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Original Article

Physiology Section

Assessment of RV Function in Patients of (COPD)

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ABSTRACT

Introduction: Chronic Obstructive Pulmonary Disease (COPD) has considerable effects on cardiac functions primarily affecting the pulmonary vasculature and then right ventricle along with left ventricle. One of the important causes of increased morbidity and mortality associated with COPD is cor pulmonale. Echocardiography provides a rapid, non-invasive method to evaluate cardiac changes. Our aim was to evaluate RVfunction in COPD as per guidelines of American Society of Echocardiography with an aim to find a simpler way of predicting cardiac morbidity.

Materials and Methods: A cross sectional observational study was conducted on 17 COPD patients attending Respiratory Medicine outdoor of R. G. KAR Medical College, Kolkata, India, through history taking, clinical examination, PFT (PFT) and Echocardiography. Statistical analysis was done by using Statistical Package for the Social Sciences (SPSS) version-17.

Results: Fractional area change of RV (FAC-%) was positively correlated with Forced Expiratory Volume in One Second (FEV1) (r = 0.4879), FEV1/ Forced Vital Capacity (FVC) ratio (r = 0.5048) and Peak Expiratory Flow Rate (PEFR) (r = 0.5361). There was strong negative correlation of Systolic Pulmonary Artery Pressure (SPAP) with FEV1/FVC ratio (r = -0.5553) and PEFR (r = - 0.4604). Right Index of Myocardial Performance (RIMP) of right ventricle was negatively correlated with FEV1/FVC ratio (r = - 0.598), PEFR (r = - 0.619), Forced Expiratory Flow (FEF) 25-75 (r = -0.515). Tricuspid annular plane systolic excursion (TAPSE) did not show any association with PFT parameters though it showed strong positive correlation with RV wall thickness.

Conclusion: This study substantiates that FAC% and RIMP can be vital prognostic factors for RV function apart from SPAP, TAPSE to define RV dysfunction and predict morbidity in COPD.

Keywords: (COPD), Cardiac complications, PFT, Echocardiography, FAC%, RIMP

INTRODUCTION

(COPD) has been defined by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) as a disease state characterized by airflow limitation which is not fully reversible [1]. Measurement of lung function is the key test necessary for diagnosis of COPD but individually it is not sufficient to predict the morbidity.

COPD is a disease of increasing public health importance around the world. GOLD estimates suggest that COPD will rise from the sixth to the third most common cause of death worldwide by 2020. Presently, COPD is the fourth leading cause of death and affects >16 million people in the United States [2].

COPD is associated with significant extra-pulmonary (systemic) effects among which cardiac complications are most common. Cardiovascular disease accounts for approximately 50% of all hospitalization and nearly one-third of all deaths in cases where (FEV1) is 50% of predicted [3]. So, a timely prediction about the cardiac involvement is of immense importance.

COPD affects primarily the right side of heart and echocardiography provides a rapid, non-invasive and accurate method to evaluate the RVfunctions along with left ventricular function [3].

The purpose of our study was to evaluate the RV functions in patients of different stages of COPD by echocardiography as per guidelines of American Society of Echocardiography [4] with an aim to find a simple way of predicting cardiac morbidity in COPD.

MATERIALS AND METHODS

A cross-sectional observational study was conducted on 17 COPD patients (age >-40 years, all male) for six months. First, the diagnosis of COPD was confirmed and evaluated for staging; by history, clinical examination, and PFT (according to GOLD criteria) in the Department of Physiology and Respiratory Medicine of RGKMCH, Kolkata, India. Subsequently, all the patients have undergone echocardiography in the Department of Cardiology of RGKMCH with special emphasis on the function of the right heart. Patients with other cardiac or respiratory problems (like bronchial asthma, Pulmonary Tuberculosis (TB), lung malignancy, lung fibrosis, heart failure, myocardial infarction); very poor echo window and who were unable to perform PFTs were excluded from this study.

All the patients gave their informed consent prior to inclusion in the study and the study protocol was approved by the ethics committee of RGKMCH.

All the patients were investigated by spirometry with electronic spirometer (model: Recorders and Medicare systems [RMS] Helios 702). The PFTs parameters included were FEV1, FVC, FEV1/ FVC ratio, PEFR, FEF25-75 [5,6]. The results of the PFTs were recorded in percent of predicted values.

All the patients were subjected to echocardiography using model: ACUSON CV 70, SIEMENS, Equip ID: 1006730741.

The echocardiography parameters were RV basal, mid-level and apical diameter, RV wall thickness, right atrial major and minor dimensions, TAPSE, RIMP, FAC%, SPAP [4].

All data collected were analyzed by SPSS version-17 for mean, SD and Pearson Correlation Test.

RESULTS

Seventeen patients were recruited in our study according to the inclusion and exclusion criteria.

The demographic profile, PFT, spo2 (oxygen saturation by pulse oximetry) and RV function test data were given in terms of mean±SD in [Table/Fig-1].

