

Electrocardiographic Findings of Patients with Chronic Obstructive Pulmonary Disease: A Case-control Study

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Abstract

Background: Chronic obstructive pulmonary disease (COPD), a common respiratory condition, causes significant obstruction of airflow, ongoing oxygen demand, functional impairments, frequent hospitalizations, and increased morbidity. Significant alterations in cardiac function are brought on by this condition. Information on COPD and the related electrocardiogram (ECG) symptoms is scarce. Our objective is to look into the various electrocardiographic abnormalities among COPD patients in the northeastern part of India in order to start early diagnosis and therapy, increase patient survival, and improve the quality of life for COPD patients.

Methods: The case-control study included 112 chronic COPD patients and 112 controls with similar age and gender. Each COPD patient underwent an electrocardiography evaluation using standard 12-lead ECG equipment. The data were examined using basic statistical methods.

Results: In the present study, the P-pulmonale was present in 52.67% of the participants with COPD. The percentages of patients with Rt axis deviation, Rt bundle branch block, and Rt ventricular hypertrophy were 48.21%, 50.89%, and 27.67%, respectively. Atrial fibrillation affects 12.50% of COPD patients, and ischemic heart disease affects 24.10% of them.

Conclusion: This study emphasizes the importance of early cardiac screening by ECG of all COPD patients to determine the prognosis and further aid in identifying individuals who are likely to have greater mortality and morbidity.

Key words: Airflow, Electrocardiography, Obstructive, Pulmonary

INTRODUCTION

Chronic obstructive pulmonary disease (COPD), a common respiratory condition, causes significant obstructive airflow limitation, ongoing oxygen dependence, functional impairments, frequent hospitalizations, and increased morbidity. In addition to reducing morbidity and death, prompt identification and treatment can prevent the condition from worsening. Therefore, even if the patient is being assessed for another cause, it is crucial for doctors to accurately identify this illness. COPD is the fourth leading

cause of death globally, but it is expected to move to third place in the following years. Significant alterations in cardiac function, including in the right and left ventricles as well as the pulmonary arteries, are brought on by this condition.^[1,2]

Numerous thoracic morphological and hemodynamic alterations that occur by COPD may affect several electrocardiographic parameters. The electrocardiographic changes seen in COPD patients are primarily caused by changes in body mass index that are correlated with clockwise rotation of the frontal QRS-vector, increased airway obstruction, right ventricular afterload, diaphragmatic displacement brought on by hyperinflation, right heart rotation, and diaphragmatic rotation caused by hyperinflation. A 12-lead electrocardiogram (ECG), which is frequently included in regular examinations in many clinical settings, can provide helpful diagnostic hints, can be used as an initial screening tool, and can also help with subsequent evaluation and management of COPD or

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emphysema. Nevertheless, some ECG alterations seen in patients with established COPD or emphysema may have independent prognostic significance.^[3-5]

Compared to individuals without COPD, patients with COPD have a higher risk of dying from an arrhythmia, a myocardial infarction, or congestive heart failure. Increased cardiovascular mortality was found in a study involving a sizable patient population, particularly in COPD patients under the age of 65.^[6-8]

There is a dearth of information about COPD and associated ECG symptoms. Therefore, to begin early diagnosis and therapy, extend patient survival, and enhance the quality of life for COPD patients, our objective is to examine the various electrocardiographic alterations among COPD patients in the northeastern region of India.

METHODS

Study Setting

The study was conducted in the in-patient and outpatient department of Medicine at MGM Medical College, Kishanganj, Bihar.

Study Type

The study was a case-control study.

A Number of Participants

The study included 112 patients with chronic COPD and 112 age- and gender-matched controls.

Inclusion Criteria

Those patients who were suffering from chronic COPD and given consent were included in the study.

Exclusion Criteria

Those with chronic COPD who were suffering from other co-morbid diseases were excluded from the study.

Study Period

The study period was from June 2021 to May 2022.

Data Collection and Analysis

All COPD patients who met the study's requirements underwent complete examinations. Postgraduate MD students in the department of medicine conducted clinical examinations. They took note of the patients' complete demographic information. Patients with COPD underwent pulmonary function testing to determine their diagnosis and level of severity. A typical 12-lead ECG equipment was used to conduct an Electrocardiography study on each COPD patient. Simple statistical techniques were employed to analyse the data.

