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The impact of COVID-19 pandemic on decreasing hospitalization rates and management of acute coronary syndrome: a study from single centre hospital in Yogyakarta, Indonesia

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ABSTRACT

The Corona virus disease-2019 (COVID-19) pandemic has an impact on the medical field, one of which is service for patients with acute coronary syndrome (ACS). Studies in other countries showed a sudden decrease in admission rates, and percutaneous coronary intervention (PCI), one of ACS treatments, has an impact due to this pandemic. This study aimed to ascertain the effect of COVID-19 on the admissions and management of patients with ACS in Yogyakarta, Indonesia. It was an observational single center study conducted by collecting data for ACS patients at Dr. Sardjito General Hospital, Yogyakarta. Admission data for March 2019 to February 2020 were pre pandemic data, while those gathered from March to December 2020 were pandemic data. Data from 864 (pre pandemic period) and 338 patients (during the pandemic period) were further analyzed. The results showed a decrease in ACS patients' admission during the pandemic. The most remarkable reduction occurred in those with ST-segment elevation myocardial infarction (STEMI), followed by non-STEMI (NSTEMI) and unstable angina pectoris (UAP) (63.4, 61.4, and 40.9%, respectively). Furthermore, the PCI procedure decreased compared to the period before the pandemic. No significant differences in patients' characteristics was observed (p>0.05), except for the incidence of pneumonia (p <0.001). Finally, the mortality rate was higher during the pandemic than before (14.8 vs 13.2%), although it was not significant (p>0.05). This study showed that COVID-19 caused a sensible reduction in the admission rates for ACS patients and the number of PCI procedures have been performed. On the other hand, their mortality rate did not increase significantly. However, it is essential to improve healthcare services for ACS patients considering the uncertainty of ending the COVID-19 outbreak.

ABSTRAK

Pandemi penyakit virus Corona-2019 (COVID-19) berdampak pada bidang medis, salah satunya adalah pelayanan kepada pasien dengan sindrom koroner akut (SKA). Studi di negara lain menunjukkan penurunan mendadak dalam tingkat penerimaan, dan intervensi koroner perkutan (PCI), salah satu perawatan ACS, berdampak akibat pandemi ini. Oleh karena itu, penelitian ini bertujuan untuk mengetahui pengaruh COVID-19 terhadap penerimaan dan pengelolaan pasien SKA di Yogyakarta, Indonesia. Penelitian ini merupakan penelitian observasional single-center yang dilakukan dengan mengumpulkan data pasien ACS di Rumah Sakit Umum Pusat Dr. Sardjito, Yogyakarta, Indonesia. Data penerimaan untuk Maret 2019 hingga Februari 2020 adalah data prapandemi, sedangkan yang dikumpulkan dari Maret hingga Desember 2020 adalah data pandemi. Data dari 864 (masa pra-pandemi) dan 338

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pasien (selama masa pandemi) dianalisis lebih lanjut. Hasilnya menunjukkan penurunan penerimaan pasien ACS selama pandemi. Pengurangan yang paling luar biasa terjadi pada mereka dengan infark miokard dengan elevasi segmen ST (STEMI), diikuti oleh non-STEMI (NSTEMI) dan angina pektoris tidak stabil (UAP) (masing-masing 63,4%, 61,4% dan 40,9%). Selanjutnya, prosedur PCI menurun dibandingkan periode sebelum pandemi. Tidak terdapat perbedaan yang bermakna pada karakteristik pasien, kecuali pada kejadian pneumonia (p<0,001). Akhirnya, tingkat kematian lebih tinggi selama pandemi daripada sebelumnya (14,8% vs 13,2%), meskipun perbedaannya tidak signifikan secara statistik. Studi ini menunjukkan bahwa COVID-19 menyebabkan penurunan yang masuk akal dalam tingkat penerimaan pasien ACS dan jumlah prosedur PCI yang telah dilakukan. Di sisi lain, angka kematian mereka tidak meningkat secara signifikan. Namun, peningkatan layanan kesehatan bagi pasien ACS sangat penting mengingat ketidakpastian berakhirnya wabah COVID-19.

