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Factors associated with mortality from acute ST segment elevation myocardial infarction

Factores asociados a la mortalidad por infarto agudo del miocardio con elevación del segmento ST

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Abstract
Introduction: Acute myocardial infarction is the most severe form of ischemic heart disease and has the highest mortality rate. Objective: To determine the factors associated with mortality from ST-segment elevation myocardial infarction (STEMI) at the emergency department of the Dr. Agostinho Neto General Teaching Hospital. Methods: A descriptive, cross-sectional study was conducted on all patients discharged with a diagnosis of acute myocardial infarction (n=130). A series of variables were analyzed to determine their association with mortality. Results: Mortality was 24.3% in patients over 60 years of age, slightly higher than in those under this age. The incidence of risk factors was high in the sample, especially systemic hypertension, diabetes mellitus, and smoking. A known history of previous ischemic heart disease, although not the most prevalent, was also significantly associated with mortality. Variables related to death in the sample included the presence of intense retrosternal pain, accompanied by palpitations, or the onset of cardiac arrest, especially in patients with anterior topography infarction and in whom reperfusion was not achieved during thrombolysis. Conclusions: Mortality from ST-segment elevation myocardial infarction was associated with some factors such as age, pain intensity, and anterior wall location
Keywords: acute myocardial infarction, ischemic cardiopathy, cardiovascular diseases

Resumen
Introducción: El infarto agudo del miocardio es la forma más grave de la cardiopatía isquémica y la de mayor mortalidad. Objetivo: Determinar los factores asociados a la mortalidad por infarto agudo del miocardio con elevación del segmento ST en el centro de urgencias del Hospital General Docente Dr. Agostinho Neto. Métodos: Se realizó un estudio descriptivo y transversal de todos los egresados con diagnóstico de infarto agudo del miocardio (n=130). Se relacionaron una serie de variables para determinar su asociación con la mortalidad. Resultados: La mortalidad fue de 24,3 % en pacientes con más de 60 años, ligeramente superior a los menores de esta edad; la incidencia de factores de riesgo fue elevada en la muestra sobre todo la hipertensión arterial sistémica, la diabetes mellitus y el hábito de fumar. El antecedente conocido de cardiopatía isquémica previa, aunque no tuvo la más alta incidencia, también se relacionó con la mortalidad de manera significativa. Fueron variables relacionadas con la muerte en la muestra la presencia de dolor intenso de localización retrosternal, acompañado de palpitaciones, o el debut con una parada cardiaca, sobre todo en pacientes con infarto de topografía anterior y en los que no se haya conseguido la reperfusión durante la trombólisis. Conclusiones: La mortalidad por infarto agudo del miocardio con elevación del segmento ST estuvo asociada con algunos factores como la edad, la intensidad del dolor y la topografía en cara anterior.
Palabras clave: *Infarto agudo del miocardio; Cardiopatía isquémica; Enfermedad cardiovascular.*

Introduction

Worldwide, ischemic heart disease accounts for about 50% of deaths and 40% of those who die are in the most socially productive and family-led ages.[1,2] In Cuba, and so it is in Guantánamo, this is the leading cause of death.[3] Acute myocardial infarction, defined as the necrosis of cardiomyocytes secondary to acute myocardial ischemia, is its most severe form and, despite advances in diagnosis and therapy, still has high mortality.[4]

Five types of acute myocardial infarction are recognized:

- Type 1 is the so-called "spontaneous" related to ischemia due to a primary coronary event with erosion, rupture, fissure or dissection of an atherosclerotic plaque that generates an intraluminal thrombus in a damaged coronary artery, with the reduction of distal myocardial flow due to an imbalance between the supply and demand of oxygen to the cardiac muscle, and subsequent myocardial necrosis. This is expressed in the electrocardiogram with or without ST segment elevation.
- Type 2 is secondary to ischemia due to increased O_2 demand or its decreased contribution due to: coronary spasm, coronary embolism, anemia, arrhythmias, high blood pressure and hypotension.
- Type 3 is the sudden unexpected death that has had symptoms of myocardial ischemia
- Type 4 is the one associated with coronary interventionism.
- And type 5 is associated with coronary artery bypass grafting.[4]