Electrocardiography

After 10 min of supine rest, a 12-lead ECG was recorded using the default filter settings, a paper speed of 50 mm/s, and a gain of 10 mm/mV. About 20% of the ECGs were randomly chosen for manual reading by one investigator, and all ECGs with ambiguous interpretations were read by two investigators. Measures were set by consensus. P-wave amplitude 2.5 mm in II, III, and aVF or 1.5 mm in V1 was considered right-atrium enlargement. Right ventricular hypertrophy and Left ventricular hypertrophy were defined by using standard criteria. Counter-clockwise rotation was medial to V3, while clockwise QRS-axis rotation (delayed transition) needed R/S transition at or lateral to V4. Axis deviations and low voltage were both defined under the Minnesota Code. A normal ECG required a heart rate of 60–80 beats/min, PR interval duration of 0.12–0.20 s, P-amplitude in V1 <1.5 mm and in II, III, and aVF <2.5, P-axis <75°, QRS duration 0.07–0.10 s, at least one QRS amplitude in limb leads ≥ 5 mm and ≥ 10 mm in precordial leads, frontal QRS-axis -30° to 90° , and transition zone at V3.^[9-11]

RESULTS

The study comprised 112 COPD patients and 112 controls who were matched for age and gender. The COPD patients' mean age was 62.84 ± 7.29 years, while the controls' mean age was 63.14 ± 7.46 years. In the study, 82% of the male patients were smoker. The exposure to biomass fuel affected all females (16%). The average amount of time people smoked was $24.6 + 4.21$ years. A history of smoking for more than 20 pack years was present in 54% of smokers. The disease lasted an average of $6.12 + 3.48$ years, ranging from 1 to 26 years. The majority of patients (64%) had symptoms that had lasted 1 to 12 years, whereas just 18% had symptoms that had lasted more than ten years. The majority of the patients (90%) had sputum-producing coughs, while 94% also experienced dyspnea, foot edema (28%), fever (18%), and decreased urine production (7%).

The present study's mean heart rate of the COPD patients was recorded as 94.14 per min compared to 76.36 per min obtained by the control group. Normal sinus rhythm was recorded in 56.4% of COPD cases as compared to 68.6% of the controls. Sinus tachycardia was present in 26.8% of COPD cases as compared to 18.6% of the controls.

Rt atrial enlargement (p pulmonale) was found in 52.67% of COPD patients compared to 10.71% of controls. Rt ventricular hypertrophy was seen in 48.21% of COPD patients compared to 9.82% of controls. Rt axis deviation was detected in 50.89% of COPD patients compared to 9.82% of controls. In contrast to 13.39% of controls,

Rt bundle branch block was found in 27.67% of COPD patients [Table 1]. In contrast to 22.32% of controls, 24.10% of COPD patients had ischemic heart disease. Compared to 6.25% of controls, 20.53% of COPD patients had low voltage complexes found in their ECG. Atrial fibrillation was observed in 12.50% of COPD patients as opposed to 4.46% of controls. Compared to 12.50% of the control group, 9.82% of COPD patients had ischemic heart disease [Figure 1].

DISCUSSION

Air trapping, persistent hypoxemia, increased work of breathing, and alveolar and pulmonary capillary damage are all features of COPD. In an effort to increase blood oxygenation, the pulmonary vessels beside under-ventilated alveoli have a tendency to constrict (hypoxic reflex pulmonary vasoconstriction), which increases pulmonary vascular resistance and the work of the right heart, causing cor-pulmonale. COPD puts a chronic strain on the right side of the heart.

Our emphasis on the fact that our COPD population was drawn from clinically stable outpatients, where LV dysfunction as well as other comorbidities that can alter the ECG, had been completely excluded, distinguishes the current study from past COPD studies.

