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Original Article

Clinical features of patients who died from acute myocardial infarction with necropsy confirmation

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ABSTRACT

Introduction: Cardiovascular diseases are one of the leading causes of death worldwide, among this group, acute myocardial infarction accounts for a large number of cases.

Objective: To characterize the clinical features of patients who died from acute myocardial infarction in the Intensive Care Unit and the Cardiology Ward of the Celestino Hernández Robau University Hospital.

Method: A descriptive cross-sectional development research was conducted in a sample consisting of 110 patients who died from acute myocardial infarction, with necropsy confirmation.

Results: There was a predominance of patients aged 65 and older (79.1%) and of males (54.5%). There were 94 patients with three or more risk factors, and hypertension (81.7%) was the most common one. The most common forms of clinical presentation were typical chest pain (52.7%) and ST segment elevation acute myocardial infarction (74.5%). The main anatomo-clinical complication was cardiogenic shock (57.3%). Fibrinolytic therapy and angioplasty were used only in 47 patients (42.7%).

Conclusions: There was a predominance of male patients, of those over 65 years of age and of the clinical presentation with the typical chest pain. Hypertension was the main risk factor. There was also a predominance of patients with three or more risk factors, ST segment elevation on the electrocardiogram and cardiogenic shock as a complication. The use of fibrinolytic therapy and angioplasty was scarce.

Key words: Acute myocardial infarction, Risk Factors, Death, Necropsy

Comportamiento clínico de pacientes fallecidos por infarto agudo de miocardio con confirmación necrópsica

RESUMEN

Introducción: Las enfermedades cardiovasculares constituyen una de las primeras causas de muerte a nivel mundial, entre este grupo, el infarto agudo de miocardio

aporta un gran número de casos.

Objetivo: Caracterizar el comportamiento clínico en los pacientes fallecidos por infarto agudo de miocardio en la Unidad de Cuidados Intensivos y en la Sala de Cardiología del Hospital Universitario "Celestino Hernández Robau".

Método: Se realizó una investigación de desarrollo, de tipo descriptivo transversal, en una muestra conformada por 110 pacientes fallecidos por infarto agudo de miocardio con confirmación necrópsica.

Resultados: Predominó la edad de 65 años o más (79,1 %) y el sexo masculino (54,5 %). Hubo 94 pacientes con tres o más factores de riesgo, y la hipertensión arterial (81,7 %) fue la que predominó. Las formas de presentación clínica más frecuentes fueron el dolor precordial típico (52,7 %) y el infarto agudo de miocardio con elevación del segmento ST (74,5 %). La principal complicación anátomo-clínica fue el *shock* cardiogénico (57,3 %). El tratamiento fibrinolítico y la angioplastia se aplicaron solo a 47 pacientes (42,7 %).

Conclusiones: Se observó un predominio del sexo masculino, de las edades superiores a 65 años, de la forma de presentación clínica con dolor precordial típico, y de la hipertensión arterial, como principal factor de riesgo; además, predominaron los pacientes con tres o más factores de riesgo, con elevación del segmento ST en el electrocardiograma y con *shock* cardiogénico como complicación. La administración de tratamiento fibrinolítico y la angioplastia fueron escasos.

Palabras clave: Infarto agudo de miocardio, Factores de riesgo, Muerte, Necropsia

INTRODUCTION

Cardiovascular diseases have been found among the leading causes of death in many countries for several decades. Among these, coronary heart diseases are the predominant cause of morbidity and mortality in the Western world, and are considered a global epidemic as they have had a significant increase in developing countries[1]. However, in recent decades trends to reduce mortality from these diseases have been reported, nevertheless they represent a considerable health care burden[2,3].

The 2012 health statistical yearbook shows, regarding the causes of death, that heart diseases are relegated to a second place after malignant tumors in adults; however, the analysis of this indicator by age, shows that in those over 65 years heart disease is the leading cause of death. In 2012, the net death rate from this cause was 197.6 per 100,000 inhabitants. Acute myocardial infarction (AMI), presented a mortality rate of 56.7 per 100,000, and in 2011, 54.6, which shows an increase of 2.1%[4].

The province of Villa Clara, in particular, showed a net rate of heart diseases of 210.6 per 100,000 inhabitants in 2012[4], and in 2010, this rate was 197.8[5], which showed an increase of heart diseases.

