Left ventricular dysfunction in patients with chronic obstructive pulmonary disease (COPD)

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ABSTRACT

Background

Chronic obstructive pulmonary disease (COPD) is a common disease with a rising global incidence. It is recognized as a chronic inflammatory condition with multisystem involvement. Among its associated comorbidities, cardiovascular disease (CVD) is particularly significant, contributing to increased morbidity and mortality in COPD patients. The purpose of the study was to determine the prevalence of left ventricular (LV) dysfunction in stable COPD patients.

Method

This cross-sectional study was conducted at department of Chest Medicine, Jinnah Postgraduate Medical Centre, Karachi, Pakistan, enrolled 85 COPD patients aged 40-70 years with over six months' disease duration. Spirometry evaluated COPD severity; echocardiography assessed left ventricular dysfunction. Data were analyzed using SPSS-19 (descriptive statistics, chi-square; p≤0.05).

Result

The study included 85 COPD patients 61 (71.8%) were males and 24 (28.2 %) females. The mean age of the patients was 59.01 ±7.62 years. Mean duration of COPD was 7.17±5.58 years. Echocardiography revealed left ventricular (LV) systolic dysfunction in 12 patients (14.1%), showing a significant association with advanced age (p = 0.01). LV diastolic dysfunction was identified in 33 patients (38.8%), with males exhibiting a higher prevalence compared to females (p = 0.033). Disease duration showed no significant correlation with LV dysfunction outcomes.

Conclusion

The results show that LV dysfunction is quite common in COPD patients, and it is especially associated with advanced age, male gender, and the severity of the disease. Because early diagnosis of left ventricular dysfunction may enhance risk classification and treatment approaches, these findings highlight the significance of routine cardiovascular screening.

Keywords: COPD, Spirometry, Systemic Inflammation, Cardiovascular Disease

Introduction

COPD is a common disease with a rising global incidence with the global burden of disease that ranked sixth as the cause of death in 1990[1]. It has become the third leading cause of death in the world since 2019[2]. COPD is recognized as a chronic inflammatory condition with multisystem disease. The mechanisms by which COPD increases risk for cardiac disease were not established, but systemic inflammation may play a role in the pathogenesis of disease. Cardiovascular disease is a major co morbidity and is the most frequent and most important disease coexisting with COPD[1]. Congestive heart failure contributes to a large number of mortality and morbidity in the world[2,3]. In the Cardiovascular Health Study, the prevalence of overall cardiovascular disease (defined as ischemic heart disease, heart failure, stroke and/or transient ischemic attack) in COPD patients was found to be 20–22% compared with 9% in

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subjects without COPD[4]. Reduced lung function as well as reduced physical activity further contribute to increased cardiovascular disease in COPD patients[5,6]. There were some common etiological and epidemiological factors, particularly tobacco use and male gender[7,8]. Hypoxemia, especially in the more severe group, can lead to significantly higher blood pressure and hence cardiovascular disease[9]. In prospective study by Macchia et al. the prevalence of airway obstruction among CHF patients was 37.3% and the prevalence of LV dysfunction among COPD patients was 17%[8].

Material and methods

This cross-sectional study was conducted at the Department of Chest Medicine, Jinnah Postgraduate Medical Centre, Karachi, Pakistan, over a six-month period from March to September 2014. A total of 85 patients were recruited using convenience sampling. The sample size was calculated using the Raosoft online calculator (www.raosoft.com/samplesize.html), based on a 95% confidence interval, 8% margin of error, and an expected prevalence of left ventricular (LV) dysfunction of 17%.

Patients aged between 40 and 70 years with a confirmed diagnosis of chronic obstructive pulmonary disease (COPD), as defined by spirometric criteria, and a disease duration of more than six months were eligible for inclusion. Patients were excluded if they had a known history of congenital heart disease, rheumatic or valvular heart disease, or any coexisting respiratory condition such as bronchiectasis, lung cancer, or obstructive sleep apnea. Those with a poor echocardiographic window were also excluded.

