

## ECHOCARDIOGRAPHIC CRITERIA FOR PULMONARY ARTERY THROMBOEMBOLISM DUE TO ACUTE MYOCARDIAL INFARCTION

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In order to determine the value of echocardiography in cases of suspected pulmonary embolism in patients with acute myocardial infarction, 152 people were examined, of which 112 were with acute myocardial infarction, 13 were with myocardial infarction complicated by pulmonary embolism, 27 were with pulmonary embolism (PE). against the background of various pathologies, except myocardial infarction. To verify the diagnosis of pulmonary embolism, a modern diagnostic algorithm was used, including lung perfusion scintigraphy. It was found that an increase in the end-diastolic size of the right ventricle, systolic pressure in the pulmonary artery, the presence of paradoxical movement of the interventricular septum, and a decrease in the collapse of the inferior vena cava during inspiration can be considered significant diagnostic signs for suspected pulmonary embolism in acute myocardial infarction. In myocardial infarction complicated by non-massive pulmonary embolism, isolated right ventricular dysfunction was not observed.

**Key words:** echocardiography, pulmonary embolism, myocardial infarction

### Introduction

It is generally accepted that echocardiographic (EchoCG) signs of overload of the right heart are inherent in massive pulmonary embolism (PE). The diagnostic significance of these symptoms in non-massive pulmonary embolism is controversial. The place of echocardiography in the diagnostic algorithm for pulmonary embolism associated with acute infarction has not been determined due to the small number of relevant studies. The purpose of this study was to determine the value of echocardiography in suspected pulmonary embolism in patients with acute myocardial infarction.

#### Object and methods of research

152 people were examined, men predominated ( $p < 0.001$ ) - 95 patients. The average age of the patients was  $61.7 \pm 1.1$  years, with men being 9-10 years younger than women ( $p < 0.001$ ). All patients were treated in the clinics of the Research Institute of Cardiology of the Tomsk Scientific Center of the Siberian Branch of the Russian Academy of Medical Sciences.

The patients were divided into three groups: the first group - with acute myocardial infarction (AMI) not complicated by pulmonary embolism (PE) - 103 people; the second group - with myocardial infarction, complicated

TELA - 17 people; the third group - with PE on the background of various pathologies, except for heart attack - 23 people (unstable angina in 9 patients, a history of coronary artery disease and deep vein thrombosis - in 8, antiphospholipid syndrome - in 1 patient, dilated cardiomyopathy was diagnosed in 2 patients (DCM), 3 patients were diagnosed with recurrent pulmonary embolism). A generally accepted algorithm was used to screen for pulmonary embolism. Verification of the diagnosis was carried out using lung perfusion scintigraphy.

Echocardiography was performed on an ACUSON 128 XP/10 device using a 2.5 MHz sector sensor. The study was performed in the first 5 days from the moment of admission to the hospital. Echocardiographic examination was carried out in one-two-dimensional Doppler and color Doppler modes according to standard methods [1, 2, 6]. The following parameters were assessed: left ventricular end-diastolic size (LVED), right ventricular end-diastolic size (RVED), left atrium (LA) diameter in B-mode, left ventricular ejection fraction (LVEF), thickness of the anterior wall of the right ventricle (PPV), systolic pressure in the pulmonary artery (SPAP), the presence of paradoxical movement of the interventricular septum (VSD). Evaluation of the symptom of decreased collapse of the inferior vena cava (IVC) included measuring its maximum diameter during exhalation and assessing its response to inspiration (more than 50%, less than 50%, or no response to inspiration). The contractility of ventricular myocardial segments was assessed in various positions—right ventricular hypokinesis (RVH) and left ventricular hypokinesis (LVH).

#### Statistical analysis

The obtained data were subjected to statistical processing using the Statistica 6 for program Windows . Quantitative indicators are presented as  $X \pm m$  (mean value  $\pm$  standard error of the mean). For indicators characterizing qualitative characteristics, the absolute number and relative value (%) were indicated. To check the coincidence of the distribution of the studied quantitative indicators in groups with normal distribution, the Kolmogorov- Smirnov goodness-of-fit test was used. The reliability of the differences in the event that the distribution law of the studied numerical indicators differed from normal was checked using the Mann-Whitney U test for independent populations. Qualitative features were compared using Fisher's exact test. Differences were considered significant at  $p < 0.05$ .

