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ORIGINAL ARTICLE

The Impact of the COVID-19 Pandemic on ST Elevation Myocardial Infarction Care Indicators at a Public Hospital in Brazil

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Abstract

Background: International publications have shown that the COVID-19 pandemic has negatively impacted the indicators of care for ST-segment elevation acute myocardial infarction (STEMI), with a potential increase in morbidity and mortality.

Objectives: To compare mortality, time from symptom onset to primary angioplasty (total delay [TD]), time from symptom onset to initial medical contact (patient delay [PD]), and time from initial medical contact to guidewire insertion in the hemodynamics laboratory (system delay [SD]) among patients admitted for STEMI at the Hemodynamics Service of Santa Casa de Passos, Minas Gerais, Brazil before and after the declaration of the COVID-19 pandemic by the World Health Organization, assessing the impact of the COVID-19 pandemic on STEMI care indicators.

Methods: This is a before-and-after study involving patients hospitalized with STEMI undergoing primary angioplasty. Data were collected retrospectively through medical record review. Clinical and demographic profiles and outcomes between the pre-pandemic and pandemic groups were compared using the chi-square test for categorical variables or Student's t-test for continuous variables. A significance level of $p < 0.05$ was adopted.

Results: There were no differences in TD (pre-pandemic: 300 min [± 159 min], 95% CI 277.1 to 322.6; pandemic: 300 min [± 148 min], 95% CI 274.3 to 326.6, p = 0.97). However, there was an increase in SD (pre-pandemic: 145 min [± 97 min], 95% CI 122.7 to 167.9; pandemic: 178 min [± 96 min], 95% CI 157.4 to 197.9, p = 0.037). There was no increase in PD (pre-pandemic: 145 min ± 133 min; pandemic: 130 min ± 117 min, p = 0.44), and no differences in mortality were observed (pre-pandemic: 9.7%; pandemic: 12%, p = 0.49).

Conclusion: The COVID-19 pandemic increased SD in the management of STEMI in the region of Passos, Minas Gerais. There were no differences in PD, TD, and in-hospital mortality.

Keywords: ST Elevation Myocardial Infarction; COVID-19; Reperfusion; Quality Indicators, Health Care.

Introduction

ST elevation acute myocardial infarction (STEMI) has a high morbidity and mortality rate.[1] Early diagnosis and immediate definition of a revascularization strategy reduce mortality.[1-3] Indicators of STEMI care are total delay (TD), patient delay (PD), and system delay (SD).[2,4] The TD is composed of the time between the onset of symptoms and the initial care (PD) and the time between the initial care and the introduction of the coronary angioplasty guidewire in the hemodynamics service (SD). The door-to-guidewire time (DGT) refers to the time interval from admission to the hospital where the hemodynamics service is located to the introduction

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of the coronary angioplasty guidewire into the culprit coronary artery, surpassing the acute occlusion; it is contained in the SD.

The COVID-19 pandemic has affected the number of STEMI admissions and their care indicators.[5] In Hong Kong,[6] the United States,[7,8] Italy,[9,10] China,[11] Spain,[12] France,[13] and in a multicenter study in Europe,[14] there were few activations of hemodynamics emergency services for the management of STEMI during the COVID-19 pandemic.

In England, during the COVID-19 pandemic, there was an increase in mortality due to cardiovascular diseases at homes, hospitals, and nursing homes compared to pre-pandemic periods.[15]

The pandemic also altered care indicators for STEMI in some countries, with an increase in SD (including DGT) and TD.[5,6,11,13,14,16] However, there is a lack of data in the literature regarding the Brazilian context.

The objective of this study is to assess the impact of the COVID-19 pandemic on care indicators for STEMI (TD, PD, and SD) among patients admitted to the Santa Casa de Misericórdia de Passos (SCMP) undergoing primary angioplasty within 12 hours of symptom onset.

Methods

A convenience sample was used, involving patients treated at the SCMP Hemodynamics Service for STEMI, who underwent primary angioplasty with a door-to-balloon time of up to 12 hours.

