

COMPARATIVE ROLE OF ECG AND ECHOCARDIOGRAPHY IN THE DIAGNOSIS OF CHRONIC COR PULMONALE IN PATIENTS WITH MODERATE AND SEVERE COPD

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Abstract: Objectives: The objective of this study was to highlight the correlations between ECG and echocardiographic changes with diagnostic role in right ventricular hypertrophy in patients with COPD GOLD stage II and III, as well as the correlations with respiratory functional impairment degree. Materials and methods: the study was conducted on a sample of 61 patients with COPD aged between 44 and 78 years old. Among them, 38 have been diagnosed with COPD GOLD stage II, and 23 with stage III. The patients underwent ECG and echocardiography with a view to detect any signs of right ventricular hypertrophy. Results: Patients with moderate and severe form of COPD often associate right ventricular hypertrophy on ultrasound, statistically uncorrelated with the degree of impaired respiratory function, but highlighting significant correlations of right ventricular hypertrophy with pulmonary artery systolic pressure (PASP) values. Electrocardiography shows a low sensitivity compared to echocardiographic method in the diagnosis of chronic cor pulmonale. Conclusions: The degree of respiratory functional impairment measured by maximum forced expiratory volume (FEV) in the first second, does not correlate with the risk of right ventricular hypertrophy. ECG method for the diagnosis of chronic cor pulmonale, although it is accessible, does not have a satisfactory sensitivity.

INTRODUCTION

Morphological and functional value of the right ventricle has clinical, prognostic and therapeutic importance in chronic cor pulmonale, secondary to COPD. The issue of the existence of right ventricular hypertrophy in COPD patients, severe and moderate form, has been intensively studied, its presence having an unfavourable prognostic significance in patients' evolution.

PURPOSE

The objective of this study was to highlight the correlations between ECG and echocardiographic changes suggestive for right ventricular hypertrophy in patients with COPD GOLD stage II and III, as well as the correlations with respiratory functional impairment degree.

MATERIALS AND METHODS

The study was conducted on a sample of 61 patients with COPD aged between 44 and 78 years old. Among them, 38 have been diagnosed with COPD GOLD stage II and 23 with stage III.

There were excluded from the study, patients who presented difficult ultrasound window and those in whom valid echocardiographic measurements could not be performed.

All patients received standard electrocardiograms in 12 derivatives.

The following criteria were considered suggestive of chronic cor pulmonale - changes in the P wave and PQ segment - P wave greater than 2.5 mm, P / R ratio greater than 0.5, P sharp in D2, D3 and aVF, P wave axis deviated to the right, +70° - + 80°; QRS changes - QRS axis deviation to

the right to +90° - + 150°, R high in V1, V1 R-R' in V1, R below 5 mm, S over 7 mm in V1; changes in St-T complex: T negative in D3 and aVF, T negative in V1 (V2, V3), T positive in D1, aVL and V5 and V6; minor disturbances of conduction in right ventricle (RV): where r' and R' large in V1, where S large in D1, aVL and V5, V6.(1)

Echocardiographic parameter used to assess right ventricular hypertrophy is the thickness of the right ventricular wall, measured in subcostal incidence during diastole; thickness higher than 5 mm suggesting the presence of right ventricular hypertrophy and chronic cor pulmonale.

Maximum limit of the right ventricular free wall thickness is 5 mm, above which the free wall is considered hypertrophic. Pulmonary artery systolic pressure was also calculated by PASP echocardiographic method. In COPD patients presenting persistent pulmonary vascular impairment, the right ventricle tends initially to hypertrophy, maintaining normal volume, followed by progressive dilation.(2,3,4,5)

RESULTS

Thickness above 5 mm suggests the presence of right ventricular hypertrophy and chronic cor pulmonale. In the study group, assessing this parameter was possible in all patients. Values above 5 mm were found in 21 patients (34.42%).

