Outcomes and Management of ST-Elevation Myocardial Infarction Patients Before and During the COVID-19 Pandemic: A Retrospective Cohort Study

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Abstract

Background. Ischemic heart disease is the leading cause of mortality and morbidity worldwide. The COVID-19 pandemic changed healthcare-seeking behavior and healthcare delivery.

Methods: This is a single-center, retrospective cohort study using a non-probability sampling of adult patients at the Philippine Heart Center who were diagnosed with ACS-STEMI. Baseline characteristics, clinical profile, management plan, and outcomes of patients were determined and analyzed in both periods.

Results: 170 STEMI patients during each period were included in the study. The mean time for the onset of symptoms to consult was 8 hours in both periods. Majority of STEMI patient had undergone primary PCI in both periods. There is a significant decline in the number of patients undergoing primary PCI during the COVID 19 period (n=116, 68%). Fibrinolysis was performed more during the COVID 19 pandemic (n=9, 5%) and none in the pre-COVID 19 period. There was a statistically significant delay in the door-to-wiring time during the pandemic. Composite outcome was significantly higher during this time with 42 patients (25%, *p=0.029*). Composite outcomes were also higher in STEMI patients with COVID-19 infection (OR 1.9, 95% CI 1.0989 - 3.2960, *p=0.022*).

Conclusion: The study confirmed that there was an increase in the rate of fibrinolysis and medical therapy alone during the COVID-19 period. There was also a significant delay in the door-to-wiring time as well as an increase in composite outcomes during the COVID-19 pandemic.

Keywords: ST elevation myocardial infarction, COVID-19 pandemic, ACS management

Introduction

Ischemic heart disease (IHD) is among the leading causes of mortality and morbidity worldwide. It was the leading cause of death (12.6% of all mortality) in the country last 2016.[1] According to the World Health Organization, Disability Adjusted Life Years (DALY) due to ischemic heart disease in the Philippines was 2,148,600 in 2016.[2] The most debilitating presentation of IHD are the Acute Coronary Syndromes (ACS). Acute Coronary Syndrome is a spectrum that is divided into Non-ST Elevation (NSTE-ACS) and ST-Elevation (STE-ACS). Complications of STE-ACS may include left and/or right ventricular dysfunction, cardiogenic shock, rupture of infarcted tissue, and fatal arrhythmias.[4] Timely reperfusion can reduce morbidity and mortality from STE-ACS. Reperfusion strategies consider the timing from the onset of symptoms, risks involved in administering fibrinolysis, and time required to initiate an invasive strategy.[5]

The 2017 ESC Guidelines for the management of STE-ACS recommended reperfusion in all patients with symptoms of ischemia of ≤12h duration and persistent ST-segment elevation. If primary PCI is not possible, fibrinolysis is recommended. Reperfusion is also indicated in patients with symptoms more than 12 hours from the time of onset if with symptoms of ongoing ischemia, hemodynamic instability, or life-threatening arrhythmias. The target maximum time from STE-ACS diagnosis to wire crossing in patients presenting at a PCI-capable hospital is ≤60minutes and ≤90minutes in transferred patients.[6]

In December 2019, it has been reported in China that there were cases of pneumonia caused by a previously unidentified coronavirus. This led to an outbreak which ultimately led to a pandemic. In response to increasing cases and local transmission of the virus, the Philippine

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government imposed an enhanced community quarantine in Luzon, limiting the population's movement, that started on March 16, 2020.

In a recent study, 41% of Adults in the United States had avoided or delayed medical care due to concerns regarding the pandemic and 12% even reported avoiding emergency or urgent care.[7] In the data presented by Solomon et al, weekly rates of hospitalization due to STE-ACS in the United States from January 1 to April 14, 2020, have gone down by up to 48% since the pandemic.[8] In another study, weekly rates for Acute MI declined by 19% for the first five weeks of the pandemic but increased by 10.5% after the first five weeks. The overall mortality for STE-ACS was higher in the first five weeks with an odds ratio of 1.52.[9] Another study regarding the outcomes and management of STE-ACS noted that weekly admissions have declined by 26%, with no statistically significant change in the time of symptom onset to medical contact, reduced probability of primary PCI with an odds ratio of 0.26, increased probability of thrombolysis with an odds ratio of 4.78, delayed primary PCI for 20.82 min in Hubei and 4.43 min in other provinces, delayed thrombolytic treatment for 22.60 min in Hubei and 4.49 min in other provinces, and higher in-hospital mortality and heart failure with an odds ratio of 1.21 and 1.1 respectively but was not statistically significant.[10]