INTRODUCTION

Acute coronary syndromes (ACS) have become one of the leading causes of death globally, especially in the acute myocardial infarction group with ST-segment elevation (STEMI). The treatment strategy can be carried out through primary percutaneous coronary intervention (primary PCI) or fibrinolysis, which aim to restore blood flow to save the myocardium, reduce infarct area, and extend life expectancy.[1]

Corona virus disease-2019 (COVID-19) pandemic has disrupted the world and impacted health issues. The exponential rise of this virus affects medical personnel in hospitals, with a continuously increasing number of victims. Therefore, the management of several diseases needs to be modified.[2,3] Management strategy for ACS patients needs to be determined by (a) risk stratification and (b) whether the patient has a confirmed case, suspected, or low risk.[2,3] However, it is necessary to understand that this change in management is not based on evidence, but it can be considered to be applied in this COVID-19 pandemic. Accordingly, future evaluations need to be conducted to recognize the potential impact on the outcome of ACS patients.[4]

Before the COVID-19 pandemic, ACS management at Dr. Sardjito General Hospital, Yogyakarta followed the European Society of Cardiology (ESC) or Indonesian Heart Association (*Perkumpulan Kardiologi Indonesia*/ PERKI) guidelines. Furthermore, the reperfusion strategy for STEMI was prioritized for primary PCI when the limit of wire crossing time did not exceed 120 min. Some cases with a crossing time of >120 min have been treated with fibrinolysis. Likewise, the NSTE-ACS case follows ESC guidelines, wherein an invasive strategy was applied, especially in patients with very high or high-risk stratification. Meanwhile, NSTE-ACS patients with low stratification will be first subjected to a non-invasive test. This study aimed to investigate whether the patient needs an invasive strategy or not. During the COVID-19 pandemic, ACS management experienced a few changes due to several considerations.

MATERIALS AND METHODS

Study design and subjects

This was an observational analytic study by obtaining data from the SCIENCE (Sardjito Cardiovascular IntENsive CarE) registry at Dr. Sardjito General Hospital, Yogyakarta, Indonesia. This registry collected data on patients treated in the cardiovascular intensive care unit (ICCU). All ACS patients treated between March 2019 to February 2020 were recorded as data before the COVID-19

pandemic, while those obtained from March to December 2020 were recorded as data during the pandemic. Meanwhile, management and outcomes were recorded during treatment until the patient was discharged. In this study, the primary reported outcome was mortality incidence from any cause.

Data collection

The subjects were sequentially sampled (consecutive sampling). Also, anamnesis, physical examination, 12-lead ECG assessment, and standard laboratory examinations were conducted for patients with ACS as the sample. Furthermore, sampling and data collection were carried out after obtaining ethical clearance from the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada/Dr. Sardjito General Hospital, Yogyakarta.

Statistical analysis

Categorical data were presented in absolute values or percentages. The data were compared with the Chi-square or Fisher Exact test. Furthermore, continuous data were displayed with the mean ± standard deviation (SD) when the distribution was normal and then

compared with Student's t-test. A p value <0.05 was considered to be significant. The IBM SPSS Statistics 24 was used for data analysis.

RESULT

The first positive COVID-19 case in Indonesia was detected on March 2nd, 2020, and it marked the beginning of a pandemic. Over time, the number of cases increased rapidly. At the end of 2020, about 740,000 cases were recorded with a mortality rate of about 22 thousand people. The pandemic impacted the health field against cardiovascular disease, namely ACS. The incidence of ACS (especially STEMI type) in hospitals has markedly decreased in several countries during this pandemic and as well as in Dr. Sardjito General Hospital, Yogyakarta.

