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Original research article

The impact of severity on cardiovascular alterations in chronic obstructive pulmonary disease

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Abstract

Introduction and Background: Chronic Obstructive Pulmonary Disease (COPD) exerts significant impacts on cardiac function, encompassing the right ventricle, left ventricle, and pulmonary vasculature.

Material and Methods: This study was undertaken in the Department of Cardiology and the Department of Respiratory Medicine, Mamata Academy of Medical Sciences, Hyderabad, Telangana, India. It was an observational study. The study was conducted from August 2022 to July 2023.

Results: The previous identification of COPD as a lung disease has been disproven, and the disease has instead been shown to be systemic in nature. The cardiovascular system is the most prominent organ outside of the lungs to suffer from this. It is widely established that cardiac dysfunction is the leading cause of death in persons with COPD of any severity. Modifications to the cardiovascular system have been shown in numerous investigations and are well documented in the literature for both mild and moderate COPD.

Conclusion: COPD severity promotes right ventricular global dysfunction and pulmonary hypertension. All COPD patients should get an echocardiography to detect early heart problems and reduce cardiac death and morbidity.

Keywords: Disease severity, cardiovascular, chronic obstructive pulmonary disease.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) exerts significant impacts on cardiac function, encompassing the right ventricle, left ventricle, and pulmonary vasculature. COPD is a prevalent condition that can be avoided and managed well. It is distinguished by a continuous restriction of airflow, typically worsening over time, and is linked to an intensified chronic inflammatory reaction in the airways and lungs due to exposure to harmful particles or gases. Exacerbations and comorbidities are significant factors that contribute to the overall severity experienced by individual patients [1, 2].

COPD is a prominent contributor to global morbidity and mortality, imposing significant economic and social implications. According to the findings of the global burden of illness study, it has been estimated that COPD which held the sixth position as a cause of mortality in 1990, is anticipated to ascend to the third position as a main cause of death on a global scale by the year 2020. A significant number of individuals diagnosed with chronic COPD experience comorbidities that exert a substantial influence on both their overall well-being and longevity [3, 4].

The presence of airflow constraint, specifically hyperinflation, has a significant impact on both heart performance and gas exchange. Pulmonary hypertension has the potential to manifest in the advanced stages of COPD, mostly as a consequence of hypoxic vasoconstriction affecting the smaller pulmonary arteries. Over time, this process leads to structural alterations characterized by intimal hyperplasia, followed by smooth muscle hypertrophy/hyperplasia [5]. The depletion of the pulmonary capillary bed in individuals with emphysema may additionally lead to elevated pressure inside the pulmonary circulation. The development of progressive pulmonary hypertension can result in the occurrence of right ventricular hypertrophy, ultimately leading to right-sided cardiac failure. There is a positive correlation between the severity of pulmonary hypertension and the progressive degradation of left ventricular diastolic function [6, 7].

The observed phenomenon can be attributed primarily to the protrusion of the interventricular septum from the hypertrophied and enlarged right ventricle into the left ventricular cavity. The majority of the elevated death rates associated with COPD, can be attributed to the cardiac implications of the condition. Echocardiography offers a quick, non-invasive, portable, and precise approach for assessing heart alterations. In the region of South India, there is a dearth of readily available research pertaining to

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cardiovascular anomalies in individuals with varying degrees of COPD, ranging from mild to extremely severe. The objective of this study is to investigate the distinct impacts on the right ventricle, left ventricle, and pulmonary blood vessels resulting from COPD, as well as their correlation with the severity of the condition [8, 10].

The study aimed to evaluate the circulatory alterations associated with COPD by the use of echocardiography. The objective of this study is to investigate the relationship between cardiovascular alterations and the degree of COPD severity.

Materials and Methods

This study was undertaken in the Department of Cardiology and the Department of Respiratory Medicine, Mamata Academy of Medical Sciences, Hyderabad, Telangana, India. It was an observational study. The study was conducted from August 2022 to July 2023.

