RESEARCH PAPER

Study of Left Ventricular Remodelling in Patients with Chronic Obstructive Pulmonary Disease

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ABSTRACT
This study aims to quantify left ventricular remodelling and the prevalence of left ventricular hypertrophy in patients with chronic obstructive pulmonary disease devoid of cardiovascular disease. It was a hospital based cross sectional includes adult patients diagnosed with COPD belonging to all classes of GOLD criteria which includes both OPD and IPD cases at SDMCMS&H. Patients with CAD, cardiomyopathy, LBBB , heart failure, significant valvular dysfunction , chronic AF, pacemaker , hypertension higher than stage1 and IDDM were excluded.
Sample size is 150 . Thorough history , clinical examination , ECG , chest xray , echocardiography done. In the echocardiography interventricular septal wall thickness(SWT), posterior wall thickness (PWT) , left ventricular end diastolic diameter (EDD) , LVH noted. LVM and RWT calculated using appropriate formula .
Results: In the present study , we noted that the mean age in the study was 70.24 years. In that 62% were males and 28% were females with male to female ratio of 1.63:1 . The mean SWT was 11.36mm , mean PWT- 11.15mm , mean LVEDD- 39.15mm. The RWT was below 0.42 in 4.67% of patients and above 0.42 in 95.33% subjects. Of the remodelling types observed 2% exhibited eccentric LVH and 98% concentric LVH. The average LVM – 202.87.
CONCLUSION: By evaluating LVM and RWT, we aimed to quantify LV remodeling and the prevalence of LVH in COPD. The majority (95.33%) had a relative wall thickness greater than 0.42, with a high sensitivity (94.3%) and specificity (95.2%). Most subjects (98%) exhibited concentric LVH, and the left ventricular mass averaged 202.87, ranging from 62.10 to 529.63. These findings highlight significant demographic, clinical, and cardiac characteristics of the study population.
KEY WORDS: COPD , Echocardiography , left ventricular hypertrophy , LVM , RWT
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INTRODUCTION

Chronic Obstructive Pulmonary Diseases is defined by GOLD criteria (2018) as " A common preventable and treatable disease which is characterized by airflow limitation and persistent respiratory symptoms due to airway and alveolar abnormality resulting from significant exposure to noxious particles or gases.(1)
COPD can involve chronic bronchitis or alveolar damage (emphysema) or ACOS (Asthma COPD overlap syndrome) which leads to chronic airflow limitation and its typical symptoms are chronic cough with sputum production and breathlessness of exertion.(2,3).
Chronic obstructive pulmonary disease consists of spectrum of obstructive airway diseases which at present is the 3rd most common cause of death in the world. (3,4).
The presence of airway obstruction is made out by calculating the ratio of the forced expiratory volume in 1s (FEV1) to forced vital capacity (FVC).
Severity of airway obstruction is determined by the percenatge of reduction of FEV1 that is – >=80 % is stage I, 50-80 stage II, 30-50 % stage III and < 30 % stage IV (5).
In this issue, the Lung India has released the joint ICS/NCCP (I) consensus guidelines for the diagnosis and management of COPD to facilitate the Indian medical practitioner to reduce the burden, diagnosis and management of COPD (6) . Globally, the COPD burden is projected to increase in future because of continuous exposure to COPD risk factors and aging in the population. (7,8)
Epidemiologic studies have shown that age is considered an important risk factor for the development of left ventricular hypertrophy.

Hypertension and obesity also serve as an independent risk factors for the development of LVH.

Very little evidence is available in this regard in a developing country like India with majority of our population at risk of developing COPD due to exposure to a number of risk factors. The quality of life dramatically decreases in patients with COPD in the presence of LVH. Left ventricular hypertrophy is a strong predictor of cardiovascular adverse effects, especially when this occurs with concentric remodelling detected by an increased relative wall thickness (9,11) .That is why, in individuals who suffer from COPD , if we give importance to the evaluation of left ventricular remodelling, it could have relevant clinical impacts in the form of improving risk stratification for future cardiovascular adverse events and augmenting prognosis. So far, this issue is still remains poorly investigated.

There are very few studies of left ventricular remodelling in patients with COPD independent of cardiovascular diseases in Karnataka.

