Impact of Diabetes Mellitus on Pulmonary Function Tests in COPD Patients

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ABSTRACT

Introduction: Chronic Obstructive Pulmonary Disease is considered as a disease that goes beyond lung involvement giving it an expression of a multisystemic inflammatory disease. The association of reduced lung functions and diabetes mellitus has been described for many years suggesting that the lung could be a target organ in diabetes mellitus. In this study, we aimed to assess the pulmonary functions in chronic Obstructive Pulmonary Disease patients with normo-glycemia, Chronic Obstructive Pulmonary Disease with diabetes mellitus and diabetes mellitus patients.

Material and Methods: The study was conducted in Jubilee Mission Medical College and Research Institute, Thrissur. After the inclusion criteria were met, patients were divided into 3 groups each 20 patients. The procedure of spirometry was performed and results were analysed.

Results: Lung functions were the least in patients with Chronic Obstructive Pulmonary Disease and diabetes mellitus. Diabetes mellitus was also an independent risk factor for reduced lung functions as was seen in non smoking diabetic females.

Conclusion: Pulmonary functions are reduced in DM independent of smoking.

Keywords: Diabetes Mellitus, Pulmonary Function Test, Chronic Obstructive Pulmonary Disease.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a disease state characterized by an abnormal inflammatory response of the lungs to noxious particles or gases. The disease is usually progressive, chronic and not fully reversible with treatment. It is often associated with various co-morbidities like diabetes, hypertension, coronary artery disease, malnutrition, endocrine disorders or anxiety. COPD is considered a disease that goes beyond the lung involvement giving it an expression of a multisystemic inflammatory disease.

COPD patients have a relatively increased risk of developing diabetes mellitus (DM) and diabetic patients have an increased risk of developing COPD. This side by side development of both diseases is a result of common risk factor like smoking and also synergistic effect of systemic inflammation mediated by common cytokines.

DM affects 1.6 to 16% of subjects with COPD. Metabolic syndrome, insulin resistance and systemic inflammation constitute risk factors for decreased lung function in healthy non smoking subjects which suggest that even in the absence of smoking DM can lead to similar effects on pulmonary function. The association of reduced lung function and DM has been described for many years suggesting that the lung is a target organ in DM and that glycemic exposure is a strong determinant of reduced pulmonary function in diabetic patients. Hyperglycemia has the potential to impact the respiratory system by inducing oxidative stress, hypoxemia, systemic inflammation, structural changes in the lung tissue and altered gas exchange.[1,2]

Decrements in the lung function of patients with DM are believed to be the consequence of biochemical alterations in the connective tissue constituents of the lung particularly elastin and collagen as well as micro angiopathy due to the non enzymatic glycosylation of proteins and of the extra cellular matrix or lung parenchyma, thickening of basal lamina, increased susceptibility to infection and a modified sarcolemma with subsequent skeletal muscle weakness which are induced by chronic hypoglycemia. Diabetic micro angiopathy itself alters the alveolar diffusion capacity of the lungs[3-9] and autonomic neuropathy may affect phrenic nerves resulting in reduced muscle tone and control of the diaphragm.

In this study, we assessed the pulmonary function in normo glycemic COPD patient, COPD patients with DM and DM patients without a history of COPD

MATERIAL AND METHODS

The study was conducted in Jubilee Mission Medical College and Research Centre Thrissur. It was a case control study over a period of 5 months from March 2016 to August 2016.

A detailed case history proforma was filled out during the recruitment of patients. Twenty normoglycemic COPD patients, 20 patients with COPD and DM and 20 diabetic patients were included in the study.

Inclusion Criteria

Patients already on treatment for COPD by a chest physician or newly diagnosed COPD patients based on post bronchodilator FEV1/FVC < 0.7 on spirometry with or without DM. Patients with DM already on treatment or newly detected patients with FBS ≥126 mg/dl without a history of COPD.

