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Functional State of the Right Ventricle In Patients With Ischemic Heart Disease And Left Ventricular Dysfunction And Congestive Heart Failure.

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***Abstract**:*
Introduction and objectives . *It is known that not in all patients with left ventricular dysfunction develops heart failure, functional state of the patients and their hemodynamic profile can be very widely . The purpose of this study to examine the clinical and hemodynamic significance of right ventricle functions in patients with ischemic heart disease with dysfunction of left ventricular and chronic heart failure.*
Methods. *The study included 46 patients with low contractile function of left ventricular - with less than 40% an ejection fraction and symptoms of chronic heart failure.*
Results. *We compared the functional indices of right ventricle in two groups of patients - with symptoms of moderate and severe heart failure to determine the clinical and hemodynamic values of right ventricle and its role in the pathophysiological processes in chronic heart failure.*
Conclusion: *The revealed correlation points to the fact that the progression of clinical symptoms of heart failure developed in close relationship with the dysfunction of the right ventricle.*
Keywords: *chronic heart failure, ischemic heart disease, left ventricle, right ventricle, heart failure.*

I. Introduction And Objectives

The problem of chronic heart failure (CHF) is still relevant. Three year survival rate is less than 50% and the risk of sudden death is 5 times higher than in the general population [1]. As a result of increasing the proportion of the elderly population and improving the treatment possibilities for ischemic heart disease (IHD) CHF has a tendency to increase and widespread [2, 3].The pathophysiology underlying of the development, compensation, progression and decompensation of CHF symptoms in patients with left ventricular (LV) dysfunction is not fully studied [4].

It is known that not in all patients with LV dysfunction develops heart failure, functional state of the patients and their hemodynamic profile can be very widely [5, 6]. Currently, pays great importance to the study of etiological factors of LV systolic dysfunction, the study of its myocardial reserves, changes in geometry, the volume of the LV diastolic dysfunction [7], the study of markers reflex neurohumoral activation in CHF [8], these issues the subject of many studies. The information in the available literature regarding the role of the right ventricle (RV) and its influence to the pathophysiological processes in heart failure (HF) is much less [3]. However, in recent years grow the interest to RV as an important predictor of mortality in patients with CHF. The purpose of this study to examine the clinical and hemodynamic significance of RV functions in patients with IHD with dysfunction of LV and CHF.

II. Methods

The study included 46 patients with low contractile function of LV- with less than 40% an ejection fraction (EF) and symptoms of CHF.
All patients were male, the average age - 52,8 ± 15 years. The majority of patients had severe clinical manifestations of coronary insufficiency, III- IV functional class (FC) angina **(by CCS)** in 33 (71.7%). II FC – in 9 (19.6%) patients and in 4 (8.7%) of them were no angina. The mean duration of disease was 4,7 ± 0,5 years, the average number of myocardial infarction for the 1 patient - 2,0 ± 0,5, the existence of post-infarction LV aneurysm was diagnosed in 14 (30.4%) patients.

III. Results

According to NYHA classification 11 (23.9%) patients were related to FC I of CHF, 14 (30.4%) - to FC II, 12 (26.1%) - to FC III, 9 (18.6%) - to FC IV. Clinical symptoms of RV HF (hypostases of the lower extremities, enlarged liver) were detected in 41.3% of patients, hydrothorax - in 6.5% of patients.Comorbidities diabetes was detected in 8.7%, chronic non-specific lung disease - in 4.3%, hypertension - 19.6% of patients. Violations of the rhythm and conductivity occurred the following frequency: AV blockade of degree I-II -

