ORIGINAL ARTICLE

Correlation of inflammatory markers with echocardiographic parameters of left and right ventricular function in patients with chronic obstructive pulmonary disease and cardiovascular diseases

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KEY WORDS

cardiovascular disease, chronic obstructive pulmonary disease, heart failure, inflammation, oxidative stress

ABSTRACT

INTRODUCTION Inflammation and oxidative stress play an essential role in the pathogenesis of chronic obstructive pulmonary disease (COPD) and cardiovascular disease (CVD).

OBJECTIVES The aim of the study was to evaluate the echocardiographic parameters of the left and right ventricular functions in patients with COPD with or without CVD and in healthy controls, and to establish their relationships with biomarkers of inflammation and oxidative stress.

PATIENTS AND METHODS The study included 24 patients with COPD and CVD, 20 patients with COPD, and 16 healthy controls. Physical examination, spirometry, and echocardiography were performed in all participants, and blood samples were collected. The levels of 8-isoprostane, leukotriene B_4, and interleukin 8 were determined in the blood and exhaled breath condensate (EBC).

RESULTS In patients with COPD, the left ventricular ejection fraction was lower than in healthy controls (58.84% ±9.57% vs. 65.50% ±3.35%, $P < 0.01$); moreover, it was lower in patients with COPD and CVD than in those without comorbidities (54.29% ±10.58% vs. 64.30% ±3.74%, $P < 0.01$). The systolic and diastolic functions of the right ventricle were lower in patients with COPD than in the control group, while systolic pulmonary arterial pressure was significantly higher in patients with COPD than in the control group (37.04 ±7.6 mmHg vs. 28.12 ±4.44 mmHg, $P = 0.01$). Some echocardiographic parameters of the left and right ventricular functions correlated with the concentrations of inflammatory markers both in serum and EBC.

CONCLUSIONS The echocardiographic parameters of cardiac function correlate with the markers of inflammation in patients with COPD, which emphasizes the inflammatory background of CVD.

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INTRODUCTION Chronic obstructive pulmonary disease (COPD) is characterized by irreversible airflow limitation, which is usually progressive and is caused by abnormal inflammatory response of the lungs to noxious particles or gases.[1-3] The pathological hallmark of COPD includes neutrophilic inflammation of the peripheral airways and destruction of the lung parenchyma, which leads to expiratory airflow limitation.[1-3]

There are several reports indicating that endogenous cytokines and eicosanoids stimulate recruitment and activation of neutrophils and promote inflammation. Studies have revealed increased levels of proinflammatory mediators such as interleukin 8 (IL-8), 8-isoprostane, and

TABLE 1 Baseline characteristics of the patients

		Group A (n = 24)	Group B (n = 20)	Group C (n = 16)
sex (F:M ratio)		3:21	10:10	12:4
age		67.75 ±9.3	65.05 ±8.0	53.1 ±7.31[a]
systolic blood pressure		146.3 ±19.01	133.25 ±18.9[b]	126.6 ±11.9[a]
diastolic blood pressure		86.6 ±8.68	83.0 ±8.79	81.6 ±6.5
FEV_1		57.14 ±20.8	60.1 ±17.1	98.3 ±8.42[a]
FEV_1-to-FVC ratio		56.9 ±9.6	59.1 ±10.9	79.2 ±5.03[a]
CRP, mg/l		3.68 ±3.56	4.84 ±3.81	1.52 ±0.98[a]
serum 8-isoprostane, pg/ml		518.0 ±274.31	652.07 ±206.19	132.4 ±127.7[a]
serum LTB_4, pg/ml		1802.02 ±626.32	1737.47 ±674.53	1303.14 ±3.92[a]
serum IL-8, pg/ml		12.04 ±7.31	9.91 ±4.38	6.7 ±5.1[a]
EBC isoprostane-8, pg/ml		15.67 ±17.71	18.20 ±20.65	9.3 ±7.43[a]
EBC LTB_4, pg/ml		44.19 ±46.67	49.75 ±62.04	14.57 ±15.9[a]
EBC IL-8, pg/ml		4.75 ±0.57	4.74 ±0.85	4.51 ±0.6
COPD, n (%, F:M ratio)	stage I	3 (12.5, 1:2)	3 (15, 1:2)	–
	stage II	11 (45.8, 2:9)	13 (65, 8:5)	–
	stage III	6 (25, 0:6)	1 (5, 1:0)	–
	stage IV	4 (16.7, 0:4)	3 (15, 0:3)	–
prevalence of CVDs, n (%)	coronary disease	21 (87.5)	–	–
	systolic heart failure	9 (37.5)	–	–
	cerebral ischemia	5 (20.83)	–	–
	peripheral artery disease	3 (12.5)	–	–
	diastolic heart failure	22 (91.7)	14 (70)	–

