

## Original Articles

### Co-Relation of Echocardiographic Findings with Severity of Chronic Obstructive Pulmonary Disease

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**Keywords :** Echocardiography, electrocardiogram, chronic obstructive pulmonary disease, cor-pulmonale, pulmonary arterial hypertension.

#### ABSTRACT

**Background :** Chronic obstructive pulmonary disease is the fourth leading cause of mortality worldwide. It is defined as a disease formally categorized by airflow limitation that is not fully reversible. Patients with chronic obstructive pulmonary disease (COPD) are at increased risk of cardiovascular disease. Electrocardiography (ECG) and echocardiography (ECHO) give valuable information about cardiac disease and prognosis in COPD patients.

**Methods :** A 50 patients of COPD fulfilling the inclusion criteria were selected. They were staged by pulmonary function test (PFT) and evaluated by electrocardiography and echocardiography. All the patients were interviewed with proper interview sheet, which was designed especially for this study. Data was analyzed using the student t-test, percentages, mean values in SPSS Software 22.0 version.

**Results :** Mean age was  $52.54 \pm 9.55$  years, with male preponderance, male to female ratio 5.25:1. Mean duration of disease was  $6.36 \pm 4.14$  years. The common symptom was breathlessness (100%). Most common ECG and ECHO finding was right axis deviation (52%) and pulmonary artery hypertension (54%) respectively. Right axis deviation and Poor 'r' wave progression were significantly correlated with disease severity by ECG findings while R.A. dilatation, R.V. dilatation and Pulmonary hypertension were significantly correlated with disease severity by ECHO findings ( $p < 0.05$ ).

**Conclusions :** COPD is more common in males and in the 5th and 6th decade. Most of the patients have advanced disease at presentation. The incidence of abnormalities of ECG and echocardiography increases with severity of COPD. ECG and echocardiography are better tools than clinical methods in detecting right ventricular dysfunction (RVD) in COPD. So COPD patients should be screened for RVD by echocardiography.

#### INTRODUCTION

COPD is characterized by slowly progressive air flow obstruction, resulting in dyspnea and exercise limitation, and pulmonary arterial hypertension (PAH) is its major cardiovascular complication.<sup>1</sup> Right ventricular (RV) dysfunction is common in patients with COPD particularly in those with low oxygen saturation. It occurs in up to 50% of the patients with moderate to severe COPD.<sup>2</sup> When present, it can reduce exercise tolerance, increase dyspnea, and contribute to an overall decrease in functional status, and portends a higher mortality rate. Its recognition and treatment may lead to prolonged survival and improved quality of life.

This study was undertaken to study the clinical and echocardiographic changes in COPD patients with different grades of severity of the disease, as assessed

clinically and through pulmonary function testing. Further, an attempt has been made to compare the electrocardiographic and the echocardiographic in observation, with respect to duration and severity of the disease and to see which of them is a better predictor of right ventricular dysfunction in COPD, so that the patients can be identified at an earlier stage of the disease, as early recognition and treatment of right ventricular dysfunction in COPD, leads to prolonged survival and improved quality of life.

#### METHODS AND MATERIALS

The present study was undertaken in department of medicine of a tertiary care hospital

##### Study Design

Hospital Based Descriptive Cross-Sectional Study

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## Target Population

Adults presented with symptoms of COPD fulfilling inclusion criteria.

## Inclusion Criteria

Consenting adult patients with

- 1) Symptoms suggestive of chronic bronchitis i.e. history of cough with expectoration of at least 3 months duration in 2 consecutive years.
- 2) Patients with history of breathlessness of long standing duration with or without cough.
- 3) Findings of COPD on physical examination and/or radiographic investigation and/or in PFT in patients with above symptoms

## Exclusion Criteria

- 1) Patients less than 18 year age.
- 2) Patients with pregnancy or having history of Bronchial asthma, Pulmonary tuberculosis, Bronchiectasis, known congenital or acquired heart diseases, Diabetes mellitus and Hypertension, thyroid disease, pneumoconiosis, LVD in 2D Echo.
- 3) Patients with altered sensorium or with any critical illness like a respiratory failure, shock, MODS.

