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Effect of COVID-19 Pandemic on Performance Measures in Acute Myocardial Infarction

Objective	To assess performance measures of attention of STEMI in Coronary Intensive Care Unit in General Hospital Camilo Cienfuegos.
Methods	Admitted patients with STEMI, from February-April 2020, were compared with patients from similar period from 2015–2019, and patients from January 2019 to January 2020. Primary endpoint were performance measures according to the 2017 AHA/ACC Clinical Performance and Quality Measures for Adults with STEMI document, and secondary endpoint were all-cause in-hospital mortality and major acute coronary events.
Results	Only 35 patients were admitted from February-April 2020. When comparing with similar periods from recent years, in-hospital death (8.3% vs. 20%; p=0.03), major complications (38.7% vs. 57.1%; p=0.03), and cardiogenic shock (6.9% vs. 17.4%; p=0.04) were significantly higher. When comparing with 2019 and January 2020, in-hospital death (9.6%; p=0.04), and major complications (35.8% p=0.03) were significantly higher in February-April 2020; however, there was no difference in prevalence of cardiogenic shock (8%; p=0.12).
Conclusion	COVID-19 pandemic had decreased prevalence of STEMI, as well as some performance measures of attention in this center.

Keywords	ST-elevation myocardial infarction; COVID-19; performance measures
For citation	Miguel Alejandro Rodríguez-Ramos. Effect of COVID-19 Pandemic on Performance Measures in Acute Myocardial Infarction. Kardiologiia. 2020;61(3):52–56. [Russian: Мигель Алехандро Родригес-Рамос. Влияние пандемии COVID-19 на показатели эффективности при остром инфаркте миокарда. Кардиология. 2020;61(3):52–56]
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Introduction

Since COVID-19 became a pandemic, the healthcare systems worldwide have been impacted [1]. Several reports have warned about mistreatment and misdiagnosis of patients with ST Elevation Myocardial Infarction (STEMI) [2], and this has become an obstacle in managing cardiovascular disorders.

However, patients from low or middle-income settings (LMIS), where latest treatments are not available, may be the most affected due to these errors [3]. In LMIS settings, health systems must act rapidly to treat patients with COVID-19, and thus overwhelming the care facilities [4]. Meanwhile, all other health issues must to be kept under control.

When it comes to acute myocardial infarction, high-quality attention depends on the action of health systems [4], and the patient's determination to seek timely medical attention. However, current trends in conditions in high income countries show a troublingly behavior [2, 5, 6].

The prevalence of STEMI has decreased around 25–40% [7]. Patients are not looking for medical attention, and when they do, they usually present with complications. Moreover, system delays of treatment are increasing as well in those locations where coronary intervention is performed [8].

In LMIS, coronary intervention (CI) is not usually performed. Thrombolytics are administered if the patient arrives within the proper time, and if the facility has the resources to do this [9]. If not, the patient is transferred, and precious time is lost. Furthermore, before proceeding with the appropriate referral, healthcare providers must test patients for COVID-19 while following at least the minimum of safety precautions [4, 10].

Thus, according to global reports [1–3], the number of patients admitted to the Coronary Intensive Care Unit of General Hospital Camilo Cienfuegos, in Sancti-Spiritus city, Cuba, is expected to decrease along with the number of admitted patients receiving proper treatment. Hence the objective of this study was to assess the prevalence and performance measures of STEMI treatment in this center, before and after the COVID-19 pandemic.

Patients and methods

In Cuba, the first cases of COVID-19 were diagnosed in early March 2020, specifically, in our district. However, since early February, the Ministry of Health initiated epidemiological surveillance, and the results were published daily in the newspaper. Comparisons were begun at this date. As seasonal variations in STEMI prevalence have been reported [11], comparisons were made with similar periods (February, March, and April) of prior years (2015–2019) from RESCUE (REgistro de Sindromes Coronarios AgUdos) records. Also, comparisons were made with the whole 2019

ISSN 0022-9040. Кардиология. 2021;61(3). DOI: 10.18087/cardio.2021.3.n1496

cohort, as several reports have used this method [2, 5, 6] instead one for seasonal variations.