AMI is a common cardiovascular disease of uncertain progression, whose lethality during the acute phase, despite the many advances achieved, is very high, which justifies efforts and resources to improve its prognosis[6-9]. The severity of the condition and its prevalence may be related to cardiovascular risk factors (CRF), modifiable and non-modifiable, that influence the onset of coronary disease. Among the modifiable ones the following are described: dyslipidemia, diabetes mellitus, smoking and hypertension, as well as, with less importance, physical inactivity, emotional stress, personality and obesity[10,11]. Among non-modifiable RF previous history of ischemic heart disease at an early age, age and sex are described. Other CRF, recognized in recent decades, such as homocysteinemia have also been described[12].

Due to the different clinical presentations of AMI, the identification of patients with acute coronary syndrome is a challenge, especially in cases where there are no obvious symptoms or electrocardiographic findings, so the diagnosis of ischemic heart disease, and especially AMI is not always easy[13-16]; that is why serum cardiac markers with high sensitivity to myocardial damage have been developed[17,18], allowing the diagnosis of AMI in patients who do not meet the classical electrocardiographic and clinical criteria[19-21].

The primary purpose of treatment for AMI is early recanalization of the infarct-related artery, that is why the immediate therapy of reperfusion, pharmacolo-

gical (thrombolysis) or mechanical (angioplasty) is so important[22].

The objective of this research was to characterize the clinical behavior of patients who died of AMI, with necropsy confirmation in the Intensive Care Unit and the Cardiology ward, of Celestino Hernández Robau University Hospital.

METHOD

A descriptive cross-sectional development research was conducted in the Intensive Care Unit and the Cardiology ward, of Celestino Hernández Robau University Hospital, in Santa Clara municipality, Villa Clara province, Cuba, from January 1, 2008 until December 31, 2012.

The study population consisted of all patients who died during this period in the hospital with AMI criteria. The sample was selected using non-probability sampling and consisted of 110 deceased. The inclusion criteria was: patients who died in the Intensive Care Unit and the Cardiology ward, to whom a pathologic study was performed, which showed AMI as the cause of death.

The information was obtained from individual medical records, the autopsy reports of the Department of Pathology and deceased records of the Statistics Department of the hospital. These documents provided the information necessary for the development of the research, as it included general data of the patient, features and clinical complications of AMI, and the behavior adopted in each case.

The information obtained was recorded in a data collection sheet that was created for that purpose. The following variables of interest were included: age, sex, CRF, AMI presentation form, anatomic and clinical complications, classification of AMI, according to electrocardiographic criteria, and reperfusion therapy.

For statistical analysis, the information was organized in a database, in Microsoft Excel; these data were exported to SPSS (Statistical Packed for Social Sciences) version 15.0 for Windows, where they were processed and the results were presented in tables and graphs with their corresponding descriptive and inferential analysis.

Frequency distribution tables with absolute (number of cases) and relative values (percentages) were created. The mean and mode was determined in the variables that required it for better presentation, as well as the standard deviation as a measure of variability.

From the inferential point of view the difference in proportions test was applied in order to test if the percentage differences had a high statistical significance ($p<0.05$).

RESULTS

Table 1 shows that patients generally died within 72.9 years; men in an interval ranging from 62 to 84 years, with a mean age of 71.6 years; while for women the age varied between 65 and 83 with a mean age of 74.4 years. The lowest age observed was 34 and the oldest 93.

In general, more men than women died, 60 and 50, respectively. The most affected age group was 65 years and over (87, 79.1%), although women show a higher proportion in this group (43, 86.0%) than men (44, 73.3%).

High blood pressure (HBP) (81.8%), previous ischemic heart disease (74.5%) and male sex (54.5%) were the main CRF found (**Table 2**); followed, in order of frequency, by diabetes mellitus (45.5%), and obesity was less frequent with only 11 patients (10,0 %).

The number and average of these CRF, according to age group are shown in **Table 3**. A total of 94 patients

Table 1. Distribution of deceased patients by age and sex. Intensive Care Unit and Cardiology Ward. Celestino Hernández Robau Hospital, 2008 - 2012.