COPD was diagnosed based on a post-bronchodilator FEV1/FVC ratio of less than 70%. The severity of airflow obstruction was categorized as mild (FEV1 ≥ 80% predicted), moderate (FEV1 50–79%), severe (FEV1 30–49%), and very severe (FEV1 < 30%). LV dysfunction was assessed using two-dimensional transthoracic echocardiography. Systolic dysfunction was defined as a left ventricular ejection fraction (LVEF) of less than 40%, while diastolic dysfunction was identified based on echocardiographic findings in patients with preserved LVEF (>40%).

Data were collected using a structured proforma. Patient demographics, including age, gender, and duration of COPD, were recorded along with spirometry results. Echocardiographic evaluations were performed by a cardiologist during outpatient visits. Informed written consent was obtained from all participants, and ethical approval was granted by the institutional review board prior to the start of the study.

Data were analyzed using SPSS version 19. Continuous variables such as age and duration of illness were presented as means with standard deviations, while categorical variables including gender, age group, COPD severity, LVEF, and presence of diastolic dysfunction were expressed as frequencies and percentages. Stratification was performed by age, gender, disease duration, and COPD severity to control for effect modifiers. Associations between categorical variables were assessed using the Chi-square test, with a p-value ≤ 0.05 considered statistically significant.

Results

A total of 85 diagnosed cases of COPD (61 males, 24 females) were included in the study (Figure 1). The mean age of the participants was 59.01 ± 7.62 years, with 48 patients aged ≤60 years (Figure 2). The mean duration of COPD was 7.17 ± 5.58 years. Spirometry-based classification of COPD severity revealed mild cases in 2 (2.4%) patients, moderate in 34 (40%), severe in 38 (44.7%), and very severe in 11 (12.9%) (Figure 3).

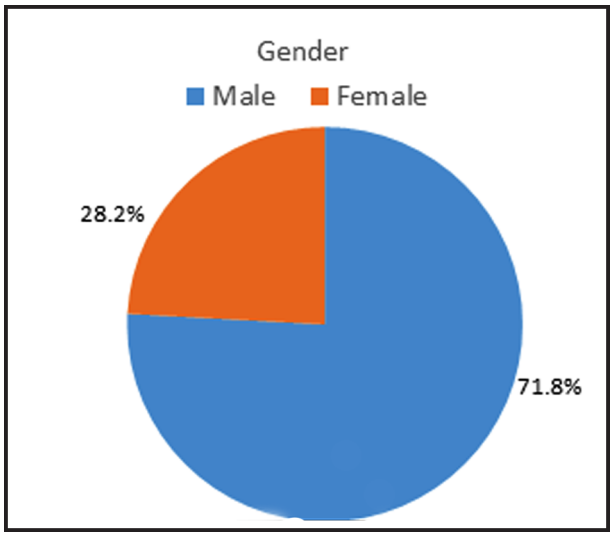

Figure 1: - Gender distribution

Left ventricular ejection fraction (LVEF) ≤40% was observed in 12 patients (14.1%), with a statistically significant reduction noted in older adults (p=0.01, Table 1). Left ventricular diastolic dysfunction (LVDD) was present in 33 patients (38.8%) and was more prevalent among males (28 males vs. 5

