Acute myocardial infarction in four secondary care hospitals in Cuba in the COVID-19 era

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ABSTRACT

Introduction: The clinico-epidemiological characteristics in the diagnosis, evolution and treatment of patients with acute myocardial infarction in the COVID-19 era depend on several factors.
Objectives: To determine the behavior of some clinico-epidemiological variables in the management of patients with acute myocardial infarction during de COVID-19 pandemic.
Methods: An observational study was carried out in four secondary care hospitals in Cuba. The following variables were used: number of admission due to acute myocardial infarction, hospital mortality, delay longer than four hours from the beginning of the symptoms to the arrival to the first medical assistance, and thrombolysis percentage. Two groups were defined, those admitted from March 1st to September 30th, 2019 (Group I) and those admitted in the same period, but from 2020 (Group II). Comparisons between both groups were made using the chi square test.
Results: There was a decrease of 53 admissions due to acute myocardial infarction in Las Tunas (112 vs. 159; p<0.05), with an increase in the number of admissions in the Hospital Enrique Cabrera in patients from Group II (98 vs. 68; p<0.05). The number of deaths and hospital mortality in Group II increased in all the centers in relation to Group I. In most of the hospitals there was an increase of the time elapsed from the beginning of the symptoms to the arrival to the first medical assistance. Thrombolysis percentage in Group II was higher than 50% in most of the centers.
Conclusions: The characteristics of COVID-19 may modify the clinical and epidemiological aspects in the management of patients with acute myocardial infarction.
Keywords: Acute myocardial infarction, Acute coronary syndrome, Disease management, COVID-19

Infarto agudo de miocardio en cuatro hospitales de atención secundaria en Cuba en la era COVID-19

Authors' contribution

MSM: Conception, conceptualization and design of the research. Project administration. collection, validation and formal analysis of the data, and drafting of the manuscript.

JAPM: Conception, conceptualization and design of the research. Review and assistance in writing the manuscript.

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MRR: Data collection, validation, formal analysis and interpretation. Review and assistance in writing the manuscript.

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RESUMEN

Introducción: Las características clínico-epidemiológicas en el diagnóstico, evolución y tratamiento de los pacientes con infarto agudo de miocardio en la era COVID-19 dependen de varios factores.

Objetivo: Precisar el comportamiento de algunas variables clínico-epidemiológicas en la atención y tratamiento de los pacientes con infarto agudo de miocardio en el curso de la COVID-19.

Método: Se realizó un estudio observacional en cuatro hospitales de atención secundaria en Cuba. Se utilizaron las siguientes variables: número de ingresos por infartos, mortalidad hospitalaria, tiempo de demora mayor de 4 horas desde el inicio de los síntomas y la llegada a la primera asistencia médica y el porcentaje de trombólisis. Se definieron dos grupos, los ingresados entre el 1 de marzo al 30 de septiembre de 2019 (Grupo I) y los ingresados en igual período pero del 2020 (Grupo II). Las comparaciones entre ambos grupos se realizaron utilizando el test de Chi cuadrado.

Resultados: Existió una disminución de 53 ingresos por infarto agudo de miocardio en Las Tunas (112 vs. 159, p<0.05), con un incremento del número de ingresos en el Hospital Enrique Cabrera en los pacientes del grupo II (98 vs. 68, p<0.05). Se incrementó el número de fallecidos y la mortalidad hospitalaria en el grupo II en todos los centros con relación al grupo I. En la mayoría de los centros se incrementó la demora desde el inicio de los síntomas y la llegada al lugar de la primera asistencia médica. El porciento de trombólisis fue superior al 50% en la mayoría de los centros en el grupo II.

Conclusiones: Las características de la COVID-19 pueden modificar aspectos clínicos y epidemiológicos en la atención y tratamiento de los pacientes con infarto agudo de miocardio.

Palabras clave: Infarto agudo de miocardio, Síndrome coronario agudo, Tratamiento de la enfermedad, COVID-19

INTRODUCTION

The global pandemic caused by the new SARS-CoV-2 coronavirus has resulted in a new and lethal disease called COVID-19. This disease has risen as the world's largest public health emergency. As of November 7, 2020, according to official data from the World Health Organization (WHO), COVID-19 had been diagnosed in 216 countries, currently active in 185 of them, with a cumulative global burden of 49 373 274 patients, of whom 1 243 083 had died, for a case fatality rate of 2.51%[1-3].

