Original Research Paper

Internal Medicine

ELECTROCARDIOGRAPHY & ECHOCARDIOGRAPHY FINDINGS IN COPD

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KEYWORDS :

INTRODUCTION

Chronic obstructive pulmonary disease is a common entity encountered in clinical practice, which is, defined by GOLD as a preventable and treatable disease with significant extra pulmonary effects.[1]

According to the World Bank data the morbidity and mortality due to COPD could reach 5th and 3rd leading causes by 2020. [2,3]

COPD is associated with significant extra pulmonary effects out of which the cardiac manifestations are most common.[4]

COPD affects the pulmonary vessels; the right ventricle leading to the development of pulmonary hypertension, corpulmonale, right ventricular dysfunction and in some cases left ventricular dysfunction as well.

The major morbidity in COPD is due the impact on cardiac performance. The early recognition and initiation of treatment may improve the survival and quality of living.

The electrocardiography is a very simple bedside investigation, which could be used to assess the cardiac changes secondary to COPD.

The echocardiography provides a rapid, portable noninvasive method to assess the right ventricular function, right ventricular filling pressures, tricuspid regurgitation, other chamber and valvular functions.

This study was undertaken to study the electrocardiographic and echocardiographic changes in COPD patients with different grades of severity of the disease, as assessed through pulmonary function testing.

AIMS & OBJECTIVES
- To assess the cardiac changes secondary to COPD by electrocardiography and echocardiography.
- To correlate electrocardiographic and echocardiographic findings with severity of COPD using GOLD guidelines.

MATERIALS & METHODS
Patients of COPD confirmed by clinical history, examination and pulmonary function tests were included in the study done at Mediciti Institute of Medical Sciences from January 2015 to January 2016

INCLUSION CRITERIA
As per GOLD guidelines, A clinical diagnosis of COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease and should undergo spirometry to confirm the diagnosis.

The ratios of FEV1/FVC less than 0.7 (70%) post bronchodilator inhalation were included in this study.

EXCLUSION CRITERIA

Patients with chronic lung disease other than COPD like bronchial asthma, restrictive lung diseases, pulmonary tuberculosis, bronchiectesis and known cardiac disorders were excluded from the study

METHODOLOGY
Data was collected from patients both IP & OP with signs and symptoms of COPD as mentioned above. These patients were clinically examined and they underwent routine investigations like hemogram, urine examination, blood urea, serum creatinine, chest x-ray, random blood sugar, sputum examination and ABG analysis. These patients also underwent pulmonary function test, ECG and ECHO.

The data thus obtained was statistically analysed using SPSS version 12.0.

RESULTS
31 cases which met the inclusion criteria were studied and the following observations were made.

Table 1: Sex distribution

Sex	No. Of cases	Percentage (%)
Male	26	83.87
Female	5	16.13
Total	31	100

In this study 84% were males and 16% were females.

Figure 1: Sex distribution
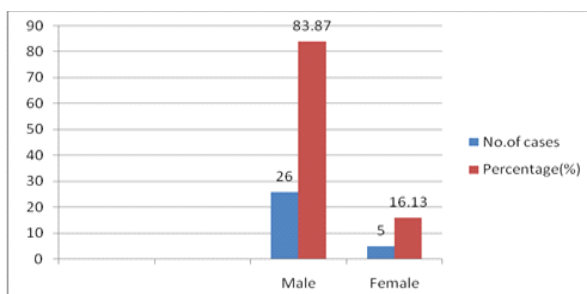
Table 2: Age distribution

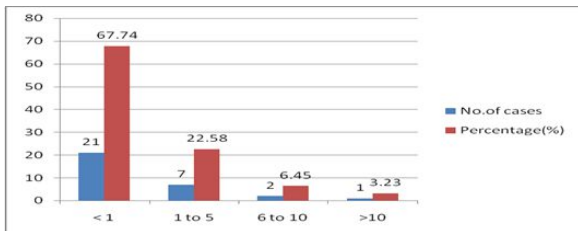| Age (Yrs)	No. Of cases	Percentage (%)
30-39	1	3.23
40-49	2	6.45
50-59	10	32.26
60-69	11	35.48
70-79	6	19.35
>=80	1	3.23
Total	31	100