Overall very less importance has been given to this aspect OF COPD. So ,SDM Medical College and Hospital, Dharwad is a major tertiary care centre in southern part of India. This study helped in identifying the association of COPD with left ventricular remodelling which will help in improving risk stratification for future cardiovascular events and augmenting prognosis Hence, this study was undertaken to see the relationship between LVH and COPD.

MATERIALS AND METHODS

Study design : Hospital based cross sectional study

Study participants : Human

Inclusion criteria

1. Age>18 years
2. Both sexes
3. Patient diagnosed with COPD belonging to all classes of GOLD criteria which includes both OPD and IPD cases at SDMCMS&H.

Exclusion criteria

1 Coronary artery disease
2. heart failure
3. significant valvular dysfunction
4. cardiomyopathies
5. chronic atrial fibrillation
6. pacemaker
7. left bundle branch blocks
8. Patients with systemic arterial hypertension higher than stage I
9. insulin-dependent diabetes were also excluded

One group- Patients with COPD.

Sampling population:

1. Patients with COPD including both OPD and IPD cases in SDMCMS&H from September 2022 to August 2023.
2. Sample size calculation Sample size: 150

Estimating the population proportion – Absolute precision

Expected proportion = .50 (50% of patients with COPD with left ventricular remodeling)

Absolute Precision (%)= 8 Desired confidence level(%)= 95

Number needed (n)= 150 patients should be taken Formula n = Z 2 pq / d2 Where, Z= Standard normal variate value (Z=1.96 at 5% alpha error) d=Margin of error=8% p=50%, q=100-50=50% E.

Study procedure :

Institutional ethical committee clearance to conduct the study was obtained.

Written informed consent from the study population was taken.

The study population includes-Patients diagnosed with COPD History of symptoms as per inclusion criteria.

History of symptoms

1) chronic cough that may produce mucus that may be clear ,white, yellow or greenish
2) Shortness of breath, especially during physical activities
3) Chest tightness
4) Frequent respiratory infections
5)Past history- Hypertension Diabetes mellitus coronary artery disease heart failure , significant valvular dysfunction, cardiomyopathies, chronic atrial fibrillation ,pacemaker, left bundle branch blocks
6) Examination Findings

Vital signs -- Pulse rate, blood pressure, heart rate, respiratory rate, saturation.

7) Complete general and physical examination will be performed
8) All investigations performed for evaluation of patient will be noted.

Relevant investigations:

Complete hemogram
ECG
2DECHO
CHEST XRAY

2decho- The interventricular septal (SWT) and posterior wall (PWT) thicknesses, systolic (ESD) and diastolic (EDD) LV diameters, LVH will be noted.

RWT was calculated as (SWT + PWT)/EDD, using the 0.42 cutoff to define eccentric (≤0.42) or concentric (≥0.42) remodelling.

The statistical tests to be used for data analysis

1. Descriptive statistics (mean, SD, frequency, and %)
2. Chi-square test for association
3. Independent t or Mann-Whitney U test (if it is necessary) A significance was set at 5% level of significance ($p<0.05$).

RESULTS AND OBSERVATIONS

In the present study, we noted that the mean age in the study subjects was 70.24 years SD + 11.11 years. The age group of the study cases was ranged between 45 years and 95 years. Most of the cases were between the age group of 61 – 80 years- 94 cases (62.67%) as depicted in table 1.

Table 2 we noted that 38% were females and 62% were males, the male to female ratio was 1.63:1. the difference in gender with respect to the incidence of COPD was statistically significant with a p value of 0.032.

In the present study, we noted that 28% were smokers as shown in Table 3.

Table 4 we noted that 22.67% had hypertension (stage1) and 40.00% had NIDDM as major comorbidities.

We noted that 68.67% had cough with expectoration, 82.67% had breathlessness and 6.00% had chest pain as shown in Table 5.

Table 6 depicts males with mean body surface area was 1.75 m2 SD + 0.088 m2 and it ranged between 1.55 m2 and 1.97 m2; in females the mean body surface area was 1.51 m2 SD + 0.095 m2 and it ranged between 1.31 m2 and 1.74 m2.

