

STUDY OF ECG FINDINGS IN COPD PATIENTS IN A TERTIARY CARE CENTRE.

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Abstract

Background: Globally, chronic obstructive pulmonary disease (COPD) is a major contributor to morbidity, disability, and mortality. ECGs are frequently abnormal in people with chronic obstructive pulmonary disease (COPD). Findings from electrocardiograms (ECGs) could be useful in making clinical decisions about this disease entity.

Aims and objectives: To evaluate the diagnostic values of ECG changes among COPD patients admitted at tertiary care hospital.

Methods: Institutional based cross-sectional study was carried out in Dr. DY Patil Medical College and Hospital, Pune, India. A sample of 130 patients with respiratory illness attending OPD under General Medicine were selected randomly during the study period of 2021-2022. A COPD diagnosis was obtained based on the patient's medical history, chest x-ray findings, and the GOLD criteria based on spirometry. We studied the electrocardiographic profile and its association with severity of the COPD.

Results: Out of the total patients, majority were male. The mean age was 53.96 ± 9.43 years. As per GOLD guidelines, 5% had mild, 38% moderate, 35.3% severe and 21.3% had very severe COPD. Most frequent Symptoms was breathlessness (92.7%) on presentation, followed by cough with sputum (79.3%). The most common ECG changes were P-pulmonale which indicates pulmonary hypertension (52.2=7%) and right ventricular hypertrophy (42.7%). Other ECG changes were Low voltage of QRS complex (34.7%), R/S ratio $V_6 < 1$ (19.3%), R/S ratio $V_1 > 1$ (24%), Right axis deviation of QRS complex (27.3%), Polymorphic P wave (10.7%), cardiac arrhythmias (5.3%) and right bundle branch block (8.7%). All ECG changes were correlated significantly with severity of the disease except Low voltage of QRS complex.

Conclusion: The results of the study showed a significant correlation between the severity of COPD and electrocardiographic changes such as P pulmonale, right ventricular hypertrophy, and right axis deviation. ECG, being simple, noninvasive and inexpensive investigating tool, can be used for cardiac screening of all COPD patients which will be helpful in the assessment of the prognosis, so that proper institution of therapy can be initiated early to prevent long-term complications of severe pulmonary hypertension and right heart failure.

Key words:COPD, P-pulmonale, Right Ventricular Hypertrophy.

Introduction:

Globally, chronic obstructive pulmonary disease (COPD) is a common health problem. Chronic obstructive pulmonary disease (COPD) is a respiratory condition characterized by airflow limitation and is associated with significant morbidity and mortality.¹⁻³ Globally, COPD is 4th leading cause of mortality and becomes 3rd leading cause of mortality by 2030 worldwide.

COPD has notable extrapulmonary consequences and is associated with substantial comorbidities that may exacerbate the disease.⁴ The relationship between the cardiovascular and respiratory systems is well established. Any alterations to the cardiovascular system might impact the respiratory system, and vice versa. COPD is majorly associated with significant extrapulmonary (systemic) consequences among which cardiac manifestations are most common. If FEV1 is greater than 50% of predicted, cardiovascular diseases are responsible for around 50% of all hospitalisations and about one third of all deaths.

The effects of COPD on the heart, right and left ventricles, and pulmonary blood arteries result in the development of diseases such pulmonary hypertension (PH), cor pulmonale (COR-P), right ventricular dysfunction, and left ventricular dysfunction.⁴ Numerous studies have shown the prognostic value of the degree of pulmonary hypertension in COPD patients, and a high degree of PH indicates a poor prognosis. Furthermore, pulmonary hypertension (PH), which is frequent COPD complication and the ensuing right ventricular dysfunction are both predictive indicators of survival in COPD.

Many earlier studies have shown association of many cardiovascular features with COPD and these changes can be demonstrated Electrocardiographically. Frequently observed ECG abnormalities in COPD are Right bundle branch block, P-pulmonale, low voltage complex, sinus tachycardia, etc.