There were also case reports of patients having mechanical complications of AMI. A recent case report presented a 64-year-old female who was treated as a non-urgent case of ACS and was transferred to another institution due to concerns about the COVID-19 pandemic. It was later found out that she had a ruptured posterolateral myocardial wall with a giant pseudoaneurysm.[11] In another case report, a 48-year-old male presented with STE-ACS and had been symptomatic for two days. He underwent revascularization but had a ventricular septal defect. Surgical closure was done and the patient was discharged.[12]

COVID-19 also has effects on the cardiovascular system. Several mechanisms have been identified, including direct myocardial injury from hypoxemia, myocarditis, stress cardiomyopathy, hypercoagulability, or systemic inflammation, which may also destabilize coronary artery plaques.[13] Previous studies revealed that pneumonia and influenza increase the risk of AMI by up to sixfold.[14] Mortality of STE-ACS alone has been estimated at 6 to 10%.[15-16] In another study, the mortality rate of COVID-19 patients with STE-ACS is 26%.[17] Elevations of inflammatory markers such as CRP and D-Dimer have been associated with cardiac injury and higher mortality in patients with COVID-19 suffering from acute MI.[18-19]

In response to COVID-19, the European Society of Cardiology (ESC) released a paper to guide diagnosing and managing cardiovascular disease during the pandemic. Several adjustments were done in the health care setting which includes triaging of patients based on risk status, wearing of personal protective equipment if there is a risk for exposure, performing a nasopharyngeal swab for admitted patients, having a dedicated catheterization laboratory for STE-ACS patients who will undergo emergency procedures, separate areas for admission of COVID 19 from non-COVID 19 cases.

The goal of reperfusion therapy is 120 minutes from STE-ACS diagnosis to reperfusion. Primary PCI is still the reperfusion of choice, but if the target time cannot be met, then fibrinolysis, if not contraindicated, should be the first-line therapy.[20] The Philippine Heart Center has adjusted in response to the pandemic by following some of the strategies presented by the ESC. The catheterization laboratory was closed from March 13, 2020, to May 4, 2020, due to staff being in quarantine and reorganization to accommodate suspected COVID-19 cases who need emergency procedures. The emergency department was also split into two areas for COVID 19 and non-COVID 19 cases on March 14, 2020.

The COVID-19 pandemic had an impact on the health care system and delay seeking medical care. It could also, directly and indirectly, affect the cardiovascular system. It may have adversely affected patients who are suffering from ischemic heart diseases.

General Objectives: To compare the difference in the outcomes and management of STE-ACS patients during the COVID-19 pandemic and the pre-pandemic time.

Specific Objectives:

1. To describe the baseline characteristics of STE-ACS patients seen at the emergency department during the pandemic and the pre-pandemic time.
2. To determine and compare the time from the onset of chest pain to Emergency Department consult of STE-ACS patients in the pre-pandemic and during the pandemic period.
3. To determine and compare the management done to STE-ACS patients in the pre-pandemic and during the pandemic period.
4. To identify and compare major adverse cardiac events (MACE) in STE-ACS patients in the pre-pandemic and during the pandemic period.
5. To determine if there is an association between COVID-19 infection and outcomes of STE-ACS patients.
6. To determine if there is a correlation between inflammatory markers on outcomes of STE-ACS patients diagnosed with COVID-19.

