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ELECTROCARDIOGRAPHIC CHANGES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND ITS CORRELATION WITH AIRFLOW LIMITATION

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Abstract

BACKGROUND: In India, chronic obstructive pulmonary disease, or COPD, is the third leading cause of death. More than 3 million COPD deaths occurred in 2012, making up 6% of all deaths worldwide. After pulmonary tuberculosis, COPD is the second most common respiratory illness. Clinicians may be better able to manage both the cardiac and respiratory elements of COPD if they are able to identify the cardiac symptoms early and apply prompt interventions. The purpose of this study is to examine how airflow limitation and ECG abnormalities in COPD patients are related. **MATERIALS AND METHODS:** For two years, from December 2019 to June 2021, 50 COPD patients at Kurnool Medical College participated in this cross-sectional observational prospective study. A spectrophotometer was used to record the ECG (Scanner). **RESULTS:** Right axis deviation of QRS (34%), incomplete right bundle branch block (40%), and RS in V6 (60%), were the most common ECG abnormalities. The correlation study showed a strong relationship between the FEV1/FVC ratio and particular electrocardiographic alterations. P wave height, QRS, RBBB, P wave axis, and R V6 height all exhibited statistically significant relationships with FEV1. **CONCLUSION**: Our data show that electrocardiogram abnormalities are common in individuals with chronic obstructive pulmonary disease, and that the severity of COPD and pulmonary functional impairment is correlated with particular ECG abnormalities. To confirm these correlations and investigate their significance for clinical care, more investigation is necessary.

Keywords: COPD, ECG, Airflow, Emphysema, Chronic Bronchitis.

INTRODUCTION

The term chronic obstructive pulmonary disease (COPD) refers to a stage of the disease marked by an irreversible limitation of airflow. Emphysema, which is characterized by the destruction and elaboration of lung alveoli, chronic bronchitis, which is characterized by a persistent cough and phlegm, and small airway disease, which is characterized by the contraction of small bronchioles, are anatomic manifestations of COPD [1-3]. An FEV1/FVC ratio of less than 0.70 is considered airflow blockage by the World Health Organization, the National Heart, Lung, and Blood Institute, and the GOLD guidelines. Airflow limitation is categorized as Stage 1 or Mild, Stage 2a or Moderate, Stage 2b or Severe, and Stage 3 or Very Severe when FEV1 is >80%, 50-80%, 30-50%, and <30% of anticipated, respectively, based on levels of FEV1 [4-5]. Even though COPD is presently the sixth most common cause of death, it is expected to rise to the third position. After pulmonary tuberculosis, it is the second most prevalent respiratory illness in India. More than 3 million COPD deaths occurred in 2012, making up 6% of all deaths worldwide [6].

Risk factors include air pollution both indoors and outdoors, exposure to biomass fuel, and occupational hazards.

Spirometry turns out to be the most trustworthy diagnostic method for airflow restriction in people with COPD. The main cause of COPD's morbidity is its effect on heart function, which is linked to pulmonary arterial hypertension and the emergence of cor cormonale [3]. It is critical to identify evidence of right-sided cardiac involvement as soon as possible. Numerous studies have shown significant extrapulmonary (systemic) consequences of COPD, with cardiac symptoms being the most common [7-8]. Hyperexpanded emphysematous lungs and the long-term effects of hypoxic pulmonary vasoconstriction on the right side of the heart are responsible for the ECG changes associated with COPD. This leads to pulmonary hypertension and subsequent right atrial and right ventricular hypertrophy. Cardiovascular disease accounts for half of all hospital admissions and a third of all deaths when FEV1 is more than 50% of expected values. Twenty to twenty-five percent of mortality in people with advanced COPD are attributable to cardiovascular disease. Because COPD affects the pulmonary blood arteries, right ventricle, and left ventricle, it can result in pulmonary hypertension, cor pulmonale, right ventricular dysfunction, and left ventricular dysfunction [9].

Diaphragm depression, which modifies the anatomic connection between the heart and electrode placements, lung hyperinflation, which alters cardiac action current conditions, and pulmonary hypertension, which results from vasoconstriction, are processes that contribute to ECG changes in increasing airway obstruction in COPD [9]. The current study was created to assess clinical and ECG changes in COPD patients at our tertiary care facility, taking all of these factors into account. The purpose of this study is to examine how airflow limitation and ECG abnormalities in COPD patients are related.