Figure 2: Age distribution
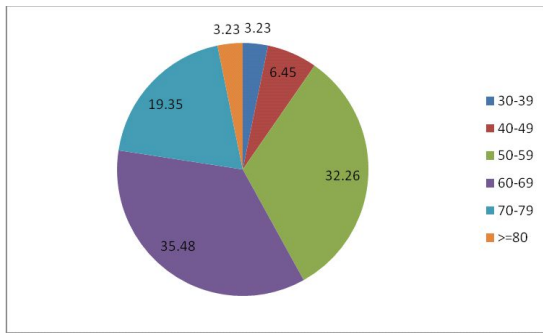
The mean age was 60 years. The maximum incidence of COPD in this study is among the age group 50-69 years (67.74%).

Only one patient was less than 40 years old and one more than 80 years.

Table 3: Duration of symptoms

| Duration of symptoms (Years)	No. Of cases	Percentage (%)
< 1	21	67.74
1 to 5	7	22.58
6 to 10	2	6.45
>10	1	3.23
Total	31	100

Figure 3: Duration of symptoms

Maximum number of patients (62%) had symptoms of less than one year of duration, and only one patient had symptoms more than 10 years.

Table 4: Severity of disease

Degree	FEV1	No. Of cases	Percentage (%)
MILD	>= 80	5	16.13
MODERATE	50-79	11	35.48
SEVERE	30-49	9	29.04
VERY SEVERE	<30	6	19.35
Total		31	100
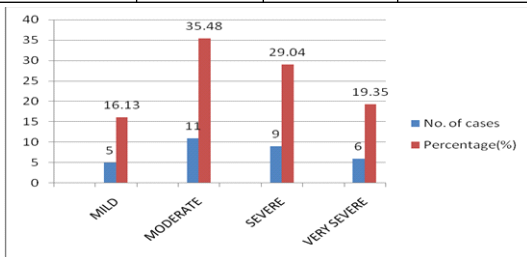
The mean FEV1 was 53.09%. Maximum number of patients (64.52%) had moderate to severe airflow obstruction at the time of presentation and only 16.13% had mild disease.

FEF$_{25-75\%}$	No. of cases	Percentage (%)
FEF$_{25-75}$ > 70	1	3.23
FEF$_{25-75}$ < 70	30	96.77

Table 5: History of smoking

Smoking	No. of cases	Percentage (%)
No	5	16.13
Yes	26	83.87
Total	31	100

83.87% of the patients were chronic smokers.
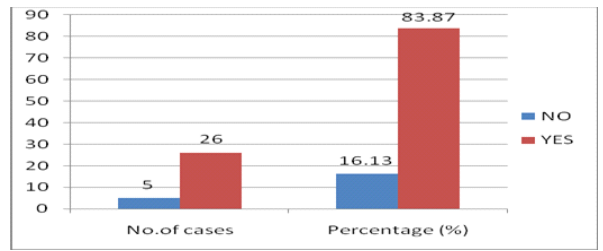
Table 6: Duration of smoking

Duration (Pack years)	No. Of cases	Percentage (%)
<10	1	3.85
10 to 19	8	30.77
20 to 29	8	30.77
30 to 39	6	23.07
>40	3	11.54
Total	26	100

Figure 6: Duration of smoking
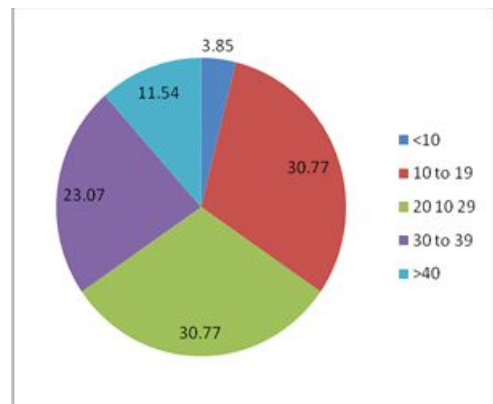
The mean duration of tobacco use was 22.5 pack years. Majority of the patients had history of tobacco exposure of at least 10-29 pack years. One patient with less than 10 pack years of exposure.