Detailed history was taken for Symptoms of COPD and development of RVD. Patients were also asked about symptoms of other diseases to exclude them from study. Detailed general examination and systemic examination was done. All patients were subjected for PFT and the best three attempts were taken. CXR, 12 lead ECG, 2D Echo and other routine investigation like Hb%, Total count, Differential count, ESR, Urine routine and microscopy, Random blood sugar, blood urea, serum creatinine were also done. All patients were treated according to standard guidelines. All the patients were interviewed with proper interview sheet, which was designed especially for this study and was filled by the author. Data was analyzed using the student t-test, percentages, mean values in SPSS Software 22.0 version.

## OBSERVATIONS AND DISCUSSION

In this study, we included 50 patients fulfilling inclusion criteria. No patient was of less than 35 years. The mean age was  $52.54 \pm 9.55$  years, range 31-75 years. Maximum incidence of COPD in this study was among the age group 41-60 years (66%). 18% patients were from 61-70 year age group, 12% patients were from 31-40 year age group. Only 4% of the patients were > 70 years. In the

present study, 84% of the patients were males and 16% were females. The male: female ratio was 5.25:1. This higher incidence of COPD in males can be attributed to smoking.<sup>3</sup> In our study none of the females were smokers but all of them had history of cooking with dried cow dung or dried wood fuel.

In the present study, it was found that laborer had highest incidence (44%) of COPD and lowest incidence (8%) was found in drivers. MS Ahmed et al<sup>4</sup> and Sunil babu M et al<sup>5</sup> has also found results comparable with present study. In the present study, all the patients were coming from urban area while none of the patients from rural area. Longer duration of tobacco exposure is mainly responsible factor in laborer and office worker.<sup>4</sup> In our study, no females patients (n=8) had history of smoking. From remaining 44 male patients, majority (40.47%) had history of smoking exposure of at least 11-20 pack years. Mean duration was 19.02 pack years. Gupta et al<sup>6</sup> and MS. Ahmed et al<sup>4</sup> also have mean of  $26.4 \pm 16.1$  pack years and  $56.24 \pm 42.25$  pack years of smoking history which is comparable to the results of present study.

In the present study, the mean duration of disease was  $6.36 \pm 4.14$  years, range 2 to 18 years. Maximum number of patients (60%) had symptoms of 1-5 years of duration, 14% patients had more than 10 years of duration. In the study conducted by Gupta et al<sup>6</sup> and Suma KR et al<sup>7</sup> the mean duration of disease was  $8.9 \pm 4.9$  years and 5.71 years respectively which was comparable to our study.

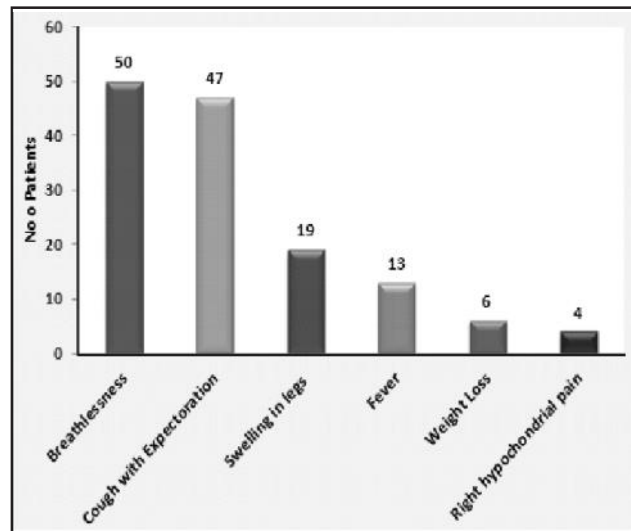
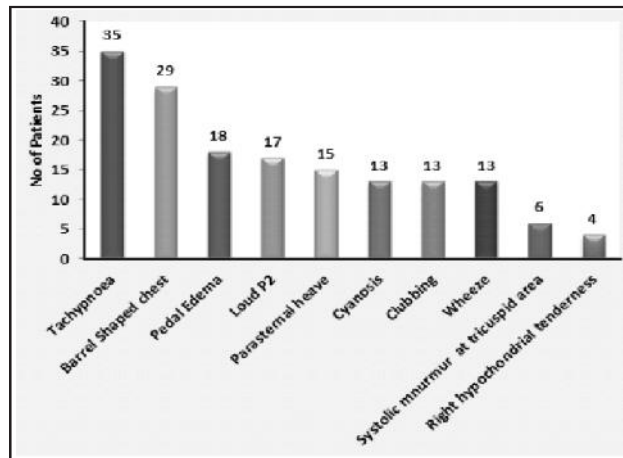


