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Structural functional parameters of the heart in patients with acute myocardial infarction with ST-segment elevation in the presence of pulmonary hypertension

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Abstract

Introduction: Acute Myocardial Infarction with ST-Segment Elevation (STEMI) is one of the major causes of morbidity and mortality all over the world. Pulmonary hypertension (LH) occurs in various clinical conditions, including diseases of the left half of the heart.

Objective: To evaluate the structural and functional features of the heart in ST-elevated myocardial infarction (STEMI) of the left ventricular wall (LV) in the presence of pulmonary hypertension (PH).

Materials and Methods: The study involved 87 patients (48 men and 37 women) with STEMI who were treated in intensive care and emergency cardiology department of the "City hospital and emergency ambulance" Zaporizhia city council. Patients were divided into two groups: 51 patients with STEMI in the presence of PH (mean age 69,30 ± 2,34 years), 36 patients with STEMI without PH (mean age 65,20 ± 2,02 years).

Results: Evaluation of the structural and functional features of LV showed that in patients with STEMI with PH compared to patients with STEMI without PH there was a significant decrease in EF (by 25.6%; p <0.05), increase in MMILV by 17.6%; p <0.05) and LVDs (by 13.3%; p <0.05). In patients with PH, the diameter of LA was 12.9% higher than in patients without PH (p <0.05).

In the study of LV diastolic function using pulsed Doppler revealed that in patients with STEMI with PH there is a significant acceleration of MVE (by 32,3%; p <0.05) and increasing in the ratio of MV E/A (by 63,4%, p <0,05) compared with patients without PH. Assessment of RV diastolic function

according to pulsed Doppler showed a significant acceleration of TVE (28,3%; p <0,05) in patients with PH.

Conclusions: In patients with STEMI pulmonary hypertension develops against the background of dilatation of the left ventricles of the heart with the formation of eccentric hypertrophy and systolic LV dysfunction. In patients with STEMI and PH we found an overload of the right ventricles of the heart with increasing size of the right ventricle and right atrium. Patients with STEMI and PH had diastolic LV and RV dysfunction with increasing MV E/E' ratio and TV E/E' ratio according to tissue Doppler.

Key words: acute myocardial infarction, pulmonary hypertension, diastolic dysfunction

INTRODUCTION

Acute Myocardial Infarction with ST-Segment Elevation (STEMI) is one of the major causes of morbidity and mortality all over the world [1]. Pulmonary hypertension (LH) occurs in various clinical conditions, including diseases of the left half of the heart [2]. According to the current classification of patients in whom PH occurs on the background of heart failure, heart disease, myocardial infarction, belong to the second group [3]. The prevalence of pulmonary hypertension (PH) in STEMI significantly is not known due to lack of large epidemiological studies in this area [3].

Recently, studies have been conducted on the prognostic significance of PH in STEMI. In the Syed Ahsan study, 2018, it was shown that PH does not significantly affect mortality in myocardial infarction without Q wave [4]. However, with increased pulmonary artery pressure these patients had significantly more cardiogenic shock and respiratory failure. Also, such patients were hospitalized for a longer time and required greater financial costs [4].

Thus, the definition of structural and functional features of the heart in patients with STEMI with PH is actual and important.

OBJECTIVE

To evaluate the structural and functional features of the heart in ST-elevated myocardial infarction (STEMI) of the left ventricular wall (LV) in the presence of pulmonary hypertension (PH).

MATERIALS AND METHODS

The study involved 87 patients (48 men and 37 women) with STEMI who were treated in intensive care and emergency cardiology department of the "City hospital and emergency ambulance" Zaporizhia city council. Patients were divided into two groups: 51 patients with STEMI in the presence of PH (mean age 69,30 ± 2,34 years), 36 patients with STEMI without PH (mean age 65,20 ± 2,02 years).

The diagnosis of myocardial infarction raised in case of typical clinical manifestations, increased troponin I level in blood, typical ECG and echocardiograph.

To determine the level of troponin we used semi-automated photoelectric fotomer FAX 303 Stat Plus (ZOMZ, Russia) with a set of Hema (troponin I-ELISA, HEMAtest, Germany).

Inclusion criteria: patients with STEMI with or without PH.

Exclusion criteria: presence of cancer, pulmonary arterial hypertension due to pathology of the respiratory system.