Table 7: Correlation of Tobacco Exposure with Disease Severity

Pack years	Mild		Moderate		Severe		Very Severe	
	No.	%	No.	%	No.	%	No.	%
<10					1	3.85		
10 to 19	3	11.54	3	11.54	2	7.69		
20 10 29			5	19.22			3	11.54
30 to 39	1	3.85			4	15.37	1	3.85
>40	1	3.85			1	3.85	1	3.85

Majority of patients with severe to very severe disease had more than 20 pack years.

Table 8: Symptoms

Symptom	No. Of cases	Percentage (%)
Cough with sputum	25	80.65
Breathlessness	31	100
Edema	4	12.9
Fever	17	54.84

All the patients in this study had breathlessness at the time of presentation. 80.65% had cough with expectoration and 54.84% had fever.

Table 9: Physical signs

PHYSICAL SIGNS	No. Of cases	Percentage (%)
Tachycardia	7	22.58
Tachypnea	26	83.87
Raised temperature	11	35.48
Raised JVP	11	35.48
Cyanosis	9	29.03
Clubbing	12	38.71
Pedal edema	8	25.81

The most common sign at presentation was Tachypnea (83.87 %).

35.48% had raised JVP, 25.81% had pedal edema indicating corpulmonale.

38.71% of the patients had clubbing and 29.03% had cyanosis, which is evidence of a hypoxic state.

Table 10: Systemic findings

SYSTEMIC FINDINGS	No. Of cases	Percentage (%)
Barrel shaped chest	16	51.61
Decreased chest movements	16	51.61
Hype resonant notes	17	54.83
Breath sounds reduced	10	32.26
Wheeze	26	83.87
Creptitations	16	51.61
Loud P2	6	19.35
Hepatomegaly	2	6.45

Wheeze was present in 83.87% of the patients.

Barrel shaped chest, decreased chest movements and hyperresonant percussion note was present in 54.83% of patients.

Loud P2 was seen in 19.35% of patients indicating pulmonary hypertension
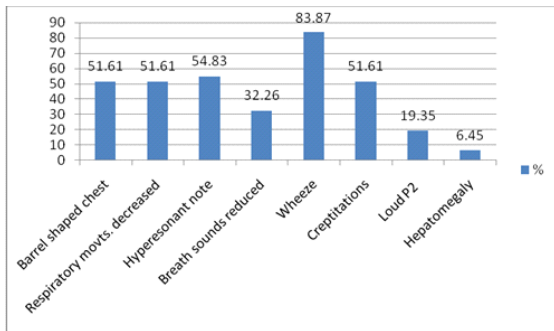

Table 11: ECG changes

ECG CHANGES	YES		NO	
	No.	%	No.	%
Right axis deviation	4	12.9	27	87.1
R/S in V1 > 1	2	6.45	29	93.55
R > 7 mm in V1	1	3.23	30	96.77
S < 2 mm in V1	2	6.45	29	93.55
qR in V1	2	6.45	29	93.55
R/S in V5 / V6 < 1	2	6.45	29	93.55
RV1 + S V5/6 > 10.5 mm	1	3.23	30	96.77
rsR in V1 with R > 10 mm	1	3.23	30	96.77
Incomplete RBBB	7	22.58	24	77.42
P Pulmonale	8	25.81	23	74.19
Low voltage complexes	2	6.45	29	93.55
Normal ECG	22	70.97	9	29.03

70.97% had normal ECG.
16.12% had RVH, P pulmonale was seen in 25.81%, incomplete RBBB in 22.58%.

