

## A correlative study of electrocardiographic, echocardiographic and hematological findings in chronic obstructive lung disease

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### Abstract

**Background:** COPD is presently the fourth major reason for mortality and further increments in its predominance and mortality can be anticipated in the coming decades. COPD represents a significant number of visits to a pulmonologist and other specialists.

**Methodology:** 101 patients are selected for the study, from in & out patient departments & causality in GGH, Kakinada attending with COPD from June 2016 to October 2018.

**Results:** The present investigation included 101 patients with stable COPD going to medical OP or admitted to the different wards in GGH Kakinada.

Increasing hematocrit (HB%, PCV) dictates further management of COPD in the form of LTOT.

The occurrence of ECG and echocardiographic discoveries are progressively normal as the sickness term and seriousness increase and echocardiography is better than ECG in the diagnosis of RV dysfunction in COPD.

**Conclusions:** COPD is a fairly common disease in the world now. It is more common in males and in the 5th and 6th decade. Most of the patients have fairly advanced disease at presentation.

In perspective of the extremely huge negative relationship of FEV1/FVC% with the expanding frequency of electrocardiographic variations from the standard an inexorably strong approach to manage treat the COPD patients can be taken with the goal that the beginning of cor pulmonale would be postponed as long as possible.

**Keywords:** COPD; Cor-pulmonale; P-pulmonale; Right ventricular systolic pressure (RVSP).

### Introduction

COPD is an imperative purpose behind unremitting grimness and mortality all through the world. Numerous individuals experience the ill effects of this ailment for a considerable length of time and pass on rashly from it or its intricacies. And according to projections, COPD [1] will be the 5th leading cause of DALYs lost world wide in 2020, thus accounting for enormous social and economic burden worldwide. COPD is described by gradually progressive airflow obstruction check bringing about dyspnea and exercise constraint and pneumonic blood vessel hypertension is its major cardiovascular complication. Right ventricular (RV) hypertrophy [3] is regular in patients with COPD especially in those with low oxygen tension. It happens in up to half of the patients with moderate to extreme COPD. Whenever present, it can lessen practice resistance, increment dyspnoea, and add to a general decline in utilitarian status, and predicts a higher death rate. Its acknowledgment and treatment may prompt delayed survival and enhanced personal satisfaction [2]. This investigation was attempted to examine the hematological, electrocardiographic and echocardiographic changes in COPD patients with various evaluations of seriousness of the disease, as assessed clinically and through pulmonary function testing. Further, an endeavor has been made to look at the electrocardiographic and the echocardiographic changes, as for span and seriousness of the illness and to see which of them is a good indicator of right ventricular dysfunction in COPD [4], so that the patients can be identified at an earlier stage of the disease, as early acknowledgment and treatment of right ventricular

hypertrophy in COPD, prompts delayed survival and individual liveliness. The present study was done:-

1. To study the blood parameters, ECG and 2D-echo findings in COPD
2. To correspond these results with length and seriousness of the ailment.
3. To ascribe these results in right heart failure (Cor-pulmonale) in COPD.

### Materials and Methods

101 patients are selected for the study, from in & out patient departments & causality in GGH, Kakinada attending with COPD from June 2016 to October 2018. An ethical committee approval and written informed consent of study subjects was obtained.

**Inclusion Criteria:** Ladies and gents of age more than 35 years with a history suggestive of COPD to be chosen from the OPD, respiratory wards of GGH Kakinada for the present examination.

The determination of COPD is made by manifestations in the history, and affirmed by physical examination, radiographic examination and lung spirometry by spiro analyzer (vitalograph).

The patients who are analyzed as having COPD according to GOLD rules with FEV1/VC < 70% are to be additionally made into 3 divisions.

**Division I:** Patients are to be chosen who satisfy the above criteria and have a place with moderate COPD dependent on anticipated FEV1 (50-80% of predicted) of stage 2.

