

## ELECTROCARDIOGRAPHIC CHANGES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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**ABSTRACT:** Chronic Obstructive Pulmonary Disease (COPD) is a common preventable and treatable state characterized by persistent airflow limitation. It is fourth leading cause of chronic morbidity and mortality world over. COPD influences the electric events of the heart. The objective was to study ECG changes in COPD and know how reliable and diagnostic they are in COPD.

**KEYWORDS:** Chronic obstructive pulmonary disease, Electrocardiogram, Right Axis Deviation of P wave, Right Axis Deviation QRS, Amplitude of R Wave, Right ventricular hypertrophy, S Waves in lead I, II, III (S I, II, III).

**AIM:** The main aim is to study ECG changes and find their significance in Chronic Obstructive Pulmonary Disease.

**INTRODUCTION:** 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. The various respiratory diseases may secondarily cause changes in the heart, which may be detected by Electrocardiograph (ECG).

COPD is the second most common lung disorder after Tuberculosis.<sup>(1)</sup> The major morbidity of COPD is due to the impact on cardiac performances, which is 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.

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

### ECG changes occur in COPD due to:

1. The presence of hyper expanded emphysematous lungs within the chest.
2. The long-term effects of hypoxic pulmonary vasoconstriction upon the right side of the heart, causing pulmonary hypertension and subsequent right atrial and right ventricular hypertrophy (i.e. cor pulmonale).

Lung hyperexpansion causes external compression of the heart and lowering of the diaphragms, with consequent elongation and vertical orientation of the heart. Due to its fixed

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attachments to the great vessels, the heart undergoes clockwise rotation in the transverse plane, with movement of the right ventricle anteriorly and displacement of the left ventricle posteriorly. The presence of increased air between the heart and recording electrodes has a dampening effect, leading to reduced amplitude of the QRS complexes. ECG is reliable and cost effective screening device and is easily accessible too. COPD influences the electrical events of the heart in many respects. It produces various anatomic changes that affect the ECG in unique ways

**MATERIALS & METHODS:** For diagnosis of COPD, guidelines by American Thoracic Society<sup>(2)</sup> and also by British Thoracic Society<sup>(3)</sup> were followed. COPD included chronic bronchitis and emphysema cases. Some other chronic lung diseases were also excluded.

Patients were randomly selected over one year and investigated with ECG. Patients underwent different clinical and radiological investigations. Further evaluation was also done by 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, , R Amp <0.7mv, SI SII SIII pattern were studied in 50 cases of COPD patients.

**Selvester and Rubin quantitative ECG criteria<sup>(4)</sup>** for COPD used in this study are: P wave axis more than +60 degrees, R and S amplitude less than 0.7 mV in limb leads, R in V6 less than 0.7mV, Sv4more than Rv4, Low voltage complexes and criteria for low voltage, when the amplitude of the QRS is less than 5mm in LI, LII, LIII; less than 7.5 mm in avR, avL, avF and less than 15 mm in precordial leads,

**RESULTS:** 50 cases of Chronic Obstructive Pulmonary Disease were studied. Out of these 36 were males and 14 were females. Majority of patients were males with smoking as the commonest risk factor.

Arrhythmias were found in 27 patients. Atrial ectopics were observed in 7 patients and Ventricular ectopics in 4 patients. Atrial fibrillation in 1 patient. Incomplete RBBB was found in 9 patients whereas complete RBBB was found in 6 patients.

42 patients (84%) of the patients had right axis deviation of P wave. P Pulmonale was found in 66(33%) of the patients.