SCMP is a 279-bed facility that provides care to patients under the Brazilian Unified Health System (SUS) and serves as the sole tertiary referral center for primary angioplasty for 27 municipalities in the Passos Regional Health Authority, located in the state of Minas Gerais, covering a population of 436,310 people.[17]

The reports from the SCMP Hemodynamics Service were reviewed using the term "primary angioplasty," which was present in all records of patients with STEMI referred to the service. The reports are stored in Microsoft Word® files. Patient data were collected and classified in a Microsoft Excel® spreadsheet, and the information was extracted from each patient's medical records. The patients were divided into two groups (pre-pandemic and pandemic) based on the date of March 11, 2020, which was chosen to correspond to the declaration of the pandemic by the World Health Organization.[18]

Patients admitted with STEMI to the SCMP Hemodynamics Service between January 1, 2018, and August 31, 2021, who underwent primary angioplasty within a maximum TD of 12 hours were included in the study. Patients who did not meet the criteria for STEMI after the medical record review, including retrospective analysis of the admission electrocardiograms (ECG), were excluded; patients who underwent primary angioplasty and were admitted with a TD of more than 12 hours were also excluded.

Copies of the initial assessment forms and the timing of the initial ECG, when available, were used to determine the cutoff between PD and SD in the retrospective analysis of medical records. The primary outcomes of interest were the indicators of STEMI care: TD, SD, and PD. The secondary outcomes included in-hospital mortality from all causes and DGT.

Statistical analysis

A database was created in Microsoft Excel 2016® for the implementation of double data entry validation. Subsequently, this database was imported into Minitab version 19® for statistical analysis.[19] The continuous variables of the clinical-demographic profile and the primary and secondary outcomes were described using mean and standard deviation. Shapiro-Wilk normality test with $p < 0.05$ was performed for all variables. Categorical variables were described using absolute and relative frequencies. Comparisons of categorical variables were performed using the chi-square test, and continuous variables between the groups of interest were compared using the unpaired Student's t-test. A significance level of $\alpha = 0.05$ was considered. The study was approved by the SCMP Research Ethics Committee under CAAE 45129621.5.0000.8043.

Results

A total of 336 patients were included between January 1, 2018, and August 31, 2021, with 192 (57%) in the pre-pandemic group and 144 (43%) in the pandemic group. There were no differences in the demographic and clinical profiles of the patients (Table 1). Evaluation of the PD and SD time intervals was only possible in 70 patients (45%) from the pre-pandemic group and 87 patients from the pandemic group (55%). Analysis of the demographic and clinical profiles was also conducted only for the patients in whom precise measurement

Table 1 – Comparison of demographic and clinical profile in patients admitted for STEMI at Santa Casa de Misericórdia de Passos, pre-pandemic and during the pandemic.

	Pre-pandemic (192; 57%)	Pandemic (144; 43%)	P value
Mean age (age ± SD)	61.7±11.4	63.3±11.6	0.2
Male sex (%)	127 (66%)	98 (68%)	0.71
SAH (%)	107 (59%)	87 (67%)	0.14
DM (%)	45 (25%)	42 (32%)	0.15
Smoking (%)	74 (42%)	49 (38%)	0.47
Previous AMI (%)	12 (6%)	15 (11%)	0.14
Patients from neighboring cities (%)	109 (58%)	80 (58%)	0.94
Killip > 1 (%)	53 (28%)	31 (23%)	0.29
Ejection fraction* (mean ± SD)	51.4%±12%	49.6%±12%	0.31

*AMI: acute myocardial infarction; DM: diabetes mellitus; SAH: systemic arterial hypertension; SD: standard deviation. *Simpson's Method.*

Table 2 – Demographic and clinical profile for patients with available PD and SD data.

	Pre-pandemic n = 70 (45%)	Pandemic n = 87 (55%)	P value
Mean age (age ± SD)	n = 70 59.6 (±10.8)	n = 87 62.9 (±11.4)	0.06
Male sex (%)	n = 70 51 (72%)	n = 87 62 (71%)	0.82
SAH (%)	n = 70 42 (60%)	n = 85 56 (66%)	0.45
DM (%)	n = 68 17 (25%)	n = 85 25 (29%)	0.54
Smoking (%)	n = 67 24 (36%)	n = 85 38 (45%)	0.27
Previous AMI (%)	n = 69 5 (7%)	n = 85 10 (12%)	0.35
Patients from neighboring cities (%)	n = 70 32 (46%)	n = 87 44 (51%)	0.68
Killip > 1 (%)	n = 68 22 (29%)	n = 79 18 (23%)	0.35
Ejection fraction* (mean ± SD)	n = 48 52% ± 12%	n = 48 50% ± 12%	0.48

*AMI: acute myocardial infarction; DM: diabetes mellitus; SAH: systemic arterial hypertension; SD: standard deviation. *Simpson's Method.*

of the intervals was possible, and no differences were observed (Table 2).