MATERIALS AND METHODS

The Institutional Ethical Committee approved this cross-sectional observational prospective study, which involved 50 participants in the general medicine department of a government general hospital. Pulmonary medicine at Kurnool Medical College, Andhra Pradesh, collaborated with the study. We got informed consent from every study participant.

Inclusion Criteria:	Exclusion Criteria:
Patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) based on symptoms and confirmed through radiographic and pulmonary function tests	Individuals with bronchial asthma, bronchiectasis, and pulmonary tuberculosis, known congenital or acquired heart diseases, diabetes mellitus, and hypertension.

Over the course of two years, from December 2019 to June 2021, data on fifty COPD patients from the Government General Hospital in Kurnool's inpatient or outpatient medical wards were collected. Electrocardiography (ECG), pulmonary function testing, chest X-ray, HRCT chest, and other required procedures were performed as measurements. Patients who met the inclusion and exclusion criteria underwent spirometry.

Right ventricular hypertrophy was defined by the ECG criteria, which included RAD of QRS, P-pulmonale, R<S in V6, and A+R-PL>0.7. P-pulmonale, rSR in right precordial leads with QRS length >0.12 seconds (incomplete right bundle branch block), R/S-ratio in V1>1, and R/S-ratio in V6 were among the criteria for cor pulmonale. The inversion of the 'T' wave in the right leads was explained by RV dilatation and strain, with hypoxia-related generalized T wave inversion identified as a nonspecific condition.

In statistical analysis, categorical data were expressed as percentages and continuous variables as means and standard deviations. Chi-square tests or one-way ANOVA were used to find differences in baseline characteristics. To evaluate the risk at each GOLD stage, unadjusted and adjusted Odd Ratios with a 95% CI were calculated for each ECG variable. Using ORs with a 95% CI, the relationship between the length of COPD, smoking status, and several ECG abnormalities was investigated. The correlation between two variables was investigated using Pearson's correlation coefficient, or "r". The statistical study was performed with IBM, Chicago, Illinois's SPSS program, version 23.0.

RESULTS

According to our research, the prevalence of mild, moderate, severe, and very severe disease was, respectively, 6%, 22%, 40%, and 32%. Forty of the fifty patients that were studied were male and had smoked in the past. The majority of them (30(60%)) smoked both beedi and tobacco; 8 patients (16%) had watched cigarette smoking, and 2 patients (4%), had both.

In female patients, there was no smoking history; nevertheless, 12% had a history of biocombustible exposure. Out of the 50 cases examined in our current study, 34% of patients were in the FEV1/FVC ratio 21–40% group, 42% in the FEV1/FVC ratio 41–60% group, and 24% in the FEV1/FVC ratio 61–70% group.

Of the patients with mild, moderate, severe, and very severe COPD, 33.33%, 45.45%, 55%, and 93.75% had abnormalities in their ECGs. In mild category COPD patients, there is an ECG change; that is, in 1 out of 3 cases (33.33 percent), RVH was found.

RVH was discovered in 50 percent of patients in the severe group, 36.36 percent in the moderate category, and 68.75 percent in the extremely severe category, in that order. P. In comparison, pulmonary disease was detected in 0% of patients in the mild group and in 9.09%, 20%, and 68.7% of 40 patients in the moderate, severe, and very severe categories, respectively. RAD was discovered in 0% of patients in the mild group but in 9.09%, 50%, and 37.5% of patients in the moderate, severe, and profoundly serious categories, in that order.

In patients classified as moderate, severe, or very severe, poor R wave progression was observed in 0% of cases, compared to 9.09%, 20%, and 56.25 percent of patients in the mild category. Only 0% of patients in the mild category had RBBB; however, 18.18%, 35%, and 68.75 percent of patients in the moderate, severe, and very severe categories, respectively, had. Atrial fibrillation was absent in patients in the mild category but present in 18.18%, 15%, and 37.5% of patients in the moderate, severe, and very severe categories, respectively. It was discovered that there was a strong correlation between these ECG abnormalities and COPD disease categories.