All patients were examined during the first five days using two-dimensional echocardiography in the machine "MyLab50" ("Esaote", Italy) by American Society of Echocardiography recommendation [5]. During the study we determined the following parameters: size of the left atrium (LA), the size of the left ventricle in systole (LVDs) and diastole (LVDd), diastolic thickness of the interventricular septum (IVSd) and posterior wall (PWd), the size of the right ventricle in diastole (RV) and right atrium (RA). Based on the data we calculated left ventricular ejection fraction (EF) and LV stroke volume (SV), myocardial mass (MM) of LV and myocardial mass index (MMI|) of LV and relative wall thickness (RWT). Systolic pulmonary artery pressure (systPAP) was determined by recommendations for diagnosis and treatment of pulmonary hypertension European Society of Cardiology and the European Respiratory Society 2015 [2]. Pulmonary hypertension was diagnosed in patients with systolic pulmonary artery pressure more than 30 mmHg.

Mode pulse Doppler parameters were determined following transmitral flow examination by echocardiography: the maximum speed of early diastolic filling (MVE) and maximum speed filling the left ventricle during systole of the left atrium (MVA), their ratio (MV E / A) and isovolumetric relaxation time (IVRT).

Left ventricular diastolic function was determined by the recommendations of the American Society of Echocardiography [6].

Statistical analysis of the data was performed using the statistical software package "Statistica 6.0 for Windows" (StatSoft Inc., № AXXR712D833214FAN5). To determine the normal distribution we used criteria Shapiro-Wilk. Given the type of distribution (normal or not) variables are presented as M ± m or Me (25-75 ‰). Double t-test for independent samples by Student we used for samples with normal distribution. Wilcoxon criterion we used for samples with uneven distribution. Evaluation of relationships between parameters was performed using the method of correlation analysis by Pearson and Spearman. The reliability of the differences between the figures stated at $p < 0.05$.

RESEARCH RESULTS

Evaluation of the structural and functional features of LV (Table 1) showed that in patients with STEMI with PH compared to patients with STEMI without PH there was a significant decrease in EF (by 25.6%; $p < 0.05$), increase in MMILV by 17.6%; $p < 0.05$) and LVDs (by 13.3%; $p < 0.05$). In patients with PH, the diameter of LA was 12.9% higher than in patients without PH ($p < 0.05$). When assessing the structural parameters of the right heart in patients with STEMI with PH revealed an

increasing the diameter of the RV (by 28.2%; p <0.05) and RA (by 21.8%; p <0.05) compared with patients with STEMI without PH.

Table 1

Structural and functional parameters in patients with STEMI wall depending on the presence of PH

The indicator units	STEMI with PH (n = 51)	STEMI without PH (n = 36)
EF, %	38,43±1,52*	51,3±1,76
SV, ml	50,34±3,98	37,24±3,67
LVDd, sm	6,42±0,23	5,89±0,20
LVDs, sm	5,21±0,21*	4,47±0,23
PWd, sm	1,11±0,04	1,08±0,03
IVSd, sm	1,10±0,03	1,13±0,04
MMLV, g/m2	204,6±8,23*	168,7±7,95
LA, sm	4,58±0,14*	3,85±0,12
RV, sm	3,16±0,13*	2,23±0,14
RA, sm	4,4±0,14*	3,4±0,14
systPPA, mm Hg	44,87±0,12*	22,75±0,11

Note: * - significant differences with group STEMI without PH (p <0,05).

When evaluating the types of LV remodeling, it was found that eccentric hypertrophy (92,2%) was mainly observed in patients with STEMI with PH, which is significantly higher compared to the group of STEMI without PH (*Table 2*). Eccentric hypertrophy is the most prognostically unfavorable type of remodeling, in which there is a pronounced systolic and diastolic dysfunction with the development of heart failure [7]. Another types of remodeling (concentric remodeling and concentric hypertrophy) in both groups were less common than eccentric hypertrophy.

Table 2

Types of remodeling in patients with STEMI according the presence of PH

Type of remodeling	STEMI with PH (n = 51)	STEMI without PH (n = 36)
Concentric remodeling	1 (1,9%)	2 (5,6%)
Concentric hypertrophy	3 (5,9%)	8 (22,2%)

Eccentric hypertrophy	50 (92,2%)*	26 (72,2%)

Note: * - significant differences with group STEMI without PH (p <0,05).

In the study of LV diastolic function (*Table 3*) using pulsed Doppler revealed that in patients with STEMI with PH there is a significant acceleration of MVE (by 32,3%; p <0.05) and increasing in the ratio of MV E/A (by 63,4%, p <0,05) compared with patients without PH. Assessment of RV diastolic function according to pulsed Doppler showed a significant acceleration of TVE (28,3%; p <0,05) in patients with PH. According to the tissue Doppler of the medial parts of the fibrous rings of the mitral and tricuspid valves in patients with STEMI with PH revealed an increase in the ratio of MV E/E' (by 43,2%; p <0,05) and TV E / E' (by 34,2%, p <0,05) compared with patients without PH.