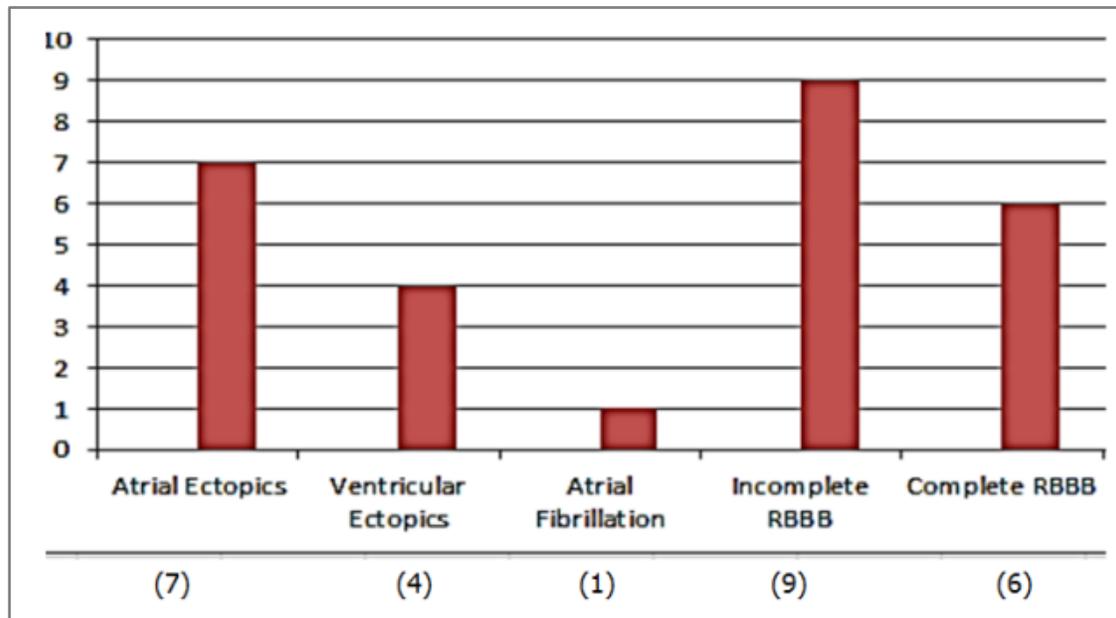
Clinically 46 patients (92%) had Emphysematous changes confirmed by X-Ray. Right Axis Deviation of P wave and RV more than 0.7 mV are the most common ECG abnormalities observed. R amplitude <0.7mV was seen in 51.6% in COPD patients.

SV4 more than RV4 was found in 19(38%) of the COPD patients. Low voltage complexes were seen in 5 patients (10%).

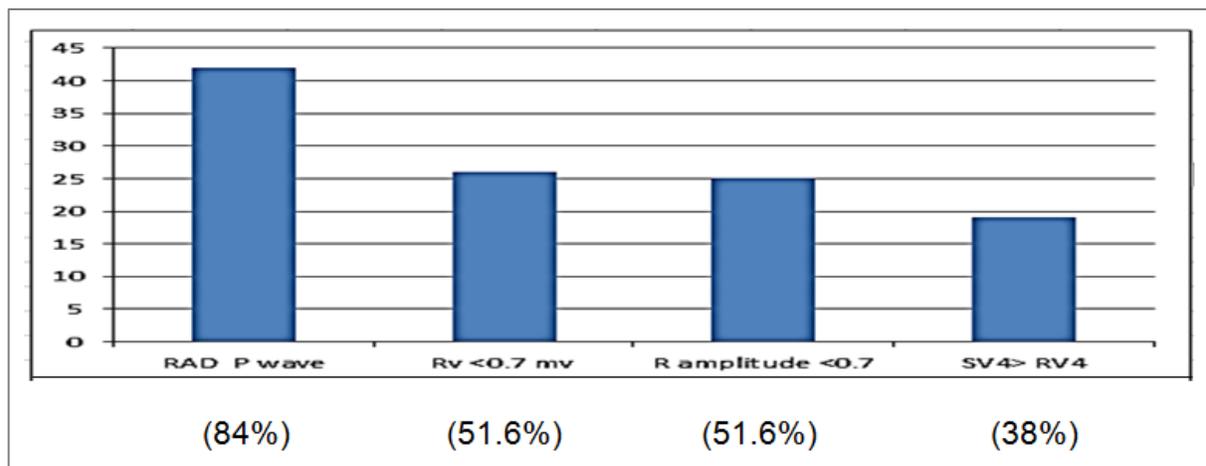
Majority of the patients had Right Axis Deviation of P wave and RV6 more than 0.7 mV with an incidence of 84% and 51.6% of patients respectively. RBBB was found in 6 patients (12%) and Incomplete RBBB was seen in 9 patients (18%).

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SI SII SIII syndrome was seen in 13(6.5%) of cases. All the patients were classified as per Selvester and Rubin quantitative ECG criteria<sup>(4)</sup> for the diagnosis of definitive and possible Emphysema.

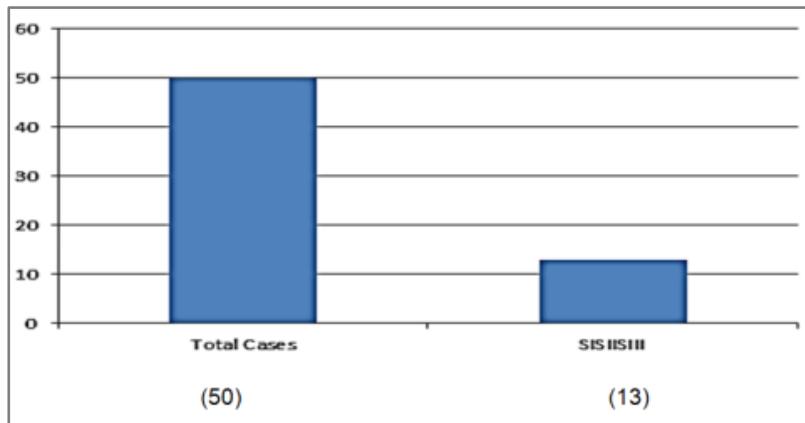


**FIG. 1: INCIDENCE OF ARRHYTHMIAS**



**FIG. 2: PREVALENCE OF RIGHT AXIS**

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**FIG. 3: SI SII SIII PATTERN**