Much has been written about this condition because of its high mortality, the need for prompt qualified medical intervention and the high costs it generates. They report the effectiveness of thrombolysis in the first hour, its worrying presentation in young patients as well as the attention in intensive care units that requires a large amount of material and human resources. Most agree that there is a growing need to reduce its lethality through strategies that address the factors that cause it.[5,6,7]

To reduce mortality, it is important to identify the factors that are associated with it, So the aim of this study is precisely to describe the factors associated with mortality from acute ST segment elevation myocardial infarction in the emergency department of the Hospital General Docente Dr. Agostinho Neto during 2021 and 2022.

Method

A descriptive cross-sectional study was conducted at the Hospital General Docente Dr. Agostinho Neto in Guantánamo, covering 2021 and 2022. All discharged patients with confirmed diagnosis of acute ST segment elevation myocardial infarction were included. For this diagnosis two out of the following three criteria were considered: clinical, enzymatic and electrocardiographic.[4]

The following variables were studied: age (completed years, recorded as less than 60 years and 60 years or more); sex (female or male); cardiovascular risk factors —whether they were present or not, and which one was present— (high blood pressure, diabetes mellitus, obesity, ischemic heart disease, smoking, dyslipidemia, sedentary lifestyle, peripheral vascular disease, family history of ischemic heart disease and chronic kidney disease); anginal pain (onset, location, intensity, character, irradiation, relief, duration, associated symptoms); topography of acute myocardial infarction (anterior, inferior or other location); prognostic according to Forrester classification (grade I, II, III, or IV); complications (mechanical, electrical or ischemic, and which of these); thrombolytic treatment (whether applied or not); reperfusion criteria (whether there were any) and state at discharge (living or deceased).

The data were obtained from the review of medical records and recorded in a spreadsheet created in EXCEL and analyzed with the Statistical Package for the Social Sciences (SPSS) software version 15 for Windows, the results were expressed in tables. To establish the association between two variables, the Pearson`s chi-square test was used; in all cases, the statistically significant value was considered when the probability (p) of occurrence was lower and equal to 0.05; the odds ratio (OR) was calculated, and 95% confidence intervals (95% CI) were established. The study was developed in accordance with the ethical principles of the Declaration of Helsinki, after approval by the ethics committee and the scientific council of the institution.

Results

Mortality from acute ST segment elevation myocardial infarction in the studied sample was 6.9%. **Table 1** shows the relationship between some epidemiological variables and mortality. Note that the mortality due to acute myocardial infarction was 24.3% in patients aged 60 years or more and in women 21.2%; although in no case there was a statistically significant relationship with death. Risk factors such as systemic hypertension and a known history of diabetes mellitus or chronic ischemic heart disease were associated with mortality in the sample, given p values below 0.05.

Anginal pain semiology is revealed in **Table 2**. Mortality was higher in patients whose anginal pain presented the following characteristics: being accompanied by cardiac arrest, having retrosternal location, being intense, presenting with an oppressive character, possessing atypical irradia-

tion, require opiates for relief, lasting more than one hour and being accompanied by syncope. The appearance characteristics accompanied by cardiac arrest, retrosternal location with intensity, lasting more than one hour and accompanied by palpitations showed a significant relationship with mortality from the statistical point of view.

Table 3 shows the characteristics specific to the type of acute ST segment elevation myocardial infarction that were most associated with mortality in the conducted study; these were: the topography compatible with the anterior wall of the left ventricle, the clinical and hemodynamic state grade IV according to the criteria of the Forrester classification and the fact that coronary thrombolysis was not performed —or, if received, did not produce the reperfusion of the affected coronary vessel—.

