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ORIGINAL ARTICLE

Clinical and echocardiographic preconditions in left main coronary artery disease

Precondiciones clínicas y ecocardiográficas en la enfermedad obstructiva de tronco coronario izquierdo

Pré-condições clínicas e ecocardiográficas nadoençaobstrutiva do tronco da coronáriaesquerda

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ABSTRACT

Introduction: cardiovascular pathologies are currentely the leading cause of death in the world, of which multivessel disease provides a high number of patients, with a marked annual mortality rate higher than those with single-vessel disease. **Objective:** to relate clinical and echocardiographic factors associated with left main coronary artery disease in patients with acute myocardial infarction at the Centro de Cirugía Cardiovascular y Cardiología in Santiago de Cuba, Cuba. **Method:** a prospective, analytical, non-experimental case-control study was conducted (case group 100 patients; control group 300 patients), during the period marked from 2017-2021. It were applied tests of the Kolmogorov-Smirnov method and, the odds ratio (OR) and the Durbin-Watson test were calculated. **Results:** the prevalence of acute myocardial infarction with ST segment elevation was found in 326 patients (81.5%) with a value of $p \leq 0.05$ (0.048); the presence of complications had a very high statistical significance with $p \leq 0.05$ (0.00714) as related value; the parietal motility index <1.7 points showed a value of $p \leq 0.05$ (0.006) with an OR of 2.063; LI 1.229 and LS 3.463. The equation predicted at a 59.7% the risk of acquiring a multivessel disease in patients with: ejection fraction less than 50% in left ventricular diameter >58 mm, left atrial pressure >25 mmHg, PMAP > 15 mmHg and decreased right ventricular systolic function. **Conclusions:** the presence of complications, the type of acute myocardial infarction, and echocardiographic parameters such as parietal motility index were predictors of multivessel disease present in the acute events.

Keywords: multivessel disease; echocardiography, acute coronary syndrome

RESUMEN

Introducción: las patologías cardiovasculares son la principal causa de defunciones en el mundo, de esta la enfermedad multivaso aporta una cifra elevada de pacientes, con una mortalidad anual significativamente más alta que la de pacientes con enfermedad de un solo vaso. **Objetivo**: relacionar factores clínicos y ecocardiográficos asociados a la enfermedad de tronco coronario izquierdo en pacientes con infarto agudo de miocardio del Centro de Cirugía Cardiovascular y Cardiología Santiago de Cuba, Cuba. **Método**: se realizó un estudio prospectivo, analítico, no experimental de casos y controles (grupo de casos 100 pacientes; grupo control 300 pacientes), durante el periodo comprendido entre 2017-2021. Se emplearon pruebas de Kolmogorov-Smirnov, se calculó la razón de disparidad (OR) y la prueba de Durbin-Watson. **Resultados**: se constató dominio de infarto agudo de miocardio con elevación segmento ST pacientes 326 (81,5 %) teniendo valor de p ≤ 0,05 (0,048); la presencia de complicaciones tuvo altísima significación estadística con valor p≤0,05 (0,00714), se evidenció que el índice de motilidad parietal <1,7 puntos, mostró un valor de p ≤ 0,05 (0,006) con un OR: 2,063; LI 1,229 y LS 3,463. La ecuación predijo un riesgo del 59,7 % de padecer una enfermedad multivaso en aquellos pacientes que presentaron: fracción de eyección menor de 50 % diámetro del ventrículo izquierdo >58 mm, presión de aurícula izquierda >25 mmHg, PMAP > 15 mmHg y función sistólica del ventrículo derecho disminuida. **Conclusiones**: la presencia de complicaciones, el tipo de infarto agudo miocardio y parámetros ecocardiográficos tales como índice de motilidad parietal, fueron predictores de enfermedad multivaso en contexto del evento agudo.