Study design

Between February and April, 2020, (COVID-19 era), 35 patients with STEMI, were admitted in the Coronary Intensive Care Unit of General Hospital Camilo Cienfuegos, in Sancti-Spiritus, Cuba. These admissions occurred at any point during the patients' in-hospital treatment, along with information of relevant performance measures, despite thrombolytic approach, or in-hospital outcome. From 2015 to 2019, during the same period, 217 patients were admitted; and in the whole of 2019 plus January 2020, 187 patients were admitted. In this last period, 10 patients were excluded from the study, because they were included in a clinical trial.

In our center, thrombolysis with national Streptokinase (Heberkinase, CIGB, La Havana, Cuba) is the standard therapy in patients with STEMI. Nearly any patient could be transferred to a tertiary center for coronary intervention.

Performance Measures

Primary endpoints were performance measures according to 2017 AHA/ACC Clinical Performance and Quality Measures for Adults with STEMI [12]. However, because of the characteristics of this condition, the performance measures related to coronary intervention will not be discussed due to lack of this procedure in the studied sample. This will also be the case for therapeutic hypothermia, which is not attempted. No PY_{12}-receptor inhibitor other than Clopidogrel was available. Noninvasive stress testing is routinely performed at 30 days after discharge from our center.

A secondary endpoint was all-cause in-hospital mortality. Cardiac mortality included death from cardiac as well as from unknown causes. Bleeding was defined as bleeding requiring red blood cell transfusion in line with GUSTO criteria. Complication rates including electrical rhythms with hemodynamic disturbance and mechanical, ischemic, and embolic complications were also studied.

The study was conducted in full conformance with the principles of the Declaration of Helsinki, and it was approved by institutional review.

Statistical analysis

Data collected from RESCUE study were transferred into the Statistical Package for Social Sciences (SPSS, version 24, IBM, Armonk, New York), which was used for data management and analyses.

Categorical variables are presented as number and percentage. Continuous variables are presented as medians and interquartile ranges since values of these variables were not normally distributed. Comparisons among different timeframes were performed using the chi-square test for categorical variables and the Mann–Whitney test for continuous variables. A $p<0.05$ indicates a significant difference among compared values.

Results

Baseline characteristics

Table 1 shows baseline characteristics of the studied population for the three periods of study. Though a homogeneous population was expected, there were three variables where a statistical difference was present. First, left ventricle ejection fraction (LVEF) (43 [35–50] vs 46 [42–52] vs 46 [41–54], p:<0.01) and Total creatine kinase (CK) values (1388 [882–1601] vs 728 [139–1140] vs 1043 [727–1426], p:<0.01) were lower in the COVID-19 era, compared with same trimester of the last 5 years and whole of 2019, respectively, despite having a shorted ischemic time (210 [112–330] vs. 240 [152–540] vs. 300 [180–780], p:<0.01). Also, during the COVID-19 era, patients with known coronary artery disease where more numerous than in the other two periods under study.

February–April, 2015–2019 vs 2020

During the pre-COVID-19 era from 2015 to 2019, a total of 217 patients were admitted between February and April. Admissions in 2020 decreased, from an annual median of 43.4 during the trimesters of the pre-COVID-19 era (14.5/mo) to 35 in 2020 (11.6/mo) ($p<0.05$). The greatest difference was in March, when only 8 patients were admitted.

The fraction of patients that received thrombolytic therapy increased from 58.1% (before COVID-19) to 65.7% in 2020. There was no significant difference in the delay for those who received thrombolytic therapy, 76.5 min (Interquartile rank 60–120) to 74.3 min (Interquartile rank 45–120; p=0.69).