All the PFT parameters were below normal limit. RV parameters

and SpO2 were within normal limit except RV wall thickness which was increased suggesting RVH without dilatation.

Correlation of PFT parameters with echocardiographic parameters were presented in [Table/Fig-2] along with scatter diagram.

Fractional area change of RV (FAC-%) was positively correlated with Forced Expiratory Volume in One Second (FEV1) (r = 0.4879), FEV1/ Forced Vital Capacity (FVC) ratio (r = 0.5048) and Peak Expiratory Flow Rate (PEFR) (r = 0.5361). There was strong negative correlation of Systolic Pulmonary Artery Pressure (SPAP) with FEV1/FVC ratio (r = -0.5553) and PEFR (r = - 0.4604). Right Index of Myocardial Performance (RIMP) of right ventricle was negatively correlated with FEV1/FVC ratio (r = - 0.598), PEFR (r = - 0.619), Forced Expiratory Flow (FEF) 25-75 (r = -0.515)

DISCUSSION

COPD is associated with significant extra-pulmonary effects among which cardiac complications are most common. The cardiac manifestations of COPD are numerous. Impairment of RV function and alteration of pulmonary blood vessels are well known to complicate the clinical course of COPD and correlate inversely with survival [3].

So far the echocardiographic parameters are concerned; MPI (Myocardial performance index) is well correlated with tricuspid regurgitation which is a manifestation of dilated right ventricle [7]. The index reflects RV impairment and the severity of impairment is proportional to the velocity of tricuspid regurgitation [8]. Other Workers measured MPI as Tei index which combines both diastolic and systolic parameters to assess global RV function [9-12].

We studied MPI by taking RIMP as RV performance indicator found similar changes as in other studies [8,10-12]. Furthermore, RIMP showed a strong negative correlation with PFT parameters except FEV1 [Table/Fig-2,3].

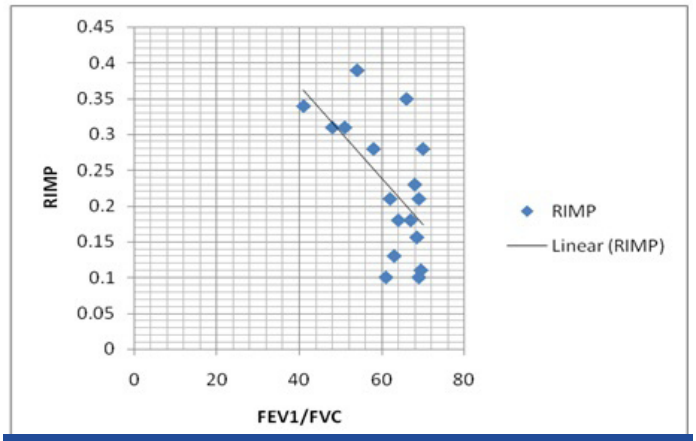
Gupta et al., showed that prevalence of Pulmonary Arterial Hypertension (PAH) has a linear relationship with severity of COPD and severe PAH is usually associated with cor pulmonale [3]. PAH is well correlated with severity of COPD in many other studies

Total No. of Patients(n)	17
Male	17
Female	0
Age (in years)	56.294±10.294
BMI(kg/m^2)	19.958±4.427
FEV1(% of predicted)	42.823±12.511
FEV1/FVC (% of predicted)	61.705±8.587
PEFR(% of predicted)	22.323±6.961
FEF25-75%(% of predicted)	16.058±6.279
FAC (%)	56.888±10.657
SPAP	35.488±10.993
RIMP	0.227±0.093
TAPSE	27.005±7.231
RV basal diameter	35.194±9.184
RV mid-level diameter	25.112±8.355
RV apical diameter	8.929±3.361
RV wall thickness	7.069±1.172
RA major dimension	37.8±7.757
RA minor dimension	35.558±9.233
SpO2	96.266±1.486

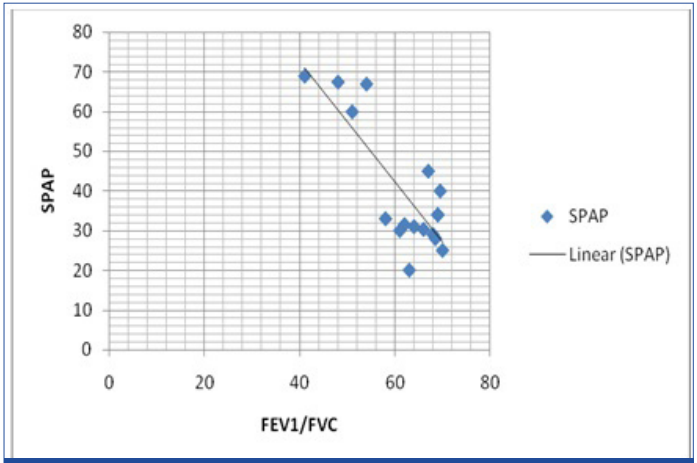
[Table/Fig-1]: The demographics, PFTs and right ventricular function tests data are given
Abbreviations: FAC%- Fractional Area Change, RIMP- Right Index of Myocardial Performance, SPAP- Systolic Pulmonary Artery Pressure, TAPSE- Tricuspid Annular Plane Systolic Excursion