Palabras clave: enfermedad multivaso; ecocardiografía; síndrome coronario agudo

RESUMO

Introdução: as patologias cardiovasculares são a principal causa de mortes no mundo, das quais a doença multiarterial contribuicomum elevado número de doentes, comumamortalidade anual significativamente superior à dos doentesuniarteriais. **Objetivo:** relacionar fatores clínicos e ecocardiográficos associados à doença da artériacoronáriaesquerda em pacientes com infarto agudo do miocárdio no Centro de Cirugía Cardiovascular y Cardiología Santiago de Cuba, Cuba. **Método:**estudo prospectivo, analítico, não experimental de casos e controles (grupo caso 100 pacientes; grupo controle 300 pacientes) foi realizado durante o período de 2017-2021. Foram utilizados os testes de Kolmogorov-Smirnov, calculado o odds ratio (OR) e o teste de Durbin-Watson. **Resultados:** 326 pacientes (81,5%) apresentaramdomínio de infarto agudo do miocárdiocomsupradesnivelamento do segmento ST, com valor de p ≤ 0,05 (0,048); a presença de complicações teve umasignificânciaestatísticamuito alta com valor de p ≤ 0,05 (0,00714), ficou evidenciado que o índice de motilidade parietal <1,7 pontos, apresentou valor de p≤ 0,05 (0,006) com OR: 2,063; LI 1.229 e LS 3.463. A equaçãopreviuum risco de 59,7% de sofrer de doença multiarterial naqueles pacientes que apresentavam: fração de ejeção menor que 50%, diâmetro ventricular esquerdo>58 mm, pressão atrial esquerda>25 mmHg, PMAP > 15 mmHg e função sistólica do ventrículo direitodiminuída**Conclusões:** a presença de complicações, o tipo de infarto agudo do miocárdio e os parâmetros ecocardiográficos, como o índice de motilidade da parede, forampreditores de doença multiarterial no contexto do evento agudo.

Palavras-chave: doença multiarterial; ecocardiografia, síndrome coronariana aguda

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INTRODUCTION

Coronary multiarterial disease is a common type of cardiovascular illness that has increased its incidence in recent years, has shown a trend toward involvement of young people. The one-year mortality of patients with multivessel disease is significantly higher than that of patients with single-vessel disease. In addition, multivessel disease is frequently accompanied by ventricular dilatation, heart failure, cardiac arrhythmia and other complications.[(1)]

Worldwide, Latin America leads the world in the number of cases of cardiovascular disease, due to the lifestyle that characterizes developing countries. Mortality due to coronary artery disease has increased in the young population in countries such as Mexico,[(2)] although the overall incidence of acute myocardial infarction has decreased in many developed countries in recent decades.[(3)]

In 2020, 29 939 deaths occurred in Cuba due to cardiovascular diseases, of which 7804 patients died of acute myocardial infarction. It should be added that 2805 coronary angiographies, 1167 angioplasties in acute patients and 190 patients underwent coronary surgeries, mostly in patients with multivessel lesions. In the province of Santiago de Cuba, in the same period, there were 2700 deaths due to cardiovascular diseases with a rate of 258 per 100 000 inhabitants, with 841 coronary angiographies, 355 patients with coronary intervention and 40 patients with multivessel disease in that period.[(4)]

On the other hand, new technological advances applied to echocardiography now make it possible to detect multivessel disease from different transthoracic views, detect significant proximal stenosis based on the presence of turbulence (aliasing) in the stenotic zone or based on the continuity equation with the analysis of the relationship between pre- and post-stenotic velocities; together with parameters such as parietal motility and biventricular systolic function that provide valuable information for predicting anatomical defects and complications.[(5)]

Due to the high incidence and morbidity due to cardiovascular diseases, especially multiarterial disease, and due to the disintegration of knowledge concerning the disease, the present investigation was developed with the aim of relating clinical and echocardiographic factors associated with left main coronary artery disease in patients with acute coronary syndrome.

METHOD

A single-center research was developed with patients admitted with acute myocardial infarction, where a prospective, analytical, non-experimental case-control study was performed, with the aim of relating clinical and echocardiographic factors associated with left coronary trunk disease in patients with acute myocardial infarction at the Center for Cardiovascular Surgery and Cardiology Santiago de Cuba, during the period from 2017-2021.

For the purposes of the study, two groups were taken into account, the case group and a control group. Both study groups (cases and controls) were part of the same population of patients with a diagnosis of acute myocardial infarction (1 206 patients), only differentiated by the fact of being carriers of left coronary trunk disease or three-vessel disease or not.

The case group consisted of all patients with electrical and mechanical complications due to this disease (100 patients) and the control group consisted of those who did not present these complications, selected from each year twice the number of cases by simple random sampling (300 patients).

Inclusion criteria:

The cases group was represented by 100 patients with obstructive left main coronary artery disease (LMAD) >50% or three-vessel disease >70%, and was defined as severe left main coronary artery disease.

The control group consisted of 300 patients with single-vessel obstructive coronary artery disease >70%, not left main coronary trunk, or without obstructive lesions >70%, as a whole individual. Simple random sampling was applied.

If the individual clinical record did not include some of the variables to be studied, this was an exclusion criterion for both groups.

The echocardiogram used was a Philips iE33 (Netherlands) and the transducer S5-1 (1.7-3.5 MHz). The main parameters were explored and measured from the apical view of the left ventricle, following the recommendations of the American Society of Echocardiography and the European Association of Cardiovascular Imaging.[6]

The dependent variable was the presence of truncal disease or multivessel disease, according to clinical or paraclinical diagnosis.

