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Original Article

Comparison Of Left Ventricular Mass Index And Left Ventricular Systolic Function Among Patients With Airway Disease.

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ABSTRACT

Background: Right Ventricular abnormalities have been identified early on, and it is common for lung issues to impact the heart. Evaluation of right ventricle role in chronic respiratory disease patients is crucial for therapy response and disease progression. In recent days, the involvement of the left ventricular system in airways disease receiving increasing attention for its recognition as critical component of many cardiovascular condition

Methods: One hundred patients with airway disease participated in a cross-sectional study. The study received ethics committee approval, and each participant provided their informed permission. Echocardiographic evaluation was used to gather information on the efficiency with which the left heart pumps and systolic function in health care recipient with airway disease.

Result: According to the study, all individuals with airway disease had normal LV masses and LV mass indices. In contrast, the RWT is elevated in all the patients with Airway disease and additionally, it was noted that patients with airway disease have somewhat less systolic dysfunction. With a shift in left ventricular morphology, concentrated left ventricular remodeling was seen.

Conclusion: Concentric left ventricular remodeling is observed, when Left Ventricular morphology is determined by Left ventricular Mass Index along with Relative Wall Thickness. Relative Wall Thickness Appears to be the only cardiac parameter independently related to all patient with Airway disease. We also noticed that patients with Airway disease have mildly reduced systolic function with ejection fraction.

Keywords: LV mass, systolic, RWT, LV remodeling

INTRODUCTION

Chronic airway diseases, particularly chronic obstructive pulmonary disease (COPD), are increasingly recognized as systemic disorders with significant cardiovascular implications, contributing substantially to global morbidity and mortality [1]. The coexistence of COPD and cardiovascular disease, especially heart failure, is well documented and is associated with poorer clinical outcomes and reduced survival. While right ventricular dysfunction and pulmonary vascular remodeling have traditionally been emphasized in COPD, emerging evidence suggests that left ventricular (LV) structural and functional alterations also play a critical role in disease progression [2,3].

Left ventricular mass (LVM), a robust marker of cardiac remodeling, has been independently associated with adverse cardiovascular events, and its regression through targeted therapeutic strategies has demonstrated prognostic benefit [4]. Early pathological and ventriculographic studies indicated increased myocardial thickness in patients with obstructive airway disease; however, subsequent investigations have yielded inconsistent findings, particularly due to limited consideration of factors such as lung hyperinflation and chronic hypoxia. Furthermore, in conditions such as obstructive sleep apnea, repetitive hypoxic stress and intrathoracic pressure changes contribute to adverse cardiovascular remodeling, highlighting the broader cardiopulmonary interaction in airway diseases [5].

Advances in echocardiographic techniques, including two-dimensional speckle-tracking imaging, have enabled the detection of subclinical biventricular dysfunction, even in the presence of preserved conventional indices such as left ventricular ejection fraction (LVEF). Assessment of LV geometry through parameters such as LV mass index (LVMI) and relative wall thickness (RWT), along with evaluation of systolic function, provides a comprehensive understanding of cardiac remodeling patterns. These parameters are particularly relevant in airway disease populations, where chronic inflammation, hypoxia, and pulmonary hypertension may subtly impair myocardial performance [6,7]. Therefore, evaluating LV mass index and systolic function in patients with airway diseases is essential for early identification of cardiovascular involvement and may offer important prognostic and therapeutic insights.

MATERIALS AND METHODS:

This cross-sectional study was conducted between September 2023 and June 2024 at Dr. M.G.R. Educational and Research Institute, Chennai, India, involving 100 patients diagnosed with airway diseases, including chronic obstructive pulmonary disease, bronchial asthma, bronchiectasis, tuberculosis, and other respiratory disorders, all of whom were admitted to ACS Medical College and Hospital with confirmed diagnoses.

Left ventricular mass (LVM), a key indicator of cardiac remodeling and cardiovascular risk, was assessed using M-mode echocardiography due to its feasibility and validated clinical applicability. LVM was calculated using the Devereux formula recommended by the American Society of Echocardiography: $LVM = 0.8 \times \{1.04 \times [(IVSd + LVIDd + PWTd)^3 - (LVIDd)^3]\} + 0.6$, and subsequently indexed to body surface area to derive the left ventricular mass index (LVMI), which was categorized based on established gender-specific reference ranges.

Relative wall thickness (RWT), an important parameter for evaluating left ventricular geometry, was calculated using the formula $RWT = (2 \times PWTd) / LVIDd$, with values between 0.32 and 0.42 considered normal; deviations from this range were used to classify concentric or eccentric remodeling patterns. Left ventricular systolic function was primarily assessed using left ventricular ejection fraction (LVEF), calculated as (stroke volume/end-diastolic volume) × 100, where stroke volume represents the difference between end-diastolic and end-systolic volumes.

In accordance with current recommendations from the European Association of Cardiovascular Imaging and the American Society of Echocardiography, LVEF measurements were obtained using the modified Simpson's biplane method from apical views to ensure accuracy and reproducibility. In selected cases, advanced echocardiographic techniques such as tissue Doppler imaging and strain analysis were utilized to detect subclinical systolic dysfunction. Patients who were physically disabled or bedridden were excluded from the study.

Ethical approval was obtained from the Institutional Ethics Committee (Approval Nos. 946/2023/IEC/ACSMCH and 945/2023/IEC/ACSMCH, dated November 17, 2023), and informed consent was obtained from all participants prior to enrollment.