Aspirin was administered at arrival and discharge. Left ventricle ejection fraction was determined, and statins were prescribed at discharge. Risk stratification for patients with STEMI was done for all patients at arrival and discharge. As shown in Table 2, beta blocker administration did not change, but was lower than 80% (77.4% vs 78.6%; p=0.89). Angiotensin converting enzyme and PY12 receptor inhibitors were slightly more prescribed in 2020.

In-hospital death (8.3% vs 20%; p=0.03), and prevalence of major complications (38.7% vs 57.1%; p=0.03), and cardiogenic shock (6.9% vs 17.4%; p=0.04) were significantly higher in the 2020 months than in the pre-COVID-19 period. No major bleeds occurred.

January 2019–January 2020 vs February–April, 2020

Since the results of the 2020 period have already been discussed, only the results from the 13 consecutive months

before the COVID-19 period will be presented and compared with that period.

A total of 187 patients were admitted between January 2019–January 2020 (14.4 patients/month). When compared with the COVID-19 period, there were no significant differences, although number of patients in March 2020 was lower (p<0.05).

Only 98 patients (56%, p: 0.32) received thrombolytic therapy during this period and treatment delay was similar (74 min vs 75 min; interquartile rank: 30–97.5 min; p=0.94). Aspirin administration at arrival was not done for 3 patients due to minor bleeding (p: 0.42). At discharge, only three patients did not receive aspirin (p: 0.39). Also, left ventricle ejection fraction was determined, statins were prescribed, and risk stratification for patients with STEMI was done. As shown in Table 2, administration of beta blockers, angiotensin converting enzyme, and PY_{12} receptor inhibitors did not change.

In-hospital death (9.6%; p=0.04), and prevalence of major complications (35.8%; p=0.03) were significantly higher in months from 2020; however, there was no difference in prevalence of cardiogenic shock (8%; p=0.12). No major bleeds occurred.

Discussion

Several reports have stated that the prevalence of STEMI in high income settings is lower during the COVID-19 pandemic [2, 5, 6]. However, in this study, that phenomenon was only observed when a sample from the COVID-19 era was compared with a sample from previous years, using a seasonal variation model. When compared with preceding year, this difference was only noted for the March cohort, the month when the first cases of COVID-19 appeared in Cuba.

Some state that COVID-19 health warnings may have inadvertently contributed to reduced contact of STEMI patients with emergency medical services (EMS) or primary care physicians [13]. Patients or relatives may be too afraid to ask for medical advice when typical STEMI symptoms appear. Most patients who decide not to contact a physician in the acute stage of their disease may then present with complications hours or days later. However, in LMIS,

Table 1. Baseline characteristics of patients with STEMI

Variable	Trimester February–April, 2020, n=35 patients	Trimester February–April, 2015–2019, n=217 patients	Year 2019–January 2020, n=187 patients	p, value
Age (yrs) (IQR)	68 (59–74)	66 (57–76)	67 (59–75)	0.75
Female gender	12 (32.4)	79 (36.4)	54 (28.9)	0.54
Diabetes mellitus type 2	9 (25.7)	57 (26.3)	47 (25.1)	0.98
Hypertension	27 (74.1)	182 (83.9)	138 (73.8)	0.4
Known CAD	**14 (40)**	64 (29.5)	37 (19.8)	0.04
Prior myocardial infarction	2 (5.7)	28 (12.9)	11 (5.9)	0.07
Prior stroke	1 (2.8)	6 (2.8)	5 (2.7)	0.99
Peripheral artery diseases	1 (2.8)	6 (2.8)	4 (2.1)	0.95
COPD	1 (2.8)	4 (1.8)	7 (3.7)	0.43
Dyslipidemia	5 (14.3)	10 (4.6)	9 (4.8)	0.07
Atrial fibrillation	1 (2.8)	2 (0.9)	1 (0.5)	0.42
Congestive heart failure	1 (2.8)	2 (0.9)	2 (1.1)	0.61
Current smoking	16 (45.7)	128 (59)	92 (49.2)	0.23
Anterior myocardial infarction	**23 (65.7)**	93 (42.8)	80 (42.7)	0.04
Left ventricle ejection fraction (IQR)	**43 (35–50)**	46 (42–52)	46 (41–54)	<0.01
eGFR (MDRD, ml/min) (IQR)	66.6 (43.2–85.9)	64.2 (47.5–85.1)	65.5 (48.8–83.9)	0.67
Glycaemia (mmol/l) (IQR)	7.1 (5.8–8.5)	6.3 (5.3–8.3)	6.4 (5.3–8.6)	0.78
Cholesterol (mmol/l) (IQR)	4.9 (4.4–6.7)	5.0 (4.1–5.8)	4.8 (3.8–5.6)	0.2
Total CK (Ul/l) (IQR)	**1388 (882-1601)**	728 (139–1140)[1]	1043 (727-1426)	<0.01
CK-MB (UI/l) (IQR)	154 (105-211)	104 (79–135)[1]	106 (81-173)	0.67
Blood pressure at admission (mmHg) (IQR)	130 (120-140)	130 (120-130)	120 (120-130)	0.72
Triglycerides (mmol/l) (IQR)	1.13 (0.9–1.2)	1.16 (0.8–1.4)	1.1 (0.76–1.3)	0.52
GRACE score at admission	110 (93-128)	108 (89-125)	111 (95-128)	0.1
Cardiogenic shock	2 (5.71)	6 (2.8)	5 (2.7)	0.63
Total ischemic time (min) (IQR)	**210 (112–300)**	240 (152–540)	300 (180–780)	<0.01