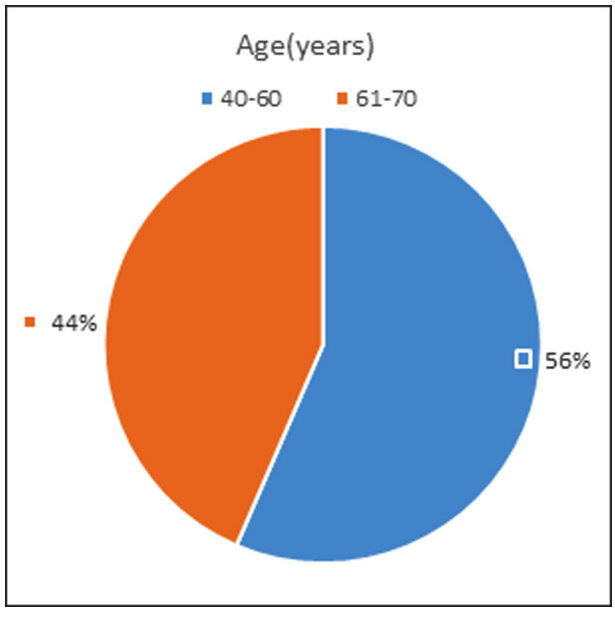

Figure 2: - Age distribution

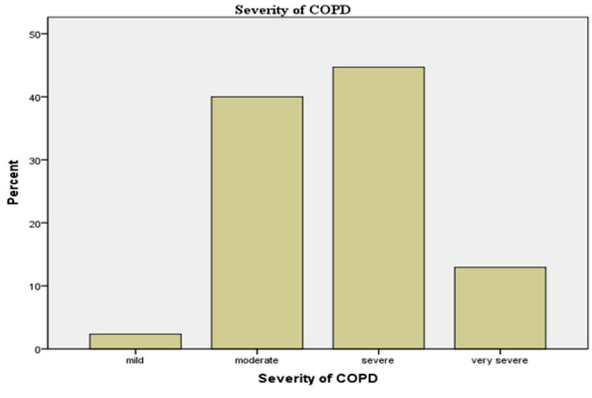

Figure 3: Severity of COPD

females, p=0.033, Table 2). Overall left ventricular dysfunction (LVD) was identified in 37 patients (43.5%) and showed significant associations with older age (p=0.037, Table 1), male gender (31 males vs. 6 females, p=0.031, Table 2), and severe COPD (p=0.004, Table 3). No significant association was found between LVD and the duration of COPD.

Table 1: Age and prevalence of LV dysfunction

		Age		Total- n (%)	p-value
		40-60	61-70		
LVEF	≤40%	3	9	12 (14.1%)	0.01
	>40%	45	28	73 (85.9%)	
LVDD	Yes	14	19	33 (38.8%)	0.032
	No	34	18	52 (61.2%)	
LVD	Yes	16	21	37 (43.5%)	0.037
	No	32	16	48 (56.5%)	

Table 2: Gender and prevalence of LV dysfunction

		Gender		Total- n (%)	p-value
		Male	Fe-male		
LVEF	≤40%	10	2	12 (14.1%)	0.33
	>40%	51	22	73 (85.9%)	
LVDD	Yes	28	5	33 (38.8%)	0.033
	No	33	19	52 (61.2%)	
LVD	Yes	31	6	37 (43.5%)	0.031
	No	30	18	48 (56.5%)	

Table 3: Severity of COPD and LV dysfunction

		Severity				Total n (%)	p-value
		Mild	Moderate	Severe	Very severe		
LVEF	≤ 40%	0	1	6	5	12(14.1%)	0.005
	>40%	2	33	32	6	73(85.9%)	
LVDD	Yes	1	8	19	5	33(38.8%)	0.13
	No	1	26	19	6	52(61.2%)	
LVD	YES	1	8	21	7	37(43.5%)	0.004
	No	1	27	17	3	48(56.5%)	

Discussion

It is generally known that pulmonary hypertension and, eventually cor-pulmonale are frequently caused by COPD. Alterations in right ventricular function may influence left ventricular performance due to their shared pericardium and interventricular septum.

Furthermore, hypoxia and chronic inflammation due to COPD also contribute for left ventricular dysfunction. Several studies have confirmed the hypothesis that COPD is an independent risk factor for heart disease. Prevalence of cardiovascular diseases is 2-3 times higher in COPD patients than population without COPD[6].