Inclusion Criteria

- Patients with known COPD cases
- Individuals with newly discovered COPD
- People above 30 years old

Exclusion Criteria

- PT Sequelae
- Individuals who are diabetes
- Known Hypertensive

Methodology

A total of 50 pateints diagnosed with COPD, whose severity was unclear, were included in this study. The patients underwent a series of investigations as outlined below. The investigation was conducted over a duration of ten months. The patients were provided with an explanation of the study specifics and gained written consent in their respective regional language. A comprehensive medical history was obtained and documented in a standardized format, encompassing details pertaining to symptoms, previous medical conditions, smoking habits, occupational background, and any concurrent ailments. The patients underwent a clinical checkup.

Results

The findings of the investigation are outlined in the subsequent section. In this study, a total of 50 individuals diagnosed with Chronic Obstructive Pulmonary Disease (COPD) were included. Out of the total sample size of 50 patients, 45 were identified as males and 5 were identified as females who took part in the study.

Table 1: Gender distribution

Sr. No.	COPD Patients	Total no of patients
1.	Males	45
2.	Females	05

The patients are classified into different categories depending on the severity determined by spirometric, in accordance with the recommendations established by the Global Initiative for GOLD. These categories are as follows:

Table 2: Severity wise patient distribution

Sr. No.	COPD Patients	Total no of patients
1.	Mild	10
2.	Moderate	15
3.	Severe	20
4.	Very severe	05

The evaluation of right ventricular systolic function through the use of tricuspid annular plane systolic excursion (TAPSE). The TAPSE readings appear to be consistent across all individuals, regardless of the severity of their COPD.

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Table 3: TAPSE right ventricular systolic function

Sr. No.	COPD Severity	TAPSE	
		Normal Mean	Abnormal
1.	Mild	2.2	-
2.	Moderate	2.5	-
3.	Severe	2.2	-
4.	Very severe	2.2	-

The objective of this study is to evaluate the link between chronic obstructive pulmonary disease (COPD) severity and right ventricular diastolic function, as determined by the e/a and e/e' ratios.

Table 4: Right ventricular diastolic function

Sr. No.	COPD Severity	Right ventricular diastolic function	
		Normal	Abnormal
1.	Mild	12	14
2.	Moderate	16	18
3.	Severe	14	12
4.	Very severe	8	6

This study found no significant correlation between the severity of COPD and right ventricular diastolic dysfunction.
There exists a correlation between the severity of COPD and the respiratory fluctuation observed in the right ventricle.

Table 5: Right ventricular diastolic function

Sr. No.	COPD Severity	Right ventricular Respiratory Variation	
		Normal	Abnormal
1.	Mild	13	12
2.	Moderate	15	20
3.	Severe	12	10
4.	Very severe	10	8

The magnitude of the aberration in right ventricular filling during respiratory variation is positively correlated with the severity of COPD.
The present study examines the relationship between right ventricular global function, as measured by the TEI index, and the severity of chronic obstructive pulmonary disease (COPD).

Table 6: Right ventricular diastolic function

Sr. No.	COPD Severity	Right side TEI Index	
		Normal	Abnormal
1.	Mild	11	10
2.	Moderate	17	22
3.	Severe	10	11
4.	Very severe	12	7

This study examines the presence of right ventricular global dysfunction, as measured by the Tei index, in cases of mild, moderate, severe, and very severe obstruction.

Discussion

It has been established that Chronic Obstructive lung Disease (COPD) is a systemic condition rather than solely a lung ailment, as previously believed. The cardiovascular system is mostly impacted by factors external to the lungs. Cardiac dysfunction is a widely recognized complication in individuals with chronic obstructive pulmonary disease (COPD) across all levels of severity, and it continues to be the primary cause of mortality in this patient population. Numerous studies have provided evidence and comprehensive documentation of the alterations observed in the cardiovascular system among individuals with mild and moderate chronic obstructive pulmonary disease (COPD) [11, 13].
During the clinical course of chronic obstructive pulmonary disease (COPD), the right ventricle and the pulmonary blood arteries are the principal components that have significant impact. The architecture of pulmonary blood arteries would experience alterations, resulting in the thickening of the intimal layer and the hypertrophy of the medial layer. These changes subsequently contribute to an elevation in pulmonary artery pressure, ultimately leading to the development of pulmonary hypertension. An elevation in pulmonary arterial pressure has been documented in a range of 30-80% of patients diagnosed with chronic obstructive pulmonary disease (COPD), as determined through the utilization of pulmonary

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arterial catheterization [14, 16].