Before the pandemic (March 2019 to February 2020), there were 864 ACS cases, consisting of STEMI (70.3%), NSTEMI (20.1%), and unstable angina pectoris (9.6%). During the pandemic (March 2020 to December 2020), the ACS incidence decreased to only 338 cases. Furthermore, over 50% decrease was found in the STEMI and NSTEMI cases, while UAP cases decreased by 40.9%. The largest drop was seen in STEMI cases, namely 63.4% (FIGURE 1).
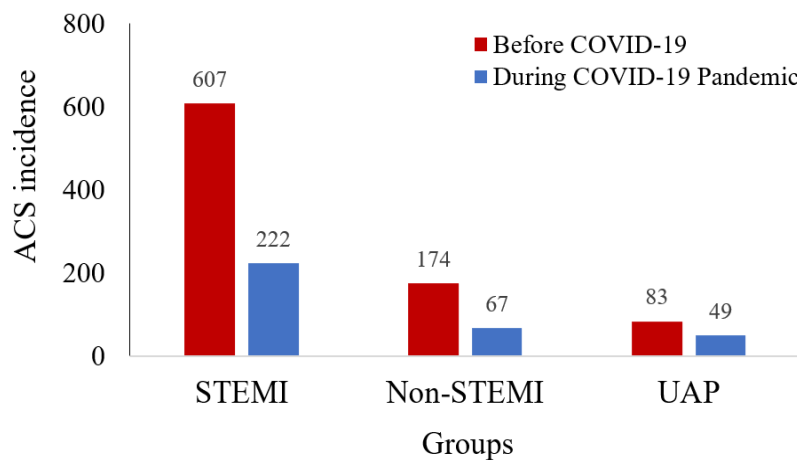

FIGURE 1. ACS incidence in Dr. Sardjito General Hospital before (March 2019 - February 2020) and during the pandemic (March 2020 - December 2020)

The standard of care of STEMI management is through reperfusion, either by fibrinolysis or primary PCI. This procedure has to be performed in a hospital with adequate facilities for both types of reperfusion. Dr. Sardjito General Hospital is one of the hospitals with PCI capable centers in Yogyakarta; hence the primary PCI is among the reperfusion options in the STEMI case.

During the pandemic, the standardized protocols have provoked delays in the treatment of ACS. All patients presenting with ACS should be considered COVID-19 possible, and patients were screened for COVID-19 before admission with an internally developed scoring system. Furthermore, ACS patients with a high COVID-19 probability score were initially hospitalized in the isolation room until the PCR swab results were out. Therefore, when the PCR swab showed negative, the patients were moved to cardiovascular intensive care (ICCU) or inpatient room. Conversely, when the PCR-swab result was positive, the care was maintained in the isolation room for COVID-19 patients.

Among 338 hospitalized ACS cases, 15 had a high probability score of COVID-19, and therefore they had to undergo treatment in the isolation room. However, out of these 15 cases, only one patient showed a positive result from the PCR swab examination (FIGURE 2).

The characteristics of ACS patients before and during the pandemic are presented in TABLE 1. There were no significantly differences in their features, such as age or gender ($p > 0.05$). Meanwhile, the comorbidities found in patients, such as pneumonia and urinary tract infections (UTIs), showed a significantly difference ($p < 0.05$).
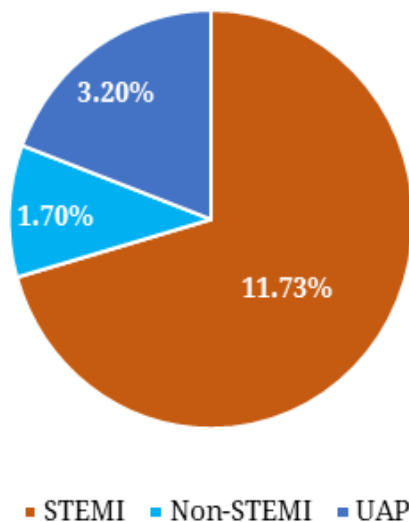

FIGURE 2. Distribution of ACS incidences with high COVID probability scores during the COVID-19 pandemic (March 2020 - December 2020).

TABLE 1. Basic patient characteristics

Parameter	Before COVID-19 (n = 864)	During COVID-19 (n = 338)	p
Age, years [median (range) years]	60 (22 – 95)	61 (24 – 98)	0.926
Sex [n (%)]			
• Male,	694 (80.3)	262 (77.5)	0.278
• Female,	170 (19.7)	76 (22.5)	
ACS type [n (%)]			
• STEMI	606 (70.1)	222 (65.7)	0.049
• Non-STEMI	174 (20.1)	67 (19.8)	
• UAP	84 (9.7)	49 (14.5)	
Killip classification [n (%)]			
• Killip I	690 (79.9)	269 (79.6)	
• Killip II	77 (8.9)	38 (11.2)	
• Killip III	33 (3.8)	11 (3.3)	
• Killip IV	64 (7.4)	20 (5.9)	
Cardiogenic shock [n (%)]	124 (14.3)	57 (16.8)	0.385
Acute heart failure [n (%)]	202 (23.4)	84 (24.9)	0.59
Risk stratification of NSTE-ACS [n (%)]			
• Very high	81 (31.5)	34 (29.3)	0.01
• High	111 (43.2)	50 (43.1)	
• Intermediate	56 (21.8)	18 (15.5)	
• Low	9 (3.5)	14 (12.1)	
Comorbid [n (%)]			
• Pneumonia	60 (6.9)	64 (18.9)	< 0.001
• Urinary tract infection	27 (3.1)	36 (10.7)	< 0.001
• Diabetes mellitus	275 (31.8)	109 (32.2)	0.888
• Hypertension	501 (58)	210 (62.1)	0.189