Table 3

Indicators of ventricular diastolic function in patients with STEMI depending on the presence of PH

The indicator units	STEMI with PH (n = 51)	STEMI without PH (n = 36)
MV E, sm/s	0,62±0,04*	0,43±0,11
MV E/A	1,47±0,09*	0,61±0,08
IVRT LV, ms	96,8±4,26	110,4±3,16
MV E', sm/s	0,08±0,03	0,11±0,02
MV E/E'	7,75±0,72*	3,91±0,49
TV E, sm/s	0,56±0,08*	0,35±0,07
TV E/A	1,16±0,08	1,01±0,06
IVRT RV, ms	71,6±0,08	78,5±0,07
TV E', sm/s	0,10±0,04	0,12±0,03
TV E/E'	4,75±0,62*	2,84±0,54

Note: * - significant differences with group STEMI without PH (p <0,05).

Discussion of research results

According to the literature, increasing the presure in pulmonary artery in patients with pathology of the left heart develops against the background of structural and functional changes of the left ventricle [2, 3]. As a result of systolic dysfunction, the pressure in the LA increases, which is the basis for the formation of postcapillary pulmonary hypertension.

In our study, the patients with STEMI had an increasing the LV and LA with a decreasing the systolic function. At the same time, patients had mainly eccentric LV hypertrophy, which is the most prognostically unfavorable type of remodeling due to high risk of complications development [7].

When assessing the structural and functional changes of the right ventricle of the heart we found the dilatation of RV and RA, due to overload of the right heart due to increased pressure in the pulmonary artery. The correlation between the increasing the pulmonary artery pressure in STEMI and diastolic dysfunction is shown in the works of many researchers [7]. The reason for the development of postcapillary PH in severe diastolic dysfunction is considered to be overload of the left atrium and round of small circulation.

Conclusions.

1. In patients with STEMI pulmonary hypertension develops against the background of dilatation of the left ventricles of the heart with the formation of eccentric hypertrophy and systolic LV dysfunction.
2. In patients with STEMI and PH we found an overload of the right ventricles of the heart with increasing size of the right ventricle and right atrium.
3. Patients with STEMI and PH had diastolic LV and RV dysfunction with increasing MV E/E' ratio and TV E/E' ratio according to tissue Doppler.

Prospects for further research. The study revealed structural and functional parameters of the heart in patients with acute myocardial infarction in the presence of PH. In the future, it is advisable to continue to study the prognostic significance of structural and functional parameters in patients with STEMI and PH.

Conflict of interest. Conflict of interest is absent.

LITERATURE

1. V.M. Kovalenko, Sci. E. Lutay, Yu.M.Sirenko. Cardiovascular disease. The classification standards for diagnosis and treatment. K .: Association of Cardiologists of Ukraine. 2016; 128 p. Ukrainian.
2. Galiè N., Humbert M., Vachiery JL 2015 ESC / ERS Guidelines for the diagnosis and treatment of pulmonary hypertension: The Joint Task Force for the Diagnosis and Treatment of Pulmonary Hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS): Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC), International Society for Heart and Lung Transplantation (ISHLT). Eur. Heart J. 2016; 37: 67-119. doi: 10.1093 / eurheartj / ehv317.
3. Guazzi M., Borlaug BA Pulmonary Hypertension Due to Left Heart Disease. Circulation. 2012; 125: 975-990. doi: 10.1161 / CIRCULATIONAHA.111.085761.

4. Ahsan S., Hamed S. The impact of pulmonary hypertension on in-hospital outcomes of non-st elevation myocardial infarction. J. Am. Coll. Cardio. in 2018; 71: 1940. doi: 10.1016 / S0735-1097 (18) 32481-1.
5. Lang R.M., Badano L.P., Mor-Avi V. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J. Am. Soc. Echocardiogr. 2015; 28: 1-39. doi: 10.1016 / j.echo.2014.10.003.
6. Nagueh SF, Smiseth OA, Appleton CP Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J. Am. Soc. Echocardiogr. in 2016; 29: 277-314. doi: 10.1016 / j.echo.2016.01.011.
7. Mehra P., Mehta V., Sukhija R. Pulmonary hypertension in left heart disease. Arch. Med. Sci. in 2019; 15: 262-273. doi: 10.5114 / aoms.2017.68938.

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