMI 1 year before the pandemic in the same period were included in the study. Groups were compared in terms of the treatments applied, pre-post-dilatation, duration of the procedure, hospitalization, and the primary end-point. Death due to MI or complications of MI was the primary end-point.

Results: The mean age of the patients was 59.7 ± 12.3 (n = 195 [75%] male). The two groups were similar in terms of gender, diabetes mellitus, hypertension, hyperlipidemia, smoking, and laboratory results. Although the median duration of the door balloon in the pandemic was similar (39 and 37 minutes, respectively; $P = .342$), the procedure times were shorter, the mean total hospitalization times were longer, and the differences were statistically significant ($P = .022$ and $<.001$, respectively). In the study group, 68 patients had pre-dilatation and 30 had post-dilatation during the procedure. The two groups were similar in terms of the primary end-point ($P = .196$).

Conclusion: Percutaneous intervention should be the routine procedure to STEMI patients during the pandemic period, despite the positive possibility of COVID-19 and the risk of transmission.

Keywords: ST-segment elevation myocardial infarction, COVID-19 pandemic, percutaneous coronary intervention

INTRODUCTION

Acute coronary syndromes (ACSs) may be a complication of COVID-19 or primarily due to a plaque rupture, ulceration, or dissection.¹⁻³ Regardless of the reason, in the case of ST-elevation, revascularization of the patient as soon as possible is the primary goal.⁴ In principle, if you are in a center where invasive procedures can be performed, you take the patient to the primary percutaneous interventional catheter laboratory; if you do not have such a possibility, you either refer the patient or give thrombolytics and transfer to the invasive center for facilitated percutaneous coronary intervention (PCI).^{5,6} These mentioned procedures have been accepted for the period before the COVID-19, and there is no definite consensus on the management of patients with ACS during the COVID-19 pandemic period.⁷

We aimed to compare the patients with ACS in the COVID-19 period and before in terms of treatment in our clinic that is an invasive center.

METHODS

A total of 111 consecutive patients, followed in coronary intensive care unit due to ST-segment elevation myocardial infarction (STEMI) between April 2020 and May 2020, and 149 control patients who were similar in age, gender, and comorbidity and were hospitalized with the same diagnosis before the pandemic in the same period (April 2019 and May 2019) 1 year ago were included in this retrospective study. In our clinic, all patients were diagnosed STEMI with minimum 24 hours of follow-up in the intensive care unit. Venous blood samples of the patients were taken and analyzed using appropriate methods on admission and during hospitalization.

Kidney and liver function tests, lipid profiles, cardiac troponin and creatine kinase-MB (CK-MB) values, complete blood counts, brain-natriuretic peptide (BNP), and C-reactive peptide level of all patients were recorded. All patients underwent coronary angiography during their hospitalization and required percutaneous intervention. The time from hospitalization to

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ORCID iDs of the authors: Y.A. 0000-0002-2798-7488; A.Ö.Ö. 0000-0003-1392-9380; K.S. 0000-0002-3579-3747; D.Ş. 0000-0002-1735-5049.

Corresponding Author: Arafat Yildirim E-mail: arafatdr@hotmail.com

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Table 1. Baseline Characteristics of Groups

Parameters	Control Group (n = 149)	Study Group (n = 111)	P
Age, years	59.4 ± 12.8	60.2 ± 11.6	.626
Male, n (%)	110 (74)	85 (76)	.612
Hypertension, n (%)	76 (51)	54 (49)	.976
Diabetes mellitus, n (%)	64 (43)	46 (41)	.899
Smoking, n (%)	46 (31)	23 (21)	.067
Hyperlipidemia, n (%)	58 (39)	42 (38)	.898

angiography, the use of stents or balloons, and whether pre–post-dilatation was performed, and the amount of opaque used and whether opaque nephropathy developed during follow-up and the patient's outcome were noted. Opaque nephropathy was defined as an increase in >25% or >0.5 mg dL⁻¹ of serum creatinine from baseline 48 to 72 hours after contrast medium administered for diagnostic or therapeutic purposes. The primary end-point of the study was death due to MI or complications of MI.

Hypertension was defined as patients' systolic and diastolic blood pressures >140/90 mmHg or if the patient was taking any antihypertensive medication. Diabetes mellitus (type 2 DM) was defined as having a previous diagnosis of DM or using anti-diabetic medication, or fasting blood glucose ≥126 mg dL⁻¹ or HbA1c >6.5%.