TABLE 1. Basic patient characteristics The management of ACS between March 2020 and December 2020 at Dr. Sardjito General Hospital has changed slightly. In the early period between March and May 2020, reperfusion strategy in STEMI patients was prioritized using fibrinolysis compared to primary PCI, especially when the patient had a high probability score. The primary PCI were prioritized when the patient experienced a cardiogenic shock after cardiac arrest or had contra-indications for fibrinolysis. However, between June and December 2020, the strategy in the form of primary PCI began to be carried out by considering the probability score. Likewise, selecting an invasive approach in the management of patients with NSTE-ACS was based on several considerations.

Most STEMI patient management still lies in the primary PCI (61.3%), followed by fibrinolysis and PCI of 21.6% (either rescue PCI or post-fibrinolytic PCI evaluation). Nevertheless, it can be seen that the PCI has decreased significantly by 70.4% compared to the period before the pandemic. This is possibly due to the declining number of STEMI patients presented at the hospital (FIGURE 3).

Meanwhile, NSTE-ACS management before and during the pandemic is presented in FIGURE 4. The invasive

therapy became the management choice for NSTE-ACS patients in the period before the pandemic. Furthermore, the NSTE-ACS patients treated with invasive strategies were 57.9% (for UAP) and 72.4% (for non-STEMI). During the pandemic, invasive strategies were still carried out in NSTE-ACS patients, namely 61.2% (for UAP) and 61.1% (for NSTEMI). It can be observed that management with an invasive strategy remains an option, compared to conservative management.

The comparison of mortality outcomes from ACS management between the period before and during the pandemic is presented in FIGURE 5. The mortality was slightly higher during the pandemic (14.8% of 338 patients) compared before the pandemic (13.2% of 864 patients). However, it was not significantly difference (p=0.468). Therefore, it can be concluded that there is no significant relationship between the mortality rate before and during the COVID-19 pandemic.
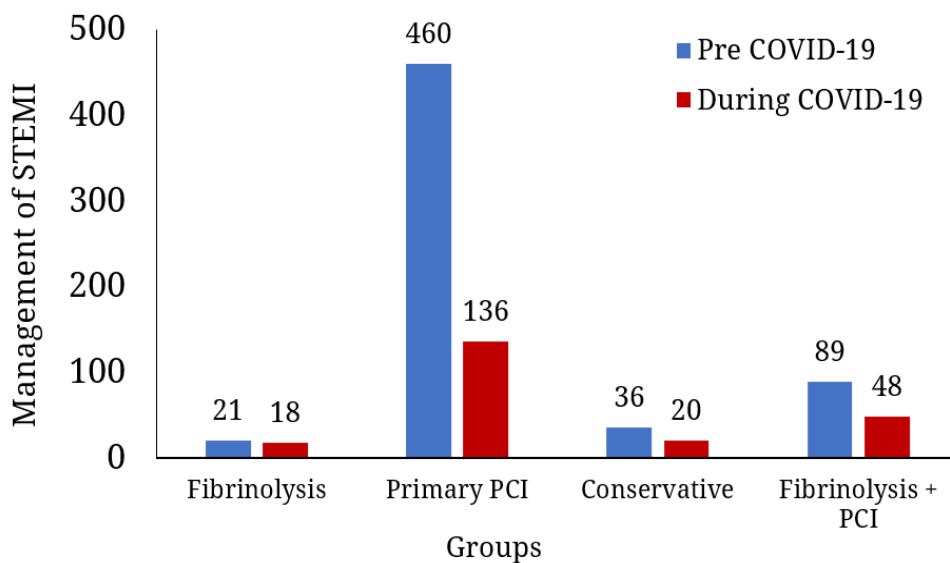