Figure 1: Symptom at presentation

In the present study (Figure 1), all the patients (100%) had history of breathlessness at presentation. Second common symptom was cough with expectoration (94%). Least common symptoms was right hypochondrial (RHC)

pain (8%). Mean Systolic Blood Pressure (SBP) was  $113.62 \pm 22.67$  and mean Diastolic Blood Pressure (DBP) was  $72.88 \pm 12.76$  mmHg. Mean pulse rate was  $98.32 \pm 16.83$  beats/minute. Kutum US et al<sup>8</sup> have mean (SBP) was  $127.24 \pm 12.60$ , mean DBP was  $77.24 \pm 6.64$  mmHg, mean pulse rate was  $87.58 \pm 8.86$  beats/minute which is similar with present study. Side effect of beta mimetic and anticholinergic agents may be the responsible factors for higher pulse rate in some patients<sup>9</sup>.



**Figure 2: Physical Signs at presentation**

Figure 2 shows that the most common sign at presentation was Tachypnoea (70%) followed by Barrel Shaped chest (58%). Least common sign was RHC tenderness (8%). Krishnan DR et al<sup>10</sup> and VN Dhadke et al<sup>11</sup> also show comparable results with present study. Commonest x-ray finding was Emphysema (80%) followed by increased bronchovascular markings (68%) and least common finding was Cardiomegaly (24%). The present study results were comparable with Krishnan DR et al<sup>10</sup> and Suma KR et al.<sup>7</sup>

In the present study PFT Shows (Table 1) that all patients had FEV1/FVC was  $< 70\%$ . Mean FEV1 was  $36.38 \pm$

**TABLE 1: SEVERITY OF COPD DISEASE**

Degree	FEV1%	No of Patients	% of patients
Mild	60-79	2	4%
Moderate	40-59	17	34%
Severe	$< 40$	31	62%
<b>Total</b>		<b>50</b>	<b>100%</b>

13.93% of predicted, range 17 to 65 % of predicted. Maximum number of patients (62%) had severe airflow obstruction at the time of presentation and only 4% had mild disease. According to Gold criteria, patients usually experience worsening dyspnea when the patient has FEV1  $< 50\%$  of predicted. Thus they tend to seek medical attention during this stage, accounting for the majority of patients who have severe obstructive defect. Kutum US et al<sup>8</sup> and Akturk F et al<sup>12</sup> also shows comparable result 45.79 % and 54% respectively with present study (36.38%). 6 patients (12%) had normal ECG and 44 patients (88%) had abnormal ECG (table 2). Commonest finding on ECG was RAD (52%) followed by 'p' pulmonale (48%) and RVH (44%). While incomplete right bundle branch block (RBBB) was least common finding (8%). Jatav VS et al<sup>13</sup> and Suma KR et al<sup>7</sup> also shows similar observation.

**TABLE 2: ECG FINDINGS**

	No of Patients	% of patients
'p' pulmonale	24	48%
Low voltage complex	14	28%
Right axis deviation	26	52%
Poor 'r' wave progression	16	32%
In complete RBBB	4	8%
Right ventricular hypertrophy	22	44%
Normal	6	12%

**TABLE 3: CORRELATION OF ECG FINDINGS WITH SEVERITY OF THE DISEASE**

	Mild (n=2)	Moderate (n=17)	Severe (n=31)	P value
'p' pulmonale		7 (41.1%)	17 (54.8%)	0.2538
Low voltage complex	1 (50%)	3 (17.6%)	10 (32.2%)	0.4354
Right axis deviation		5 (29.4%)	21 (67.7%)	0.0247
Poor 'r' wave progression		5 (29.4%)	11 (35.4%)	0.0084
In complete RBBB			4 (12.9%)	0.2638
RVH		5 (29.4%)	17 (54.8%)	0.1651
Normal	1 (50%)	5 (29.4%)		0.1797