Table 12: Correlation of ECG with duration of the disease

ECG Findings	< 1 Year (n=21)		1-5 Years (n=7)		>5 years (n=3)		r	p
	No.	%	No.	%	No.	%		
P Pulmonale	5	23.8	2	28.5	1	33.3	-0.961	>0.05
Low voltage complex	2	9.5					-0.866	>0.05
Incomplete RBBB	5	23.8	2	28.5			-0.993	<0.05
RAD	3	14.2	1	14.2			-0.982	>0.05
R/S V1>1	2	9.5					-0.866	>0.05
R V1>7	1	4.7					-0.866	>0.05
S V1<2	2	9.5					-0.866	>0.05
qR V1	2	9.5					-0.866	>0.05
R/S V6<1	2	9.5					-0.866	>0.05
RV1+SV5/V6>10.5	1	4.7					-0.866	>0.05
rsR V1 WITH R>10	1	4.7					-0.866	>0.05

Incomplete RBBB was the only change which has significant correlation with severity of the disease. (p< 0.05)

Table 13: Correlation of ECG with severity of the disease

ECG Findings	Mild (n=5)		Moderate (n=11)		Severe (n=9)		Very Severe (n=6)		r	p
	No.	%	No.	%	No.	%	No.	%		
P Pulmonale			4	36.3	1	11.1	3	50	0.424	>0.05
Low voltage complex					2	22.2			0.258	>0.05
Incomplete RBBB	1	20	1	.09	2	22.2	3	50	0.944	<0.05
RAD					2	22.2	2	33.3	0.894	>0.05
R/S V1>1	1	20					1	16.6	0.000	>0.05
R V1>7	1	20							-0.775	>0.05
S V1<2							2	33.3	-0.775	>0.05
qR V1					1	11.1	1	16.6	0.894	>0.05
R/S V6<1					1	11.1	1	16.6	0.894	>0.05
RV1+SV5/V6>10.5					1	11.1			0.258	>0.05
rsR V1 WITH R>10					1	11.1			0.258	>0.05

Incomplete RBBB was the only ECG change with significant correlation with severity of the disease.(p<0.05)

Table 14: ECHO findings

ECHO Findings	No. Of cases	Percentage (%)
RA Dilatation	13	41.94
RV Dilatation	13	41.94
RV Hypertrophy	2	6.45
RV failure	2	6.45
PAH	13	41.94

Table 15: PAH Severity on ECHO

PAH	No. of cases	Percentage (%)
Mild PAH	5	16.13
Moderate PAH	8	25.81
Severe PAH	0	0
No PAH	18	58.06

Table 16: Correlation of ECHO changes with duration of disease.

Echo Findings	< 1 Year (n=21)		1-5 Years (n=7)		>5 years (n=3)		R	p
	No.	%	No.	%	No.	%		
RA dilatation	10	47.6	2	28.5	1	33.3	-0.912	>0.05
RV dilatation	10	47.6	2	28.5	1	33.3	-0.912	>0.05
RV hypertrophy	2	9.5					-0.866	>0.05
RV failure	1	4.76			1	33.3	0.0	>0.05
PAH	10	47.6	2	28.5	1	33.3	-0.912	>0.05

10/21 patients (47.6%) with less than one year of disease had features of corpulmonale.

2/7(28.5%) patients in 1-5 years category and 1/3(33.3%) patients in > 5 years category had corpulmonale.

Table 17: Correlation of ECHO with severity of disease.

Echo Findings	Mild (n=5)		Moderate (n=11)		Severe (n=9)		Very Severe (n=6)		r	p
	No.	%	No.	%	No.	%	No.	%		
RA dilatation	1	20	5	45.4	5	55.5	2	33.3	0.188	>0.05
RV dilatation	1	20	5	45.4	5	55.5	2	33.3	0.188	>0.05
RV hypertrophy			1	9.09			1	16.6	0.447	>0.05
RV failure			1	9.09			1	16.6	0.447	>0.05
PAH	2	40	4	36.3	5	55.5	2	33.3	0.086	>0.05

5/11 patients (45.4%) in moderate, 5/9 patients (55.5%) in severe disease category had features of corpulmonale. 1/5(20%) with mild disease and 2/6(33.3%) in very severe disease had corpulmonale.

Table 18: Correlation of PAH with duration of disease.

Duration of the disease		< 1 Year (n=21)		1-5 Years (n=7)		>5 years (n=3)		r	p
		No.	%	No.	%	No.	%		
PAH grade	Mild	4	19.04			1	33.3	-0.721	>0.05
	Moderate	6	28.5	2	28.5			-0.982	>0.05

4/21(19.04%) patients had mild PAH with less than 1 year disease and 1/3(33.3%) had mild PAH with > 5 years disease.