**Division II:** Patients are to be chosen who satisfy the above criteria and have a place with severe COPD dependent on anticipated FEV1 (30-50% of predicted) of stage 3.

**Division III:** Patients are to be chosen who satisfy the above criteria and have a place with very severe COPD dependent on anticipated FEV1 (< 30% of predicted) of stage 4.

**Exclusion Criteria:** Patients to be barred from the present investigation are bronchial asthma, known OSA, other pulmonary ailments, known left heart failure. Other tumorous growths, uncontrolled blood pressure, significant valvular infection and known coronary vein diseases (Angina, ischemic changes in resting ECG, or known cases of MI).

Very poor echogenic subjects in whom significant echo examination couldn't be performed were likewise to be prohibited from the present investigation. Patients with non-visualization or poor visualization of just a single or couple of parameters being considered within the sight of recordable readings of alternate parameters, anyway are to be incorporated.

**Procedure:** After enlistment for the examination an intensive physical examination is done and routine examinations with extraordinary reference to Hb% and PCV (according to Proforma) were done. The patients were exposed to the accompanying examination.

**Roentgen Findings:** Chest x-ray Postero - anterior view and lateral view obtained to detect right heart enlargement [7] and / or pulmonary artery dilatation.

**ECG Findings:** A standard 12 lead electrocardiography acquired for each utilizing a compact ECG machine. The following criteria is used to detect right ventricular hypertrophy [8].

1. P-pulmonale design (P wave >2.5 mm) in leads II, III, avF.
2. Right axis deviation of QRS complex.
3. R/S amplitude ratio in V6 is less than 1.
4. R/S amplitude ratio in V1 more than 1.
5. Clockwise rotation of the electrical axis.
6. Right bundle branch block.
7. S1 Q3 or S1, S2, S3 patterns.

**Spirometry:** The spirometry was carried out with help of BPL ARPEMIS spiroanalyser (vitalograph) with flow volume loop and volume time curve. The test was conducted as per the latest standards developed by ATS & ERS.

**Echocardiographic Examination:** All the individuals of the 3 groups are subjected to echocardiographic examination. During the echocardiographic studies, recommendations of the American society of echocardiography regarding

nomenclature, standards and quantification in M- mode [5] and 2-D echo are followed. The following echocardiographic parameters are to be studied.

**M- Mode Echocardiography:** The recordings are made in parasternal view. The subjects are positioned in supine, or 15-45 left lateral position to minimize distortion of the right sided chambers, since these chambers are of particular interest in this study. All the measurements in the M- mode are taken from "Leading Edge" to "Leading edge" as proposed by American society of echocardiography.

With direct 2-D guidance using a moving cursor, the following measurement were recorded in M- mode.

Right ventricular free wall thickness (Anterior wall):- It is measured only on echocardiogram in which the epicardial [6] and endocardial surfaces had been brought out by damping and if required by a high frequency transducer. The thickness is measured as the space between the epicardial surface echo and the endocardial surface echo.

**B - Mode two Dimensional Echocardiography:** While performing this study the subject is positioned in the supine position. A four chamber view is obtained by keeping the transducer at the point of maximal impulse and angling the pointer of the transducer at 90 to the right shoulder. The adjustments are made carefully until an image of all four chambers with maximal length of right and left ventricle and mitral and tricuspid valve visualization is obtained.

The adjustments are made to the point, at which the endocardium is visualized without excessive loss of lateral or axial resolution.

Still frames of right ventricle at end diastole and right atrium at end systole are projected on the monitor screen and measurements of each chamber at its largest size was taken.

## Results

The current examination done on 101 patients with stable COPD, attending OPD and inpatients to the different units in GGH KAKINADA.