Data are number and (percentage) or medians and (interquartile range) [1], Data available for only 128 patients.
ACE, angiotensin converting enzyme; ADP, adenosine diphosphate inhibitor; eGFR, estimated glomerular filtrate; CAD, coronary artery disease; CK, creatine kinase, COPD, chronic obstructive pulmonary disease.

ISSN 0022-9040. Кардиология. 2021;61(3). DOI: 10.18087/cardio.2021.3.n1496

Table 2. Performance measures of attention of STEMI in General Hospital Camilo Cienfuegos

Performance Measure (PM)	Trimester February-April. 2020, n=35 patients	Trimester February-April. 2015–2019, n=217 patients	p, value[1]	Year 2019-January 2020, n=187 patients	p, value[2]
PM-3 Beta blocker prescribed at discharge	22/28 (78.6)	154/199 (77.4)	0.89	131/187 (70)	0.35
PM-6 ACEI or ARB prescribed for LVSD	7/7 (100)	18/19 (94.7)	0.54	26/29 (89.6)	0.37
PM-7 Time to fibrinolytic therapy*	74.3 min (45-120)	76.5 min (60-120)	0.69	75 min; (30–97.5)	0.94
PM-9 Reperfusion therapy	23 (65.7)	126 (58.1)	0.39	98/187 (52.4)	0.32
PM-12 Cardiac rehabilitation patient referral from an inpatient setting	16 (57.14)	85 (42.7)	0.15	87/169 (51.4)	0.33
PM-13 PY_{12} Receptor inhibitor prescribed at discharge	28/28 (100)	193/199 (97)	0.35	164/169 (97)	0.38
PM-17 Participation in ≥1 Regional or National Registries that include patients with acute myocardial infarction	Fulfilled	Fulfilled since 2018	–	Fulfilled	–
Quality Measure. QM-4 Aldosterone antagonist prescribed at discharge for patients with LVSD	5/7 (71.4)	8/19 (42.1)	< 0.01	17/29 (58.6)	0.34

Data are number and (percentage) or medians and (interquartile range) [1], Comparison of percentage between trimesters February–April 2015–2019 vs. 2020; [2], Comparison of percentage Jan 2019–Jan 2020 vs. trimester February–April 2020; ACEI, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; LVSD, left ventricular systolic dysfunction.

resources to offer proper treatment for these complications may be absent.