Methodology

Study Design and Time Period. This is a single-center, retrospective cohort study using a non-probability sampling of adult Filipino patients aged 19 and above who were diagnosed to have STE-ACS at the Emergency Department of Philippine Heart Center. Excluded in the study were patients who had the following:

- Dead on arrival at the Emergency Department
- Severe aortic stenosis
- Hypertrophic obstructive cardiomyopathy
- Heart failure from any cause

- Previous history of intracranial hemorrhage
- Three vessel disease or involvement of the left main artery with or without previous history of revascularization
- No consent for any invasive procedures

Operational definition of terms

- COVID-19 Pandemic – A period starting from March 16, 2020
- Cardiac symptoms – symptoms such as chest pain or discomfort, dyspnea, shortness of breath, or epigastric pain.
- Door-to-wiring time – Time from ER consult to the passing of the coronary guide wire inserted during PCI on the occluded segment of the infarct-related artery recorded in the cardiac catheterization laboratory.
- Door-to-needle time – Time from ER consult to the administration of fibrinolytic (Alteplase) recorded in the chart.
- Effectiveness of reperfusion – Successful fibrinolysis recorded in the chart or TIMI3 flow post PCI as recorded in the cardiac catheterization laboratory.
- Cardiogenic shock – Patients who are Killip IV upon admission or who were diagnosed and managed as cardiogenic shock throughout the admission.
- In-hospital heart failure – Patients who are Killip II-III on admission or who were diagnosed and managed as a case of heart failure during admission
- Life-threatening arrhythmias – Episodes of ventricular tachycardia, ventricular fibrillation, or ventricular asystole.
- Mechanical complications of MI – Being diagnosed to have papillary muscle rupture or ventricular septal rupture or ventricular free wall rupture.
- Inflammatory markers – C-reactive protein (CRP) and D-dimer
- Coronary artery bypass grafting – An open-heart surgery used to treat coronary artery disease using an artery or vein to circumvent an obstructed coronary artery.
- Medical management – Patients who did not receive fibrinolysis, primary PCI, or coronary artery bypass grafting.

Data Collection Procedure. Consecutive eligible patients were identified and were enrolled in the study from both periods. Records of patients were reviewed and their baseline characteristics were obtained (*Figure1*). Clinical parameters such as the onset of cardiac symptoms to ER consult, presentation of the patient, and Killip classification were documented. Diagnostics such as ECG results, Chest X-ray, and Troponin I levels were recorded. STE-ACS patients who were diagnosed to have COVID-19 based on their nasopharyngeal swab test were identified. Inflammatory markers and systolic function on echocardiography on admission were obtained.

Management strategy and success of reperfusion were identified as well. If the patient had undergone a coronary angiogram, the vessels involved were identified. Revascularization strategies whether culprit-only PCI, completion PCI, or complete revascularization were determined. The outcome of interest determined includes in-hospital mortality and in-hospital complications such as cardiogenic shock, heart failure, and life-threatening arrhythmias. Collected data were tabulated and analyzed.

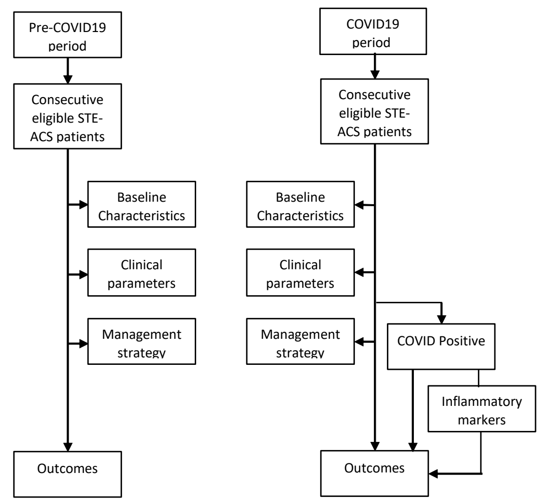

Figure 1. Flow chart of Study

Sample Size Calculation.[13] A minimum of 177 are required for the study population based 8% mortality rate during the COVID-19 period among AMI patients, 5% level of significance, and 4% desired half-width of the confidence interval.[9]