**Age distribution in COPD Patients:** The age of the patients being studied ranged between 40yrs to 81yrs. The moderate COPD division varied from 48yrs to 81yrs with a mean age of  $63.2 \pm 11.29$ yrs. The ages in severe COPD group were 40yrs to 70yrs and mean  $60.36 \pm 9.90$ yrs and in very severe COPD division was 40yrs to 80yrs and mean  $56.02 \pm 9.08$ yrs.

**Table 1: Age distribution in COPD**

Column 1	Stage of COPD	Mean Age
Stage 2	Moderate COPD	$63.2 \pm 11.29$ yrs
Stage 3	Severe COPD	$60.36 \pm 9.90$ yrs
Stage 4	Very Severe COPD	$56.02 \pm 9.08$ yrs

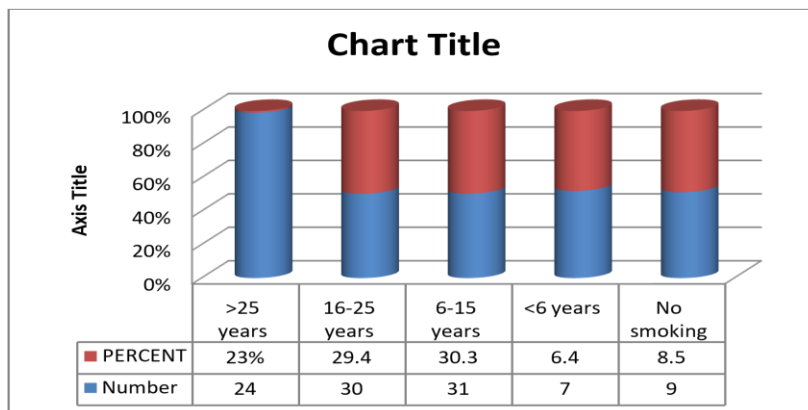
**Table 2: Distribution of COPD severity in specific age groups**

Age Distribution	Moderate (n=35)	Severe (n=30)	Very Severe (n=36)
41-50	2	5	15
51-60	13	9	12
61-70	14	12	7

71-80	5	3	2
>80	1	-	-
Median Age	63	59	55.5
Standard Dev	8.31	9.69	9.57

Majority of moderate & severe stage COPD pts belonged to 51 to 70yrs age group.  
Majority of very severe COPD pt's belonged to 41 -60yrs age division.

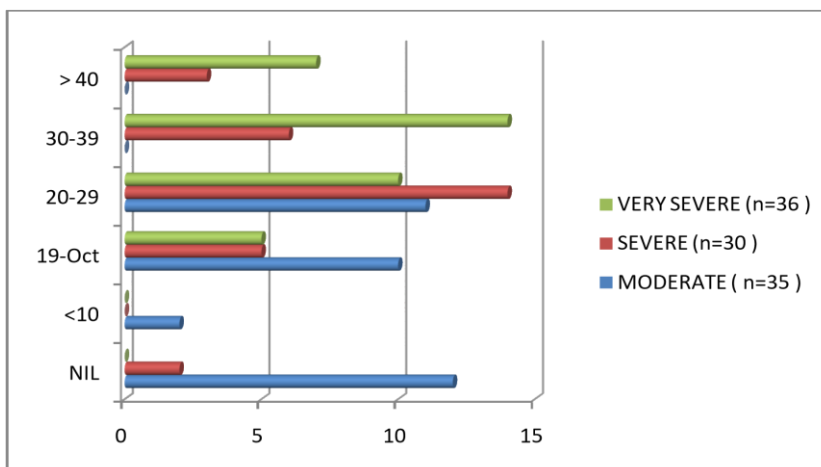
**Smoking History**



**Fig. 1**

**Table 3**

Duration (pack years)	No of patients (n=101)	Percentage
NIL	14	13.86
<10	2	1.98
10-19	20	19.8
20-29	35	34.65
30-39	20	19.8
>40	10	9.9



**Fig. 2**

Most of the patients have an average pack years about 10-40 pack years.  
More than 30 pack years is observed among severe and very severe groups of COPD.