The purpose of the current study was to examine the diagnostic utility of ECG in assessment of COPD of patients. Additionally, a correlation between the electrocardiographic alterations and the length and severity of the disease has been attempted.

Methods:

Study design and Population

An institution based cross-sectional study was carried out at Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pune, India. The study was conducted during the period from **January 2020 to May 2021. Present study included** 150 consecutively selected COPD patients who were above 30 years admitted under the department of General Medicine. All the patients above 30 years who were spirometrically proven chronic obstructive pulmonary disease were included for the study. Patients with history of cardiac diseases like ischemic heart disease, rheumatic heart disease, valvular heart diseases, congenital heart disease etc, patients with Bronchial asthma, Tuberculosis, Ischemic Heart Disease, Rheumatic Heart Disease, Thyrotoxicosis were excluded from the study.

Study procedure and measurements

Institutional ethical committee clearance was obtained and informed consent was taken from all the patients.

A comprehensive physical examination and standard investigations were performed after participants were recruited for the study. All of the patients who were chosen underwent a clinical examination to look for signs of ventricular hypertrophy, cardiomegaly, PH, and/or heart failure. They were also asked for history of their respiratory and cardiovascular symptoms. Patients were investigated for routine investigation such a complete blood count, renal function test, random blood sugar testing, as well as a chest X-ray and electrocardiogram. The patients were subjected to the spirometric examination and the patients were graded according to the severity of COPD with guidelines given by GOLD. The COPD patients were classified into 4 groups as per their severity:

Group I- Patients having FEV/FVC 0.7 or less, but having a FEV1 of more than 80% of predicted value.

Group II- Patients selected fulfil the above criteria and belong to moderate COPD based on predicted FEV1 (50 - 80% of predicted value).

Group III- Patients selected fulfil the above criteria and belong to severe COPD based on predicted FEV1 (30 - 50% of predicted value).

Group IV- Patients selected fulfil the above criteria and belong to very severe COPD based on predicted FEV1 (< 30% of predicted value)

Electrocardiographic Assessment

A standard 12-lead electrocardiography obtained for each using a portable ECG machine. The following ECG changes were detected and correlated with spirometric test-

- a. P-pulmonale pattern (P-wave amplitude > 2.5 mm) in leads II, III, avF;
- b. Right axis deviation of QRS complex (beyond + 90 degrees).
- c. Right ventricular hypertrophy.
- d. Right bundle branch block.
- e. Low voltage QRS complexes.
- f. Polymorphic p-wave.

Statistical analysis:

Data was analysed using Statistical Package for Social Sciences (SPSS) software version 20. It was analyzed for descriptive characteristics and later Chi square test was used see how

strongly ECG changes were related with spirometric findings of COPD patients. Data was presented in form of pie charts, bar graphs, frequency tables and percentages. For statistical tests, a P value of less than 0.05 ($P < 0.05$) was considered to be statistically significant.

Results:

In the present study consecutive 150 patients with COPD were enrolled with mean age was **53.96±9.43** years. Male predominates (80.7%) the study population. The mean duration of smoking observed was 25.06 ± 10.59 years with a range of 6 to 50 pack years. The mean duration of disease was 7.61 ± 2.56 years. Majority of the patients had breathlessness (92.7%) on presentation, followed by cough with sputum (79.3%) and swelling over both feet (76%). Most common sign at presentation is tachypnoea (85.3%), followed by wheez (80%), loud P2 (40.6%) suggestive of pulmonary hypertension, pedal edema (34.6%), 17.3% patients had parasternal heave which is indicative of right ventricular hypertrophy, raised JVP shows evidence of congestive cardiac failure in 26%.

Study findings shows 70% of the patients had X-ray feature of hyperinflated lung fields, 38.6% of the patients had increased bronchovascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 34.6% of the patients. Cardiomegaly on X-ray was present in 20%.

As per GOLD guideline, majority of the patients had moderate COPD (38%), followed by 35.3% patients had severe and 21.3% had very severe and 5.3% had mild COPD.