Values are presented as mean ± standard deviation.

a $P = 0.001$ vs. groups A and B, **b** $P = 0.02$ vs. group A

Abbreviations: COPD – chronic obstructive pulmonary disease, CRP – C-reactive protein, CVD – cardiovascular disease, EBC – exhaled breath condensate, F – female, FEV_1 – forced expiratory volume in 1 second, FVC – forced vital capacity, IL-8 – interleukin 8, LTB_4 – leukotriene B_4, M – male

leukotriene B_4 (LTB_4) in the sputum, bronchoalveolar lavage fluid,[4,5] and exhaled breath condensate (EBC)[6,7] in patients with COPD. Their concentrations were higher than those observed in asthma,[8] healthy smokers,[9,10] and nonsmokers.[6,7] Therefore, all 3 parameters may serve as markers of inflammation in COPD.

Various studies have provided some evidence that COPD is associated with extrapulmonary abnormalities, which include cachexia, weight loss, osteoporosis, pulmonary infections, and increased risk of the development of cardiovascular and neoplastic diseases. It seems that chronic inflammation in the lungs is a source of systemic inflammation in patients with COPD.[3,11,12] Although cardiovascular disease (CVD) often coexists in these patients, the exact links between these diseases have not been fully explained. A common risk factor for COPD and CVD as well as genetic factors may help clarify this phenomena; however, several investigators have suggested the potential role of systemic inflammation in COPD as an underlying cause of CVD.[3,11,12] COPD is associated with a 2- to 3-fold higher risk of CVD. In addition, low forced expiratory volume in 1 second (FEV_1) is an independent risk factor of all-cause and cardiac-related mortality in these patients.[13-15]

There have only been a few studies in patients with COPD and CVD that focused on the usefulness of echocardiography in the assessment of cardiac function and pulmonary hypertension (PH),[16,17] and only a few studies evaluating the correlations of inflammatory and oxidative stress markers with echocardiographic parameters of the left and right ventricular functions in patients with COPD.[18,19] Therefore, the aim of this study was to assess the relationship between the echocardiographic parameters of myocardial dysfunction and the concentrations of inflammatory markers in the blood and EBC of patients with COPD.

PATIENTS AND METHODS The study included 44 patients with COPD, stages I–IV,[1] with or without coexisting CVD, and 16 healthy individuals that served as controls. The exclusion criteria were as follows: exacerbation of COPD within 2 weeks preceding the study, asthma, tuberculosis, malignancy, and pregnancy.

The diagnosis of CVD was based on at least 1 of the following criteria: 1) coronary heart disease in the past (myocardial infarction, coronary intervention, positive result of the stress test, or at least 50% coronary stenosis on angiography; 2) systolic heart failure (clinical signs and

symptoms of cardiac failure with left ventricular (LV) ejection fraction (LVEF) of <45%–50% on echocardiography; 3) peripheral arterial disease (clinical symptoms, abnormal ankle–brachial index, or at least 50% stenosis of the vessel confirmed by imaging studies, or a history of percutaneous or surgical intervention); 4) cerebral ischemia in the past (transient ischemic attack or ischemic stroke, confirmed by imaging studies, or invasive treatment of cerebral ischemic disease).