The distribution of PD, SD, and TD is presented in Figure 1, and the means in minutes, standard deviations, and confidence intervals are shown in Table 3. The pandemic increased the average SD by 35 minutes (p = 0.037). The DGT in minutes, which is part of the SD, did not show a statistically significant change. PD and TD also did not exhibit a statistically significant impact between the two groups. The number of deaths did not differ significantly.

Data from Tables 4 and 5 demonstrate the results of primary and secondary outcomes for patients from Passos and the neighboring municipalities. Among patients from Passos, there was a statistically significant reduction in PD in minutes during the pandemic, which was not observed among patients from neighboring municipalities. There were no statistically significant differences in SD during the pandemic between patients from Passos or the neighboring municipalities. The TD for patients from Passos and the neighboring municipalities also did not differ significantly during the pandemic.

Discussion

In this study, we observed that the pandemic has affected the local healthcare system's response to STEMI. The SD significantly increased, without a change in DGT, indicating that the time between initial assessment and transfer to SCMP was prolonged. This effect may be due to system overload and modified triage and treatment protocols implemented during the pandemic. Patients arrive at SCMP from other hospitals in neighboring cities, as well as from the Emergency Care Unit (UPA, acronym in Portuguese) that provides emergency care for patients covered by the SUS, who do

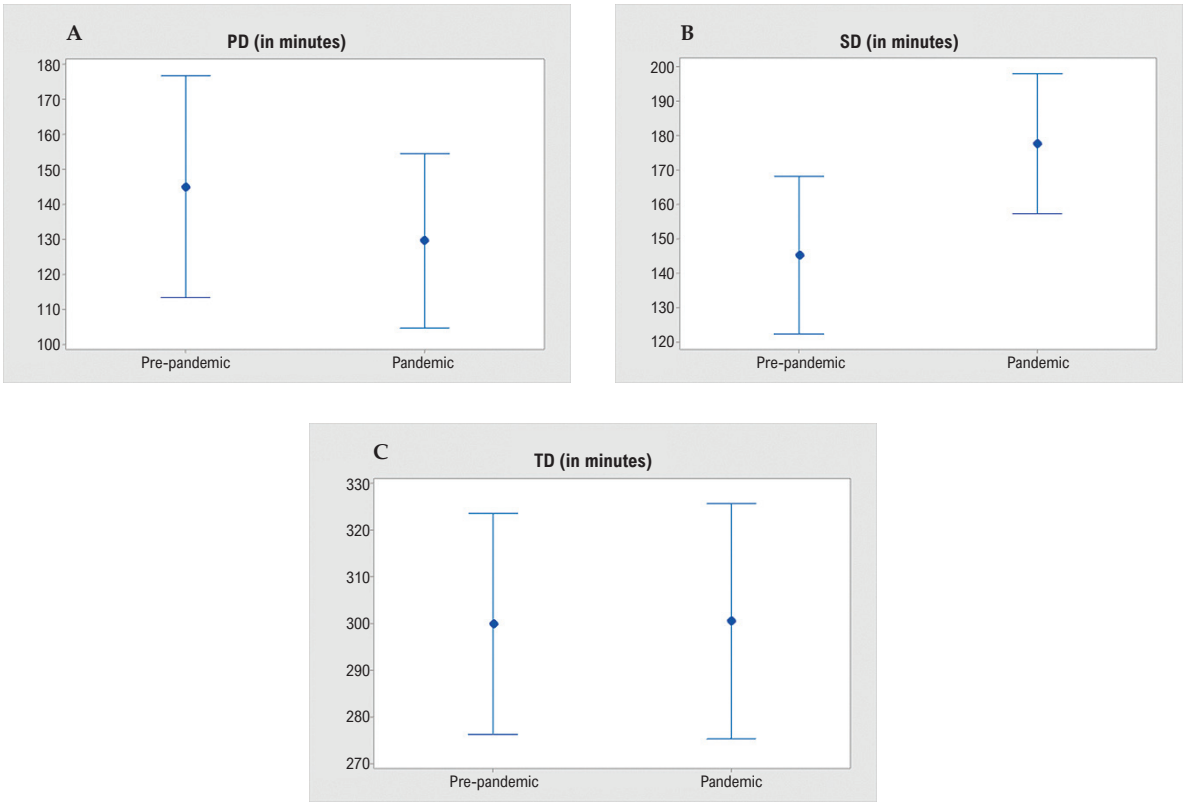

Figure 1 – Mean and standard deviation of PD (A), SD (B), and TD (C), in minutes, according to pre-pandemic and pandemic periods, with p value based on Student's t test.
TD: total delay; PD: patient delay; SD: system delay.

not have direct access to SCMP and either come on their own or are transported by emergency medical services (SAMU, acronym in Portuguese).

No differences were observed in DGT, indicating that the care provided by the healthcare team at SCMP was not significantly impacted by the pandemic.

Demographic and clinical data did not differ between the pre-pandemic and pandemic groups, indicating that there was no influence on the analyzed outcomes. De Luca et al.[14] revealed a proportional reduction in patients with hypertension among cases of STEMI during the pandemic, and Rangé et al.[13] found a higher incidence of cardiogenic shock during the pandemic as differences in demographic and clinical data, which were not observed in our study.