To verify a possible association between the presence of right ventricular hypertrophy and COPD stage, we analyzed the distribution of cases with right ventricular wall above 5 mm correlated with the stage of COPD. The chart showing the distribution of cases of right ventricular wall more than 5 mm depending on the stage of COPD

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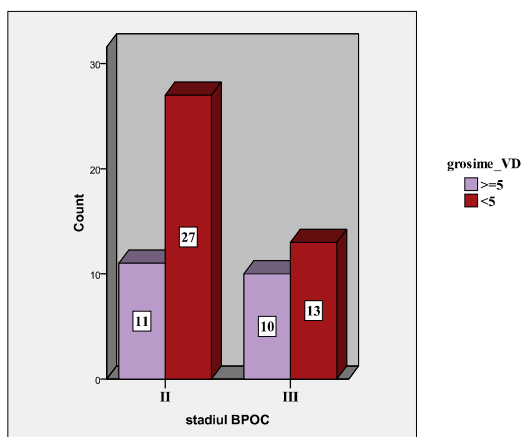
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CLINICAL ASPECTS

highlights the presence of a higher share of those with right ventricular impairment in COPD stage III compared to stage II.

In 28.95% of patients with COPD stage II, right ventricular wall above 5 mm was present, as well as in 43.48% of patients with COPD stage III. To apply the Z-test for proportions, $p = 0.379$ has been obtained, suggesting insignificant differences with a significance level of 0.05.

Figure no. 1. Frequency of right ventricular wall thickness correlated with COPD stage

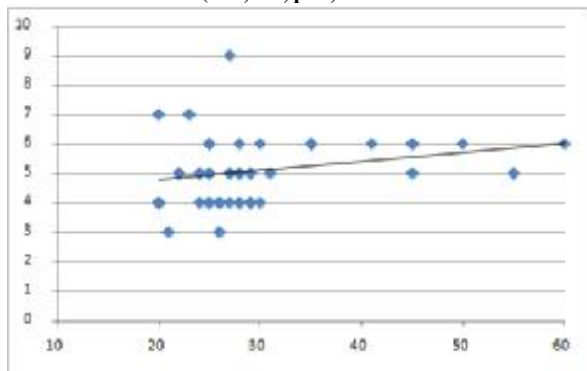


To study the correlation of right ventricular wall thickness with systolic pulmonary artery pressure and right ventricular ejection fraction (RVEF), linear correlation analysis was applied and Pearson correlation coefficient was calculated. As a result, I showed significant correlations between right ventricular wall thickness (weak and direct correlation) and pulmonary artery systolic pressure and RVEF (weak and inverse correlation).

Table no. 1. Correlations of right ventricular wall thickness

RV thickness wall with:	Forced expiratory volume (FEV)	PASP	RVEF	RV diastolic function
r	-0.190	0.260	-0.279	-0.035
p	0.142 ^{ns}	0.043 ^s	0.029 ^s	0.786 ^{ns}

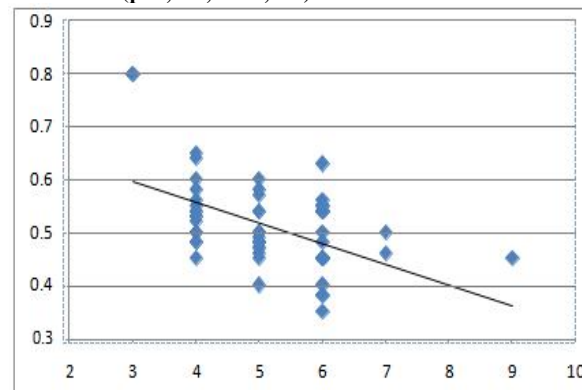
Figure no. 2. Correlations between right ventricular wall thickness and PASP ($r=0,260$, $p=0,043$)



This parameter is easy to obtain and holds an important value because in this study, as in other studies, it is significantly statistically correlated with PASP value.

It is known that the first hemodynamic consequence of pressure overload in pulmonary circulation is the right ventricular hypertrophy, dilation of cavities occurring only in the late stages of COPD. There are also known the pathophysiologic and prognostic significance of right ventricular hypertrophy, as well as the natural succession of the gradual decline of right ventricular systolic function, secondary to its morphological changes.

Figure no. 3. Correlation of right ventricular thickness wall with RVEF ($p=0,029$, $r=-0,279$)



Comparative analysis of ECG changes suggestive for chronic cor pulmonale (CCP) and right ventricular hypertrophy highlighted on ultrasound

ECG is a routine investigation, accessible and extremely useful in evaluating patients. Regarding patients with COPD, it is also widely used to highlight heart disease affection co-existence to detect ischemic changes, rhythm or conducting disorders, as well as changes suggestive of chronic cor pulmonale, such as the presence of P-wave of pulmonary type, right ventricular hypertrophy elements or right bundle branch block (RBBB), QRS axis deviated to the right or above 90°.