The mean heart rate of the COPD patients in the current study was 94.14 beats per minute, compared to the control group's 76 beats per minute. The study confirms that COPD patients have higher heart rates than controls.^[12] In COPD patients 56.4% and 68.6% of controls had normal sinus rhythms, respectively. In COPD cases, the prevalence of sinus tachycardia was 26.8%, compared to 18.6% in controls. These findings are consistent with the research conducted by Agarwal *et al.* in 2008 and Pal *et al.* in 2020.^[13,14]

In the current study, 52.67% of the subjects with COPD had peaked P-waves, defined as amplitude >2.5 mm. Rt axis deviation, Rt bundle branch block, and Rt ventricular hypertrophy were all reported in 48.21%, 50.89%, and 27.67% of COPD patients, respectively. In addition, these findings are in accordance with the 2008 study by Agarwal *et al.*^[13] Emphysema, which reduces the QRS amplitudes, may be the cause of the low voltage complexes reported in the ECG of 20.53% of COPD patients in the current study. All these findings of P-pulmonale, rightward QRS axis deviation, right ventricular hypertrophy, and Rt bundle branch block increase with the longer duration of the disease.^[14-16]

In the current study, ischemic heart disease was present in 24.10% of COPD patients and 12.50% have atrial fibrillation. This study's increasing percentage of atrial

Table 1: ECG changes of COPD patients

ECG changes	No. of patients (n=112 Cases)	Percentage	No. of patients (n=112 controls)	Percentage
Rt atrial enlargement (p pulmonale)	59	52.67	12	10.71
Rt ventricular hypertrophy	54	48.21	11	9.82
Rt axis deviation	57	50.89	11	9.82
Rt bundle branch block	31	27.67	15	13.39
Ischemic heart disease	27	24.10	25	22.32
Low voltage complexes	23	20.53	7	6.25
Atrial fibrillation	14	12.50	5	4.46
Non-specific ST-T changes	11	9.82	14	12.50

ECG: Electrocardiogram, COPD: Chronic obstructive pulmonary disease

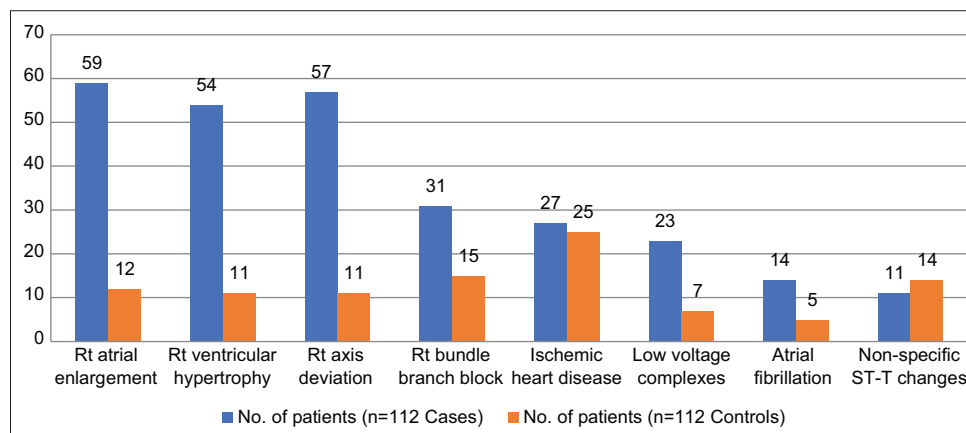


Figure 1: Electrocardiogram changes in chronic obstructive pulmonary disease patients

fibrillation and ischemic heart disease is due to the increased number of patients with advanced disease.^[17,18]

ECG anomalies of better knowledge in COPD can progress the findings of ECG interpretation and assist identify the main pathophysiology of diseases that affect the airways. Therefore, it is essential to highlight early cardiac screening to evaluate the prognosis and risk of morbidity and death in COPD patients.

Study Limitations

The study had a very small sample size and was done over a short period of time.

Future Directions of the Study

To determine whether patients with COPD experienced any significant changes in their cardiovascular functions, future directions of the study should involve a larger sample size and a longer study period using equipment such as cardiac catheterizations, echocardiography, and other contemporary instruments.

CONCLUSION

Most parameters can be observed when screening COPD patients with an ECG. However, compared to ECG, echocardiography may be a more effective modality for detecting cardiac dysfunction. To assess the prognosis and further help identify those who are likely to experience increased morbidity and mortality, this study emphasizes early cardiac screening by ECG of all COPD patients.

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