Statistical Analysis. Descriptive statistics will be used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion will be used for categorical variables, median and interquartile range for non-normally distributed continuous variables, and mean and SD for normally distributed continuous variables. Independent Sample T-test, Mann-Whitney U, and Fisher's exact/Chi-square test will be used to determine the difference in mean, rank, and frequency, respectively, between before and during the COVID-19 outbreak. The odds ratio and corresponding 95% confidence intervals from binary logistic regression will be computed to determine significant factors of outcomes. All statistical tests will be two-tailed tests. Shapiro-Wilk will be used to test the normality of the continuous variables. Missing variables will neither be replaced nor estimated. Null hypotheses will be rejected at a 0.05α-level of significance. STATA 13.1 will be used for data analysis.

Results

A total of 340 patients were included in the study, 170 patients for each period. *Table I* summarizes the baseline characteristics of patients in the pre-COVID and COVID-19 periods. The mean age for each period was 56 years. Most of the patients are male with 139 patients (82%) and 145 patients (85%) during the Pre-COVID and COVID

Table I. Baseline Characteristics of Patients

Baseline Characteristics	Pre COVID-19 (n=170)	During COVID-19 (n=170)	p-value
	Frequency (%); Mean + SD		
Age	56.38 + 10.38	56.23 + 10.52	0.891
Sex			0.465
Male	139 (81.76)	145 (85.29)	
Female	31 (18.24)	25 (14.71)	
Ejection fraction using Simpson's method by echocardiography	49.74 + 11.01	49.04 + 11.89	0.587
Hypertension	103 (60.59)	111 (65.29)	0.432
Diabetes	46 (27.06)	48 (28.24)	0.904
Smoker	94 (55.29)	78 (45.88)	0.104
Previous revascularization	0	3 (1.76)	0.248
Other Comorbid conditions			0.545
Stroke	3 (1.76)	5 (2.94)	
CKD	1 (0.59)	0	
Gout	1 (0.59)	0	
Polycythemia vera	1 (0.59)	0	
Family History of CAD	15 (8.82)	15 (8.82)	1.000

Table II. Clinical Parameters

	During COVID-19 (n=170)	Pre COVID-19 (n=170)	p-value
	Frequency (%); Mean + SD; Median (IQR)		
Onset of cardiac symptoms to ER consult	8 (6 to 12)	8 (5 to 10)	**0.045**
Symptom on presentation			0.111
Chest discomfort	161 (94.71)	164 (96.47)	
Dyspnea/Shortness of breath	2 (1.18)	5 (2.94)	
Epigastric discomfort	5 (2.94)	1 (0.59)	
Others	2 (1.18)	0	
Killip Class			0.431
I	129 (75.88)	133 (78.24)	
II	30 (17.65)	25 (14.71)	
III	8 (4.71)	5 (2.94)	
IV	3 (1.76)	7 (4.12)	
ECG findings			0.720
Septal wall	0	3 (1.76)	
Anteroseptal wall	29 (17.06)	25 (14.71)	
Anterior wall	55 (32.35)	54 (31.76)	
Anterolateral wall	25 (14.71)	24 (14.12)	
Lateral wall	0	1 (0.59)	
Extensive anterior	5 (2.94)	5 (2.94)	
Inferior wall	56 (32.94)	57 (33.53)	
CLBBB	0	1 (0.59)	
Chest X-ray findings			**0.007**
Normal	70 (41.42)	87 (54.04)	
Pulmonary congestion	38 (22.49)	33 (20.5)	
Pulmonary edema	12 (7.1)	13 (8.07)	
Pneumonia	30 (17.75)	9 (4.97)	
Pleural effusion	3 (1.78)	1 (0.62)	
PTB	16 (9.47)	19 (11.8)	
Troponin I level*	10,388 (1,475 to 42,756)	4.325 (0.71 to 21.2)	N/A

**HsTroponin was utilized during the COVID-19 period as the determination of troponin has already been updated.*

periods respectively. The mean ejection fraction on echocardiography for both periods is 49%. Hypertension is the most prevalent risk factor in both periods with 103 patients (61%) in the pre-COVID period and 111 (65%) in the COVID period followed by smoking, and diabetes.