**Spirometry Results**

**FVC (Liters):** FVC in patients with very severe obstruction had a mean of 1.88±0.50 as compared to the moderate and severe patients who had a mean of 2.30±0.45 and 2.13 ±0.42 respectively In this way it was modified essentially in patients with serious obstruction (P < 0.01).

**FEV (Liters):** Similarly there was a change in FEV estimations of patients with exceptionally serious deterrent

[12]. The obtained mean values of FEV in very Severe patients was 0.58±0.16, when compared to that of moderate and severe with mean of 1.44±0.35 and 0.95±0.24 respectively which was statistically significant (P<0.01).

**FEV %:** The FEV % in very severe patients, (mean 25.17±3.69) was lower than that of moderate and severe patients, mean (63.10±6.0 and 42.17±4.77) respectively. The decrease was statistically significant (P<0.01).

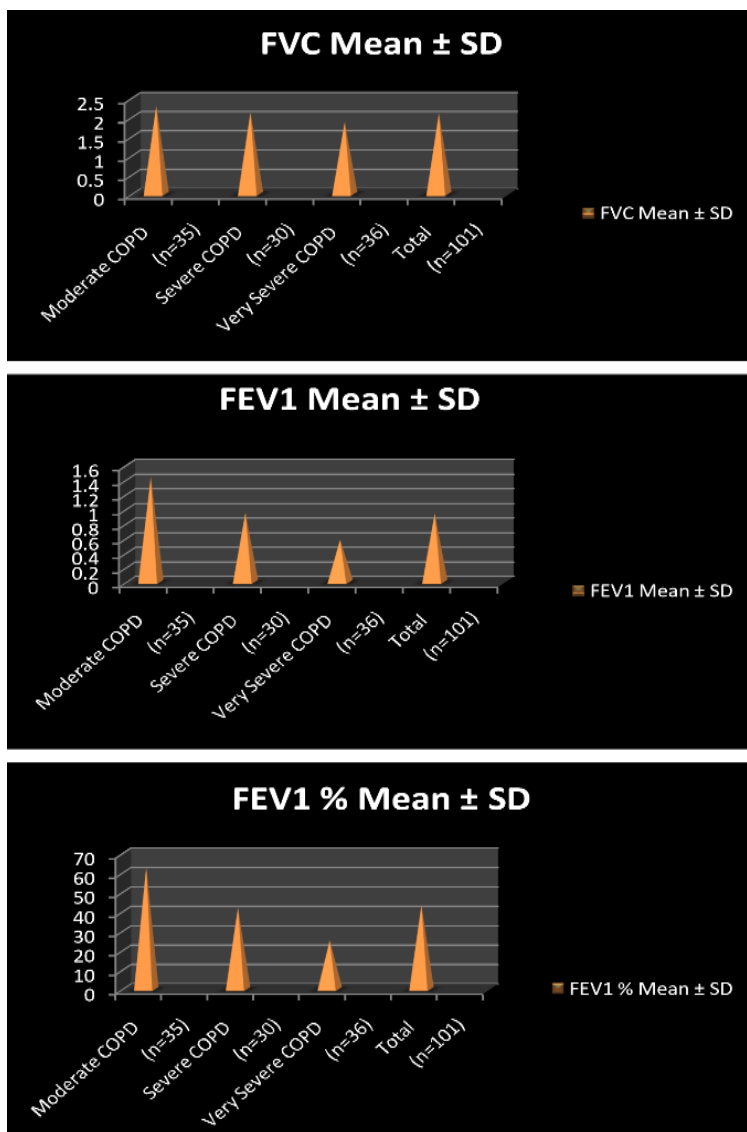


Fig. 3

Table 4: Haematological parameters

	Hb% (gm/dl)		PCV	
	Range	Mean ± SD	Range	Mean ± SD
Moderate COPD	9.1 - 15.2	12.46 ±1.36	24.1 - 44.1	35.53 ±4.3
Severe COPD	10.6-16.4	12.84 ±1.51	30.5 -45.7	36.67 ±4.09
Very Severe COPD	9.9-16.7	13.88±1.57	27.4 - 45.8	39.8±4.31
Total (101)	9.1 -16.7	13.08 ± 1.6	24.1 - 45.8	37.4± 4.67
Significance	F=8.414	P=0.001	F=9.243	P=0.001

