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Left Ventricular Remodeling Among Patients with Pulmonary Hypertension on the Background of Chronic Obstructive Pulmonary Disease Combined with Hypertension

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Abstract

Aim of the study. To determine left ventricular remodeling among patients with pulmonary hypertension on the background of the chronic obstructive pulmonary disease combined with hypertension.

Methods: The results of the study are based on data from a comprehensive survey of 170 patients aged 40 to 65 years with COPD, 123 of which had pulmonary hypertension (of these 87 had stage II HT and 36 were without HT) and 47 ones had no PH.

Results: The LVMI value of 121.63 [96.02 ; 146.00] g/m^2 was higher in the group of patients with PH on the background of COPD, both against the level of 94.61 [81.87 ; 117.73] g/m^2 in the group of patients with COPD without PH, and - 93.72 [88.29 ; 106.39] g/m^2 in the group of healthy individuals, ($P < 0.05$). The RWT was considerably higher in the groups of patients with PH on the background of COPD was 0.40 [0.37 ; 0.44] versus 0.38 [0.34 ; 0.39] in the group of patients with COPD without PH ($P < 0.05$). The LVPWd was 1.11 [1.04 ; 1.21] cm in the subgroup of patients with PH on the background of COPD combined with HT considerably exceeded the value of 0.96 [0.90 ; 1.01] cm in the subgroup of patients with PH on the background of COPD without HT, ($P < 0.05$). The change in the LVMI and RWT was similar. It was determined that in the PH subgroup with COPD combined with HT, eccentric LV hypertrophy significantly

prevailed in 49.4 %, while in the PH subgroup with COPD without HT, the normal LV model was in 35 (97.2 %) individuals ($P < 0.05$).

Keywords: left ventricular remodeling among, chronic obstructive pulmonary disease, pulmonary hypertension

Introduction

Chronic obstructive pulmonary disease (COPD) is one of the most widespread diseases of internal organs, with a tendency to increase morbidity and mortality, which accounts for almost 6 % of all deaths in the world. This disease significantly reduces the quality of life of patients and is one of the main causes of disability that are hard to be treated [1], [2].

Currently, the problem of comorbidity is very relevant for patients with COPD, most often among patients of this category hypertension (HT) occurs. The mechanisms of mutual influence of these diseases are very contradictory, as evidenced by ambiguous data of researchers [3], [4].

An urgent medical and social problem of our time is the development of pulmonary hypertension (PH) in patients with COPD. In Ukraine, there are no data on the prevalence and mortality from PH and its various forms, which is due to the lack of a single training and consultation center and registry of these patients [5].

The mechanisms of PH formation in COPD combined with HT remain poorly understood and are probably caused by multifactorial effects. The processes of remodeling the vascular wall and heart are inseparable, they complement each other and are involved in the formation of PH. It is necessary to take into account the characteristics of diseases in conditions of comorbidity, since the presence of HT aggravates the prognosis among patients with COPD, increasing the risk of cardiovascular complications and mortality [6], [7].

It should be noted that the features of PH in the combined COPD with HT remain poorly understood. Usually, in most works, individual aspects of this problem are considered. However, it is necessary to take into account the characteristics of diseases in conditions of comorbidity, in order to effectively carry out therapeutic measures. Therefore, the features of heart remodeling among patients with PH on the background of COPD with HT in recent years have aroused great scientific and practical interest, which determined the purpose of this study.

The aim of the study: to determine left ventricular remodeling among patients with pulmonary hypertension on the background of the chronic obstructive pulmonary disease combined with hypertension.

Material and methods

The results of the study are based on data from a comprehensive survey of 170 patients aged 40 to 65 years with COPD, 123 of which had pulmonary hyper-

tension (of these 87 had stage II HT and 36 were without HT) and 47 ones had no PH. In the period of 2015-2018, we conducted a survey of patients who were on inpatient treatment in the pulmonology Department of the municipal institution "Zaporizhzhia regional clinical hospital" of the Zaporizhzhia regional Council. Almost healthy 31 people were examined on an outpatient basis.

The criteria for inclusion in the study were: male and female patients aged 40-65; known duration of COPD more than 1 year; informed consent of the patient to participate in the study.