FIGURE 3. Management of STEMI patients at Dr. Sardjito Hospital before and during the COVID-19 pandemic.
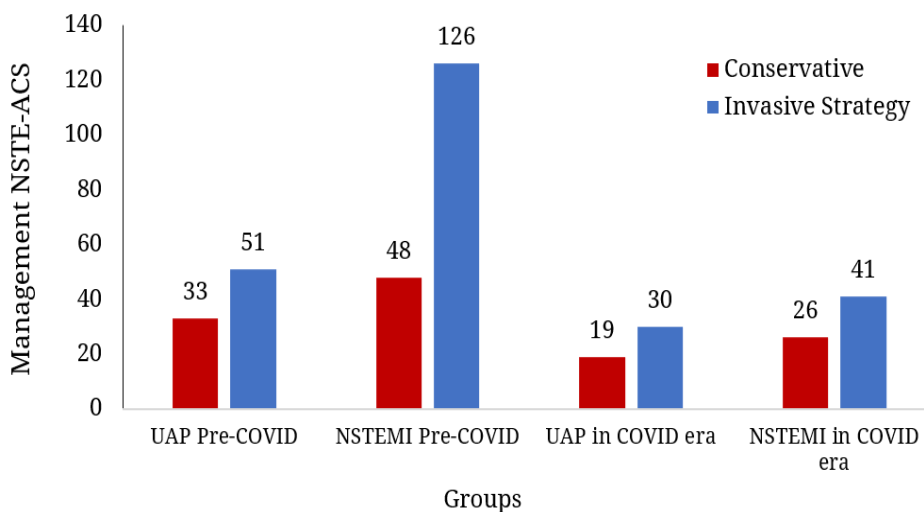

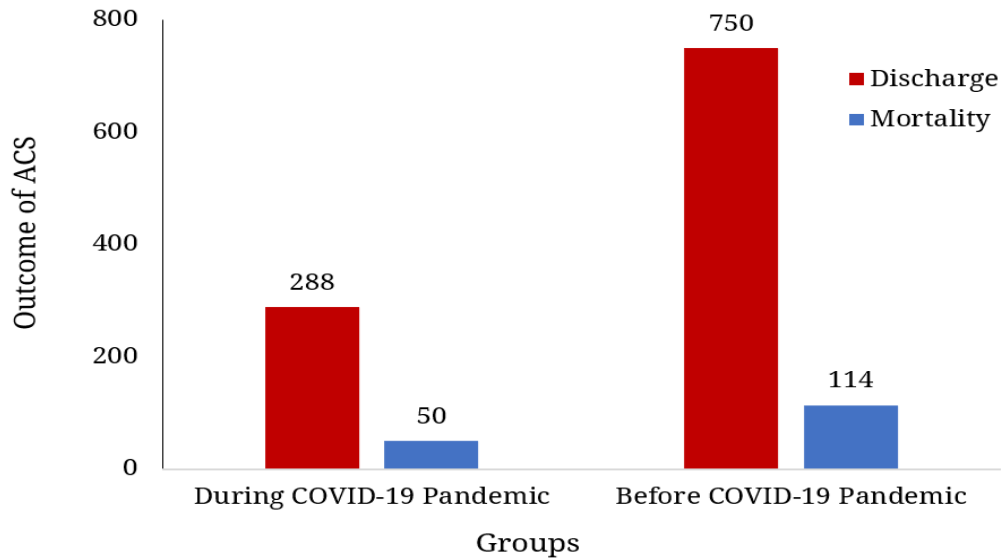FIGURE 4. Management of NSTE-ACS patients at Dr. Sardjito General Hospital before and during COVID-19

FIGURE 5. The outcomes of ACS patients in Dr. Sardjito General Hospital before and during COVID-19 pandemic

DISCUSSION

The COVID-19 pandemic began with the discovery of the first reported case from the city of Wuhan in China in December 2019. The disease has developed into a pandemic that has infected more than 87 million people and caused more than 1.8 million deaths in early January 2021.[6,7] The COVID-19 outbreak has affected the world of health, one of which is the incidence of ACS.[2,8-12]

This study showed that the treated ACS cases have decreased by 60.8%, i.e. from 864 (March 2019 to February 2020) to 338 cases (March 2020 to December 2020) during the pandemic. Furthermore, the lowest number was observed in the early pandemic period and the end of 2020.

