Original Research Article

Left ventricular dysfunction in chronic obstructive pulmonary disease

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Abstract

Introduction: The prevalence of LV dysfunction is probably high in COPD patients because this condition shares common risk factors. The diagnosis of left heart failure is difficultin the early phases of COPD and also during exacerbation due to similarities in signs and symptoms. Bio-markers like hsCRP is found to be elevated in stable phase as well as in exacerbation of COPD. **Objectives:** To assess LV Dysfunction (Systolic and Diastolic) and to correlate Age, Symptoms, Duration and stage of illness, CRP with LV Dysfunction. **Methods:** Total 100 patients of which 50 were age and sex matched controls not having COPD complying with Inclusion and Exclusion Criteria. After taking history and clinical examination they were evaluated for COPD and Left ventricular Dysfunction using PFT and Echocardiogram. **Results:** Out of 50 patients, 37 patients (74%) had Diastolic dysfunction, of them 2 patients had Systolic dysfunction also. 13 patients were normal. In the control group only 4 had Diastolic Dysfuncion.CRP was high in 35% (70%) of patients. In the higher age group of 50-60 years Diastolic dysfunction was significant. In patients of GOLD stage IV 5 out of 5 patients (100%) whereas in GOLD stage I and II it was in 1 case (16.66%) and21 case (80.76%) respectively. While comparing with the control group incidence of LV dysfunction parameters and CRP is more in case group. **Conclusion:** There is increased incidence ofLV Diastolic dysfunction and also with advanced GOLD stage. CRP also correlates well LVDD. Therefore it is pertinent to explore LVDD in all patients with acute exacerbation of COPD and advanced disease stage.

Keywords: COPD, Left Ventricular Dysfunction, Diastolic Dysfunction.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of Chronic Morbidity and Mortality worldwide. It is the fifth leading cause of death world wide [1]. Acute exacerbation of COPD (AECOPD) accounts for large amounts of the Morbidity and Mortality attributed to COPD [2]. AECOPD refers to the exaggeration of COPD symptoms: aggravation of dyspnoea, an increase in expectoration volume, and a change in the appearance of sputum which becomes purulent [3]. Although dominated by bacterial or viral infection, etiologies of AECOPD remain unrecognised in as much as one third of these patients [4].

Added to this, acute left ventricular (LV) dysfunction is suspected as a cause of exacerbation in many such patients. Never the less in many of these situations LV dysfunction might be associated without being the cause of the exacerbation. Yet a diagnosis of LV dysfunction in patients with dyspnoea is challenging to the emergency department physicians, because bed side clinical assessment has a poor performance record and cardiac function test with enough accuracy to diagnose (in particular echo-cardiography) are not always possible because they are unavailable or difficult to interpret [5]. The prevalence of LV dysfunction is probably high in COPD patients because this condition shares many risk factors with coronary disease: age, male predominance, cigarette smoking and so on [6].

The diagnosis of left heart failure is fraught difficult notably in the early phases of COPD and also during exacerbation due to similarities in signs and symptoms. Importantly co-existence of COPD and heart failure is plausible in view of overlap of risk factors: notably smoking. Echocardiography is essential for establishing

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the diagnosis of heart failure. Accessibility to this diagnostic facility however is limited for primary care patients and echocardiography is not a part of the standard investigational protocol of pulmonologists. It seems therefore plausible that a considerable proportion of patients with a diagnosis of COPD have concomitant heart failure which remains unrecognized by primary care physicians or pulmonologists. In addition, due to similarities in symptoms some COPD patients may be misclassified and in fact have heart failure. Earlier studies suggested that the use of pulmonary medication often coincides with unrecognized heart failure [7,8].

The prevalence of heart failure can be as high as 20% – 30% in those COPD patients who are referred for acute exacerbation. [9,10]. However information is lacking on the prevalence of left heart dysfunction as a cause of left heart failure in the much larger population of patients with stable COPD. Development of right ventricular hypertrophy and eventual right heart failure is also quite common in patients of COPD. However, some disturbance in left ventricular function has been observed by several workers among such patients. The present study is undertaken with a view to determine the degree of disturbance in left ventricular function if any, among patients of COPD. Bio-markers like hsCRP is found to be elevated in stable phase COPD patients and Brain Natriuretic Peptide (BNP) and amino terminal Pro-brain Natriuretic Peptide have been shown to perform well in distinguishing between dyspnea of cardiac origin and dyspnoea of pulmonary causes in patients attending emergency department [11-16].

However extrapolation of these results to the specific context of AECOPD is not straight forward because BNP secretion might be secondary to left ventricular stress or right ventricular stress. [17,18].

In this study we have also tried to find out the prevalence of raised CRP in those patients of COPD with LV dysfunction. Traditional texts and review articles suggest that dyspnoea due to COPD can be readily distinguished from LVF by clinical, radiographic and spirometric abnormalities. COPD may obscure clinical signs of LVD, both disorders may produce paroxysmal nocturnal dyspnoea, orthopnoea and cough.

