

# Concordance between Doppler and pulsed-wave Doppler tissue imaging in estimation of the degree of left ventricular dysfunction and correlating it to the degree of chronic obstructive pulmonary disease



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**Objective:** As a consequence of leftward shift of the interventricular septum and of pericardial restraint, related to the degree of right ventricular dilation, alveolar hypoxia and related pulmonary vascular changes, left ventricular function is influenced by chronic obstructive pulmonary disease (COPD). The aim of this study was to assess the prevalence of echocardiographic abnormalities by conventional echocardiography and Doppler tissue imaging (DTI) in COPD patients according to the degree of disease severity.

**Methods:** We enrolled forty consecutive patients with COPD and twenty matched control. Twenty of the patients were suffering from mild form of COPD, twenty were suffering from severe form of COPD as decided by pulmonary function test and arterial blood gases and twenty apparently healthy non COPD control persons were subjected to echocardiographic assessment to left ventricular diastolic and systolic functions by conventional echocardiography and DTI at the mitral annulus.

**Results:** There were no significant statistical difference between the three groups as regards the age and the gender. There were significant statistical differences between the patients and the control as regards the diastolic functions of the left ventricle. E and A waves obtained by conventional Doppler and by DTI showed significant statistical difference between mild, severe forms of COPD and control subjects. The degree of diastolic dysfunction increased significantly with increase of the severity of COPD.

**Conclusion:** Left ventricular diastolic function is significantly affected in patients with COPD and the degree of affection is related to the severity of COPD.

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**Keywords:** COPD, LV diastolic dysfunction, DTI, Pulmonary function test

**Disclosure:** Authors have nothing to disclose with regard to commercial support.

Received 14 January 2015; revised 12 April 2015; accepted 17 April 2015.  
Available online 27 April 2015

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Peer review under responsibility of King Saud University.  
URL: [www.ksu.edu.sa](http://www.ksu.edu.sa)  
<http://dx.doi.org/10.1016/j.jsha.2015.04.001>



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## Introduction

Chronic obstructive pulmonary disease (COPD) is a common cause of pulmonary arterial hypertension. Increased right ventricular afterload caused by pulmonary hypertension in patients with COPD eventually leads to dilation of the right ventricle (RV), with or without hypertrophy. There are several studies demonstrating that patients with COPD have RV systolic and/or diastolic dysfunction [1,2]. Previous studies have shown that patients with COPD also have left ventricular (LV) diastolic dysfunction [3,4]. Impairment of LV diastolic filling is related to the prolongation of LV isovolumic relaxation and the impediment of rapid filling, as a result of leftward interventricular septal shift and distortion of early diastolic geometry [5,6]. Mechanisms of impaired LV filling in very severe COPD include alveolar hypoxia, related pulmonary vascular changes, and pulmonary hyperinflation. Alveolar hypoxia causes pulmonary artery vasoconstriction and vascular remodeling [7]. Inflammation is considered one of the systemic manifestations of COPD and provides an alternative hypothesis for the explanation of the relationship between airflow limitation and cardiovascular risk [8].

Doppler tissue imaging (DTI) is evolving as a useful echocardiographic tool for quantitative assessment of left ventricular (LV) systolic and diastolic function. Studies have explored the prognostic role of DTI-derived parameters in major cardiac diseases, such as heart failure, acute myocardial infarction, and hypertension. In these conditions, myocardial mitral annular or basal segment systolic and early diastolic velocities have been shown to predict mortality or cardiovascular events [9].

The aim of this study is to assess the prevalence of echocardiographic abnormalities by conventional echocardiography and Doppler tissue imaging in COPD patients according to the degree of disease severity.

## Methods

### *Patient selection*

The study included 40 consecutive patients from outpatient clinics, while the control group comprised 20 age and sex-matched, healthy subjects who were not COPD patients. COPD diagnosis was confirmed according to the guidelines established in the Global Initiative for Chronic

### Abbreviations

COPD	chronic obstructive pulmonary disease
DTI	Doppler tissue imaging
LV	left ventricle
RV	right ventricle
GOLD	Global Initiative for Chronic Obstructive Lung Disease
FEV1	Forced expiratory volume
FVC	flow-volume curves
IC	inspiratory capacity
TLC	total lung capacity
PFTs	pulmonary function tests

Obstructive Lung Disease (GOLD). COPD was categorized according to the GOLD stages, considering the Forced expiratory volume (FEV<sub>1</sub>) (% predicted) and arterial blood gas values [10,11].

Before inclusion, an informed written consent was obtained from each patient after full explanation of the study protocol. The protocol was reviewed and approved by our local institutional human research committee, which conforms to the ethical guidelines of the 1975 Declaration of Helsinki, revised in 2002.

The exclusion criteria consisted of a primary diagnosis of other respiratory diseases such as asthma, restrictive disorders, tuberculosis sequelae, or interstitial fibrosis, as well as sleep apnea/hypopnea syndrome, or lung cancer. In addition, a primary diagnosis of unstable angina, congestive heart failure (New York Heart Association class III or IV) or other chronic diseases, such as uncontrolled diabetes mellitus, kidney or liver failure and cancer, also constituted grounds for exclusion. Patients were assessed on three different days of the same week through clinical evaluations, spirometry, and echocardiogram tests.

### *Pulmonary function tests*

Pulmonary function tests (PFT) were carried out in the pulmonary function unit using the flow-volume curves (FVC). Subjects performed the FVC maneuver by inhaling fully and then exhaling as rapidly as possible; to complete the loop, subjects inhaled as rapidly as possible from the maximal expiratory level back to maximal inhalation. An arterial sample was obtained from the radial artery to perform arterial blood gases (ABGs) for measuring the arterial oxygen tension (PO<sub>2</sub>).

COPD patients were divided into two groups, each group comprising 20 patients. The study also

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