10.9% of the patients, left bundle branch block - in 13.0%, right bundle branch block - 17.4%, paroxysmal atrial fibrillation - in 19.6% of patients. The PVCs of high gradations by Laun, III-IV gradation was determined in 16 (34,9%), paroxysms of sustained ventricular tachycardia were available in 3 (6,5%) patients. Heart rate variability (HRV) was reduced: SDNN was 97,5 ± 25,37ms^2.Drug therapy of CHF includes receiving beta-blockers (66% patients), ACE inhibitors - (92%), nitrates - (84%), calcium antagonists (32%), diuretics (76%), the average daily dose of furosemide was - 47 7 ± 7,9 mg / day, the cardiac glycosides - 22%, aspirin (100% of patients). Antiarrhythmic therapy with Cordaron received 21.7% of the patients.
We compared the functional indices of RV in two groups of patients - with symptoms of moderate and severe HF to determine the clinical and hemodynamic values of RV and its role in the pathophysiological processes in CHF. For this purpose all patients were divided into 2 groups: one group of 25 patients - with moderate clinical symptomatic of CHF FC I - II by NYHA and 2nd group of 21 patients - with severe clinical symptomatic of CHF FC III – IV by NYHA.
Comparative characteristics of clinical data of patients in both groups are presented in Table 1. Groups were not significantly different by angina severity and duration of disease. The average amount of myocardial infarction for 1 patient in group 1 was - 2,6 ± 1,0 more than in group 2 - 1,3 ± 0,1. Post-infarction LV aneurysm more common in group 2 - 63%, versus 41% in group 1.
Clinical manifestations of RV HF were detected in 5% of patients in group 1 and 84% in group 2, hydrothorax - only in patients of group 2 (13%). Radiographic signs of venous stasis in the pulmonary circulation were determined in 62% of patients in group 1 and 100% - in 2 groups. Cardiothoracic index was not significantly higher in group 2: 0,5 ± 0,01 and 0,6 ± 0,01, respectively in the groups 1 and 2.
AV block of I and II degrees was noted the same frequency in both groups: 5% of patients in group 1 and 9% - in group 2. Bundle-branch block detected more often in patients of group 2. Complete and incomplete left bundle branch block was observed in patients of group 1 in 3% of cases and in group 2 – 13%, complete and incomplete right bundle branch block respectively in 5% and 16% cases.

Table1. Supraventricular and ventricular arrhythmias were significantly higher in patients with severe heart failure: paroxysmal atrial fibrillation was observed in 12% of patients with moderate CHF, 28.6% of patients with severe HF, high grade ventricular arrythmia by Lawn - in 20% and 44%, respectively. Heart rate variability was significantly lower in patients with severe heart failure: SDNN- 112,5 ± 11,4 and 75,0 ± 4,97 in the group 1 and 2 respectively ($p < 0.01$). Stroke volume (SV) RV was in group 1 - 127,67 ± 9,9 ml and in group 2 - 80,8 ± 6,6 ml ($p < 0.001$).
Table 2 shows the geometry of the RV parameters depending on severity of heart failure.

Table 2. Dilatation of the RV were detected more frequently in group 2 in comparing with group 1, 88% and 47% respectively. Diastolic and systolic dimensions of the RV in patients of group 2 over 15% ($p < 0.05$) and 24.2% ($p < 0.001$) respectively and it was detected a large area of the RV in diastole and systole, 25.7% ($p < 0.05$) and 36.5% ($p < 0.001$) respectively (table 2). Systolic shortening of the 2 groups patients was significantly reduced ($p < 0.05$) in comparing with group 1.It was revealed large dimensions of the right atrium in patients with severe HF, 13.6% in comparing with moderate HF patients ($p < 0.05$). It is known that the presence of regurgitation largely determines the severity and progression of HF. In our study, patients with moderate HF

I degree of tricuspid regurgitation was detected in 52%, II degree 8% and in 9 (40%) patients tricuspid regurgitation was not revealed. Tricuspid regurgitation was found in 23,5% of I degree patients with severe HF, II degree - in 42,9%, III degree - in 23.8% and only in 9.5% of patients tricuspid regurgitation was not detected. RV wall thickness during diastole was some greater in patients with severe HF, all parameters were statistically unreliable ($p > 0.1$). However, revealed changes testify more expressed hypertrophy of the RV in patients of this group.

IV. Discussion

In patients surveyed by us was revealed diastolic dysfunction of RV as relaxation violation, 52% of cases in group 1 and in group 2. The rates of peak E transtricuspid blood flow in patients of groups 1 and 2 were 52,3 ± 2,3 and 45,1 ± 4,7 cm/s, respectively ($p > 0.5$) and shortening of the speed raised the peak A filling rate from 52.9 A ± 4,5 to 40.5 ± 2.1 cm/s, respectively ($p < 0.05$). The ratio E/A was 1,02 ± 0,08 in patients group 1 and 0,96 ± 0,08 in the 2nd group ($p < 0,05$).