The mean Hb % of study group is 13.08 ± 1.6 .PCV is 37.4

**Table 5: ECG parameters**

ECG findings	Moderate COPD (n=35)	Severe COPD (n=30)	Very Severe COPD (n=36)	Total (n=101)	'P' Value
'P' Pulmonale	10(28.57%)	12(40%)	16(45%)	38(37.6%)	0.093
R/S in V1 >1	2(4.76%)	2(5%)	5(15%)	9(8.91%)	0.227
R/S in V6 <1	3(9.52%)	8(25%)	14(40%)	25(24.75%)	0.005
Right axis deviation	2(4.76%)	6(20%)	13(35%)	21(20.7%)	0.008
RBBB	2(4.76%)	3(10%)	5(15%)	10(9.99%)	0.972
S1,S2,S3 or S1 Q3	-	-	1	1	0.990

Most basic ECG in ECG finding in mod COPD pts is P pulmonale

Most basic discoveries in severe and very severe COPD are P pulmonale, R/S in V6<1 and RAD.

S1Q3 was seen in just a single instance of severe COPD.

## 2D-Echocardiography Results

**Table 6: Relation of 2D Echo results with severity of the COPD**

Echo findings	Moderate (n=35)	Severe (n=30)	Very severe (n=36)	Total (N=101)	'P' Value
R. A. dilatation	2	6	15	23	0.001
R.V. dilatation		4	24	28	0.001
R.V. hypertrophy	4	8	12	24	
IVS motion abnormality		2	16	18	0.001
Pulmonary hypertension	8	17	27	52	0.001

Pulmonary hypertension was identified in 52 out of 101 cases of the study group.

24 out of 36 very severe COPD cases showed RVD

IVS motion abnormality observed in 16 out of 36 cases in very severe COPD.

## Discussion

COPD is quick rising as a risk to world in pandemic extent. With the expansion in smoking in developing nations, particularly India and China, COPD is required to wind up the third driving reason for death all over the world by 2020.

The present examination was embraced to research the example and extent of clinical parameters and in addition Lab parameters in particular ECG, ECHO [8] and Blood parameters and to explore the connection between the seriousness of the sickness and parameters.

The investigation comprise of 101 subjects which were additionally separated into 3 divisions relying on the seriousness of the malady. (FEV1% of anticipated).

Division I contains subjects with moderate COPD (stage II), Division II has subjects with severe COPD (stage III) while Division III has subjects with very severe COPD (stage IV).

Every one of the people in various divisions were exposed to definite history and physical examination. Spirometric parameters were assessed with the help of spirometer. All patients underwent electrocardiography, conventional radiography [9] and echocardiography along with routine tests with particular reference to Hb% and PCV.

The aim of the present work was to assess the respective value of physical examination, chest x-ray, ECG, echocardiography and hematological parameters and their relationship between the severities of COPD.

1. The age of the patients being studied ranged between 40yrs to 81yrs. The moderate COPD group ranged from

48yrs to 81yrs with a mean age of  $63.2 \pm 11.29$  yrs. The severe COPD aggregate were 40yrs to 70yrs and mean  $60.36 \pm 9.90$  yrs and in very severe COPD was 40yrs to 80yrs and mean  $56.02 \pm 9.08$  yrs. Despite the fact that the mean age in the very severe division was less contrasted with alternate divisions the beginning of disease was a lot before in severe COPD contrasted with other COPD's and the time of beginning smoking [10] in this category was approximately a decade before compared to other groups.