Table II summarizes the clinical parameters in both periods. The mean time for the onset of cardiac symptoms to ER consult was 8 hours in both periods. Majority of the patient in both periods presented with chest discomfort, 164 patients (96%) in the pre-COVID and 161 (95%) in the COVID period. The majority had

Table III. Inflammatory markers and Troponin in patients with COVID-19

	Samples (n)	Median (IQR)
COVID-19 Positive	168	21 (12.5)
CRP*	21	44 ml/L (27 to 72)
D-dimer**	19	635 ng/ml (384 to 1185)
HsTrop I***	19	9181 ng/L (1513 to 37734.5)

**CRP - Reference range: 0.0-10.0 mg/L*
***D-dimer – Reference range: 0.00-499.00 ng/ml*
****HsTrop I – Reference value: <29 ng/L*

Table IV. Management Strategy

Parameter	Frequency (%)		p-value
	Pre COVID-19 (n=170)	During COVID-19 (n=170)	
Primary PCI	145 (85.29)	116 (68.24)	<0.001
TIMI Flow			0.002
1	2 (1.36)	1 (0.85)	
2	5 (3.4)	17 (14.41)	
3	140 (95.24)	100 (84.75)	
Door to wiring, minutes	72 (54 to 99)	105 (80 to 139)	<0.001
Activation to wiring, minutes	40 (33 to 57)	61 (49 to 78)	<0.001
Vessel involvement	(n=167)	(n=129)	0.305
Single	69 (41.32)	61 (47.29)	
Multivessel	98 (58.68)	68 (52.71)	
Vessel involved			
Left main	6 (3.59)	6 (4.65)	0.769
LAD	140 (83.83)	110 (85.27)	0.75
LCx	80 (47.9)	43 (33.33)	0.013
RCA	94 (56.29)	71 (55.04)	0.906
PCI strategy	(n=74)	(n=58)	0.539
Culprit only PCI	32 (43.24)	21 (36.21)	
Staged PCI	16 (21.62)	11 (18.97)	
Complete revascularization	26 (35.14)	26 (44.83)	
Fibrinolysis	0	9 (5.29)	0.004
Successful (n=9)	-	5 (55.56)	-
Door to needle time (mins)	-	150 (90 to 210)	-
CABG	6 (3.53)	6 (3.53)	1
Medical alone	19 (11.18)	41 (24.12)	0.003

Table V. Outcomes in STE-ACS Patients

Outcomes	Frequency (%)		p-value
	Pre COVID-19 (n=170)	During COVID-19 (n=170)	
Composite outcome	25 (14.71)	42 (24.71)	0.029
In-hospital mortality	10 (5.88)	20 (11.76)	0.084
Cardiogenic shock	10 (5.88)	14 (8.24)	0.526
Heart failure	21 (12.35)	26 (15.29)	0.53
Arrhythmias	9 (5.29)	12 (7.06)	0.653
Mechanical complications of MI	0	5 (2.94)	0.061

Killip Class I on presentation at the Emergency Department with 133 (78%) patients during the pre-COVID period and 129 (76%) during the COVID period. Inferior wall infarction is the most common ECG finding in both periods which is seen in 57 patients (33.53%) in the pre-COVID period and 56 patients (32.94%) during the COVID period. Most of the patients had normal chest radiograph presentation which is seen in 87 patients (54%) in the pre-COVID period and 70 patients (41%) in the COVID period. This is followed by radiologic findings of pulmonary congestion and pneumonia. The mean troponin value during the pre-COVID period was 4.325 (54x than the upper reference limit) with a reference range of 0.00-0.08 ng/ml. However, during the COVID

Table VI. Association of COVID-19 to outcomes of STE-ACS patients

	Odds Ratio	95% CI	p-value
Composite outcome	1.9031	1.0989 to 3.2960	0.022
In-hospital mortality	2.1333	0.9671 to 4.7057	0.060
Cardiogenic shock	1.4359	0.6193 to 3.3291	0.399
Heart failure	1.2811	0.06899 to 2.3790	0.433
Arrhythmias	1.3587	0.5570 to 3.3141	0.501
Mechanical complications of MI	-	-	-