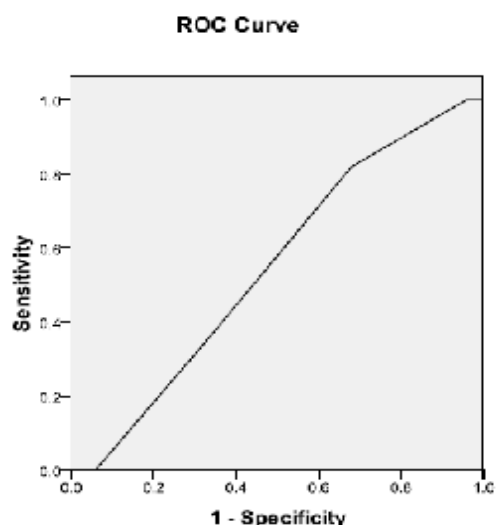
However, the low sensitivity of ECG is well known, regarding subclinical early diagnosis of chronic pulmonary heart, especially in the early stages of right heart damage. To assess the sensitivity and specificity of signs suggesting the chronic cor pulmonale highlighted on ECG (any change present, respectively the right ventricular hypertrophy and / or QRS axis over 90°) compared with the echocardiographic method to assess right ventricular hypertrophy (right ventricular wall over 5 mm), sensitivity, specificity and the area under the ROC curve were calculated.

Table no. 2. Performance of echocardiographic marker of right ventricular hypertrophy – right ventricular wall thickness and ECG signs suggestive of chronic cor pulmonale

		EKG signs suggestive of chronic pulmonary hear		Total
		YES	NO	
RV thickness	>5mm	14	7	21
	<5mm	7	33	40
Total		21	40	61

Comparative statistical analysis of ECK and echocardiographic changes

Figure no. 4. ROC and AUC curves for EKG signs of chronic cor pulmonale and right ventricular wall thickness. Area under the ROC curve is AUC=0.546



The presence of signs of chronic cor pulmonale on the electrocardiogram did not prove to be a good classifier for chronic cor pulmonale. The specificity of the method is of 83%, but sensitivity is of 67%. Although it has the advantage of being accessible, ECG cannot exclude the presence of right ventricular damage, being necessary to complete the echocardiographic method with laboratory investigations, for the early diagnosis of chronic cor pulmonale.

CONCLUSIONS

1. Echocardiographic method of diagnosing chronic cor pulmonale shows higher accuracy than the electrocardiographic method in diagnosing chronic cor pulmonale.
2. No statistically significant correlation could be established between the degree of pulmonary function impairment (COPD stage) and right ventricular wall thickness highlighted echocardiographically.
3. Right ventricular wall thickness correlated significantly with PASP and RVEF not with FEV, concluding that the emergence of chronic cor pulmonale is not strictly correlated with the degree of respiratory functional impairment, having a multifactorial determinism.

REFERENCES

1. Dudea C. Cordul pulmonar cronic – CPC Atlas de electrocardiografie clinică. 1988;1:299-309.
2. Onbasili A, Polatly M, Tekten T, Ceyhan C, Kaya M. Assessment of right ventricular functions with myocardial performance index method in patients with chronic obstructive pulmonary disease. Comparative study with healthy subjects. Eur J Echocardiography Abstracts Supplement. December; 2003.
3. Pyankov W, Chuyasova Y, Pyankova I, Kirov S. The value of Tei-index for the complex echocardiographic diagnosis of right ventricular dysfunction in patients with chronic obstructive pulmonary disease. Eur J Echocardiography Abstracts Supplement. December; 2006.
4. Bianchi M, Zuccarelli A, Castiglioni MG. Left and right ventricular diastolic function in patients with chronic

obstructive pulmonary disease. Eur J Echocardiography Abstracts Supplement. December 2003.

5. Bossone E, Bodini BD, Mazza A, Allegra L. Pulmonary Arterial Hypertension. The Key Role of Echocardiography. Chest. 2005;127:1841836.