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# P Wave Morphological Changes in Ecg And Its Correlation With Clinical, Radiological And 2 D Echo Profile in Respiratory Disorders.

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**ABSTRACT**

*Introduction: ECG is the easiest diagnostic tool. P wave morphological changes are found in Respiratory disorders. These changes suggest many changes in heart and correlated with echocardiography. and can be used as diagnostic tool and severity of condition.*
*Aims and objectives: 1)To study P wave morphological changes in ECG in Respiratory disorders. 2)To Establish correlation between P wave morphological changes in ECG with clinical, radiological, and Echo profile in Respiratory disorders.*
*Materials and methods: A prospective study of 50 Respiratory cases having P wave changes in ECG from March 2011 for one and half year in Dhiraj Hospital. All P wave changes were correlated with clinical, radiological and 2 D Echo profile.*
*Results: In respiratory system 50 cases had COPD. In COPD cases On analysis P axis was significantly correlated with RV (p value <0.05),While P amplitude in lead II was significantly correlated with both RV (p value<0.05) and RVSP (p value<0.05),P inclination in V1 significantly correlated with RV (p value <0.05).*
*Conclusion: To conclude from this study, P wave morphology changes in ECG has significant correlation with severity of disease in COPD*

Keywords : P wave, ECG, 2D Echo, Respiratory disorders

## INTRODUCTION

Respiratory disorders are the major health problem across the globe and more in developing countries. Delay in diagnosis and treatment is one of the key factors for early morbidity and mortality associated with it.

Smoking and Choola blowing are the major etiological factors for Chronic obstructive pulmonary diseases.

Electrocardiogram (ECG) is the one of the basic diagnostic tool which can be helpful in early diagnosis and delaying morbidity and mortality associated with respiratory disorders.

ECG is the record of time-varying bio-electric potential generated by the electrical activity of heart. It is used to measure the functional activity of heart. Nobel Laureate, William Einthoven has first recorded the ECG in 1903. Due to the ease of use and non invasiveness, ECG is not only used as a prime tool to diagnose the various cardio- respiratory disorders affecting the heart but also to monitor it.[1]

P wave abnormalities on the resting ECG have been associated with abnormal atrial size in pulmonary or cardiovascular disease. Abnormalities of P wave morphology have a limited sensitivity for echocardiographic findings and have been associated with left sided heart diseases or severe lung disease. [2]

Morris and co-workers found that the algebraic product of the duration and amplitude of the terminal portion of the P wave in $V_1$ (P terminal force) allowed them to separate patients with left sided valvular heart disease from normal subjects in 92% of their series. Hence they used the nonspecific term “left atrial involvement” as a definition of P wave changes associated with left sided heart diseases.[3]

Calatayud and co-workers found P amplitude has shown a positive correlation with radiological evidence of chronic obstructive lung disease.[4]

P pulmonale has been used as indirect evidence of right ventricular hypertrophy by various authors and is also helpful in diagnosing chronic obstructive lung disease and pulmonary hypertension and cor pulmonale associated with it.[5]

Thus P wave abnormalities are common findings that should not be ignored. And various P wave parameters can be useful with its diagnostic and prognostic value. And these P wave morphology changes are also helpful in early diagnosis and delaying morbidity and mortality in cardiovascular and respiratory disorders.[2]

**AIMS AND OBJECTIVES**

1. To study P wave morphological changes in ECG in Respiratory disorders. And to study clinical, radiological and Echo profile of those cases.
2. Establish correlation between P wave morphological changes in ECG with clinical, radiological, and Echo profile in Respiratory disorders.

**MATERIALS & METHODS:**

**MATERIAL:**

This is a prospective observational study of 50 patients admitted over one and a half year between 2011-12 in Dhiraj Hospital & SBKS MIRC, Vadodara.

Patients of respiratory disorders who were admitted in ICU & ICCU were screened and such patient who had P wave morphology changes in their ECG were taken into study. Cases who were taken were evaluated on history, symptomatology, examination, investigations, radiology (chest X ray), 2D ECHO mainly (Right Ventricle (RV), Right Ventricle systolic pressure (RVSP), Left atrium (LA), Ejection fraction (EF) & other parameters), P wave morphology is evaluated and correlated in detail with above mentioned parameters.

All 2D ECHO were done by cardiologist with GE Vivid-e echo machine. All ECG were taken by automated BPL ECG machine. All recordings were confirmed manually. Ischemic heart disease (IHD) cases that have P wave morphology changes in ECG and were taken in to study were proven by coronary angiography also.

**METHOD:**

Each patient first will be evaluated and history will be taken and will be investigated for the routine labs. And re- evaluated in detail.

**ECG-** All P wave parameters were evaluated in detail. All ECGs were evaluated with magnifying glass and if needed then scanned copies were evaluated with zooming in with the software. As P wave is best seen in lead II and $V_1$ , both leads were evaluated in detail under following parameters.