- All male patients except 4 had a history of smoking for 5yrs or more. Out of 14 females in the study 4 females are reverse smokers and 5 females are exposed to biomass fuel due to firewood cooking. Among the rest 4 male and 5 female patients who are non-smokers, no positive reason could be set up and subsequently natural factors for instance air contamination and second hand smoking might be considered as the conceivable etiology for COPD in them. The favored method of smoking was cigarettes. Out of 101 patients incorporated into the examination, 14 individuals expended half pack or less, 54 individuals devoured roughly 1pack every day and 19 patients devoured > 1pack of cigarettes/beedies every day and 14 patients who are non-smokers.
- The PFT parameters namely FEV1, FVC and FEV1% was significantly altered, FEV1, FVC and FEV1% are inversely and significantly related to severity of COPD decreasing with the severity of the COPD.

4. In the present study, the lower and higher values of Hb% (g/dl) varied from 9.1 -16.7 with a mean of  $13.08 \pm 1.6$ . Hb% (g/dl) of 9.1 - 15.2 with a mean of  $12.46 \pm 1.36$ , 10.616.4 with a mean of  $12.84 \pm 1.51$  and 9.9-16.7 with a mean of  $13.88 \pm 1.57$  in moderate, severe and very severe COPD patients respectively. The lower and higher values of PCV varied from 24.1 - 45.8 with a mean of  $37.4 \pm 4.67$  PCV in moderate, severe and very severe divisions have 24.1 - 44.1, 30.5 -45.7 and 27.4 - 45.8 with a mean of  $35.53 \pm 4.3$ ,  $36.67 \pm 4.09$  and  $39.8 \pm 4.31$  respectively. Both Hb% and PCV are exceptionally increased values in patients with severe obstruction.
5. In the present examination out of aggregate 101 patients, 60(59%) patients demonstrated ECG changes suggestive of association of right half of the heart. The most widely recognized anomaly was 'P' pulmonale (moderate-28.57%, severe 40% and very severe 45%). 'P' pulmonale was seen in more regularly in patients with severe COPD. The R/S proportion in V < 1 related fundamentally well with the seriousness of COPD, 3(9.52%) in moderate COPD, 8 (25%) in severe COPD and 13 (40%) patients in very severe COPD had this variation from the normal.
6. P-pulmonale has been used as an unusual tool of right ventricular hypertrophy by various makers [12]. The clarification behind the qualifications in the ECG revelations in our examination may be a direct result of the manner in which that the model measure was nearly nothing and besides as we had arranged the patients to different social occasions diverged from exchange examinations which were finished on huge number of patients without order. Different conditions like RBBB (Prolonged QRS >0.10 sec, wide terminal s wave in lead 1, V5, V6 and RSR complex in V1) are additionally observed in around 10 cases. S1S2S3 disorder is found in one case which represents posterior displacement of apex.
7. **Connection of ECG Discoveries with Severity:** The occurrence of 'p' pulmonale, right axis deviation and right ventricular hypertrophy expanded as the severity of disease increased. Increased frequency of 'p' pulmonale [13], right axis deviation, and RVH are seen with expanding severity. Different investigations relating the ECG discoveries with severity of the malady have additionally mentioned comparable objective facts, and furthermore have given distinctive clarifications for their perception.
8. **Correlation of ECG Discoveries with Term of Indications:** The incidence of 'p' pulmonale, right axis deviation and right ventricular hypertrophy increased as the duration of disease increased. The other findings of low voltage complexes and poor progression of 'r' wave did not show any correlation to duration of disease. 'P' pulmonale, RAD, RVH and incomplete RBBB [14] which are ECG signs of cor-pulmonale [15], are found with increasing incidence as duration of disease, increases.
9. **Analysis of Echocardiographic Findings:** In the present examination, 57% (56/101) of the patients had echo proof of, containing R. V. dilatation, R. V. hypertrophy, R. A. dilatation [11], or interventricular septum movement variation from the norm. Study relates well with the greater part of the discoveries in the investigation by Himelmann et al. Frequency of interventricular septum movement irregularity. In the present examination (16/101) patients (17%) had echo proof of interventricular movement [16] abnormality in the form of paradoxical movement or systolic bowing into the left ventricle, which is a sign of systolic over load of right ventricle In a study by Danchin et al (1987) 3 patients (7.5%) had paradoxical motion of the interventricular septum. The generally low rate of PAH in the moderate COPD in the present examination is a result of moderately vast investigation amass contrasted with Higham et al., and in any case, the occurrence in the moderate and the SEVERE COPD's are observed to be reasonably corresponding. RVSP obtained from ECHO showed >50 in case of moderate COPD and >80 in severe varieties.
10. **Correlation of Echocardiographic Findings with Duration of Symptoms:** All the echocardiographic findings generally showed an increasing trend in the incidences, with increasing duration of symptoms significant correlation was found with R. V. dilatation [17], pulmonary hypertension, whose incidence were significantly higher, longer the duration of the disease. This can be explained by the fact that longer the existence of disease, higher is the chances that the patient has developed pulmonary hypertension and cor pulmonale [18] and also right heart failure. In present investigation we additionally seen that even a portion of the patients with mild COPD will in general have highlights of PAH as proved by ECG and Echocardiographic parameters. It might should be affirmed by huge population based investigations. In this study the diagnosis of cor-pulmonale [19] could be made by clinical method, electrocardiographic method and echocardiographic method. Echocardiography is better than ECG or clinical methods, to detect the presence of cor pulmonale [20] in patients with COPD. But gold standard for detecting PAH being right heart catheterization which is an invasive method and not available widely in most of developing nations may be substituted with 2d echo with Doppler. It is well known that clinical signs are often difficult to detect in patients with COPD, because of over inflation of chest and posterior rotation of heart. Echocardiography in COPD is not without inherent drawbacks. The substernal area of the correct ventricle itself, and furthermore the troubles presented by the over expansion of lungs, which decreases the window accessible for examination, prompts issues in obtaining a good echocardiographic study.

