

A Study to Assess the Electrocardiographic Changes in the COPD Patients and its Correlation with the Severity of Disease**Rajneesh Kumar¹, Abu Huraira², Himanshu Kumar³, Hemant Narayan Ray⁴**¹Senior Resident, Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India²Senior Resident, Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India³Senior Resident, Department of Cardiology, IGIC, Patna, Bihar, India⁴Professor and HOD, Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India

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Corresponding Author: Dr. Abu Huraira

Conflict of interest: Nil

Abstract:**Aim:** The aim of the present study was to assess the electrocardiographic changes in the COPD patients and to correlate Electrocardiographic changes with the severity of disease.**Methods:** This hospital based cross sectional study was conducted at department of cardiology among patients of COPD who presents to our hospital during study period. Duration of study was 18 months. The present study included a total of 100 cases of COPD coming to our hospital during study period.**Results:** Male predominance was seen in the study group with 70% males to 30% females. A total of 58% cases were still smoking while 32% cases quit smoking after diagnosis of COPD. Out of the total 100 cases, 51% had mild symptoms, 36% had moderate symptoms while 13% had severe symptoms as per GOLD criteria. Severity assessment as per CAT scale showed 64% as low risk i.e. grade A and B while 32% were at high risk i.e., grade C and D. Most common ECG abnormality was arrhythmia among COPD cases (45%) followed by RAD – P wave (46.5%) and p-pulmonale (31%). Most common type of arrhythmia among COPD cases were sinus tachycardia (28%) followed by right bundle branch block (12%). Atrial fibrillation was seen in 1% cases. Gender distribution was comparable among cases with and without ECG changes (p=0.160). A significant association was observed between ECG changes in COPD cases with its severity. Prevalence of ECG changes increases from 37.5% in CAT grade A to 100% in grade D (p<0.01).**Conclusion:** COPD is more common in males and in the 5th and 6th decade of life. Most of the patients have mild to moderate disease at presentation. ECG abnormalities were common in cases of COPD, affecting seven out of ten cases and have a significant association with COPD and symptoms severity. The most common electrocardiographic abnormality seen was arrhythmias.**Keywords:** Chronic Obstructive Pulmonary Disease, Prevalence, ECG changes, arrhythmiaThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow limitations, generally progressive and associated with an increased chronic inflammatory response to the airways and lungs due to harmful particles or gases. [1] Heart disease is one of the comorbid factors of COPD; patients with COPD have a high chance of developing heart disease. [2] The coexistence of two conditions cannot be separated from the linkage of the function of the lungs and heart. It most likely can be caused by having the same risk factors: smoking, age, unhealthy lifestyle, and low socioeconomic factors. [3,4] COPD patients are more likely to be

hospitalized and die from cardiovascular disease, [5] which impacts the management of patients. [6]

Changes in the electrocardiogram (ECG) image are associated with the risk of acute exacerbation and an increased risk of death in patients who do not have a previous heart history. [7–9] ECG images are often found in COPD patients, such as right axis deviation (RAD), right bundle branch block (RBBB), P-pulmonary/right atrial hypertrophy (RAH), and right ventricle hypertrophy (RVH). This ECG change in COPD patients is highly related to the severity of the disease. [9–11]

Chronic airway obstruction is an important and rapidly increasing problem in different parts of the world. Chronic obstructive pulmonary disease (COPD) is a progressive disease characterized by airflow limitation/obstruction i.e. either not reversible at all or only partially reversible. COPD is associated with abnormal inflammatory response of the lungs to chronic inhalation exposure from smoke, dust and other air pollutants. It manifest as chronic cough with or without sputum production. Chronic bronchitis and emphysema are grouped together as COPD as these conditions cannot be separated. [12-15] Manifestation of disease as chronic cough with or without sputum production for more than three months of a year for at least two consecutive years is considered essential for COPD. It may or may not be accompanied with progressive breathlessness. A detailed discussion on guidelines for management of COPD is available in a recent study by Jindal et al. [16]

The aim of the present study was to assess the electrocardiographic changes in the COPD patients and to correlate Electrocardiographic changes with the severity of disease.

Materials and Methods

This hospital based cross sectional study was conducted at department of cardiology Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India among patients of COPD who presents to our hospital during study period. Duration of study was 18 months.

Thus, present study included a total of 100 cases of COPD coming to our hospital during study period. Consecutive type of non-probability sampling was followed for selection of cases.

Inclusion Criteria

1. All the patients should be more than 18 years of age
2. Diagnosed Cases of COPD

Exclusion Criteria

1. Bronchial asthma
2. Post pulmonary TB
3. Myocardial infarction
4. Ischemic heart disease
5. Congestive heart failure
6. Pericardial effusion.

Methodology: Study was Informed consent was taken from all diagnosed cases of COPD, before inclusion in the study. Diagnosis and severity of COPD can be staged on the basis of spirometry. In pulmonary function testing, a post-bronchodilator FEV1/FVC ratio of <0.70 is commonly considered

diagnostic for COPD. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) system categorizes airflow limitation into stages. In patients with FEV1/FVC <0.70:

- GOLD 1 - mild: FEV1 \geq 80% predicted
- GOLD 2 - moderate: 50% \leq FEV1 < 80% predicted
- GOLD 3 - severe: 30% \leq FEV1 < 50% predicted
- GOLD 4 - very severe: FEV1 < 30% predicted.