Table VII. Association of CRP levels to outcomes of STE-ACS patients

	Odds ratio	95% CI	p-value
Composite outcome	1.0318	0.98 to 1.09	0.225
In-hospital mortality	1.0457	0.93 to 1.17	0.435
Cardiogenic shock	1.0333	0.96 to 1.11	0.359
Heart failure	1.0479	0.97 to 1.12	0.173
Arrhythmias	1.0069	0.95 to 1.07	0.819
Mechanical complications of MI	-	-	-

Table VIII. Association of D-dimer to outcomes of STE-ACS patients

	Odds ratio	95% CI	p-value
Composite outcome	1.0054	0.99 to 1.01	0.126
In-hospital mortality	1.0003	0.99 to 1.001	0.494
Cardiogenic shock	1.0003	0.99 to 1.001	0.485
Heart failure	1.003	0.99 to 1.001	0.485
Arrhythmias	1.0021	0.99 to 1.005	0.237
Mechanical complications of MI	-	-	-

period, High sensitivity troponin I (HsTrop I) is now used in the Philippine Heart Center and this has a different reference value of <29 ng/L, the mean HsTrop I was 10,388 (358x the reference value).

Table III shows the Inflammatory markers and Troponin values in STE-ACS patients who had COVID-19 21 (12.5). The mean CRP is 44 which is 4.4x the upper reference range. The mean D-dimer is 635 which is 1.27x higher than the upper reference range. The median HsTrop I was 9181 (317x the reference value).

Table IV shows the management strategy done in both periods. The majority of STE-ACS patients had undergone primary PCI in both periods which was done in 145 patients (85%) during the pre-COVID 19 period and in 116 patients (68%) during the COVID 19 period. There is a significant decline in the number of patients undergoing primary PCI during the COVID-19 period.

Conversely, Fibrinolysis was performed on nine patients (5%) during the COVID 19 period and none during the pre-COVID 19 period. CABG has a similar frequency of performance in both periods.

Among those who have undergone PCI, TIMI3 flow is observed in 140 patients (95.24) during the pre-COVID 19 period and in 100 patients during the COVID 19 period. There is a significant difference in the angiographic success of the PCI between the pre-COVID 19 and COVID 19 periods. There is a delay of 35 minutes in the door-to-wiring time during the COVID 19 period which was statistically significant when compared to the pre-COVID 19 period. There is also a significant increase in the number of patients who underwent medical management alone in the COVID period with 41 patients (24%) as compared to the pre-COVID 19 period of 19 patients (11%).

Multivessel disease predominated in both periods with 98(59%) patients in the pre-COVID 19 period and 68 patients (53%) in the COVID 19 period. The majority had involvement of the left anterior descending artery which is seen in 140 patients (84%) in the pre-COVID 19 period and 110 (85%) during the COVID 19 period.

Fibrinolysis was not performed during the pre-COVID 19 period as compared to nine patients (5.29%) during the COVID period. Fibrinolysis was successful in five out of nine patients (56%). The mean door-to-needle time in patients who had fibrinolysis was 150 minutes.

Table V demonstrates the outcomes of STE-ACS patients in both periods. The composite outcome was significantly higher during the COVID 19 period with 42 patients (25%).

There was no significant difference in terms of in-hospital mortality, cardiogenic shock, heart failure, arrhythmias, and mechanical complications of AMI.

Table VI showed no significant association between COVID-19 infection and outcomes of STE-ACS patients.

Tables VII and VIII showed no significant association between the elevation of CRP and D-dimer with the outcomes of STE-ACS patients.

Discussion

Ischemic heart disease is the leading cause of death and morbidity worldwide and in the Philippines. The COVID-19 pandemic began in December 2019 and has had an impact on healthcare delivery and patient health-seeking behavior worldwide. Beginning March 16, 2020, the government instituted the enhanced community quarantine, which limited population movements.