Coronavirus disease has affected health care resources worldwide in many countries, disrupting people's lifestyles and reorganizing health care systems to cope with the increase in affected patients. To give just one example, the unstoppable pandemic in Italy meant that intensive care and coronary intensive care unit (CICU) beds were not sufficient to care for patients with respiratory failure secondary to COVID-19. Some regions, such as Lombardy, had to reorganize and centralize the treatment of patients with acute cardiovascular disease in four centers[4,5].

Initial studies on the pathophysiology of COVID-19 revealed a large systemic inflammatory response, with elevated erythrocyte sedimentation rate, C-reactive protein, D-dimer, and interleukin-6. This response would suggest that there would be an increase in the destabilization of the atheromatous plaque, with a resulting increase in acute coronary syndromes and cerebrovascular accidents; however, the reports to date do not provide evidence of this[6,7].

Acute cardiac injury is reported among the cardiovascular manifestations in patients with COVID-19 and occurs in 7-28% of hospitalized patients. The presence of sustained ventricular tachycardia and ventricular fibrillation has been found in 5.9% of patients.

In a series of 191 patients, heart failure appeared as a complication in 23% of all cases, a figure that increased to 52% among deceased cases[8-10]. In a study conducted by Bahtt *et al.*[7] in 15 centers in the United States, they observed a 43% reduction in hospitalization rates for cardiovascular conditions, including heart failure, acute coronary syndromes and strokes. In particular, several studies worldwide have emphasized the decrease in acute myocardial

infarctions (AMI) in the COVID-19 era, as evidenced by some clinical and epidemiological characteristics of interest in these patients, including a decrease of up to 40% in activations of hemodynamics and interventional cardiology laboratories in this period[7,11-13].

Cuba has not escaped the scourge of COVID-19. As of November 7, the number of confirmed cases amounted to 7297, with 130 deaths, for a lethality rate of 1.78%, figures much lower than those reported by other countries, such as Belgium, with almost the same number of inhabitants. In this European country, the number of positive cases currently stands at 487 949 patients, with 12 708 deaths, for a case fatality rate of 2.6%[3].

The good intersectoral organization in the country, in terms of the management of the epidemic, with the support, follow-up and monitoring of the highest authorities of the Cuban government has been highlighted by several international institutions, a fact that has led to the daily incidence of COVID-19 being controlled in figures that prevent health institutions in Cuba from collapsing, a fact that seems to be a determining factor in the influence of this pandemic on the care of patients with cardiovascular diseases, including patients with AMI. In Cuba, there are not many studies demonstrating the epidemiological behavior of patients with AMI during these pandemic months, despite the number of international studies published on the subject.

The possibility of having a multicenter infarction registry (RECUIMA for its acronym in Spanish) that includes centers from different regions of the country makes it possible to perform these analyses by dynamically comparing variables of clinical-epidemiological interest in the care of patients with AMI in this type of situation. For this reason, our research was carried out with the objective of knowing the behavior of some clinical variables in the management of patients with AMI in the context of the COVID-19 pandemic in four secondary care health centers in Cuba.

METHOD

An observational study was conducted in patients admitted with a diagnosis of AMI, without associated diagnosis of COVID-19, in four secondary care hospitals in Cuba, *Hospital Dr. Ernesto Guevara* (Las Tunas), *Hospital Camilo Cienfuegos* (Sancti Spíritus), *Hospital Enrique Cabrera* y *Hospital Salvador Allen-*

de (Havana), all belonging to the multicenter project of the Cuban Infarction Registry (RECUIMA). In the case of the first three, the patients were admitted to the CICU and in the case of the *Hospital Salvador Allende* to the general intensive care unit.

Despite the fact that the fourth definition of AMI leaves no room for doubt in order to proceed to its diagnosis, in this series of centers in which the suggested biomarkers are not determined (troponins), a diagnosis was made if the patient presented two or more of the following parameters:

- Symptoms of ischemia.
- Significant new or presumably new ST-segment changes, or new left bundle branch block with positive Sgarbosa criteria.
- Development of pathological Q waves in the ECG.
- Elevation of twice the normal values of creatine kinase-MB (CK-MB) or total CK, with confirmation of the characteristic enzyme curve and in the absence of other pathologies that may elevate them.
- Imaging evidence of new-onset loss of viable myocardium or new-onset regional wall motility abnormalities.
- Identification of an intracoronary thrombus by angiography or autopsy.