The study was approved by the Clinical Research Ethics Committee of the Ministry of Health of our country and local Clinical Research Ethics Committee of the Adana Health Practice and Research Center (No.: 799, date: April 22, 2020). The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

Statistical Analysis

Kolmogorov–Smirnov test was used to determine whether variables were homogeneously distributed. Continuous variables were expressed as mean ± standard deviation and compared using Student's t test and Mann–Whitney U test for variables without normal distribution. Categorical variables were presented as total number and percentages and compared using

the chi-square test and Kruskal–Wallis test. Receiver operating characteristics (ROCs) curve analysis was used to demonstrate the predictive value of variables in primary end-point. A two-tailed P value of <.05 was considered as statistically significant, and 95% confidence interval (95% CIs) were presented for all odds ratios. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM SPSS Corp.; Armonk, NY, USA).

RESULTS

A total of 260 patients (mean age, 59.7 ± 12.3, 195 males [75%]) were included in this retrospective study. Baseline characteristics of patients and diagnosis on admission were summarized in [Table 1](#).

Laboratory parameters, angiographic properties, and hospitalization times of patients are listed in [Table 2](#). There were not any differences in terms of routine biochemical results, whole blood count tests, and cardiac markers between the two groups. STEMI included in the study were transferred from the emergency department directly to the catheter laboratory. Although we found a trend toward an increase in door balloon time during the pandemic period, this was not significant. The procedure time was shorter for those who applied during the pandemic period. Pre- and post-dilatations were also less preferred in this group. Considering the length of stay in the intensive care and cardiology service, it was seen that the circulation was faster, and the hospitalization period of the patients was shorter in the prepandemic period. The amount of opaque material used during angiography was less in patients in the pandemic period, and as a result, the rate of opaque nephropathy was statistically significantly lower in the study group compared to the control group. The two groups were similar in terms of the primary end-point.

ROC curve analysis determined that intensive care unit hospitalization time was the only independent predictor of primary end-point (area under curve (AUC): 0.989; CI 95%: 0.967–0.998; P = .007) ([Figure 1](#)).

DISCUSSION

Although the COVID-19 viral infection, caused by coronavirus, usually manifests with respiratory symptoms caused by severe pneumonia, cardiac involvement can be seen in cases and, when seen, leads to worsening of prognosis.^{8–10} It is known

Main Points

- Despite the risk of transmission during the COVID-19 outbreak, primary percutaneous coronary intervention (PCI) was continued for STEMI patients.
- It was determined that the duration of PCI was shorter.
- It was determined that the rate of opaque nephropathy was lower.
- It was determined that in-hospital mortality was similar.
- It was once again determined that the simple and fastest procedure for STEMI patients is the best.

Table 2. Laboratory Results and Angiographic Properties of Groups

Parameters	Control Group (n = 149)	Study Group (n = 111)	P
Glucose	159.9 ± 66.3	167.4 ± 87.5	.660
Urea	34.4 ± 16.7	34.0 ± 16.2	.858
Creatinine	0.8 ± 0.4	0.8 ± 0.5	.424
GFR	93.4 ± 24.6	92.5 ± 25.1	.773
WBC	11.5 ± 4.7	12.0 ± 5.2	.428
HGB	13.3 ± 3.0	13.6 ± 1.7	.447
PLT	245.6 ± 77.4	241.5 ± 68.8	.656
LDL	129.1 ± 39.2	135.7 ± 28.9	.104
HDL	39.7 ± 8.7	40.6 ± 7.1	.107
BNP	2598.4 ± 5067.6	2774.4 ± 5842.8	.796
Ck-MB	30.7 ± 41.5	25.2 ± 40.6	.288
Troponin	18886.0 ± 22176.4	33677.0 ± 56514	.305
Infarct related artery, n (%)			.278
LAD	73 (49)	44 (40)	
CX	25 (17)	25 (22)	
RCA	51 (34)	42 (38)	
Door to balloon, minute	37 (17–62)	39 (19–64)	.342
Procedure time, minute	17 (9–57)	15 (10–40)	.022*
Predilatation, n (%)	109 (73)	68 (61)	.042*
Post-dilatation, n (%)	60 (40)	30 (27)	.026*
Opaque, mL	190 (100–350)	180 (100–260)	.025*
Opaque nephropathy, n (%)	52 (35)	23 (21)	.013*
Hospitalization, hours			
Intensive care	30.0 ± 22.0	35.5 ± 21.6	.048*
Total	74.4 ± 11.2	81.8 ± 16.8	<.001*
Primary end-point, n (%)	11 (7)	4 (4)	.196