Exclusion Criteria

Patients aged more than 80 years, those having a history of bronchial asthma, interstitial lung disease, concomitant lung cancer, present or past history of tuberculosis, decompensated cardiac disease and patients not willing to participate in the study were excluded from the trial.

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The procedure of spirometry was explained to the patient. Anthropometric measurements and other details were recorded. The procedure was done using a computerized vitalograph series following the principles of spirometry in a sitting position. Hexokinase method was used to measure the blood sugars and the analysis was done by Olympus AU 400. HbA1C was measured by HPLC method and the instrument used was Bio RADD-10.

STATISTICAL ANALYSIS

Data thus obtained was analyzed by unpaired t test and ANOVA using the statistical software namely SPSS.

RESULTS

The study included 60 patients who were categorized into 3 groups.

1. Group 1-COPD patients
2. Group II-COPD with DM
3. Group III-DM patients

Maximum patients were in the age group of 61-70 years showing that COPD commonly affects the elderly population. The COPD severity distribution in the three groups is shown in figure 1. According to the GOLD (Global Initiative for Chronic Obstructive Lung Disease) grading system for COPD based on post bronchodilator FEV1, lung functions were found to be normal or near normal in 75% of DM patients (group II). Very severe and severe COPD patients were seen in group II that is COPD with DM. Though, the first group was suffering from COPD, patients with severe disease were seen in a few patients clearly indicating that DM has a detrimental effect on the lung functions.

Table 1 shows that group II patients (COPD with DM) had relatively higher sugars and HbA1C levels are compared to group III (that is DM) alone indicating that systematic inflammation, metabolic syndrome and corticosteroid therapy quite often used in COPD patients could induct a diabetic state in such patients. Table 2 shows that lung functions were reduced in group II patients (COPD with DM) as compared to group I and group III patients. It could be interpreted that presence of DM worsens the lung functions including FVC, FEV1, FEV 25-75 and PEF and pushes the COPD patients to the next severity stage. COPD and DM act as double edged sword in reducing the lung functions as is seen in table 3 proving that lung is a target organ for damage patients with DM. Group 2 patients had lowest lung functions followed by group 1 and lastly by group 3.

DISCUSSION

In this study, we tried to associate the lung function in COPD with DM patients. Our study shows that lung functions were much affected in group II than group and III. Irfan *et.al*, studied PFT in diabetics and showed that there was a significant

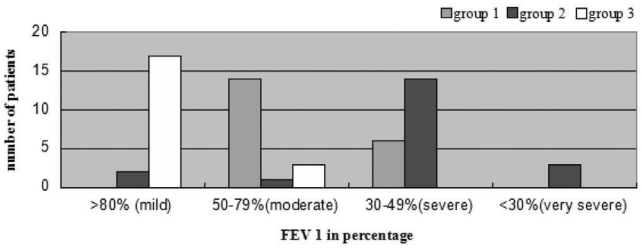

Figure-1: COPD severity distribution in 3 groups

Parameter	COPD (Mean±SD)	COPD with DM (Mean±SD)	DM (Mean±SD)	*P* value
RBS(mg/dl)	-	233.1±49.52713	230.73±36.87521	0.014
FBS(mg/dl)	-	124.65±13.6122	122.9286±16.07418	0.037
HbA1C	5.7±0.56	7.9±1.89	7.64±1.55	0.001