Different study showed Prevalence rates of left ventricular systolic dysfunction in patients with COPD range from 4 to 32%[10]. In this study 14% patient had reduced left ventricular systolic function which was significantly higher in elderly population and people having severe COPD. It is comparable with a prospective cohort study done by Macchia et al., in which spirometry-confirmed COPD (n=218) were included, 13% patient had LV systolic dysfunction but that was done on older age group; on contrary to our study only 3% patient had LVDD and 17% had overall LV dysfunction[9]. In a study done in India, LV systolic dysfunction was present in 3.2% of all COPD patients and its severity increases with level of severity of COPD. LV diastolic dysfunction was more common than systolic dysfunction[11]. In general population, despite the underlying risk factors, only 2% had reduced systolic function[15]. So, we can make an impression that COPD is an independent risk factor for LV systolic dysfunction.

This study showed very high prevalence of LVDD i.e. 38.8% patients and it was significantly higher in male population. In a cross-sectional study done by Redfield et al. in community, 28% of the population had diastolic dysfunction[12]. This study also shows that overall, 43.5% had LV dysfunction. Other published papers reported a prevalence of ventricular dysfunction in patients with COPD ranging from 9 to 52%[13].

individuals with COPD with ventricular dysfunction have a risk of death that is more than twice as high as that of individuals without ventricular dysfunction.

In a study done in COPD patients, LV diastolic function was significantly impaired and its magnitude was related to the increase in pulmonary artery pressure, while systolic LV function was well preserved[14]. In another study LV diastolic dysfunction was noted in 84% cases and both systolic and diastolic dysfunction was recorded in 2% case. An observational cross-sectional study including 50 cases of stable COPD patients done in India showed statistically significant positive correlation of the LV diastolic dysfunction with the age of the patients, duration of symptoms and stage of diseases[15]. Hospital based study done in Postgraduate Medical Institute, Lady Reading Hospital, Peshawar in which 1019 patients were recruited, the distribution of the causative factors of CCF were evaluated, COPD was responsible in 1.47% of heart failure[16]. Most of the studies showed significant left ventricular diastolic dysfunction than systolic dysfunction in COPD patients. Several population studies have related reduced forced expiratory volume in first second levels with an increase in cardiovascular disease and all-cause mortality[17-20].

Limitations

As this study was done in tertiary care hospital setting, data presented on this study doesn't represent the true prevalence of LV dysfunction among all COPD patients in community, as significant number of patients doesn't present to hospital especially in early stage of the disease. Furthermore, not every patient with COPD can undergo echocardiographic procedures, and it can occasionally be challenging to evaluate ventricular dysfunction in patients with severe emphysema and dyspnea.

It is well accepted that biomass exposure is an important risk factor for COPD and in our social set up most of the females are exposed to biomass. So, they were at high risk for developing COPD. In our study, males and females were not equally matched. Another limitation in the study is the prevalence of coronary artery disease, which is unknown in study population.

ECG and Echocardiography screening should be performed in all the patient with COPD where facility is available. Larger sample size representative of the general population can be enrolled for large-scale study to find out the true prevalence of the disease. Comparative studies of ventricular dysfunction and heart failure in stable patients and those who present with exacerbation

can be conducted since patients with COPD who have cardiovascular co-morbidity are more likely to experience exacerbations.

Conclusions

This study showed that COPD patients had higher prevalence of left ventricular diastolic, systolic as well as overall ventricular dysfunction. Such patient may not respond to COPD treatment if underlying LV dysfunction and failure is present and not treated appropriately and can be the cause of worsening symptoms. Treatment of heart failure and COPD are different. So, early detection of disease may prevent overtreatment of COPD and proper treatment of heart disease and risk reduction for avoidable mortality and morbidity.

These findings highlight the importance of recognizing COPD as a systemic condition, extending beyond its traditional classification as solely a pulmonary disorder. In clinical practice, maintaining a high index of suspicion for cardiac dysfunction in COPD patients may significantly reduce preventable morbidity and mortality.

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