It is probable that a skeptical population, in absence of diagnosed coronary artery disease, would not go for treatment of chest pain due to fear of infection by undiagnosed or asymptomatic COVID-19 patients. However, when evaluating the actions taken by the government to protect citizens from COVID-19, and after observing that diagnostic tests for COVID-19 were available, patients began to seek medical attention for chest pain as frequently as during the months before the pandemic began. According to data from the Health Ministry before May 18, only three events of local transmission has been reported, and 68 patients had tested positive for COVID-19 in this district.

The decrease in prevalence of STEMI may be explained by several factors. First, although patients with known coronary artery disease may recognize symptoms of myocardial ischemia better than others who haven't suffered these symptoms, and they may seek for medical attention, other patients may relate the symptoms to non-ischemic etiologies and not seek medical attention. As the number of patients seen in health centers may have been diminished, care providers may have identified better and faster those who may have required transfer to a specialized or secondary center. This transfer might have been done faster too, as system became decongested.

Second, the increase in performance measures may be misleading. As the number of patients decreases, administration of proper treatment for emergencies may be enhanced, as care providers focus simultaneously on fewer patients. Strategies to increase performance measures by decreasing the number of patients that actually need medical attention in specialized facilities may have been learned from experiences in the COVID-19 era.

Finally, the higher mortality during the February-April, 2020 period may also be confusing. Up to three risk factors for coronary artery disease were more prevalent in this period. Thus, during this period, patients seem to have had greater intrinsic risk, i.e., lower LVEF and higher CK, for complications than patients from other periods, although this was not expressed is risk scales such as GRACE. However, anterior myocardial infarction was found in ~20% more patients than the other two periods.

With regard to system delay time, this report seems to be an exception to the rule. System delays had not increased as widely reported. This may be a result of the prevalence of COVID-19 or a more rapid responses of care givers to patients who present with dyspnea or chest discomfort. Also, during these months, only very-ill patients may have sought medical attention, and physicians may have handled them properly, due to the absence of patients with minor complaints. Such complaints may sometimes divert the physician's attention from patients with more serious chief complaints.

However, the incidence of patients who received thrombolytic therapy may be misleading. This increase was not due to better performance during this period. Also, the increased mortality and complication rates during the February-April, 2020 period should not be interpreted as poorer performance either, because this occurred due to a decrease in STEMI presentations in the emergency room where immediate therapy could have been initiated.

However, reasons are not important. If patients with chest discomfort present in the emergency room, they should be properly diagnosed and treated despite their other symptoms [14, 15]. Monitoring these metrics will give us a starting point for improvement during the future.

To this date, comparisons of performance measures in the COVID-19 era to determine if the decrease in the prevalence of STEMI could change the quality of medical attention in LMIS are lacking [1]. Although this time frame is too short to conclude that COVID-19 has negatively impacted the care of STEMI, care givers in low/middle-income settings should continuously monitor these markers in order to detect an early variation in trends.

Limitations

This study has several limitations. It was a single center study. Also it was a retrospective analysis of a cohort of patients admitted in a secondary hospital in a LMIS, with a free of charge universal access to state-funded health care and with no private practice. Second, our sample may have hidden some relationships that might appear with a larger sample. Finally, although an update in protocols was carried out in 2016, and performance measures may have been slightly different in these years, sample data from 2015 and 2016 were not predominant in this report.

Conclusion

COVID-19 pandemic decreased the prevalence of STEMI, as well as some performance measures of attention in General Hospital Camilo Cienfuegos, Sancti-Spiritus, Cuba. The apparent decrease in prevalence may have been due of the impact of patients who needed medical assistance but refused to seek it for fear of COVID-19.

Declarations

Ethics approval and consent to participate: the study was conducted in full conformance with the principles of the Declaration of Helsinki, and it was approved by institutional review. Consent to participate was waived due to the nature of the study. Consent for publication: not applicable. Availability of data and materials: the datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request. Funding: not applicable. Authors' contributions: all authors read and approved the final manuscript.

Acknowledgements

the author thank health care givers all over the world who have fought against COVID-19.

No conflict of interest is reported.

The article was received on 21.12.2020

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