Complications presented by the patients are seen in figure 1. In the same patient, several complications were present, so they are non-excluding variables. The 26 deceased patients had complications, while 89 of the living ones had complications as well, for an 85.5%. The most frequent were electrical with 65.2%, followed by mechanical with 58.3%. Among the former, the presence of premature ventricular contraction, ventricular arrhythmias, atrio-ventricular block of various types and atrial fibrillation stand out. Among the latter ones, heart failure, cardiogenic shock, left ventricular free wall rupture and acute mitral regurgitation highlight. Another set of complications were the ischemic ones, which occurred in 33% of patients, such as the infarction extension and post-infarction angina. In addition to a group of extracardiac complications at 26.1%, which included acute renal failure, adrenoceptic pericarditis, pulmonary thromboembolism, pneumonia associated with mechanical ventilation and multiple organ failure.

Discussion

Among the patients studied, the profile of morbidity and mortality of acute myocardial infarction type researched varies in relation to the frequency of various elements, such as present risk factors, age, sex, location of the infarction, extension of it, its complications, as well as the application or not of thrombolytic therapy and its effectiveness. Therefore, this study satisfied the lack of a previous characterization of these patients and the elements associated with mortality from acute ST segment elevation myocardial infarction at the

Table 1. Relationship of some epidemiological variables with mortality from acute ST segment elevation myocardial infarction

Characteristics	Global (%) n = 130	State at discharge		P value*	OR (IC-95%)
		Alive (%) n=104 (93,1)	Dead (%) n=26 (6,9)		
Age				0,18	
Less than 60 years	60 (46,2)	51 (85)	9 (15)		0,5 (0,2-1,4)
60 years or older	70 (53,8)	53 (75,7)	17 (24,3)		1,8 (0,7-4,5)
Sex				0,82	
Male	78 (60)	63 (80,8)	15 (19,2)		0,9 (0,4-2,1)
Female	52 (40)	41 (78,8)	11 (21,2)		1,1 (0,5-2,7)
Risk factor				0,53	1,4 (0,5-4,1)
HBP	82 (63,1)	61 (74,4)	21 (25,6)	0,03	2,9 (1,1-8,5)
Diabetes mellitus	76 (58,5)	56 (73,7)	20 (26,3)	0,03	2,8 (1,1-7,7)
Obesity	71 (54,6)	56 (78,9)	15 (21,1)	0,72	1,2 (0,5-2,8)
Ischemic HD	61 (46,9)	43 (70,5)	18 (29,5)	0,01	3,2 (1,3-8,0)
Smoking	70 (53,8)	57 (81,4)	13 (18,6)	0,95	0,9 (0,4-2,4)
Dyslipidemia	57 (43,8)	44 (77,2)	13 (22,8)	0,03	1,6 (0,6-3,9)
Sedentary lifestyle	51 (39,2)	39 (76,5)	12 (23,5)	0,29	1,4 (0,6-3,4)
PAD	43 (33,1)	38 (88,4)	5 (11,6)	0,85	1,1 (0,5-2,6)
CKD	5 (3,8)	4 (80)	1 (20)	1	1,0 (0,1-9,3)
PFH ischemic HD	33 (25,4)	24 (27,3)	9 (27,3)	0,22	1,7(0,7-4,5)

*Pearson`s chi-square test

CI: Confidence intervals; CKD: Chronic kidney disease; HBP High blood pressure; HD, Heart disease; OR: Odds ratio; PAD: Peripheral arterial disease; PFH ischemic HD: Pathological family history of ischemic heart disease

Table 2. Anginal pain semiology and its relationship with mortality from acute ST segment elevation myocardial infarction