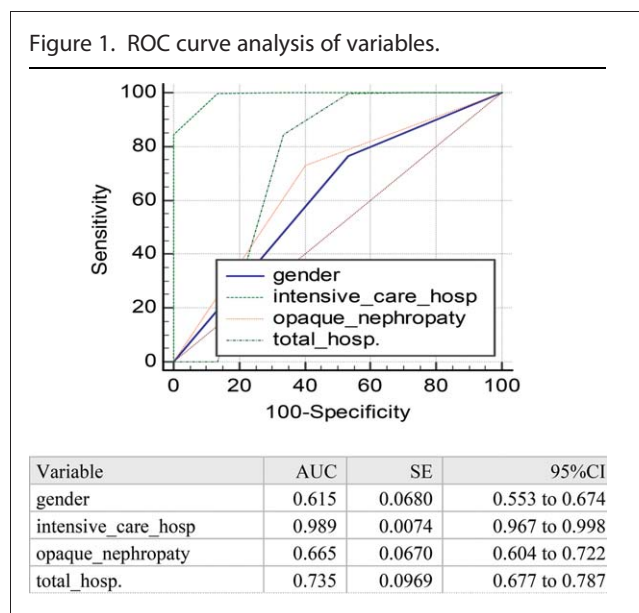
Abbreviations: BNP, brain natriuretic peptide; CK, creatine kinase; CX, circumflex artery; GFR, glomerular filtration rate; HGB, hemoglobin; HDL, high-density lipoprotein cholesterol; LAD, left anterior descending artery; LDL, low-density lipoprotein cholesterol; PLT, platelets; RCA, right coronary artery; WBC, white blood cell.

*Statistically significant.

that COVID-19 may cause various symptoms such as classical type 1 MI due to obstructive coronary artery disease, angiographically normal coronaries, myocarditis, or left ventricular dysfunction due to stress cardiomyopathy.^{11,12} Among them, patients with ACSs are the most difficult to manage.

With the widespread use of centers where primary percutaneous coronary intervention can be performed, STEMI patients

have increased survival and decreased serious complication rates.^{13,14} Although the COVID-19 pandemic in nowadays has a negative impact on life, the necessity of the primary intervention for STEMI patients is open to discussion, but it is still the accepted procedure. Vejpongsa et al.¹⁵ point out that influenza and other viral infections are seen simultaneously in 1% of patients with acute MI, and less patients in this group undergo angiography and less of them are revascularized.¹⁶



Secco et al.¹⁷ suggested that PCI for ACS is often required in Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) patients and may improve prognosis.¹⁸ In our clinic, which has the capacity to perform invasive procedures for 24 hours, STEMI patients are transferred directly from the emergency department to the angio laboratory, whether or not COVID-19 is suspected, and percutaneous intervention is performed as soon as possible. Considering the pandemic period and before, the lack of a significant difference in the door balloon durations of these patients is the biggest indicator of this. Mahmud et al.¹⁹ pointed out that all patients presenting with STEMI nowadays should be considered COVID-19 positive. Since STEMIs were taken directly to the angiography laboratory, all of them were considered COVID-19 (+) in our study too.

The patients included in this study were taken to the primary PCI catheter laboratory, and the cardiologists who performed the procedure made practices to keep the patient contact as short as possible and to reduce the complex procedure rates. Many studies have shown that viral load is directly proportional to contact time.^{20,21} For this reason, it is observed in our study that applications such as pre-post-dilatation, which would prolong the procedure during angiography, decreased in proportion. Similarly, the amount of opaque used is less in patients in the pandemic period in relation to the duration. Consequently, the rate of opaque nephropathy was lower in the study group. We think that the increase in intensive care and service hospitalization times is due to the examinations and consultations that are developed due to the patients' admission during the pandemic process and requested to exclude or confirm the diagnosis of COVID-19.

The fact that no difference was observed in the mortality rates of the patients should be considered as a success of invasive cardiologists even during the pandemic period. The difference in features related to the angio procedure suggests that the simplest is sometimes the best choice.

Limitations

The most important limitation of the study is that it is retrospective and single centered. Since there is no follow-up after discharge, we do not have information about long-term morbidity and mortality. As a result, it is not possible to comment on the medium- and long-term results of the techniques related to angiography, the decrease in pre- and post-dilatation applications.

CONCLUSION

For STEMI patients in the pandemic period, no increase in in-hospital mortality was recorded with the continuation of routine primary PCI application and minor changes in technical practices by the cardiologists who performed angiography.

Ethics Committee Approval: This study was approved by the Ethics Committee of the Adana Health Practice and Research Center (No.: 799/55, date: April 24, 2020).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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