Electrocardiographic Findings

The most common electrocardiographic finding is P-Pulmonale (52.7%). The next common finding is right ventricular hypertrophy (42.7%) out of which all had right axis deviation, followed by R/S in V5/6 < 1 and R/S in V1 > 1 . Right axis deviation of QRS complex found in 27.3% COPD patients. ECG finding of low voltage of QRS complex was noticed in 42.7% patients, 8.7% had RBBB and AF was found in 5.3%.

Prevalence of P pulmonale and RVH increased with severity of COPD which is statistically significant. P pulmonale was seen 35.1% of mild COPD, 66% of severe degree and 75% had very severe COPD. Similarly, RVH is seen in 36.8% of moderate degree, 49.1% of severe degree and 53.1% of very severe degree patients. Right axis deviation is seen in 47.2% of severe degree. In this study all the above ECG findings were significantly correlated with severity of the disease except Low voltage of QRS complex. ECG demonstrated that 'p' pulmonale, RAD (right axis deviation), poor r-wave progression, incomplete RBBB and RVH, Polymorphic P wave and atrial fibrillation was significantly correlated with severity of the disease ($p < 0.05$).

DISCUSSION:

A cross sectional- descriptive study was carried out among COPD patients with the aim to study correlation between ECG changes and spirometric parameters in patients with COPD. There was a striking preponderance of male patients in the study. This might be due to higher prevalence of smoking in this gender and also males are more susceptible to smoking than females. Utilizing biomass and coal as their primary sources of energy for cooking, heating,

and other household needs may be a significant risk factor for female patients developing COPD. This study is similar to other studies done by dhadke et al,⁵Jatav VS et al.⁶ Suma et al,⁷ Swathi talari et al,⁸As people get older, their lung function (FEV1) decreases, and additional risk factors can also accelerate the progression of the illness. Maximum numbers were seen in 6th and 7th decades. Prevalence of COPD in this age group was mainly attributed by longer duration of tobacco exposure. Similar age distribution was observed in other clinical studies.^{9,10}The mean years of exposure of smoking was found to be 25.06 years \pm 10.59 (SD) with a range of 6 to 50 pack years. In the studies by Suma et al⁷ and Jatav VS et al⁶ mean duration of smoking was 23.2 years and 25.06 pack years respectively which is similar to the present study.

The mean duration of symptoms was 7.61 ± 2.56 years. The majority of the patients (56.7%) had symptoms related to COPD for six to ten years. Most of the patients had breathlessness (92.7%) on presentation, followed by cough with sputum (79.3%) and 76% patients also reported swelling over both feet. This study correlates with Suma et al, Jatav et al, Lokesh et al⁹ studies. Most common clinical finding was decreased chest expansion and tachypnea (85.3%).

Based on GOLD criteria all the patients were classified into mild, moderate, severe and very severe. Only 5.3% in mild degree of COPD. Majority were in the moderate group (38%) followed by 35.3% in severe group and 21.3% had very severe COPD. This study findings were similar to the studies by Suma et al, Jatav et al studies who also used GOLD guidelines for staging of severity of COPD.

It is well recognised that cardiovascular involvement can worsen the clinical course of individuals with chronic obstructive pulmonary disease by impairing right ventricular function and pulmonary blood vessels. The longevity of COPD patients has been impacted by these changes.¹¹These dysfunctions can be demonstrated on ECG. In the current study, the most frequent ECG change observed was P-pulmonale (52.7%). This is in accordance with findings of studies conducted by Gupta et al¹² (2015) and VK Singh et al¹³ (1989), which states that p-wave axis $> +90^\circ$ is a common ECG abnormality. Several studies demonstrated the importance of P pulmonale in ECG and correlated with severity of COPD. The studies by Biljana Lazović et al¹⁴(14.5%), Hina Banker et al¹⁵ (35%). Jayadev S Mod et al¹⁶ (45%). Alexander V et al¹⁷(52.5%) showed significant proportion of P pulmonale. This variation is because of variation in severity of COPD.