DISCUSSION

Our research sought to determine whether pulmonary function test findings in patients with Chronic Obstructive Pulmonary Disease (COPD) were correlated with electrocardiographic alterations. The majority of patients in our study group fell into the Severe (40%) and Very Severe (32%) categories, indicating the advanced stage of the disease. This finding highlights the distribution of COPD severity in our study population. Our study found that male patients had a significant smoking prevalence, with the majority of them being beedi and pipe smokers. Although the percentage of patients who smoked was lower, it is nevertheless significant to note that 16% of the male patients had previously smoked. This emphasizes the necessity of tailored smoking cessation programs, particularly in areas where several tobacco products are widely used. Furthermore, it was found that female patients' exposure to combustibles was a risk factor, highlighting the significance of taking a variety of environmental exposures into account when determining the etiology of COPD.

Our research showed that electrocardiographic abnormalities were significantly more common in COPD patients. R<S in V6 (60%), Incomplete Right Bundle Branch Block (40%), and Right Axis Deviation of QRS (34%), were the most common ECG abnormalities. These results are consistent with other research that indicates a high frequency of cardiac involvement in COPD patients. Additionally, the relationship between particular ECG alterations and the severity of COPD was investigated. As the severity of COPD worsened, we saw an increasing trend in the prevalence of ECG anomalies. All severity categories had noticeable levels of Right Ventricular Hypertrophy (RVH), with a high percentage of Very Severe COPD patients (68.75%) having it. Right Bundle Branch Block (RBBB), Poor R wave progression, P-pulmonale, and Right Axis Deviation (RAD) all showed a similar pattern of rising prevalence with more severe COPD. P K et al.'s study [6] looked into how a cohort of sixty patients' COPD severity was distributed. 10% of the sample had mild disease, 30% had moderate disease, 35% had severe disease, and 25% had very severe disease, according to the data. Of the sixty patients, forty-five were men, and thirty had previously smoked. The most common types of smoking were beedi and chute (20(44%)), however 5 patients (11%) had a history of both and 10 patients (22%) reported smoking cigarettes. Fascinatingly, 15% of patients who were female had previously been into contact with biocombustibles. 25% of the patients fell into the FEV1/FVC ratio 21–40% group, 50% into the 41-60% group, and 25% into the 61–70% group, according to an analysis of the spirometry data [7].

Significant relationships between particular electrocardiographic alterations and the outcomes of pulmonary function tests were shown by the correlation analysis. Importantly, statistically significant associations between FEV1 and the P wave axis, QRS axis, P wave height, R V6 height, and RBBB were observed. According to these results, some ECG abnormalities may be used to identify pulmonary function impairment in COPD patients. The potential value of ECG as a non-invasive method for determining cardiac involvement and forecasting pulmonary function decline in COPD is suggested by the connections that have been shown between ECG alterations and both pulmonary function and the severity of COPD. Clinicians can manage both the cardiac and respiratory components of COPD more effectively by identifying these cardiac symptoms early and applying prompt therapies. A few of the drawbacks of our study are the cross-sectional design and limited sample size. To prove causation and investigate the dynamic link between cardiac involvement and

pulmonary function in COPD, longitudinal studies with bigger cohorts are required. Furthermore, a thorough evaluation of comorbidities and a thorough history of smoking would offer a more nuanced picture of the research population.

CONCLUSION

Finally, our research shows that electrocardiogram abnormalities are common in patients with COPD, and that certain abnormalities are correlated with the severity of both COPD and pulmonary function impairment. These results add to the increasing amount of data demonstrating the value of integrated therapy for COPD patients, taking cardiac and respiratory factors into account. To confirm these correlations and investigate their significance for clinical care, more investigation is necessary.