The GOLD guideline uses a combined COPD assessment approach to group patients according to symptoms and previous history of exacerbations. Symptoms were assessed using the COPD assessment test (CAT) scale. The cases were grouped as follows:

- Group A: low risk (0-1 exacerbation per year, not requiring hospitalization) and fewer symptoms (mMRC 0-1 or CAT <10)
- Group B: low risk (0-1 exacerbation per year, not requiring hospitalization) and more symptoms (mMRC \geq 2 or CAT \geq 10)
- Group C: high risk (\geq 2 exacerbations per year, or one or more requiring hospitalization) and fewer symptoms (mMRC 0-1 or CAT <10)
- Group D: high risk (\geq 2 exacerbations per year, or one or more requiring hospitalization) and more symptoms (mMRC \geq 2 or CAT \geq 10).
- All the cases were then subjected to standard 12 lead ECG. A 12 lead ECG including 3 bipolar limb leads, 3 unipolar limb leads and 6 unipolar precordial leads was performed.

All necessary precautions desired in ECG were observed. ECG was done by single channel BPL cardiart various 108 T/MK-V I machine. Various ECG parameters like rate, axis deviation, P-wave changes, QRS complex, T-wave, ST changes etc. were observed. The axis of P value and QRS complex was calculated by hexaxial reference system. ECG changes such as Right Axis Deviation of P Waves, P Pulmonale, Right Axis Deviation QRS, RBBB, SV4 > RV4, RAmp < 0.7mv, SISIISIII pattern were studied. These changes were then correlated with the severity of disease.

Statistical Analysis:

Qualitative data was represented in the form of frequency and percentage. Association between qualitative variables was assessed by Chi-Square test. Quantitative data was represented using Mean \pm SD. Analysis of Quantitative data between the two groups was done using unpaired t-test if data passed Normality test and by Mann-Whitney Test if data

failed Normality test. A p-value < 0.05 was taken as level of significance. SPSS Version 21.0 was used for most analysis and Microsoft Excel

2010 for graphical representation.

Results

Table 1: Patient characteristics

Gender	N	%
Male	70	70
Female	30	30
Mean age	62.58 years	
Smoking status		
Not smoking	10	10
Still smoking	58	58
Quit smoking	32	32
COPD duration		
1-5 years	27	27
9-10 years	30	30
>10 years	43	43
Mean duration	9.72 years	
Symptoms as per GOLD criteria		
Mild	51	51
Moderate	36	36
Severe	13	13
CAT Scale		
A	32	32
B	32	32
C	24	24
D	12	12

Mean age of the study cases was 62.58 years. Male predominance was seen in the study group with 70% males to 30% females. A total of 58% cases were still smoking while 32% cases quit smoking after diagnosis of COPD. Mean duration of COPD was 9.81 years with 42.6% cases having COPD for over

10 years. Out of the total 100 cases, 51% had mild symptoms, 36% had moderate symptoms while 13% had severe symptoms as per GOLD criteria. Severity assessment as per CAT scale showed 64% as low risk i.e. grade A and B while 32% were at high risk i.e., grade C and D.

Table 2: Distribution of study groups as per type of ECG changes

Type of ECG Changes	N	%
Arrhythmias	45	45
p-pulmonale	31	31
RAD- P wave	46	46
Low QRS	9	9
SV4>RV4	9	9
R Amp <0.7 mv	8	8
SI SII SIII Pattern	11	11

Most common ECG abnormality was arrhythmia among COPD cases (45%) followed by RAD – P wave (46.5%) and p-pulmonale (31%).

Table 3: Distribution of study groups as per type of arrhythmias present

Arrhythmias	N	%
Sinus Tachycardia	28	28
RBBB	12	12
Atrial Ectopy	4	4
AF	1	1

Most common type of arrhythmia among COPD cases were sinus tachycardia (28%) followed by right bundle branch block (12%). Atrial fibrillation was seen in 1% cases.

Table 4: Association of ECG changes in COPD cases with gender

Gender	ECG Changes		Total
	No	Yes	
Female	2	10	12
	16.66%	83.34%	100%
Male	28	60	88
	31.82%	68.18%	100%
Total	30	70	100
	30%	70%	100%
p- value - 0.160			

Gender distribution was comparable among cases with and without ECG changes (p=0.160).

Table 5: Association of ECG changes with severity of COPD

GOLD Grade	ECG Changes		Total
	No	Yes	
Mild	24	27	51
	47.05%	52.95%	100.0%
Moderate	6	30	36
	16.66%	83.34%	100.0%
Severe	0	13	13
	0.0%	100.0%	100.0%
Total	30	70	100
	30%	70%	100.0%
p- value <0.01			

A significant association was observed between ECG changes in COPD cases with its severity.