RESULTS:

A total of 100 patients with airway diseases were included in this cross-sectional study, comprising pulmonary hypertension (n = 28), bronchial asthma (n = 21), chronic obstructive pulmonary disease (n = 20), bronchiectasis (n = 16), and tuberculosis (n = 15), all of whom underwent comprehensive echocardiographic evaluation. Comparative analysis of left ventricular mass index (LVMI), left ventricular mass (LVM), relative wall thickness (RWT), and left ventricular ejection fraction (LVEF) demonstrated notable variations across the different disease groups.

Patients with tuberculosis exhibited a mean LVMI of 113.44 g/m², LVM of 188.69 g, RWT of 0.44, and LVEF of 50.12%, while those with bronchiectasis showed a mean LVMI of 111.22 g/m², LVM of 183.35 g, RWT of 0.47, and LVEF of 49.85%. Similarly, individuals with chronic obstructive pulmonary disease had a mean LVMI of 113.00 g/m², LVM of 186.83 g, RWT of 0.44, and a comparatively lower LVEF of 48.70%. Patients with bronchial asthma demonstrated mean values of LVMI 112.44 g/m², LVM 185.00 g, RWT 0.47, and LVEF 49.90%, whereas those with pulmonary hypertension had LVMI 113.42 g/m², LVM 184.94 g, RWT 0.48, and LVEF 50.63%. Across all groups, LVMI and LVM values were consistently elevated, suggesting a pattern of cardiac remodeling associated with airway diseases. RWT values were predominantly in the higher range (0.44–0.48), indicating a tendency toward concentric remodeling. Although LVEF remained within the lower limits of normal, a relative reduction was observed, particularly among patients with chronic obstructive pulmonary disease. These findings were statistically significant, with p-values <0.05 across all categories, indicating a meaningful association between airway diseases and alterations in left ventricular structure and systolic function. Percentage-based analysis further supported these findings, demonstrating consistent trends in LVMI, LVM, RWT, and LVEF across all disease groups, reinforcing the presence of subclinical cardiac involvement in patients with airway pathology (Table-1&2).

RISK FACTORS	AVERAGES				P VALUE
	LVMI	LVM	RWT	EF	
Tuberculosis	113.44	188.69	0.44	50.12%	0.001
Bronchiectasis	111.22	183.35	0.47	49.85%	0.002
Chronic Obstructive Pulmonary Disease	113.00	186.83	0.44	48.70%	0.005
Bronchial Asthma	112.44	185.00	0.47	49.90%	0.001
Pulmonary Hypertension	113.42	184.94	0.48	50.63%	0.001

TABLE 1: Table summarizing the average of left ventricular mass index and systolic function

RISK FACTORS	PERCENTAGES				P VALUE
	LVMI	LVM	RWT	EF	
Tuberculosis	43.70%	60.92%	44.43 %	50.12 %	0.001
Bronchiectasis	42.85%	59.19%	47.09 %	49.85 %	0.002
Chronic Obstructive Pulmonary Disease	43.53%	60.31%	44.39 %	48.70 %	0.005
Bronchial Asthma	43.31%	59.73%	46.92 %	49.90 %	0.001
Pulmonary Hypertension	43.69%	59.70%	46.75 %	50.63 %	0.001

TABLE 2: Table summarizing the percentage of left ventricular mass index and systolic function

DISCUSSION:

The present study demonstrates significant alterations in left ventricular (LV) geometry and systolic function among patients with airway diseases, reinforcing the concept of cardiopulmonary interaction in chronic respiratory disorders. Previous studies have reported a positive but statistically non-significant association between left ventricular mass index (LVMI) and disease severity in obstructive sleep apnea ($p = 0.161$) [14]; however, our findings extend this observation across a broader spectrum of airway diseases. In the present cohort, although LVMI and left ventricular mass (LVM) values were largely within near-normal limits, relative wall thickness (RWT) was consistently elevated (0.44–0.48), indicating a predominance of concentric remodeling. This suggests early structural adaptation of the myocardium rather than overt hypertrophy, likely mediated by chronic hypoxia, increased intrathoracic pressure, and systemic inflammation. These findings are consistent with prior reports highlighting the influence of pulmonary hyperinflation and airflow obstruction on LV structure and function [3,5]. Furthermore, the interplay between chronic obstructive pulmonary disease and cardiovascular pathology has been well documented, emphasizing shared pathophysiological mechanisms and increased morbidity [1,2]. In our study, left ventricular ejection fraction (LVEF) remained within the lower limits of normal; however, a relative reduction particularly among patients with chronic obstructive pulmonary disease suggests early systolic dysfunction.

Similar observations have been reported in previous studies demonstrating subclinical LV dysfunction in patients with COPD and asthma [8,11,12]. The consistently elevated RWT across all disease categories further underscores its importance as an independent predictor of adverse cardiovascular outcomes, even in the absence of significant LV hypertrophy. Evidence from studies on sleep-disordered breathing also supports the role of chronic intermittent hypoxia in contributing to LV remodeling and functional impairment [4,15]. Collectively, these findings indicate that airway diseases are associated with subtle yet significant changes in LV geometry and systolic performance, which may precede clinically overt cardiac dysfunction. Therefore, comprehensive echocardiographic evaluation, including LVMI and RWT assessment, is essential for early detection of cardiovascular involvement and improved risk stratification in patients with airway diseases.

CONCLUSION:

In conclusion, airway diseases are associated with early alterations in left ventricular geometry and subtle impairment of systolic function. Despite largely normal LVMI and LVM, the consistent elevation of relative wall thickness indicates concentric remodeling, while mildly reduced ejection fraction suggests subclinical dysfunction. These findings emphasize the importance of routine echocardiographic evaluation for early detection of cardiovascular involvement and improved risk stratification in patients with airway diseases.

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