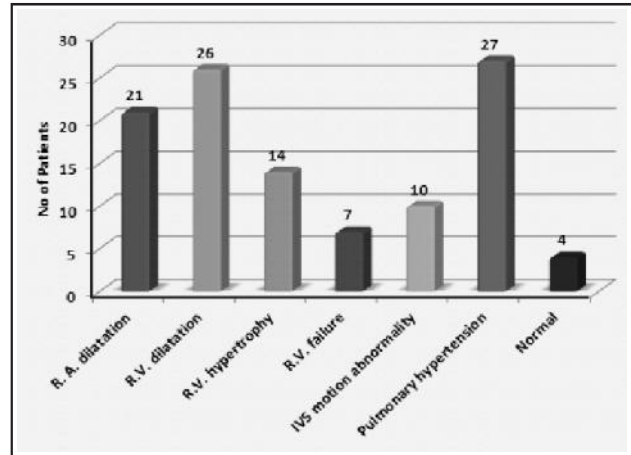
**TABLE 4: CORRELATION OF ECHO FINDINGS WITH SEVERITY OF THE DISEASE**

	Mild (n=2)	Moderate (n=17)	Severe (n=31)	P value
R. A. dilatation		3 (17.6%)	17 (54.8%)	0.0431
R.V. dilatation		4 (23.5%)	23 (74.1%)	0.0001
R.V. hypertrophy		3 (17.6%)	11 (35.4%)	0.3329
R.V. failure			7 (22.5%)	0.1594
IVS motion abnormality		1 (05.8%)	9 (29.1%)	0.1226
Pulmonary hypertension	1 (50%)	5 (29.4%)	21 (67.7%)	0.0386
Normal	1 (50%)	3 (17.6%)	0	0.2102

In the present study, 31 patients of severe COPD had abnormal ECG finding. Out of which RAD (67.7%), RVH (54.8%), p' pulmonale (54.8%), were common finding in them. Out of 17 patients of Moderate COPD 12 patient had abnormal ECG finding. Out of which 'p' pulmonale (41.1%), RAD (29.4%), RVH (29.4%) were common and 5 patients had normal ECG (29.4%). Out of 2 patients of Mild COPD 1 patient (50%) had abnormal ECG which was low voltage complex and 1 patient (50%) had normal ECG. Incidence of ECG abnormalities increases with the severity of disease like p' pulmonale 41.1% vs 54.8% in moderate vs severe disease respectively. Statistical correlation was found with right axis deviation and Poor 'r' wave progression which was also significant (i.e.  $p < 0.05$ ). Jatav VS et al<sup>13</sup> and Suma KR et al<sup>7</sup> also shows similar observation. Low voltage complexes and poor progression of 'r' wave, both incidence also increased with increasing severity, but it was not found to be statistically significant in case of low voltage complexes.

Electrocardiographic changes accompanying increasing airway obstruction and arterial blood gases in chronic bronchitis and emphysema are due to several mechanisms like hyperinflation of lungs, depression of the diaphragm, hypoxia and changes in body chemistry and vasoconstriction and reduced pulmonary vascular bed as a result of destructive parenchymal changes as suggested by Spodick and Co-workers.<sup>14</sup> In cases with little or no airway obstruction, these ECG changes are due to positional changes of heart, while in those with severe airway obstruction, both positional changes and hypertrophy or dilation, or both, of the right side of heart are likely to be responsible for the very high incidence of these electrocardiographic features.

In this study (Figure 3), 4 patients (8%) had normal echocardiographic finding and 46 (92%) patients had abnormal echocardiographic finding. Pulmonary

**Figure 3: ECHO Findings**

hypertension which was commonest (54%) finding followed by RVD (52%), RAD (42%), RVH (28%), RVF (14%). Kutum US et al<sup>8</sup> and Suma KR et al<sup>7</sup> also found similar results.

Table 4 shows that in patients of severe COPD, RVD (74.1%), PAH (67.7%), RAD (54.8%) were abnormal echocardiographic finding. Out of 17 patients of Moderate COPD, 14 patients had abnormal echocardiographic finding out of which PAH (29.4%), RVD (23.5%), RVH (17.6%) were common and 3 patients had normal Echo (17.6%). Out of 2 patients of Mild COPD, 1 patient (50%) had abnormal Echo which was pulmonary hypertension and normal 1 patient (50%) had normal Echo. It is observed that Incidence of Echo abnormalities increase with severity of disease like RVD 23.5% VS 74.1% in moderate VS severe disease respectively.

All the findings had statistically significant correlation with severity except R. V. hypertrophy and inter ventricular wall motion abnormality, this is probably because of (1) lesser number of patients in the moderate severity group. (2) Relative difficulty in getting the exact measurement of

the thickness of R.V. free wall, as it is difficult to differentiate from the surrounding structures and (3) Local variations in the right ventricular wall thickness in relation to the presence of trabeculae the right ventricle. Kutum US et al<sup>8</sup> and Suma KR et al<sup>7</sup> also found statistically significant and comparable results to our study.