Table 6: Association of ECG changes in COPD cases severity of symptoms

CAT Scale	ECG Changes		Total
	No	Yes	
A	20	12	32
	62.5%	37.5%	100.0%
B	5	27	32
	15.625%	83.375%	100.0%
C	5	19	24
	20.84%	79.16%	100.0%
D	0	12	12
	0.0%	100.0%	100.0%
Total	30	70	129
	30%	70%	100.0%
p- value <0.01			

Prevalence of ECG changes increases from 37.5% in CAT grade A to 100% in grade D (p<0.01).

Discussion

COPD is often associated with different co-morbidities and systemic consequences, which further impair functional status, reduce quality of life and increase mortality. [17] In human being, the respiratory and circulatory systems are so intimately related that changes in one sooner or later may cause changes in the other. Heart is the most damaged organ for COPD as systemic complication and

develops much pathology of cardiovascular disorders (CVDs). The cardiac manifestations of COPD are directly due to pulmonary arterial hypertension and the development of Cor Pulmonale. It is very important to recognize early evidence of right sided cardiac involvement in patients with COPD. The clinical manifestations of Cor pulmonale are relatively late and can even be masked by hyper inflated lungs. [18] The CVDs developed among COPD patients as systemic effect can be diagnosed by different instruments including electrocardiogram (ECG). ECG is the graphic

records of time-varying bio-electric potential generated by the electrical activity of heart which used to measure and monitor the structural and functional activity of the heart for its ease of usage and non-invasiveness. The ECG changes observed among heart of COPD patients are arrhythmia, axis deviation, heart chamber enlargement and hypertrophy. [19,20]

Mean age of the study cases was 62.58 years. Male predominance was seen in the study group with 70% males to 30% females. A total of 58% cases were still smoking while 32% cases quit smoking after diagnosis of COPD. Mean duration of COPD was 9.81 years with 42.6% cases having COPD for over 10 years. Out of the total 100 cases, 51% had mild symptoms, 36% had moderate symptoms while 13% had severe symptoms as per GOLD criteria. Severity assessment as per CAT scale showed 64% as low risk i.e. grade A and B while 32% were at high risk i.e., grade C and D. In a study on socio-demographic co-relates of chronic lung diseases in Eastern India by Tiwari et al [21] majority (54.5%) of the subjects were males and majority belonged to the age group between 40-60 years with mean age of 51.3 years. In a similar study by Jastrzêbski et al [22] mean age of subjects was 58.7 years with male predominance (63%). A total of 59% had mild symptoms, 31% had moderate symptoms while 10% had severe symptoms. In a study by Hasaneen N et al [23] 85% of cases of AECOPD were either current smokers or ex-smokers while in the study by Raji H et al [24] almost 94% cases gave history of smoking. Anup Banur [25] observed history of smoking in 90% of the patients.

Most common ECG abnormality was arrhythmia among COPD cases (45%) followed by RAD – P wave (46.5%) and p-pulmonale (31%). Most common type of arrhythmia among COPD cases were sinus tachycardia (28%) followed by right bundle branch block (12%). Atrial fibrillation was seen in 1% cases. Gender distribution was comparable among cases with and without ECG changes ($p=0.160$). A significant association was observed between ECG changes in COPD cases with its severity. Prevalence of ECG changes increases from 37.5% in CAT grade A to 100% in grade D ($p<0.01$). Chaudhari R [26] observed ECG abnormalities in 88% patients of COPD. Most common ECG abnormality was RAD – P wave (52%), p-pulmonale (48%) and RVH (44%). Prevalence of ECG changes among mild, moderate and severe cases increases gradually from 50% to 82.4% to 100% respectively ($p<0.01$). Demissie WR [27] observed prevalence of abnormal ECG as 83.75% where arrhythmia accounted for 50%, atrial enlargement 48.8%, myocardial infarction (MI) 41.3%, axis deviation 35%, other ECG abnormalities (poor R-wave progression and low QRS amplitude) 35% and ventricular hypertrophy

15%. The identified associated factors with the abnormal ECG were smoking and severity of COPD with their specific adjusted odds ratio (AOR) and 95% CI of 2.2(1.5-8.6) and 3.2(2.0-8.4) respectively. Singh II [28] in their study also concluded that electrocardiographic changes are found to be observed more with those who have higher grade or degree of airway obstruction. Relationship between ECG findings and degree of airway obstruction is found to be highly significant. Thus, to summarize, present study showed high occurrence of ECG changes in COPD patients, especially rhythm disturbances. A 12 lead ECG is an easy and efficient tool in detecting cardiovascular complications like pulmonary hypertension, 'p' pulmonale and RV dysfunction in COPD patients. ECG changes significantly correlated with disease severity.

Conclusion

COPD is more common in males and in the 5th and 6th decade of life. Most of the patients have mild to moderate disease at presentation. ECG abnormalities were common in cases of COPD, affecting seven out of ten cases and have a significant association with COPD and symptoms severity. The most common electrocardiographic abnormality seen was arrhythmias. As cardiovascular events especially arrhythmias are a leading cause of COPD-related mortality, every patient of COPD, should undergo ECG monitoring for early diagnosis of rhythm disturbances, thereby ensuring prompt treatment and better prognosis.

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