Exclusion criteria from the study were: uncontrolled hypertension; stage III hypertension; the presence of decompensated diabetes, the presence of myocardial infarction in anamnesis, chronic heart failure of IIB - III stage; cancer; presence of contraindications to the administration of drugs and their components; drug addiction, alcohol addiction, mental illness; refusal of a patient to participate in the study.

Patients were divided into groups after determining their compliance with the criteria for inclusion / exclusion of the study, depending on the presence of pulmonary hypertension:

- the first group included 123 patients with PH and COPD (median age was 59.0 [51.0 ; 65.0] years);
- the second group consists of 47 patients with COPD without PH (median age was 58.0 [50.0 ; 65.0] years);
- the third group consisted of 31 practically healthy individuals (the median age was 56.0 [54.0; 58.0] years).

Echocardiography and Doppler echocardiography were performed on all subjects on the EnVizor HD device (Japan) in M- and B- modes according to the standard method with a location frequency of 1-5 MHz according to common practice. EACVI (European Association of Cardiovascular Imaging), ASE (The American Society of Echocardiography). To defined left ventricular end-diastolic dimension (LVEDD), interventricular septal end diastolic dimension (IVSd), left ventricular end diastolic posterior wall dimension (LVPWd), was calculated left ventricular mass index (LVMI), LV relative wall thickness (RWT). Analysis of the LVMI was performed separately for both men and women, using the norms presented in the ASE / EACVI (2015) guidelines: 115 g/m^2 for men and 95 g/m^2 for women. The mean pressure in the artery pulmonary (MPAP) was assessed using method F. Er et al. [8].

Characteristics of patients who are under the study. In the group of patients with PH on the background of COPD, 24 (19, %) patients had stage II of the disease and 99 ones (80.5 %) - stage III, in the group of patients with COPD without PH, there were 11 (23.4 %) people had stage II and 36 ones (76.6 %) - stage III. Groups of patients were comparable in COPD stage ($p > 0.05$).

In the PH group with COPD, the median mean pressure in the artery pulmonary (MPAP) was 31.00 [29.00 ; 42.00] mmHg. there were 84 (68.3 %) patients with the I degree of PH and 39 (31.7 %) ones with the II degree of PH. Infectious exacerbation was detected in 70 (56.9 %) of 123 patients. In the PH subgroup on COPD combined with HT (n = 87), the median mean pressure in the

artery pulmonary was 32.00 [31.00 ; 42.00] mmHg. and was considerably higher against 31.00 [26.00 ; 35.50] mm Hg. in the PH subgroup on the background of COPD without HT (n = 36) (P < 0.05).

Statistical processing of the results obtained. We determined the distribution of data using the Shapiro-Wilk criterion, then used the method of descriptive statistics with the calculation of the median and interquartile range Me [25 ; 75], indicated the volume of the analyzed group (n). Comparison of two groups with a parametric distribution was performed using the Student's test (t-test). When comparing more than two independent variables, ANOVA analysis was used, followed by post-hoc analysis. When the distribution was different from the normal one, we analyzed it using nonparametric tests: when comparing two independent samples, we used the Mann - Whitney method (U-test), and in the case of more than two, we used the Kruskal-Wallis method. For the level of statistical significance (p), it is recommended for biomedical research below 0.05.

Results and Discussion

The indicators of left ventricular remodeling among the examined individuals were determined according to the standard ultrasound protocol of the heart. The results obtained are presented in Table 1.

Table 1. The indicators of left ventricular remodeling among the examined individuals (Me [25; 75], n = 201)