Pulmonary hypertension subsequently increases the afterload on the right ventricle, resulting in the dilation and hypertrophy of the right ventricle. Furthermore, it has been seen that the left ventricle can be impacted, either independently or in conjunction with the right ventricle. The primary objective of this study is to evaluate the cardiovascular alterations observed in individuals with chronic obstructive pulmonary disease (COPD) and examine their association with the severity of the condition. In the southern region of India, it is challenging to locate readily available studies pertaining to this subject matter. The key characteristics of this study are, According to the recommendations established by the Global Initiative for Chronic Obstructive Lung Disease (GOLD), the study included a total of 51 participants with varying degrees of COPD severity as determined by spirometry. Specifically, there were 6 participants classified as having mild COPD, 14 participants with moderate COPD, 17 participants with severe COPD, and 14 participants with very severe COPD. This finding indicates a higher prevalence of pulmonary hypertension in severe patients compared to milder instances [17, 21].

While TAPSE and ejection fraction results within the normal range suggest normal ventricular systolic function, the ejection fraction decreases as the severity of the disease progresses. There is no significant correlation between left ventricular global dysfunction and the severity of the disease. Contrary to these findings, in a publication inside the Respiratory Medicine journal in 2010, it was found that individuals diagnosed with chronic obstructive pulmonary disease (COPD) exhibit impaired functioning of the right ventricle due to airway obstruction, as well as sub-clinical malfunction of the left ventricle resulting from arterial stiffness. This study further elucidates that individuals with chronic obstructive pulmonary disease (COPD) exhibit cardiovascular alterations, even in the presence of modest airway obstruction [22, 24].

A study published in the European Journal of Echocardiography in 2006 suggested that the Tei index is a primary metric in the field of echocardiography for assessing right ventricular dysfunction in individuals with chronic obstructive pulmonary disease (COPD). The study revealed the coexistence of right and left ventricular dysfunctions in individuals diagnosed with chronic obstructive pulmonary disease (COPD). In a 2011 publication in the journal LUNG INDIA, researchers conducted a study that examined the prevalence of pulmonary hypertension, right ventricular dysfunction, and left ventricular dysfunction in individuals with chronic obstructive pulmonary disease (COPD). The study found that these conditions were more commonly detected in individuals with COPD, and their presence was strongly associated with the severity of the disease. The primary focus of this study revolves around the analysis and interpretation of Echocardiographic data. The haemoglobin levels seen in all cases fall within the lower end of the normal range, with no instances of polycythemia detected [25, 27].

Prior to the occurrence of right ventricular failure, the focus on the underlying pulmonary disease may distract from the recognition of pulmonary hypertension and the subsequent enlargement of the right ventricle. This is due to the concealment of clinical signs and symptoms. In patients with COPD, regardless of its severity, the identification, continuous monitoring, and proper management of cardiovascular anomalies can lead to a reduction in morbidity and mortality. Echocardiography is a primary modality for evaluating cardiovascular alterations in individuals with chronic obstructive pulmonary disease (COPD) and should be included in the assessment of all patients, regardless of the severity of their condition [26, 28].

Conclusion

As the severity of chronic obstructive pulmonary disease (COPD) escalates, there is a concurrent rise in both right ventricular global dysfunction and pulmonary hypertension among affected patients. It is recommended that all individuals diagnosed with chronic obstructive pulmonary disease (COPD) receive a comprehensive cardiac assessment with echocardiography. This diagnostic tool can effectively identify early signs of cardiac abnormalities, hence enabling timely intervention to mitigate the risk of cardiac-related mortality and morbidity.

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None

Conflict of Interest

None

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