The independent variables were divided into demographic and echocardiographic (defined as the specific type of disease or alteration according to imaging findings):

Age (>65 years or <65 years); sex (male and female).
Type of acute myocardial infarction [non-ST-elevation myocardial infarction (NSTEMI); elevation myocardial infarction ST (STEMI)].
Left ventricular systolic function (LVSF): LVSF>50% or LVSF<50%.
Mean pulmonary artery pressure (MPAP): after determination of regurgitant flow obtained by peak tricuspid regurgitation velocity which was calculated by Bernoulli equation obtaining the medical regurgitation gradient MPAP>25 mmHg or MPAP<25 mmHg.
Left auricle pressure (LAP) LAP>15 mmHg or LAP<15 mmHg.

Right ventricular systolic function (RVSF): was determined by peak velocity of S of the Doppler tissue pulsed. The normal value was taken as >9,5 mm. TDI RV >9,5 mm; TDI RV <9.5 mm (TDI RV: right ventricular systolic function).
Parietal motility index (IWS): the left ventricular segmental motility index was calculated by dividing the left ventricle into 17 segments, quantifying the dyssynergic areas according to their severity: hypokinesia, akinesia, dyskinesia and normal motility; with cut-off value: IWS>1.7 points or IWS<1.7 points.

In the statistical analysis of the data, the SPSS package version 22.0 was used, which allowed determining the absolute and relative frequencies for qualitative variables and the mean and standard deviation for quantitative variables. Kolmogorov-Smirnov normality distribution tests were performed, showing a value of p≤0.05. To establish the strength of the association, the Odds Ratio (OR) disparity ratio with 95% confidence interval was calculated. A logistic regression analysis was performed where Durbin-Watson test was obtained to demonstrate autocorrelation of the residuals p≤0.05. In addition, the collinearity test between the independent variables was taken into account.

The tables were analyzed and discussed using inductive and deductive scientific methods. The results were compared with similar studies, which allowed conclusions to be drawn and recommendations to be issued.

The authors declare their commitment to confidentiality and protection of the information collected during the research. Authorization was also requested from the center's management and the approval of the Research Ethics Committee and the Scientific Council for the execution of the research.

RESULTS

Table 1 shows the predominance of patients <65 years with 74 % of the total, showing an OR value: 0.76, behaving as a protective factor, with a value p≥0.05 (0.188) (did not have statistical significance); also observed predominance of male sex with 56.3 % having OR: 1.37, behaving male sex as a risk factor, although it did not have significant causal association with value p≥0.05 (0.187).

Table 1. Analysis of demographic variables according to study groups

Demographic variables		Patients group						p	OR
		Cases		Controls		Total			
		No.	%	No.	%	No.	%		
Age	> 65 years	21	21.0	83	27.7	104	26.0	0.188	0.76
	< 65 years	79	79.0	217	72,3	296	74.0		
Sex	Male	62	62.0	163	54.3	225	56.3	0.187	1.37
	Female	38	38.0	137	45.7	175	43.8		

Source: Medical records. OR: Odds ratio, p≤0.05.

Regarding the type of presentation of acute myocardial infarction, STEMI dominated with 326 patients (81.5 %) with a value of p≤0.05 (0.048); on the other hand, the presence of complications had very high statistical significance with a value of p≤0.05 (0.00714) showing a correlation between the presence of complications and the presence of multiarterial disease (Table 2).

Table 2. Analysis of complications according to study groups

Clinical variables		Patients group						p
		Cases		Controls		Total		
		No.	%	No.	%	No.	%	
Type of IMA	IMACEST	88	88.0	238	79.3	326	81.5	0,048
	IMASEST	12	12.0	62	20.7	74	18.5	
Complications	Complications	16	16.0	21	7.0	37	9.3	0,00714
	Uncomplicated	84	84.0	279	93.0	363	90.8	

Source: Medical records. Ji-cuadrado p≤0.05.

Logistic regression was performed to quantify the relationship between echocardiographic variables. The model explained 75% of the variation.

Another point showed that IWS<1.7 evidenced a value of p≤0.05 (0.006) with an OR: 2.063; LI 1.229; LS 3.463; behaving as a predictor factor to present multivessel disease. On the other hand, the equation predicted a 59.7% risk of developing multivessel disease in those patients who presented: LVEF<50%, LVEDD>58 mm, IAP>25 mmHg, PMAP>15 mmHg, decreased RVEF; or vice versa, patients with echocardiographic parameters of LVEF>50%, IAP>25 mmHg, LVEDD<58 mm and elevated RVEF, with a 40% risk of developing multivessel disease (Table 3).