The LV diastolic failure was diagnosed if the typical clinical signs and symptoms of heart failure were present with preserved LVEF of less than 45% and echocardiographic dysfunction of LV after exclusion of significant valvular heart disease and other than cardiac causes of clinical symptoms (e.g., lung disease). LV diastolic dysfunction was diagnosed according to the Paulus criteria.[20] If the LVEF was greater than 50%, the E/E' ratio was estimated. The E/E' values of less than 8 excluded and those exceeding 15 confirmed the presence of the LV diastolic dysfunction. If E/E' was between 8 and 15, the E/A ratio, the left atrial volume index (LAVI) with the LV muscle mass index (LVMI) were assessed. The E/A ratio lower than 0.5 and/or the LAVI greater than 40 ml/m^2 and/or the LVMI greater than 122 g/m^2 in women and 149 g/m^2 in men indicated LV diastolic dysfunction. Therefore, on the basis of those criteria, LV failure was not clearly diagnosed in patients with COPD and CVD (TABLE 1); however, in the majority of the patients, LV diastolic dysfunction was observed.

Patients were divided into 3 groups: 24 patients with COPD (stages I–IV) and CVD (group A), 20 patients with COPD without CVD (group B), and 16 healthy individuals serving as controls (group C). The characteristics of the patients are presented in TABLE 1. All participants signed informed consent, and the study protocol was approved by the local ethics committee.

Study protocol After informed consent was signed by all participants, the medical history was taken with a particular attention to the symptoms and risk factors of COPD and CVD. Furthermore, physical examination with anthropometric measurements (body weight, height, waist girth) were done. Additionally, in all participants, spirometry and echocardiography were performed and blood samples were collected to evaluate the serum levels of C-reactive protein (CRP), 8-isoprostane, LTB_4, and IL-8. Furthermore, EBC was collected from all individuals for the assessment of 8-isoprostane, LTB_4, and IL-8.

Spirometry Spirometry was performed in all participants using the daily calibrated spirometer (Lungtest 1000, Mes, Kraków, Poland) according to the standards.[21]

Collection of exhaled breath condensate EBC was collected using the EcoScreen device (Jaeger, Hoechberg, Germany) according to the manufacturer's instructions. The EBC was obtained between 8 and 10 a.m. Patients had to stop smoking cigarettes at least 12 h before the collection and were not allowed to use multivitamin preparations for 4 weeks prior to the procedure. Approximately, from 2.5 to 3.0 ml of the EBC was frozen and stored at –20°C for further analysis.

Collection of peripheral blood Blood samples were collected in the morning. The serum CRP concentration was assessed using the AU-400 analyzer (Olympus, Beckman Coulter Inc, New York, United States), and part of the serum samples were frozen and stored at –20°C for further analysis.

Determination of leukotriene B_4, interleukin 8, and 8-isoprostane levels The concentrations of LTB_4, IL-8, and 8-isoprostane in the peripheral blood and EBC were measured according to the manufacturers' instructions using the Leukotriene B4 Kit and Isoprostane Kit (Cayman Chemical Company, Ann Arbor, Michigan, United States) as well as the IL-8 Quantikine kit (R&D Systems, Minneapolis, Minnesota, United States).

Echocardiography Echocardiography was performed using the Siemens Acuson X300 ultrasound machine equipped with a transducer probe of 1.0 to 5.6 MHz, P5-1 (Siemens, Erlangen, Germany). The examination was done in a semi-recumbent left lateral position of the patient, and images were taken from routine parasternal, apical, and subxiphoid views.

To evaluate the systolic function of the right ventricle (RV), the following parameters were measured[22-25]: tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), diastolic area of the RV (DARV), systolic area of the RV (SARV), and systolic peak velocity of the tricuspid annulus measured by pulsed-wave tissue Doppler (S't). To evaluate the diastolic function of the RV, Doppler parameters were used: peak velocity of an early diastole E-wave transtricuspid flow and peak velocity of atrial systole A-wave transtricuspid flow (Et/At), as well as peak early diastole (E't) and peak atrial systole (A't) of the tricuspid annular velocity (E't/A't), RV myocardial performance index = the global index of efficiency of the RV (RVMPI), and systolic pulmonary arterial pressure (SPAP). The SPAP was estimated by summing the pressure in the right atrium with the peak pressure gradient between the RV and the right atrium. The pressure in the right atrium was estimated based on the width of the inferior vena cava and its collapse during inhalation.