6/21(28.5%) had moderate PAH with disease less than a year and 2/7(28.5%) had moderate PAH with more than 1 year duration of the disease.

None had severe PAH.

Table 19: Correlation of PAH with severity of disease.

Severity of the disease		Mild (n=5)		Moderate (n=11)		Severe (n=9)		Very Severe (n=6)		r	p
		No.	%	No.	%	No.	%	No.	%		
PAH grade	Mild	1	20	2	18.1	1	11.1	1	16.6	-0.258	>0.05
	Moderate	1	20	2	18.1	4	44.4	1	16.6	0.183	>0.05

1/5(20%) with mild PAH had mild disease, 2/11(18.1%) with mild PAH had moderate disease, 1/9(11.1%) had mild PAH with severe disease and 1/6(16.6%) with very severe disease had mild PAH.1/5(20%) had mild disease with moderate PAH, 2/11(18.1%) had moderate PAH with moderate disease, 4/9(44.4%) with severe disease had moderate PAH, 1/6(16.6%) with very sever disease had moderate PAH.

DISCUSSION
1. Sex distribution

Study	Male (%)	Female (%)
RL Agarwal et al [5]	66.7	33.3
V. K. Singh et al [6]	94.6	5.4
Present study	83.9	16.1

COPD is a male dominant disease, the high prevalence in males which is due to higher prevalence of smoking in this gender, and also males are more susceptible to smoking than females[7]. In the present study, males accounted for 83.87 % of the study population, with a male-female ratio of 5.20:1 (Table: 1). As shown in the table above, all the studies indicate a higher incidence of COPD in males.

2. Age Distribution
The mean age was 60 years. The maximum incidence of COPD in this study is among the age group 50-69 years (67.74%).

Study	Mean Age (Yrs)	SD
RL Agarwal et al [5]	37.8	+-14.24
Niranjan Mambally Rachaiah et.al [8]	63.17	+- 10.45
Present study	60	+- 10.58

3. Duration of symptoms

Majority of the patients (90%) were symptomatic for less than 5 years. In the study conducted by Gupta et al, 1989 [9], the mean duration of symptoms was 8.9±4.9 years.

4. Severity of the disease
In the present study, majority of the patients had moderate COPD (35.48%) according to GOLD criteria. In a similar study by NK Gupta et al [4], the number was maximum in the mild COPD category i.e. 45%. In a recent study conducted in Mysore by Niranjan Mambally Rachaiah et.al [8] they found 50% patients had moderate COPD and 42 % had severe COPD.

5. History of smoking and its correlation with disease severity
In the present study, 84 % patients were chronic smokers with a mean duration of smoking being 22.5 pack years. 63% patients with severe disease had smoking duration more than 20 pack years whereas for very severe disease 100% patients had smoking duration more than 20 pack years. Hence, higher the pack years more severe is the disease.

In a similar study on COPD patients by Niranjan Mambally Rachaiah et al [8] smoking was seen in 88 % patients and as with our study, they also found that there was a dose response relationship between number of pack years of smoking and decline in lung function.

6. Symptoms at presentation
Breathlessness is the symptom that commonly causes the patient to seek medical attention, and is usually the most disabling of these symptoms. Patients often date the onset of their illness to an acute exacerbation of cough with sputum production, which leaves them with a degree of chronic breathlessness. Close questioning usually reveals the presence of a "smokers cough" (which is usually disregarded by the patient), with scanty mucoid sputum, mainly in the morning for many years.

In the present study, we observed that all patients came with complaints of breathlessness to the hospital and Cough with sputum was the next common complaint, seen in 80 % patients. In comparison to study by Niranjan Mambally Rachaiah et al [8], they observed cough with sputum as presenting complaint for all patients and breathlessness was seen in 94% patients.

7. Physical examination
The most common sign seen on examination at the time of presentation was Tachypnea i.e. 83.87 % patients. According to study by Gupta and Khastgir [9], also tachypnea was the commonest sign at presentation, seen in 100% patients.