Several factors could be the underlying reasons for the decrease in admissions. First, some suggest that the patients might be afraid of contracting the virus while staying in the hospital due to this hospital's status as the primary referral for COVID-19 patients. Second, referrals from health facilities outside Dr. Sardjito General Hospital, Yogyakarta has decreased during this pandemic. Many of these referral cases are accompanied by a suspicion of being infected by COVID-19 (based on the screening score system developed internally). Meanwhile, the treatment room for COVID-19 patients at the hospital is often full; subsequently, many ACS patients cannot be referred. On the other hand, when they are not suspected of COVID-19, then the referral process can run smoothly because non-COVID treatment rooms are still available.

Another interesting hypothesis proposed by de Rosa *et al.*,[13] is whether the decrease in admissions is related to low physical stress or the condition of people that get a lot of rest during quarantine. Furthermore, lockdown in several countries is a possible trigger for a decrease in acute decompensated episodes of cardiovascular diseases, such as low levels of air pollution, low job stress, or a reduction of work activities. However, this condition is likely to be in contrast to other impacts due to lockdown, such as psychosocial stress caused by social distancing policies, daily routines that are stopped, fear of losing a job, and an uncertain future.[14]

Studies conducted around the world found the same results concerning the admission rate. One of these was a study by Mafham *et al.*,[15] which reported a decrease in admissions in the UK by 40% (95% CI 37-43), from an average of 3017 cases per week in 2019, to 1813 cases in mid-February to late March 2020. In April and May 2020, ACS admissions increased by 2522 cases, or decreased by 16% (95% CI 13-20) when compared to the average admission rate in 2019.

This study showed a decrease in admission rate, especially in the STEMI patients, namely 63.4%, followed by a decrease in the incidence of NSTEMI (61.4%) and UAP (40.9%). Meanwhile, a study by ESC on 141 countries in 6 continents showed that since the COVID-19 pandemic, STEMI admission rates have decreased by> 40%. These STEMI patients appeared to be taking longer to present to the hospital after the onset of chest pain. In addition, as many as >40% visited the hospital beyond the optimal time for reperfusion management, either by primary PCI or thrombolysis, with subsequent impact on mortality. One of the independent predictors of high delay rate from STEMI patients is a change in the structure of cardiac services in the country due to the imposing lockdown policy.[14]

Another study conducted at a multicenter in Italy by obtaining data on acute myocardial infarction (AMI) patients showed a decrease in AMI admissions by 48.4% compared to the same week period in 2019 (p <0.001). Furthermore, a significant decrease was found for both STEMI (26.5%, 95% confidence interval (CI) 21.7 - 32.3; p = 0.009) and NSTEMI (65.1%, 95% CI 60, 3 - 70.3; p <0.001) cases. The decrease in STEMI admission rate was found to be more in females (41.2%; p = 0011) than males (17.8%; p = 0.191).[13] This is slightly different from the current study, where the proportion of ACS incidence in females was more dominant than males.

The health service policy during the pandemic in Dr. Sardjito General Hospital, Yogyakarta, especially in the emergency room, has changed. Every patient is first screened using an internally developed scoring system. Among 338 admitted patients, 15 (4.43%) had a high probability score of COVID-19. Therefore, the treatment was initially carried out in a particular COVID-19 room until the results of the PCR swab were out. Out of these 15 patients, 11 (70.3%) were with STEMI. Also, reperfusion was performed in 6 patients, either in the form of fibrinolysis (1 patient), primary PCI (2 patients), and fibrinolysis followed by PCI action (3 patients). The remaining 5 underwent conservative management. It turned out that from the PCR- swab examination results, only one patient was confirmed positive for COVID-19.

The characteristics of admitted patients before and during the pandemic were not significantly different. Only other comorbid diseases in the form of infections (pneumonia and urinary tract infections) were observed (p <0.001). The pneumonia incidence during the pandemic has indeed increased. Nevertheless, out of the 338 patients, it was found that only 1 had pneumonia caused by the SARS-Cov2 virus. This study also showed that the presentation of ACS patients with complications like cardiogenic shock or acute heart failure was not significantly different between the time before and during the pandemic.