Two groups were defined: group I patients admitted from March 1 to September 30, 2019 and group II patients admitted in the same period but in 2020.

The data were entered into the RESCUE software, a patient data collection platform of the REgistro CUbano de Infarto de Miocardio Agudo (RECUIMA)[14], and then transferred to the Statistical Package for Social Sciences (SPSS, version 24, IBM, Armonk, New York), for better use and management of the database.

The categorical variables were presented as number and percentage, while the continuous variables were transformed into dichotomous variables based on a pre-established cut-off point, and presented as number and percentage. Comparisons between the two groups were made using the Chi-square test for all variables, since they were all categorical variables.

The following variables were used: number of admissions for AMI, total deaths, hospital mortality, percentage of thrombolysis, and mean time between the onset of symptoms and first medical care, adjusted to a dichotomous variable, with a cutoff point of 4 hours.

The need for informed consent of the participants was not necessary due to the retrospective nature of the study and the fact that their personal data are not recorded in this manuscript. Each of the RECUIMA managers in each center was contacted and access to the institutional database was requested, based on the provisions of the document Methodological Basis of the Cuban Registry of Acute Myocardial Infarction: from utopia to reality, in the section "Ethical Considerations"[14].

RESULTS

Fourteen fewer patients were admitted in 2020 among the four participating centers (**Table 1**). There was a decrease of 53 admissions for AMI in Las Tunas in the study months in 2020 compared to 2019 (112 vs. 159). There was an increase of 30 admissions in group II (98 cases) at *Hospital Enrique Cabrera,* compared to group I (68 cases).

There were 34 deaths in group II, 8 more than in the same period of 2019, with a slight increase in hospital mortality (9.8 vs. 7.2; p=0.21), as shown in **Table 2**. An increase in hospital mortality was evidenced in all centers in the 2020 period: three more deaths in the case of Sancti Spíritus: three in the

Hospital Salvador Allende, and four in the *Hospital Enrique Cabrera.*

A 28.2% and 24.4% of patients admitted for infarction in Las Tunas and Sancti Spíritus respectively, arrived after 4 hours from the onset of symptoms (**Table 3**), both figures higher than the same period in 2019. In the case of those admitted to the *Hospital Enrique Cabrera* and *Hospital Salvador Allende*, the number decreased compared to 2019.

The percentages of thrombolysis in all the centers were above 50% in 2020, except for the *Hospital Salvador Allende*; however, only one of the centers reached figures above 65% (*Hospital Enrique Cabrera* 66.3%), which also showed an increase in thrombolysis in relation to 2019. The percentage of patients who received thrombolytic treatment at the *Hospital Salvador Allende* in 2020 was lower (56.3% vs. 30.0%) compared to the same period in 2019 (**Table 4**).

DISCUSSION

The clinical and epidemiological characteristics in the diagnosis, evolution and treatment of patients with AMI/acute coronary syndrome in the COVID-19 era seem to depend on several factors: severity of

Table 1. Distribution of patients with acute myocardial infarction admitted to four secondary care hospitals in Cuba.

Hospitals	Total	Group I		Group II		p
	Nº	Nº	%	Nº	%	
Hospital Dr. Ernesto Guevara	271	159	58.3	112	41.7	< 0.05
Hospital Camilo Cienfuegos	245	118	48.2	127	51.8	> 0.05
Hospital Enrique Cabrera	166	68	41.0	98	59.0	< 0.05
Hospital Salvador Allende	26	16	61.5	10	48.5	> 0.05
Total	708	361	51.0	347	49.0	> 0.05

Table 2. Deceased and in-hospital mortality due to acute myocardial infarction.

Hospitals	Group I (n=361)		Group II (n=347)		p
	Deceased	%	Deceased	%	
Hospital Dr. Ernesto Guevara	14	8.7	12	10.7	0.59
Hospital Camilo Cienfuegos	9	7.6	12	10.4	0.61
Hospital Enrique Cabrera	3	4.4	7	7.1	0.46
Hospital Salvador Allende	0	0	3	30.0	0.02
Total	26	7.2	34	9.8	0.21

the number of cases with this viral infection, possible collapse of health systems, income levels of the countries and the help that government institutions and health systems are able to provide to this new pandemic that has modified people' lifestyles worldwide, as well as the decrease in economic indicators that influence the determinants of medical care in each country.