Radiographic and clinical findings of pulmonary congestion and cardiomegaly may be obscured by large barrel chest and hyper-inflated lungs of patient with emphysema. Evidence of airway obstruction and a bronchodilator response on pulmonary function test is found not only in COPD, but also in acute congestive failure [19-21]. Hence in this present study we tried to show the prevalence of LVD co-existent with COPD in the absence of factors known to produce LVD.

Objectives

1.To assess LV Dysfunction(Systolic and Diastolic).

2.To correlate Age, Symptoms, Duration and stage of illness, CRP with LV Dysfunction.

Methods

a) Study Type: Cross-sectional Analytical Study.

b) Sample Size: 100 patients with Left ventricular Dysfunction were enrolled.

c) Sampling Technique: Consecutive Non-probability sampling technique used.

d) Inclusion Criteria: Any patient with COPD between 50 – 65yrs. The upper age limit is 65 yrs since above that; sizeable number of otherwise normal persons can develop diastolic dysfunction.

e) Exclusion Criteria: Acute myocardial infarction within 6 weeks, Severe congestive cardiac failure, Hypertension, Diabetes, Valvular Heart Diseases, Known patient of Cardiomyopathy.

f) Procedure: After taking approval from Hospital ethical Committee, written informed consent were taken from patients. 50 patients with COPD admitted in Medicine Indoor and 50 age and sex matched patients not having COPD were enrolled in this study. A detailed history followed by clinical examination were documented as per proforma. PFT, Chest X-ray, ECG, Echocardiogram to document Systolic and Diastolic Dysfunction and CRP in blood examination were done. Transthorasic Echocardiogram was done wherever necessary. Echocardiographic analysis

The echocardiograph device was an Envisor C model (Philips Medical Systems, Andover, Massachusetts, USA) equipped with a 2.0–4.0 MHz probe capable of capturing second harmonic, tissue, pulsed, continuous and color Doppler traces, as well as one- and two-dimensional mode images. With participants positioned in left lateral decubitus and monitored using an electrocardiographic lead, the following Echocardio-graphic cuts were performed: short parasternal axis to measure ventricles, aorta and left atrium and apical two, four and five chambers to evaluate cavities and systolic and diastolic functions of ventricles. All of the

measurements were performed in accordance with the American Society of Echocardiography/ European Association of Echocardiography recommendations. An average of three measurements was calculated for each variable.

The left ventricular (LV) mass (LVM) was calculated according to the following formula: LVM= 0.8× {1.04× [(LVDD+IVSDT+PWDT)3-LVDD3]}+0.6, where LVDD, IVS and PWDT represent the LV diastolic diameter, interventricular septum and posterior wall thickness, respectively. The left ventricular systolic function was evaluated by measuring the ejection fraction (EF) according to the Teichholz method.

The LV diastolic function was evaluated by measuring the early (E wave) and late (A wave) diastolic mitral inflow velocities, their ratio, the E wave deceleration time (EDT) and the isovolumic relaxation time (IVRT).

Results

Table 1: Diastolic dysfunction in cases vs controls.

2	No of patients having Diastolic dysfunction		percentage
50 (cases)	37		74%
50 (controls)	04		8%
CRP			
	No of patients		**Percentage**
>0.60	35		70%
<0.60	15		30%
GOLD Stage & Diastolic dysfunction			
	N0 of patient	**DD**	**Percentage**
1	6	1	16.66%
2A	26	21	80.76%
3	13	10	76.92%
4	5	5	100%
CRP &Diastolic dysfunction			
	N0 of patient	**DD**	**Percentage**
>.60	35	34	97.14%
<.60	15	3	20%
CRP in cases and controls			
Cases (Mean+/-SD)		Controls (Mean+/-SD)	P Value
0.699+/-0.184		0.414+/-0.063	<0.001

In our study, we found that Diastolic dysfunction is a significant occurrence in the case arm than among control arm.CRP is also significantly raised in COPD patients (p value<0.001) and in patients having raised CRP have diastolic dysfunction too (p value 0.0000 i.e<0.05).Comparing the presence of diastolic dysfunction in early stage i.e. 1 and in advanced stage i.e. 4 we find that the association between stage 4 disease and diastolic dysfunction is significant (P = 0.0057 i.e. < 0.05).

Table 2: Various parameters of LV Functions in cases vs controls

Indices of LVD	Cases (Mean+/-SD)	Controls (Mean+/-SD)	P Value
E/A	0.964+/-0.257	1.218+/-0.135	<0.001
DT	242+/-14.424	230.44+/-8.836	<0.001
IVRT	94.2+/-9.029	80.88+/-7.862	<0.001
EF	60%+/-0.062	60%+/-0.029	>0.001

We find that each parameter of DD (E/A, DT, IVRT) to be abnormal in the case group we find that each parameter of DD is significant (P < 0.001) in the case group, whereas parameter of SD (EF) is not significant (P > 0.001).