Age groups (years)	Sex				Total	
	Female		Male			
	Nº	%	Nº	%	Nº	%
Less than 45	0	0	2	3,3	2	1,8
45 – 54	1	2,0	3	5,0	4	3,6
55 – 64	6	12,0	11	18,3	17	15,5
65 and over	43	86,0	44	73,3	87	79,1
Total	50	100,0	60	100,0	110	100.0
Mean ± SD	74,4 ± 9,1		71,6 ± 12,4		72,9 ± 11,1	

p>0,05
Source: Data Collection Sheet

(85.4%) had three or more, whereas 12 (10.9%) had two, and only 4 patients (3.6%) had a single CRF associated with AMI. The highest number of cases with three or more factors is provided by the group aged 65 or older, with 73, and the highest average of CRF is present in the age group between 45 and 54 years, that has an average of 5,8 CRF per patient.

Table 2. Risk factors present in deceased patients.

CRF	Deceased	
	Nº	%
Hypertension	90	81,8
Previous ischemic heart disease	82	74,5
Male sex	60	54,5
Diabetes mellitus	50	45,5
Smoking	36	32,7
Dyslipidemias	34	30,9
Family history of coronary disease	13	11,8
Obesity	11	10,0

Table 3. Distribution of deceased patients by age and amount of CRF found.

Age groups (years)	Number of CRF							
	One		Two		Three or more		Total	Average
	Nº	%	Nº	%	Nº	%	Nº	
Less than 45	0	0	0	0	2	100	2	3,5
45 – 54	0	0	0	0	4	100	4	5,8
55 – 64	1	5,6	2	11,1	15	83,3	18	4,4
65 and over	3	3,5	10	11,6	73	84,9	86	4,0
Total	4	3,6	12	10,9	94	85,4	110	4,2

Table 4. Clinical presentation forms of AMI in deceased patients.

Clinical presentations	Nº	%
Typical chest pain	58	52,7
Acute pulmonary edema	25	22,7
Cardiorespiratory arrest	12	11,0
Syncope	9	8,2
Atypical chest pain	6	5,4
Others	4	3,6

It was found that 58 deceased (52.7%) had typical chest pain at admission, (**Table 4**). Other presentations forms were acute pulmonary edema (22.7%) and cardiac arrest (11.0%). Other less common symptoms were syncope (8.2%) and atypical chest pain (5.4%).

Table 5 presents the anatomo-clinical complications present in AMI with (STEMI) and without ST elevation (NSTEMI). Cardiogenic shock was the most common complication for both types of AMI because it affected 63 patients (57.3%). Other complications were conduction disorders (19.1%), the pump failure without shock (18.2%) and serious cardiac arrhythmias (17.3%), and less frequent were cardiac tamponade, occlusion stent and pulmonary embolism. The following are other complications with fewer numbers of cases: pericarditis, postinfarction angina, mitral regurgitation, thrombus in the left ventricle, aneurysms and pseudoaneurysms.

Table 5 also shows the distribution of patients regarding the elevation or non-elevation of ST segment. Of the total of cases in the study, 82 had ST segment elevation (74.5%) and 28 (25.5%), segment depression.

Of a total of 110 patients angioplasty was performed only in 10 (9.1%) and thrombolytic therapy in 37, representing 45.1% of the 82 that might have received it as they had STEMI (**Table 6**). 45.9% of patients received thrombolysis before 2 hours of symptom onset, 43.2% with a delay of more than 6 hours, and 10.8% in the range between 2 and 6 hours. It is noteworthy that fibrinolytic therapy and angioplasty were only applied to 47 patients (42.7%).

DISCUSSION
AMI is a phenomenon observed more often in people over 60 years, although there has been an increase of acute episodes in younger individuals[23]. These results agree with Ramos *et al.*[24] and Alvarez *et al.*[25], who showed that this age group is most susceptible due to the impact, over the years, of atherogenic risk factors.

Table 5. Distribution of deceased patients according to anatomo-clinical complications.

Anatomo-clinical complications	STEMI (n=82)		NSTEMI (n=28)		Total (n=110)	
	Nº	%	Nº	%	Nº	%
Cardiogenic Shock	50	61,0	13	46,4	63	57,3
Conduction disorders	19	23,2	2	7,1	21	19,1
Pump failure (Killip class IV)	18	22,0	2	7,1	20	18,2
Serious cardiac arrhythmia	16	19,5	3	10,7	19	17,3
Cardiac tamponade	15	18,3	2	7,1	17	15,5
Stent occlusion	6	7,3	1	3,6	7	6,4
Pulmonary embolism	4	4,9	0	0,0	4	3,6
Others	3	3,6	0	0,0	3	2,7

Table 6. Reperfusion treatment used in patients who died due to AMI.