Due to the dramatic growth of this disease, patients with COVID-19 overload emergency departments, hospital wards and intensive care units in several countries, which has led to a decrease in elective health-care activities and, in many cases, to the displacement of emergency departments such as CICU to other hospital centers. There are several reports in a number of studies from different countries (**Table 5**) regarding the decrease in admissions for AMI/acute coronary syndromes in the COVID-19 era[2,11,12,15-19].

The economic consequences of the pandemic are an aspect to be taken into account when explaining the decrease in admissions for cardiovascular conditions, especially in countries without public access to health care. A study in the United States reveals that around 25 million people have lost their health insurance during the pandemic[6].

There are other hypotheses to explain the decrease in admissions: fear of becoming infected or coming into contact with COVID-19 positive patients in the hospital, reduction of certain unhealthy behaviors, such as salt intake in restaurants, or the reduction in environmental pollution due to the reduction in vehicle traffic; on the other hand, in developed countries, the increase in telemedicine means that patients can consult a health professional when they present symptoms and prevent them from progressing and deteriorating their cardiovascular health[6,20].

It is noteworthy that the decrease in the number of cases in Las Tunas occurred in the two months with the highest number of COVID-19 positives in the province (April and August). On April, due to health services restructuring, it was necessary to allocate the second largest hospital in the province to provide care for patients with respiratory conditions, and the provincial CICU assisted all patients admitted for acute coronary syndrome in that hospital; however, the number of infarctions admitted de

Table 3. Time delay greater than 4 hours from the onset of pain and first medical assistance.

Hospitals	Group I (%)	Group II (%)	p
Hospital Dr. Ernesto Guevara	26.5	28.2	0.81
Hospital Camilo Cienfuegos	19.4	24.4	0.35
Hospital Enrique Cabrera	29.4	26.5	0.81
Hospital Salvador Allende	43.7	30.0	0.48

Table 4. Percentage of thrombolysis in patients admitted with infarction.

Hospitales	Group I (%)	Group II (%)	p
Hospital Dr. Ernesto Guevara	53.4	51.1	0.77
Hospital Camilo Cienfuegos	48.3	50.4	0.75
Hospital Enrique Cabrera	55.9	66.3	0.14
Hospital Salvador Allende	56.3	30.0	0.02

creased significantly.

A study conducted from March 13 to April 9, 2020, in one of the Italian centers where it was necessary to reorganize and centralize the treatment of patients with cardiovascular disease, evidenced an increase in admissions for acute coronary syndrome and ST-segment elevation AMI (STEMI), when compared to the same period in 2019; However, in-hospital mortality also increased significantly (10.0% vs. 4.0%)[5]. A similar scenario occurred in the Department of Cardiology of the Enrique Cabrera Hospital, which, due to medical care restructuring in the capital, had to take on patients from other municipalities who were not usually admitted to the center, a situation that account for the increase in the number of cases.

Governments and medical societies have insisted on the need to stay at home. This may be causing people to postpone hospital attendance. A study conducted in Australia[21] in patients with STEMI reported a fourfold increase in the time between symptom onset and patient arrival at first medical attention, 11 hours longer compared to the pre-COVID stage. In most of the centers, the study corroborated an increase in the number of patients arriving more than 4 hours after the onset of symptoms at the site of first medical care.

A study conducted in India suggests that the delay of AMI patients in attending first medical care from the onset of pain is related to lack of transportation in the country, loss of medical services in first medical care institutions due to changes in their work routine, sick personnel due to COVID-19 or

Table 5. Some international studies demonstrating the decrease in admissions for AMI/ACS in the COVID-19 era.

