Comparative Study Between Tissue Doppler Imaging and Radionuclide Scintigraphy in Evaluation of Right Ventricular Function in Patients with Chronic Obstructive Pulmonary Disease

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in Critical Care Medicine

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Abstract

Background: Cor-pulmonale complicates 2-6/1000 of patients with chronic obstructive pulmonary disease (COPD).The early diagnosis of RV dysfunction 2ndry to pulmonary hypertension can reduce morbidity &mortality.

Aim of Work: The objective of our study is to assess the usefulness of tissue Doppler imaging (TDI) in evaluation of RV function in patients with COPD in comparison to first pass radionuclide angiography (FPRNA) which is the gold standard method. Another aim is to determine the relationship between lateral tricuspid annulus TDI parameters and PASP as estimated by continuous wave Doppler in patients with COPD.

Patients and Methods: Thirty patients with COPD diagnosed by history, clinical examination, CXR, laboratory findings (ABG, CBC), 12-lead ECG, TDI (to measure MPI, Sm, SmVTI, Em/Am), FPRNA (to measure RV EF)

Results: Based on the nuclear study (FPRNA) our 30 pts divided to 17pts (56.7%) with RVEF > 45% (55.2±1.4) and 13 pts (43.3%) with RVEF < 45% (37.7±6.2). From the 1st 17 pts, 15 pts showed by TDI, MPI < 0.7 (0.56±0.09) and Sm ≥ 12 cm/s (15.3±1.7 cm/s) and 2 pts showed MPI ≥ 0.7 Sm < 12 cm/s. From the 13 pts with RVEF < 45% (37.7±6.2) 12 pts exhibited by TTI MPI ≥ 0.7 and Sm < 12cm/s (mean 0.83±0.05 and 9.7±1.07 cm/s respectively) and one pt exhibited normal MPI and Sm. Based on the relationship between PASP measured by continuous Doppler tricuspid valve and lateral tricuspid annular velocities Sm (13.7±2.9cm/s), SmVTI (2.2±0.7), Em/Am (0.6±0.2). The correlation was r = -0.61 for Sm, r = -0.72 for SmVTI and r = -0.60 for Em/Am. The results of TDI and FPRNA in evaluation of RV function compared to clinical signs of cor-pulmonale were P-value 0.001and 0.01 respectively. Also in our study we compared between diameter of RV measured by conventional echocardiography and result of TDI in evaluation of RV function where p-value = 0.01.

Conclusion: There is significant correlation between TDI and FPRNA in the ability to detect RV dysfunction in COPD pts by a sensitivity 92.3%, specificity 88.2% and P-value = 0.001. There is a good negative correlation between PSAP measured by continuous Doppler and later tricuspid annular velocity with P-value 0.001. There is a significant correlation between result of TDI and FPRNA in evaluation of RV function compared to clinical data signs of cor-pulmonale where P-value = 0.001 and 0.01 respectively. Also there is a significant correlation between results of TDI in evaluation of RV function and diameter of RV measured by conventional echocardiography where P-value = 0.01. TDI is considered a new, easy, bedside and less expensive technique in assessment of RVEF.

Key Words: Tissue Doppler Imaging, Peak Myocardial Systolic Velocities, Myocardial Performing Index, First Pass radionuclide Angiography, Chronic Obstructive Pulmonary Disease and Cor-Pulmonale.

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Marwa El-Sayed

Contents

List of Abbreviations

2D-TDI	**:**	2 dimentional tissue doppler imaging
$4V^2$	**:**	Peak velocity at ricuspid regurgitant jet
5-HT	**:**	5 – Hydroxy tryptamine
5-HTT	**:**	5 – Hydroxy tryptamine transporter
ABG	**:**	Arterial blood gases
ACE	**:**	Angiotensin converting enzyme
AF	**:**	Atrial fibrillation
AVD	**:**	Atrioventricualr delay
CAD	**:**	Coronary artery disease
cAMP	**:**	Cyclic adenosine monophosphate
CO	**:**	Cardiac output
COPD	**:**	Chronic obstructive pulmonary disease
CPs	**:**	Countrate per second
CRT	**:**	Cardiac resynchronization therapy
CXR	**:**	Chest X-ray
DMI	**:**	Doppler myocardial imaging
ECG	**:**	Electrocardiogram
ED	**:**	End diastole
EDV	**:**	End diastolic volume
EF	**:**	Ejection fraction
Em	**:**	Early diastolic wave
eNOS	**:**	Endothelial nitric oxide synthase
ES	**:**	End systole