The deceleration time of early diastolic blood flow (DTE) and isovolumic relaxation time (IVRT) in patients of group 2 were 200,1 ± 12,38 and 150,0 ± 9,4 ms, respectively, while in group 1 these figures were 228,9 ± 15,6 and 93,0 ± 10,3 ms respectively. There weren`t significant differences of DTE between the groups ($p > 0,2$). However, it was found a significant elongation of IVRT rate ($p < 0,05$).

In analyzing the relationship between CHF FC and geometric performance of RV it was found correlation the ESD RV (r = 0,37; p <0,005) with the EDD RV (r = 0,43; p <0,001), as well as indicators of the RV diastolic function - a peak of E the transtricuspid blood flow (r = - 0.35; p <0.05) with E/A rate (r = - 0.28; p <0.06). It was revealed correlation the SV RV with the E/A of RV (r = 0,48; p <0,001) and not statistically significant correlation E/A of RV with the LV ejection fraction. Our data suggest the RV pump function depending on the severity of myocardial dysfunction content.

V. Conclusion

Thus, the results of carrying out study show that in group of patients with severe clinical manifestations of HF it can be detected significantly more severe myocardial dysfunction of the RV in comparing the patients with mild symptoms of HF, in comparison with the severity of LV myocardium violation which manifests itself with more severe changes in the geometric parameters of the RV. The revealed correlation points to the fact that the progression of clinical symptoms of HF developed in close relationship with the dysfunction of the RV.

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Table1. Comparative clinical characteristics of patients with moderate and severe CHF.

Indicator	**Moderate CHF (FC I-II)**	**Severe CHF (FC III-IV)**
Number of patients	25	21
Age (years)	49,4±1,7	56,5±1,7
CCS Functional Classification of Angina No angina II FC III FC IV FC	 3 12% 5 20% 19 76%	 1 4,8% 4 19% 14 66,7%
Disease duration (years)	4,5±0,1	5,2±0,9
The average number of myocardial infarction	2,6±1,0	1,3±0,1
LV aneurysm	5 (20%)	9 (42,9%)
FC of CHF (by NYHA) I FC II FC IIIFC IV FC	 23,9% 30,4% 0 0	 0 0 26,1% 19,6%
Clinical manifestations of RV heart failure: Edema of the lower extremities Liver increase Hydrothorax	 8% 8% 0	 33,3% 33,3% 6,5%
X-rays data: Venous stasis in the pulmonary circle of blood circulation Cardio-thoracic index	 64% 0,5±0,01	 100% 0,6±0,01
Comorbidities: Diabetes CNPD Arterial hypertension	 8% 0 32%	 9,5% 4,4% 4,8%

Rhythm and conduction violations:	5 %	9 %
AV- block 1 – 2 degrees	3 %	13 %
LBBB	5 %	16,0%
RBBB	1,0	4,8 %
Paroxysmal SVT	12%	28,6%
Paroxysmal AF	20%	44,0 %
High grade PVCs by Lawn	112,5±11,4	75,0±4,9
HRV (SDNN)		

Table 2. Performance of the RV geometry in patients with moderate and severe heart failure.

Indicators	**I group**	**II group**
RV dilatation	47%	88%
EDD RV (cm)	34± 0,12	4,0±0,15*
ESD (cm)	2,5±0,16	3,3±0,16**
Systolic shortening	29,6±2,2	17,9±1,8
Systolic area (cm²)	13,4±1,0	21,1±1,3**
Diastolic area (cm²)	20,8±1,6	28,0±1,5*
Right atrium (cm)	3,8±0,2	4,4±0,3*
Tricuspid regurgitation		
No	40 %	9,5%
1 degree	52%	23,8 %
2 degree	8%	42,9%
3 degree	-	23,8 %
RV wall thickness in diastole (cm)		
Front wall	0,42±0,02	0,47±0,03
Side wall	0,47±0,02	0,5±0,03
Bottom wall	0,57±0,02	0,56±0,03
Interatrial septum	0,75±0,05	0,81±0,06
RV wall thickness during systole (cm)		
Front wall	0,57±0,03	0,6±0,05
Side wall	0,72±0,03	0,65±0.06
Bottom wall	0,76±0,04	0,77±0,06
Interatrial septum	0,86±0,07	0,9±0,08

Note: * $p<0.05$ ** $p<0,001$