Pain semiology	Global (%) n = 130	State at discharge		P value*	OR (IC-95%)
		Alive (%) n=104 (93,1)	Dead (%) n=26 (6,9)		
Onset					
At rest	88 (67.7)	69 (78,4)	19 (21,6)	0,151	1,4 (0,5-3,6)
On exertion	31 (35,2)	28 (90,3)	3 (9,7)	0,099	0,4 (0,1-1,3)
With cardiac arrest	8 (6,1)	4(50)	4 (50)	0,001	4,7 (1,3-23,4)
Location					
Precordial	101 (77.7)	83 (82,2)	18 (17,8)	0,246	0,6 (0,2-1,5)
Retrosternal	70 (53,8)	51 (72,9)	19 (27,1)	0,027	2,8 (1,1-7,3)
Other	98 (75,4)	81 (82,7)	17 (17,3)	0,118	0,5 (0,2-1,2)
Intensity					
Intense	103 (79.2)	78 (75,7)	25 (24,3)	0,017	8,3 (1,1-24,1)
Not intense	27 (20,8)	26 (96,3)	1 (3,7)	0,017	0,1 (0,0-0,9)
Character					
Oppressive	116 (89,2)	93 (80,2)	23 (19,8)	0,887	0,9 (0,2-3,5)
Burning/heaviness	111 (85,4)	90 (78,9)	21 (21,1)	0.456	0,7 (0,2-2,0)
Poorly defined	6 (4,6)	5 (83,3)	1 (16,7)	0,834	0,7 (0,1-7,1)
Irradiation					
Typical	77 (59,2)	53 (68,8)	24 (31,2)	0,205	0,1 (0,0-1,3)
Atypical	9 (6,9)	7 (77,8)	2 (22,2)	0,795	1,1 (0,2-5,9)
Relief					
Nitrites	94 (72,3)	81 (86,2)	13 (13,8)	0,004	0,3 (0,1-0,7)
Opiates	36 (27,7)	23 (63,9)	13 (36,1)	0,004	0,3 (0,1-0,7)
Duration					
Less than one hour	44 (33,8)	42 (95,5)	2 (4,5)	0,001	0,1 (0,0-0,5)
One hour or more	86 (66,2)	62 (72,1)	24 (27,9)	0,001	8,1 (1,8-16,2)
Accompanying symptoms					
Dyspnea	93 (71,5)	74 (79,6)	19 (20,4)	0,845	1,1 (0,4-2,9)
Diaphoresis	73 (56,2)	55 (75,3)	18 (24,7)	0,132	2,0 (0,8-5,0)
Death feelings	59 (45,4)	47 (79,7)	12 (20,3)	0,929	1,0 (0,4-2,5)
Palpitations	54 (41,5)	37 (68,5)	17 (31,5)	0,005	3,4 (1,4-8,4)
Syncope	11 (8,5)	7 (63,6)	4 (36,4)	0,156	2,5(0,7-9,4)

*Pearson`s chi-square test

CI: Confidence intervals; OR: Odds ratio

Hospital General Docente Dr. Agostinho Neto. It provides information necessary for future decision-making, especially those aimed at reducing mortality from this cause with the implementation of preventive strategies.

Most of the reviewed studies show that acute myocardial infarction has a higher incidence and mortality in people aged 60 years or older.[5,7,8] Studies conducted in Cuba showed that the largest proportion of patients, especially those who died, were between 60 and 69 years old, which is consistent with this study.[5,9,10] It is known that with increasing age the risk of acute myocardial infarction is higher, as the effects of cardiovascular risk factors on the genesis of atherosclerotic vascular damage are greater. In fact, several prognostic models include old age as a determinant of mortality.[6-8]

The number of patients under 60 years who had an infraction was remarkable, which supports the views of researchers who point out that coronary heart disease affects increasingly younger peo-

Table 3. Characteristics of the type of acute ST segment elevation myocardial infarction and their relationship with mortality

Infarction characteristics	Global (%) n = 130	State at discharge		P value*	OR (IC-95%)
		Alive (%) n=104 (93,1)	Dead (%) n=26 (6,9)		
Topography					
Anterior	60 (46.1)	42 (70)	18 (30)	0,008	3,3 (1,3-8,3)
Inferior	59 (45,4)	53 (89,8)	6 (10,2)	0,021	0,3 (0,1-0,8)
Other	11 (8,5)	9 (81,8)	2 (18,2)	0,874	0,9 (0,2-4,3)
Clinical and hemodynamic state according to Forrest classification					
I	42 (32.3)	41 (97,6)	1 (2,4)	0	0,1 (0,0-0,5)
II	57 (43,8)	48 (84,2)	9 (15,8)	0,288	0,6 (0,5-1,5)
III	8 (6,1)	5 (62,5)	3 (37,5)	0,201	2,6 (0,6-11,5)
IV	18 (13,8)	5 (27,8)	13 (72,2)	0	9,4 (3,4-15,1)
Thrombolytic treatment					
Yes	95 (73.1)	80 (84,2)	15 (15,8)	0,004	0,4 (0,2-1,0)
No	35 (26,9)	24 (68,6)	11 (31,4)	0	4,6 (1,8-11,2)
Reperfusion n=95					
Yes	68 (71,6)	58 (85,3)	10 (14,7)	0	0,2(0,1-0,6)
No	27 (28,4)	22 (81,5)	5 (18,5)	0	5,3(1,6-12,1)