#### Results and its discussion

When comparing patients of groups 1 and 2, there was an increase in the end-diastolic size of the right ventricle against the background of acute infarction complicated by PE, up to  $38.41 \pm 1.95$  mm, versus  $32.07 \pm 0.56$  mm ( $p = 0.001$ ) . Against

the background of dilatation of the right ventricle, the level of systolic pressure in the pulmonary artery in the 2nd group of patients was significantly higher and amounted to  $40.12 \pm 4.25$  mm versus  $27.13 \pm 0.91$  mm ( $p=0.012$ ) in patients 1- th group. In order to differentiate between acute overload of the right and chronic overload, it is customary to use the thickness of the anterior wall of the right ventricle, which is  $<5$  mm in case of acute overload [15]. In the study, it was significantly higher in group 2, where 3 (13%) patients had signs of hypertrophy of the anterior wall of the right ventricle. The wall thickness of the right ventricle was  $4.47 \pm 0.21$  mm in group 2, versus  $3.66 \pm 0.08$  mm in patients of group 1 ( $p=0.001$ ). Perhaps this indicates a tendency towards hypertrophy of the wall of the right ventricle in patients of group 2. For indicators characterizing the size and volume of the left sections, the ejection fraction of the left ventricle, no significant differences were obtained (Table 1)

***Echocardiographic indicators sick With sharp heart attack myocardium, infarction complicated by pulmonary embolism, and pulmonary embolism (M+t)***

Index	THEM	MI+PE	TELA	Credibility differences between groups
	n=103	n=17	n=23	
	1 group	2nd group	3 group	
Finite diastolic size left ventricle (LV EDR), mm	$55.86 \pm 0.5$ 2	$54.00 \pm 1.0$ 6	$59.43 \pm 1.7$ 8	R. <sub>2</sub> =0,i P/=0.07 p <sub>2</sub> .;=o,ozb
Finite diastolic size right ventricle (RV EDR), mm	$32.07 \pm 0.5$ 6	$38.41 \pm 1.9$ 5	$38.70 \pm 1.9$ 1	R. =0.001 P <0.001 R.; h = 0.98
Fraction emission left ventricle (LVEF),%	$50.95 \pm 0.9$ 2	$46.41 \pm 2.2$ 9	$45.74 \pm 2.3$ 1	R. o = 0.12 R. =0.06 P.,=0.88
Thickness front walls right ventricle (PSPZh)	$3.66 \pm 0.08$	$4.47 \pm 0.21$	$4.22 \pm 0.17$	R. =0.001 P/ =0.004 th;=o,zb
Diameter left atria (LP), mm	$37.34 \pm 0.6$ 7	$40.18 \pm 1.2$ 6	$43.87 \pm 1.6$ 4	R. 0=0.11 R. =0.001 P.,=0.50
Systolic pressure V pulmonary arteries (SDLP), mm Hg. Art.	$27.13 \pm 0.9$ 1	$40.12 \pm 4.2$ 5	$39.35 \pm 3.7$ 6	R. =0.012 P/=0.007 th;=0.98

When comparing patients of groups 2 and 3, the sizes of the right parts of the heart did not differ significantly. Systolic pressure in the pulmonary artery was increased to the same extent. The end-diastolic dimensions of the left ventricle were significantly higher in patients of group 3:  $59.43 \pm 1.78$  mm versus  $54.00 \pm 1.06$  mm ( $p=0.036$ ) in patients of group 2. This is explained by the fact that group 3 included patients with dilated cardiomyopathy, in whom the initial dimensions of the left ventricle were higher.

Volume overload of the right ventricle is characterized not only by the expansion of its cavity, but also by the paradoxical movement of the interventricular septum: during systole, the interventricular septum bends into the cavity of the left ventricle [15]. Pathological movement of the interventricular septum was observed in 5 patients from group 3, 3 patients from group 2 and 1 patient from group 1. There was a significant difference between groups 1-2 ( $p=0.007$ ). All patients with paradoxical movement of the interventricular septum had high pulmonary hypertension - above 50 mmHg. st (Table 2).