Correlation of PFT Parameters With Echocardiographic parameters	Pearson Correlation Coefficient (r)			
	FEV_1	FEV_1/FVC	PEFR	FEF_{25-75}
FAC%	0.4879	0.5048	0.5361	0.3745
SPAP	-0.2917	-0.5553	-0.4604	-0.3511
RIMP	-0.336	-0.598	-0.619	-0.515

[Table/Fig-2]: Shows strong positive correlation between FAC% and FEV1 (r = 0.4879), FEV1/FVC ratio (r = 0.5048) and PEFR (r = 0.5361) but not with FEF25-75 (r = 0.3745) and strong negative correlation between SPAP and FEV1/FVC ratio (r = -0.5553), PEFR(r = -0.4604),) but not with FEF25-75 (r = -0.3511) and FEV1 (r = -0.2917). There is also strong negative correlation between RIMP and FEV1/FVC ratio (r = -0.598) PEFR (r = -0.619), FEF25-75 (r = -0.515) but not with FEV1 (r = -0.336)



[Table/Fig-3]: Shows strong negative correlation between RIMP and FEV1/FVC ratio (r = -0.598)

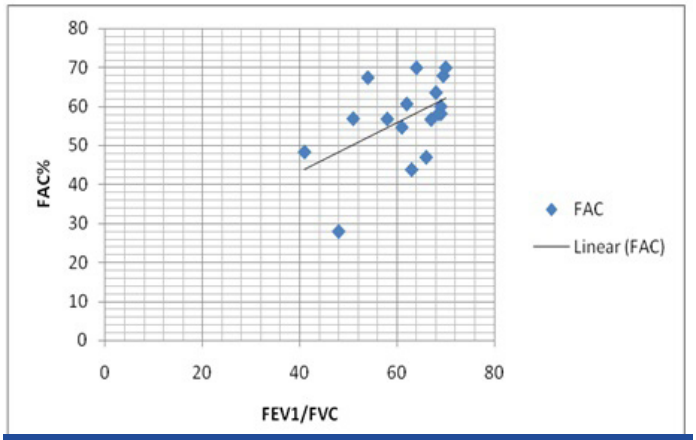


[Table/Fig-4]: Shows strong negative correlation between SPAP and FEV1/FVC ratio (r = 0.5553)

[13,14]. But resting patients of moderate COPD with oxygen saturation > 90% [15] and pao2 > 60 mm Hg [16-18] do not show pulmonary hypertension.

In our study, oxygen saturation was found to be within normal limit in all patients [Table/Fig-1]. SPAP was estimated in our study, which showed strong negative correlation with FEV1/FVC ratio and PEFR [Table/Fig-2,4] but SPAP in most of our patients (64.7%) was within normal limit.

Measurement of ejection fraction is another important criterion to define morbidity and also an important predictor of exercise capacity, mortality, etc. [19-21]. But a proper measurement requires sophisticated method like angiography, radionuclide techniques using equilibrium angiography, thermo dilution in right heart catheterization, first pass radionuclide scan by (multiple-gated acquisition) MUGA etc [19,20,22]. FAC% correlates with Right Ventricular Ejection Fraction (RVEF) measured by Magnetic Resonance Imaging MRI also [23,24].



[Table/Fig-5]: Shows strong positive correlation between FAC% and FEV1/FVC ratio (r = 0.5048)

In our study, FAC% was measured; it was used as a guide for assessing ejection fraction and was found to correlate positively with all PFT parameters except FEF25-75 [Table/Fig-2,5].

In present study, the RV diameters, wall thickness and RA dimensions were measured as per guidelines of American Society of Echocardiography (ASE) [4] [Table/Fig-1]. It shows increased RV wall thickness suggesting RVH but RV and RA dimensions were within normal limit suggesting no dilatation [Table/Fig-1]. These results showed similar changes as in other studies [16]. TAPSE was also measured in our study but it did not show any association with PFT parameters, but it showed strong positive correlation with RV wall thickness.

CONCLUSION

This study substantiates that FAC% and RIMP can be vital prognostic factors for RV function apart from SPAP and, TAPSE. Our study may be helpful to define RV dysfunction in COPD and predict cardiac morbidity in a very simple manner which will help in modification of treatment strategies in COPD. However, the study population was small and further studies with larger number of subjects with multicentric design are required for confirmation.

Future scope: Simple echocardiography as per recommendation of ASE seems to be a satisfactory tool to find out the cardiac involvement in COPD before undertaking any invasive and sophisticated methods like Modified Discrete Cosine Transform MDCT, MRI, first pass radionuclide scan, strain rate imaging, etc. in our set up and can be helpful in management of cardiac complications, treatment modification and timely intervention so that cardiac morbidity as well as mortality associated with COPD can be cut down.

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