An SPAP of more than 36 mmHg was used to diagnose mild PH, while moderate and severe PH was defined as an SPAP above 49 mmHg and 79 mmHg, respectively.

The EF was used to evaluate LV systolic function as a derivative of LV diastolic and systolic volume with the Simpson's method using the software installed in the ultrasound machine. To

TABLE 2 Echocardiographic parameters of the left ventricular function in patients with chronic obstructive pulmonary disease and healthy controls

	COPD (groups A + B)	Control	*P* value
EF, %	58.84 ±9.57	65.50 ±3.35	<0.01
E/E'	10.08 ±3.99	7.22 ±1.18	<0.01
E/A	0.84 ±0.33	1.12 ±0.31	<0.01
E, m/s	0.68 ±0.17	0.82 ±0.13	<0.01
A, m/s	0.85 ±0.18	0.74 ±0.26	0.07
E', m/s	0.07 ±0.02	0.12 ±0.02	<0.01
LVSD, mm	33.57 ±6.77	29.7 ±2.67	0.02
LVDD, mm	48.93 ±5.43	46.13 ±2.63	0.05

Values are presented as mean ± standard deviation.

Abbreviations: EF – ejection fraction, E/A – peak velocity of early diastole E-wave transmitral flow and peak atrial velocity systole/A-wave transmitral flow ratio, E/E' – peak velocity of early diastole transmitral flow-E/peak early diastole mitral valve annular velocity-E' ratio, LVDD – left ventricular diastolic diameter, LVSD – left ventricular systolic diameter, others – see TABLE 1

TABLE 3 Echocardiographic parameters of right ventricle function in patients with left ventricular diastolic diameter and healthy controls

	COPD (groups A + B)	Controls	*P* value
TAPSE, mm	26.66 ±2.61	28.31 ±1.66	<0.01
FAC, %	51.3 ±4.59	55.84 ±3.25	0.01
SARV, cm^2	10.25 ±3.62	8.21 ±2.20	0.04
DARV, cm^2	20.88 ±6.28	18.45 ±3.99	0.15
S't, cm/s	15 ±2.53	16.42 ±2.42	0.06
E't/A't	0.64 ±0.1	1.06 ±0.30	<0.01
Et/At	0.91 ±0.26	1.26 ±0.28	<0.01
RVMPI	0.51 ±0.12	0.25 ±0.06	<0.01

Values are presented as mean ± standard deviation.

Abbreviations: DARV – diastolic area of the right ventricle, Et/At – peak velocity of the early diastole E-wave transtricuspid flow/peak velocity of atrium systole A-wave transtricuspid flow ratio, E't/A't – peak early diastole (E't) /peak atrium systole (A't) tricuspid valve annular velocity ratio, FAC – fractional area change, RVMPI – right ventricular myocardial performance index, SARV – systolic area of the right ventricle, S't – tricuspid valve annular peak systolic velocity, TAPSE – tricuspid annulus plane systolic excursion, others – see TABLE 1

assess LV diastolic function, we used the E/A ratio (peak velocity of an early diastolic transmitral flow [E] and peak velocity of atrial systolic transmitral flow [A]) and the E/E' ratio (peak velocity of early diastolic transmitral flow [E] and peak early diastole mitral valve annular velocity [E'], measured with pulsed-wave Doppler).[22]

Statistical analysis The data were expressed as mean with standard deviation. To determine data distribution, the Kolmogorov–Smirnoff test was used. The groups were compared using the *t* test for normally distributed data and the Mann–Whitney test for nonparametric data. The Pearson's test was used to determine significance between quantitative variables. When more than 2 groups were compared, the analysis of variance was used. To assess correlations, the Spearman test was applied. Data were analyzed using the Statistica 6.0 software (StatSoft, Krakow, Poland). A *P* value of less than 0.05 was considered statistically significant.

RESULTS The EF was lower in patients with COPD (groups A and B) than in controls. When LV diastolic function was evaluated, the E/E' ratio was higher and the E/A ratio was lower in patients with COPD than in healthy controls (TABLE 2).

Both TAPSE and FAC, reflecting RV systolic function, were smaller, while SARV was greater in patients with COPD compared with the control group. Furthermore, the tissue Doppler parameters of the RV systolic function were nonsignificantly lower in patients with COPD compared with healthy subjects ($P = 0.06$) (TABLE 3).