***Frequency echocardiographic signs pathological movement interventricular septum, decreased collapse of the inferior vena cava after a deep inspiration, hypokinesis of the right ventricle at sick With sharp heart attack, heart attack complicated TELA, And TELA***

Indicators Ultrasound hearts	THEM	THEM + TELA	TELA	Credibility differences		
	n=103	n=17	n=23	12 _	2- 3	13 _
	1 group	2nd group	3 group			
Pathological movement interventricular partitions (VSD)	1 (1.0%)	3(17.6%)	5(21.7%)	0.007	0.54	0.009
Collabing bottom hollow veins < 50% after deep inhalation	6 (5.8%)	10 (58.9%)	7 (30.4%)	<0.001	0.07	0.002
Hypokinesis right ventricle (GKPZH)	29 (28.2%)	6 (35.2%)	4(17.4%)	0.39	0.22	0.18
Hypokinesis left ventricle (LVG)	88 (85.4%)	15 (88.2%)	20 (87%)	0.059	0.65	0.62

The absence or decrease in collapse of the inferior vena cava during inspiration by less than 50% or more is considered one of the signs of increased pressure in the right atrium [2, 15]. A significant difference was found in the frequency of the symptom of decreased collapse of the inferior vena cava during inspiration between patients of groups 1-2 ( $p < 0.001$ ) (Table 2).

In 3 patients with pulmonary embolism from groups 2 and 3, this sign was observed against the background of pericardial effusion. In all cases, MPAP was increased from 48-68 mm Hg. Art.

From previous studies it is known that right ventricular dysfunction occurs in 80% of patients with PE with a perfusion defect > 60%. Isolated hypokinesis of the right ventricle is a prognostically unfavorable symptom that occurs in patients with massive pulmonary embolism and a patent foramen ovale and is the basis for more active therapy. Based on the results of numerous studies, it is known that right ventricular dysfunction of varying degrees of severity also occurs in 40-50% of patients with myocardial infarction of the left ventricle of lower localization, against the background

of left ventricular dysfunction. In addition, this echocardiographic finding may reflect left ventricular filling pressure and right ventricular afterload after anterior transmural infarction. In groups 1 and 2 of patients with acute infarction, right ventricular hypokinesis was observed against the background of left ventricular dysfunction. These were mainly patients with lower localization of the infarction; 1 patient was diagnosed with right ventricular infarction, and 3 patients with anterior localization infarction. No significant difference in the frequency of this sign was found. In patients of group 3, right ventricular hypokinesis was also visualized against the background of left ventricular dysfunction. These were patients with DCM and unstable angina. No isolated right ventricular dysfunction was observed in all three groups of patients.

According to the literature, the presence of right ventricular dilatation, tricuspid regurgitation, reduction or absence of collapse of the inferior vena cava after a deep inspiration, diagnosed using transthoracic echocardiography, have a sensitivity of about 50% and sensitivity of about 90% [5, 8, 9, 10] . Despite the fact that among the examined patients there was not a single case of massive TEL A , the results of echocardiography convincingly show a significant difference and a fairly high specificity of these signs against the background of an acute infarction complicated by non - massive TEL A. Thus , when comparing the echocardiographic data of the 1st and 2nd groups, a statistically significant difference was found between them in the following parameters: in group 2 there were higher indicators of right ventricular pressure P , CDL A , frequency of paradoxical movement of the interventricular septum and frequency reducing the collapse of the inferior vena cava after a deep breath. Considering that no statistically significant difference in these parameters was found among patients in groups 2 and 3, these groups were combined to study the sensitivity and specificity of the listed echocardiographic signs in relation to the diagnosis of T EL A (Table 3).

***Sensitivity And specificity echocardiographic indicators for the diagnosis of pulmonary embolism against the background of acute myocardial infarction***

Sign	Sensitivity	Specificity
Finite diastolic size left ventricle (LV EDR) > 36 mm (B-mode)	62.5%	74.8%
Systolic pressure V pulmonary arteries (MPAP) > 30 mmHg . Art.	54.5%	67%
Pathological movement interventricular partitions (VSD)	17.5%	99%
Decrease collabs bottom hollow veins after deep breath < 50%	47.5%	94.2%

### **Conclusions**

1. An increase in the end-diastolic size of the right ventricle, systolic pressure in the pulmonary artery, the presence of paradoxical movement of the interventricular septum, a decrease in the collapse of the inferior vena cava after a deep inspiration can be considered significant diagnostic signs for suspected T E L A in acute myocardial infarction.

2. In myocardial infarction complicated by non-massive T E L A , isolated right ventricular dysfunction was not observed.

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