This study found no statistically significant difference between the timing of symptom onset and to time of ER consultation. This is analogous to a previous study conducted in which there was also a reduced number of primary PCIs performed and a higher fibrinolysis rate performed during the COVID 19 period when compared to the pre-COVID 19 period. This is comparable to the study of Xiang D, et al, which found a lower likelihood of primary PCI with an odds ratio of 0.26 and a higher likelihood of thrombolysis with an odds ratio of 4.78.[10]

Another element to consider is the unavailability of the catheterization laboratory from March 13, 2020, to May 4, 2020, which may have reduced the number of primary PCIs performed. This had an impact on the number of fibrinolysis procedures performed, since STE-ACS patients who are supposed to undergo PCI but within the time frame of fibrinolysis would undergo fibrinolysis instead. The unavailability of the catheterization laboratory may have also affected the decision to do medical therapy alone than primary PCI. There was a significant reduction in the proportion of patients having TIMI 3 flow after PCI during the COVID period 100 (84.75%) compared to 140 (95.24%, $p=0.02$) in the pre-pandemic period.

Contrary to this, the findings of de Luca, et al, showed no significant difference in the rate of TIMI 3 flow post-procedure. This was attributed to the prothrombotic state of COVID-19.[23]

The door-to-wiring time is significantly delayed during the COVID period compared to the pre-COVID period. De Luca, et al, showed an association between the COVID pandemic and door-to-balloon longer than 30 min (adjusted OR: 1.17; 95% CI: 1.05 to 1.29; p = 0.003). The most likely cause of the delay is the use of personal protective equipment as part of preventive steps when dealing with a suspected illness as well as the COVID-19 swab testing of patients who would undergo emergency procedures. This was noticeable during the early COVID-19 period and has since improved as policies have been adopted. There is a delay of 120 minutes in the door-to-needle time.

During the COVID-19 period, the composite outcome is statistically greater. Higher rates of in-hospital mortality, cardiogenic shock, heart failure, arrhythmias, and mechanical complications of MI were seen, however, this was not statistically significant. This is also consistent with the findings of another study, which revealed an increase in in-hospital mortality and heart failure with odds ratios of 1.21 and 1.1, respectively, but it was not statistically significant.[22]

Among STE-ACS patients with COVID-19, there was a higher odds ratio for composite outcomes (OR: 1.9031, 95% CI 1.1 to 3.3, p-value 0.0.22) which was also statistically significant. The mortality rate for ACS STE-ACS patients with COVID-19 infection was 9.5%. This is also comparable to the result of the study of Hamadeh et al which showed an 8.8% mortality rate.[17] There was also no significant association between CRP and D-dimer in the outcomes of STE-ACS patients with COVID-19 infection. This may be due to the low number of STE-ACS patients who are COVID-19 positive which was only 21 (12.5%).

Limitations of the Study

There are various limitations to this study. For instance, this is a single-center study conducted at a hospital specializing in cardiovascular illness. A multi-center investigation could provide a more accurate picture of the situation during the COVID-19 period.

The second limitation of this study is that the subjects were not matched, and other confounding factors could have influenced the findings.

Finally, this study solely looked at STE-ACS in-hospital mortality and comorbidities. Longer-term follow-up may be more useful so that mortality and complications after discharge can be assessed.

Conclusion

The implications of the COVID-19 pandemic on the care and outcomes of STE-ACS patients were investigated in this study. It confirmed that there was an increase in the rate of fibrinolysis and medical therapy alone during the COVID-19 period. There is also a significant delay in the door-to-wiring time as well as an increase in composite outcomes during the COVID-19 era, even though there was no statistically significant difference in complications during and before the COVID-19 pandemic. There was also an increased composite outcome in STE-ACS patients with COVID-19 infection.

Recommendations

In retrospect, even though we were in a pandemic, the care of emergency cases such as STE-ACS should not be adversely impacted. Policies may be created to ensure that patients suspected of having COVID-19 or similar infections in the future are handled safely. Even during a pandemic or similar disasters, the authors suggest adhering to current standards for the care of STE-ACS.

It is also recommended that multiple centers also conduct similar studies to see if the findings are the same.

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