Treatment	Nº	%
Fibrinolytic	**37**	**45,1[a]**
< 2 hours	17	45,9[b]
2 - 6 hours	4	10,8[b]
≥ 6 hours	16	43,2[b]
PTCA	**10**	**9,1[c]**
Primary	5	50,0[d]
Facilitated	1	10,0[d]
Rescue	4	40,0[d]

Caption. a: Percentage value based on the total of STEMI patients (82), b: values based on the total number of patients who received thrombolysis (37), c: percentages based on the total number of patients in the study (110), d: values based on the total number of angioplasties performed (14).

In turn, Alvarez *et al.*[25] and Montalescot *et al.*[26] report male sex predominance; however, other authors have found female predominance[27,28]. Thus, it is generally a disease that affects both men and women, a behavior more evident for ages over 50, when women lose their estrogenic protection, as it has been suggested that estrogens increase serum levels of high density lipoprotein (HDL), which reduces the risk of atherogenesis in women of childbearing age, so after this phase the trend is to equalize the incidence of the disease in both sexes[29]. Therefore, male sex is considered a risk factor for the occurrence of AMI in patients younger than 60 years.

Knowledge of CRF has allowed acting on their control and modification, which has a positive influence on primary and secondary prevention of cardiovascular diseases. A study performed in Spain by Vázquez *et al.*[30] in STEMI patients, shows hypertension (53.3%), smoking (44.7%), hyperlipidemia (38.2%) and diabetes mellitus (32.9%) as primary CRF. However, age, diabetes mellitus and previous ischemic events[31] are linked to lethality to a greater extent; these results are similar to ours, where diabetes mellitus and a history of AMI ranked as frequent CRF in deceased patients.

Apparently, the reduction of in-hospital mortality of patients with acute coronary syndromes has led to an increased number of cases with chronic coronary diseases that are likely to suffer new cardiovascular events. A 3-year follow-up of the REACH (Reduction of atherothrombosis for Continued Health) trial revealed that all cardiovascular events increase from 25.5 to 40.5%, and cardiovascular mortality increases from 4.7 to 8.8% if more than one vascular region is affected[32].

Smoking is considered the most worrying CRF in young patients with AMI, because it enhances the process of atherogenesis by increasing the oxidation of low-density lipoproteins and decreasing HDL-cholesterol, which makes the endothelium-dependent vasodilation difficult and favors platelet aggregation and coronary spasm[23,33].

A Chilean study which assessed 1,168 patients with NSTEMI, found that the highest impact CRF was hypertension (49%), followed by dyslipidemia, smoking and diabetes mellitus[34] and Ramos *et al.*[24], in 2010, detected in 177 patients, that the most frequent CRF were hypertension (64.4%), smoking (53.7%) and history of previous AMI (41.2%), which coincides with our results, except what was stated regarding smoking which was lower in our study, perhaps attributable to the fact that smoking in our province is a phenomenon that generally characterizes the younger population, underrepresented in the selected sample.

The least observed CRF are obesity and family his-

tory, which is consistent with the literature reviewed [10-12,23,34].

Baena *et al.*[35] in a study of 2,248 patients, found that 39.1% of cases did not present any CRF, 32.8% had only one associated factor and 17.5% had two; while 6.9% had three factors and only 3.7% from four to six CRF. These results are completely different from ours, where cases with three or more CRF predominated in all age groups. However, these same authors[35] suggest that the number of CRF is directly proportional to the occurrence of any coronary disease and the risk is particularly high in subjects with more than three CRF. It is clear that the sample used in our research consisted of deceased with necropsy confirmation, so it is expected that due to the severity of the illness that triggered death, they presented several associated CRF.

Data from observational studies have shown the limitations of anamnesis to identify patients with AMI. Indeed, about 25% of infarcts were not recognized in the first medical encounter, due to absence of pain or presence of atypical symptoms[36-38]. And Gutiérrez *et al.*[39] in a research with geriatric patients found that the predominant symptom in a third of patients was pain. Other presentations were: dyspnea, mental confusion, acute pulmonary edema, hemiplegia and shock.

As noted in our study, the typical pain was the predominant presentation form. Its prominence as chief complaint in emergency rooms justifies having protocols to optimize the available resources to minimize the risk of inappropriate discharge.