Table-1: Glycemic status in 3 groups

Parameters	Males			Females		*P* value
	COPD (Mean±SD)	COPD with DM (Mean±SD)	DM (Mean±SD)	COPD with DM (Mean±SD)	DM (Mean±SD)	
FVC pre(L)	1.83±0.36	1.39±0.29	3.06±.093	1.12±0.30	1.93±0.36	0.001
FVC post(L)	1.93±0.45	1.56±0.37	3.16±0.94	1.26±0.42	2.05±0.41	0.001
FEV1 pre(L)	1.17±0.27	0.81±0.22	2.64±0.73	0.72±0.24	1.64±0.33	0.001
FEV1 post(L)	1.25±0.30	0.88±0.22	2.78±0.83	0.79±0.35	1.77±0.32	0.001
FEV1/FVC pre	0.64±0.09	0.58±0.10	0.88±0.07	0.63±0.05	0.84±0.05	0.001
FEV1/FVC post	0.65±0.11	0.57±0.12	0.88±0.57	0.61±0.007	0.87±0.054	0.001
PEF pre(L/Min)	249.15± 67.14	166.23±58.51	409.89±212.65	125±24.75	283.16±90.8	0.001
PEF post(L/Min)	264.78± 68.21	174.7±58.51	447.89±212.65	144.66±23.69	296.60±87.57	0.001
FEF 25-75(L/s)pre	0.74±0.24	0.50±0.22	3.41±0.82	0.44±0.19	2.11±0.78	0.001
FEF 25-75(L/s)post	0.85±0.34	0.54±0.23	3.96±1.02	0.46±0.25	2.33±0.69	0.001

Table-2: Comparison of lung function in 3 groups

Mean Values	Group 1 (COPD)	Group 2 (COPD with DM)	Group 3 (DM)	ANOVA P value
Duration of COPD in years	6.45	10.56	-	-
Duration of Diabetes in years	-	11.2	6.525	-
Lung function (FEV1 in percentage)	57.3	46	98.95	0.0001***
***Significant P value <0.001				

Table-3: Co-relation of COPD, DM and FEV1 (%)

reduction in FVC, FEV1.[7] They also stated that impaired lung function was independent of smoking and is likely to be a complication of DM itself. Davis et.al also showed that reduced lung volumes are the result of chronic complications of DM and is related to glycemic exposure.[10] Kaminsky has opined that lung function is an important marker of increased mortality in diabetic patients.[11]

Pathophysiology of reduced lung function is still an interesting research issue. Normal lung mechanics and gas exchange are influenced by the integrity of pulmonary vasculature and connective tissue. In a study by Mahmoud,[9] it was found that the alveolar epithelium, capillary endotheluim and basal laminae were thickened on election microscopy when compared with the controls. In addition, thickening of the basal laminae was of the same magnitude in lung and kidney favouring that diabetic microangiopathy existed in the pulmonary vascular bed. The origins of pulmonary function impairment in DM are thought to derive from four primary sources: non enzymatic glycosylation of lung collagen and elastin by advanced glycosylation end products (AGES) generated by disrupted glycemic control resulting in reduced elasticity of the lung. Pulmonary microcragropathy reducing the diffusion capacity and autonomic neuropathy affecting the phrenic nerves and the diaphragm have also been observed. Finally hyperglycemia resulting in frequent infective exacerbations also is associated with poor outcome.

This study showed that lung function in terms of FEV1, FVC, FEV1/FVC, FEF 25-75 were the least in COPD with DM group than DM group. This study has certain limitations though. The study size was small and we cannot analyze the result in different ethnic group. The PFTs were not repeated to access the changes of pulmonary function among the same subjects over a period of time.

It has been shown that DM is associated with continuing damage, dysfunction and failure of various organs including the lungs. Indeed it seems prudent to add the spirometry to the tools available for monitoring DM and important sequelae.

CONCLUSION

We conclude that COPD with DM patients showed a decrease in PFT values compared to the other two groups. The findings of the study proved that lung is a target organ for damage in DM and that the glycemic exposure is a strong determinant of reduced pulmonary function in type 2. Pulmonary functions are reduced in DM independent of smoking as was seen in the female non smokers. As pulmonary dysfunction may be one of the earliest and early measurable non metabolic alterations in DM, patients with DM are suggested to undergo PFT along with other investigations. It is advisable therefore, that diabetic patients must undergo periodic spirometry tests to assess the severity of lung function impairment. These measures will help in preventing lung damage in initial stage and thus contribute to reduction in morbidity and mortality of these patients.

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