Variable	Patients with PH and COPD (n = 123)	Patients with COPD without PH (n = 47)	Healthy individuals (n = 31)
	1	2	3
LVEDD, cm	5,37 [5,03 ; 5,67]	5,32 [4,92 ; 5,57]	4,96 [4,69 ; 5,40]
P-value	$p_{1-2} = 1,0$	$p_{2-3} = 0,04$	$p_{1-3} = 0,002$
IVSd, cm	1,07 [0,99 ; 1,20]	0,94 [0,84 ; 1,03]	0,94 [0,88 ; 0,98]
P-value	$p_{1-2} < 0,001$	$p_{2-3} = 1,0$	$p_{1-3} < 0,001$
LVPWd, cm	1,08 [0,99 ; 1,18]	1,02 [0,84 ; 1,03]	0,94 [0,89 ; 0,98]
P-value	$p_{1-2} < 0,001$	$p_{2-3} = 0,41$	$p_{1-3} < 0,001$
LVMI, g/m^2	121,63 [96,02 ; 146,00]	94,61 [81,87 ; 117,73]	93,72 [88,29 ; 106,39]
P-value	$p_{1-2} < 0,001$	$p_{2-3} = 1,0$	$p_{1-3} < 0,001$
RWT	0,40 [0,37 ; 0,44]	0,38 [0,34 ; 0,39]	0,37 [0,35 ; 0,41]
P-value	$p_{1-2} < 0,001$	$p_{2-3} = 1,0$	$p_{1-3} = 0,01$

In the group of patients with PH on the background of COPD, the LVEDD was 5.37 [5.03 ; 5.67] cm and was significantly higher by 8.3 % compared to healthy individuals, where this indicator was 4.96 [4.69 ; 5.40] cm, (P < 0.05). In the group of patients with COPD without PH, there was a considerable increase in the LVEDD f 5.32 [4.92 ; 5.57] cm versus 4.96 [4.69 ; 5.40] cm among healthy individuals (P < 0.05), but did not have a significant difference with the group of patients with PH on the background of COPD (P > 0.05).

Comparing IVSdб there was a essential difference between the groups of patients with COPD with and without PH: 1.07 [0.99 ; 1.20] cm versus 0.94 [0.84 ; 1.03] cm, respectively ($P < 0.05$). When comparing the median of this indicator in groups of patients and healthy individuals, where it was 0.94 [0.88 ; 0.98] cm, a significant increase was found in the group of patients with PH on the background of COPD by 13.8 %, ($P < 0.05$), while with the group of patients with COPD without PH, there was no likely discrepancy, ($P > 0.05$).

There was a considerable increase in LVPWd in the group of patients with PH on the background of COPD was 1.08 [0.99 ; 1.18] cm, both in comparison with the value of 1.02 [0.84 ; 1.03] cm in the group of patients with COPD without PH, and 0.94 [0.89 ; 0.98] cm in the group of healthy individuals, ($P < 0.05$). The median of this indicator in the COPD group without PH did not significantly exceed the value in the group of practically healthy individuals ($P > 0.05$).

The LVMI value of 121.63 [96.02 ; 146.00] g/m^2 was higher in the group of patients with PH on the background of COPD, both against the level of 94.61 [81.87 ; 117.73] g/m^2 in the group of patients with COPD without PH, and - 93.72 [88.29 ; 106.39] g/m^2 in the group of healthy individuals, ($P < 0.05$). There was no so great difference in this indicator between the group of COPD patients without PH and healthy individuals ($P > 0.05$). The RWT was considerably higher in the groups of patients with PH on the background of COPD was 0.40 [0.37 ; 0.44] versus 0.38 [0.34 ; 0.39] in the group of patients with COPD without PH ($P < 0.05$). Comparing the median of this indicator in the group of patients with PH on the background of COPD with a value of 0.37 [0.35 ; 0.41] in the group of healthy individuals, it was significantly 8.1 % higher ($P < 0.05$).

The left ventricular remodeling rates in patients with PH were divided according to the presence of TH. The results obtained are presented in Table 2.

In the subgroup of patients with PH on the background of COPD combined with HT, the LVEDD was 5.47 [5.08 ; 5.77] cm and was significantly higher by 7.3 % compared to 5.10 [4.88 ; 5.35] cm in the subgroup of patients with PH on the background of COPD without HT, ($P < 0.05$). The IVSd value of 1.17 [1.03 ; 1.23] cm in the subgroup of patients with PH on the background of COPD combined with HT was higher compared to 0.91 [0.84; 1.03] cm in the subgroup of patients with PH on the background of COPD without HT, ($P < 0.05$). The LVPWd was 1.11 [1.04 ; 1.21] cm in the subgroup of patients with PH on the background of COPD combined with HT considerably exceeded the value of 0.96 [0.90 ; 1.01] cm in the subgroup of patients with PH on the background of COPD without HT, ($P < 0.05$). The change in the LVMI and RWT was similar.