1) P wave duration in lead II
2) P wave amplitude in lead II
3) P:PR segment in lead II (*Marcus Index:* The ratio between duration of P wave and P-R segment )
4) P axis
5) P inclination in lead V1
6) P terminal force in lead V1(*Morris index:* The "P" terminal force in lead $V_1$ . Morris index is derived by multiplying the depth of the terminal "P" wave deflexion in mm in $V_1$ by the duration (in seconds). The value is expressed in millimeter-seconds (mm.sec). Normally up to 0.03 mmsec )

**Chest X-Ray-** to see cardiomegaly, emphysema,mitralzation of heart etc

**2D ECHO–**is useful in both diagnosis and for correlation of parameters. M-mode is used where Left atrium, interventricular septum and posterior wall are visualized. Left ventricular end diastolic and systolic pressures are measured to calculate fractional shortening and EPSS which all in turn helps in assessing systolic dysfunction In 2D echo- ejection fraction-visual is measured in addition to RV, LV and LA sizes which help in assessing diastolic dysfunction. In Doppler Mitral Regurgitation (MR), Tricuspid Regurgitation (TR) and changes of Pulmonary arterial hypertension PAH (RVSP) are noted in addition to mitral valve study (E/A)

**CBC , RFT , LFT, RBS , Electrolytes are routine investigations. Other investigations if required.**

**INCLUSION CRITERIA**

1. Patients of cardio- respiratory disorders who had P wave morphology changes in their ECG admitted in ICU & ICCU .
2. Patients who are 18yrs or older in age , and give consent to be part of this study.

**EXCLUSION CRITERIA:**

1. Patients Below 18 yrs of age.
2. Patients who do not give their consent to be a part of this study

**STATISTICAL METHODS :**

Data was cleaned, Validated and Analyzed by SPSS 20.0 & Epi. Info 7 software.

- **Descriptive Statistics:**

For continuous variable range, mean and standard deviation were calculated and for categorical variables proportion and percentage were obtained.

- **Bi-Variate analysis:**

To know the association between dependent and independent variable chi-square and correlation applied accordingly.

In our study we have taken following ECG and 2D Echo parameters as significant parameters;

**ECG :**

1) P wave duration in lead II > 0.12 second.
2) P amplitude >2.5 mm in lead II (P pulmonale)
3) P:PR segment >1.6 in lead II
4) P inclination >1.5 in lead $V_1$
5) Negative P terminal force >=0.04 in lead $V_1$
6) P axis >=+$90^0$ in RS cases and LAD of P axis for CVS cases

**2D Echo:**

1) Left Atrial Enlargement (LAE) : LA > 38 mm or > 3.8 cm
2) Right Ventricular Enlargement : RV > 25 mm or > 2.5 cm
3) Pulmonary hypertension : Right Ventricular Systolic Pressure (RVSP)>35 mmHg
4) Ejection Fraction : <50%

**RESULTS :**

Out of 50 patients of respiratory system who had P wave changes in ECG, 37(74%) were male and 13 (26%) were female. Out of that 46 (92%) patients had Chronic Obstructive Pulmonary disease (COPD) only, while 4 (8%) had COPD with old pulmonary Tuberculosis (TB).

Out of 50 patients with P wave changes, dyspnoea and cough with expectoration were presenting complaint in all the patients, while oedema was in 17 (34%) cases..

**P wave:**Out of 50 cases with P wave changes in respiratory system , P wave amplitude > 2.5 mm in lead II (P pulmonale) was found in all 50(100%) cases while P axis>=+$90^0$ was found in 44(88%) patients, P inclination >1.5 mm in lead $V_1$ was found in 25 (50%)cases, P terminal force >=0.04 mmsec was found in 4 cases and P wave duration>0.12 was found in 3 patients. Out of all, P pulmonale and P axis >=+$90^0$ were the most common findings in all COPD cases.

**Chest X ray:**Amongst 50 cases of COPD with P wave changes, emphysema was found in 42 (84%) patients, while cardiomegaly was found in 10 (20%) cases.

**2D ECHO:**assesment of respiratory cases (COPD) with P wave changes the most common findings were, RV>25 mm in 32(64%) cases ,while RVSP >35 mmHg was found in 30(60%) cases.

**Correlation of P wave with 2D ECHO**

| Parameter | P axis>=+$90^0$ | P amplitude>2.5 | P inclination >= 1.5 in $V_1$ |
|---|---|---|---|
| RV > 25 mm. ( 32 out of 50) | 31(97%) | 32 (100%) | 16 (50%) |

| Parameter | P axis>=+90$^0$ | P amplitude>2.5 | P inclination >= 1.5 in $V_1$ |
|---|---|---|---|
| RVSP > 35mmHg.( 30 out of 50) | 29(97%) | 30 (100%) | 14(47%) |

Out of 32 patients with RV>25mm ,P pulmonale was found in all cases, Paxis >=+90$^0$ was found in 31(97%) cases while P inclination >1.5 was found in 16(50%) patients. Out of 30 patients with RVSP>35 mmHg ,P pulmonale was found in all cases , P axis >=+90$^0$ was found in 29 cases while P inclination >1.5 was found in 14 patients.