Regarding complications, the highest percentage of patients with cardiogenic shock is attributed to the fact that our research was conducted in deceased, and shocks along with severe ventricular arrhythmias are the most lethal complications.

According to Alvarez *et al.*[25], in a study in Matanzas, they found that 12.4% of patients had conduction disorders, and 3.5% of the deceased had third-degree atrioventricular block. Ramos *et al.*[24] found cardiac arrest, cardiogenic shock and arrhythmias as the most frequent complications.

Rodriguez *et al.*[27] who identified complications in deceased patients, found that the most common one was cardiogenic shock (41.8%), followed by serious cardiac arrhythmias (35.24%), acute pulmonary edema and the advanced atrioventricular block, both with 15.57%.

Pump failure, with its most severe presentation,

cardiogenic shock, currently holds the leading cause of in-hospital mortality, and death from this cause occurs primarily in the first three to four days of progression [14,17,40-43].

The results of this study agree with many others, where there is a predominance of STEMI; however, advances in noninvasive diagnostic techniques at the bedside have shown a significant increase of NSTEMI [18,44,45].

Santos *et al.*[23] and Alvarez *et al.*[25] found an incidence of STEMI of 69.3 and 70.33%, respectively, and Coll-Muñoz *et al.*[44], in the province of Cienfuegos, obtained the result closest to ours (77.6%).

The incidence of hospital admissions for STEMI varies from country to country; the most comprehensive registry of STEMI in the European region is probably the one made in Sweden, where the incidence is 66 per 100,000 inhabitants per year[18]. Similar data were collected in the Czech Republic, Belgium and the United States, where it has been found that STEMI incidence rates decreased between 1997 and 2005 from 121 to 77 deaths per 100,000 inhabitants, while NSTEMI incidence rates increased slightly from 126 to 132; which shows that the incidence of STEMI is declining, while there is a concomitant increase in the incidence of IAMSEST[18].

Reperfusion of AMI-related vessel is the treatment of choice and time is a determining factor. Ramos *et al.*[24] found that 75.7% of patients arrived at the hospital within 6 hours of symptoms onset, 10.7% between 6 and 12 hours, and 9.6% between 12 and 24 hours.

Coronary, pharmacological or mechanical reperfusion prevents many complications by achieving reduced infarct area, better healing and therefore less remodeling with reduced incidence of electrical and mechanical complications. Sherwood *et al.*[46] reported a reduction in mortality when reperfusion is timely applied; they also state that in studies where thrombolysis was applied in the first 90 minutes after pain onset, mortality was only 1%; whereas, Bazart *et al.*[47] found that from a total of 74 patients, only 12.2% received fibrinolytic therapy within the first two hours, 29.7% between the third and fourth hour, 18% between the fifth and sixth hour, and 33.7% received it more than six hours later.

Delay times referred to in our research show that a considerable number of cases (35.5%) received fibrinolysis in times over six hours, something that is re-

lated to lethality, because after that time the useful-ness of this treatment is uncertain.

Another factor that could lead to death is the limited number of patients who received fibrinolytic therapy in relation to the total of STEMI cases (45.1%), although our result is similar, or even superior to that found by other authors[24,25,48].

A European study found that of 4,035 STEMI pa-tients, only 35% was treated with thrombolytic thera-py. Greece, had the highest application rate of therapy with 52% and Lithuania the lowest rate, with only 13%. On average, 20% of eligible patients for therapy did not receive it[49].

PTCA rates worldwide are far superior to ours[18,22], which was only performed in 12.7% of patients who died. Ramos *et al*.[24] reported 26.6% of primary PTCA and Alvarez *et al*.[25] used it in 60.94% of all cases. The low number of angioplasties performed is explained by several reasons: the study was performed on deceased, the time from symptoms onset to hospital arrival was prolonged, and in this province, the availability of per-cutaneous coronary intervention is limited to office hours.

CONCLUSIONS

The patients who died of AMI with necropsy con-firmation were mostly male, over 65 years of age and with typical chest pain as presentation form. The most common CRF were hypertension and a history of is-chemic heart disease; besides most of the deceased presented three or more CRF. STEMI and cardiogenic shock predominated. Thrombolytic therapy was admi-nistered to a small number of cases and PTCA was performed in a very small number of them.

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