Authors	Country	Nº of centers	Decreasing percentage	Study duration (weeks)
Coughlan *et al.*[2]	Ireland	1	36% (AMI)	3
Rattka *et al.*[15]	Germany	1	25% (AMI)	4
Secco *et al.*[16]	Italy	3	52% (ACS)	4
Braiteh *et al.*[18]	United States	4	41% (ACS)	8
De Filippo *et al.*[12]	Italy	15	50% (ACS)	6
Metzler *et al.*[19]	Austria	19	39% (ACS)	4
De Rosa *et al.*[11]	Italy	54	48% (AMI)	1
Xiang *et al.*[17]	China	1372	26% (AMI)	8

AMI, acute myocardial infarction; ACS, acute coronary syndrome

health system overload. However, Showkathali, *et al.*[20], in the same study, stated that after the first 5 weeks of emergency closure they noticed an increase in the early attendance of patients to the hospital, after the onset of symptoms.

In a study performed in China,[17] also referred to by Ranard,[4] a comparison is made of patient data 4 weeks before and after the start of the COVID-19 outbreak, using the registry of 1372 patient care centers in that country. They emphasize that from the beginning of the pandemic, the treatment protocol for STEMI patients was modified, and reperfusion therapy was prioritized instead of primary angioplasty, to reduce the risk of infection of health care professionals. These investigators found a weekly reduction in admissions of 26%, which was greater in Hubei (62%), the epicenter of the pandemic in China. Similarly, the delay times between the onset of pain and the first medical care were increased, also greater in Hubei; and 55% of STEMI patients walked in to the emergency services. A number of societies around the world have redesigned guidelines for the care and treatment of AMI patients during the COVID-19 pandemic, and have made recommendations in some cases to create regional percutaneous coronary intervention (PCI) and referral CICU services. The use of fibrinolytic therapy has been recommended in other countries. Percutaneous coronary intervention is performed in patients after medical evaluation or if they do not have reperfusion with fibrinolytics. Hence, the results published in relation to reperfusion therapy may vary from country to country, depending on the different reorganizations approved in the COVID era[1,5,17]. A study carried out in England[22] showed that, at the end of March, in patients with STEMI, primary PCI and my-

ocardial revascularization surgery during admission were reduced by 18% and 75%, respectively; and a study carried out in China[17] showed a decrease in PCI and an increase in thrombolysis, in accordance with the modifications made by that country in the treatment of patients with STEMI during the pandemic.

In the following investigation, none of the centers could perform PCI, which is common in most secondary care hospitals in Cuba, where reperfusion therapy, using streptokinase, is the cornerstone in the treatment of STEMI. Except for thrombolysis rates at Salvador Allende Hospital in 2020, all others were as expected.

The impact of the COVID-19 era on PCI was evaluated in a study by the European Association of Percutaneous Coronary Intervention[23] in which 636 members were surveyed in different countries of that geographical region. The decrease in the performance of coronary angiography worldwide is due to several factors. Concerning the personnel working in the hemodynamics laboratories, there was a 59% decrease associated with quarantine, 43% with COVID-19 infection and 59% with the need to reallocate personnel to other areas in the hospitals, such as the emergency departments or the CICU. Another aspect to take into account according to the interviewees is the lack of protection of personnel and patients going to the hemodynamics laboratories, all this caused a decrease in elective and emergency procedures, with a decrease in activations in acute coronary syndromes and, specifically, a 27% reduction in cases of STEMI.

The reduction in the number of PCIs in most centers may explain some of the results regarding the increased length of stay in AMI patients in the

COVID-19 era[20].

LIMITATIONS

The changes experienced in some of the clinical-epidemiological variables in the care and treatment of patients with AMI seem to depend to a large extent on the degree of incidence and control of the pandemic in a given country. This study, despite being carried out in only four centers (which means that its results are not significant to generalize them at the country level), does provide elements on the impact of the COVID-19 pandemic on some important indicators in the treatment of patients with AMI in Cuba. Another fact to take into account is that it is not possible to evaluate other variables of interest, such as the performance of PCI, because the participating centers do not have hemodynamics and interventional cardiology laboratories.

CONCLUSIONS

The characteristics of COVID-19 can modify aspects related to management of patients with acute myocardial infarction, hence the multifactorial nature of the elements to be taken into account. There was a significant decrease in admissions for myocardial infarction at the *Hospital Ernesto Guevara*, with a significant increase at the *Hospital Enrique Cabrera*, due to the reorganization of services at the latter center. The number of deceased and in-hospital mortality increased in group II in all centers compared to group I. Thrombolysis was higher than 50% in most centers in group II.

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