The RV diastolic function (E't/A't, Et/At) was lower in patients with COPD than in healthy subjects. Moreover, RVMPI was higher in patients with COPD compared with the control group (TABLE 3).

The SPAP was higher in patients with COPD (37.04 ±7.6 mmHg) than in controls (28.12 ±4.44 mmHg, $P = 0.01$). PH was diagnosed in 22 patients (50%) with COPD, of which 2 patients suffered from moderate and 20 patients from mild PH.

Further analysis revealed a lower EF in patients with COPD and CVD than in those with COPD without CVD (54.29% ±10.58% and 64.30% ±3.74%, respectively; $P < 0.01$). The E/E' ratio was higher in group A compared with group B (11.16 ±4.97 vs. 8.79 ±1.72, respectively; $P = 0.04$); however, the E/A ratio did not differ between

TABLE 4 Echocardiographic parameters of the right ventricular function in the study groups

	COPD with CVD	COPD without CVD	*P* value
TAPSE, mm	25.96 ±2.84	27.5 ±2.1	0.05
FAC, %	51.13 ±4.71	51.49 ±4.56	0.80
SARV, cm^2	11.18 ±4.11	9.13 ±2.62	0.06
DARV, cm^2	22.62 ±6.77	18.78 ±5.01	0.04
S't, cm/s	14.1 ±2.21	16.09 ±2.51	<0.01
E't/A't	0.61 ±0.1	0.67 ±0.1	0.04
Et/At	0.90 ±0.03	0.93 ±0.26	0.70
RVMPI	0.54 ±0.11	0.48 ±0.13	0.15

Values are presented as mean ± standard deviation.

Abbreviations: see TABLES 1 and 3

groups A and B (0.82 ±0.3 vs. 0.86 ±0.38, *P* = 0.68).

The assessment of the RV systolic function revealed a higher DARV (*P* = 0.04) and lower S't in group A (*P* <0.01). Although SARV was higher and TAPSE was lower in group A compared with group B, the difference was not significant (*P* = 0.06 and *P* = 0.05, respectively) (TABLE 4).

The E't/A't ratio was lower in group A than in group B, while the Et/At ratio was not different between the groups. Moreover, the RVMPI did not differ between groups A and B (TABLE 4).

The SPAP was similar in groups A (37.17 ±7.50 mmHg) and B (36.90 ±7.91 mmHg, *P* = 0.91). PH was diagnosed in 10 patients (42%) from group A and 12 patients (60%) from group B: moderate PH was observed in 4% of the patients in group A and 5% of those in group B, while mild PH was observed in 38% and 55% of the patients, respectively.

Statins were administered in 12 patients (50%) from group A and 3 patients (15%) from group B; however, treatment did not affect LV and RV functions. The SPAP did not differ between patients who received statins and those who did not (38.2 ±5.67 mmHg vs. 36.45 ±8.45 mmHg, *P* = 0.47). Furthermore, PH was diagnosed in 8 patients (53%) treated with statins and in 14 patients (48%) who were not taking statins. All patients treated with statins suffered from mild PH, while 7% and 41% of the patients who did not receive statins had moderate and mild PH, respectively.

Furthermore, serum CRP levels correlated positively with the RVMPI and SPAP and negatively with E't/A't. Moreover, serum 8-isoprostane levels correlated negatively with E't/A't, Et/At, and FAC. Higher serum 8-isoprostane levels were associated with a higher RVMPI. There was a positive correlation between 8-isoprostane levels in EBC and E/E'. Furthermore, serum LTB_4 levels correlated negatively with E/A, Et/At, E't/A't, and FAC, but positively with E/E', SPAP, and RVIMP. There was an inverse correlation between serum IL-8 levels and EF, and a positive correlation between IL-8 concentrations in the EBC and SARV, DARV, and RVIMP (TABLE 4).