**FIG. 4: X- Ray of chest showing Vertical Positioning of heart and lung inflation**



**FIG. 5**

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FIGURE 5: Above ECG shows Right Axis, Peaked P waves in inferior leads >2.5mm (P pulmonale with P wave Rightward axis (inverted in AVL), Clockwise rotation of heart with a delayed R/S transition point (Lead V) and absent R waves in right pre-cordial leads (SV1, SV2, SV3 pattern)



FIG. 6

FIGURE 6: Above E.C.G shows Peaked P waves, Right Axis, Low QRS voltage.

**DISCUSSION:** The ECG may reflect changes due to hyperinflation of lungs and RVH. The following changes are usually seen in COPD and Cor Pulmonale with their respective sensitivities and specificities in detecting the presence of lung disorder. Right Axis Deviation P, P Pulmonale, Right Axis Deviation QRS, SI SII SIII and RBBB.

Right Axis Deviation P wave was found to be 75% sensitive but only 12.5% specific for right atrial enlargement. Right Axis Deviation (more than 90 degrees) had 34% sensitivity and 100% specificity for Right atrial enlargement (Kaplan).<sup>(5)</sup> Right axis deviation is usually present when RVH is present. However, it is sometimes seen in patients with pure emphysema even in absence of RVH, simply because of hyperinflation and changes in heart position.

Varied prevalence of COPD among adult population is reported in India.<sup>(6-11)</sup> Several studies<sup>(12-14)</sup> reported changes in the activity of heart including P-wave axis and amplitude, rightward displacement of QRS and T-axis, reduction of amplitude of QRS complex in limb and precordial leads, sinus tachycardia, Right bundle branch block (RBBB) etc, among COPD patients. However, COPD patients probably are not usually assessed by electrocardiogram in routine medical practice particularly in developing countries like India.

In chronic obstructive pulmonary disease, hyperinflation of the lungs leads to depression of the diaphragm, and this is associated with clockwise rotation of the heart along its longitudinal axis. This clockwise rotation means that the transitional zone (defined as the progression of RS to QR in the chest leads) shifts towards the left with persistence of an RS pattern as far as V5 or even V6. This may give rise to a "pseudo infarct" pattern, with deep S waves in the right precordial leads simulating the appearance of the QS waves and poor R wave progression seen in anterior myocardial infarction. The amplitude of the QRS complexes may be small in patients with chronic obstructive pulmonary disease as the hyper inflated lungs are poor electrical conductors.

Normal heart rate observed in 71.4% COPD patients, ECG changes were present in 35.7% COPD patients. Peaked P-wave was observed in 35.7% COPD patients, whereas duration of QRS

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complex was abnormal in only 8.1% of the patients. None of the COPD patients showed abnormal P-wave duration.

Cardiac arrhythmias may occur in patients with chronic obstructive pulmonary disease, particularly in association with an acute respiratory tract infection, respiratory failure or pulmonary embolism. Arrhythmias are sometimes the result of the underlying disease process but may also occur as side effects of the drugs used to treat the disease. Arrhythmias are mostly supraventricular in origin and include atrial extra systoles, atrial fibrillation or flutter, and multifocal atrial tachycardia. Ventricular extra systoles and ventricular tachycardia may also occur in chronic obstructive pulmonary disease

Ventricular extra systole and ventricular tachycardia may also occur in obstructive pulmonary disease, particularly in association with an acute respiratory tract infection, respiratory failure or pulmonary embolism. Arrhythmias are sometimes the result of the underlying disease process but may also occur as side effects of the drugs used to treat the disease. The arrhythmias are mostly supraventricular in origin and include atrial extra systoles, atrial fibrillation or flutter, and multi focal atrial tachycardia. Ventricular extra systole and ventricular tachycardia may also occur.

**CONCLUSION:** P Pulmonale is most observed manifestation of Right Atrial Enlargement. Right Axis Deviation QRS is the most observed ECG manifestation of right ventricular Hypertrophy in COPD.

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