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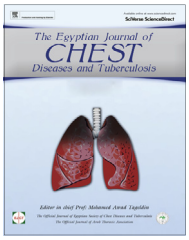

ORIGINAL ARTICLE

Evaluation of left ventricular function in patients with chronic obstructive pulmonary disease with or without pulmonary hypertension

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KEYWORDS

Left ventricular function;
Diastolic dysfunction;
COPD;
Pulmonary hypertension

Abstract *Background:* Chronic obstructive pulmonary disease (COPD) is a common entity in clinical practice. Development of right ventricular hypertrophy and eventual right side heart failure is also common in such patients. However, some disturbance in left ventricular (LV) function has been observed among such patients.

Objectives: The aim of this study was to evaluate LV function in patients with chronic obstructive pulmonary disease (COPD) with or without pulmonary hypertension.

Patients and methods: Thirty-six patients with COPD without additional cardiac diseases and 12 age and sex-matched healthy subjects were enrolled into the study. All patients underwent spirometry, standard and tissue Doppler echocardiography.

Results: 20 COPD patients (55.6%) had pulmonary hypertension. Left ventricular systolic function did not differ between patient and control groups. However the difference between both groups was significant regarding left ventricular diastolic function and left ventricular global function. Left ventricular diastolic function and global function differed significantly between different COPD grades. Patients with pulmonary hypertension had significantly higher heart rate, less E wave peak velocity (measured by DTI) ($P \leqslant 0.05$), less E/A ratio (measured by DTI) ($P \leqslant 0.01$) and E/A ratio (measured by flow) and higher myocardial performance index ($P \leqslant 0.05$) than normal pulmonary pressure patients.

Conclusion: Left ventricular diastolic function and LV global function are affected in COPD patients especially with progression of the disease. COPD patients with pulmonary hypertension

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are more liable to LV diastolic and global dysfunction than normal pulmonary pressure COPD patients. Doppler tissue echocardiography is a better tool in the assessment of left ventricular function.

Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality throughout the world. Many people suffer from this disease for years and die prematurely from it or its complications. COPD is the fourth leading cause of death in the world [1], and further increases in its prevalence and mortality can be predicted in the coming decades [2].

Pulmonary hypertension (PH) is an important complication in the natural history of chronic obstructive pulmonary disease (COPD). Its presence is associated with reduced survival and greater use of healthcare resources [3].

Cor pulmonale, which can occur in very severe COPD, is characterized by elevated pulmonary vascular resistance and right heart failure, with associated reductions in left ventricular filling, left ventricular stroke volume, and cardiac output, although left ventricular ejection fraction is generally preserved [4]. This disorder may occur as a result of various mechanisms, including loss of pulmonary vascular capacity due to parenchymal destruction, hypoxic pulmonary arterial vasoconstriction [5] and pulmonary hyperinflation with elevated intrathoracic pressure [6].

Aim

The aim of this study was to evaluate LV function in patients with chronic obstructive pulmonary disease (COPD) with or without pulmonary hypertension.

Patients and methods

This study population included 36 patients with stable COPD confirmed by medical history and pulmonary function tests who were admitted to Chest Department, Menoufiya University Hospitals in the period from May 2010 to August 2011. Twelve healthy age and sex matched persons with normal spirometry were used as a control group for comparison.

Exclusion criteria

Exclusion criteria were as follows: (1) other pulmonary diseases as pulmonary tuberculosis, bronchiectasis, interstitial pulmonary disease, etc. (2) unstable cardiorespiratory status, defined as the occurrence of respiratory failure, bronchopulmonary infection, or congestive heart failure in the previous 2 months; (3) structural diseases of the heart (valvular heart disease, congenital heart disease, and cardiomyopathy) (3) ischemic heart disease defined as typical angina pectoris, prior myocardial infarction, positive exercise test result, positive myocardial scintigraphy or positive coronary angiography findings.

Methods

After having an informed consent from all patients, every one of them underwent the following procedures: resting ECG tracing, systolic and diastolic blood pressure measurement, echocardiography and resting spirometry.

Echocardiography was performed in all patients according to the same protocol with the use of GE Vivid 5 Vingmed; Horten, Norway machine equipped with 1.5–4 MHz sector transducer probe and included the following:

(A) Conventional echocardiography

- Measurement of LV EF% by M-mode by measurement of LV systolic and diastolic dimensions obtained through long-axis parasternal approach in M-mode projection.
- LV diastolic filling patterns were determined by the mitral inflow pulsed wave Doppler examination. In the apical 4-chamber view, the Doppler sample volume was placed in the middle of LV inflow tract 1 cm below the plane of mitral annulus between the mitral leaflet tips, where maximal flow velocity in early and late diastole was recorded [7].

The diastolic parameters were measured from at least three beats and were defined as follows: *E-wave*, early maximal transmitral flow velocity; *A-wave*, peak velocity during atrial contraction in late diastole; and ratio between the early peak transmitral flow velocity (E) and late peak atrial systolic velocity (A) [E/A ratio].

- The right ventricular systolic pressure (RVSP) was obtained from the velocity of tricuspid regurgitation. (Tricuspid regurgitation velocity $\geqslant 2.9$ m/s). The value of 10 mmHg, obtained from the modified Bernoullie equation was added to the pressure gradient between the right ventricle and right atrium, as the expected right atrium v wave pressure [8]. As pulmonary stenosis was excluded in all patients, it was agreed that the RVSP value obtained, relates to the pulmonary artery pressure.

(B) Pulsed wave DTI

The pulsed wave Doppler tissue imaging (PW. DTI) was performed using the same machine. From the apical 4 and 2-chamber views, the Doppler sample volume was placed at four different sites of the mitral annulus: anterior, lateral, septal and inferior sites in order to record major velocity time intervals: IVCT (isovolumetric contraction time), IVRT (isovolumetric relaxation time) and S wave duration (ejection time).

The regional myocardial velocity waves were systolic velocity (S wave; cm/s), peak early diastolic filling velocity (E_m; cm/s) and peak late diastolic filling velocity (A_m; cm/s), also E_m/A_m ratio and E_{flow}/E_m were calculated [9].

Myocardial performance index (MPI) was calculated by the sum of isovolumic contraction time and relaxation time divided by ejection time. Mean MPI value was calculated [10].