On evaluation of the respiratory system clinically 27 (18.00%) had B/L NVBS, 12(8.00%) had decreased breath sounds ,38(25.33%) had expiratory rhonchi ,14(9.33%) had basal 7(4.67%) and IAA crepts as shown in Table 7.

Table 8 shows various chest xray findings chest xray findings.

ECHO FINDINGS

In the present study, we noted that interventricular septal wall thickening ranged between 8 and 20 with a mean 11.36 SD + 1.766 as shown in Table 9.

Table 10 shows that PWT(Posterior wall thickness) ranged between 8 and 18 with a mean 11.15 SD + 1.65.

We also noted that LVEDD ranged between 22 and 60 with a mean 39.15 SD 5.886 as shown in Table 11.

As in Table 12 we noted that relative wall thickness 4.67% had less than 0.42 and 95.33% had relative wall thickness more than 0.42

we evaluated the type of remodelling 2% had eccentric LVH and 98% had concentric LVH in Table 13.

Table 14 shows LVM ranged between 62.10 and 529.63 mean of 202.87 SD + 71.8.

In the present study, we noted that LVMI (Left ventricular mass index) ranged between 34.84 and 306.87 mean of 123.43 SD + 45.22 as shown in Table 15.

Fig 16 shows We noted that at a level of 0.42 the RWT had a 94.3% sensitivity and 95.2% specificity. The AUC was 0.63

DISCUSSION

It is a well-known fact that COPD is primarily a respiratory insufficiency disorder affecting cardiac geometry and function as an extrapulmonary manifestation of the disease in the long run.

Chronic inflammation of the lung parenchyma and other vascular changes are the hallmark of the disease apart from ventricular hypertrophy and heart failure. RV is largely affected due to the immense pressure gradient in the pulmonary vasculature due to pulmonary hypertension. Although it is worth to remember that left ventricle is equally affected in later stages in severe and very severe COPD.

This study highlights about the structural and functional compensatory alterations operating in COPD, leading to the development of cardiac hypertrophy. LV echo parameters deranged are LVIDd, LVIDs, LVM, LVMI, LVEF%, Similarly, RV parameters deranged are RVM, RVMI, RVEF %, etc., and the velocities also mimic the same effect demographic data.

In the present study, we noted that the mean age in the study subjects was 70.24 years SD + 11.11 years. Most of the cases were between the age of age group of 61 – 80 years 94 cases (62.67%).

PM Short et al[11] in their study noted that the mean age was, 70 SD + 9 years. which is similar to the present study, Gautam SK et al [10] noted that the mean age was s 59.94 (±10.37) years, range 40-85 years which is slightly lesser than the present study, Jugal Kishore Bajpai et al [16] noted that the age group ranged between 30 years and 80 years, 56.67±11.65 years.

In the present study, we noted that 38% were females and 62% were males the male to female ratio was 1.63:1. Gautam SK et al [10] noted that 84% of the patients were males and 16% were females. Jugal Kishore Bajpai[16] noted that the mean body weight in COPD cases was 25.88±11.87.

Echo findings

In the present study, we noted that interventricular septal wall thickening ranged between 8 and 20 with a mean 11.36 SD + 1.766. The thickness of the interventricular septal wall varied between 8 and 20 mm, with a mean of 11.36 mm and a standard deviation of ± 1.766. The posterior wall thickness ranged from 8 to 18 mm, with a mean of 11.15 mm and a standard deviation of ± 1.65. The left ventricular end-diastolic diameter ranged from 22 to 60 mm, with a mean of 39.15 mm and a standard deviation of ± 5.886. The relative wall thickness was below 0.42 in 4.67% of participants and above 0.42 in 95.33% of subjects. The sensitivity and specificity at the 0.42 level were 94.3% and 95.2% respectively, with an area under the curve (AUC) of 0.53.

Of the remodelling types observed, 2% exhibited eccentric left ventricular hypertrophy (LVH) while 98% displayed concentric LVH. The range of left ventricular mass was between 62.10 and 529.63, with an average of 202.87 (standard deviation ± 71.8).

In the present study, we noted that PWT ranged between 8 and 18 with a mean 11.15 SD + 1.65.

Gupta et al [15] noted that 0% cases had normal echocardiographic parameters LVH was seen in 9 cases 22.50%, LVDD was seen in 19 cases 47.50% LVSD was seen in 3 cases 7.50%.