*Pearson`s chi-square test

CI: Confidence intervals; OR: Odds ratio

ple.[6,8,11] For example, Estévez Rubido et al.[6] found that acute ST segment elevation myocardial infarction was more common in young males.

In the reviewed studies about the occurrence of infarctions according to patient´s sex it was found that it affects more males[11,12] however, the more advanced the age probabilities in both sexes are paired since during menopause women loose the estrogenic protection.[5,14,15] In the current study mortality was superior in women, a result that coincide with the study published by González Rodríguez R et al.[5] in Pinar del Río, Cuba. However, it is in contrast with other pointing out a greater mortality in elderly men[14,15] Alfonso Alfonso Y et al. [12] and Vitón Castillo AA et al.[13] did not describe association between sex and mortality from infarction.

The cardiovascular risk factors identified in the patients studied correspond to those recognized in other studies. It is noted that systemic hypertension is the most frequent in these patients, as for example pointed out by Loso Hernández JD et al.[7] an incidence of hypertension of 29.2%. However, Santos Medina M et al.[16] had in their sample 81.9% of patients with infraction with this risk factor and in the research by Alonso Carballo J. et al.[9] this was present in 73.6% of patients. The current study approaches this last figure with 63.1%.

For their part, Arredondo Bruce AE et al.[15] identified systemic hypertension and smoking as the most common risk factors, in this research smoking was present in 53.8% of the sample studied but not related to death. Bergrath S et al.[17] report increased frequency of obesity, hypertension and diabetes mellitus. Windle SB et al.[18] y Matos Santiesteban MA et al.[11], respectively observed that smoking and hypercholesterolemia were the most important risk factors.

Discrepancies regarding the frequency of epidemiological characteristics present in the various studies and the coincidence or not with the one presented, are related to the methodology used

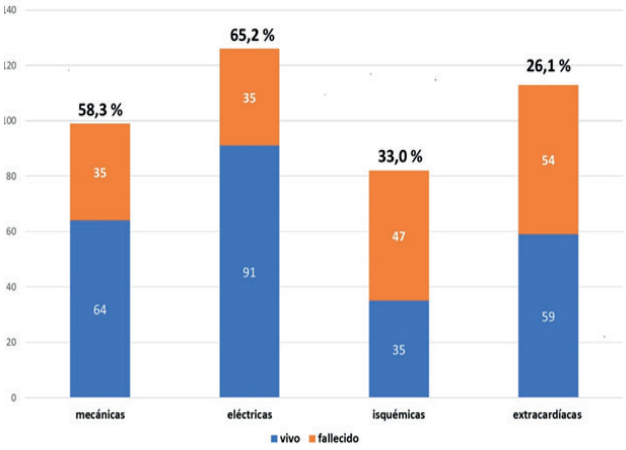

Fig. 1. Complications presented in the patients studied with acute ST segment elevation myocardial infarction

in the research, the possibilities of identifying all factors, as well as the characterization of lifestyles, dietary habits, hereditary and environmental factors, among others that condition atherogenesis, which accuracy was not always possible.

As in other studies,[5,9] most of the patients studied presented with oppressive anginal pain, precordial and with typical irradiation. Alonso Carballo J et al.[9] report that 62.3% of the infarcted patients they studied presented typical clinical manifestations. Acute myocardial infarction can occur through complications such as acute cardiogenic pulmonary edema, cardiogenic shock, cardiac arrest, or be silent or manifest with atypical symptoms.[9]

Regarding the topography of the infarction, the results match other reviewed reports.[5,16,19] Santos Medina M et al.[16] and Aguiar Pérez JE et al.[19] found higher mortality in patients with anterior location topography. On the other hand, others point to the predominance of inferior or anterolateral located infarctions.[7,8] The higher mortality in patients with anterior wall location is due to being usually more extensive, transmural and associated with ischemic ventricular dysfunction, extension of infarction and wall rupture.