8. ECG changes
The common ECG changes seen in the present study were- right axis deviation (13%), incomplete RBBB (23%) and P pulmonale (26%). Similar observations were made in study by Niranjan Mambally Rachaiah et.al [8]. In their study incidence of RAD was 42%, RBBB was seen in 4% patients and p pulmonale in 42% patients.

In the present study, peaked P-wave i.e. amplitude more than 2.5 mm, was recorded in 26% of the patients, whereas it was seen in 35.7% of the cases with COPD in the study by RL Agarwal et al [5]. In Spodicks [10] series, 13.9% of COPD patients had P-wave equal or greater than 2.5mm. Carid and Wilcken [11] found incidence of P-pulmonale in 15.5% of their COPD patients, while Scott et al [12] recorded same incidence of 32.7% in their studies.

Low voltage QRS complexes were seen in only 6.5 % patients in the study whereas in the study by RL Agarwal et al [5] it was seen in none of the COPD patients. In comparing low voltage complexes in patients with severe COPD it was found that 22% of patients with severe COPD had a low voltage complex which is similar to finding of study by Dvorah Holtzman et al [13] who found it to be 29%.

70 % patients with COPD in our study had normal ECG as compared to 35 % in study by RL Agarwal et al [5].

The ECG changes which as seen are due to change in haemodynamics of pulmonary vasculature due to hypoxia, pulmonary vascular surface area reduction and change in cardiac position.

Persistent and progressive change in pulmonary vasculature results in direct effect on cardia in the form of right ventricular hypertrophy and

dilation as well as right atrial enlargement[14].

Correlation of ECG findings with severity and duration of the disease: we observed statistical significance in correlation between RBBB on ECG and the duration as well as severity of the disease.

9. ECHO changes
In the present study, 41.94% of patients had RA and RV dilated and 41.9% had PAH. In the study by NK Gupta et al[4], Cor pulmonale was seen in 17.5 % patients. Study done in 1958 by Himelmann et al[15] showed incidence of Cor pulmonale as 75%. Hence incidence of cor pulmonale in COPD is variable.

17/31(55%) patients had a normal 2D echo which is similar to NK Gupta et al[4] who did a study on echocardiographic findings in COPD patients and found that 50% patients had a normal ECHO.

Correlation of ECHO changes with duration of disease.
47.6% patients with less than one year of disease had features of corpulmonale. 28.5% patients in 1-5 years category and 33.3% patients in > 5 years category had corpulmonale. There was no statistical correlation between the duration of the disease and the ECHO changes.

Correlation of ECHO with severity of disease.
45.4% patients in moderate, 55.5% in severe disease category had features of cor pulmonale. 20% with mild disease and 33.3% patients in very severe disease had cor pulmonale.

PULMONARY HYPERTENSION
58% patients had no PAH. There was no correlation found between PAH and severity and duration of the disease. In the study by NK Gupta et al[4] they found that the severity of pulmonary hypertension increased with the severity of the disease, however, no such correlation was found in our study.

SUMMARY
- COPD was seen predominantly in male smokers.
- Majority of the COPD patients were in the age group of 50-70 years.
- Breathlessness and Cough with expectoration were the commonest presenting complaints in COPD patients.
- On examination these patients had tachypnoea, signs of hyperinflated chest and signs of pulmonary hypertension.
- For assessment of the severity of the disease, spirometry is the simplest and sensitive tool.
- Majority of the patients had moderate COPD according to GOLD classification.
- The common ECG findings in COPD patients were P pulmonale, RBBB, RAD and RVH.
- Incomplete RBBB was the only ECG change with significant correlation with severity and duration of the disease.
- The commonest findings on 2D ECHO were RA and RV dilatation and PAH.
- Incidence of cor pulmonale increased as the severity of the disease increased.
- There was no statistical correlation between the ECHO findings and duration of disease.
- There was no statistical correlation between PAH and severity and duration of the disease.

CONCLUSIONS
- Computerised spirometry is a useful investigation in diagnosis of COPD. Forced expiratory volume in the first second is the most useful parameter to diagnose as well as assess the severity of the disease.
- ECHO is a more sensitive test compared to ECG in detecting early cardiac changes in patients with COPD.
- However ECG is a simple bedside test, hence it must be routinely included in the workup for evaluation of COPD patients.

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