Table 3. Logistic regression according to patient group

	B	Standard error	Sig.	Exp(B)	95% C.I. for EXP(B)	
					LI	LS
FEVI	0.131	0.250	0.599	1.140	0.699	1.861
DTDVI	-0.422	0.359	0.241	0.656	0.324	1.327
FEVD	-0.289	0.317	0.363	0.749	0.402	1.395
PMAP	-0.228	0.265	0.390	0.796	0.473	1.339
PAI	-0.082	0.258	0.750	0.921	0.556	1.527
IWS	0.724	0.264	0.006	2.063	1.229	3.463
Constant	1.650	0.804	0.040	5.209	-	-

Source: Medical records.
Legend: OR: odds ratio; LVEF: ejection fraction; LVEDD: left ventricular end-diastolic diameter; RVEF: right ventricular fraction; LAP: mean pulmonary artery pressure; LAP: left atrial pressure; IWS: parietal motility index; LL: lower limit; UL: upper limit; LVEDD: left ventricular end-diastolic diameter.

DISCUSSION

Although there has been continuous progress in the investigation of the functional impact of obstructive coronary lesions in a direct way through the measurement of fractional flow reserve, the criteria for revascularization in acute myocardial infarction are still anatomical. Identifying patients with more extensive coronary artery disease by less sophisticated and minimally invasive means would be of great benefit to patients. This should be reflected in a better prognosis with fewer occurrences of complications.

In the present investigation it was found that there was no significant relationship between age and multivessel disease. Milian, *et al*.[7] described that the average age of patients with multivessel disease was 67 years.

According to Aldama-Hernández, *et al*.[8] in their study, the average age was 65 years and the male sex predominated.

According to García-Blass, *et al*.[9] age is the most important isolated risk factor for the stratification of an acute coronary event, a powerful predictor of adverse events and mortality. With aging, the prevalence of coronary risk factors, associated comorbidity, clinical cardiovascular disease, complexity of cardiovascular disease and frailty increases.

Puymirat, *et al*.[10] revealed that patients with multivessel disease are older, have more risk factors and comorbidity before the coronary event and myocardial revascularization, but this does not coincide with the findings of the present study.

Giugliano, *et al*.[11] add that, in terms of sex, a lower incidence of the most severe forms of ischemic heart disease is reported among premenopausal women. Non-obstructive forms and etiologies in acute coronary syndromes other than the usual mechanism of atherosclerotic plaque rupture with a variable degree of thrombosis and local inflammatory process predominate in these women.

With respect to sex in the present study, sex was not statistically significant, but there was a minority of females, which was similar to the data obtained by the aforementioned author.

The presence of multivessel disease in coronary artery disease has been associated with worse prognosis in acute myocardial infarction, including low reperfusion and high risk of adverse events and mortality compared to single-vessel disease.

Kusunose, *et al*.[12] note in a population-based study, the presence of low ejection fraction was significant in patients with multivessel disease, also the parietal motility index was high in these patients compared to those without multivessel lesions.

The data obtained in the current investigation reported the statistical significance obtained in the parietal motility index and multivessel disease.

As noted by Baron, *et al*.[13] the motility index evaluates left ventricular segmental function and was supposedly superior to left ventricular ejection fraction, which was a powerful predictor of adverse cardiovascular events. The above expressed has similarity with what was obtained in the present study.

Kim, *et al*.[14] reported that patients with remodeling and lower global left ventricular systolic function were associated with multivessel disease. The initial left ventricular diastolic diameter was higher in patients with remodeling and multiarterial disease with high statistical significance. This shows similarities with this research developed by the authors.

Baumann, *et al*.[15] showed that age, male sex, type of previous myocardial infarction, left ventricular systolic function independently predicted multivessel disease.

In the present study, ejection fraction less than 50%, male sex, acute myocardial infarction with ST segment elevation behaved as predictive risk the first two; and the third showed a highly significant association with independent variables that identified multivariate disease in the multivariate analysis; which shows similarity and relationship with what has been shown by authors referred to above.[14,15]

On the other hand, it is advisable to analyze the limitations of the present study, so it would be convenient to analyze more representative samples of the population and to add more echocardiographic parameters, which would provide better results.

CONCLUSIONS

The presence of complications, the type of acute myocardial infarction and echocardiographic parameters, such as the wall motion index, were predictors of multivessel disease in the context of the acute event.

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The authors declare that there are no conflicts of interest.

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