Matsushita *et al.*,[16] conducted an analysis to determine the characteristics differences between ACS patients before (2019) and during the pandemic. This study obtained data from a hospital in Strasbourg, France. Characteristic data from 174 ACS patients between March 1st to April 20th, 2019 were compared with 106 patients on the same date and month during the pandemic. The results showed no characteristics difference between the population, such as age, gender, and risk factors.

The management of ACS patients is a concern, especially on reperfusion in the STEMI case. Although the primary PCI is an effective reperfusion strategy for STEMI cases, this action is relatively not the main choice. The increased exposure risk to the SARS-Cov2 virus is related to the unavailability of "negative pressure" cardiac catheterization rooms, availability of personal protective equipment (PPE), and the difficulty of manipulating catheters and guidewires. This influences the decision to perform primary PCI in STEMI patients during this pandemic. Consequently, fibrinolysis is the alternative to PCI when there are no contraindications.[5] In the early pandemic (around March-May 2020), fibrinolysis was used as the main choice of reperfusion strategy in STEMI patients that were especially suspected of having COVID-19 comorbid in our hospital. Over time and the formation of a more structured screening system, the primary PCI was carried out with a low probability score. So, the primary PCI procedure was still the main treatment (61.3% of STEMI cases) during the pandemic. This study found that the primary PCI procedure had decreased by 70.4% compared to those before the pandemic. This is probably due to the decreasing number of STEMI admissions.

A study in USA regarding the impact of the COVID-19 pandemic on STEMI services also showed a decrease in the volume of primary PCI actions related to a decrease in the admission rate. Furthermore, the pandemic has affected STEMI services, especially in terms of lengthening the activation time of the catheterization room for primary PCI action.[17,18] This is known as 'wire crossing time' that was also found in this study (average 'wire crossing time' during the pandemic at the hospital was 203.03 min). This is mainly due to the screening process that takes a long time in the emergency room to determine whether a patient has the virus or not. Some of the screening examinations carried out include a chest X-ray or even a lung MSCT. These examinations aim to detect the presence of ground-glass opacity (GGO) image, which is a characteristic sign in COVID-19 patients.

This study showed that an invasive strategy is still an option in NSTE-ACS management. Over 60% of NSTE-ACS patients (both NSTEMI and UAP) underwent an invasive strategy. The number of PCI procedures is indeed less than those before the pandemic. This is because the number of NSTE-ACS patient admissions has decreased. The same result was also found in a UK study, where the PCI procedure for NSTEMI patients decreased by 37%.[15] Likewise, a study in Italy found that the proportion of NSTEMI patients undergoing PCI procedure decreased by 13.3% (p = 0.023).[13]

This study showed the mortality rate during the COVID-19 pandemic was greater than that before (14.8% vs 13.2%). However, it was not statistically significant. Furthermore, an increase in the ACS case fatality rate was reported in Italy, namely 13.7% compared to 4.1% before the pandemic (RR = 3.3, 95% CI – 6.6; p < 0.001). The STEMI cases increased by 3.3% compared to 1.7% in 2019 (RR = 1.9, 95% CI 0.5 - 6.7, p = 0.309) for NSTEMI cases.[13] The increased mortality rates need to be evaluated, whether it lies in the patient's delay in seeking treatment or the provided medical services.

This study has several limitations. First, it was conducted in only one hospital, and therefore, the actual data regarding the ACS incidence and management in the population cannot be generalized. Second, related to the retrospective design of this study, the data affecting the management and outcome of ACS patients are less explored due to limitations in data collection. Third, the PCR swab examination as the gold standard for establishing diagnosis was not carried out in all ACS patients in the

early days of the pandemic. Hence the asymptomatic ones were not detected.

CONCLUSION

The current study reported considerably lower rates of hospitalization for ACS at Dr. Sardjito General Hospital, Yogyakarta. This decrease is caused by multiple factors, both from patients and the change of the healthcare system. The early period of the pandemic is altered the clinical approach of ACS patients. However, as it progresses, improvements have been made in the hospital service system. The mortality rate during the COVID-19 pandemic is not difference compared to before the COVID-19 pandemic. However, it is essential to improve healthcare services for ACS patients considering the uncertainty of ending the COVID-19 outbreak. Hence, further studies need to be conducted by involving hospital networks to determine the actual condition of ACS incidence and management.

ACKNOWLEDGEMENTS

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