ESV : End systolic volume

FEV1 : Forced expiratory volume / in 1st second

FPRNA : First pass radionuclide angiography

FVC : Forced vital capacity

GERNA : Gated equilibrium radionuclide angiography

HCO3 : Bicarbonate

IL-8 : Interleukin – 8

IVCT : Isovolumetric contraction time

IVRT : Isovolumetric relaxation time

LA : Left atrium

LBBB : Left bundle branch block

LTB4 : Leukotriene B4

LV : Left ventricle

MAT : Multifocal atrial tachycardia

MI : Myocardial infarction

MM-TD : Corlor M-mode tissue doppler imaging

mPAP : Mean pulmonary artery pressure

MPI : Myocardial performance index

MVG : Myocardial velocity Gradient

PA : Pulmonary artery

PaCO2 : Arterial cabon diaoxide tension

PaO2 : Arterial oxygen tension

PASP : Pulmonary artery systolic pressure

PCWP : Pulmonary capillary wedge pressure

PE : Pulmonary embolism

PET : Positron emission tomography

PH	**:**	Pulmonary hypertension
PVCs	**:**	Premature ventricular contractions
PVR	**:**	Pripheral vascular resistance
PWP	**:**	Pulmnary wedge pressure
PW-TDI	**:**	Pulsed wave tissue doppler imaging
RA	**:**	Right atrium
RAO	**:**	Right anterior oblique
RAP	**:**	Right atrial pressure
RNV	**:**	Radionuclide angiography
RV	**:**	Right ventricular
RVEF	**:**	Right ventricular ejection fraction
RVMI	**:**	Right ventricular myocardial infarction
SaO2	**:**	Arterial oxygen saturation
Sm	**:**	Peak myocardial systolic velocity
SPECT	**:**	Single photon emission computed tomography
SV	**:**	Stroke volume
SVC	**:**	Superior vena cava
SVO2	**:**	Venous oxygen saturation
TC-99m	**:**	Technetium 99m
TDI	**:**	Tissue Doppler imaging
TNF-α	**:**	Tumor necoriss factor alfa
TR	**:**	Tricuspid regurge
VT	**:**	Ventricular tachycardia

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Introduction

Chronic obstructive pulmonary disease (COPD) is one of major causes of chronic morbidity & mortality throughout the world ***(1)***.

COPD is characterized by air flow limitation that is not fully reversible ***(1)***.

A diagnosis of COPD should be considered in any patients who have symptoms of cough, sputum production, dyspnea and / or a history as exposure to risk factors for the disease. The diagnosis is confirmed by spirometry ***(1)***.

One of the most common complications of COPD is corpulmonale. Corpulmonale is defined as an alteration in right ventricular structure & function due to parenchymal lung disease ***(2)***.

Severe pulmonary hypertension increase right ventricular after load & eventually lead to clinical syndrome of right heart failure with systemic congestion ***(3)***.

Two dimensional echocardiography is not feasible in assessment of right ventricular (RV) function. In addition two dimensional echocardiography doesn't provide haemodynamic information about right ventricular filling pressures, which can be derived from Doppler echocardiography studies ***(4)***.

Tissue Doppler imaging TDI is an extension of conventional Doppler flow echocardiography & has been proven to be useful & feasible clinical tool for assessing systolic & diastolic function since its introduction in early 1990s ***(5, 6)***. Also, it recently has emerged as a new method useful for predicting right atrial pressure and evaluation of right ventricular systolic and diastolic function ***(7, 8, 9)***.

Radionuclide ventriculography (RNV) is considered the gold standard for estimating the right ventricular ejection fraction (RVEF). Abnormal RV function in patients with COPD has been demonstrated by both first-pass & gated blood pool scanning ***(10)***.

Aim of The Work

1. The objective of our study is to assess the usefulness of tissue Doppler imaging TDI in evaluation of RV function in patients with chronic obstructive pulmonary disease in comparison to first pass radionuclide angiography FPRNA which is the gold standard method.

2. To determine the relationship between tricuspid lateral annulus TDI parameters and PASP as estimated by continuous wave Doppler in patients with COPD.

Chapter I

Chronic Obstructive Pulmonary Disease & Cor Pulmonale

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality throughout the world. COPD is currently the fourth leading cause of death in the world, and further increases in the prevalence and mortality of the disease can be predicted in the coming decades. A unified international effort is required to reverse these trends ***(1)*.**

Definition:

COPD is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases ***(1)*.**

A diagnosis of COPD should be considered in any patient who has symptoms of cough, sputum production, dyspnea, and /or a history of exposure to risk factors for the disease. The diagnosis is confirmed by spirometry. The presence of a post-bronchodilator FEV_1 <80% of the predicted value in combination with an FEV_1 /FVC<70% confirm the presence of airflow limitation that is not fully reversible ***(1)*.**

Classification of Severity:

A simple classification of disease severity into four stages is recommended. The management of COPD is largely symptom-driven, and there is only an imperfect relationship between the degree of airflow limitation and the presence of symptoms. The staging, therefore, is a pragmatic approach aimed at practical implementation and a very general indication of the approach to management. All FEV_1 values refer to post - bronchodilator effect ***(1)*.**

Stage 0: At Risk:

Characterized by chronic cough and sputum production. Lung function, as measured by spirometry, is still normal.

Stage I: Mild COPD

Characterized by mild airflow limitation (FEV_1/FVC) < 70% but FEV_1> 80% predicted) and usually, but not always, by chronic cough and sputum production. At this stage, the individual may not even be aware that his or her lung function is abnormal.

Stage II: Moderate COPD

Characterized by worsening airflow limitation (30 > FEV_1 < 80% predicted) and usually the progression of symptoms, with shortness of breath typically developing on exertion. This is the stage at which patients typically seek medical attention because of dyspnea or an exacerbation of their disease.