## Conclusions

COPD is one of the most common ailment on earth. It is progressively normal in gents and in the fifth and sixth decade. A major proportion of COPD patient's presence as a severe and very severe disease.

1. ECG changes significantly correlated with low values of FEV1/FVC ratio. It very well may be construed that ECG is a valuable bedside test to evaluate the seriousness of COPD.
2. On ECG, the most common abnormality observed was 'P'- pulmonale but R/S ratio in V6 < 1 correlated significantly well with the severity of COPD.
3. In the Echocardiographic study, the right heart parameters were significantly increased when very severe COPD group were compared to moderate and severe COPD.
4. In viewpoint of the to a great degree colossal negative relationship of FEV1/FVC% with the extending recurrence of electrocardiographic varieties from the standard an undeniably compelling approach to manage treat the COPD patients can be taken so the beginning of corpulmonale would be deferred to the extent that this would be possible.
5. The incidence of ECG and echocardiographic findings are more common as the disease duration and severity increase and echocardiography is better than ECG in the diagnosis of RV dysfunction in COPD.
6. Increasing haematocrit (HB%, PCV) dictates further management of COPD in the form of LTOT.
7. Ultimately the diagnosis of PAH requires right heart catheterization which is the gold standard which measures MPAP. CARDIAC MRI may override this as gold standard. But right heart catheterization is an invasive procedure and is associated with certain morbidities and also not widely available in less advanced countries like ours. In the present study 2D echo Doppler proved to have a role in detecting corpulmonale. Hence, it is concluded that all patients with moderate and severe COPD should be screened for PAH by which severity can be assessed, more intensive treatment can be adopted.

**Conflicts of Interests:** None declared.

**Acknowledgements:** Nil

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