#### LIMITATION OF THE STUDY

There is small sample size in this study and we also had excluded COPD patients with comorbidities like hypertension, LVD, DM, Thyroid diseases, other respiratory diseases etc. So results of this study may not reflect entire population of COPD.

#### CONCLUSION

COPD is more common in males and in the 5th and 6th decade. Most of the patients have advanced disease at presentation. The incidence of abnormalities of ECG and echocardiography increase with severity of COPD. ECG and echocardiography are better tools than clinical methods in detecting R.V. dysfunction in COPD. So COPD patients should be screened for RVD by echocardiography.

#### REFERENCES

1. M. A. Higham, D. Dawson, J. Joshi, P. Nihoyanno Paulos, N W Morell. Utility of echocardiography in assessment of pulmonary hypertension secondary to COPD. *Eur. Respir. J.* 2001;17:350-355.
2. James R Klinger, Nicholas S Hill. Right ventricular dysfunction in chronic obstructive pulmonary disease, Evaluation and management. *Chest* 1991;99:715-23.
3. Global Initiative for Chronic Obstructive Lung Disease – Global Strategy for Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary disease. <http://www.goldcopd.com> (accessed. 27-01-2017).
4. Ahmed MS, Neyaz A, Aslami AN. Health-related quality of life of chronic obstructive pulmonary disease patients: Results from a community based cross-sectional study in Aligarh, Uttar Pradesh, India. *Lung India* 2016;33:148-53.
5. Sunil BM, Praveen N, Naik V. A study of clinical profile, radiological features, electrocardiographic and echocardiographic changes in chronic cor pulmonale in a rural hospital. *Journal of Evolution of Medical and Dental Sciences.* 2013 Nov 11;2(45):8827-41.
6. Gupta S, Khastgir T, Gupta MP, Sethi KK, Manoharan S. Clinical, Haemodynamic and Echocardiographic study in chronic cor pulmonale. *JAPI* 1989;37(6): 373-376.
7. Suma K. R, Srinath S, Praveen. "Electrocardiographic and Echocardiographic Changes in Chronic Obstructive Pulmonary Disease (COPD) of Different Grades of Severity". *Journal of Evolution of Medical and Dental Sciences* 2015; Vol. 4, Issue 30, April 13; Page: 5093-5101, DOI: 10.14260/jemds/2015/744.
8. Kutum US, Deb D, Sarma PC, Deb T, Pujar R. A study on chronic obstructive pulmonary disease (COPD) patients with reference to echocardiographic findings. *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS.* 2015 Dec 24;4(103):16814-21.
9. Warnier MJ, Rutten FH, Numans ME, Kors JA, Tan HL, de Boer A, Hoes AW, De Bruin ML. Electrocardiographic characteristics of patients with chronic obstructive pulmonary disease. *COPD: Journal of Chronic Obstructive Pulmonary Disease.* 2013 Jan 16;10(1):62-71.
10. Krishnan DR, Srihari B. A study on the severity of right ventricular dysfunction in correlation with the severity of lung dysfunction in chronic obstructive pulmonary disease patients- COPD. *The Ame J Sci& Med Res.* 2015;1(1):112-9.
11. VN Dhadke, SVDhadke And N Raut et al clinical profile in chronic obstructive pulmonary disease patients and their evaluation with spirometry and 2D echo International Journal Of Current Research 2015; Vol 7, Issue. 02, pp.12480-12488.
12. Aktürk F, Bıyık I, Kocaş C, Ertürk M, Yalçın AA, Savaş AU, Kuzer FP, Uzun F, Yıldırım A, Uslu N, Çuhadaroğlu Ç. The role of electrocardiography in evaluation of severity of chronic obstructive pulmonary disease in daily clinical practice. *TuberkToraks.* 2013;61(1):38-42.
13. Jatav VS, Meena SR, Jelia S, Jain P, Ajmera D, Agarwal V, Dayma CL, Arif M. Electrocardiographic characteristics of patients with chronic obstructive pulmonary disease and its correlation with disease severity. *International Journal of Advances in Medicine.* 2017;23;4(2):514-8.
14. Tandon MK. Correlation of electrocardiographic features with airway obstruction in chronic bronchitis. *Chest* 63(2):146-148.