Discussion

In the present study we have found presence of LVD in COPD patients and have found that majority of them have Diastolic dysfunction and that it is a significant occurrence ($p < 0.001$) in them. In our study, also we got diastolic dysfunction in the control group; however comparing two groups we found DD is more prevalent in patients with COPD.

In our study we found dyspnoea to be the predominant symptom. Although some studies indicate a weak relationship between the symptoms of dyspneoa and indicators of disease severity (FEV, LVEF)[22-24], there also exist some other studies which indicate that no relationship is evident between them [22,25,26]. We too did not find any significant association between this predominant symptom of dyspneoa and DD ($p > 0.05$).

Funk GCet alreported that the maximal atrial filling velocity was increased and the early filling velocity was decreased in patients with COPD compared to control subjects [27]. The early flow velocity peak/late flow velocity peak (E/A) ratiomarkedly decreased in patients with COPD compared to control subjects (0.79 + 0.035 vs 1.38 + 0.069, respectively; $p < 0.0001$), indicating the presence of left ventricular diastolic dysfunction. The atrial contribution to total left diastolic filling was increased in patients with COPD. This was also observed in COPD patients with normal PAP, as ascertained using a right heart catheter. The atrial contribution to total left diastolic filling was further increased in COPD patients with higher PAP. PAP correlated with the E/A ratio ($r = -0.85$; $p < 0.0001$).

In our study also, early flow velocity peak/late flow velocity peak (E/A) ratio was markedly decreased in patients with COPD compared to control subjects (cases 0.964 +0.257 vs. controls 1.218 +0.135 respectively; $p < 0.001$) and the values of DT and IVRT were increased in them compared to control subjects (cases 242 + 14.424 vs. controls 230.44 +8.836 and cases 94.2 + 9.029 vs. controls 80.88 + 7.862respectively; $p < 0.001$)

In our study too we founda trial contribution to total left diastolic filling was further increased in COPD patients with higher PAP as we saw the occurrence ofP Pulmonale, an ECG marker of pulmonary hypertension to be significant in the cases having DD ($p<.05$). Suchoń Eet alreported in COPD patients LV diastolic function is significantly impaired and its magnitude is related with increase in pulmonary artery pressure, while systolic LV function is well preserved [28]. In our subset of patients we observe that there is increase prevalence of DD but only in two patients we got systolic dysfunction (SD) which is not significant statistically. As we have excluded patients with known myocardial infarction, ischaemic heart disease, dilated cardiomiopathy, so cause of SD in these two patients cannot be confirmed. To find out hidden ischaemic heart disease or myocardial disease, cardiac catheterization, coronary angiography or myocardial biopsy were necessary but these procedures were out of our reach. Regarding patients who have echo proved DD, we found DD is more prevalent in the higher age group, however since age related myocardial changes occur in normal person's without COPD, and age related increased occurrence were reported in the case arm also.

DD is more prevalent in our study in patients whose duration of symptoms was more than 5 years. This observation is significant ($p < 0.05$) among the cases. DD is found to be more prevalent in those who presented with predominant dyspnoea. However statistical analysis fails to show any significant association between symptom nature and DD ($p > 0.05$)

Another salient feature in our study is that significant occurrence of DD in the advanced stage of COPD i.e. GOLD STAGE IV than in early stage of the disease i.e. GOLD STAGE I, probably higher presence of pulmonary hypertension and right ventricular strain by the virtue of inter ventricular dependence accounts for this observation.

In our study we found raised CRP, is a significant occurrence among DD patients in the case arm. However, though traditional studies depict hsCRP to be raised in COPD patients due to scarcity of resources we used ordinary CRP as an alternative. Raised CRP in the COPD patients in our study is not solely due to chest infection in these patients since initially they were all stabilized with nebulization and antibiotics; they represent an inflammatory nature of the disease itself and a plausible cause of their significant association with DD may be the contribution of this inflammatory process in atherogenesis thereby giving rise to microvascular ischemia to the cardiac muscle.

Kirsten Jörgensenet al **reported** LV in patients with severe emphysema is hypovolemic,and operates on a steeper portion of the LV function curve,while indices of systolic function are not significantly impaired compared to non-emphysematous controls.

A. K. Poddar et al [29]. Reported parameters of LVD like MRCF, EF, FS were depressed in the subset of patients of COPD with Corpulmonale and overt right heart failure while in patients of COPD with Corpulmonale only the parameters of LVD were intact. **However, our finding is that** diastolic dysfunction is present in majority of patients of COPD without any features of overt failure i.e in stable phase COPD.

Conclusion

Left ventricular diastolic dysfunction is significantly present in COPD patients more in those with Older age, Long symptom duration, Advanced stage of disease, Pulmonary hypertension and Raised CRP level.

Facts regarding raised CRP level: It is nothing new to know that, COPD is a systemic and inflammatory disease. Like any other inflammatory disease, CRP is also raised in our study. The inflammation is giving rise to atherogenesis and microvascular ischaemia leading to diastolic dysfunction. This data only reinforces the current knowledge of association between raised CRP, inflammation and microangiopathy.

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