The main therapeutic objective in acute ST segment elevation myocardial infarction is the application of myocardial ischemia-reperfusion strategies such as thrombolysis or primary percutaneous angioplasty because they reduce its mortality.[5, 20,21]

The results that are revealed regarding the application of thrombolysis are similar to those from other studies.[5,9,11] Santos Medina M et al.[14] and Plain Pazos C et al.[20] applied it to more than 50% of the patients they studied, and its application was associated with lower mortality. In the institution where the study was conducted, only the prescription of systemic coronary thrombolysis is possible, as there are no possibilities for coronary interventionism.

When thrombolysis was not applied in this study it was because the ischemia time window exceeded 12 hours. The delay in its implementation is a predictor of mortality and an indicator of health care quality, so it is associated with increased mortality.[9,11,16] In all cases of the sample was due to delays in diagnosis due to a low perception of the patient requesting medical help.

Most of the patients studied presented complications, especially of electrical type, result similar to other studies.[1,15] Several authors[11,22] agree that ventricular arrhythmias are the main complication and cause of mortality from acute myocardial infarction, because they usually occur in extensive heart attacks, with a higher incidence of hemodynamic complications.

Cardiogenic shock was most associated with the probability of dying, as claimed by other authors.[9, 12] It is established that the degree of ischemic ventricular dysfunction determines in the short term the death of 40-80% of those who die, since such cases usually have a loss of cardiac muscle mass greater than 40%.[15,18]

The most frequent and most associated conditions with mortality were pulmonary thromboembolism, extension of acute myocardial infarction and pneumonia associated with invasive mechanical ventilation. Other researchers have found that cardiogenic shock, hyperglycemia greater than 15 mmol/L, biventricular infarction, heart failure, delay or non-application of thrombolysis are more likely to influence infarction mortality in people over 70 years of age, expression of the diversity of variables predicting the risk of death from acute myocardial infarction, whose identification is influenced by the variables evaluated in each study.[16,21]

It is estimated that complications and mortality from acute myocardial infarction decrease when reperfusion strategies are implemented, guaranteed to recover the injured muscle in time and when secondary prevention based on evidence is established.[23] According to studies from Latin America, used as evidence in their guidelines, they report that the development of heart failure, kidney disease, the presence of cardiovascular risk factors such as type 2 diabetes mellitus, high blood pressure and active smoking, as well as a low socioeconomic level and old age, are clinical indicators of increased mortality risk.[24]

It is important to achieve patient care in the shortest time possible and try to open the culprit vessel, thereby reducing complications and thus mortality. Health promotion actions are also needed to eliminate ethnic or behavioral issues that cause delays or improvements in the quality of health systems, such as accessibility or transportation.[25]

When a patient who has had an acute myocardial infarction leaves hospital systems alive, it is therapeutically important to achieve the following three vital objectives without prioritizing their importance: 1) to keep the culprit coronary artery open if it was possible to reperfuse the patient during hospitalization or open the culprit coronary artery if it was not opened, 2) to protect the heart muscle to maintain contractile function as well as possible, and 3) to avoid a new event.[24]

It is identified that a limitation of the study was its retrospective nature and the use of medical records as a source of information. Nevertheless, it provides valuable information for future research.

Conclusion

Mortality due to acute ST segment elevation myocardial infarction at the Hospital General Docente Dr. Agostinho Neto was more frequent in those over 60 years of age, although without a signifi-

cant relationship. Some risk factors were statistically associated with mortality, such as the presence of systemic hypertension and a history of diabetes mellitus or previous ischemic heart disease. The presence of severe pain from retrosternal location, accompanied by palpitations or the onset with a cardiac arrest, were also variables related to death in the sample, especially in patients with infarction of anterior topography in which reperfusion was not achieved during thrombolysis.

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