**Statistical analysis.**

| Parameter | RV | RVSP |
|---|---|---|
| P axis | r=0.322 p=0.023 | r=0.255 p=0.074 |
| P amplitude in lead II | r=0.379 p=0.007 | r=0.304 p=0.032 |
| P inclination in $V_1$ | r=0.319 p=0.024 | r=0.212 p=0.139 |

On analysis P axis was significantly correlated with RV (p value <0.05), While P amplitude in lead II was significantly correlated with both RV (p value<0.05) and RVSP (p value<0.05). P inclination in $V_1$ significantly correlated with RV (p value <0.05).

**DISSCUSSION :**

**Comparison of P pulmonale in studies of COPD:**

P pulmonale has variable prevalence in different studies on ECG and Echo in COPD cases, ranging from 10 % to 95%, in present study also all 50 cases who had P wave morphology change in RS showed P pulmonale in all 50 cases.[4,5]

In a study by Jensen et al. of 228 patients of COPD suggested P amplitude> 0.2mv in lead II had a poor 4 year survival and chroinicity of illness , in our study also all 50 patients of ICU had P wave amplitude more than 0.25 my in lead II and majority of them had critical condition.[7]

Similar study by Smith J. M. et al, 128 patients of severe COPD showed P amplitude in lead II as predictor of mortality and severity of disease. In our study also all 50 severe COPD patients admitted in ICU had P pulmonale.[8]

In a comparative study of 63 patients of COPD with pulmonary hypertension by Oswald et al. showed ECG changes had specificity of 86% and sensitivity of 51% in detecting pulmonary hypertension. In our study also RVSP >35 mmHg was found in 30 out of 50 patients of COPD who had P wave morphological changes in COPD in the form of P amplitude>2.5 mm in lead II in 50 patients, P inclination >1.5 in lead $V_1$ in 25 patients , P axis ≥ +90$^o$ was found in 44 patients Amongst them P amplitude >2.5 mm in lead II correlated with RVSP (p=0.032,r=0.304) but poorly correlated.[9]

In a comparative study of 30 COPD cases by Nayak S.K et al between ECG and Echo findings suggested good correlation In our study also P wave amplitude in lead II , P inclination in lead $V_1$ and P axis >=+90$^0$ correlated with RV and RVSP .

In study of 50 COPD cases by Vij et al showed 90% of the cases had echo and ECG changes like P pulmonale , RAD, RVH etc . In our study also P pulmonale was found in all 50 cases of COPD and had good correlation of RV and RVSP .[11]

Many criteria's have been suggested for diagnosis of RVH e.g. 1) Wiedemann H P et al , 2) Murphy et al ,3) Philips and Burch et al , 4) Padmavati and Raizada et al ,5)Who criteria , in which P wave parameter were one of the criteria, mainly P pulmonale and P axis to right . In our study also all RV>25mm patients had P pulmonale and P axis > +90$^0$. Both were significantly correlated with RV , In our study P inclination in lead $V_1$ also correlated significantly with RV.

The ECG sign of P pulmonale ranges from 10 to 95 % in many studies e.g. in Chappell et al 10%, Silver et al 46.2% Padmavati et al 95%, Murphy et al 26.4 %. Avinash et al 42% In our study also P pulmonale was found in all cases and which was significantly correlated with RV and RVSP which can be utilized as a diagnosis of COPD and early diagnosis of Cor P.

**Comparison of P axis in COPD, Cor pulmonale cases in various studies.**

In a study by Avinash et al 32 out of 50 COPD, Cor P cases had RAD of P wave (64%) and in echo RV>25mm and RVSP>35mmHg were common parameters. In our study also P axis >=+90$^0$was found in 44 patients and was significantly correlated with RV.[12]

**CONCLUSION**

- Since after the discovery of ECG, still it has maintained its role as a basic screening, diagnostic and monitoring tool.
- P wave changes in ECG by various parameters should not be neglected and can be used as a screening, diagnostic and monitoring parameter in various respiratory disorders. These P wave parameters will be helpful in early diagnosis and delaying morbidity and mortality associated with respiratory disorders.
- Because of significant correlation between P wave parameters in ECG with radiological and echocardiography parameters, these ECG changes can be used as a screening, diagnostic and monitoring parameter.
- In respiratory system P pulmonale, P inclination >1.5mm in lead $V_1$, P axis >= +90$^0$ can be helpful in diagnosing respiratory disorders like COPD and also early detection of cor -pulmonale amongst them.

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