FIGURES

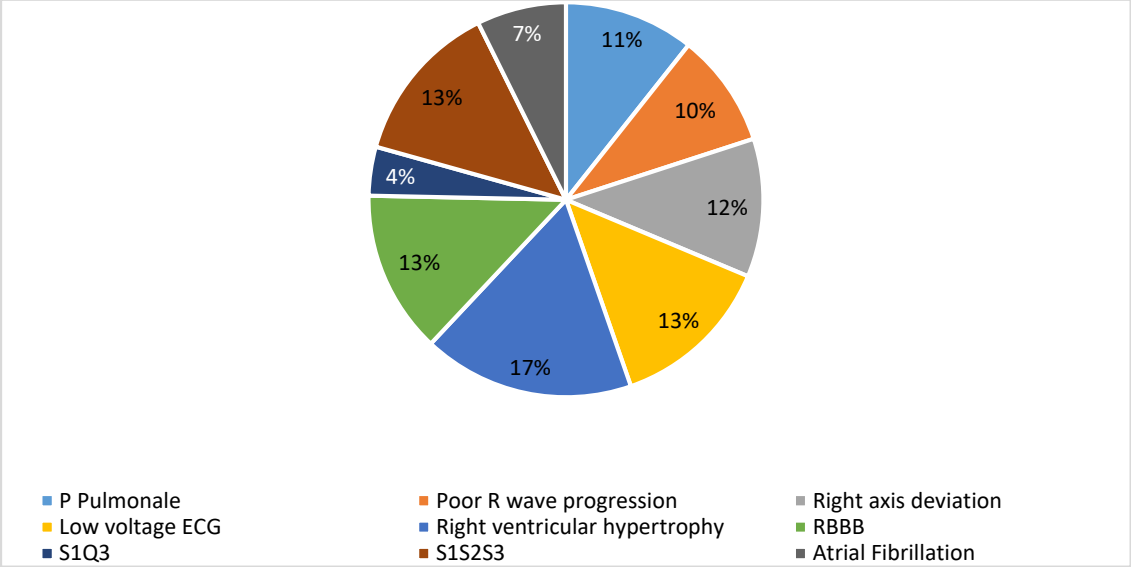

Figure 1: Distribution of ECG Findings in COPD Patients

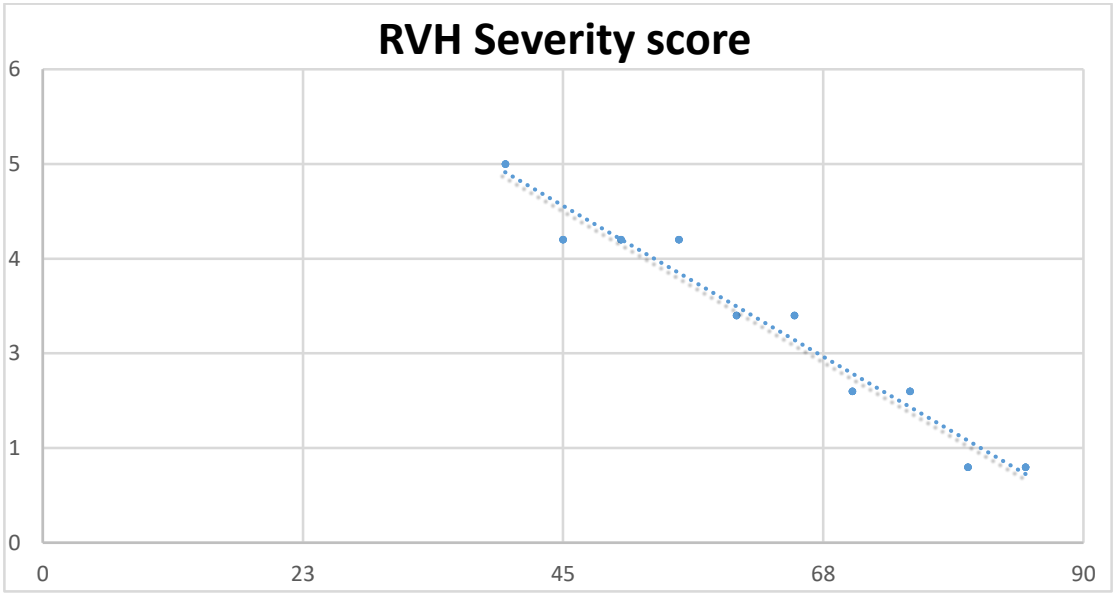

Figure 2: Correlation between RVH Severity Score and FEV1

TABLES

Table 1: Prevalence of Electrocardiographic Changes in COPD Patients

Electrocardiographic Changes	Prevalence (%)
Right Axis Deviation of QRS	34
P-pulmonale	32
R<Sin V6	60
Incomplete Right Bundle Branch Block	40
Dominant "R" Wave in Right Precordial Leads	28

Table 2: Correlation between Electrocardiographic Changes and Pulmonary Function Test Results

Electrocardiographic Changes	Correlation with FEV1
P wave axis	1.04 ± 0.28 (p=0.0029)
QRS axis	0.94 ± 0.24 (p=0.0002)
P wave height	0.87 ± 0.17 (p<0.0001)
R V6 height	0.89 ± 0.17 (p = 0.001)
RBBB	0.86 ± 0.00 (p<0.0001)

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