Scholz et al.[20] demonstrated, in a prospective multicenter study including 15,800 patients from 2017 to 2020 in Germany, that there were no differences in the number of admissions for myocardial infarction during the pandemic compared to the pre-pandemic period. They also found no significant differences in TD, SD, PD, and in-hospital mortality from STEMI.

On the other hand, De Luca et al.[14] conducted a multicenter European study involving 6,609 patients and found that the pandemic resulted in a reduction in admissions for STEMI and increased the DGT, TD, and in-hospital mortality among these patients. The mortality was significantly higher among patients infected with COVID-19, but it was also higher among non-infected patients (with statistical significance in both groups).

Rangé et al.,[13] in a multicenter study involving 2,064 patients in France, observed a non-significant trend towards increased PD, SD, and TD during the pandemic, as well as an increase in composite in-hospital outcomes including death, stent thrombosis, myocardial infarction, unplanned coronary revascularization, stroke, and major bleeding.

Table 3 – Primary and secondary outcomes for the total sample according to the "pre-pandemic" and "pandemic" groups

	Pre-pandemic	Pandemic	P value
Death (%)	n = 187	n = 133	0.49
	18 (9.7%)	16 (12%)	
DGT in minutes (mean ± SD)	n = 184	n = 132	0.53
	67.7±31.2	70±32.5	
PD in minutes (mean ± SD)	n = 70	n = 87	0.44
	145±133	130±117	
System delay in minutes (mean ± SD)	n = 72	n = 89	0.037
	145±97	178±96	
TD in minutes (mean ± SD)	n = 178	n = 135	0.97
	300±159	300±148	

SD: standard deviation; TD: total delay; PD: patient delay; DGT: door-to-guidewire time.

Table 4 – Primary outcomes of patients from Passos, Minas Gerais, Brazil

	Patients from Passos		
	Pre-pandemic	Pandemic	P value
PD in minutes (mean ± SD)	n = 38	n = 43	0.044
	143.2±134	92.5±74.2	
System delay in minutes (mean ± SD)	n = 38	n = 44	0.049
	95.4±88.3	134.6±88.8	
TD in minutes (mean ± SD)	n = 76	n = 57	0.34
	256±162	232±125	

SD: standard deviation; TD: total delay; PD: patient delay.

Xiang et al.[11] evaluated 25,150 patients and demonstrated that the PD was not affected by the pandemic, but the SD and in-hospital mortality for STEMI increased during the COVID-19 outbreak. There was no distinction between patients infected with SARS-CoV-2, and more patients received thrombolytic therapy instead of primary angioplasty during the epidemic months, which was statistically significant.