In the study, 46% of the cases showed ECG findings suggestive of RVH which is similar to Marvin L. et al¹⁸ study where RVH was seen in 43.6% and Millard FJC¹⁹ study which shows RVH in 45.7% of patients.

In the present study, all the ECG pattern significantly increased as the severity of the disease increased. Incidence of 'p' pulmonale, right axis deviation, RVH and evidence of atrial fibrillation increases with severity of COPD increased. M. K. Tandon²⁰ found increased incidence of RAD, P-pulmonale and dominant S wave in V5/6 with increasing evidence of severity. Also, P-pulmonale, incomplete RBBB, RVH, RAD had significant correlation with duration of symptoms ($p < 0.05$).

ECG changes are mostly brought about by hypoxia-induced changes in the pulmonary vasculature's hemodynamic. The increased air (hyperinflation of the lungs) present between the heart and the recording electrodes has a dampening effect that lowers the amplitude of the

QRS complexes. As a result, we may state that evolving ECG results show that the COPD is progressing and is of a greater grade.

We found that 5.3% of cases had cardiac arrhythmias (atrial fibrillations and ectopics). Patients with COPD are more likely to develop pulmonary hypertension and cardiac arrhythmias. PH makes patients more susceptible to arrhythmias by stretching of the right atrium and right ventricular muscles. Arrhythmias are mostly supraventricular in origin. Ventricular extra systoles and ventricular tachycardia may also occur in COPD.²¹

CONCLUSION

Present study reveals a significant frequency of cardiac morbidities such as cor pulmonale and RV dysfunction as seen in ECG pattern. We draw the conclusion that there is a strong correlation between right ventricular hypertrophy-related ECG abnormalities and the severity of COPD. Therefore, an electrocardiogram must be performed on all COPD patients during their initial evaluation in order to detect early and get treated timely for the complications like cor pulmonale and pulmonary hypertension. Thus, COPD patients with the most parameters observed can be screened using an ECG.

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Tables and Figures

Table 1: GOLD staging of COPD

GOLD guideline	frequency	Percent
80 (Mild)	08	5.3
50-80 (Moderate)	57	38.0
30-50 (Severe)	53	35.3
<30 (Very severe)	32	21.3

Table 2: Radiological findings among COPD patients

Radiological findings	frequency	Percent
Hyperinflated lung	105	70.0
Increased BVM	58	38.6
Cardiomegaly	30	20.0
Dilated RDPA >16mm	52	34.6

Table 3: Electrocardiographic finding of COPD patients

ECG findings*	frequency	Percent
p Pulmonale	79	52.7
Right axis deviation of QRS complex	41	27.3
R/S in V1 >1	36	24.0
R/S in V6 <1	29	19.3
RBBB	13	8.7
AF	08	5.3
RVH	64	42.7
Polymorphic P wave	16	10.7
Low voltage of QRS complex	52	34.7

*Multiple response

Table 4: Electrocardiographic finding of COPD patients as per severity of the patients

ECG findings	GOLD staging			Total (n=150)	P value
	Stage II (%)	Stage III (%)	Stage IV (%)		
	(n=57)	(n=53)	(n=32)		
p Pulmonale	20 (35.1)	35 (66.0)	24 (75.0)	79 (52.7)	0.000
Right axis deviation of QRS complex	07 (12.3)	25 (47.2)	09 (28.1)	41(27.3)	0.000
R/S inV1>1	06 (10.5)	14 (26.4)	16 (50.0)	50 (33.3)	0.000
R/S in V6<1	05 (8.8)	10 (18.9)	14 (43.8)	29 (19.3)	0.000
RBBB	00 (00)	08 (15.1)	05 (15.6)	13 (8.7)	0.012
AF	00 (00)	03 (5.7)	05 (15.6)	08 (5.3)	0.016
RVH	21 (36.8)	26 (49.1)	17 (53.1)	64 (42.7)	0.029
Polymorphic P wave	03 (5.3)	11 (20.8)	02 (6.2)	16 (10.7)	0.029
Low voltage of QRS complex	18 (31.6)	24 (45.3)	10 (31.2)	52 (34.7)	0.063