In the subgroup of patients with PH on the background of COPD combined with HT, the following types of LV remodeling were present: normal LV model was 2 (2.3 %) patients, eccentric LV hypertrophy was detected in 43 (49.4 %) patients, concentric LV hypertrophy in 33 (37.9 %) and 9 (10.4 %) concentric LV remodeling. In the subgroup of patients with PH on the background of COPD without HT, the following types of LV remodeling were observed: a normal LV model was found in 35 (97.2 %) individuals, eccentric LV hyper-

Table 2 The indicators of left ventricular remodeling among patients with PH depending on the presence of HT (Me [25; 75], n = 123)

Variable	Presence HT	
	Patients without HT (n = 36)	Patients with HT (n = 87)
LVEDD, cm	5,10 [4,88 ; 5,35]	5,47 [5,08 ; 5,77]
P-value	p < 0,001	
IVSd, cm	0,91 [0,84 ; 1,03]	1,17 [1,03 ; 1,23]
P-value	p < 0,001	
LVPWd, cm	0,96 [0,90 ; 1,01]	1,11 [1,04 ; 1,21]
P-value	p < 0,001	
LVMI, g/m^2	93,69 [81,74 ; 103,74]	134,01 [117,27 ; 154,79]
P-value	p < 0,001	
RWT	0,38 [0,35 ; 0,40]	0,42 [0,38 ; 0,44]
P-value	p < 0,001	

trophy was detected in 1 (2.8 %) patient, concentric LV hypertrophy and concentric LV remodeling were not found.

It was determined that in the PH subgroup with COPD combined with HT, eccentric LV hypertrophy significantly prevailed in 49.4 %, while in the PH subgroup with COPD without HT, the normal LV model was in 35 (97.2 %) individuals ($P < 0.05$).

The pulmonary hypertension detected among our patients with COPD was mostly moderate, which is consistent with the data of other authors. So, in the study of W. Seeger et. al., it was found that the prevalence of pulmonary hypertension in COPD depends on the severity of the disease and methods for assessing pressure in the pulmonary artery, with pulmonary hypertension more often mild or moderate [9, 10].

To date, cardiac remodeling in patients with HT has been studied in sufficient detail, while left ventricular remodeling among patients with COPD combined with HT remains a poorly understood topic, which is presented in a small number of scientific researches. Of course, the results obtained by us fully fit into the theory that the main manifestation of structural and geometric changes in LV among patients with HT is myocardial hypertrophy. It is formed as an adaptive response of the myocardium to pressure load. The LV remodeling in combination with COPD and HT certainly has the features of its pathological restructuring, while the predominance of two types is determined by eccentric and

concentric LV hypertrophy. However, there are different data on the proportion of these types in cohorts of patients with COPD combined with HT, which is probably caused by the duration and course of the disease [11], [12], [13], [14].

Thus, in patients with PH on the background of COPD, heart remodeling processes occur, which is accompanied by more pronounced LV remodeling in the presence of HT. An important part of the COPD control strategy that can improve overall outcomes should be not only the treatment of comorbidities but also the impact on the pathogenetic links that unite them. This will open up a potentially new approach to treating these patients, which requires further research.

Conclusions

1. In patients with PH on the background of COPD together with HT, there is a greater vise in the legacy of the lower artery for patients with PH on the background of COPD without HT.

2. Increased value of LVMI and RWT in patients with PH on the background of COPD occurs when HT, which characterizes the process of remodeling PH.

3. It was indicated that among all the patients with PH on the background of COPD, in one of the patients with PH, 49.4 % of the patients had eccentric hypertrophy of the LV.

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Ethical Declaration. The study was carried out in conformity with the Declaration of Helsinki.The study was approved by the local ethics committee of State Institute «Zaporizhzhia Medical Academy of Postgraduate Education of Ministry of Health of Ukraine».

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