Daoulah et al.[16] showed that in April 2020, during the pandemic, there was a statistically significant increase in patients with DGT > 90 minutes compared to DGT < 90 minutes in Saudi Arabia, compared to the same months in 2018 and 2019, revealing the impact of the pandemic on this indicator. They also found an increase in TD during the pandemic, but without statistically significant differences in mortality.

In Hong Kong, there was also a significant increase in DGT.[6] McLaren et al.[21] demonstrated an increase in the time between patient arrival and ECG, as well as between ECG and contact with the catheterization team in Canada; these variables were not recorded in our study.

Differences in the impact of the pandemic may exist, depending on the organization of the healthcare system or the countries' level of development. The PD was reduced with statistical significance only among patients from Passos, but not among those from neighboring municipalities. This may reflect a different behavior, with greater perception of disease severity and less delay in seeking medical care influenced by the pandemic. The fear of contracting COVID-19 did not increase the PD. It may also reflect the population's confidence in the local emergency care. However, the same effect was not observed in neighboring municipalities, possibly due to a lesser impact of COVID-19 in those areas or a higher number of patients residing in rural areas, farther from initial medical care.

Rangé et al.[13] found a statistically significant increase in PD among patients who sought emergency services for STEMI during the pandemic, but there was no statistically significant increase in PD when considering the overall sample.

There were no differences in in-hospital mortality; however, the delay in SD can be used as a substitute outcome for in-hospital and post-discharge mortality for STEMI. This impact may have occurred in other regions of the country as well.

Several reasons have been suggested to justify the variation in the number of STEMI cases admitted to hospitals and the worsening of STEMI care indicators during the pandemic,[22,23] including the following: the incidence of STEMI may have decreased due to reduced pollution, decreased access to tobacco and processed food in cities with restrictions, and changes in people's routines; viral infection symptoms overlapping with myocardial infarction symptoms, making diagnosis challenging; patients' fear of attending hospitals and contracting

Table 5 – Primary outcomes of patients from neighboring municipalities

	Patients from neighboring municipalities		
	Pre-pandemic	Pandemic	P value
PD in minutes (mean ± SD)	n = 32	n = 44	0.56
	147±133	166±139	
System delay in minutes (mean ± SD)	n = 34	n = 45	0.3
	201±74.7	219.8±85.1	
TD in minutes (mean ± SD)	n = 100	n = 78	0.44
	334±151	351±143	

SD: standard deviation; TD: total delay; PD: patient delay.

SARS-CoV-2; restricted access to healthcare services due to system overload; temporary suspension of outpatient consultations; temporary suspension of elective cardiac catheterizations and coronary angioplasties, as well as elective non-invasive tests; the influence of the pandemic on the clinical diagnostic method in the emergency department to exclude COVID-19 diagnosis and prevent healthcare workers' infections.[22,23]

Limitations of this study include a small sample size, retrospective analysis, unavailable data for some patients in the sample, and the absence of data on COVID-19 infections among the sample patients. Due to the small sample size, it was not possible to compare outcomes between the two periods with higher numbers of COVID-19 cases (waves) in Passos.

Conclusion

The pandemic has impacted the indicators of STEMI care, increasing the SD in the Passos region. The PD decreased during the pandemic among patients from the main city, Passos, but not among patients from neighboring municipalities. There was no difference in the TD, DGT, and in-hospital mortality in this study involving patients from the Passos region who were referred for primary angioplasty in the main city.

Author Contributions

Conception and design of the research, analysis and interpretation of the data and statistical analysis: Vargas TT, Pazin Filho A; acquisition of data: Vargas TT, Sonoda LY, Hawerroth MGL, Coutinho SF, Ferreira GG, Mendes MMM; writing of the manuscript: Vargas TT; critical revision of the manuscript for intellectual content: Vargas TT, Sonoda LY, Hawerroth MGL, Coutinho SF, Ferreira GG, Mendes MMM, Costa MRA, Schimidt A, Pazin Filho A; translate to English: Costa MRA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee on Animal Experiments of the Comitê de Ética em Pesquisa de Santa Casa de Misericórdia de Passos (MG) under the protocol number CAAE 45129621.5.0000.8043.

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