DISCUSSION In this study, we demonstrated that the EF was lower in patients with COPD than in healthy controls and in patients with COPD and CVD than in those without comorbidities. Moreover, we showed that the EF was not affected by statins. Although it had been suggested earlier that the RV dysfunction in patients with COPD does not significantly affect the LV function,[15,26] LV systolic dysfunction was diagnosed previously in 10% to 46% of the patients with stable COPD.[27] In addition, the EF of our patients with COPD was similar to that observed previously in patients with severe COPD, respiratory failure, and pulmonary hypertension.[23]

According to the criteria used in our study, LV diastolic dysfunction was diagnosed in 82% of the patients with COPD, in 92% of the patients with COPD and CVD, and in 70% of the patients with COPD without CVD. LV diastolic dysfunction affected 93% of the patients treated with statins and 77% of the patients not receiving such treatment.

Similarly to our study, Suchoń et al.[16] and Funk et al.[28] observed a significantly lower E/A ratio in patients with COPD compared with healthy controls. Moreover, using the E/A ratio, Schena et al.[23] demonstrated LV diastolic dysfunction in patients with COPD with symptoms of chronic RV failure. In contrast, Bagnato et al.[26] showed no difference in the E/A ratio between patients with COPD and healthy controls. Unfortunately, the above studies enrolled only patients with COPD without CVD; therefore, we cannot directly compare those findings with our results.[16,23,27,28] It is possible that the LV diastolic dysfunction in patients with COPD without CVD could be induced by systemic inflammation and did not significantly affect the intensity of systemic inflammation.

The echocardiographic assessment of the RV revealed its lower systolic and diastolic function in patients with COPD compared with healthy controls and in patients with COPD and CVD compared with those without comorbidities. Statins did not affect the RV systolic function. Similarly, Tayyareci et al.[29] revealed lower values of S't in patients with COPD compared with controls while Caso et al.[30] showed significantly lower values of TAPSE in patients with COPD and PH than

TABLE 5 Correlations between echocardiographic parameters and biomarker levels in exhaled breath condensate and serum of patients with chronic obstructive pulmonary disease

	Serum				EBC	
	CRP	8-isoprostane	LTB_4	IL-8	IL-8	8-isoprostane
RVMPI	$r = 0.29$ $P < 0.05$	$r = 0.35$ $P < 0.05$	$r = 0.44$ $P < 0.05$		$r = 0.32$ $P < 0.05$	
SPAP	$r = 0.3$ $P < 0.05$		$r = 0.42$ $P < 0.05$			
E't/A't	$r = –0.3$ $P < 0.05$	$r = –0.44$ $P < 0.05$	$r = –0.48$ $P < 0.05$			
Et/At		$r = –0.28$ $P < 0.05$	$r = –0.47$ $P < 0.05$			
FAC		$r = –0.34$ $P < 0.05$	$r = –0.46$ $P < 0.05$			
E/A			$r = –0.28$ $P < 0.05$			
E/E'			$r = 0.28$ $P < 0.05$			$r = 0.29$ $P < 0.05$
EF				$r = –0.34$ $P < 0.05$		
SARV					$r = 0.35$ $P < 0.05$	
DARV					$r = 0.36$ $P < 0.05$	

Values are presented as mean ± standard deviation.

Abbreviations: see TABLES 1, 2, and 3

in those with COPD without PH and healthy subjects. Of the parameters of the RV diastolic function, Funk et al.[28] observed a lower Et/At ratio in patients with COPD without CVD compared with healthy controls, which is in line with our study. Marangoni et al.[31] showed a significant difference in the value of tricuspid inflow velocity ratio between patients with COPD with PH and patients with COPD without PH and healthy controls. Caso et al.[30] showed a significantly lower E't/A't ratio in patients with COPD than in healthy controls, and the presence of PH did not affect the E't/A't ratio. Furthermore, Melek et al.[32] observed lower values of E't/A't in patients with COPD and PH than in those with COPD without PH. Yilmaz et al.[33] revealed a significantly higher RVIMP in patients with COPD compared with healthy controls, and this parameter differentiated between patients with and without PH.