William J. Anderson Tet al [14] noted that the LV ejection fraction was increased with a mean of in 63.4, the The LV mass index in patients with COPD was 96.2 g/m2. François Jardin et al [17] COPD exhibited a markedly reduced LV cavity (LVES, 28.9 ± 14.6 ml/m2 versus 51.5 ± 11.0 ml/m2; LVEDV, 67.7 ± 24.6 ml/m2 versus 103.2 ± 19.9 ml/m2). An increased thickness of both left ventricular free wall and interventricular septum was also evidenced in patients with COPD (17).

In the present study, we noted that relative wall thickness 4.67% had less than 0.42 and 95.33% had relative wall thickness more than 0.42, we noted that at a level of 0.42 the RWT had a 94.3% sensitivity and 95.2% specificity, the AUC was 0.53.

Janne Mykland Hild et [13] al noted that the increases in RV wall thickness was seen in COPD cases (3.5 ± 0.5 mm to 5.5 ± 1.0 mm (95).

In the present study, we evaluated the type of remodelling 2% had eccentric LVH and 98% had concentric LVH. And that of LVM ranged between 62.10 and 529.63 mean of 202.87 SD + 71.8.

Jugal Kishore Bajpai's [16] study reported a narrower range for LVM (122.56 ± 88), suggesting a potentially different demographic or clinical profile of their study population. Both studies show a similar mean LVEF of 60.34 ± 12.0%, indicating consistency in left ventricular function assessment despite differences in LVM.

In our current study, we have observed several significant findings regarding cardiac morphology and function in patients with COPD. Firstly, the interventricular septal wall thickness ranged from 8 to 20 mm, with a mean of 11.36 mm and a standard deviation of ± 1.766. This variability indicates a notable structural adaptation within the heart, likely in response to chronic respiratory insufficiency. Similarly, the posterior wall thickness ranged from 8 to 18 mm, averaging at 11.15 mm with a standard deviation of ± 1.65.

Furthermore, our echocardiographic assessments revealed that the left ventricular end diastolic diameter ranged widely from 22 to 60 mm, with a mean of 39.15 mm and a standard deviation of ± 5.886. This variability underscores the diverse cardiac manifestations seen in COPD patients, reflecting both adaptive and pathological changes over the disease course.

Relative wall thickness (RWT) analysis indicated that 4.67% of participants had RWT values below 0.42, whereas 95.33% exhibited values above this threshold. We found that at a RWT cutoff of 0.42, sensitivity was 94.3% and specificity was 95.2%, with an area under the curve (AUC) of 0.53, highlighting the diagnostic utility of this parameter in identifying cardiac hypertrophy in COPD.

Regarding cardiac remodelling types, our study identified that 98% of patients demonstrated concentric left ventricular hypertrophy (LVH), while 2% exhibited eccentric LVH. This predominance of concentric remodelling suggests a uniform response to the chronic hemodynamic stress associated with COPD.

In terms of left ventricular mass (LVM), we observed a wide range between 62.10 and 529.63, with a mean of 202.87 and a standard deviation of ± 71.8. This variability in LVM underscores the complex interplay between pulmonary and cardiac pathology in COPD patients.

Comparatively, Jugal Kishore Bajpai's [16] study reported a narrower range for LVM (122.56 ± 88), suggesting potential differences in patient demographics or disease severity between our study populations. Notably, both studies reported similar mean values for left ventricular ejection fraction (LVEF) at 60.34 ± 12.0%, indicating consistent findings regarding left ventricular function despite variations in LVM.

Overall, these findings highlight the intricate cardiac adaptations and pathophysiological changes in COPD, underscoring the importance of comprehensive cardiac evaluation in managing these patients.

CONCLUSION

By evaluating LVM and RWT, we aimed to quantify LV remodeling and the prevalence of LVH in COPD. The majority (95.33%) had a relative wall thickness greater than 0.42, with a high sensitivity (94.3%) and specificity (95.2%). Most subjects (98%) exhibited concentric LVH, and the left ventricular mass averaged 202.87, ranging from 62.10 to 529.63. These findings highlight significant demographic, clinical, and cardiac characteristics of the study population.