Furthermore, we showed that SPAP was significantly higher in patients with COPD than in controls; however, neither CVD nor treatment with statins significantly affected SPAP. Of patients with COPD, 50% were diagnosed with PH. Similar results were obtained previously. Suchoń et al.[16] described higher SPAP in patients with COPD than in healthy controls. Shrestha et al.[17] diagnosed mild and moderate PH in 49% and 18% of the patients with COPD, respectively. However, contrary to our results, a 6-month treatment with pravastatin significantly reduced SPAP in patients with COPD and PH.[34] However, we cannot compare our results with those findings because that study lacked detailed characteristics of the patients or the data on SPAP before treatment with statins.[16,17,34]

Finally, there were some significant correlations between echocardiographic parameters of the RV and LV functions and inflammatory markers measured in the serum and EBC of the patients with COPD. The systolic, diastolic, and global function of the RV aggravated with the increasing levels of CRP, 8-isoprostane, LTB_4 in serum and IL-8 in EBC. Similarly to Damas et al.,[19] we observed a negative correlation between EF and serum IL-8 levels. Moreover, E/E' correlated positively with the 8-isoprostane level in EBC and with serum concentrations of while E/A negatively correlated with serum LTB_4 concentrations. In addition, we showed a positive correlation between the SPAP and serum concentrations of CRP and LTB_4. Such relationships between echocardiographic parameters and concentrations of proinflammatory markers have not been presented before.

The main limitation of our study is a relatively small number and heterogeneity of the patients with CVD. Statins, which were used by some patients, could also affect some inflammatory parameters. However, significant correlations between the serum concentrations of CRP, LTB_4, IL-8, and 8-isoprostane and EBC concentrations of 8-isoprostane, LTB_4, and IL-8 with the parameters of heart function could indicate that systemic inflammation and oxidative stress might contribute

to the development of LV and RV systolic and diastolic dysfunction in patients with COPD.

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ARTYKUŁ ORYGINALNY

Korelacja markerów zapalenia z echokardiograficznymi parametrami funkcji lewej i prawej komory serca u chorych na przewlekłą obturacyjną chorobę płuc i choroby sercowo-naczyniowe

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SŁOWA KLUCZOWE

choroby sercowo-naczyniowe, niewydolność serca, przewlekła obturacyjna choroba płuc, stres oksydacyjny, zapalenie

STRESZCZENIE

WPROWADZENIE Zapalenie i stres oksydacyjny odgrywają istotną rolę w patogenezie przewlekłej obturacyjnej choroby płuc (POChP) i chorób sercowo-naczyniowych (CSN).

CELE Celem pracy była ocena echokardiograficznych parametrów funkcji lewej i prawej komory serca u chorych na POChP z lub bez towarzyszących CSN i u osób zdrowych oraz określenie ich związku z biomarkerami zapalenia i stresu oksydacyjnego.

PACJENCI I METODY Badanie objęło 24 chorych na POChP i CSN, 20 chorych na POChP i 16 zdrowych osób. U wszystkich uczestników przeprowadzano badanie przedmiotowe, spirometrię i badanie echokardiograficzne oraz pobrano próbki krwi. Dodatkowo oceniano stężenie 8-izoprostanu, leukotrienu B_4 i interleukiny 8 we krwi i w kondensacie powietrza wydechowego (*exhaled breath condensate* – EBC).

WYNIKI U chorych na POChP frakcja wyrzutowa lewej komory była istotnie niższa niż u osób zdrowych (58,84 ±9,57% *vs* 65,50 ±3,35%, p <0,01); ponadto była niższa u chorych na POChP z CSN niż u chorych bez CSN (54,29 ±10,58% *vs* 64,30 ±3,74% p <0,01). Czynność skurczowa i rozkurczowa prawej komory serca chorych na POChP była mniejsza niż u zdrowych, podczas gdy skurczowe ciśnienie w tętnicy płucnej było istotnie wyższe u chorych na POChP niż w grupie kontrolnej (37,04 ±7,6 mm Hg *vs* 28,12 ±4,44 mm Hg; p = 0,01). Niektóre echokardiograficzne parametry oceniające funkcję lewej i prawej komory serca korelowały ze stężeniami markerów stanu zapalnego zarówno w surowicy, jak i w EBC.

WNIOSKI Parametry echokardiograficzne funkcji mięśnia sercowego korelują ze stężeniem markerów zapalenia u chorych na POChP, co podkreśla podłoże zapalne CSN.

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