Limitation of the study

Cross-Sectional Design**:** The work is a hospital-based cross-sectional study, meaning it can only determine associations at a single point in time rather than tracking progression or establishing direct cause-and-effect relationships.

Small Sample Size**:** The investigation evaluated a relatively small cohort of only 150 patients.

Single-Centre Setting: The research was conducted exclusively at a single tertiary hospital limits how well the findings can be generalized to broader geographical populations

Ethical approval - Taken

Conflict of interest- NIL

Tables

Table 1

AGE	CASE NO	PERCENT
45-50 YEARS	5	3.33%

51- 60 YEARS	25	16.67%
61- 70 YEARS	46	30.67%
71- 80 YEARS	48	32.00%
81- 90 YEARS	21	14.00%
MORE THAN 90 YEARS	5	3.33%
TOTAL	150	100.00%

Table 2

GENDER	CASE NO	PERCENT
FEMALE	57	38.00%
MALE	93	62.00%
TOTAL	150	100.00%

Table 3

SMOKING	CASE NO	PERCENT
ABSENT	108	72.00%
PRESENT	42	28.00%

Table 4

COMORBIDITIES	CASE NO	PERCENT
HYPERTENSION(stage1)	34	22.67%
NIDDM	60	40.00%

Table 5

CLINICAL PRESENTATION	CASE NO	PERCENT
COUGH WITH EXPECTORATION	103	68.67%
BREATHLESSNESS	124	82.67%
CHEST PAIN	9	6.00%

Table 6

BSA	MEAN	STDEV	MINIMUM	MAXIMUM
MALES	1.75 m2	0.088 m2	1.55 m2	1.97 m2
FEMALES	1.51 m2	0.095 m2	1.31 m2	1.74 m2

Table 7

RESPIRATORY SYSTEM EXAMINATION	FREQUENCY	PERCENT
GROSSLY NORMAL	27	27.55%
B/L NVBS	18	18.37%
DECREASED BREATH SOUNDS	12	12.24%
EXPIRATORY RONCHI	38	38.78%
BASAL CREPTS	14	14.29%
IAA CREPTS	7	7.14%

Table8

CHEST XRAY	Frequency	Percent
GROSSLY NORMAL	35	35.71%
HYPERINFLATED LUNG FIELDS	32	32.65%
INCREASED BRONCHOVASCULAR MARKINGS	5	5.10%
HOMOGENOUS OPACITY	16	16.33%
PROMINENT BRONCHOVASCULAR MARKINGS	2	2.04%
RIGHT BRONCHIECTATIC CHANGES	1	1.02%
RIGHT LOWER LOBE OPACIFICATION	1	1.02%
RIGHT PLEURAL EFFUSION	3	3.06%

S/O ASPIRATION PNEUMONIA	1	1.02%
S/O BIBASAL PNEUMONIA	1	1.02%
S/O COAD CHANGES	1	1.02%

Table 9

	TOTAL NUMBER	MINIMUM	MAXIMUM	MEAN	STD DEVIATION
SWD	150	8	20	11.36	1.766

Table10

PWT	N	Minimum	Maximum	Mean	Std. Deviation
PWT	150	8.0	18.0	11.155	1.6502

Table11

	TOTAL NUMBER	MINIMUM	MAXIMUM	MEAN	STD DEVIATION
LVEDD	150	22	60	39.15	5.886

Table 12

RWT	CASE NO	PERCENT
less than 0.42	7	4.67%

Table 13

TYPE OF REMODELLING	N	PERCENT
concentric	147	98.0%
eccentric	3	2.0%

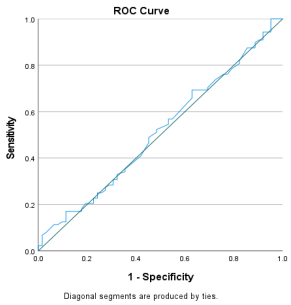
Table14

	TOTAL NUMBER	MINIMUM	MAXIMUM	MEAN	STD DEVIATION
LVM	150	62.10	529.63	202.8723	71.83035

Table15

	TOTAL NUMBER	MINIMUM	MAXIMUM	MEAN	STD DEVIATION
Left ventricular mass index	150	34.84	306.87	123.43	71.83035

Figure 16



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